Guidance for Land Management in the Chesapeake Bay Watershed

Response to Comments

Executive Order 13508, Chesapeake Bay Protection and Restoration, dated May 12, 2009 (74 FR 23099, May 15, 2009), directed EPA to prepare and publish a guidance for federal land management in the Chesapeake Bay watershed by May 12, 2010. A draft of this guidance was released for public comment on March 24, 2010 (75 FR 91294, March 24). EPA provided for a peer technical review, conducted by the Science and Technical Advisory Board (STAC) for the Chesapeake Bay. EPA also worked closely with our federal agency partners and provided for two federal reviews. The final guidance (http://www.epa.gov/nps/chesbay502) incorporates revisions resulting from public comments, consideration by the federal agencies, and peer review comments. Here, EPA provides responses to the Public (including federal agencies) and to the STAC comments.

Response to Public Comments

Chapter 2. Agriculture

Comment: This guidance imposes federal mandates on state and local governments to regulate industry, agriculture and other businesses, and goes beyond the Agency's authority under the CWA by making specific recommendations concerning on-farm decisions and practices.

Response: This is a technical guidance document that in no way creates any regulatory requirements for Federal agencies, State and local agencies, or individuals in the private sector. Rather, it presents strictly technical guidance regarding a host of state-of-the-art information on the tools and actions that can be strategically taken to reduce nutrient and sediment loadings to the Bay. This is available to federal, state, and local agencies, as well as NGOs, so that they may identify the practices and actions that can be implemented using their respective programs.

Comment: EPA guidance should do more than compile recommended tools and practices; it should create performance expectations not only for federal land management activities, but for federal agency and staff engagement with state, local, and private land owners and managers. Voluntary, unenforced suggestions have not produced water quality improvements in the past, and the time for mandated rules is now if improvements in water quality are to be achieved over the next decade or two. EPA needs to work closely with USDA to restrict the use of commercial fertilizers and manures on farms and homes or face continuing failures in a nutrient-overloaded Chesapeake Bay.

Response: This is a technical guidance document that in no way creates any regulatory or programmatic requirements for Federal agencies, State and local agencies, or individuals in the private sector.

Comment: This guidance should include a detailed discussion of the non-traditional markets and alternative uses for manure currently available and under development.

Response: While EPA recognizes the need to create new markets and alternative manure uses, this chapter does not cover the emerging technologies and financial mechanisms that are currently being developed to address these needs. EPA and other partners, however, are working to develop new markets and alternative manure uses. There are many private sector technological advances being made. Also, the opportunities for creating banks and new markets are being thoroughly fleshed-out at the federal, state and local levels.

Comment: EPA has not conducted an analysis of the economic impacts the guidance document will have on either categories of agricultural production or profitability of individual farms in the Chesapeake Bay watershed.

Response: EPA was required by Section 502 of the Chesapeake Bay Executive Order to develop "guidance for Federal land management in the Chesapeake Bay watershed describing proven, cost-effective tools and practices that reduce water pollution, including practices that are available for use by Federal agencies." This guidance complies with that requirement. The E.O. does not require EPA to conduct an economic impact analysis for this guidance, and EPA has not done so. Indeed, since the recommended practices are not legally binding, it is not expected to cause adverse economic impacts. However, EPA has included information on the costs of many of the practices discussed in the guidance. Producers and others can use this information to help make informed decisions regarding practice selection.

It has been documented that it is possible to reduce some costs by using nutrient management planning and conservation tillage. However, whether these practices have a net gain or loss is site specific, and we recognize many producers will need financial assistance and in this guidance we mention many programs available to help producers move in this direction.

Comment: This guidance suffers from a lack of collaboration and coordination with stakeholders and other interested parties.

Response: Over the course of the last 12 months, EPA has hosted numerous stakeholder listening sessions to hear input and suggestions on the response to the Executive Order. The Implementation Measures presented in this technical guidance were identified based upon technical information, as well as input at these stakeholder listening sessions. EPA has worked closely with the Federal agencies, which are the only entities directly affected by the guidance. EPA has also engaged in a peer review process involving 21 independent peer reviewers. Furthermore, EPA provided 30 days for the public to comment on draft guidance.

Comment: EPA should establish an additional review period (six mo.) for a formal and broad technical review of this draft guidance document by USDA, State Departments of Agriculture, State Dept's of Environmental Protection and other interested parties, and during that time, USDA and Land Grant Universities be tasked with evaluating the cost effectiveness and economic impacts, as well as the environmental effectiveness of the practices recommended. There then should be an additional public comment period.

Response: EPA has worked with our Federal partners to assure that the document meets their needs in implementing land management practices in accordance with Section 501 and 502. EPA also received peer review from many experts in the subject areas covered in the guidance. EPA expects to, as it has done in the past, continue to consider new information as it becomes available and to reevaluate the guidance as appropriate.

Comment: The effectiveness values presented in the guidance are not being utilized in the process to develop the Chesapeake Bay Total Daily Maximum Load (TMDL).

Response: Because this guidance presents the state-of-the-art, the practices and related efficiencies identified in the guidance are not necessarily currently reflected in the Chesapeake Bay model or the Scenario Builder. The Bay program has identified a process for efficiencies to be adopted in the model, and the description of this can be accessed at <http://archive.chesapeakebay.net/pubs/Nutrient-Sediment_Control_Review_Protocol.pdf>.

Comment: The guidance document makes a critical assumption that the major cause of the nutrient problems in the Bay is mismanagement on farms. While improving nutrient management on farms is very important to solving the problem, this is not the only or even the major cause of the nutrient problems in the Bay. Over arching issue that is driving the problem we see on individual farms is the structure of animal agriculture in the watershed and the resulting nutrient excesses at the farm and watershed level. Changing on-farm management without addressing the nutrient imbalance issue in an economically sustainable way cannot succeed. This document does, for the first time in this process, recognize the imbalance issue, but fails to address it other than very superficially and continues almost a total emphasis on on-farm management alone as the solution.

Response: EPA recognizes the work of the Mid-Atlantic Water Program, who has prepared the background information on the nutrient imbalances in the Chesapeake Bay watershed. While we understand the limitations of this information, we recognize the significance this work has on providing the agricultural community the needed information so that we can move towards sustainable production in the bay watershed.

Phosphorus

The comments received raised a number of questions about P saturation percentage (Psat). Before addressing each comment specifically, EPA used the following guiding principles to develop this section of the guidance:

- This technical guidance is divided into three sections, source control, in-field control, and edge-of-field controls. While the section describing the Psat Implementation Measure is source control (determining where crops should be planted), the hydrologic component of planning as well as other soil and erosion control and site management parameters are described throughout the document. The Psat Implementation Measure does not stand alone, rather it is to be integrated into the agricultural production plan, soil conservation plan, and nutrient management plan along with other needed Implementation Measures for the site.
- EPA understands that there is a desire among some members of the agricultural academic and policy communities to investigate possible modifications that can improve the current host of existing State P Indices, including the possibility of being able to instances when P should not be applied at all. As indicated in the responses to comments discussed below, EPA believes that the P index at this time is significantly flawed and that its use in many cases is likely to result in significant over-applications of P to cropland and result in P-laden runoff to the Chesapeake Bay. It may be that at some point in the future, current significant shortcomings in the P indices will be overcome and that they would become adequate tools to be used to protect the Chesapeake Bay. In such cases, EPA would be pleased to modify this Implementation Measure. However, at present, EPA believes that it would be inappropriate to base its recommendations for protection of the Chesapeake Bay on the P index approach.
- Directions to access current P Index information are provided in Appendix 2 of Chapter 2.

Comment: The draft guidance document does not provide an adequate definition of Psat.

Response: The guidance has been revised to include this definition: "P saturation percentage is a tool that can estimate the degree to which P sorbing sites are saturated with P". There is also an example provided presenting other pathways for movement of P into solution.

Comment: To properly use Psat as a parameter for looking at the availability of soluble P in soil to runoff, soil sampling depth is critical and must be clearly defined.

Response: EPA agrees that the depth of sampling is a relevant factor in properly using Psat. The implementation measure has been revised to include discussion of this point.

Comment: While Psat has been shown to be a useful parameter to quantify the availability of soluble soil P to runoff or leachate water, it does not account for site hydrology, which has been shown to be overwhelmingly responsible for P loss in runoff and leachate.

The P Index provides a holistic assessment of site variables affecting P loss (hydrologic, management and chemical).

A large body of research, much of it from the Chesapeake Bay Watershed, supports the conclusion that management of P on the basis of a soil P variable alone is inadequate.

Psat is a soil chemical variable that does not account for transport potential which is covered by the P Index. Consequently, management using Psat alone provides a narrow consideration of factors affecting P loss and will produce unintended consequences as land managers seek to optimize land applications of manures and fertilizers using Psat.

Response: The Psat Implementation Measure does not stand alone, rather it is to be integrated into the agricultural production plan, soil conservation plan, and nutrient management plan along with other needed Implementation Measures for the site. Psat is a valuable tool as an environmental indicator of soil P availability to runoff (Kleinman and Sharpley 2002; Beauchemin and Simard 1999).

Maguire et al. (2007) noted that there are limitations to the P-Index, particularly when manure is the source of nutrients, because of the high P-content in manure; they also noted that "for long-term sustainability, applications of P must approach a balance with crop removal." This E.O. directs EPA to develop technical guidance describing the next generation of tools and practices that will protect and restore the bay. We have developed the P implementation measure based on the idea that agriculture can be a sustainable land use in the bay watershed if the practices employed on the land are implemented at the points of source control, in-field, and edge of field in order to avoid, control and trap nutrients and sediment.

The presentation of tools and practices in this guidance is divided into these three areas that are necessary in agricultural production to control and minimize the movement of nutrients and sediments. No implementation measure in this guidance should be isolated and considered alone, as a host of measures implemented will be required to bring agriculture to long term sustainability as well as restoring the bay. While the P-Index collectively accounts for site hydrology and transport potential, it leaves out the accumulation of P in the soil, which Psat incorporates into the analysis. By considering all appropriate information for these three areas, the producer will be able to successfully and holistically incorporate a host of implementation measures from this guidance into the production plan, soil conservation plan and nutrient management plan, thereby taking appropriate steps towards sustainability.

Specifically, there are implementations measures in this guidance that reflect the actions that can be taken to incorporate site hydrology, nutrient management, and transport potential into the plans:

- Site hydrology: A-3, A-4, A-10, A-12, A-13, A-14, A-15
- Nutrient management: A-1, A-2, A-5, A-6, A-9, and A-10
- Transport potential: A-7, A-10, A-11, A-16, A-17, A-18, A-19, A-20

Comment: A recent study by Buda et al. (2010) showed that soils with high runoff potential, but low soil P content (and low Psat), yielded more than 8 times more P in runoff than did soils that were high in P (and high in Psat), but had low runoff potential.

Research in Pennsylvania, Maryland and New York has shown that transport (hydrologic) potential of a site readily overwhelms source variables (such as soil Psat). Therefore, management by a source variable alone (e.g., soil Psat) will result in greater application of P to soils that have low soil P, but high transport potential.

Response: The Psat Implementation Measure does not stand "alone", rather it is to be integrated into the agricultural production plan, soil conservation plan, and nutrient management plan along with other needed Implementation Measures for the site. Factors relating to the runoff and transport of P are addressed, for example through soil conservation measures contained in our guidance that call for in-field controls and edge-of-field controls. In addition, where higher runoff potential exists, full implementation of the HEL implementation measure will decrease the likelihood of this occurrence, since soils with high runoff potential will be retired from intensive production or will be managed to meet T (through the soil conservation plan) and meet the requirements of the nutrient management plan.

Comment: Psat does not account for recently applied P sources. It has been shown repeatedly that fresh manure and fertilizer applications will dominate P loss regardless of soil test P or Psat over the short term. Thus, manure application on a site with potential for transport is likely to result in large losses of P regardless of whether the Psat is above or below 20%. While the P Index accounts for recently applied sources of P, soil Psat does not.

Response: The Psat Implementation Measure does not stand alone, rather it is to be integrated into the agricultural production plan, soil conservation plan, and nutrient management plan along with other needed Implementation Measures for the site. Specifically the full implementation of the in-field control cropland implementation measures will account for the transport issues of recently applied P sources.

The soil amendment implementation measure has been revised for clarity and now states: "Use soil amendments such as alum, gypsum, or water treatment residuals to increase P adsorption capacity of soils, reduce desorption of water-soluble P, and decrease P concentration in runoff".

Comment: The thresholds observed in laboratory extraction comparisons (e.g., the change points identified in Butler and Coale, 2005) are not reproducible in the field and are more a function of the chemistry of the extractants than they are actual processes determining P loss in the field.

A scientifically-defensible basis is required for selecting Psat as a single variable guiding P management and for establishing 20% as a Psat threshold above which P cannot be applied to soils.

Response: Based on the information presented in this guidance, there is a foundation for the implementation measure. EPA recognizes the importance of continuing to refine the body of literature available. The guidance notes the need for continued refinement at the physiographic level as well as the soil level.

There is a host of information compiled in Maryland, Virginia, and Pennsylvania that presents Psat as analyzed across counties (Kovzlove et al. 2010). Additional information has shown that while soils can retain significant amounts of P, soils release of P to water once the saturation is above 20% (Beauchemin and Simard 1999; Khiari et al. 2000; Kleinman and Sharpley 2002; Beck et al. 2004, and Butler and Coale 2005).

Comment: Use of Psat within the P Index could improve the soil test P variable currently found within the P Index, particularly for fields where P leaching is the primary concern (e.g., the Delmarva Peninsula, but that only accounts for 6% of the land area of the Bay Watershed). However, surface runoff studies conducted as part of the National P Research Project in New York and Pennsylvania showed that soil test P (Mehlich 3 P) provides excellent estimation of dissolved P concentration in runoff and this measure is readily available from current testing programs (whereas Psat is not).

Response: EPA recognizes that Psat is an important feature that could improve the usability of the P index in long term nutrient management planning, particularly where P leaching is the primary environmental concern. EPA does not recommend any one methodology for determining Psat. We understand that the methods used to determine Psat are depended upon the chemical features of the extracts and do not provide conversion factors between the methods mentioned. EPA understands that the method of P analysis should always be clearly described in any presentation of Psat or soil test P. Also, while Psat and soil P are correlated, by determining the P application based on P-Sat, EPA's recommendation will still allow application beyond realistic yield goals in areas where Psat is lower than 20 percent; soil P is a more conservative estimate for P applications.

Comment: The use of Psat to guide P management represents a major setback to current nutrient management programs that rely upon the P Index.

Use of Psat within the P Index could improve the soil test P variable currently found within the P Index, particularly for fields where P leaching is the primary concern.

If the intent of the current guidance is to make current P management guidelines more restrictive, adjustments can be made to the P Index to achieve this goal.

Response: This E.O. directs EPA to develop technical guidance describing the next generation of tools and practices that will protect and restore the bay. We have developed the P implementation measure based on the idea that agriculture can be a sustainable land use in the bay watershed if the practices employed on the land avoid, control and trap nutrients and sediment.

EPA understands that there is a desire in the agricultural academic and policy communities to investigate possible modifications that can improve the current host of existing State P Indices and include descriptions noting the instances when P should not be applied at all. It may be that at some point in the future, if the P Indices are modified to reduce their tendency to result in recommended applications that are in excess of crop needs and become better suited towards addressing Psat impacts on water quality, EPA would be pleased to modify this Implementation Measure.

Comment: It is unclear how the NUE concept and included NUE practices are to be included in the development of a nutrient management plan or integrated into the nutrient management planning process.

Response: A host of NUE tools can assist nutrient management planners in developing the N application rate on the basis of in-field variability. By using tools to increase crop NUE, N loss is minimized through reductions in leaching, surface flow, ammonia volatilization, nitrification and denitrification, and soil erosion by calibrating the N input to the yield potential and crop needs.

Comment: It is unclear whether the "environmental risk assessment" tool is targeted at nitrogen loss potential, P loss potential or both. It is critical that there is recognition that the P Index is an implemented P loss assessment tool in the Chesapeake Bay Watershed.

Response: This tool under development is targeted at nitrogen loss potential.

HELs

Comment: HELs should continue to be farmed and recommendations should focus on adequate treatment of productive working lands, not the retirement of productive working lands.

Response: Emerging and alternative markets can be used in conjunction with this recommendation to make this viable for the producer.

We have modified this implementation measure. First, this no longer applies to pasture. Also, instead of "retire" as the only recommended option, we have modified the language to state that either the land should be retired or a soil conservation plan should be developed and implemented to reduce sheet and rill erosion to the Soil Loss Tolerance Level (T) alongside the implementation of a nutrient management plan.

References

Beauchemin, S. and R.R. Simard. 1999. Soil Phosphorus Saturation Degree: Review of Some Indices and their Suitability for P Management in Québec, Canada. *Canada Journal of Soil Science* 634: 615-625.

Beck, M.A., L.W. Zelazny, W.L. Daniels and G.L. Mullins. 2004. Using the Mehlich -1 Extract to Estimate Soil P Saturation for Environmental Risk Assessment. *Soil Science Society of American Journal* 68:1762-1771.

Butler, J.S. and F. J. Coale. 2005. Phosphorus Leaching in Manure-Amended Atlantic Coastal Plain Soils. *Journal of Environmental Quality* 34:370–381.

Maguire RO, Ketterings QM, Lemunyon JL, Leytem AB, Mullins G, Osmond DL, Weld JL. 2007. Phosphorous Indices to Predict Risk for Phosphorous Losses. SER-17 Position Paper. <http://www.sera17.ext.vt.edu/index.htm>

Khiari, L., L. E. Parent, A. Pellerin, A. R. A. Alimi, C. Tremblay, R. R. Simard, and J. Fortin. 2000. An Agri-Environmental Phosphorus Saturation Index for Acid Coarse-Textured Soils. *Journal of Environmental Quality* 29:1561-156

Kleinman, P.J., and A. Sharpley. 2002. Estimating Soil Phosphorus Sorption Saturation from Mehlich 3 Data. *Communications in Soil Science and Plant Analysis* 33(11&12), 1825-1839.

Kovzelove, C*., T. Simpson, and R. Korcak. 2010 Quantification and Implications of Surplus Phosphorus and Manure in Major Animal Production Regions of Maryland, Pennsylvania, and Virginia. Water Stewardship, Inc., Annapolis, MD. * On detail from U.S. EPA <http://www.corporatewaterstewardship.org/downloads/P_PAPER_FINAL_2-9-10.pdf>.

Chapter 3. Urban and Suburban

Comment: The document focuses on municipal concepts, such as codes and ordinances, financial incentives, and SWPPPs that may not apply to many federal facilities, rather than on the mechanisms that federal facilities use such as policies, specifications, planning documents, and operating procedures.

Response: In response to this comment, we have added, and led each text section, with those tools applicable to federal facilities (policies, contract specifications, etc.), followed by how municipalities would have parallel codes and ordinances. More references were provided to primary federal facility planning guides, including GSA P-100 (U.S. General Services Administration 2005), but not many other specific ones since agencies have their own. Discussions on items not as applicable to federal facilities were put into context, such as the discussion on "lot density". For "financial incentives", that discussion was also put into context (it was noted that for municipalities, a variety of financial incentives exist used for this purpose). Incentives recommended for federal facilities were awards and recognition programs and requirements in contract specifications for property leased by the facility. For smart growth, the text was revised to include how it can be applicable to federal facility planning, for examples, facilities should locate along existing transportation corridors and where there is existing water and sewer infrastructure in place, where feasible and appropriate. We did include other information that may be relevant to others who may choose to use this document such as municipalities.

Comment: Who makes the determination of the applicable site-specific water quality standard?

Response: Where a permit is being issued, the determination is made by the appropriate discharge permitting authority (either the State or EPA) ultimately is responsible to make the determination.

Comment: Are we referring to 95th percentile volume? We should only manage the volume that will not be infiltrated.

Response: No changes to the 438 guidance were made or intended. It should mean the 95th percentile storm depth. Yes, only the volume that will not be infiltrated would be otherwise managed.

Comment: Not all federal facilities are required to have Stormwater Pollution Prevention Plans (SWPPPs), so a comparison with good housekeeping programs might be better.

Response: We have clarified what types of federal facilities with industrial activities might be subject to SWPPPs (from fedcenter.gov) as follows:

Specifically, a facility must obtain permit coverage for industrial activities if the activity falls under:

- *One of the 11 categories of Industrial Storm Water Activities, including construction, that result in storm water discharge to Municipal Separate Storm Sewer Systems (MS4s), or directly to waters of the United States, or*
- *one of the 30 Industrial Sectors listed for the Multi-Sector General Permit.*

These activities are defined by either the facilities certain Standard Industrialization Classification, or a general description of the facilities industrial activities.

Federal Facilities that often require storm water permit coverage include:

- *General Services Administration (Federal Government construction)*
- *Naval Facilities Command (transportation vehicles)*
- *Army Corps of Engineers (DoD construction)*
- *Bureau of Reclamation (transportation vehicles), and*
- *Other facilities that perform industrial activities, have vehicle fleets and frequently undergo building construction*

Comment: MS4 requirements (including good housekeeping, etc.) apply for some federal facilities, and could be expanded to cover commercial facilities.

Response: To clarify, a sentence from an existing EPA fact sheet was added that gives historical information on when the Phase II program was expanded to include some federal facilities. It also provides a link to the EPA background factsheet on "MS4 and Federal and State Lands" applicability (USEPA 2005).

Comment: Replace "Tributary strategy" reference with "Watershed Implementation Plan".

Response: We have done so. Also, a link to the EPA site describing WIPs in the Chesapeake Bay was added.

Comment: For turf management definition, need to define "high input prescription management".

Response: We have deleted the term "prescription" and defined "high input", using public comments as a basis for this definition.

Comment: For turf management, what is the value of "life cycle management".

Response: The implementation measure regarding "life cycle management has been deleted.

Comment: The impact of management of turf on federal lands will not be nearly as significant to restoring the Bay as management of turf on non-federal lands.

Response: The purpose of this document is to provide guidance on Federal land management practices, with the goal of providing Federal leadership in the implementation of best practices throughout the Bay watershed. It is understood that across the Bay watershed in general, non-federal pollutant loadings are more significant and will need to be controlled as part of the effort to achieve clean water in the bay.

Comment: While information on homeowners and lawn care companies is relevant to nutrient and pesticide loading to the Bay from turf, the information is not as pertinent to federal lands.

Response: See the response to the response to the previous comment. In addition, a number of federal agencies in the Bay watershed practice nutrient and pesticide management on properties that they manage. We did include other information that may be relevant to others who may choose to use this document such as municipalities

Comment: Perhaps the document should recommend that federal facilities consider modifying their operations procedures or contract specs to reduce the use of P fertilizer in turf.

Response: This recommendation was added.

Comment: Incentive programs are good info for municipal governments but are not really pertinent for federal agencies who can effect change by changing their operating procedures or contract specifications. If the incentives section stays in this document, suggest a separate sections stating how federal facilities can evaluate conversion of landscape.

Response: A change was made noting that these types of incentives are applicable to municipalities. The information on the incentive types was left in the document to provide comprehensive information.

Comment: Too short review time.

Response: The tight deadline established in the Executive Order necessitated a 30-day comment period

Comment: EPA is extending its authority in addressing non-federal programs and lands.
Response: This is guidance and as such does not impose requirements.

Comment. Guidance is too long and coverage too broad, tends to dilute focus on bay priorities.

Response: Length of document was necessary to address the full set of land management topics that are impacting the Bay. The topics for federal land mangers are similar in many cases to municipal land management, and the municipal area has more relevant cases and examples to cite than federal facilities at this time. We did cite federal land information and data wherever available.

Comment: Commenter requested support of WLAs for POTWs to encourage smart growth.
Response: Addressing WLAs is outside the scope of this document and is being addressed in other aspects of EPA's programs and activities to restore the Chesapeake Bay.

Comment: The guidance should provide a framework for federal governments and municipalities to coordinate. A regional approach for stormwater management would allow for consistency.

Response: These issues are outside of the scope of this technical guidance document. However, EPA is addressing Federal/local coordination issues in other aspects of the Chesapeake Bay program.

Comment: Guidance should be provided on the recommended guidelines for stormwater discharge when the 95^{th} percentile rain event cannot be contained and used on site, for example if there are site constraints or back-to-back storms.

Response: The EISA requirements Energy Independence and Security Act (EISA) of 2007 and the subsequent EPA guidance (USEPA 2009) call for replication of predevelopment hydrology with respect to runoff volume, flow, duration and temperature. Discharges associated with large storm events, back-to-back storm events, or from site conditions that preclude the use of LID techniques (potential exceptions are listed in the document and in the EPA EISA guidance) should attempt to replicate that discharge rate and duration as much as possible. Designs should incorporate a safety factor where appropriate to protect against some back-to-back storms. State and local stormwater management regulations, both inside and outside the Bay area, also provide restrictions on the allowable discharge rate to protect against channel erosion and downstream flooding in the event of large storms.

Comment: Certain proprietary products can enhance soil functions and should be mentioned in the guidance.

Response: EPA does not promote proprietary products in our guidance documents.

Comment: The science does not support EPA's suggestion that banning the use of refined tar-based sealants at federal facilities or in any other location would have any discernable effect on the concentrations of PAHs in the Chesapeake Bay watershed.

Response: EPA does not address this issue in this document.

Comment: The document should go further to create performance expectations for federal land managers and federal staff engaged with state, local, and private managers, such as providing direction in issuance of NPDES permits. The document should set substantive steps for land managers, agency programs, and permit writers. The recommendations should be expanded to non-federal lands through the federal permitting authorities. The implications of the Rapanos decision should be discussed.

Response: This document does not address the regulatory NPDES permit program under Section 402 of the CWA, nor does it address the wetlands program under Section 404 of the CWA. These are outside the scope of the document.

Comment: EPA should revisit and improve the list of practices.

Response: EPA agrees that there are numerous additional practices and variations on practices. The references listed include detailed descriptions of multiple variations and details on each practice. In the interest of creating a manageable document EPA elected to reference existing material in lieu of repeating material already comprehensively addressed in other regional guidance manuals.

Comment: Not enough emphasis is placed on retrofits. There should be more discussion on barriers to programs successful programs, permits, and establishment of recommendations to ensure that impervious reductions are implemented through NPDES permits and other federal programs.

Response: Retrofits and barriers are both addressed in the guidance document with references to existing guidance applicable to both federal facilities and municipalities. Permits and permitting program recommendations are outside the scope of this document.

Comment: The 2007 Energy Independence and Security Act (EISA) predevelopment hydrology requirements are guidance, not a requirement.

Response: This is an incorrect statement. They are required for Federal agencies, who are the primary audience for this Federal land management guidance. EISA 2007 Section 438 states: "The sponsor of any development or redevelopment project involving a Federal facility with a footprint that exceeds 5,000 square feet shall use site planning, design, construction, and maintenance strategies for the property to maintain or restore, to the maximum extent technically feasible, the predevelopment hydrology of the property with regard to the temperature, rate, volume, and duration of flow."

Comment: The terms 'maximum extent technically feasible' and 'extent feasible' are both used.

Response: The term "maximum extent technically feasible" is used in EISA Section 438. The document has been revised to include consistent use of that term.

Comment: The report should reflect lessons learned from the area jurisdictions in the implementation of LID.

Response: Each of the lessons learned cited by the commenter are addressed in the final document .

Comment: LID is not consistently less expensive than traditional stormwater controls.

Response: The document states that costs may be more or less, depending on many factors. However, more and more developers and communities are finding that using LID can save them money.

Comment: Some homeowners are opposed to it because it denies them use of their properties.

Response: This document focuses on federal lands. However, all drainage controls, traditional or LID, require either public lands or drainage easements on private land. This is not unique to LID stormwater drainage controls.

Comment: Many LID controls have standing water, they create concerns about mosquitoes, animal pests, and potential danger to children or because they judge standing water to be unsightly and undesirable.

Response: Design manuals call for a drawdown of water in a timeframe to prevent mosquitoes. Individual design and construction can and should address this issue. Designs can limit the standing water depth to none or to user specifications.

Comment: Homeowners are opposed to paying for LID maintenance or to maintaining the devices themselves for a variety of reasons.

Response: This document has been written for federal facilities to implement. However, we note that traditional practices such as stormwater ponds also require maintenance. The level of maintenance should be considered in practice selection. Responsibility for maintenance, whether private or public, is decided at the local level. Moreover, it should be noted that many LID practices are viewed by many homeowners as amenities. This points out the value of using LID practices that are attractive as well as functional.

Comment: Localities are worried about the burden that will fall on them to track hundreds or thousands of LID devices, update LID maintenance plans, hire staff to collect fees, certify that maintenance has been done, and correct LID failures.

Response: This document focuses on federal facilities. However, current traditional stormwater management requirements often result in lot-level stormwater management practices, particularly for commercial lots, and management practices for small groups of homes, all of which can be tracked in information management systems routinely used by municipalities. It is recognized that the tracking and maintenance of stormwater management practices represents a significant responsibility to local stormwater management authorities. The use of distributed controls will increase the number and decrease the size of management practices, but the systems for tracking are established in many municipalities.

Comment: The potential exists for LID requirements to in urban areas to chase out redevelopment completely from urban areas, which Maryland has already experienced with the introduction of its new stormwater program.

Response: This document focuses on federal facilities. However, many more economically significant factors than stormwater management contribute to the decision to develop or redevelop in an area, and stormwater management requirements will likely be present in any area of development or redevelopment. It is also noted that implementing improved stormwater management in redevelopment projects contributes to a reduction of flash-flooding of urban streets and properties.

Comment: Some engineers have expressed concern that using LID in urban settings may damage nearby underground building footings and/or underground infrastructure and may cause flooding to nearby basements or other structures.

Response: Infiltration should not be used where damage to structures can result. Other methods of LID are available as described in the guidance document.

Comment: Cautions need to be expressed in any LID guidance concerning the use of infiltration devices in the vicinity of drinking water aquifers, high water tables, shallow underground rock formations, or areas prone to flooding.

Response: These cautions are noted in the document. However, it is noted that some areas prone to flooding have successfully constructed LID practices in their watersheds and achieved not only flash flood reductions but improved water quality and enhanced groundwater replenishment. Two such examples are presented in the guidance document, the Capitol Regional Watershed District in Minnesota (Capitol Region Watershed District 2010), and the Sun Valley Watershed in Los Angeles, California (City of Los Angeles 2004).

Comment: Local site conditions determine the applicability of LID.

Response: This is noted in the guidance document.

Comment: The ICC 700 National Green Building Standard should be recognized in the document.

Response: EPA is supportive of the development of green building standards by many entities, including the National Association of Home Builders (NAHB). EPA is not recognizing in this document all of the green standard certifications that are available; the notation of a standard was related to the particular buildings being highlighted.

Comment: The 2007 EPA document on Potential Cost Savings of LID/Green Infrastructure (USEPA 2007): this study is well-known in the building community as being inaccurate and on the whole poorly done. NAHB requests that it be deleted from this report and not used by EPA in the future to represent the cost savings potential of LID.

Response: Comment noted. EPA supports the validity of the study. See specific discussion below.

Comment: The study incorrectly reports that only 1 of the 17 case studies had an increased cost to implement LID/ESD. A quick read of the study reveals that several of the case studies contained multiple sub-projects that were independently evaluated. In several cases, many of these sub-projects resulted in increased costs to implement ESD. However, all of these are excluded from the report summary on the basis that 'the results do not lend themselves to display in the format of the table'. For example, the Central Park Commercial Redesign - undertaken by the Friends of the Rappahannock - indicated that 5 out of the 6 pad sites evaluated for this planned development cost more to implement using LID/ESD.

Response: The purpose of the omission of studies from Table 2 was to avoid misrepresenting the nature of the data that were available for each study. For example, the Central Park retrofits only examined cost additions and reductions, not overall project costs for the different stormwater management approaches. Other projects with positive cost benefits were omitted from the table for similar reasons. For example, the Poplar Street study did not present detailed cost data, and the Portland Downspout Disconnection program was evaluated Citywide, not on a site-by-site basis.

Comment: The study actually evaluated 24 projects (several of the case studies contained multiple, independently evaluated sites). Sixteen of the twenty-four sites are Greenfield and large-lot residential projects that lend themselves to LID/ESD and conservation design principles. The remaining 8 projects are community retrofits where the actual costs of implementing the LID/ESD measures (green roofs, disconnecting downspouts, retrofitting parking lots, etc) was compared against a theoretical and worse-case alternative. For example, the costs of Portland's Downspout Disconnection Program were compared to an underground pipe to contain a comparable volume.

Response: Individual projects were included in the report based on the availability of data on costs for LID vs. traditional stormwater management. There were several key studies that evaluated Greenfield-type projects, and many fewer that examined retrofits. At the time research was conducted, there were no high-density studies that had enough data to be included in the report.

In the case of Portland's Downspout Disconnection Program, the City is actually building underground pipes to manage combined sewer overflows, so this is an appropriate comparison. They were able to reduce the required storage capacity of the pipes because of downspout disconnection and other decentralized retrofit approaches.

Comment: The case studies failed to account for direct cost additions and lost opportunities as a result of the implementation of LID/ESD. For example, the retrofit of a parking lot at City Hall in Bellingham, WA using rain gardens is reported to cost 80%, or $22,000, less than a structural, underground alternative. This study reports that to implement the rain gardens 3 out of 60 parking spaces, or 5%, need to be lost. This directly results in a reduction of approximately 1,000 square feet of space, or allowable density, which has a quantifiable economic value that is not accounted for. Depending on the local market, the $22,000 could be absorbed after the first year of occupancy at $22/square foot. In this case, clearly the long term cost benefit of the 3 parking spaces and associated 1,000 square feet of office outweigh the upfront costs of the structural stormwater BMP.

Response: The commercial value of the lost parking spaces was not applicable to the City of Bellingham parking lot retrofits because both pilot projects were implemented at existing public properties with office space density that was already established. Furthermore, numerous case studies have discussed developments that chose LID designs that enabled the elimination of the pond that would have been required in a conventional stormwater design, thereby gaining more space that enabled increased development lots to be sold. For example, residential subdivisions in Prince George's County and Frederick County, Maryland, eliminated ponds and thereby created space for six additional lots and two additional lots, respectively (EcoNorthwest. 2007).

Comment: Most of the cost savings referenced was due to reductions in road widths. In almost all cases, the roads were reduced to widths narrower than allowed by the National Fire Code.

Response: Significant cost savings were achieved from a variety of project attributes, including the size reduction or elimination of stormwater pipes and ponds. With regard to reduced road widths, minimum road widths can be evaluated on a local level in partnership with local emergency response departments to ensure that vehicles can safely navigate and narrow-width streets. This type of site design modification is not expected to be applicable to all settings and development types. See also the Center for Watershed Protection's "Better Site Design" (CWP 1998)

Comment: All case studies failed to account for the costs associated with the intensive maintenance needs of the small-scale BMPs. Instead, this study incorrectly assumes that maintenance costs will be reduced through the application of LID in almost all cases. One case study of a Greenfield residential project that looked at the issue of maintenance reported that maintenance costs were $600 more per lot than conventional design.

When considering maintenance implications, ESD/LID needs to be evaluated in two groups. The first group, which is generally going to be less expensive to maintain, are the sprawling and large lot residential communities that are designed and graded such that the LID/ESD approach includes flat slopes that filter and infiltrate water, also known as non-structural practices. In this group, ESD/LID is inherent in the design due to the significant amount of open space. The second group of ESD/LID is the use of micro-scale practices (micro-bioretention, landscape infiltration, etc) and alternative surfaces (green roofs, pervious paving materials). These practices are highly maintenance intensive. The micro-scale practices rely upon infiltration of runoff through the soil media. In order to properly function, the soil media needs to be remediated frequently to maintain porosity otherwise they backup, fail to function, and overflow. Alternative surfaces also require frequent maintenance (2-3 times/year) to maintain porosity of paving materials and ensure adequate plant coverage and soil conditions of green roofs.

Response: Properly designed LID/ESD BMPs can be engineered for minimum maintenance (similar to landscaping), particularly if a pretreatment area is incorporated into designs. These BMPs are not appropriate for treatment of runoff with high sediment loads. High sediment loads should first be addressed through appropriate land-management techniques or traditional stormwater pretreatment BMP's. These factors are site-specific and difficult to generalize on a national scale. It is noted that stormwater management facilities, whether LID or conventional, require maintenance. The level of maintenance should be considered when selecting practices and this is noted in the document.

Comment: The case studies with the greatest cost savings utilizing LID/ESD are sprawling residential single family projects. Builder experience has shown that residential communities in Maryland with 3+ acre lots and open section roads designed under the ESD regulations have negligible to no infrastructure costs for stormwater management. This is primarily because they can be constructed using non-structural approaches since there is a significant amount of land available. While this is useful for LID/ESD for this limited application, this pattern of development (large lot residential) is inconsistent with the pattern of smart growth envisioned in many community master plans.

This study contains no case studies of private or public redevelopment of high-density, mixed use projects. Part of the policy debate that occurred in Maryland related to stormwater includes a discussion of how ESD incentivizes sprawl and discourages a high-density, mixed use pattern of development proximal to multiple transportation opportunities. If anything, this study confirms that ESD/LID is cheaper for large lot sprawl and provides no information related to smart growth projects.

Aside from the analysis provided above, missing from the debate is a third category of projects: 'smart growth/high-density, new development projects'. These are the projects that are planned with higher densities, similar to what is often being categorized as 're-development', but located on properties with little or no impervious pavement. Many requirements fail to address these projects and assume that the redevelopment provisions include all smart growth projects - that's not the case. These high-density projects located on low-no impervious properties will be the most adversely affected types of projects because they will be held to the higher 'new development' standard while having the form of higher-density (little-no area available to accommodate ESD) projects.

Response: Individual projects were included in the report based on the availability of data on costs for LID vs. traditional stormwater management. There were several key studies that evaluated Greenfield-type projects, and many fewer that examined retrofits. At the time research was conducted, there were no high-density studies that had enough data to be included in the report.

Since the time the 2007 report was prepared, however, additional information has become available. The document cites some examples: 1) Portland Bureau of Environmental Services (City of Portland 2008) study of green roofs shows that life-cycle benefits of a green roof provide a higher net-present value to the public and to the owner over time – this study is primarily applicable to high density, mixed use construction; 2) A Lenexa, Kansas, study that evaluated single family residential, multifamily residential, commercial/retail, and warehouse/office, and determined that there were cost savings associated with the application of LID techniques versus traditional stormwater management techniques, and were therefore able to gain local support for implementing LID standards (Beezhold and Baker 2006); 3) Capitol Regional Watershed District, encompassing areas of St. Paul, MN, that is highly impervious, approximately 42% impervious, found LID retrofits were not only less costly (saving $0.5 million in capital costs) to install than conventional stormwater management to solve flooding problems, they provided the additional benefit of improved water quality for a local recreational lake that had been chronically impaired from urban stormwater runoff pollutants (CRWD 2010).

Comment: The commenter provided several citations on the uptake of pollutants by managed turf grasses, reduction in air temperature by turf grasses, and how turf grass systems can improve stormwater infiltration.

Response: The general benefits of air temperature and air pollution reduction, and soil infiltration improvement, are not exclusive to managed turf grass but are characteristic of other vegetation as well. In order to put this information on turf grasses in context, the similar benefits of other vegetation (native grasses, shrubs, wetland plants, ground covers, trees, mosses, etc.) should concurrently be presented for comparison. The relative benefits of many different types of vegetation were not included in this document.

Comment: The commenter provided a recommendation to rephrase the term fertilizer ban to fertilizer restriction.

Response: The term was changed.

Comment: The commenter provided suggestions for litter, leaf collection, outreach and education, and street sweeping as pollution prevention practices.

Response: Most of these practices are already cited in the document. At the commenter's suggestion, implementation of a leaf litter collection program with composing and reuse was added as a source control measure. This was added in the table on pollution prevention and source control practices.

Comment: Recognize the need to consider natural daylight/nighttime conditions in planning and development in order to protect species that require the natural light cycle in order to propagate.

Response: A reference to this consideration was added with a supporting citation from the federal facilities design guide US General Services Administration (2005) GSA P-100-2005-2.12 Landscape Lighting, which references www.darkskies.org.

Turf

Comment: The guidance should strongly encourage the development of integrated infiltrative surfaces and provide solutions for increasing the permeability of existing infrastructure:

- Practices to increase infiltrative and retentive capacity of turf and landscape areas
- Practices to develop healthy soils (organic matter, micro & macro fauna)
- Implementation of best cultural practices for turfgrass and landscape area maintenance (recycle clipping, longer grass, drought conditioning, supplemental irrigation)
- Integrate landscape, trees, and grass areas to increase pervious surfaces and maximize infiltration through initial design or redesign and maintenance of existing landscapes

Response: The guidance was revised to put a stronger emphasis on cultural management practices based on the Scotts Miracle Grow Company recommendations.

Comment: Caution must be exercised when estimating "inputs" and relating input reductions to potential load reductions. All inputs are not equal, are not static, and are not reflective of loads nor the fact that they many of the inputs mitigate and reduce loads by reducing run-off, sedimentation, and increasing infiltration capacity of greenspace. The estimated fertilizer and pesticide inputs presented in the draft report are very high. Turfgrass fertilizer use has been estimated (based on reported usage data) to be less than 100 million pounds across the entirety of all states in the Bay watershed (DE, MD, PA, VA, WV), which is less than the draft report estimates for the watershed alone (227 million pounds for the 64,000 sq. mi. watershed). The draft estimated volume for 2,4-D is over 25% of nationwide turfgrass use of 11 million pounds reported by EPA (EPA, 2005). While input information is directionally informative, care must be taken to avoid simple extrapolation to load potentials. For this reason, the Agency may consider removing this information from the draft report. We hope the Agency finds this input helpful. Please utilize us a resource for product content.

Response: The definitions for terms such as high inputs were modified based on the Scotts Miracle Grow Company recommendations. The section on 2,4-D was deleted. The bay wide fertilizer estimates were adjusted based on the numbers provided by the Scotts Miracle Grow Company and recommendations to modify application assumptions provided by Environmental and Turf Services, Inc.

Comment: As we develop the technical framework for the management of nutrients in our urban ecosystems, research shows (D.J. Soldat, 2008, Groffman, 2004) two principals result in the greatest reduction of nutrient loading that leads to the eutrophication of our waterways.

- Decrease Impervious Surfaces: The key element to reducing urban runoff is to decrease the percentage of impervious surfaces and one of the best ways is to increase green space.
- Increase erosion control and water retention on pervious surface: Most nitrogen and phosphorus movement from pervious surfaces is in the form of sediment erosion.

Landscape areas and turfgrass is an essential part of this equation. Healthy, properly maintained grass is shown to increase infiltration rates and reduce volume runoff and sediment. Other environmental benefits of grass include (J.B. Beard, 2004):

- Erosion control
- Dust control
- Reducing storm water runoff
- Flood control
- Enhancing groundwater retention and recharge
- Entrapment and biodegradation of organic chemicals
- Reducing the urban heat island effect
- Reducing noise pollution
- Carbon sequestration

While we understand the benefits of healthy turf grass to water quality and the environment, we acknowledge that product formulation and consumer education of best cultural practices can further improve water quality. This report surveys peer reviewed technical papers on nitrogen, phosphorus and sediment runoff from urban turfgrass for input to the Technical Guidance to fulfill Section 502 of the Chesapeake Bay Executive Order should cover as it relates to urban turfgrass.

Best management practices include:

- Mowing High: This allows for greater root length and density, which allows the plant to better absorb nutrients and soil moisture. Taller grass also keeps the soil surface cool and shaded, prevent rainfall impact on the soil surface, and crowds out weeds.

- Return Clippings or Use a Mulching Mower: Recycling grass clippings returns essential nutrients to the soil (ex phosphorus and nitrogen).
- Clippings add organic matter to the soil, improving soil health, vigor, and infiltration capacity.
- Keep Fertilizer and Grass Clippings Off Impervious Surface: Grass clippings, leaves, fertilizer, and yard debris left in gutter or streets will be washed into storm sewers and surface waters.
- Fertilize in Spring and Fall: Early and middle spring and the fall is when turfgrass absorbs the most nutrients. Never fertilize when the ground is frozen.
- Use a Proper Spreader: Drop spreaders or rotary spreaders with a side guard help to keep fertilizers on the lawn and off impervious surfaces.
- Mulch Tree Leaves: Mulching leaves into the grass adds organic matter and nutrient to build a healthy soil.
- Avoid Fertilization before Heavy Rainfalls

Response: The benefits of turf were addressed in the guidance. References provided by Scotts Miracle Grow Company were reviewed and cited in the guidance. For example, reference articles by Kussow, Petrovic, Easton, Soldat that were provided by the Scotts Miracle Grow Company were cited. In addition, a section on turf cultural management practices was inserted based on the recommendations under the Scotts Miracle Grow comments pertaining to the Education of Best Management Practices.

Comment: The commenter commented about the assumptions made in the guidance regarding the use of 2,4-D and the application practices associated with the herbicide 2,4-D/A.

Response: These assumptions and the associated discussion regarding 2,4-D/A were deleted from the guidance.

Comment: As the largest crop in the watershed, turfgrass has been unfairly identified as a significant polluter of the Bay, its tributaries and ground waters. Dubious data, unscientific references, and non-credible sources have been used as basis for the position that turfgrass in the watershed is significantly contributing to pollution of the Bay. We strongly disagree with this position and the following comments will provide cited evidence to the contrary, refuting the citations identifying turfgrass as a significant polluter, as contained in the Executive Order 13508 Implementation Guidelines. The focus of our comments is in reference to Section 5 (Turf Management) of Chapter 3, Controlling Urban Runoff. We agree with many of the positions outlines in the guidelines , such as implementation of proper mowing practices, selecting the proper turfgrass at establishment and utilizing an efficient irrigation system. Among others, these are steps that the turfgrass industry already promotes to address responsible management. In reference to the following: we call attention to the fact that no scientific data from peer-reviewed studies from reputable journals are used as support.

- Reducing total turf area through initial design or redesign of existing landscapes will improve water quality.

- Reduction of total area maintained under ' high input' (as defined in the guidelines), will improve water quality.
- Converting turf to low or lower maintenance vegetated areas (e.g. naturalized forest, meadows, etc.) will significantly improve water quality.

Response: The Agency did not state in the guidance that turf has been identified "as a significant polluter of the Bay, its tributaries and groundwaters." The Agency noted in the guidance that turf management has the potential to negatively impact the Chesapeake Bay watershed; that turf does not provide the same ecological services that native forests provide in terms of hydrologic function, habitat and overall function; and that specific management practices can be used to reduce potential water quality impacts that may result from poor turf management. Turf does not have the same hydrologic footprint or function that is provided by a mature hardwood or mixed hardwood forest. For example, a study by Kays, 1980 showed that infiltration rates comparing pine-mixed hardwood forest had a final constant infiltration rate of 12.42 inches per hour and when the forest understory and leaf litter were removed, the resultant lawn had a mean infiltration rate of 4.41 inches per hour. Infiltration rates for four other "disturbed" land types were tested and they had infiltration rates around two orders of magnitude less than the rates for native forest conditions.

Dierks, 2007, noted that turf does not provide the same degree of infiltration, interception and runoff attenuation that is provided by mature forest with its associated layer of duff and underground deep root structure. In addition, it should be noted that mature forests shade sensitive aquatic systems. Because native landscapes provide a broad suite of ecological benefits in addition to the soil stabilization, infiltration and filtration benefits that turf provides, the Agency believes that protection of native forest or restoration of native forest or other vegetated land cover types is beneficial to water quality and water resources

The Agency explicitly acknowledges in the guidance that turf can be used beneficially in many applications to reduce runoff from bare, compacted or disturbed soils; that turf can filter pollutants and promote infiltration; and that turf can be beneficial in reducing the impacts of runoff from impervious surfaces especially in an ultra-urban environment. However, it must be noted that managing turf in a manner that minimizes runoff requires great care and expert management. For example, many lawn care fertilizer products sold in major lawn and garden and hardware stores across the Chesapeake Bay watershed recommend applications four times a year that total in the neighborhood of 140 pounds per acre annually of nitrogen. These levels approach those used by farmers who grow corn. Thus much high-input turf is receiving annual applications that are similar to agricultural fields, and require expert care to minimize runoff or infiltration. Many of the applicators of these fertilizers are either homeowners or local applicators who in many instances are likely to not manage and time their fertilizer applications and their lawns in such an optimal manner as to avoid runoff or infiltration of nitrogen. Even larger private and public entities have varying strategies for turf management, some of which result in increased pollutant loadings. Some of these management strategies inevitably result in increased loadings of nutrients and air pollutants that are eventually deposited into the Chesapeake Bay watershed.

Although there is a lack of published research that seeks to directly compare turf to mature deciduous forests in terms of water quality and hydrology, there is data on the hydrology of both forests and turf management as well as a number of water quality studies that show nutrient exports from turf landscapes e.g., . Soldat and Petrovic (2008) noted with respect to turf that "runoff and leaching losses vary from inconsequential to severe depending on rate, source and timing of fertilizer application" and "Soil properties were found to have a larger effect on runoff volume than vegetative properties." These studies were cited and discussed in Section 5.3.3 of the guidance. Finally, it should be noted that in general, native forests do not require periodic fertilization to maintain stand density and overall forest health and that turf requires ongoing management to ensure that it functions as desired.

Comment: A reference from the Center for Watershed Protection (Schueler, 2000), states that 70 percent of the turf in the watershed can be found in home lawns. The actual figures are 82.4% in New York (USDA-NASS, 2003) and 82.6% in Maryland (SDA-NASS, 2005). Therefore, the 70% number may not be current. We agree that roughly 50% of home lawn turf is maintained using some level of inputs, besides mowing. However, the Agency disagrees that in the majority of lawns, the level of inputs applied is significant and worthy of a 'high input' designation.

Response: The guidance was revised to reflect new data provided by the Chesapeake Stormwater Network 2010 estimates and more recent studies by Milesi et al (2005) and Fender (2004). Again we note that major fertilizer companies in the Chesapeake Bay Watershed recommend applications of approximately 140 pounds per acre year of nitrogen, which is just slightly below typical applications by farmers on cornfields.

Comment: Surveys by the Scotts Company, (Augustin, 2007) show that consistently from state to state, 50% of homeowners do not apply any fertilizer to their lawns, as Schueler stated. Of the remaining 50% of homeowners, 75% are do-it -yourselfers (DIY) and 25% hire a lawn service. Therefore, of the approximately 14.4 million acres of home lawn turf(70% of3.8 million acres, as reported by Schueler), 7.2 million acres receive some fertilizer. Additionally, professional lawn care companies make the applications on 25% (1.8 million acres) of the 7.2 million acres. Also of the DIY homeowners, 93% apply fertilizer only once or twice a year. Therefore, only 7% of DIY homeowners would really be considered 'high input ' by our definition. Additionally, surveys by the Scott Miracle Grow Company show that DIY homeowners typically apply only 4 - 9 grams of nitrogen per square meter annually (this is equivalent to 35 - 80 Ibs. acre). Averaging this figure comes to 57.8 Ibs of nitrogen per acre per year, or 1.33 pounds of nitrogen per 1000 sq. ft. per year. The Scotts numbers differ from numbers reported by Schueler. Given that Schueler does not cite any scientific references of published surveys in his document, we strongly question the accuracy and credibility of information in his document.

We also question the assumption within Table 3-42 stating that turf management recommendations suggest that one inch of water be applied during the growing season (to maintain green cover), further assuming that this is a common practice for all homeowners in the 'high input' category. The New York State Turfgrass Survey noted that only 15% of surveyed homeowners ever irrigated their lawns. We assert that this figure is consistent for all the states in the Chesapeake Bay watershed. Therefore, table should cite an adjusted value

Response: In response to the comment on the table which contained estimated fertilizer, pesticide and irrigation use in the Chesapeake Bay, the table was deleted and the numbers were recalculated and inserted into the text based on assumptions and data provided by the Scotts Miracle Grow Company regarding high input use of fertilizers. However, we note that major fertilizer companies in the Chesapeake Bay Watershed recommend applications of approximately 140 pounds per acre year of nitrogen, which is just slightly below typical applications by farmers on cornfields.

Comment: Section 5.2.1 Soil Compaction : Soil compaction in urban environments is a real and significant problem. The document incorrectly implies that turf is linked to soil compaction in lawns. Mismanagement of soil prior to establishing turf is the cause of soil compaction. If the soil is mismanaged prior to establishment of any plant, the problems associated with soil compaction will persist regardless of the plant species established. Choosing not to plant turf will not overcome soil compaction. Improved soil management during home construction and landscape installation will reduce soil compaction.

Response: The subsection on soil compaction was deleted from the section on turf related impacts and discussed in the context of soil amendments as a cultural turf management practice. The commenter was correct in noting that soil compaction does not result from turf cultivation.

Comment: Section 5.2.2 Fertilizer Applications: Information on page 3-128, Lines 34-36, state that homeowners typically apply fertilizer rates exceeding 100 lbs of N per acre per year. The study by Morton and Sullivan focused on applications in only two counties on Long Island, NY, most likely not typical of homeowners in the watershed. Schueler states that clearly one-third of homeowner lawns are managed by lawn care companies (Lines 36-37) . Scotts Company surveys, however, dispute the one-third figure, citing and estimate of 25%, which has remained consistent for many years (Augustin, 2010). In addition, the document states on the same page, Lines 6-8, that results from the National Gardening Survey of2000 indicate that 83.9% of households apply fertilizer to their lawns and 63.8% apply pesticides. We contacted the National Gardening Association and they could not confirm these figures and stated that these figures seem to be high by a factor of two. Therefore, since we do not own a copy of this survey (it must be purchased at a significant cost), we cannot confirm these figures. However, these numbers go against surveys conducted by the Scotts Company over a period of many years. Another question not addressed by the document is: "What happens to fertilizers applied to turf?" Researchers from the University of Minnesota and the University of Wisconsin (Bierman, et al, 2009) addressed phosphorus runoff from turf maintained as a home lawn. They concluded that "maintaining a healthy, dense stand of turf can reduce phosphorus transport by reducing runoff depth". Stier and Kussow from the University of Wisconsin compared the runoff from buffer strips of prairie species and fine fescues on a golf course. The researchers concluded that: "The lack of difference between buffer strips could be surprising to some persons as native plants (i.e. prairie) are often thought of somehow being inherently better for the environment in all respects than turfgrasses; however, this is simply not the case. Data from the studies show that it is impossible to achieve zero phosphorus in runoff or nitrate in leach ate as both of these minerals are often naturally abundant and play an important role in healthy ecosystems. In the current study, our data did not indicate golf course fairway management to be a significant source of either phosphorus or nitrogen." It is interesting that a very large study, funded by the National Science Foundation and conducted by the Cary Institute of Ecosystem Studies, was not referenced in the document. Dubbed the 'Baltimore Ecosystem Study', this work studies many aspects of the water quality in urban and suburban streams in the Baltimore, MD area of the Chesapeake Bay watershed . This landmark study, interestingly enough, started with the assumption that home lawns were a major source of nitrogen loading in the regions ' streams. However, the study ultimately concluded "Home lawns, thought to be major sources of N in suburban watersheds, have more complex coupled carbon and N dynamics than previously thought, and are likely the site of much N retention" (Cary Institute, 2010). We advocate a thorough review of the Baltimore study and other included peer-reviewed scientific references

('References' at the end of this document). There is a large collection of research on nutrient transport in turfgrass systems that need to be used in developing the Executive Order 13508 Implementation Guidelines.

Response: The table which contained estimates of fertilizer, pesticide and irrigation water use was deleted and the fertilizer application rates and estimates revised based on data from the Scotts Miracle Grow Company. Studies regarding the benefits and potential impacts of turf management fertilization practices and mowing practices were cited in the document. Results from the Baltimore Ecosystem Study were also cited in the guidance. Increased emphasis on cultural management practices regarding mowing height, fertilizer applications practices and the benefits of stand density were provided and relevant studies were cited as appropriate. The numbers for total pounds of nitrogen applied in the Chesapeake Bay watershed were also revised in Section 5.2.1 in response to industry comments on application rates and cultural application practices. (Nonetheless, we note that some prominent Scotts Miracle Grow products as well as other companies' sold for routine use by homeowners that contain recommendations for 4 annual applications that total well in excess 100 pounds per acre year of nitrogen.)

Comment: Section 5.2.3 Pesticide Applications: The speculation displayed in the document that many homeowners apply large amounts of pesticides, or even apply pesticides at all, is inappropriate and incorrect. Lines 20-23 and 27-30 on page 3-129 offer a worst case scenario of pesticide use that is totally inaccurate. Broadleaf weed herbicides containing 2,4-D are rarely applied to an entire lawn. They are usually applied as spot applications directed to the targeted weed. It is incorrect to assume that all I. 71 million acres of 'high input' turf are treated broadly with 2,4-D. Again, no peer-review studies are referenced in the document to support included claims. The fate of pesticides applied to turf has been investigated by researchers for many years. Fate and Management of Turfgrass Chemicals (Clark and Kenna, 2000), reports on the research delivered in a symposium sponsored by the American Chemical Society. It provides a foundation for understanding pesticide fate in turfgrass systems and the practices necessary to minimize potential environmental risk from pesticide applications from turfgrass. The book states: " ... it is significant that turfgrass systems appear to have a very large capacity to retain and degrade compounds that are applied to them..." (p. 104). This statement fully confirms findings by the researchers at the Cary Institute for Ecosystems Studies in the Baltimore Ecosystem Study.

Response: The pesticide related impacts subsection in the draft was deleted in response to comments. Discussion, however, about cultural management practices relating to turf applications was provided in Section 5.3.4.

Comment: As stated above, the information given in this section is not supported by peer-reviewed studies. On page 3-130, Lines 2-3, the document states turfgrass tends to require more water than many commonly used landscape plants. There is no citation to support this statement. In addition, the statement on page 3-130 (Lines 7-9) that all ' high input' lawns in the watershed would likely be irrigated using the one inch per week rate is pure conjecture and absolutely incorrect. Please refer again to the New York state survey where only 15% of homeowners irrigate their lawns. Assuming twelve weeks of dry weather per year where 1.0 inch of irrigation water would be required seems to be a worst case scenario and unrealistic. The publication Water Quality and Quantity Issues for Turfgrasses in Urban Landscapes (Beard and Kenna, 2008) is a credible and rigorous reference for turfgrass irrigation and water issues.

Response: Research from Foster (1994) was cited to substantiate the statement that irrigated grass can use more water than other landscape types. The table in the draft which contained the irrigation estimates and the 1" of water irrigated per week assumption was deleted. The publication Water Quality and Quantity Issues for Turfgrasses in Urban Landscapes (Beard and Kenna, 2008) was used as a reference for this guidance.

Comment: This section references groups that lack scientific expertise (SafeLawns.org) and the section also fails to address credible counter viewpoints that are supported by science. We urge you to consult engineers and researchers for facts on the environmental impacts of lawns. One such literature review by Sahu (2009) concluded that turfgrass sequesters more carbon than is emitted by mowing. Qian and Follet (2002) found that golf course managed sequestered about one ton of carbon per acre per year for the first 25-30 years, which is roughly equivalent to the carbon sequestered by an acre of managed land in the Conservation Research Program (CRP).

Current studies are underway to address carbon emissions and sequestration in turf. The Colorado Golf Carbon Project (Golf Preserves, 2010) is a joint project sponsored by the golf industry, golf courses in Colorado, Colorado State University, and the USDA Agricultural Research Service. The project's goal is to determine the carbon sequestered vs. the carbon used by golf courses in Colorado (i.e. the carbon balance).

The Executive Order 13508 Implementation Guidelines mentions a study by Townsend-Small (20IOa) that evaluated carbon sequestration and nitrous oxide emissions from picnic areas and athletic fields in California. This article was published by American Geophysical Union and has issued a correction (Townsend-Small, 2010b) due to inaccurate calculations that lead to more than a ten-fold overestimation of carbon emitted. As part of the correction, the authors now conclude that lawns may have actually a positive carbon balance, if managed conservatively.

However, the author's assumption of 15 lbs. of nitrogen applied per year on the athletic fields is about four times too high from what is the norm in that region, and therefore extremely unrealistic. This overestimation of nitrogen levels skews the carbon released via nitrous oxide to the point where the athletic fields have a negative carbon balance.

Response: The discussion on carbon sequestration was deleted in response to comments and the lack of research comparing the carbon sequestration of turf to mature deciduous forest. In addition, Mosko, 2009 was cited in response to the statistic reported by Safelawns.org.

Comment: There are instances of incorrect information in this section. One example is on Page 3-131, Lines 10-11, that states lawn fertilizer should be applied in early spring early in the growing season. This statement is incorrect and contradictory to many studies in the scientific literature and recommendations made by state turfgrass extension specialists. The document cites a number of municipal governments that have passed legislation that restricts phosphorus use yet does not include any data on the impact of the legislation in reducing phosphorus in surface water. The impact of Ann Arbor, MI phosphorus ordinance cited is based on one year of data and the conclusions do not consider other plausible explanations for the reduction in phosphorus in water that was observed.

Response: The document has been edited to reflect industry comments on correct fertilizer applications timing. In response to the comment on the paucity of data correlating the impacts of phosphorus restrictions on improvements to water quality, the Agency agrees more monitoring is indicated. Although the Ann Arbor, Mi ordinance is a fairly recent ordinance, and long-term data is not yet available, the initial indications from the first year of monitoring are very positive in terms of the relationship between the restriction and reduced phosphorus loadings to receiving waters.

Comment: The value of soil amendments to improve the physical, chemical and biological properties of soil is well documented. The recommendations do not take into consideration the expense involved in purchasing and incorporating the suggested amendments. In addition, the practical challenge of incorporating a soil amendment to a depth of 8 to 12 inches as suggested on page 3-136, Lines 15-16, is not addressed.

Response: Inexpensive soil amendment practices are available for improving soil conditions. The Agency is not recommending amendments to all soils that is currently covered by turf. Site conditions will determine whether an amendment is necessary. It is common practice for the turf industry to aerate and fertilize turf areas, and the use of organic amendments is a common and cost effective practice to do so. The Agency recognizes that not all soils need amendment and that cost may prohibit all degraded soils on a facility from being amended. The Agency recommends that facilities or municipalities look for opportunities to amend soils based on need, i.e., environmental performance, cost, practicality, etc. Finally, recommended soil amendment depth will again be dependent on site conditions and other factors and not all sites necessarily need this degree of amendment. In cases where turf is being replaced by biorentention systems or other stormwater management practices designed to retain or infiltrate runoff, soils it may be necessary to amend soils to a depth that provides the requisite storage volume to meet the state or local regulatory requirements.

Comment: It is well established that healthy, biologically-rich soil protects the environment and the Chesapeake Bay by helping to retain and efficiently use nutrients such as nitrogen and phosphorus, thus keeping the excess content out of the Bay. Chapter 3 Section 5.3 of the Executive Order states, "Soil amendments can be used to enhance soil properties, increase the infiltrative and retentive capacity of soils. Soils can be amendment by adding sand or other bulk materials, organic matter such as compost, inorganic or organic fertilizers. There is some evidence that the use of compost teas and the inoculation of soils with microbes and mycorrhizal fungi can increase soil health and plant productivity, but additional research is needed." In truth, the beneficial effect of microorganisms on improving nutrient use efficiency has been known for many years. The publications cited below offer just a few of the excellent examples of these effects. Both trade and academic publications increasingly cite "Integrated Nutrient Management" (INM) approaches that incorporate techniques for enhanced efficiency fertilizer (EEF) use, as well as microbial inoculants as means to improve nutrient use efficiency. The INM concept is supported by many national and international agencies – including the US Department of Agriculture, the Food and Agriculture Organization (FAO) of the United Nations, and the Food Policy Research Institute – in a variety of research programs. Our company AMS – has alone conducted over 500 field, university and third party studies over the past 12 years demonstrating the benefits of biological approaches for nutrient management; including a presentation at the EEF conference (sponsored by the International Fertilizer Industry Association) in Miami, Florida in March 2010. The growing academic interest, investment and discovery in microbial product contributions to nutrient management are reflected in the papers now being published in peer-reviewed journals. A few examples – each of which has been published within the last two years – are shown here:

- Enhanced plant nutrient use efficiency with PGPR and AMF in an integrated nutrient management system (Adesemoye et al (2008) Can. J. Microbiology. 54:876-886)
- Fertilizer-dependent efficiency of Pseudomonads for improving growth, yield and nutrient use efficiency of wheat. (Shaharoona et al Naveed (2008) Appl. Microbiol. Biotechnol. 79:147-155.)
- Effectiveness of organic-/bio-fertilizer supplemented with chemical fertilizers for improving soil water retention, aggregate stability, growth and nutrient uptake of maize (Ahmad et al, (2008) Jour. Sust. Agric. 31(4):57-77.)
- Integrated nutrient management for production, economics and soil improvement in winter vegetables. (Dass et al, (2008) Inter. J. Veg. Sci. 14(2):104-120.)

While research continues at an increasing rate, we would nonetheless submit that there is sufficient knowledge of these applications and their effects to simply state: "There is evidence that the use of compost teas and the inoculation of soils with microbes and mycorrhizal fungi can increase soil health and plant productivity."

Response: In response to comments, the passage regarding biological approaches to soil amendments has been revised. The studies provided by the commenter were conducted on agricultural crops and could not be directly applied to research conducted on turf. However, the basic assumptions regarding the benefits of biological approaches that were supported by the commenter are discussed and the relevant research papers cited.

Comment: One commenter commented that Pitt (1992) noted that residential lawns produced only a fraction of the total runoff of impervious areas and that stormwater monitoring agencies have been unable to directly link stream nitrate concentrations to prior lawn fertilization applications, that there is strong evidence that most pesticides remain on the lawn until they eventually degrade and that recent monitoring efforts are routinely detecting commonly used weed killers and insecticides in urban streams.

Response: The Pitt studies cited are somewhat old and the research has conflicting interpretations. Studies by USGS and other entities have demonstrated that urban streams have house and lawn care pesticide concentrations that are detectable. Drawing a direct connection between lawn fertilization and nitrate concentrations in streams is difficult on a watershed basis because of inconsistent application rates and timing as well as other factors that may attenuate or influence concentrations in streams.

Comment: "An identification of areas where soil amendments be used [sic] to enhance soil health and the infiltration capacity of the soils" (p. 3-126). The general concept is good, but there is minimal scientific/agronomic basis to support the use of many organic amendments such as microbial inoculants, compost teas, humic acids, etc., unless the soils are very seriously damaged or deficient. Researchers at the University of Massachusetts and the University of Georgia have studied these claims and found little to recommend the products. There is a much larger database to support the use of sand and compost.

Response: The section on soil amendments was revised to include studies that relate to this issue. EPA agrees that there is insufficient evidence at this time to conclusively prove the benefits of these biological approaches on turf health and soil function, but that studies on agricultural crops indicate that these benefits will probably apply to turf management. The agency agrees that compost and other soil amendments such as sand can improve soil function.

Comment: 5.2.2 Fertilizer Applications: This is a short, but very important section that spans the bottom of p.3-128 through the top of p.3-129. "Homeowners typically apply fertilizer at rates exceeding 100 lbs of N per acre per year, whereas some commercial lawn care companies are known to apply fertilizer at twice those rates (Morton et al. 1988)." This is a misleading statement. This is a good paper by Art Gold and his students, but the EPA authors have misused it. Morton et al. are referring to a survey of Long Island (Nassau and Suffolk Counties) homes that was published in 1978. It is inappropriate to generalize to the other 3,100+ US counties as well as to the present time, at least 32 years after the survey was conducted, and then to use this in a critical calculation in an authoritative document.

Response: In response to comments, this study and reference were deleted.

Comment: "Reported nitrogen fertilization can average over 100 lbs/ac/yr when homeowners apply fertilizers to over 200 lbs/ac/yr when they are applied by commercial lawn care companies" (Morton et al. 1988). This is another misleading statement, and it falsely quotes the authors. The statement in the EPA guidance document is in quotes, and the authors never said that, nor would Dr. Gold ever have said that. The original authors were careful to state that their statistic on homeowner use refers to a specific survey of a specific part of New York which is not in the Chesapeake Bay watershed, and the professional application rate was based on a personal communication for that specific area. No average was reported, and no extrapolation was made to other areas of the country. If averages were available, they would likely demonstrate the relatively large number of homeowners that do not ever apply turf fertilizer, nor hire others to do so. (The National Gardening Association survey cited immediately below indicates that only 23% of US households hired a lawn care company and/or a landscape company in 2009.) Has EPA considered the fact that many homeowners only fertilize their front lawns? (See also the discussion immediately below regarding the percent of US households that apply no fertilizer.) Any true average of all US households and/or all households within the Chesapeake Bay watershed is likely much less than 50 lb/A, and the average for households where fertilizer is applied is likely less than 70 lb/A. Augustin (2009) reported that typical do it yourself homeowners apply 36-80 lb N/A nationally, but this does not account for the homeowners that apply no fertilizers. We can help the EPA or its contractor obtain more specific information, if requested.

Response: In response to comments references to the Morton (1988) and the National Gardening Association survey were deleted for reasons addressed by the commenter. The Agency in estimating the potential loadings of fertilizers in the Chesapeake Bay utilized data provided by Scotts Miracle Grow to revise the totals.

Comment: "Results obtained from a National Gardening Association survey indicate that 83.9 percent of households apply fertilizers to their lawns and 63.8 percent apply pesticides (National Gardening Association, 2000)." These numbers are very high and highly suspect. According to the National Gardening Association (NGA), the following numbers are more appropriate, based on a statistically designed, national survey of 2500 households (B. Butterfield, Director of Research, NGA, personal communication, April 21, 2010): Approximately 44% of the nation's households applied fertilizers outdoors to gardens and/or lawns in 2009, and this number has never approached 83.9%. Note that some unknown fraction of this number applied fertilizer to gardens only. This 2009 result is based on the following survey results: there are 116 million US households, 72% of which (83 million) did some level of lawn and garden work somewhere inside or outside their homes in 2009, and 61% of this 72% of the population - 44% purchased fertilizers for use. Similarly, approximately 39% of the nation's households applied pesticides to their outdoor property, not 63.8%. In addition, some unknown fraction of this number would have only applied pesticides to cracks and crevices, building exteriors, or ornamental plants. This 2009 result is based on the following survey results: 54% of the households that did some level of work in this area (72% of the total) applied at least one outdoor pesticide at least once - 0.54 X 0.72 = 0.39, or 39%. These numbers should be corrected in the document, and any assessments that rely on these numbers should be reevaluated.

Response: Due to the absence of published data that is consistent with the personal communication with the National Gardening Association, the reference to the National Gardening Association survey results was deleted.

Comment: "Homeowners are instructed to follow the label instructions to determine application rates. By examining instructions from two such labels for commercially available herbicides (below), one can estimate an annual amount of pesticides applied to lawns in the Chesapeake Bay watershed, assuming all high-input turf acreage is subject to pesticide application at prescribed rates." It is not appropriate to state that "one can estimate an annual amount" of pesticide loading based on an assumption that all high-input acreage is treated, because that would never happen. Such a calculation in an authoritative document such as this, which will provide a basis for future TMDL compliance by multiple jurisdictions, is politically irresponsible. The pesticide industry can comment on the frequency of households that might actually use these products, as well as the application rates. In addition, it is important for the EPA to realize that many/most herbicide applications are done on a spot-treat basis or to the front yard only. Perhaps a dialog that involves EPA's Office of Pesticide Programs, pesticide registrants, and outside scientists would be appropriate to establish a more realistic exposure scenario. This calculation should be deleted or modified.

Response: In response to comments the calculation was deleted.

Comment: Rather than protecting the Chesapeake Bay, it is likely that the Executive Order as currently written will lead to more harm to the bay as it promotes low input turf grass that will degrade the environment as it allows nutrients and sediment to flow into the Chesapeake Bay.

Conversely, thick healthy turf protects the environment and the Chesapeake Bay by reducing the amount of storm water runoff while recharging local aquifers, preventing soil erosion and sedimentation and keeping excess nitrogen and phosphorus out of the Bay.

To provide better protection for the Chesapeake Bay, those living the in watershed should fertilize their lawns as part of a regular maintenance regime to protect the Bay.

Rather than promote the reduction of fertilizer for turf, EPA should focus on outreach, education and other efforts to promote the adoption and improvement of products, such as our advanced granular technology in order reduce the nutrient and sediment flow into the Chesapeake Bay. As part of The Andersons commitment to environmental stewardship, we developing advanced granule technology under a cooperative technology development grant with four industry collaborators and the State of Ohio. A major thrust of this development work is the commercialization of "next generation" granules. These granules are based on one of three technology thrusts that result in granular products that perform more efficiently. In conclusion, The Andersons fully shares EPA's goal of protecting and restoring the Chesapeake Bay and for that reason we are actively working to quickly refine and incorporate our advanced granule technology into as many of our products as possible. We encourage EPA to actively promote products, such as our advanced granule technology and other products and equipment that are intended curb the runoff of nutrients and sediment into the Chesapeake Bay. True nutrient management can only be achieved by advancing standards and performance measures and educating all applicators, growers, lawn care applicators, golf course superintendents, and homeowners about products specifically formulated to reduce runoff

Response: The commenter noted that turf has the potential to reduce water pollution by decreasing runoff and pollutant discharges. The Agency agrees that turf has a role in protecting water quality and that properly managed turf can filter runoff, reduce runoff volume through evapotranspiration and infiltration. The Agency also agrees that outreach and education to change cultural practices are important and has emphasized these practices in the guidance. The Agency supports such efforts through the Clean Water Act Section 319 Nonpoint Source Program. The Agency does not promote specific proprietary products, but does promote the use of practices and approaches that can be used to reduce water pollution such as the proper management of turf grasses to reduce runoff related impacts.

Comment: The reductions in turf suggested in Chapter 3 are not based on science. PLANET believes that an arbitrary specification limiting turf will lead to the loss of many of the valuable ecosystem services provided by healthy, well-maintained landscapes with an appropriate blend of turf and other plants. Chapter 3 goes to great length to cherry-pick documents and situations around the country to paint a picture that turfgrass establishment and maintenance is a detriment to the environment. The fact is the majority of places with turfgrass in the Chesapeake Bay states do not fit your scenarios and, based on cost alone, will not ever be changed to other plantings by landowners. Humans have used turfgrass to enhance their environment for more than 10 centuries. Turfgrass has functional, recreational, and aesthetic benefits, and it is one of the most cost-effective means of trapping and holding surface water that may contain eroded soil and organic chemicals, thereby helping to reduce the amount of siltation and organic chemicals that enter sewers, streams, rivers, and lakes. PLANET believes it would be more effective to work with the existing landscapes, and to educate landowners and the industry to improve the methods of caring for turfgrass to increase its environmental benefits. Turf provides a very dense ground cover, and, compared to ground covers without thatch, it has a greater capacity for absorbing and holding water. Even in your own publication, Healthy Lawn, Healthy Environment, you mention the benefits of turfgrass, which were also included in your funded initiative, "Lawns and the Environment." Scientific research has documented the many benefits of turfgrass to our environment. Turfgrass lawns, parks, and open areas:

- Provide a natural, comfortable, and safe setting for fun and games.
- Release oxygen and cool the air.
- Control pollution and reduce soil erosion.
- Purify and replenish the water supply.

Also to be considered is the economic impact on the service industry of the suggested reduction of total turfgrass and its maintenance that are called for in this Executive Order. As an industry, turfgrass is considered to well exceed the $25 billion mark. In addition, more than 500,000 people are estimated to make their livelihood directly from the care and maintenance of turfgrass. The sale of lawn care products, which represents nearly one-third of all money spent on gardening in the country, is estimated to total more than $4 billion a year.

Response: The Agency has included discussions on the benefits of turfgrass from both environmental and social perspectives in the guidance. The guidance does not contain an arbitrary specification nor does it limit the use of turf. The guidance contains recommendations for changes in cultural practice that are voluntary and based on sound assessments and evaluations. The same commenter also noted that there were potential economic implications to the turf industry. Although the Agency was not directed to conduct a cost benefit analysis, the Agency was instructed to recommend cost effective practices. The agency believes that the practices recommended in the guidance are cost effective based on reduced maintenance costs and that changes in management practice will continue to support jobs and products to design and maintain landscapes that meet multiple social and environmental goals.

Comment: Steps to establish and properly maintain turfgrass vary greatly across the United States. The manual appears to impose one standard that will apply from the hot, semi-arid southwest to the cold, wet Mid-Atlantic and North-Eastern states. For instance, page 3-131 calls for lawn fertilizer to be applied in the early spring. Virginia's Department of Conservation and Recreation has invested hundreds of thousands of dollars to promote fall fertilization.

Response: In response to comments, the recommendations on fertilizer application timing were revised. The document is not intended to impose one standard that will apply nationally. The Agency recognizes that geography and local conditions will determine what cultivars and management programs are suitable for turf regionally.

Comment: One of the most impressive aspects of this document is the stated emphasis on replicating predevelopment hydrology, rather than the traditional pollutant-focused approach to watershed management (3-5). The most effective method for achieving reductions in pollutant loading is to reduce the volume of stormwater. Yet, on several occasions the document reverts to the pollutant-centered approach. There is an important, but subtle interaction between volume and source management for turfgrass areas: a properly fertilized stand of turfgrass can improve infiltration and reduce runoff volume. This effect is achieved by the increase in plant density created by proper nitrogen fertilization (100-150 lbs/acre), which slows the speed of the runoff water allowing for more infiltration. This effect is shown by Easton and Petrovic (2004) and Bierman et al. (2010), where unfertilized turfgrass had greater losses of P in runoff than properly fertilized turfgrass. It is not clear that switching to alternative plantings will result in lower phosphorus losses as demonstrated by Steinke et al. (2007), who suggest that the primary source of phosphorus in runoff from vegetated areas is the vegetation itself. This conclusion is supported my own work in the field (Soldat et al., 2009). Another troubling aspect of the document is the underlying assumption that vegetation alone strongly affects environmental quality. For instance, on page 3-127, the document suggests that replacing a native area with turf will lead to a myriad of negative outcomes. However, it can be convincingly argued that each of these outcomes is a factor of the construction practices and urbanization of the land. If a native area is replaced by a subdivision and native plants put back in lieu of turfgrass, every single negative outcome would remain true for the newly planted native vegetation. In short, the focus on vegetation is short-sighted, and more attention should be paid to the remediation and conservation of soils in urbanizing areas. If urban soils have a bulk density closer to concrete than native soils (3-37), it is the fault of the construction practices rather than the vegetation. It is a simple act to require chisel plowing of organic matter into the soil profile at the conclusion of a construction project. At this point, either native plantings or turfgrass can achieve predevelopment hydrological standards. Finally, the UC-Irvine study cited by the document (3-130) was found to be flawed, the authors overestimated carbon inputs by a factor of 12 (month to year conversion). The authors have since published a retraction, and their newly calculated results show that turf maintained with 100 lbs/acre of nitrogen can more than offset the carbon required to maintain it. The authors' high maintenance scenario used 750 lbs/acre of nitrogen, an incredibly high and practically unrealistic application rate. To improve the credibility of this document, I suggest any reference to this flawed study be removed.

Response: The commenter noted that research supports the use of improve turfgrass stand density in terms of reduced pollutant loadings. The studies provided by the commenter are reviewed and discussed in the guidance, e.g., Soldat (2009) and Easton and Petrovic (2004) and the Agency agrees that properly managed turf can be used to reduce runoff-related problems especially in cases where runoff is discharged from impervious surfaces such as pavements or from areas with unvegetated or compacted soils. The Agency agrees with the commenter that restoration of urban soils should be a priority, and the Agency recommends this practice to reduce runoff and improve runoff quality. Finally, the same commenter recommended that the UC Irving study on turf and carbon sequestration be deleted and the Agency concurs that the study methodology needed adjustments and accordingly deleted it from the final guidance.

Comment: The commenter noted that the Chesapeake Bay watershed receives more than 30-35 inches of precipitation a year and that irrigation of turf should not be a concern and where it is of concern it can be addressed by irrigation sensors.

Response: The Agency agrees that irrigation sensors are one solution to prevent overwatering. However, as the industry has noted, changes in cultural practices and education of turf grass owner and maintenance personnel is also important. Over irrigation and over application of fertilizers and pesticides are common problems and furthermore many landowners neither desire nor have the funds to put in irrigation systems driven by moisture sensors. Changes in management approach and grass species are low cost means to reduce inputs.

Comment: Pg 1-5. Turf management has become a major issue in the watershed, and development patterns promise rapid future growth of this land use. Thus, it is good to see turf management singled out n the list of new issues. However, the way turf management is described in item 3 . (as a crop) could make someone think the emphasis should be on turf farms. Editing of this paragraph should clarify that this is primarily an urban land use issue with many manifestations (homes, businesses, churches, golf courses, etc.)

Response: The commenter suggested clarification that the use of the term turf does not only apply to sod farms but to lawns. The guidance was edited to incorporate this suggestion.

References

Beard, J.B. and M.P. Kenna. (Eds.). 2008. Water Quality and Quantity Issues for Turfgrasses in Urban Landscapes. *Council for Agricultural Science and Technology*. Ames, Iowa.

Beezhold, M.T., and D.W. Baker. 2006. Rain to Recreation: Making the Case for a Stormwater Capital Recovery Fee. *Proceedings of the Water Environment Federation* (WEFTEC), 2006)

Capitol Region Watershed District (CRWD). 2010. *CRWD Stormwater BMP Performance Assessment and Cost-Benefit Analysis.* http://www.capitolregionwd.org

Center for Watershed Protection (CWP).1998. *Better Site Design: A Handbook for Changing Development Rules in Your Community*. Center for Watershed Protection, Ellicott, MD. <http://www.cwp.org/Store/bsd.htm

Chesapeake Stormwater Network. 2009. *The Clipping Point: The Grass Crop of the Chesapeake Bay Watershed*. Baltimore, MD. <http://www.chesapeakestormwater.net/all-things-stormwater/the-clipping-point-the-grass-crop-of-the-chesapeake-bay-wate.html>. Updated June 10, 2009. Accessed February 4, 2010.

City of Los Angeles Department of Public Works. May 2004. *Final Sun Valley Watershed Management Plan.*. www.sunvalleywatershed.org/ceqa_docs/plan.asp

City of Portland. 2008. *Cost Benefit Evaluation of Ecoroofs 2008.* City of Portland Bureau of Environmental Services, Portland, OR. <http://www.portlandonline.com/BES/index.cfm?a=261053&c=50818>)

Dierk, S. 2007. Not All Green Space is Created Equal - The Hydrologic Benefits of Native Landscapes. *Stormwater*. <http://www.stormh2o.com/sw_0703_not.html>

Easton, Z.M. and A. M. Petrovic. 2004. Fertilizer Source Effect on Ground and Surface Water Quality in Drainage from Turfgrass. *Journal of Environmental Quality*. 33:645-655.

EcoNorthwest. 2007. *The Economics of Low-Impact Development: A Literature Review*. Eugene, OR

Energy Independence and Security Act (EISA) of 2007 (P.L. 110-140, H.R. 6), Section 438

Foster, R.S. 1994. Landscaping that Saves Energy and Dollars. *Globe Pequot Press*, Old Saybrook, CT.

Kays, B. L. 1980. Relationship of Forest Destruction and Soil Disturbance to Increased Flooding in Suburban North Carolina Piedmont. In: METRIA—*Proceedings of the Third Conference of the Metropolitan Tree Improvement Alliance*, Rutgers State University, NJ; 118-125. <http://www.barrettkays.com/downloads/metria.pdf>

Milesi, C., C.D. Elvidge, J.B. Dietz, B.J. Tuttle, R.R. Nemani, and S.W. Running. 2005. Mapping and Modeling the Biogeochemical Cycling of Turf Grasses in the United States. *Environmental Management* 36(3):426–438.

Morton, T., A. Gold, and W. Sullivan. 1988. Influence of Overwatering and Fertilization of Nitrogen Losses from Home Lawns. *Journal of Environmental Quality* 17:124–130.

Mosko, S. 2009. *No Such Thing as a Green Lawn*. <http://www.boogiegreen.com/>. Updated December 10, 2009. Accessed March 9, 2010.

National Gardening Association. 2000. National Gardening Survey. *National Gardening Association*, Burlington, VT.

Soldat, D., and Petrovic, A. 2008. The Fate and Transport of Phosphorus in Turfgrass Ecosystems. *Crop Science.* 48:2051-2065. Published online November 24, 2008.

Soldat, D., A. Petrovic, and Q. Ketterings. 2009. Effect of Soil Phosphorus Levels on Phosphorus Runoff Concentrations from Turfgrass. *Water, Air, Soil Pollution* 199(1-4):33–44.

U.S. Environmental Protection Agency. 2007. *Reducing Stormwater Costs through Low Impact Development (LID) Strategies and Practices*. U.S. Environmental Protection Agency, Washington, DC. <http://www.epa.gov/nps/lid>

U.S. Environmental Protection Agency. 2009. *Technical Guidance on Implementing the Stormwater Runoff Requirements for Federal Projects under Section 438 of the Energy Independence and Security Act*. U.S. Environmental Protection Agency, Washington, DC. <http://www.epa.gov/owow/NPS/lid/section438/pdf/final_sec438_eisa.pdf>)

U.S. Environmental Protection Agency. 2005. Stormwater Phase II Final Rule: Federal and State-Operated MS4s:Program Implementation**,** EPA 833-F-00-012. http://www.epa.gov/npdes/pubs/fact2-10.pdf

U.S. General Services Administration, Office of the Chief Architect, Facility Standards for the Public Building Service, March 2005, www.gsa.govv/P100

Chapter 4. Forestry

Comment: The tone of the chapter gives the reader the idea that forestry operations are bad for water quality in the Chesapeake Bay watershed, when in fact the magnitude of water quality impacts attributable to forestry operations is small compared to other sources and the presence of forests is one of the best ways to protect the bay's water quality. There is no argument that it is important to use appropriate BMPs during forestry operations to protect water quality, but the chapter should cast forests, and forestry operations on those forests, in a more positive light and stress the importance of maintaining land in forest cover for water quality protection. After all, as the chapter states, the contribution of forestry operations to water quality impairment in the bay watershed is very small, so implementing additional water quality protections during and after forestry operations would at best lead to infinitesimal improvements in water quality.

The chapter needs to stress the importance of forests to protecting the bay's water quality and the need to both conserve forests in the bay watershed and increase the acreage of forest cover in the watershed. The danger of presenting forest operations in a negative light is that readers could get the idea that converting land to another use (development) would be better for water quality than leaving it in forest cover. In fact, keeping land in forest cover is better for water quality than any other land use, even with intensive forestry operations occurring on that forest land. Furthermore, by recommending more forestry practices for water quality protection than landowners must already comply with, the potential profit from forest land management could be reduced, and the additional forest practice requirements could create an incentive for forest landowners in the bay watershed to convert that land to another, more profitable use.

Response: Revisions to the chapter included integrating forest conservation concepts into the document better and rewording parts of the introduction that were reviewed as being "negative" to emphasize the importance of forested land in the bay watershed and of conserving forest land.

A considerable amount of additional information was added to the guidance that explains and emphasizes the linkage between forested watersheds and the water quality benefits derived from forested watersheds. The additional information is in the form of references, tables, and text. Also, additional information on forest conservation the concept of sustainable forestry was included.

Comment: The guidance goes overboard in justifying the high tech nature of the tools. The recommendations call for the use of high tech tools, like LiDAR and Digital Elevation Models (DEM) that are less appropriate for timber operations on the scale of those in the East. The implications are that field work is obsolete-- too time consuming - that models and remote sensing can do the work better than people who know the land.

Response: Recognizing that the forest land in the Chesapeake Bay watershed is primarily owned by private individuals with small land holdings and limited budgets, and recognizing that this document would be available on the Internet and would most likely read by the private forest owner, the chapter was revised in order to distinguish between tools and approaches that would be more appropriate for smaller landowners and provides specific information on low-cost tools that can be used to meet the unique needs of smaller and non-industrial class of forest landowners.

Chapter 5. Riparian Area Management

Comment: Chapter 5 on Riparian Area Management is very good. This topic is fundamental to restoring the Chesapeake Bay, as protecting and restoring riparian buffers are a necessary complement to any pollution control measures.

Response: EPA appreciates this support.

Chapter 6. Decentralized Wastewater Treatment Systems

Comment: We would like to applaud EPA's efforts to protect and restore one of our ecological national treasures, specifically, …for reducing nitrogen loadings from onsite systems…

Response: EPA appreciates this support.

Comment: With regard to the 5 mg/L N reduction credit when using time-dosed, pressure-drip dispersal within 1 foot of the ground surface, the New Jersey Pinelands Commission eliminated credit for drip as they determined it not being effective.

Response: EPA contacted the NJ Pinelands Commission which confirmed that this is incorrect. The Commission never provided, nor rescinded, credit for the use of shallow drip dispersal of effluent for decentralized wastewater treatment systems. Further, Commission staff with expertise in decentralized wastewater management voiced support for EPA's approach when it learned of the credit. EPA has modified the language for applying this credit to eliminate the specific reference to drip dispersal in response to another comment and to eliminate the credit in sandy and loamy sand soils.

Comment: Disagree that "nearly all solids and phosphorus (P) discharged from decentralized systems are retained by the soil," especially in sands. A rewrite was suggested.
Response: EPA has added a new section on P with significant clarifying language and new references, as suggested by reviewer.

Comment: Change a portion of the statement on page 6-6, line 13, from "5 mg/L" to either "less than 5 mg/L" or "3 mg/L".

Response: This sentence has been modified to:

"However, some systems do perform optimally in removing TN [total nitrogen] from the effluent—e.g., to concentrations lower than 5 mg/L"

Comment: With regard to page 6-11, line 20, is the cost range really $3,500 - $57,000"? The high end of this range appears incorrect.

Response: EPA thanks the reviewer for catching this typo. The sentence and the related following sentence have been changed to:

> *Capital costs for add-on denitrification systems range from $3,500 to $7,000 and more per EDU, with O&M expenses of less than $100 per year (Washington State Department of Health 2005). Note that these are added costs, and do not include costs for the septic tank, nitrification process unit, or soil dispersal system—just the add-on component.*

Comment: With regard to page 6-12 line 10, the range of $8,000 to $18,000 is low in my experience, especially for the higher required nitrogen removal. It is our opinion that the upper range is $35,000, which is heavily influenced by site conditions and location design conditions (such as deeper sewer depth in colder areas for frost protection and labor/equipment rates).

Response: EPA has changed this paragraph to the following:

> *New cluster systems generally range from $10,000 to $18,000 per EDU in non-urbanized areas of new development, with higher costs for retrofits in urban areas, depending on the treatment technology used (USEPA 2010; Tetra Tech 2007).*

Comment: It is suggested that information on other nitrogen removal components that have received MASSTC testing be included in Table 6-2.

Response: Table 6-2 in the public draft is now Table 6-3, which EPA otherwise left intact. Most of the data in that table is from the MASSTC testing center, which analyzes performance from many systems. Data from the performance tests are released to the public, or withheld, based on contractual agreements between MASSTC and the system owner/vendor. In many cases, data for specific systems are not available due to these contractual arrangements. EPA included the system performance results applicable to the topic in this chapter, and expanded its descriptions of decentralized treatment technologies in section 4 to include new subsections on land/vegetative treatment systems and membrane bioreactors. EPA modestly expanded descriptions of technologies described in the public draft version.

Comment: Please consider adding the attached reference for Nitrex performance from Barnstable County, Massachusetts.

Response: EPA has added this reference.

Comment: The N-removal performance levels specified for various risk zones are presented in the implementation measures as if they are discharge standards, begging the issue of compliance monitoring and enforcement.

Response: Compliance monitoring and enforcement are important activities for ensuring the long-term performance for any wastewater treatment system. States and local communities typically have the authority needed for providing this assurance. EPA is not proposing to regulate decentralized treatment systems at the federal level, nor is EPA recommending that local authorities cede control. As stated in implementation measure D-3, EPA is recommending that "treatment system performance…" be sustained "in perpetuity through management contracts with trained and certified operators for all advanced N-removal systems, and responsible management entity (RME) operation and maintenance (O&M) for all cluster and non-residential systems. RMEs include sanitation districts, special districts, and other public or private entities with the technical, managerial, and financial capacity to assure long-term system performance."

Comment: Cluster systems are preferred by EPA, but local zoning, comprehensive planning, and site suitability / design negotiation (review) are major roadblocks to timely implementation. Most developers go with by right lots, some with absorption areas individually staked in suitable soils by easement. Localities and regulatory agencies need to have reasonable requirements and fast track review.

Response: EPA has found that nitrogen-removing cluster treatment systems cost less on a per-house basis, perform better, are more efficient to operate and maintain, and are generally better able to support treatment services in densely developed areas than individual home systems. For these and other reasons, EPA notes in Chapter 6 that integrated wastewater planning is an important consideration for providing effective, efficient treatment. There are many examples of development served by cluster treatment facilities across the nation. Communities that support long-range planning for providing wastewater services typically are able to leverage cost savings and performance enhancements. Requiring individual homeowners in densely populated residential areas to own, operate, maintain, and manage highly sophisticated electro-mechanical nitrogen removal wastewater treatment facilities has not proven to be successful in many locales.

Comment: I recommend an across-the-board, deem-to-comply BMP approach with a reasonable nitrogen reduction goal, such as 50%.

Response: EPA stands by its risk-based, N-removal performance level approach as both achievable and manageable. Affordable market technologies exist that exceed the goal preferred by the commenter. Moreover, EPA considered, and rejected, percentage-based nitrogen reduction goals. One problem with percentage-based goals includes highly variable levels of N in the wastewater influent from system to system, which would result in equally variable levels of N in effluent from system to system, resulting in its own management challenges and no guarantee that N loads to the Chesapeake Bay will be managed to the extent needed to protect and restore the Bay.

Comment: To achieve the proposed discharge standards for an individual onsite system will require facility-specific operation. Developing a suitable pool of operators will take some time.

Response: EPA's guidance presents the implementation measures needed to ensure successful performance. While EPA recognizes that many of the technologies exist presently and have already demonstrated the performance levels specified in the implementation measures, EPA also acknowledges the commenter's point regarding the need for more trained personnel to implement the measures in this chapter.

Comment: Performance at verification and research facilities will be difficult to replicate in actual field application.

Response: All of the environmental technology verification studies referenced in this chapter involved actual field applications in real-world settings and conditions. For example, the La Pine Demonstration Study involved 49 private homeowners in a geologically challenging environment—an area with rapidly draining soils over a shallow unconfined aquifer that serves as the region's only source of drinking water where nitrate levels are increasing as a result of rapid development and the proliferation of septic systems on small residential parcels.

Comment: The cost benefit per pound of nitrogen is questionable, particularly when considering the atmospheric nitrogen produced by the power plant to power these pumps and blowers.

Response: This comment focuses on energy sources and policy, and is speculative and outside the scope of this guidance. NOx emissions are regulated separately by EPA under the Clean Air Act. The region and nation have made strides to reduce NOx through regulatory and nonregulatory actions. EPA has included the cost of energy required to operate treatment system equipment in the operation and maintenance information provided in this chapter.

Comment: These standards assume a direct discharge to the waterway and do not take into account other soil based pathways of nitrogen attenuation.

Response: This chapter does not address systems that discharge directly to waterways, which are regulated under Section 402 of the Clean Water Act. This guidance recognizes the benefit of soil attenuation of nitrogen in this chapter. N attenuation through soil pathways is a key basis for the risk-based, N-removal performance levels specified in D-1. This is why the specified N standard 1000 feet or more from surface waters is 2 to 4 times higher than zones closer to surface waters.

Comment: The document has many references to equal distribution to the soil system but no firm requirement. The document needs to state that time-dosed equal distribution is to be required on all systems regardless of effluent quality.

Response: EPA recognizes that time-dosed equal distribution is beneficial, and acknowledges that broad and equal distribution of effluent to the soil is important. It should be noted that the overall document constitutes guidance, and not regulatory requirements. The purpose of this chapter is to identify realistic performance levels that decentralized systems need to achieve to help restore the Chesapeake Bay. The chapter also highlights existing technologies that are known to achieve these standards. EPA does not express a preference regarding which technologies and practices are used to achieve these performance levels, but does provide for a significant credit (a 5 mg/L performance boost) for implementing time-dosed, pressurized effluent dispersal within the first foot of the ground surface.

Comment: Virtually all research involving the use of pretreated effluent into the soil involves controlled application, whether onto columns or in situ, with low pressure distribution or drip dispersal. Elimination or the decrease of soil-interfaced clogging coupled with microbial reductions results in enhanced performance. Typical conclusions are that increased loading rates and reduced separations to limitations are possible. Many states allow one of the two only.

Response: EPA has based the guidance in this chapter on both laboratory and field research, including field testing of actual system types at residential and other facilities. EPA is focusing mostly on the treatment system technologies in this guidance, and is providing less credit for soil based denitrification, which has not been shown to be significant in most situations (i.e., capable of producing effluent in the 5 to 20 mg/L range). EPA is not recommending either increasing loading rates or reducing separation distances in this guidance.

Comment: Gravity dispersal of pretreated effluent to conventional trench type systems is an inappropriate practice for several reasons. It is anticipated that pretreated effluent will not form a biomat at the trench bottom interface, and effluent will readily flow deeper into the soil column. The result is deeper microorganism penetration (pass through) into the soil column, particularly in the case of compromised effluent quality.

Response: EPA acknowledges the points made by this comment, which appear to support EPA's approach for limiting conventional systems described in this chapter. In general, a properly functioning (and properly sited) conventional septic system will remove significant levels of bacteria, but there will always exist the possibility of some bacteria contamination of ground water or surface waters, especially where systems are densely sited (e.g., one or more per acre) or placed in areas with highly permeable soils. Most of the types of systems described in this chapter are capable of meeting the performance levels specified in D-1, especially when the other implementation measures are adhered to.

Comment: Without the protection of the soil by an anaerobic biomat, there will the translocation of fines deeper into the soil column that will cause clogging. Additionally, the biological "gluing" agents, developed over time, that are an important component of soil structure, are washed away, destroying the structure and likely fluidizing the soil with time.

Response: Biomat type and structure is a function of wastewater constituents and composition, soil type and geochemistry, soil oxygen levels, soil biota, climate, and other factors. EPA recognizes the importance of the biomat in degrading organic compounds, physically filtering fines and colloidal material, attenuating bacteria and other organisms, and generally contributing to the wastewater treatment process. Denitrification of nitrified effluent in the biomat varies somewhat – depending on oxygen levels, availability of carbon, and bacteria species present – but in general is not reliably significant in lower soil horizons.

EPA has included implementation measures D-3 and D-4 to address long term system performance. In addition to specifying management contracts and inspection schedules, the guidance recommends:

> *Requiring reserve areas for installing a replacement soil dispersal system that is equal to at least 100 percent of the size of the original effluent dispersal area. Treatment systems using effluent time-dosing (i.e., not demand-dosing) to the soil can have reserve areas equal to at least 75 percent of the total required drainfield area. Systems with pressurized drip effluent dosing or shallow pressurized effluent dispersal and those with dual drainfields operated on active/rest cycles (i.e., alternating drainfields) can have reserve areas equal to at least 50 percent of the original required dispersal area.*

Comment: When the hydraulic conductivity of the soil is exceeded, the pores are full and the effluent moves down the [drainfield] trench. This condition is similar to an anaerobic trench except that the anaerobic biomat protects the soil column clogging at the soil interface. When circumstances are such that pretreated effluent "creeps" down the trench, the entire soil column, not just the surface is clogged, and likely anaerobic. Resting will likely not restore the soil.

Response: EPA's implementation measures should go far to guard against the creeping soil-based failure described above by encouraging improved technologies and management. EPA acknowledges the points made in this comment, but notes that resting a drainfield for a period of several months has been shown to aid in restoring soil hydraulic conductivity (by eliminating saturation by incoming effluent), breaking up existing biomats through aerobic degradation, and generally improving the drainfields capacity to treat effluent. With regard to resting, Fairfax County, Virginia, has 20 years of data that show this strategy, when properly implemented, greatly increases the life of septic systems that rely on conventional drainfields and protect against creeping soils-based failures. EPA agrees that if resting is attempted after a drainfield has already experienced the type of failure described in this comment, the soil is not likely to be restored. The active rest/dose cycling is a preventative strategy to guard against failures, not a restorative strategy. Because of the difficulties in appropriately characterizing soil treatment in the drainfield, EPA has focused the implementation measures in this chapter on specific treatment technologies that produce an effluent that is low in nitrogen prior to discharge from the treatment technologies to the soil.

Comment: Pump to gravity is not equal distribution.

Response: As noted above in response to a previous comment about gravity distribution, EPA has focused the implementation measures in this chapter on treatment technologies that produce an effluent that is low in nitrogen prior to soil dispersal because it results in better and more consistent performance with regard to N removal. This approach minimizes reliance on soil-based attenuation of nitrogen species in the effluent. It is expected that removal of most of the nitrogen through treatment processes that occur prior to soil discharge will greatly improve effluent quality, and result in less nitrogen inputs to the Bay.

Comment: "Drip dispersal" is very different than "low pressure pipe networks." The credits given to shallow placed drip dispersal are appropriate and supported by research.

Response: EPA appreciates the support expressed for this approach. In fact, there is no mention of low pressure pipe networks in this guidance.

Comment: Recent studies have (Buchanan, Hepner, Converse) indicate that with drip dispersal there is no statistical difference in constituent concentrations, including nutrients, at one foot of separation between pretreated effluent and domestic septic tank effluent.

Response: EPA has reviewed a significant body of research on soil-based treatment of nutrients, and has focused this chapter on treatment technologies that reduce nitrogen concentration in the effluent prior to soil dispersal. Studies regarding nitrogen removal in the soil matrix note that denitrification and plant uptake are the primary treatment processes, and both vary considerably based on soil type, composition, chemistry, biota, overlying vegetation type, climate, and other factors. Nitrogen removal is also affected by lateral effluent plume migration, and the environment in which it occurs. EPA recognizes in this chapter that soil treatment of nitrified effluent is not significant in most cases, but may be enhanced by applying the pretreated effluent in a dosed manner high in the soil profile, where carbon content is typically higher and plant roots are typically present. The credit recognized by EPA in this chapter for shallow dosed effluent dispersal is minimal – 5 mg/L – and is based upon process that occur in the immediate vicinity of the dispersal piping and in the downslope soil matrix, through which the effluent plume moves over time.

Comment: Large Capacity Septic Systems that serve 20 or more people per day are Underground Injection Control (UIC) Class 5 Injection Wells under the Safe Drinking Water Act (SDWA). Also, any septic system accepting waste other than sanitary wastewater is a UIC Class 5 Injection Well. Section 144.26 of the SDWA describes the inventory requirements of UIC Injection Wells.

Response: The following text was added to section 3.5, System Configuration:

> It should be noted that soil-discharging wastewater systems that have the capacity to serve 20 or more people per day are defined by EPA as Class 5 underground injection wells, and are therefore subject to permitting and other requirements for large capacity septic systems under the federal Safe Drinking Water Act. Further, any decentralized system that accepts waste other than sanitary wastewater (such as industrial waste) is an Underground Injection Control (UIC) Class 5 Injection Well. UIC regulatory information for large capacity septic systems is posted at http://www.epa.gov/safewater/uic/class5/types_lg_capacity_septic.html.

Comment: We recommend strongly that all nitrogen-reducing systems be third-party field verified. Consider changing:

> *Effluent standards may be met by either system design or performance.*
>
> to:
>
> *Effluent standards may be met by system design and third-party field verification*.

Response: EPA believes that state and local agencies should have the flexibility to determine how the N performance levels designated in Implementation Measure D-1 are met. All of the Bay states have their own treatment system design review and verification programs they rely on for evaluating the application of various decentralized wastewater treatment technologies. Once the application of these technologies are well established, EPA does not believe that there is a significant interest to be served by requiring all future applications of these technologies to be re-evaluated. EPA has considered this comment and agrees that the third-party verification (such as through environmental technology verification programs) is desirable and has modified the sentence in question as follows:

> *Effluent standards may be met by either system design or performance, as verified by third-party design review or field verification.*

Comment: There is abundant research showing that shallow pressurized dispersal, which incorporates timed-dosing, is one of the most effective means of utilizing the naturally occurring soil biota for enhanced nutrient removal… Consider changing:

> *A 5 mg/L N reduction credit is given when using time-dosed, pressure-drip dispersal within 1 foot of the ground surface.*
>
> to:
>
> *A 5 mg/L N reduction credit is given when using time-dosed, pressure-drip dispersal within 1 foot of the ground surface or when using shallow pressurized dispersal within 1 foot of the ground surface.*

Response: EPA agrees with this comment, and in concert with Comment #1, has revised this text as follows:

> *Except in sandy or loamy sand soils, a 5 mg/L N reduction credit is given when using time-dosed, pressurized effluent dispersal within 1 foot of the ground surface and more than 1.5 feet above a limiting soil/bedrock condition.*

Further, a suggested reference to support this suggestion was added (Stewart 1988) and cited later in the chapter.

Comment: In further support of shallow pressurized dispersal, consider changing a sentence in Implementation Measure D-4 from:

> *Systems with pressurized drip effluent dosing and those with dual drainfields operated on active/rest cycles (i.e., alternating drainfields) can have reserve areas equal to at least 50 percent of the original required dispersal area.*
>
> to:
>
> *Systems with pressurized drip effluent dosing or shallow pressurized effluent dispersal and those with dual drainfields operated on active/rest cycles (i.e., alternating drainfields) can have reserve areas equal to at least 50 percent of the original required dispersal area.*

Response: EPA agrees. This change was made.

Comment: When talking about the ability of sequencing batch reactors (SBR) to meet the 20 mg/L total nitrogen (TN) threshold, is this referencing effluent quality leaving the system or post soil interface? If this is a reference of the systems ability to meet 20 mg/L TN leaving the treatment unit, I would suggest reviewing the Maryland results from their BAT nitrogen-reducing field verification program, as it has demonstrated that technologies using these treatment processes have not been capable of meeting the 20 mg/L TN effluent quality. In fact, the only technology to meet the 20mg/L threshold was the AdvanTex recirculating textile filter. If the assertion is that these technologies can meet the 20 mg/L TN when incorporating a 50% soil reduction credit then that should be spelled out more clearly.

Response: The reference is to effluent quality. EPA reviewed a number of studies on various system types in developing the implementation measures in this chapter. Like all treatment systems, the performance of SBRs can vary somewhat, but their performance in producing an effluent in the 20 mg/L range has been verified through independent third party studies. This chapter cites MASSTC verification, for example (Washington State Department of Health 2005), and the LaPine study (Rich, 2005). The AdvanTex recirculating textile filter has also demonstrated treatment performance in the 20 mg/L range, and lower, and is also included among the better-performing treatment systems referenced in this chapter.

Comment: Based on the supporting references presented, revise upwards the performance information for removing N using recirculating media filters / multi-pass textile filters in the chapter narrative and in Table 6-1. Specifically, for the multi-pass textile filter entry in Table 6-1, change the TN removal efficiency from 14%-38% to 65%-70% and change the effluent TN from 9-83 mg/L to 3-55 mg/L, which represents the performance of Orenco's AdvanTex AX20 multi-pass textile filter.

Response: EPA has revised the performance information for recirculating media filters / multi-pass textile filters in the chapter narrative and in Table 6-2 to align with this new supporting documentation (with specific mention in the table that this performance applies to the AdvanTex AX20). A citation to the 2009 NSF International field verification report to Pennsylvania DEP (a key supporting reference provided) was added to the table footer and this reference was added to the end of this chapter. Note that since a new table was added to this chapter, Table 6-1 from the public draft was renumbered to Table 6-2 in the final guidance.

Comment: Under the "Attached Growth" heading in Table 6-1, the Nitrex unit is represented as being able to reduce TN by up to 96%. The Nitrex is an add-on unit that is specifically designed to be fed a highly treated and nitrified effluent so that it can provide for additional denitrification (reducing nitrate-n to nitrogen gas). Therefore, it must be preceded by a reliable pre-treatment unit that can consistently produce effluent quality that is <10 mg/l BOD5/TSS and <5 mg/L NH_3. The Nitrex data presented in Table 6-1 represents pre-treatment from a packed-bed media filter. The Nitrex unit cannot receive raw wastewater like the other technologies listed in the table and therefore is not achieving this level of reduction independently. We feel it is important to distinctly identify these types of add-on treatment units as such when categorizing technologies. It is important to note that there are other proprietary add-on units similar to Nitrex that perform equally well, (e.g. integrated water services (IWS)).

Response: The NITREX system is discussed in the chapter narrative in the section titled "Add-On Anoxic Filters with a Carbon Source." EPA clarified a sentence on cost for such systems from:

> *Note that this does not include the septic tank, nitrification step, or soil dispersal system—just the add-on component.*

to:

Note that these are added costs, and do not include costs for the septic tank, nitrification process unit, or soil dispersal system—just the add-on component.

EPA investigated and determined that there are no third party testing or published studies to verify the performance of other add-on units similar to NITREX available in the U.S., including any from Integrated Water Services. EPA did add the following text to this section:

Others claim to have similar systems with comparable performance, although to date, independent field verification is lacking.

Comment: We are concerned about the information presented in Table 6-2. This table only represents a small subset of technologies and available third party testing programs. Furthermore 6-2 is promoting technologies that have been proven not to function in the field to levels required to protect Chesapeake Bay watershed. There are numerous other testing programs, including field-testing, that are not represented in this table and that is a great disservice to the manufacturers whom participated in said programs. We would suggest incorporating other third party verification(s) of performance to this section. We have attached the final report from Maryland Department of Environment, which summarizes the field performance of the AdvanTex recirculating media filter on 12 homes for 12 months. We have provided an additional data set from the Pennsylvania On-lot Technology Field Verification Program, where 11 AdvanTex Treatment Systems were tested monthly on individual residences for nearly 3 years; NSF was the third party verification agency. We would request that you add a summary of AdvanTex performance to table 6-2 based on these third party field data sets. Additionally, field data should be used for all systems, when available. This would provide more meaningful information to the decision makers on the ground at the state level. Consider for a moment a local regulator whom is looking to the EPA for guidance on how to reduce nutrient loads from onsite systems. Based on their reading of this table, they would think any number of these systems would be appropriate to promote as a reliable TN reducing technology. Some time goes by and now these same systems that have been touted by the local agency, based on guidance from the EPA, are not meeting effluent limits. This will put the local agency in the difficult position of bearing the brunt of public dissatisfaction, as well as being the target for potential litigation from manufacturers of technologies that do function in the field and have the data to back it up. This is the current situation in Maryland and makes a strong case for field verification with an enforcement mechanism that can remove technologies that do not perform in the field.

Response: Table 6-3 (formerly Table 6-2) presents a summary of six different technologies for reducing N. Results for all of these came from actual field testing under real world conditions at the Massachusetts Alternative Septic System Test Center (MASSTC) under stringent independent testing. In fact, all of the environmental technology verification studies referenced in this chapter involved actual field applications in real-world settings and conditions. For example, the La Pine Demonstration Study involved 49 private homeowners in a geologically challenging environment—an area with rapidly draining soils over a shallow unconfined aquifer that serves as the region's only source of drinking water where nitrate levels are increasing as a result of rapid development and the proliferation of septic systems on small residential parcels. The narrative and other tables present performance results for other technologies. EPA has added a summary of the performance for AdvanTex in Table 6-2 (formerly Table 6-1) and has referenced the Pennsylvania On-lot Technology Field Verification Program report produced by NSF International in 2009.

References

NSF International. 2009. *Final Evaluation Report, Pennsylvania Onlot Technology Verification Program, Orenco Systems, Inc. AdvanTex AX20N*. Prepared for Pennsylvania Department of Environmental Protection, Ann Arbor, Michigan.

Rich, B. 2005. *La Pine National Demonstration Project Final Report, 1999 – 2005*. Decentralized Wastewater Treatment Demonstration Project funded by the US Environmental Protection Agency and supported by the Deschutes County (OR) Environmental Health Division, Oregon Department of Environmental Quality, and the US Geological Survey.

Stewart, L.W., and R.B. Reneau Jr. 1988. *Shallowly Placed, Low Pressure Distribution System to Treat Domestic Wastewater in Solils with Fluctuating High Water Tables*. Journal of Environmental Quality 17(3):499-504.

Tetra Tech. 2007. *Cost and Performance of Onsite and Clustered Wastewater Treatment Systems* (unpublished). Tetra Tech, Inc., Fairfax, VA.

U.S. Environmental Protection Agency. 2010. *Individual and Clustered (Decentralized) Wastewater Management Program Elements*. Web Supplement. <http://www.epa.gov/owm/septic/pubs/onsite_handbook.pdf>. Updated January 2010. Accessed February 24, 2010.

Washington Department of Health. 2005. *Nitrogen Reducing Technologies for Onsite Wastewater Treatment Systems*. <http://www.psparchives.com/publications/our_work/hood_canal/hood_canal/n_reducing_technologies.pdf > Prepared for the Puget Sound Action Team, by Washington Department of Health, Olympia, WA. Accessed April 27, 2010.

Chapter 7: Hydromodification

EPA did not receive comments from the public on Chapter 7.

Response to Peer Reviewers' Comments

Chapter 2. Agriculture

Many of the comments made by the peer reviewers regarding the phosphorus and nitrogen Implementation Measures replicate those questions raised by the public. We are not replicating those comments below.

Comment: The Agriculture chapter provides an excellent overview of land management practices that can be utilized to reduce the potential of non-point nutrient losses from land to water.

The identified measures appear to represent current consensus as the best approaches for nutrient reduction from agriculture in the Chesapeake Bay.

Response: The Executive Order directs EPA to develop technical guidance describing the next generation of tools and practices that will protect and restore the bay. We have developed the implementation measures based on the idea that agriculture can be a sustainable land use in the bay watershed if the practices employed on the land are implemented at the points of source control, in-field, and edge of field in order to avoid, control and trap nutrients and sediment.

Comment: What is the source of the information?

Response: Information on the effectiveness of practices included in this chapter is largely taken from literature published after the year 2000 to build on the earlier literature that was used in the development of the *National Management Measures to Control Nonpoint Pollution from Agriculture* (USEPA 2003). For some practices, however, the literature search went back farther in time. This includes, for example, drainage water management, a practice not addressed to any extent in USEPA's 2003 guidance. The bulk of literature used in this chapter comes from professional journal publications (e.g., *Journal of Environmental Quality*), but information is also derived from government documents and resources (e.g., USDA conservation practice standards), books, Cooperative Extension publications, proceedings from professional meetings, and on-line publications by professional groups and industry. Most literature was found through keyword searches of sources such as the National Agricultural Library Catalog and specific professional journals. Literature specific to the Chesapeake Bay watershed states was given top priority, but relevant literature from across the United States and from other countries was included to provide as complete coverage as possible on each of the topics addressed in this chapter.

Practice cost data taken from the literature and other sources were converted to 2010 dollars using the conversion factors provided by the U.S. Inflation Calculator (2010). Exceptions are that cost data provided for fiscal year 2010 by states were not changed and aggregate cost data expressed over a range of years were not converted to 2010 dollars. Unless specified, the year of publication was used as the initial year for conversion of dollars.

Soil Amendments

Comment: The implementation measures that reference soil amendments should provide examples because amendments of this type are not common knowledge within the agriculture sector.

Response: Specific examples and additional material on amendments have been included in the implementation measures discussions.

Chapter 3. Urban and Suburban

Comment: Several additional references were recommended on the benefits of conservation developments, and on costs of implementing low impact development requirements. Recommendations were made for document organization and editing.

Response: These references were reviewed and many were incorporated into the document. Organization was improved.

Comment: Several recommendations were made for clarifications on those elements applicable to the Bay, such as urban forestry, that may not apply elsewhere. Other minor clarifications were recommended.

Response: These clarifications were added to the document.

Comment: While LID and green infrastructure approaches may represent a marked advance over previous approaches there may remain some circumstances when conventional approaches and techniques to managing stormwater may be appropriate. Do they no longer have any place in an expanded menu of stormwater management tools?

Response: The document does include references to “traditional” stormwater management tools for water quality protection. Clarification was added that the fact sheets are for new technologies, traditional technology design information is widely available in existing stormwater manuals. In addition, EPA notes that, as explained in the introduction to the document, this guidance supplements the Management Measures for Urban Areas document that EPA published several years ago (EPA 2005a), which goes into great detail on the full range of traditional stormwater management practices

Comment: Enhance with information on the stormwater hydrologic cycle and N and P cycles.

Response: Additional information was added. However, we note that in general, rather than providing a text on background hydrology, the document’s purpose is on the management practices. More detailed information on hydrology is provided in many applicable texts

Comment: Recommend adding more emphasis on treatment trains with some comprehensive examples.

Response: EPA agrees**.** Additional emphasis was added. This is an important design consideration.

Comment: Analyze the special characteristics of The Chesapeake Bay's drainage basin, including climate, industries, common pollutants in stormwater (not the national one), current common practices of urban stormwater management and their deficiencies, etc. Then the report could recommend more specific and effective measure for this estuary. The document has some specific information on Chesapeake Bay, but not enough. This is more literature review than actual study on particular issues**.**

Response: This level of detail is more appropriate for the individual Watershed Implementation Plans, that will also include non-federal facilities. This document focuses on the practices that can be used throughout the watershed as needed, not specific to a particular watershed or site-by-site basis.

Comment: The document needs to discuss city renovation and neighborhood development.

Response: Some additional information was provided on redevelopment programs and projects.

Comment: There is not a description of existing state and local policies for the region. As a starting point, we need to assess what state stormwater policies are in place.

Response: Each State has its own set of existing stormwater laws, regulations and policies. The purpose of this guidance is to present practices that will enable the achievement of water quality goals for the Bay. For reasons discussed in the document, EPA believes that the approach set forth in Section 438 of the 2007 Energy Independence and Security Act is the most significant approach needed to achieve these goals. Moreover, Congress has already required that Federal agencies, for whom this document is primarily written, must comply with Section 438.

Comment: Some elements need to be implemented at a local level and some at a state level, or at different scales, but this is rarely made clear. It would be much more helpful to clearly state actions that are recommended for each level of government**.**

Response: Recommendations for implementation approaches for private lands, municipalities or states was outside the scope of the document (to provide guidance on the best practices for federal facilities to implement to protect water quality). However, implementation at different geographic scales was addressed by showing examples of programs operating at different scales (national to site-scale), and by addressing regional planning, watershed planning, smart growth, and low-impact development and stormwater treatment.

Comment: The proposed standard of retaining the 95% rainfall event is not fully developed. Is this proposed as a general performance standard? Is it to apply to redevelopment? This would be challenging in very high density areas. What exemptions would apply, and on what basis? This is not clear.

Response: Retaining the 95^{th} percentile storm event is not a proposed standard in this document. Rather, the guidance follows the requirement of Section 438 of the 2007 Energy Independence and Security Act that Federal facilities must restore or maintain predevelopment hydrology for any new development and redevelopment exceeding 5,000 square feet to the maximum extent technically feasible. Discussions of technical feasibility in the implementation of Section 438, based on site conditions, for example, are contained in the document.

Comment: Provide more examples for the Chesapeake Bay watershed.

Response: Additional case studies were added, both in the Chesapeake Bay watershed and nation-wide.

Comment: Add more information on watershed planning and management.

Response: Information was added on the key components of watershed planning. Watershed planning is noted as a critical step to both cost-effective program implementation and ensuring results. References to comprehensive watershed planning resources are provided.

Comment: The issue of costs is where controversy is likely to come. It requires more explanation and a reconciliation of likely conflicts that inevitably arise. It would perhaps be more valuable to outline the different aspects of the costs (capital, O&M, etc), and a decision process for determining the cost of a practice in relationship to the benefits it provides and to the alternatives. Observation of reduction in costs is focused upon capital costs. It does not include other independent studies that assert a potential increase in costs (Stephenson and Beamer 2008), and neglects mention of O&M and management costs. This may be due to the lack of sufficient data on O&M and management costs, (this is mentioned later on in the Chapter), but should be disclosed up front to be fair.

Response: Additional information on evaluating the costs of stormwater management practices was provided to help decision-makers determine how to value the benefits and costs of stormwater management practices. The reference to Stephenson and Beamer, 2008, was added and discussed. The cost information was supplemented with examples of cost assessments other than capital costs, including life-cycle costs, net present value, net present value with monetized environmental and social benefits, and unit cost evaluations (cost per unit of pollutant removed).

Comment: Add additional information about the required length of precipitation data based on statistical analysis to determine the 95th percentile rainfall event. Include a hydrology reference that covers required length of record information**.**

Response: A reference was provided (Chang 1977).

Comment: Definitive recommendations for street widths would be much better than a listing of what other communities have done, especially considering that only one is from the region.

Response: The determination of an appropriate street width is site specific. This document raises awareness of the issues and provides the management practices available, and useful resources such as implementation examples.

Comment: Make definitive recommendations or provide specific guidance standards, policies and practices; mostly these are just a cataloguing of options and examples.

Response: The requirement for federal facilities (from Section 438 of the 2007 Energy Independence and Security Act) is to restore predevelopment hydrology for runoff volume, rate, duration and temperature for facilities over 5,000 sf for new development and redevelopment. Presentation of recommendations was clarified to highlight each implementation measures. Each federal agency has its own policies, standards, and specifications and recommendations are made to incorporate these implementation measures into each federal agencies policies, standards, and specifications.

Comment: The section on redevelopment lacks detail, despite its importance in the region.

Response: Additional information was added on redevelopment.

Comment: Add a fact sheet on infiltration.

Response: This was added.

Turf

Comment: At page 282, under "turf management," some mention of golf courses seems appropriate. New Jersey, in fact, devised and distributed a golf course best management practices manual at one point.

Response: A section was added to incorporate a discussion and provide an example of a good manual on golf course best management practices in response to this comment.

Comment: This document contains a great deal of very good information. However, in its current state, it lacks flow and formatting that reduces readability and usefulness. The document needs to be carefully reviewed by the scientific authors to ensure flow and reduce repetition (there are some sections that are repeated word for word, not just general ideas).

Response: The document has been greatly revised and edited to address this and other comments regarding organization, grammar, flow, formatting, readability, repetition, tables and figures, consistency of text with tables and figures, reference lists and other similar issues.

Comment: This document also lack consistency in formatting: The references are not consistently formatted in the text or reference list. There is an inconsistency with the use of tables and figures. Many times information that should be included as a table is put in a "box" as a figure. Table and figure captions are lacking information; tables and figures need to have detailed captions for stand alone use. There is a large use of bulleted information. Formatting is very inconsistent. Recommend BMP descriptions be formatted better for individual use. It is likely that sections of this document will be pulled out and used separately, especially section 6.

Response: The document has been greatly revised and edited to address this and other comments regarding organization, grammar, flow, formatting, readability, repetition, tables and figures, consistency of text with tables and figures, reference lists and other similar editorial comments.

Comment: This section relies heavily on information for outside the Chesapeake Bay watershed, which provides a strong background for turf management in the more arid west. However, the document would be greatly improved if additional, more local information was added, for example, showing actually water requirements for different grass species (warm season vs. cool season; deeper rooted plants; impact of mowing height; etc.) in conjunction with typical precipitation patterns. Converting turf to more natural landscapes has the potential to have a significant impact on water quality…BUT it is difficult to get people to make the conversion. Thus, additional information on smaller changes that can have an impact would be beneficial.

Response: The Agency agrees with this comment and has provided relevant information from within the Chesapeake Bay watershed to the extent that it has been available. The commenter also suggested that additional information on smaller changes in lieu of conversions to more natural landscapes would be useful in the guidance. The Agency agrees with this comment, and to the extent that such information is available we have provided (e.g., information in earlier sections regarding Bayscaping and rain gardens).

Comment: Page 296-297 Xeriscaping examples: I know the document is intended to be broad based, but to be relevant in the Chesapeake region, a local example (not western) would be helpful.

Response: One commenter suggested that a local example of xeriscaping in the Chesapeake Bay be added to the xeriscaping section. The Agency believes that some of the practices are transferable to the Chesapeake Bay and that the information provided may be useful to some readers so the Agency provided a few examples of programs that promote xeriscaping. An example from the National Institutes of Health in Bethesda, Maryland was also inserted.

Comment: The document has some specific information on Chesapeake Bay, but not enough.

Response: Chesapeake Bay-specific examples were included to the extent available, and were generally presented first.

Comment: I have a concern on the effectiveness of soil amendment or restoration. This practice basically loosens up soil and remixes it with compost. However, it may increase TSS because less compacted soil is more prone to soil erosions. It also increases nutrients in surface runoff and subsurface flow. Even if it might reduce runoff pollutant due to temporarily reduction in volume, the subsurface flow should not be neglected. In addition, in a long term, the organic matters will decompose and soil will become naturally compacted. Even the cited references are contradictory on this topic.

Response: This effect may be true if the soil is not stabilized with vegetation. If soil amendments or restoration takes place, the long-term health of the soils should be maintained by planting and maintaining vegetation that promotes soil retention, infiltration and pollutant filtration, i.e. the soil has a stable vegetative cover that is protected from erosion by leave cover, duff and roots which bind the soil and prevent soil detachment and mobilization.

Comment: Reduce turf management inputs (nutrients, pesticides, irrigation water) (page 282. This section needs a brief introduction to goals/background of turf management. Otherwise, a reader does not know what the purpose of the listed bullet items is. A better structure is needed.)

Response: A rewritten introduction providing context and intent were provided.

Comment: In most cases, sections 3-5 fail to make concrete recommendations or provide specific guidance; mostly these are just a cataloguing of options and examples. This constitutes a huge missed opportunity. Certainly we have learned something from all of these experiences; why not recommend specific standards, policies and practices, at least as a starting point.

Response: This guidance document does provide concrete recommendations regarding a number practices. It does so to the extent that EPA believes that a uniform standard, policy or practice can and should be applied across the board. However, in many cases, EPA did not believe we had a basis for doing so. Often this is because many site-specific factors need to be considered in making an appropriate management decision.

Comment: Sections 5.3.1 – 5.3.3. These sections present a series of examples with no introductory or interpretive text. At a minimum, it would be beneficial to explain why these are being presented.

Response: The section was rewritten.

Comment: Section 5.3.1. As for other sections of this report, is there a model restriction that EPA wants to recommend?

Response: The use of fertilizer restrictions should be determined based on state or local conditions and not universally applied without considering local factors.

Comment: Section 5.3.3. So what's the upshot? Does the EPA recommend any local or state restrictions?

Response: See previous comment on local restrictions and models.

Comment: Section 5.3.10. All the xeriscaping examples are Southwestern, which is where the approach is most used. I.e., xeriscaping is used in xeric areas. Probably need to justify why this is being recommended for a mesic area, especially as it appears to be counter to some of the previous recommendations, which called for planting water-using vegetation that increase transpiration rates.

Response: Additional explanation was added in response to the comment as well as a local example.

Comment: Section 5, generally: This section was mainly a review of various methods and case studies. Not all are entirely consistent. What are the recommendations for local government policies?

Response: This is a technical document and providing specific recommendations for local policies is beyond the scope of this document; local policies should be determined by local conditions and capacity to implement specific policies. Generally, in this section, EPA made a number of technical recommendations, which provide an analytical framework for considering appropriate management options to reduce runoff or infiltration of pollutants.

References

Chang, M. 1977. An evaluation of precipitation of gage density in mountainous terrain. *Journal of the American Water Resources Association* 13(1)**:**39–46 (published online June 8, 2007).

Stephenson, K., and B. Beamer. 2008. *Economic Impact Analysis of Revisions to the Virginia Stormwater Regulation, Final Report.* Prepared for the Virginia Department of Conservation and Recreation, Richmond, VA.

U.S. Environmental Protection Agency. 2005a. *National Management Measures to Control Nonpoint Source Pollution from Urban Areas*. U.S. Environmental Protection Agency, Washington, DC

Chapter 4. Forestry

Comment: The chapter suffers from trying to address two goals: Management on Federal lands and therefore large tracts and large contracted firms for forest management, and forest management of the small forest tracts in private ownership typical of the Chesapeake basin. Many of the recommended practices and the studies cited are more appropriate for owners of large tracts of land (in the thousands of acres) rather than for the typical forest land owner in the Chesapeake Bay watershed, who might own from 10 to 20 acres. Examples of practices appropriate for owners of large forest tracts but not for small forest tract owners include LiDAR and DEM, which are tools that require budgets and data beyond the reach of most forest tract owners in the Chesapeake basin. The practices that need to be included are those that are appropriate for owners of small forest tracts who have limited budgets.

Response: The primary intended audience of the document is the federal land manager; therefore, the information in the chapter was chosen on the basis of it being relevant to that audience. Recognizing, however, that the forest land in the Chesapeake Bay watershed is primarily owned by private individuals with small land holdings and limited budgets, the chapter distinguishes between what is appropriate for a federal land and for such a private land owner, notes which recommendations are specifically aimed at federal land managers, and makes recommendations specifically for private land owners. For instance, additional information discusses off-the-shelf public domain tools that are analogous to expensive high-tech approaches (LiDAR and DEM) but are either free or very affordable and enable innovative small forest tract planning techniques that lead to both cost savings and improved water quality outcomes.

Comment: The tone of the chapter gives the reader the idea that forestry operations are bad for water quality in the Chesapeake Bay watershed, when in fact the magnitude of water quality impacts attributable to forestry operations is small compared to other sources and the presence of forests is one of the best ways to protect the bay's water quality. There is no argument that it is important to use appropriate BMPs during forestry operations to protect water quality, but the chapter should cast forests, and forestry operations on those forests, in a more positive light and stress the importance of maintaining land in forest cover for water quality protection. After all, as the chapter states, the contribution of forestry operations to water quality impairment in the bay watershed is very small, so implementing additional water quality protections during and after forestry operations would at best lead to infinitesimal improvements in water quality.

The chapter needs to stress the importance of forests to protecting the bay's water quality and the need to both conserve forests in the bay watershed and increase the acreage of forest cover in the watershed. The danger of presenting forest operations in a negative light is that readers could get the idea that converting land to another use (development) would be better for water quality than leaving it in forest cover. In fact, keeping land in forest cover is better for water quality than any other land use, even with intensive forestry operations occurring on that forest land. Furthermore, by recommending more forestry practices for water quality protection than landowners must already comply with, the potential profit from forest land management could be reduced, and the additional forest practice requirements could create an incentive for forest landowners in the bay watershed to convert that land to another, more profitable use.

Response: Revisions to the chapter included integrating forest conservation concepts into the document better and rewording parts of the introduction that were reviewed as being "negative" to emphasize the importance of forested land in the bay watershed and of conserving forest land. Additional information on forest conservation the concept of sustainable forestry was included, along with discussion of current efforts to increase "forest certification" and the associated costs and benefits.

Comment: Reviewers raised concerns about some specific technical details in the chapter: (1) the discussion of soil litter layer depth related to water quality protection and the required width of a streamside management area (SMA), (2) the practice of allowing thinning in SMAs and whether a wider SMA, which is typically what is recommended, is always preferred, (3) the need to divert water from forest roads at regular and frequent intervals to minimize the erosive power of runoff, (4) whether adding wood chips to a harvested site to reduce nutrient runoff is advantageous, (5) the complications involved in recommending that a variable-width SMA be used based on anything other than the slope of the land adjoining a stream. Reviewers encouraged EPA to re-examine these discussions.

Response: These technical discussions were revised per the suggestions provided by the reviewers. In addition, a number of the "Implementation Measures" were rewritten to combine similar activities and practices were modified to ensure higher accuracy. Where appropriate, additional references were added to further strengthen the recommended practices.

Comment: "….I find this revision along with the original 2005 manual to be an incredible resource and it only improves with this refinement."

"Overall complete, and the practices which are recommended are sound and based on up to date information."

Chapter 5. Riparian Area Management

Comment: EPA's guidelines are made less effective when the authors spend too much time focusing on secondary habitat (aquatic and terrestrial) benefits rather than water quantity and quality, which have a more direct impact on the condition of downstream waters (Chesapeake Bay). Although often conceptualized as diffuse inputs, non-point source pollution and concentrated stormwater flows enter streams at specific locations, and these should be priorities for establishing or conserving existing buffers rather than simply increasing forest stream miles. It's time to focus on the key issue. Even if it is a decision of individuals or local managers, EPAs message should be clear about the priorities.

Response: The decision for emphasizing the ecological benefits in early drafts was because volumes have been written about the water quality benefits of riparian buffers, while little has been written about these secondary benefits, specifically how these secondary benefits work hand in hand with the primary benefits of reducing diffuse pollutants. There is some newer research that suggests fully functioning stream ecosystems that are dependant on healthy riparian areas can further process excess nutrients and sediment. Designing riparian buffers as part of a treatment train for pollutant removal ignores these functions. However, the reviewers concern is valid, and information was reorganized so that pollutant removal is mentioned first when the benefits of riparian areas are discussed.

Comment: "One emphasis should bring out the potential utility of developing next generation decision support tools (GIS and remote sensing based) that can lead to site specific and better adaptive management of riparian buffer ecosystems."

Response: GIS decision support tools have been added to the report, and we added information from the references provided.

Conflation of riparian effects in urban and agricultural settings

Comment: "The document does not do enough to separate what is known about the benefits of buffers in agricultural systems (lots) and urban systems (much less), particularly with regard to mediation of alterations to water quantity and quality"

Comment: "there are some scientific details regarding the role of riparian buffers in urban areas, hydrology, and stream hydraulics that could be improved.."

Response: We agree with these comments, and plan to rework the sections in question to make this distinction more clear. In addition, we added more information on floodwater storage and increasing streambank strength based on the references provided by the reviewers.

Pollutant Removal Estimates

Comment: "When generalizing across regions, percent reduction of edge-of-field inputs is less useful for prioritizing strategic riparian conservation or restoration because croplands in different regions yield different amounts of excess nutrients. Thus similar fractional reductions have different implications for downstream waters."

Comment: "Non-uniform delivery (preferential flow) of groundwater the riparian ecosystems should also be recognized. As stated earlier nitrate delivery via seeps has been found to be important and will affect ability of the ecosystem to remove nitrogen. The issue of "bypass" flow of groundwater under the soil zone influenced by buffers should be addressed."

Comment: "While there are examples where riparian buffers are effective at nutrient removal, this effectiveness is highly variable. Peer-reviewed scientific research in the past two decades has shown that the flow paths by which precipitation reaches stream channels are highly complex (see references by Burt and McDonnell). Thus, residence time within the soil and contact with the biologically active regions of the soil (typically top 1 m) are highly variable. Therefore, nutrient reductions are also highly variable."

Response: We dedicated more space to the discussion of pollutant removal estimates using the references provided by the reviewers, but will continue to present pollutant removal effectiveness as percent reduction because that is what is most commonly used in the literature. Preferential flow is definitely a concern, but there are currently no easy ways to find these. We mentioned that preferential flow can greatly affect efficiency, but since we could find no cost effective methods to evaluate this phenomenon, we will go no further than to mention it is an issue.

The 70% goal

Comment: "The goal of increasing streamside forests from 60% to 70% over generalizes the problem because in order to function as a filter, buffers need to be located between pollutant sources and streams along flow pathways (Weller et al. 1998 Ecol Apps, Baker et al. 2006/2007 Land Ecol). Interrupting this flow path connectivity is far more important than whether or not contiguous forest exists along the channel margin because, unless pollutant transport pathways are filtered, increasing riparian forest will have little demonstrable impacts on water quality. Thus, some gaps are far more critical than others, and some existing forest has far greater conservation value than others. This principle applies to both urban and agricultural systems, though the location for performing this filtering likely varies in each system."

Comment: "For water quality targets, with the exception of stream temperature, it may be misguided to rely strongly on targets of percent coverage of stream length for buffers. Considerable spatial variability exists within these ecosystems. A strong argument can be made for targeting and site-specific management of riparian buffers. Angier et al. (2008) found that groundwater nitrate was primarily delivered to a coastal plain first order stream in Maryland via concentrated upwelling zones. This conclusion finds further generalization by a recent study by ODriscoll and DeWalle (2010) of a piedmont headwater stream in Pennsylvania. Locating these "critical" areas in the landscape seems most promising for reducing nitrate and possibly pesticide export to streams. "

Response: This is partially addressed by including information on GIS decision support tools that are designed to locate areas where forested buffers will have the greatest pollutant removal benefit. The 70% goal was chosen by the Chesapeake Bay Program in 2003. Their reasoning is that the single most important indicator of watershed health is the amount of forest in that watershed. Forests covered 95% of the Chesapeake watershed prior to European settlement and now account for 58% of the watershed. Because they are situated along streams and shorelines, riparian forest buffers play a particularly critical role in processing nutrients and sediments that flow off non-forest land uses before entering streams. Additionally, outcomes of scientific research support a 70% target for riparian forest cover to maintain healthy functioning watersheds (Goetz et al. 2003; and King et al. 2005).

References

Goetz, S. J.; Wright, R. K.; Smith, A. J.; Zinecker, E. & Schaubb, E. 2003. IKONOS imagery for resource management: Tree cover, impervious surfaces, and riparian buffer analyses in the mid-Atlantic region. *Remote Sensing of Environment,* 88:196-208

King, R. S.; Baker, M. E.; Whigham, D. F.; Weller, D. E.; Jordan, T. E.; Kazyak, P. F. & Hurd, M. K. 2005. Spatial Considerations For Linking Watershed Land Cover To Ecological Indicators In Streams. *Ecological Applications.* 15:137-153

Chapter 6. Decentralized Wastewater Treatment

Comment: EPA is to be commended for offering guidance to the states to move to some level of nitrogen (N) removal in all decentralized wastewater treatment systems.

Response: EPA appreciates this support.

Comment: The use of soil discharging cluster systems is appropriately encouraged.

Response: EPA appreciates this support.

Comment: Houses using onsite wastewater disposal systems continue to represent a substantial amount (20-30%?) of all new construction and are a growing source of N to Chesapeake Bay. Remediation of all existing systems is probably not feasible. However, it is essential that all new and replacement systems reduce effluent nitrogen to the lowest levels possible.

Response: EPA appreciates this comment.

Comment: The recommendation that conventional "septic systems" no longer be used for new development or replacement of failing systems is not emphasized and highlighted as much as it needs to be. It is implied in the first section but not explicitly, and cautiously, stated until Section 4.1 (bottom of page 511) where it states "they (conventional systems) are no longer appropriate for use in new communities or densely developed areas in the Chesapeake Bay watershed". Several Bay states acknowledged the need to stop installing conventional systems on new construction in their existing tributary strategies but they remain the dominant system used, probably being installed on 90% or more of new construction not served by central sewer. *EPA needs to be strong and clear in its guidance that the states should take actions to not allow the installation of conventional onsite wastewater disposal systems by a defined date.*

Response: This guidance does not recommend banning conventional systems throughout the watershed. EPA agrees that the chapter states, rather explicitly, that such systems "are no longer appropriate for use in new communities or densely developed areas in the Chesapeake Bay watershed." EPA still considers conventional systems to be a viable option outside sensitive areas (e.g., beyond 1,000 feet from surface waters) and in isolated parcels outside of subdivisions (i.e., outside of densely developed areas) where there is sufficient land around such systems to increase the treatment opportunities and travel time through the soil horizon. EPA believes the recommendations, as stated in the implementation measures makes it clear that conventional systems should be the exception and not the rule.

Comment: It is recommended that all new or replacement systems discharge nitrate at concentrations of 10mg/L or less… [as] … it is generally thought that once nitrates reach groundwater, the majority will eventually be discharged to surface water, so limiting nitrate release from the disposal system is critical.

Response: The scientific literature supports some attenuation of N over lateral travel distance through the soil, based on factors discussed in this chapter. Recommending the 20 mg/L N effluent standard for most systems outside the sensitive zones (in the bulk of the Chesapeake Bay watershed) provides considerably more treatment options at more justifiable costs, and therefore provides for greater flexibility.

Comment: Systems should not be installed within 200 feet of surface water, rather than going to 5mg/l at 200ft and stopping installation at 100 ft, as recommended in the guidance. It is questionable that the cost of going from 10mg/l to 5 mg/l justifies its use in the 100 ft zone proposed or would allow it to be feasible for all new or replacement systems. However, the guidance should be updated over time to incorporate enhanced N removal technologies.

Response: EPA believes that extending the 100-foot setback from surface waters and open channel MS4s for decentralized systems to 200 feet would be highly restrictive on local zoning and would not significantly increase protection of the Bay, EPA has specified that the first 100 feet beyond the recommended setback is afforded the highest level of protection using the best available technology—which currently produces effluent in the 3-5 mg/L range for N. This already-low effluent will undergo further attenuation in the soil before it can reach open water and the Bay. EPA agrees that this guidance should be updated over time to incorporate the most advanced N removal technologies that are economically feasible.

Comment: The need for a "responsible management entity" (RME) is suggested for cluster systems. The need for appropriate oversight of operation and maintenance for all advanced N removing systems cannot be over-emphasized. This is just as critical for individual as for cluster systems. It is recommended that operation and maintenance agreements be part of all advanced N removal system permits and that annual reporting of O&M and system function by a RME or private inspector be required. It is also suggested that an effluent sample be taken and analyzed for TKN and nitrate either during each inspection or biennially. The greatest concern with implementation of N removing system is whether or not they have proper O&M and continue to function as designed over time. While inspections can be performed by the private sector, it may be time to reconsider the "rural sanitary management district" concept that was discussed during the 1970-80s whereby a sanitary authority be established to manage the inspection, analysis and record keeping program needed to assure acceptable O&M of N removing systems if they are placed on all new or replacement systems. The district could collect fees from individuals with these systems and contract the inspections, sampling and performance evaluations thus assuring that they will occur rather than expecting individual homeowners to contract the needed services. This would allow location and performance tracking of all N removing systems.

Response: EPA appreciates this support for its management recommendations for decentralized systems as specified in implementation measure D-3. EPA added language that recommends

RMEs not only for all cluster systems, but for non-residential mechanized systems, as well. EPA has provided additional clarification that RMEs may be either public or private. Specifically, the following text was added to implementation measure D-3:

> *RMEs include sanitation districts, special districts, and other public or private entities with the technical, managerial, and financial capacity to assure long-term system performance.*

In lieu of recommending annual reporting and biannual effluent monitoring for all advanced N removal systems, which may be overly burdensome, EPA has clarified one of the recommendations specified in implementation measure D-4 as follows:

> *Requiring inspections for all systems on a schedule according to wastewater type, system size, complexity, location, and relative environmental risk. At a minimum, qualified inspectors inspect all systems at least once every 5 years and inspect existing systems within sensitive areas at least once every 3 years. Inspect advanced treatment systems, cluster systems, and those serving commercial, institutional, or industrial facilities at least semiannually and manage such systems under an operation and maintenance agreement or by an RME. Inspections are consistent with EPA management guidelines for individual and cluster systems. A service professional or other trained personnel conducts routine monitoring of all systems, and periodic effluent sampling for cluster and non-residential systems, on the basis of system type, operating history, manufacturer's recommendations, and other relevant factors.*

Comment: While it may be desirable to have GPS locations on all onsite systems, it is questionable if it is a wise use of limited funds when such funds could be used to establish and staff rural sanitary management districts.

Response: EPA stands by its recommendation that basic inventory information – including system location – should be collected. Implementation measure D-4 recommends developing "GIS-based inventories" of all decentralized systems in the Chesapeake Bay watershed. EPA believes knowing where these systems are located is key information needed to manage these systems and support wastewater planning and watershed protection activities. EPA does not mention the use of GPS technology to derive this information and has no preference regarding how this information is collected. Parcel-level data in GIS format is commonly available through local real estate tax assessment databases, which also usually includes whether each parcel is served by central sewer or decentralized systems. Since this information is likely to exist already, EPA believes the local authorities with decentralized system management responsibilities should have access to it as well.

Comment: Figures and tables are included in the text but they are never cross-referenced in the accompanying text. All tables and figures included should be cross-referenced and discussed in the accompanying text, however briefly.

Response: EPA has addressed this comment in the final version by the addition of reference text throughout the chapter—most notably near the beginning of section 4, which has been expanded.

Comment: In Section 4 many technologies are mentioned but the technologies are described in the table and figures only. This means the reader knows the performance of each system but no information on the configuration of the technology is discussed. For example NITREX has by far the best performance described in all of Chapter 6, but we have no information on what the NITREX process is. There is no discussion of the NITREX process in the text even though it is the only technology shown that results in an effluent lower than 10 mg/L as N (2.2 mg/L as N). I would think that every technology resulting in less than 20 mg/L as N (the top 4 technologies in Figure 2) merits description in this text. Alternately the authors could categorize the technologies… for example is there a certain type of technology that results in most of the high efficiency processes (e.g. 3 of the top 4 are tertiary denitrification systems with carbon addition)? Why are some technologies so much more efficient than others? The current version has no such discussion. [Specific suggestions on how to reorganize the chapter to provide this detail were offered]

Response: EPA has expanded the chapter narrative to ensure a reasonably consistent level of information for every technology summarized in the tables and figures. EPA acknowledges that this chapter does not contain significant detail on the technologies discussed in this chapter and believes that such detail is beyond the scope of this document. EPA has provided references for all technologies to allow readers who desire more detail to obtain it. EPA added a new Table 6-1 to accompany Figure 6-2. The new table presents the system components and type classifications for all the technologies included in Figure 6-2.

Comment: Somewhere in the text it needs to be pointed out that not all carbon sources are equal in terms of O&M requirements. For example, adding methanol implies that data is gathered frequently enough, and with rapid enough turn-around, that methanol will not be overdosed or underdosed—both of which would result in deterioration of the effluent quality (one in terms of effluent BOD, the other in terms of effluent nitrogen). Sawdust and newspapers, in contrast, will only need to be replaced when effluent nitrogen breaks through (i.e. the denitrification capacity of the sawdust or newspaper has been exhausted, i.e. the readily biodegradable components of the carbon source have been completely oxidized). Possibly a sub-section on different carbon sources should be included.

Response: EPA added the following text to section 3.2:

> *Carbon sources are not equal in terms of O&M requirements. For example, methanol is very sensitive to under- or over-dosing, and thus requires special attention to ensure that the system is monitored enough to control dosing for optimal N-removal and BOD control. By contrast, sawdust and newspapers need to be replaced only when effluent nitrogen breaks through (i.e. the denitrification capacity of the sawdust or newspaper has been exhausted).*

O&M costs are provided for various specific carbon-dependent N-removal technologies.

Comment: The authors should mention zero valent iron as a possible PRB for removal of nitrate, although it results in ammonia rather than nitrogen gas and its costs are very different. Ammonia sorption/partitioning to either soil or other materials is an essential aspect of making such systems workable. The authors may wish to state it is not cost-effective if they are aware of recent literature that reaches this conclusion but there needs to be some mention of it nevertheless. Two references were provided.

Response: EPA added the following text regarding zero valent iron for use in permeable reactive barriers (PRBs), along with both references that were provided:

> *Zero valent iron, now used for some industrial wastewater treatment applications, has been studied as a nutrient removal media in PRBs and other system components. Obstacles with this technology include reduction of nitrate to ammonia rather than nitrogen gas and relatively high costs (Cheng 1997). New variations of this technology hold promise for removing some of these obstacles (Lee 2007).*

Comment: With regard to PRBs that rely on degradable carbon sources, the authors need to clarify why limestone or some other calcium salt/alkalinity is required. Denitrification produces alkalinity and is not nearly as sensitive to pH changes as, for example, nitrification is. What is the reason for adding alkalinity (which should result in an alkaline pH in combination with the denitrification)?

Response: A calcium supply, such as lime, is needed in carbon-based PRBs as a pH adjustment, not just a source of alkalinity. If nitrification takes out all of the alkalinity as a result of the greater than 7:1 demand for each unit of ammonia that is nitrified, the pH will drop to very low values. The added calcium carbonate in the PRB buffers the pH into a more acceptable range for the denitrifiers, whose actions will restore about 50% of the original alkalinity when completed. When sulphur-based autotrophic denitrification is involved, the limestone is actually needed to sustain the denitrification reaction.

However, this is a level of operational detail that exceeds EPA's overall intent for this guidance. The sentence referenced above was replaced by the following text:

> *The most effective [PRBs] for removing nitrate from plumes are filled with a carbon-based media mix that controls for changes in pH.*

Comment: Do the costs given for composting toilets include the parallel greywater treatment system? The costs of both need to be included so that a total cost and total O&M can be calculated.

Response: The cost of providing a parallel greywater system is extremely variable and providing this information is beyond the scope of this guidance. However, EPA modified the following text to clarify this point:

> *A greywater treatment system will be needed if the facility generates sink, laundry, or other greywater.*
>
> to:
>
> *A greywater treatment system is needed if the facility generates sink, laundry, or other greywater, therefore adding to the cost.*

Comment: What does the acronym LID stand for?

Response: LID stands for Low Impact Development. EPA removed the reference to LID, as it was not needed in this chapter of the guidance. LID is discussed at length in Chapter 3 of this guidance.

Comment: The chapter makes no mention of the membrane bioreactor (MBR). Detail and Web links are provided.

Response: Based on the information provided, EPA added the following text on MBRs within section 4.3:

> *Nitrogen removal in larger cluster applications of suspended growth systems (i.e., > 200 homes) may be enhanced by the incorporation of a membrane bioreactor process unit (MBR), which screens wastewater through very small pore-size filters. MBRs are more common to centralized treatment facilities, due to operating costs and economy of scale issues. However, individual home-sized and small cluster units are beginning to be developed for the U.S. market (e.g., BioBarrier, ZeeWeed; WERF, 2006).The high quality effluent provides opportunities for treated water reuse. Cost and performance data for individual and small cluster applications of MBRs are not widely available and are likely to vary greatly. Energy costs, particularly to operate the pumping components, significant, especially in smaller system applications (USEPA 2007).*

EPA added supporting references to the end of the chapter.

Comment: The chapter fails to mention natural vegetative wastewater treatment systems. Detail and Web links are provided.

Response: Based on the information provided, EPA added a new subsection titled "Land/Vegetative Treatment Systems" in renumbered section 4.2 with the following text:

> *Land treatment systems, such as spray irrigation systems, are permitted in some places, but have not been widely used due to their large land area requirements (EPA 2000). In general, these vegetative treatment systems have been poor performers with regard to N removal. However, in recent years, significant advances have been made. The Living Machine, a proprietary decentralized wastewater treatment system has been used successfully for large capacity applications, such as schools. While this system delivers advanced N removal, it relies on multiple treatment processes including anaerobic and aerobic reactors, a clarifier, and an "ecological fluidizer bed" (USEPA 2002), which drive up the cost. Eco-machines are similar in concept to The Living Machine, and are also capable of advanced N removal. Costs for both of these technologies make sense for only fairly large capacity applications. They are not practical for individual residential systems, but may be useful for cluster and large system applications.*

Comment: The report focuses exclusively on nutrient REMOVAL technologies and makes no mention of technologies to RECOVER nitrogen and phosphorus from wastewater. Typically, in an effort to meet effluent compliance, the wastewater treatment industry expends tremendous resources to get rid of the ammonia present in wastewater and drive it towards N2 gas. In this approach, large amounts of energy are expended for aeration to enable nitrification, and large quantities of chemicals such as methanol are used to facilitate denitrification. The approach also contributes to the generation of greenhouse gases through both energy expenditure as well as the release of CO2 (nitrification) and nitrous oxide (nitrification and denitrification) from these treatment steps. Meanwhile, in order to meet the huge fertilizer demand from the agricultural industry, society expends more energy to convert N2 gas to ammonia (via the Haber Bosch process) and causes environmental damage and NPS runoff through phosphate mining. Both ammonia and phosphate are already present in wastewater. A truly sustainable approach is to shift our emphasis towards the recovery of these nutrients from wastewater so that they can be used as fertilizers, rather than focusing only on nutrient removal strategies. A combination of both recovery and removal should be considered and promoted through the regulatory framework towards the ultimate goal of simultaneous environmental protection and resource conservation.

The following paper is a good reference on the paradigm shift that is occurring on looking at wastewater as a resource: http://pubs.acs.org/doi/pdf/10.1021/es9010515

As both a regulatory agency and a trendsetter, the EPA should be at the forefront of promoting sustainable practices such as wastewater resources RECOVERY.

Towards the shift towards nutrient recovery, EPA should encourage the development and implementation of source control technologies. Waterless urinals, often used as water-saving measures, present an opportunity for nutrient recovery. Urine-separating toilet technology is another strategy for source control of nitrogen to reduce the burden on subsequent wastewater treatment facilities, whether decentralized or centralized. The following article describes the success of this technology in Europe:

http://pubs.acs.org/doi/abs/10.1021/es9028765

Response: EPA acknowledges the points made by this comment about the importance of nutrient recovery and source control. While a full treatment of the topic of nutrient removal and source control technologies associated with wastewater is beyond the intent of this document, in response to this comment, EPA has added a new section (4.9) on effluent reuse with the following text:

> *Reuse of treated wastewater system effluent can significantly reduce nitrogen discharge to the environment. Many of the technologies suggested for advanced decentralized wastewater treatment in the Chesapeake Bay watershed can, with adaptations, be used to produce reclaimed water for beneficial reuses, including aquifer recharge, landscape irrigation, toilet flushing, fire protection, cooling and other non-potable indoor and outdoor purposes (US EPA 2004). When reclaimed water is used for irrigation, reuse can offset potable water demand by augmenting supply while sequestering nutrients in vegetative matter and offsetting fertilizer use (WERF 2010). Reclaimed water technologies generally include recirculating filtration systems and membrane bioreactors, amended with disinfection systems (most commonly, chlorination and/or ultraviolet disinfection), online monitoring systems, onsite storage, and sometimes specific chemical feed systems for conditioning treated effluent to meet water quality demands for specific reuses (e.g., pH adjustment for cooling water). Non-reactive dye injection is sometimes required by building codes for reclaimed water to be used indoors. Costs for decentralized reclaimed water systems are highly context-specific and dependent on the intended reuse application, system size, and local or state regulatory requirements (WERF 2010), but can be assumed to add 50 percent to the costs of a more traditional decentralized system.*

References

Cheng et al. Reduction of nitrate to ammonia by zero-valent iron. *Chemosphere.* Volume 35, Issue 11, December 1997, Pages 2689-2695.

Lee, S., K., S. Rhee and J. Park. 2007. *Development of a New Zero-Valent Iron Zeolite Material to Reduce Nitrate without Ammonium Release*, *Journal of Environmental Engineering*, *Vol. 133, No. 1, pp. 6-12.*

U.S. Environmental Protection Agency. 2000. *Onsite Wastewater Treatment Systems Technology Fact Sheet 12—Land Treatment Systems*. U.S. Environmental Protection Agency, EPA-625-R-00-008 Office of Research and Development, Washington, DC.

U.S. Environmental Protection Agency. 2002b. *Wastewater Technology Fact Sheet: The Living Machine*. U.S. Environmental Protection Agency, EPA-832-F-02-025 Office of Water, Washington, DC.

U.S. Environmental Protection Agency. 2004. Guidelines for Water Reuse. US Environmental Protection Agency. EPA-625-R-04-108. August 2004. http://www.epa.gov/ord/NRMRL/pubs/625r04108/625r04108.htm

U.S. Environmental Protection Agency. 2007. *Wastewater Management Fact Sheet—Membrane Bioreactors*. U.S. Environmental Protection Agency, Office of Water, Washington, DC. <http://www.epa.gov/owm/mtb/etfs_membrane-bioreactors.pdf>., Accessed April 29, 2010.

WERF. 2010. Distributed Water Infrastructure in Sustainable Communities: A Guide for Decision-makers. WERF DEC3R06. March 2010. www.werf.org/distributedwater

Chapter 7. Hydromodification

Comment: Reviewers felt that the chapter was poorly written, poorly organized, and incomplete and that it should be made more apparent that the chapter is an addendum to the existing 2007 EPA guidance document. In addition, there was a comment that the discussion of two of the practices was not "balanced" in terms of size.

Response: The chapter underwent a thorough review and modification of both text and format in order to provide a more thorough, readable, and understandable document. Numerous sections were expanded upon, with additional references provided by the STAC. The dam removal and natural channel design sections of the chapter have been re-written to be more concise and "balanced" and improved upon using reference sources recommended by reviewers. All recommended practices have been moved to a separate section of the document and a table has been developed to help guide the reader in identifying whether the practice is existing, updated or "next generation, as well as their location in the document." As suggested by one reviewer, a "check box" has been developed in order to show applicability of practices amongst the various Implementation Measures. Additional sources of information, including Chesapeake Bay region studies, were added. Finally, text was added in order to explicitly state that this chapter and the 2007 guidance are intended to be used in tandem.

Comment: One reviewer commented that the "Implementation Measures" are confusing.

Response: Additional information has been added to more fully characterize each Implementation Measure.

Comment: One reviewer felt that the practices discussed include many hard structures that may exacerbate erosion and reduce nitrogen removal capacity and that a preference should be shown toward the use of approaches that maintain the interaction between surface water and the bank, riparian, and shore sediments.

Response: The document was modified in order to recognize the advantages of employing bio-engineered solutions; it now explicitly states that bio-engineered practices should receive explicit preference over traditional hard engineering approaches where appropriate.

Comment: One reviewer felt that the document suffered from not having a clear section on restoration prioritization that focuses on watershed levels and not individual sites.

Response: The context for employing restoration practices has been improved and a discussion of prioritization has been added. We explain that restoration projects and practices should not be viewed in isolation, but that they should be chosen with a view toward which projects best achieve watershed goals and be based upon a watershed assessment.

Comment: "The EPA has identified the best available, proven, cost-effective practices at this time."

"The data presented in the report regarding the costs/benefits of practices are sound and based on widely accepted scientific literature. The data are up-to-date and the relevant literature is appropriately cited."

"In all, the report does a fine job of evaluating hydromodification practices and their applicability to reducing sediment and nutrient loading to the Chesapeake Bay."