Comment Response Document
Regarding the Total Maximum Daily Load (TMDL) of Nutrients (Phosphorus) for the Upper Monocacy River Watershed, Frederick and Carroll Counties, Maryland

The Maryland Department of the Environment (MDE) has conducted a public review of the proposed Total Maximum Daily Load (TMDL) of Nutrients (Phosphorus) in the Upper Monocacy River Watershed. The public comment period was open from July 26, 2012 through August 24, 2012. MDE received four sets of written comments from Mr. Barry Miller of Redland Brick, Commissioner Blaine Young of Frederick County, Ms. Marian Norris of the National Park Service and Mr. Thomas Devilbiss of Carroll County.

Below is a list of commentors, their affiliation, the date comments were submitted, and the number referenced to the comments submitted. In the pages that follow, comments are summarized and listed with MDE's response.

Author	Affiliation	Date	Comment Number
Mr. Barry Miller	Redland Brick	8/3/2012	1 – 6
Hon. Blaine Young	Frederick County Board of County Commissioners	8/15/2012	7 – 15
Ms. Marian Norris	National Park Service	8/16/2012	16 – 17
Mr. Thomas Devilbiss	Carroll County Dept. of Planning	8/24/2012	18 – 38

Comments and Responses

Comment 1: It has been my concern that additional sampling requirements for phosphorus will be added to the Rock Ridge Plant NPDES permit as a requirement on its next revision as a result of the development of this TMDL, simply to confirm to MDE that we are <u>not</u> discharging Phosphorus, as the cost of sampling and testing six outfalls on a monthly basis is significant

> **Response:** The Rock Ridge Plant (Redland Brick, Inc. NPDES Permit No. MD0052345) is a minor industrial facility located in the Upper Monocacy watershed. As explained in the TMDL report, all minor industrial facilities are given an aggregate waste load allocation based on the facilities' aggregate WLA in the Bay TMDL. However, for every Chesapeake Bay industrial discharger, and as part of their permit renewal process, MDE is currently undergoing assessment of the level of nutrients that these facilities could potentially discharge. The commentor expressed in his comment that his facility is "not discharging phosphorus." To confirm that statement, the permitee will be asked to submit a representative amount of TN and TP sampled data for any surface water discharge with the permit renewal application. More specifically, the amount of samples required will depend on the size of the discharge. Twelve

monthly samples for discharges greater than or equal to 0.1 MGD and four quarterly samples for discharges with an annual average of less than 0.1 MGD. Based on these data, MDE will determine whether or not the facility will be required to do nutrient monitoring. (MDE does not require monitoring of ground water discharges.) If the data show that no TN or TP containing compounds are being added to the wastewater, and that the source water is not high in nutrients, then there will be no need to limit or monitor the discharge for nutrients.

Comment 2: I request that the news releases of Governor Martin O'Malley listed on the Maryland DNR website dated February 13, 2012 and April 19, 2012 are included in the public comments for these TMDL developments. In the February news release the Governor announced the "results of Maryland's 2001 Fall Oyster Survey show the highest survival rate" and that this has been the trend in recent years. In the April news release the Governor announced that based on the winter dredge survey, the "Chesapeake Bay's juvenile blue crab population is at the highest level on record and the overall blue crab population is at its highest level since 1993". Furthermore, the Governor specifically noted, "Today's announcement marks four years in a row of progress to restore the blue crab." Remarkably, the increases in oyster and crab populations have occurred at the same time that the moratorium on the harvest of striped bass was eliminated and possession limits have been liberalized. (The blue crab is the primary food source of the striped bass in the Chesapeake Bay.) This information is based on scientific data and shows that the water quality in the Chesapeake Bay is currently adequate if not good. It also shows that prior improvements in water quality may be adequate. This is a basis to show that this TMDL may not be necessary.

Response: The news releases requested by the commentor to be included in the TMDL report are related to the Chesapeake Bay and its tidal tributaries. MDE does not consider them necessary within this TMDL report. While nutrient and other pollutant reductions from the non-tidal tributaries draining into the Chesapeake Bay may have contributed to progress made towards a healthier Chesapeake Bay, it can't be proven that progress is specifically due to nutrient reductions in the Upper Monocacy River watershed or that the Upper Monocacy River is meeting its local water quality standards. This TMDL is necessary to ensure that nutrients, in particular phosphorus, are not impacting local water quality in the Upper Monocacy River.

Comment 3: No cost analysis was conducted in the development of this TMDL. We are limited in our environmental stewardship by only two things- the limits of available technology and the economics of available technology. If the economics are not acceptable it does not matter if technology is available. Our country and state is in the deepest depression since 1929. As an example, our Rocky Ridge Plant has been shut down and our employees have been laid off for significant periods <u>each</u> year since 2006. I sat in prior Water Implementation Plan (WIP) and TMDL meetings and have heard farmers, business, and residents say they cannot add additional cost to their business. In a study issued to the Maryland Chamber of Commerce last October it was noted that the cost of the Water Implementation Plan (WIP) will cost each Maryland resident over $10,000. I am aware that a number of municipalities in Washington County, Maryland have formally told Washington County that they will not implement their portion of the WIP as they cannot afford it. Business and residents do not have that luxury. In the [August 1, 2012] meeting, County Commissioner Paul Smith noted that Frederick County has the largest land mass of any county in Maryland but only on fourth of the population of neighboring Montgomery County. Therefore, the implementation costs will be four times as much for Frederick County residents. I do not question if MDE followed the EPA protocol in the development of this TMDL but if the protocol does not require a cost analysis to be performed it is significantly shortsighted. All residents and businesses want clean water but how clean can we afford it to be?

> **Response:** The development of a TMDL is a process to determine the assimilative capacity of a particular substance based on a combination of the water quality criteria and the designated uses. Neither the Clean Water Act nor current EPA regulations direct states to develop implementation plans and/or cost analyses as part of the TMDL development and approval process.
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> Specific implementation measures and cost analyses are beyond the scope of the traditional TMDL process. Analyzing the costs of potential mitigation measures would occur at a later implementation stage in which the concerns raised by the commentor could be considered by the interested parties responsible for the TMDL implementation. However, reasonable assurance of implementation is demonstrated through technical feasibility and funding mechanisms outlined in Maryland's Phase II Chesapeake Bay Watershed Implementation Plan and further summarized in this document.

Comment 4: The data used in the development of the WIP and the TMDL is flawed and should not be used to set TMDL limits for these waterways. In addition, data used is dated and better data is available. In my comments on the WIP prior, I noted that MDE used data for Sideling Hill Creek, 15 Mile Creek, and the Savage River in the models used to set TMDL limits. These waterways are cold water streams, in a colder climate, in mountainous areas, are predominantly covered by forest, and primarily spring fed, with significant tree cover, and has never supported naturally reproducing trout. They do not compare and the data for one should not be used to propose regulations for the other. If MDE does not have the data it needs to implement the model, it either needs to get the appropriate data or it needs to use a different model prior to writing regulations. Comparable streams for the Monocacy River would be the Conococheague Creek in Washington County, MD. The data used in the development of this TMDL originates in the 1970's. Land use had dramatically changed during that same time making that data obsolete. Participants in the [August 1, 2012] meeting talked of having data that MDE refused to use. This gives the impression that MDE has handpicked that data to get the TMDL it wants.

> **Response:** MDE conducted a data solicitation for information relevant to this TMDL in 2009. All available data consistent with state monitoring protocols from 1998 to the time of TMDL development were considered. The land use and phosphorus loads used in the development of this TMDL represent conditions in 2009. Please also see the response to Comment #10.
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> The TMDL endpoint, the phosphorus loading threshold compatible with meeting Maryland's standards for protecting aquatic life, was set based on the median forest normalized phosphorus loading rates for the geographic scale of MD 8-digit watersheds which are currently supporting their Aquatic Life Use in 1st through 4th order streams in the Eastern Piedmont and Highland regions. Biologists developing MD's biological assessment methodology consider the fish and benthic invertebrates in this combined region to have similar community structure, and thus comparisons across watersheds in this region are valid. Because the calculation of the median is fairly insensitive to outliers or extreme values, it is not the case that all of the 1st through 4th order streams in a watershed would have to be high-quality waters to meet the threshold. Please also see the response to Comment #14.

Comment 5: MDE should work with Pennsylvania in the development of their TMDL for the Monocacy River, before developing their own. The Monocacy River originates in PA and MDE does not know what, if any, action PA will take in a TMDL development for the Monocacy. Likewise, the Susquehanna River is the largest tributary of the Chesapeake Bay. It is quite likely that PA TMDL development and subsequent implementation could significantly lessen the burden of phosphorus reduction and the related financial impact for Maryland residents and businesses while still obtaining the same results. MDE should wait.

> **Response:** This TMDL is to address nutrient impacts to biological communities in the 1st through 4th order streams in the watershed, not the mainstem of the Monocacy River. For that reason, only portions of Pennsylvania which are headwaters to the 1st through 4th order streams in the MD portion of the watershed are subject to TMDL reductions. Moreover, as can be seen in Figure 1 of the main report, a majority of 1st through 4th order streams in the MD portion of the watershed do not originate in Pennsylvania, so reductions in phosphorus loads in Pennsylvania will have no impact on them. Therefore, it is unlikely that reductions in loads from Pennsylvania alone would remedy the nutrient impairment addressed by this TMDL.

Comment 6: MDE should converse with EPA rather than impact the residents and businesses. On slide 36 of their presentation, MDE admits they could have a better scientific understanding of the impact of nutrients on aquatic life. MDE admits it would like more data. MDE is bound on implementing a TMDL while other states wait. We do not know what will happen upstream. It is great that MDE will revisit the status of nutrient impairment in 2025 but the residents and businesses will be impacted upon finalization of the TMDL on the issue of their next NPDES permit. The public is not opposed to implementing sound environmental regulation. MDE should delay the finalization of the TMDL and WIP until they have better data and the financial climate is better.

> **Response:** MDE is following EPA guidance and regulations in addressing this phosphorus impairment listing by establishing this TMDL with the best readily available science and data and within the timeframe required by EPA. MDE cannot delay the finalization of this TMDL based upon the current economic climate. As stated in comment #3, the development of a TMDL is a scientific process to determine the maximum amount of a specific substance or pollutant that a waterbody can assimilate and still meet its water quality standards. Implementation and costs related to it, therefore, are beyond the scope of this process.
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> Additionally, independent of the establishment of this TMDL, residents and businesses will be required to do their share in reducing nutrients to meet Chesapeake Bay water quality standards under the Bay TMDL Watershed Implementation Plan. Permits for municipal NPDES WWTPs will not require further phosphorus reductions, beyond those listed in the Bay TMDL, because the waste allocations for WWTPs established have been adopted for the Upper Monocacy River phosphorus TMDL. The 20% restoration requirement in Phase I MS4 permits and successive permits should achieve the phosphorus reductions to meet both the Bay TMDL and the local TMDL. Similarly, jurisdictions upstream of Maryland's waters will also be required to implement measures necessary to meet water quality standards in the Chesapeake Bay; therefore it is reasonable to expect that nutrient reductions will take place in upstream waters. As explained in the TMDL report, by 2025 when the Bay TMDL is fully implemented, MDE will review the status of the nutrient impairments in the Upper Monocacy River, based on additional monitoring data and any improvements in the scientific understanding of the impact of nutrients on aquatic life.

Comment 7: The loads assigned to Frederick County Government's NPDES MS4 permit in the technical memos use a calculation of the MS4 are to calculate the load. We have observed that the Maryland Department of the Environment (MDE) is currently using two different definitions of the MS4 area, and that neither is consistent with the Clean Water Act. One method is described in the "Accounting for Stormwater Wasteload Allocations and Impervious Areas Treated" draft document dated June 2011 and used by the Stormwater program. This method includes the entire jurisdictional boundary of the County in the MS4 and subtracts non-urban areas and areas operated by other permit holders. The second method, used by the TMDL program, used census-designated urban areas to define the MS4. This includes agricultural land and excludes some of the county's actual MS4. The Clean Water Act specifically designated the Phase I MS4 as the storm sewer system, its appurtenant conveyances and drainage areas. The MDE's methods overestimated the area of the MS4 and the sweep of the county government's control.

> **Response:** The method used in calculating the National Pollutant Discharge Elimination System (NPDES) Regulated Stormwater Wasteload Allocation (WLA) is based on Frederick County's Municipal Separate Storm Sewer System (MS4) permit applied jurisdiction-wide and covering all urban areas within the County, except for those developed areas regulated under a separate NPDES stormwater permit. Within the Upper Monocacy River watershed, the urban areas not covered under the County's Phase I MS4 permit include those areas associated with the Phase II Municipal MS4s, the State Highway Administration's (SHA) Phase I MS4, and "Other Regulated Stormwater Sources" (including state and federal Phase II MS4s, industrial facilities regulated for stormwater discharges, and construction sites). The individual Frederick County Phase I MS4 WLA, presented within the point source technical memorandum to the Total Maximum Daily Load (TMDL), is based on reductions applied to the urban stormwater loads associated solely with the Frederick County MS4 area and excludes urban stormwater loads associated with the other NPDES stormwater permits within the watershed. This methodology is consistent with the MS4 definition outlined within the Maryland Department of the Environment (MDE) Stormwater Program's guidance document, *Accounting for Stormwater Wasteload Allocations and Impervious Areas Treated*, which states that a County's MS4 permit applies jurisdiction-wide, except to those areas regulated under a separate NPDES stormwater permit. Furthermore, this methodology is consistent within the definition outlined within the Clean Water Act, which states that the areas draining to a storm-sewer system that are owned and operated by a Phase I jurisdiction are regulated via that jurisdiction's MS4 permit.
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> However, the methodology for calculating the NPDES Regulated Stormwater WLA within the Upper Monocacy River Nutrient TMDL does represent a deviation from the original methodology applied in calculating the NPDES Regulated Stormwater Target Loads within Maryland's Phase II Watershed Implementation Plan (WIP) for the Chesapeake Bay Nutrient and Sediment TMDLs. The original methodology applied in the Phase II WIP assumed that very low density and rural developed areas were not covered under a given County's MS4 permit. In order to exclude these areas from MDE's delineation of NPDES regulated stormwater, the combination of the US census "urbanized areas" (from the 2009 US Census Update Data) and "core" urban areas from the United States Geological Survey (USGS) Chesapeake Bay Program Office's

(CBPO) 2006 Chesapeake Bay Land-Cover Dataset (CBLCD) were applied. This method is consistent with the landuse assumptions in the Bay TMDL. To accurately reflect new MS4 permit conditions, the final version of the Draft Phase II WIP has been revised to include the entire urban area within a given MS4 County as being included within the NPDES Regulated Stormwater Target Loads.

Comment 8: The implications [of this TMDL] to wastewater treatment plants several years down the road are unclear, and we would like MDE to explain them to us.

Response: As explained above, the Chesapeake Bay TMDL WLA for municipal WWTPs has been adopted for this TMDL. There are no additional requirements for municipal WWTPs under this TMDL. For major municipal or industrial WWTPs, the facilities have an individual WLA which is the same as the Bay TMDL allocation and it is stated in the TMDL report. For minor facilities, as in the Bay TMDL, an aggregate WLA has been developed and is to be shared among all minor facilities. This aggregate load and the facilities to which this load apply are also presented in the report. All facilities will have to comply with their NPDES permit requirements as established by MDE's NPDES Permits Program under their regular permitting process. Currently, no facility has additional requirements from the local TMDL over what will be required for the Bay TMDL.

Comment 9: Developing TMDLs at such a large scale means that even if there are substantial areas within a watershed that are not contributing to an impairment, they are also included as impaired. We believe that MDE can effectively delist many of these areas by modeling to the catchment scale, which Frederick County has done using EPA's SWMM Model.

Response: Currently MDE is managing biological listings at the Maryland 8-digit watershed scale using a stratified random sampling approach to obtain a statistically valid assessment. This is a balance of resources and scale when managing Maryland's many watersheds. Because of this, the TMDLs were developed to be consistent with the 303(d) listing scale. The commentor is correct to say, however, that at a finer scale there may be streams with healthy biological communities. It is MDE's expectation that implementation should focus on specific areas of the watershed that are known to have localized impacts and is encouraging localities to focus on local implementation. Therefore, it would be appropriate for Frederick County to target its phosphorus reduction efforts on catchments which are likely to have significant phosphorus impacts on biota and thereby accelerate the restoration of the biological community in the 1^{st} through 4^{th} order streams in the watershed.

Comment 10: MDE did not use data from Frederick or Montgomery County to develop its assessment despite the availability of randomly stratified data points using Maryland Biological Stream Survey methodologies. Furthermore, the number of recent data points in the sample used to create the TMDL does not appear to represent a statistically valid sample size unless you include Round 1 data collected in the 1990s.

> **Response:** MDE conducted a data solicitation for information relevant to this TMDL in 2009. All available data consistent with state monitoring protocols from 1998 to the time of TMDL development were considered. The land use and phosphorus loads used in the development of this TMDL represent conditions in 2009.
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> MDE would like to incorporate all available data into the Biological Stressor Identification (BSID) analysis; however, all data must contain all parameters included in the MBSS Round 2 dataset. Many counties conduct biological sampling with MBSS protocols; however, currently there are no counties that collect all the same parameters as DNR (water chemistry, all habitat assessments, fish sampling, etc). Without all the same parameters there would be gaps in the dataset. The BSID analysis uses only the Round 2 data set, because the MBSS Round 1 does not have all parameters that are contained in the Round 2 dataset. Round 1 data is only included if the attributable risk value (AR) for all stressors identified is under 75%.
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> Related to the validity of using a small sample size of recent data, the results in the BSID analysis are statistically valid because they are based on the exact Mantel- Haenszel approach.[1] The exact Mantel-Haenszel method was applied due to the small sample size and stressors were not considered unless they were determined to be statistically significant and also determined to be ecologically plausible.

Comment 11: An "impaired stream miles" calculation was used. What is the methodology for this calculation?

> **Response:** Maryland's Biological Listing Methodology (BLM) is based on the Maryland Biological Stream Survey (MBSS), which assesses biological conditions in 1st through 4th order streams. MBSS monitoring sites are selected based on a random sample design which allows for unbiased estimates of overall watershed conditions. The BLM is based on the MBSS fish and benthic indices of biological integrity (IBI) scores. An IBI greater or equal to 3 generally means that the site supports aquatic life. Year-to-year variability is taken into account by calculating a minimum allowable limit (MAL) based on comparison with the

[1] Mantel, N., and W. Haenszel. (1959) *Statistical aspects of the analysis of data from retrospective studies of disease.* Journal of the National Cancer Institute, 22, 719-748.

variation in biocriteria observed at MBSS sentinel sites sampled every year. The percent impaired stream miles is calculated based on the percent of sites in a watershed which have IBI scores below the MAL. Reporting the number of biologically-impaired stream miles is a requirement of the EPA for 303(d) listing purposes.

Documentation of BLM can be found at http://www.mde.state.md.us/programs/Water/TMDL/Integrated303dReports/Documents/Assessment_Methodologies/Biological_AM-streams_2012.pdf

Comment 12: The nutrient trading program in the draft offset policy as well as Maryland Assessment Scenario Tool models from MDE focus on nitrogen reductions, but P is the limiting nutrient here. This fact is predicted to make the tracking for P less accurate and the reductions more difficult to achieve.

Response: The commentor's question or concern is not clear. MAST has been developed for the assessment of nitrogen, phosphorus and sediment reductions. The draft offset policy is still undergoing public review with concerns and comments raised by the many stakeholders being discussed by State reviewers prior to adoption.

Comment 13: The loss of agriculture in Frederick County is unfortunate, and we are working to protect the family farm. As farms release more phosphorus pollution per acre than other land uses, and there are predictions as to the decline [in farming acreage in the County], has anyone looked at [any] predicted [decline in] future phosphorus loads from farms becoming inactive.

Response: Phosphorus loading rates for different land use sectors have been estimated using the Chesapeake Bay Watershed Model. Using these loading rates, the decrease in phosphorus loads resulting from farmland changing to forest or developed land can be estimated. MDE is not clear if the commentor refers to inactive farms as potentially different land uses (urban, forest, pasture) or as "abandoned" land. The decline in phosphorus loads from active farms becoming inactive or abandoned is included in the Phase II WIP under the "land retirement" BMP. Details of this can be found in Maryland's Phase II WIP (http://www.mde.state.md.us/programs/Water/TMDL/TMDLImplementation/Pages/FINAL_PhaseII_WIPDocument_Main.aspx).

Comment 14: There is no numeric criterion for phosphorus in non-tidal streams. The TMDL is set at the loading rates for reference streams which are not only unimpaired, but also contain some of the highest quality waters in the state, several of which include Tier II Antidegradation areas. There is no clear sense of how much phosphorus these reference streams could take before becoming impaired. This suggests that all water bodies must meet high quality reference stream conditions in order to not be impaired. This sets an impossible standard for areas which have existing development and agriculture, and sets restoration thresholds that require additional costs to retrofit over and above meeting the designated use of the water body. MDE suggests that we can make improvements and then reevaluate; however we are working with real dollars and long budget horizons that make such a suggestion impractical. The real question is at what point phosphorus begins to impair the water body, which is where the TMDL should be set. We have not addressed that here [This is not addressed in the TMDL].

> **Response:** See response to Comment #4. The phosphorus loading threshold, which is the endpoint for this TMDL, was based on the median forest normalized phosphorus load from all unimpaired watersheds in the Eastern Piedmont and Highlands. Some of these watersheds have a significant amount of Tier II Antidegradation area, some do not. What these watersheds have in common is that they are supporting their Aquatic Life Use, which is the minimum acceptable requirement for meeting water quality standards.
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> The reference watershed approach is the standard method to set a TMDL endpoint when there are no numerical criteria. The loading rates from unimpaired watersheds are used to set the maximum load compatible with meeting water quality standards. MDE has already used this methodology to develop sediment TMDLs approved by the EPA. In Region III, both Pennsylvania and Virginia have also developed TMDLs based on the reference watershed approach.
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> MDE recognizes the uncertainty inherent in setting a phosphorus loading threshold using the reference watershed approach for non-tidal nutrient TMDLs. EPA guidance[2] specifies that greater margins of safety should be used when there is more uncertainty. The margin of safety for non-tidal nutrient TMDLs is implicit and is based on selecting the median rather than the 75th percentile, for example, of the forest normalized phosphorus load from unimpaired watersheds.

Comment 15: The following table illustrates [that] the reductions required by the Chesapeake Bay TMDL for stormwater are dwarfed by the reductions required by local TMDLs. Green cells represent approved TMDLs. Yellow cells are under development and red cells have no activity. The cost numbers for the Bay TMDL for Frederick County are $1,503,450,109 for stormwater to reduce 7000 pounds of phosphorus. What will be the cost to reduce 1,204,192 pounds?

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[2] U.S. Environmental Protection Agency. 1999. Protocol for Developing Nutrient TMDLs. EPA 841-B-99-007.Office of Water (4503F), United States Environmental Protection Agency, Washington D.C. 135 pp.

Watershed	Stormwater Reductions (all sources)		
	Sediment tons	Nitrogen lbs	Phosphorus lbs
Chesapeake Bay****	2,286*	78,000*	7,000*
Lower Monocacy River	5,055.7***		17,030***
Lake Linganore****	130,975**		1,168,900**
Upper Monocacy River	1,987.6***		772***
Double Pipe Creek	1,811.9***		16,132***
Catoctin Creek	1,342.4***		1,358***

*Regulated Developed Stormwater. Includes all MS4 permit holders.

** Nonpoint source load. Earlier TMDL developed with MS4 loads in NPS loads.

***NPDES stormwater WLA. Includes all MS4 permit holders.

****Linganore is part of the Lower Monocacy. All watersheds are part of Chesapeake Bay.

Response: It is not clear whether the phosphorus reductions from Chesapeake Bay and Lake Linganore are comparable to the phosphorus reductions reported for the Lower Monocacy River, Upper Monocacy River, Double Pipe Creek, and Catoctin Creek. The latter include loads from all permit holders, even those in neighboring counties, and also include the revisions in the definitions of MS4 areas discussed in the response to Comment #7. In contrast, from the comment, the Chesapeake Bay phosphorus reduction appears to be restricted to Frederick County. The Bay reduction reported is also seems to be measured in delivered load, unlike the non-tidal TMDLs where the reductions are in EOS loads.

The Lake Linganore load reduction reported in the table is approximately twenty times the baseline load reported in the Lake Linganore TMDL. Therefore, the suggestion that the phosphorus TMDLs for the Lower Monocacy River, Upper Monocacy River, Double Pipe Creek, or Catoctin Creek would entail a significant additional burden on the County is not supported by the table as it now stands.

However, any load reduction differences between the lake TMDLs and the Draft Phase II Bay WIP can be due to differing model assumptions, including landuse and precipitation periods. Currently, MDE is working to resolve the differences in lake TMDLs when compared to the Draft Bay Phase II WIP. Because the Double Pipe Creek, Upper Monocacy and Lower Monocacy phosphorus TMDLs use the same modeling systems as that in the Phase II WIP, the loads are comparable. Moreover, because the Bay WIP has a tracking and accountability component, credit from load reduction practices can be consistently applied to both the local TMDL and Bay TMDL.

Regarding the costs, what is presented in the comment assumes that it will cost approximately $240,000 per pound of phosphorus reduced. Current figures from a 2012 Chesapeake Bay Commission report[3] indicate that the average cost per pound of phosphorus reduction for urban BMPs is between $20,000 to $50,000 per pound, which is about 5 to 10 times less than the figure presented. MDE is committed to working with both the local jurisdictions and EPA to identify current costs.

Comment 16: Regarding the assumption that septic systems contribute insignificant amounts of phosphorus: While this may be true now, with the implementation of requirements for nitrogen reducing septic tanks to meet the Chesapeake Bay TMDL requirements will presumably lead to the quantity of phosphorus flowing from septic systems to exceed that of nitrogen, potentially tipping the TN:TP ratio to a point where phosphorus is no longer the limiting factor. Would the amounts of phosphorus from septic systems still be insignificant in such a situation? Assuming all other sources as described in the report are successfully controlled....

Response: TP loads from septic systems are negligible because phosphorus tends to strongly adsorb to soil particles. Nutrient limitation applies to a water body as whole, not individual sources. Even if nitrogen exported from septic systems is significantly reduced, it is unlikely to make nitrogen the limiting nutrient in 1st to 4th order streams. Because the median TN:TP ratio is considerably higher in this watershed, it would require significant nitrogen reductions, beyond the reductions required by the Bay TMDL, to lower the ratio to the 5:1 level indicative of nitrogen limitation.

Comment 17: The TN:TP ratio is used as the rationale for addressing phosphorus primarily in this report to reduce the biological impairments which may be due to BOD and eutrophication effects, but could the quantity of nitrogen be directly affecting the biota in some instances? A blue aquatics syndrome?

Response: As the commentor suggests, this TMDL primarily addresses the adverse impacts which excess phosphorus nutrients associated with eutrophication can have on stream aquatic life. In addition, Maryland has adopted water quality criteria to protect aquatic life from the toxic affects of excess nitrogen, specifically ammonia. These criteria for ammonia have been incorporated in the BSID analysis, which did not identify ammonia as a stressor in this watershed. Other than ammonia toxicity, the toxic effects of other forms of nitrogen like

[3] Nutrient credit trading for the Chesapeake Bay: An economic study
Van Houtven, G., Loomis, R., Baker, J., Beach, R., & Casey, S. (May 2012). Nutrient credit trading for the Chesapeake Bay: An economic study: Prepared for Chesapeake Bay Commission. Research Triangle Park, NC: RTI International.

nitrate have not been scientifically established. MDE is prepared to adopt criteria should future scientific research establish, for example, that nitrate concentrations above a threshold could induce methemoglobinemia or “blue baby syndrome” or any other toxic effects in fish or other aquatic life.

Comment 18: The process by which MDE has identified the impairing substance and quantified the necessary, regulatory enforceable criteria is based on a number of conservative assumptions, computer simulations, statistical interpretations, and “professional judgment” on the part of MDE. Carroll County Government will be responsible for the Regulated Urban loads portion of the TMDL through its NPDES Phase I permit, and will be left to determine how to comply with this new regulatory requirement.

Response: Although the original 1996 listing of Upper Monocacy River’s nutrient impairment was based on professional judgment, over the last decade MDE has strived to develop a quantitative process of assessing and classifying accepted impairments-based rules of scientific evidence. Maryland has adopted a Biological Listing Methodology (BLM), based on the probabilistic monitoring design of the Maryland Biological Stream Survey (MBSS), which permits statistically valid inferences on the number of stream miles not supporting their Aquatic Life Use in an 8-digit watershed, based on MBSS sampling results. Survey design and site location selection are discussed in the MBSS Quality Assurance Report (EA-03-1), found at: http://www.dnr.state.md.us/streams/pdfs/ea-03-1_qaqc.pdf.

The BLM is described more detail in: http://www.mde.state.md.us/programs/Water/TMDL/Integrated303dReports/Documents/Assessment_Methodologies/Biological_AM-streams_2012.pdf

To identify biological stressors of 8-digit watershed not supporting their Aquatic Life Use, MDE developed the Biological Stressor Identification (BSID) analysis. The BSID uses the case/control methodology, originally developed by Mantel and Haenszel (1959)[4], to test the statistical strength of the association between diseases and their potential causes based on retrospective studies, i.e. studies which used existing data, not data collected according to experimental design. The case/control methodology is part of the standard method of epidemiology and is appropriate for environmental studies where it is difficult, if not impossible, to design controlled experiments. It was also developed in accordance with EPA guidance for stressor identification, which can be found at: http://water.epa.gov/scitech/swguidance/standards/criteria/aqlife/biocriteria/stressors_index.cfm. Documentation of the BSID methodology can be found at:

[4] Mantel, N., and W. Haenszel. (1959) Statistical aspects of the analysis of data from retrospective studies of disease. Journal of the National Cancer Institute, 22, 719-748.

http://www.mde.state.md.us/programs/Water/TMDL/Documents/www.mde.state.md.us/assets/document/BSID_Methodology_Final.pdf.

The Maryland BSID methodology was explicitly intended to provide a scientific weight of evidence approach that includes a final review by professional biologists prior to being applied in Maryland's 303(d) listing methodology. Based on BSID analysis, over a dozen nutrient listings on the 1996/98 303(d) list have been removed. In contrast, the BSID verified a strong association between nutrients and biological impairment in the Double Pipe Creek, Upper Monocacy River, and Lower Monocacy River watersheds. That is also supported by the high nutrient loading rates in this area reported from the Phase 5.3.2. Watershed Model and consistent with the USGS Sparrow Model (http://pubs.usgs.gov/sir/2011/5167/).

Because removing the nutrient impairment from the Integrated List cannot be justified, a TMDL is necessary. There are no numerical criteria for phosphorus for free-flowing stream in Maryland. The reference watershed approach is the standard method to set a TMDL endpoint under those circumstances. The loading rates from unimpaired watershed are used to set the maximum load compatible with meeting water quality standards. Computer simulation models are the standard method for quantifying loads in both the impaired and reference watersheds. MDE has already used this methodology to develop sediment TMDLs approved by the EPA. In Region III, both Pennsylvania and Virginia have also developed TMDLs based on the reference watershed approach.

In summary, MDE has used established methodologies to: (1) confirm that Upper Monocacy River is not supporting its Aquatic Life Use in 1st through 4th order streams; (2) confirm that phosphorus contributes to the impairment; and (3) determine a phosphorus loading rate consistent with supporting the Aquatic Life Use.

Comment 19: The processes by which the stressors are identified are based on a number of statistical manipulations and conclusions by MDE that are outside the realm of traditional scientific principle and practice. For example, one sampling round for benthic/fish that is then used via statistical manipulation to relate with potential nutrient impairment when compared to data from other watersheds is not standard hydrologic assessment.

Response: The current Integrated Report listings determined by MDE's biological listing methodology infer degraded biological conditions for which the stressors, or causes, are unknown. In order to determine the predominant cause of degraded biological conditions, the MDE Science Services Administration has developed a biological stressor identification process using guidance established by the United States Environmental Protection Agency.

The biological stressor identification process involves the development of causal scenarios that illustrate how the interactions, ecological processes, and sources are associated with individual stressors. Using an epidemiological model, those stressors can be linked to the biological degradation observed. The epidemiological model which is the basis of MDE's BSID analysis uses a case-control, risk-based approach to systematically and objectively determine the predominant cause of reduced biological conditions. The method applied is adapted from the field of epidemiology and has a strong statistical foundation. In addition this method has been used by EPA for larger scale assessments and is cited in several scientific papers (see link for details: http://www.epa.gov/bioiweb1/pdf/VanSickleandPaulsen_2008_Assessing_the_attributable_risks_relative_risks_and_regional_extents_of_aquatic_stressors.pdf)

The BSID analysis estimates the strength of association between various stressors and the biological community, and the likely improvement of biology if a given stressor were removed. The assessment compares the likelihood that a stressor is present, given that there is a degraded biological condition, by using the ratio of the incidence within the case group as compared to the incidence in the control group. The case group is defined as the sites within the assessment unit with degraded biological conditions and the controls are sites with similar physiographic characteristics that have good biological conditions.

The BSID process will use results from the BSID analysis to evaluate each biologically impaired watershed and determine potential stressors and sources. Interpretation of the BSID analysis results is based upon components of Hill's Postulates (1965), which propose a set of standards that could be used to judge when an association might be causal. The components applied are: 1) the strength of association which is assessed using the odds ratio; 2) the specificity of the association for a specific stressor (risk among controls); 3) the presence of a biological gradient; 4) ecological plausibility which is illustrated through final causal models; and 5) experimental evidence gathered through literature reviews to help support the causal linkage.

The BSID process uses general causal scenarios to aid the interpretation of how land-use conditions might generate in-stream stressors and how the resulting impacts can alter the biological community and structure. There are four general causal scenario models MDE uses to interpret of results from the BSID analysis: sediment/flow, energy source, inorganic pollutants, and non-load. With a general understanding of ecological processes within casual scenarios and knowledge of impaired watersheds, one can determine likely causes of degraded biological conditions.

The BSID process by which MDE has addressed biological listings has been accepted by EPA.

Comment 20: The process by which the TMDL is quantified in this document is based on computer models of the Chesapeake Bay watershed that are driven by nutrient exports derived from land use. It appears that the regional factor applies some type of empirical data to check model output, but no discussion is provided to substantiate how this is completed. Further, no nutrient data is available to run the model. A model has utility as a predictive tool, but MDE is using model outputs to establish quantitative regulatory standards that cannot, at this point, be verified by empirical data.

> **Response:** Nutrient export targets for specific land uses were based on a review of empirical studies of nutrient export rates in the scientific literature. Nutrient export values were modified based on County-scale information on fertilizer and manure application rates and crop uptake. Watershed models are not calibrated at the field scale, but at the watershed scale, by comparing simulated concentrations or loads with monitoring results. The Chesapeake Bay Program's Phase 5.3.2. Watershed Model, used in this TMDL, has calibrated nitrogen and phosphorus monitoring data at over 60 monitoring stations in Maryland, including one station at Big Pipe Creek and four other stations on the mainstem Monocacy River. For additional details on model calibration, please see *Chesapeake Bay Phase 5.3 Community Watershed Model*. EPA 903S10002 - CBP/TRS-303-10. U.S. Environmental Protection Agency, Chesapeake Bay Program Office, Annapolis MD. December 2010, http://ches.communitymodeling.org/models/CBPhase5/documentation.php#p5modeldoc.

Comment 21: Is the Chesapeake Bay 5.3.2 model designed to be implemented at the sub 8-digit watershed scale? Recent correspondence from EPA to MDE specifically discusses the potential limitations when applying the phase 5.3.2 model at the County or sub-watershed level, especially as it is related to "pounds of pollutant reductions". If so, what accommodations were made to ensure the model was calibrating properly?

> **Response:** The Phase 5 Watershed Model development process considered all available data at the finest consistent scale possible within the Bay watershed. "Consistent" is defined here as a comparable level of accuracy for all watersheds, where these data include precipitation and landscape characteristics such as slope, land cover, land use, nutrient applications, monitoring data, etc. While it can be said that the Phase 5 Model accuracy improves with aggregation and increased spatial scale, the use of Phase 5 for local TMDLs has the merit of the best available information consistently applied at the local scale. The alternative local scale approach is incorporation of additional local data at a more localized scale into a separate model, but that has the tradeoff of inconsistent analyses among different local jurisdictions. Given the relative merits of the two approaches, we believe that local allocations should be evaluated on a case-by-case basis, which is what each Bay Partner State is doing.

For example, in Maryland, the unit of TMDL assessment is at a watershed scale the same size or larger than the Phase 5 river segments. The Phase 5 river segments were designed to facilitate representation of the Maryland watersheds (the so called "8-digit" watersheds). As part of its contribution to the Phase 5 model development, MDE collected monitoring data to calibrate Phase 5 at the scale of the 8-digit watersheds. Consistency of the scale of analysis among local TMDLs and between local TMDLs and the regional Bay TMDL is considered to be an important advantage.

Excluding the Double Pipe Creek watershed, the Upper Monocacy River is represented by three river-reach modeling segments in the Watershed Model. Two segments have water quality data used to calibrate the model, and one of those segments also has a USGS gage which is used in the hydrology calibration. In addition, two water quality monitoring locations and one USGS gage downstream on the Monocacy River were also used to calibrate the model. The Watershed Model is therefore adequate at the 8-digit scale for representing phosphorus loads in the Upper Monocacy River.

MDE continues to work with the Chesapeake Bay Program to improve the model even further. Any improvements made to the model will be taken into account when the status of the Antietam Creek phosphorus impairment is reviewed after the Bay TMDL has been fully implemented.

Comment 22: Land Use data: how was urban footprint "extensively modified?" Further, what assumptions were made in order to capture subdivisions that would otherwise be so small as to be less than the pixel resolution of the LULC data? Was this process peer reviewed by objective experts to ensure its applicability? Was this also done to identify additional forested areas that were smaller than the resolution of the pixels?

Response: As per Section 2.1.1 of the main TMDL report, the urban footprint in the 2006 Chesapeake Bay Land-Cover Dataset (CBLCD) was "extensively modified" via reclassifications using NAVTEQ roads data and institutional area polygons. These reclassifications were based on the proximity of underlying pixels to these areas, applying different methods for determining the spatial thresholds to these features as per rural residential areas adjacent to the secondary road-network and suburban residential subdivisions. In terms of pixel resolution, the CBLCD has a resolution of 30 meters x 30 meters, which equates to a total area of 900 squares meters, or approximately 0.2 acres. Thus, resolution is not an issue in terms of accurately delineating residential sub-divisions. Rather, the reclassification techniques are meant to correct for the algorithms applied in classifying the raw Landsat imagery, which result from the spectral confusion of similar land-cover types (i.e., the similar spectral properties of turf grass, or pervious urban lands, vs. pasture). No reclassification techniques were applied to more accurately classify forested lands, because forest is a "left-over" in the final tabular Chesapeake Bay Program Phase 5.3.2 (CBP P5.3.2) watershed model land-use, after the incorporation of the agricultural census data; therefore, the most important function of the CBLCD, relative to informing the final watershed model land-use, is determining urban acres per land-river segment. For full methods and reclassification techniques applied in modifying the 2006 CBLCD urban foot-print, which were extensively peer reviewed, please the memorandum from the US Geological Survey's Chesapeake Bay Program's Office entitled: "Methods for Estimating Past, Present, and Future Developed Land Uses in the Chesapeake Bay Watershed Phase 5.3."

Comment 23: Atmospheric deposition is not considered part of the equation, but is an actual source of phosphorus to the watershed. Scientific literature indicates that airborne phosphorus accounts for 10 to 20 % of total phosphorus loadings to water bodies. The TMDL quantifies atmospheric deposition of total phosphorus at 0.01%, which is quite a bit less than other research indicates. How did MDE arrive at the figure and what are the potential implications to the overall detailed loads by "land-use?"

Response: The phosphorus loads from atmospheric deposition represent phosphorus deposited on open water only. Open water makes up less than 0.03% of the land surface in the Upper Monocacy River watershed, so it is not surprising that the loads from atmospheric deposition are small. Phosphorus deposited on the land surface is assumed to be transported by wind from other land surfaces and therefore does not represent a net input to the watershed. Assumptions about nutrient and sediment loads to the tidal Chesapeake Bay system and the specific phosphorus atmospheric loading rates for the Phase 5.3.2 Watershed Model can be found in: "Smullen, J. T., J. L. Taft, and J. Macknis. 1982. "Nutrient and Sediment Loads to the Tidal Chesapeake Bay System." In: U.S. EPA Chesapeake Bay Program Technical Studies: A Synthesis. Annapolis, MD: Chesapeake Bay Program Office."

Comment 24: The Future TMDL conditions identify a scenario whereby there will be no phosphorus related impacts affecting aquatic health. How will that be measured? Will that be how TMDL compliance is measured?

Response: The goals of the first phase of implementation of this TMDL is identical to the goals of the Chesapeake Bay TMDL, so compliance with this TMDL will be measured by compliance with the Bay TMDL. After the Bay TMDL is fully implemented, MDE will review the status of the phosphorus impairment. Possible outcomes include: (1) based on available biological monitoring data, the 1st through 4th order streams in the watershed are supporting their Aquatic Life Use; (2) based on additional data, BSID analysis shows that phosphorus is not associated with the biological impairments in the watershed; or (3) based on available biological monitoring data, the 1st through 4th order streams in the watershed are not supporting their Aquatic Life Use. These are not the only possible outcomes. Please also see responses to comments #29 and #34 below.

Comment 25: It appears that, using the MDE "methodology," that total phosphorus may be one of several stressors identified as potential associated with low IBI scores. It was not seen definitively how any given potential stressor was definitively associated with a given impairment. Further, it seems as though the list of potential causes (stressors) is not exhaustive. Has it been demonstrated that phosphorus is negatively impacting aquatic life use? Using the BSID method; how was MDE able to isolate P amongst the universe of possible variables that influence IBI scores? For example, could varying soils have an impact on IBI scores when looking at the reference and sample watersheds?

Response: The BSID analysis is intended to establish a causal connection between potential stressors and biological impairments based on the standards set by Hill's Postulates.[5] Those standards include: 1) the strength of association which is assessed using the odds ratio; 2) the specificity of the association for a specific stressor (risk among controls); 3) the presence of a biological gradient; 4) ecological plausibility which is illustrated through final causal models; and 5) experimental evidence gathered through literature reviews to help support the causal linkage. Nutrient impacts on biota are well documented in the ecological literature. They include: (1) diurnal swings in DO or pH caused by excess primary production; (2) fouling of substrate or habitat; and (3) trophic shifts due to changes in the food web or deviation from normal energy pathways. The presence of a statistically significant association of the stressor with biological impairment in the specific watershed (as measured by the odds ratio), in combination with the general scientific knowledge of impacts of the stressor on biota, establish the presumption of a causal relationship between the stressor and biota. In other words, in accordance with Hill's postulates, causation is established by a strong statistical association embedded in a scientifically-plausible causal story. For this reason, a causal model showing the effects of nutrients is included in the BSID report. See also the response to Comment #19.

Comment 26: Are specific data associated with the BSID available? For example, confidence interval information would be useful in reviewing the association of odds ratios in order to gain a better understanding of the strength of the "association" between "excessive" phosphorus loads and low IBI scores.

Response: The statistical results presented in the BSID report in Tables 1 through 3, represent only part of all the statistical parameters derived from the BSID analysis. In addition to the parameters presented in those tables, there are

[5] Hill, A. B. 1965. *The Environment and Disease: Association or Causation?* Proceedings of the Royal Society of Medicine, 58: 295-300.

four additional statistical parameters that can provide more detail on the statistics behind the stressor and source determinations for the Upper Monocacy. The additional information was not presented in the report but is available upon request. These four additional statistical parameters are:

1. The output probability of the Mantel-Haenszel exact test or the p value: using a 90% confidence level, if the p value is less than the 0.10 (less than ten percent chance of making a Type I error of a false positive), the stressor is identified as statistically significant.

2. The odds ratio at the lower confidence limit: when the p value is significant ($p<0.10$), the odds ratio at the lower confidence limit is greater than 1. These are the concurrent values that make the yes/no determination.

3. The mean confidence limit odds ratios: provides perspective, but do not impact the final determinations.

4. The upper confidence limit odds ratios: also provides perspective, but do not impact the final determinations.

Information regarding the statistical analysis used in the BSID Process can be found on MDE's Maryland Biological Stressor Identification websites: http://www.mde.state.md.us/programs/Water/TMDL/Pages/Programs/WaterPrograms/tmdl/bsid_studies.aspx
and
http://www.mde.state.md.us/programs/Water/TMDL/Documents/www.mde.state.md.us/assets/document/BSID_Methodology_Final.pdf

Comment 27: The TMDL is for the 8-digit watershed, however the BSID uses data collected in and relevant for only 1st to 4th order streams. The geographic scale difference indicates that the data is not appropriate to draw conclusions about the entire 8-digit watershed.

Response: The stressor id analysis is based primarily on the MDDNR MBSS round two dataset. This principle dataset uses a statewide probability-based sampling design to assess the biological condition of first-, second-, third-, and fourth-order non-tidal streams (determination based on the solid blue line shown on U.S. Geological Survey 1:100,000-scale maps) within Maryland's 8-digit watersheds (Klauda et al. 1998, Roth et al. 2005). MDDNR MBSS sites are sampled within a 75-meter segment of stream length. Individual sampling results are considered representative at the 75-meter segment, but because of design, the data can be used to estimate unbiased conditions of streams within an assessment unit (8-digit watershed). The MDDNR MBSS conducted two rounds of sampling between 1995 and 2004: the first round was designed to assess major drainage basins (i.e., Maryland 6-digit) on 1:250,000-scale maps; and the second round was designed to assess smaller (i.e., Maryland 8-digit) watersheds on 1:100,000-scale maps.

Comment 28: The impact of eutrophication on smaller-order streams has been evaluated using the BSID process to determine whether phosphorus is a potential stressor of the biological community. Empirical data associated with eutrophication such as phosphorus, chlorophyll-a, DO either do not exist, or do not support the claim. However, MDE has chosen to use a statistical method to infer that nutrients throughout the watershed must be the source of less than good IBI scores at some locations in the watershed.

Response: The primary goal of the stressor ID analysis is to identify the most probable cause(s) for observed biological impairments in Maryland 8-digit watersheds, by ranking likely stressors affecting a watershed using the suite of physical, chemical, and land use data available. Ranking of stressors is accomplished by developing a risk-based, systematic, weight-of-evidence approach. The risk-based approach is adapted from the field of epidemiology and estimates the strength of association between various stressors and a degraded biological community.

Interpretation of the stressor identification analysis results is based on components of Hill's Postulates (Hill 1965), which propose a set of standards that could be used to judge when an association might be causal. The components applied are: 1) the strength of association which is assessed using the odds ratio; 2) the specificity of the association for a specific stressor, which evaluates the rate of correct classification in the control group; 3) the presence of a biological gradient; 4) ecological plausibility (illustrated through the causal models); and 5) experimental evidence gathered through literature reviews to help support the causal linkage.

The BSID process is built upon previous efforts EPA and other States have used to address biological impairments, uses concepts from the field of epidemiology, and is based on components of Hill's Postulates (Hill 1965). MDE addressed biological listings in both 2010 and 2012 Integrated Report, which were approved by EPA.

Hill, A. B. 1965. The Environment and Disease: Association or Causation? *Proceedings of the Royal Society of Medicine* 58: 295-300.

Comment 29: The CBP model is used to quantify loads. Is that how progress will be measured as well since no criteria exists and DO [levels] indicate there are no excess nutrients?

Response: The goals of the first phase of implementation of this TMDL are identical to the goals of the implementation of the Chesapeake Bay TMDL, so progress towards this TMDL can be measured through progress towards implementation of the Bay TMDL. The CBP model, MAST, and future biological and water quality monitoring and analysis, among other methods, can be used to measure progress.

After the Bay TMDL is fully implemented, MDE will review the status of the phosphorus impairment to determine if local water quality has been met or if further implementation measures are needed to fully attain local water quality.

Comment 30: Prettyboy Reservoir watershed is listed as one of the reference watersheds indicating that nutrient loads are at an acceptable level such that IBI scores are not impacted. However, MDE issued a TMDL for this watershed in 2007 for total Phosphorus. How can an impaired watershed in TMDL analysis be used as the reference site to assess water quality in another watershed? Could it be that the BSID does not adequately assess the impacts of water chemistry on biological health? Or, is Prettyboy Reservoir watershed experiencing improved water quality?

Response: The 1^{st} through 4^{th} order streams in the Prettyboy Reservoir watershed are not impaired; only the impoundment is impaired. Lakes and reservoirs are generally considered to be more sensitive to nutrient impacts than rivers and streams. The phosphorus loading rates are compatible with supporting a healthy aquatic community in the Prettyboy Reservoir tributaries although they still lead to excess eutrophication, as demonstrated by chlorophyll *a* concentrations, in the reservoir. It is also possible that measures taken to protect the reservoir have had beneficial effects on local water quality in 1^{st} through 4^{th} order streams.

Comment 31: The geographic scale of TMDL development in the State of Maryland is the 8-digit watershed, also know as the Water Quality Limited Segment (WQLS). The DNR CORE/TREND benthic macro-invertebrate data collected at the discharge of this watershed indicates that current water quality is “good.” This indicates that the receiving water body is receiving water from the “WQLS” this is meeting water quality standards according to MDE’s guidance. However, it appears that MDE has chosen to look at individual MDSS sites collected throughout the watershed to draw conclusions about overall watershed health using a statistical methodology usually associated with case/control studies in epidemiology. The result is that a semi-quantitative measure (IBI) that provides information about a 75 meter long reach of stream is now manipulated to support an impairment for a substance for which no empirical data exists, at a scale beyond which the individual IBI results could possibly be relevant. It would seem that is MDE chooses this method; the WQLS should then become each 75 meter stream reach represented by IBI results.

Response: The WQLS, in this case, as specified in the 2010 Integrated List and TMDL, is the 1st through 4th order streams in the 8-digit watershed. The response to Comment #38 below explains in more detail how an upstream waterbody can be impaired while a downstream waterbody is unimpaired. Biological impairment at the 8-digit scale is based on statistical inference from the results of the Maryland Biological Stream Survey (MBSS). MBSS uses a probabilistic monitoring design to select sites. The monitoring design is used to justify statistically-valid inferences at the 8-digit scale. The case-control methodology of the BSID is based on the MBSS sampling to allow for valid inferences to the 8-digit watershed scale.

Comment 32: Why is the stressor analysis based on benthic data collected only during 2002, the year of the drought of record in Central Maryland? An extremely dry period will results in lower scores for aquatic resources. As stated in III.a(f) of MDE's, Biological Assessment Methodology for non-tidal wadeable streams, currently under review: ***The IBI scores of stream sampling sites affected by excessive drought or intermittent conditions will not be used in assessment decisions. Other sampling sites influenced by low flow conditions may also not be used.*** The USGS reported on July 3, 2002, *streamflow and groundwater levels are showing the effects of the hydrologic drought that the region has been experiencing for at least 10 months* (U.S. Department of the Interior: U.S. Geological Survey, News Release; *Record Low Water Levels Show the Effects of Long-term Hydrologic Drought*, 2002).

Response: Maryland Department of Natural Resources did some research on the effects on the drought and biological conditions.

Information can be found at:

http://dnr.maryland.gov/streams/mbss/2002_pts.html.

A report was also written by DNR:

http://www.dnr.state.md.us/streams/pdfs/ea-05-1_data03.pdf.

Page 2-20 states:

"As a result of this period of low precipitation culminating in severe drought during 2002, it was expected that the abundance of fish and other aquatic organisms would be lower in 2003 than previous years. However, Sentinel Site CBI scores were not consistently low due to the drought and low flow conditions. At the same time, the drought did negatively impact a few sites in the Coastal Plain physiographic province. CORS-102-S-2002 and WCHE-086-S-2002 both went dry in the summer of 2002. In addition, MATT-033-S-2002 consisted only of a few standing pools and had the lowest FIBI score in the four years that it has been sampled. This illustrates that although the drought was widespread, only certain watersheds appeared to be adversely impacted during the drought."

Comment 33: Recognizing that the reference sites also experienced the same climatological conditions, stream baseflow is a function of not only precipitation, but also groundwater discharge that is specific to site geology type and structure, topography, soils, and a number of other physical factors. Was this considered?

Response: The biological metrics that constitute the IBIs are based on reference sites in the Eastern Piedmont and Highlands that are subject to the same variability in natural conditions that impact baseflow. Reference sites are distinguished by the fact that they are sites of minimum human disturbance, as measured by land use or other factors. The fact that stream baseflow at a site is a function of soils, topography, geology type and structure, and other physical factors are not taken into account in determining the IBI score at a site or in determining whether the IBI score indicates biological impairment. Biological assessment, however, is at the scale of the 8-digit watershed. That assessment recognizes that there is unexplained variability in the IBI scores across a watershed by taking into account the confidence interval on the percent of stream miles failing to support their aquatic life use. Natural variability in physical factors affecting baseflow is "noise" with respect to the "signal" of biological impairment at the 8-digit scale. See the response to Comment #35

Comment 34: The P load reductions are expected to result in improved IBI scores. Is that how the TMDL progress will be measured? If not, how will progress be measured?

Response: Progress towards water quality improvements in the watershed can be measured in many different ways. As the commentor suggests, one possible way is using IBI scores from future MBSS surveys. See also response to comment #29.

Comment 35: MDE's recommendation from their Biological assessment Methodology for Non-tidal Wadeable Streams, currently under review states, *that an average site IBI scores, based on a minimum of three consecutive years of data* be utilized. It cannot be assumed that a singular score is the distribution mean score, and that the distribution is normal. With such assumptions, the likelihood of type I error still remains high when the Minimum Allowable IBI limit (MAL) is used in place of available data. This assumptive and statistically insufficient data is misleading and decision makers utilizing this analysis are inadequately informed.

Response: The question at issue in the Biological Listing Methodology, Section III.b.4, is given that there is temporal variability in IBI scores, what is the appropriate target value or threshold to which an IBI score at a site should be compared to determine if it is impaired. If a threshold of 3 is chosen, then a minimum of three years of data from the site must be used to take into account temporal variability. Because it is not practical to sample repeatedly at a site, an alternative approach was taken which calculates the temporal variability (i.e. the distribution) of IBI scores of a site with an average IBI score of 3. The calculation of the distribution is based on coefficients of variation in IBI scores from sentinel sites, which are sites in good condition which are sampled every year for this purpose. The distribution in question is not of the site being evaluated but, in effect, the distribution of the threshold. This procedure is in accordance with EPA's guidance for taking into account temporal variability (EPA.2002.Consolidated Assessment and Listing Methodology: http://water.epa.gov/type/watersheds/monitoring/calm.cfm). The MAL represents the minimal detectable difference from an average IBI score of 3 for a single sample. Documentation of the biological listing methodology can be found at: http://www.mde.state.md.us/programs/Water/TMDL/Integrated303dReports/Documents/Assessment_Methodologies/Biological_AM-streams_2012.pdf.

Comment 36: Does a less than fair IBI mean that aquatic life is not being protected? Or does it/could it mean that in the specific location(s) where IBI sampling were completed, the local groundwater discharges is less than ideal, soils are erosion prone and substrate is impacted, etc. and the IBI scores may or may not be the result of eutrophication. The only data MDE has, DO, does not support the assertion. The statistical methodology, which may or may not be a valid scientific approach to cause/effect in this instance, does not necessarily support the assertion. Why is MDE imposing a regulatory burden on the County based on such a dubious scientific linkage?

Response: An IBI score of less than fair indicates degradation of biological communities in that stream reach. Degradation at any particular site can be caused by any one stressor or a multiple of stressors. Total phosphorus, orthophosphate, low dissolved oxygen, and low dissolved oxygen saturation was identified as having significant association with degraded biological conditions in the Upper Monocacy River watershed.

Comment 37 BSID states that 33% of biologically impacted stream miles are associated with high phosphorus. How did they get that percentage? Are MBSS stations associated with a certain number of stream miles, or is there some other method used?

Response: These percentages represent Attributable Risk (AR) or the percentage of cases with poor to very poor benthic or fish IBI impacted by the stressor. A grab sample cannot be divided into miles; instead, this theoretical AR value is used as a means of describing the more tangible concept of impaired stream length. Information on the statistical analysis and methodology can be found at:

http://www.mde.state.md.us/programs/Water/TMDL/Documents/www.mde.state.md.us/assets/document/BSID_Methodology_Final.pdf .

Comment 38: The CORE/TREND data and trend is in Table 7….where is that data available. It appears that this data indicates IBI is good to very good which indicates that upstream watershed is healthy and not having impact on aquatic ecosystem. Station MONO269 showed no change from the good/very good rating and Station MONO528 showed a moderate improvement. Why is the watershed then listed as impaired? If further monitoring identifies the upstream watershed as being impaired, then the TMDL should be specifically applied and written for the segments that are not supporting their aquatic life uses.

Response: In general, it is not valid to infer upstream water quality from downstream water quality, particularly if there are different types of ecosystems within a watershed. One type of ecosystem may be more sensitive to nutrient impacts than another. Aquatic biological communities differ according to the size and type of a given waterbody. The River Continuum Concept (RCC) is frequently invoked in explaining these differences in the case of free-flowing streams.[6] According to the RCC, a shift in biological community can occur when streams are roughly 3rd or 4th order in size. For example, in non-wadeable streams 4th order and larger, inputs or leaf litter and the shredder invertebrates that process them are not as important. Because the biological communities are different, the assimilative capacity for nutrients can also be different. Fourth-order streams approximately mark the boundary between wadeable and non-wadeable streams which also explains why different assessment methods are appropriate for the mainstem Monocacy River and the smaller 1st through 4th order streams in the watershed, and why the former can have good water quality while the latter are not supporting their Aquatic Life Use.

The Maryland Biological Stream Survey (MBSS) evaluates wadeable 1st through 4th order streams; the CORE/TREND program evaluates streams 4th order and larger which are not necessarily wadeable. The CORE/TREND program assessment methodology evaluates individual metrics and does not apply a combined IBI. Please see Friedman, E. 2009; "Benthic Macroinvertebrate Communities at Maryland's CORE/TREND Monitoring Stations: Water Quality Status and Trends;" Maryland Department of Natural Resources.CBWP-MANTA-MN-09-1, http://dnr.maryland.gov/streams/pdfs/12-332009-375_benthic.pdf, for additional information on the CORE/TREND program.

[6] Vannote, R. L., G. W. Minshall, and K. W. Cummins. 1980. The river continuum concept. Canadian Journal of Fisheries and Aquatic Science (37):130-137.