Appendix H. Responsiveness Summary

Lake Whatcom Watershed
Total Phosphorus and Bacteria
Total Maximum Daily Loads

Volume 1. Water Quality Study Findings

November 2008

Publication No. 08-03-024AppH

DEPARTMENT OF
ECOLOGY
State of Washington

Publication and Contact Information

This appendix is linked to the main report on the Department of Ecology's website at www.ecy.wa.gov/biblio/0803024.html

Data for this project are available at Ecology's Environmental Information Management (EIM) website www.ecy.wa.gov/eim/index.htm. Search User Study ID, WHATCOM.

Ecology's Study Tracker Code for this study is 02-051.

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Following are public comments the Washington State Department of Ecology (Ecology) received while the draft of this document was posted on the web (August 18 through September 17, 2008). Ecology responses to the comments are also provided.

Summary of Changes

Changes to the document as a result of public comments primarily reflect clarification. The section on bacteria was rewritten to be easier to understand. In the Watershed Description section, changes to hydrology are described, and justification for not considering boating activities is provided. A scenario evaluating the impact of reducing withdrawals and spilling additional water into Whatcom Creek was addressed.

List of Respondents

ID	Name of Respondent
COB	City of Bellingham
CT	Craig Thomas
DC	Dana Carpenter
FG	Fred Gustafson
JW	John Watts
MN	Merlin Noggle
BP	Barbara Parker
PFPS	People for Puget Sound
RM	Roger McMullan
TP	Tom Pratum
WH	Wendy Harris
WC	Whatcom County

Response to Comments by Group

There are broad categories (e.g. implementation, monitoring). Under the broad category a subcategory will collect like comments summarized by bullets. The respondent(s) that raised the issue will be listed by the respondent code(s).

Proposed Pollutant Allocations

Use of phosphorus loading and "Developed Acres"

Comments

- Flow reduction is a surrogate for P-removal (COB)
- Use mass/time and not "developed acres" (WC)
- "Developed acres" is too crude because it varies by location and between new and old development (WC)

Responses

When forest is removed, the functions that are lost are storage and infiltration. Both functions reduce peak flows in the creek and increase baseflows. Peak flows which cause streambank erosion are represented with greater uncertainty in the HSPF model, but it is clear that more natural hydrology will reduce the loading associated with streambank erosion as well as the loading associated with excess flow. However Ecology recognizes merely reducing flow without addressing concentration will not be sufficient.

Because of the variability of phosphorus loading over time and space, a more readily measureable surrogate would be appropriate. As noted in the report, the selection of an appropriate surrogate will have to be made after consideration of those actions that are proposed for implementation. The purpose of proposing the "developed acres" surrogate at this time is to provide an illustration of the impact of development without nutrient controls and guidance on a possible approach to implementing the TMDL. It would also be possible to establish the TMDL using the mass/time of phosphorus and then develop interim goals using other measures. But it will be necessary to establish some measure that can be readily used to ensure implementation is progressing appropriately.

If land covers are available that differentiate between old development with poor nutrient controls and new development with highly effective nutrient controls, it would be possible to assign new development a discounted impact. That is, the model could account for the benefits of native vegetation retention and other best management practices, essentially reducing the acres that are considered developed acres in newer development.

The final allocations will be made based on the choices made by the city and county about how development in the future will change and how existing development will be changed. Those new approaches will be used to develop the loading to the lake that will form the basis of the final TMDL allocations.

Implementation Suggestions

Alternative drinking water suggestions

Comments

- Better water treatment was suggested (RM)
- Move intake to Basin 3 (verbal)
- Draw water from Baker Lake or other alternate source (newspaper blog)

Responses

The use of the lake as a drinking water source was a factor in making this project a high priority for Ecology to address. But the water quality standards demand that all uses must be supported. Even if Lake Whatcom were no longer used as a drinking water source, the lake needs to be protected for fish and other aquatic life, and for the aesthetic qualities that it provides. Decisions

regarding alterative treatment for drinking water or alternative sources of source water are beyond the scope of this study and do not alter the conclusions.

In-lake treatment alternatives

Comments

- Install a blower to aerate the lake (FG)
- Adjust lake levels to reduce erosion (BP)

Responses

Whole lake treatment has historically not been a sustainable practice on a large scale. Introducing oxygen to the hypolimnion needs to be done without breaking stratification or additional nutrients would be released. This makes the cost for treating entire lakes prohibitive. However if either the city or county can make a credible case that one of the in-lake treatment options can be sustained, it can be considered as a part of the implementation package.

The water budget of the lake in the summer is largely controlled by water availability and water use. In most years, the lack of water in the Middle Fork of the Nooksack available for diversion to Lake Whatcom causes the drop in lake level. Water conservation will reduce the lowering of the lake surface somewhat. In the winter, the lake level is lowered to provide reserve storage to avoid flooding of Whatcom Creek during storm events. The maximum height at which the city can manage the lake surface is set by a court settlement. The constraints of water budget, need for flood storage, and court settlements restrict the ability to manage lake levels

Other specific implementation suggestions

Comments

- Recognize that storage and infiltration will not work in all locations (for example, because of high phosphorus in groundwater), and other strategies are needed (WC)
- Limit/eliminate development, impose moratorium (MN, RM)
- Include flow reduction as phosphorus-removal strategy (COB)
- Sewering appears to help other lakes, could it help Lake Whatcom? (CT)
- Ban gas-powered boats (RM, MN)

Responses

These specific suggestions on how to implement the TMDL will be passed on to the local governments for their consideration.

Although storage and infiltration of stormwater is likely to be a significant part of TMDL implementation, Ecology recognizes that a variety of other tools are available that may also help reduce phosphorus and that different situations will call for a different set of tools.

A moratorium is a temporary measure. Local governments will need to consider if such a measure is necessary prior to establishing the regulations that will last into the future.

Where septic systems have failed for existing development and suitable alternatives do not exist, extending sewers into rural areas has alleviated problems with sewage disposal. Septic systems that are properly sited, designed, constructed, and maintained are an appropriate way to dispose of sewage. Extending sewage collection systems is limited under the Growth Management Act to prevent sprawl into rural areas.

The primary water quality impact on the lake from gas-powered boats is through exhaust gasses. The lake is not currently listed for primary gasoline constituents or combustion by-products. Phosphorus in unleaded gasoline is limited to 0.005 grams per gallon, or approximately 0.002 g/kg, making it a very minor contributor. Because both Whatcom County and the City of Bellingham have prohibited two-stoke engines using carburetors, and the short duration of the boating season on Lake Whatcom, it is believed the contribution of phosphorus from boating activity is not significant. If further study shows the contribution to be significant, Ecology, the city, and the county can take additional action.

General implementation comments

Comments

- How to implement the TMDL should be included (WH)
- Wants to participate in development of implementation plan (WC)
- Recognize and work with the City on a wide range of phosphorus-reduction methods (COB)
- Resources on what to do should be included (JW)
- Emphasize a unified watershed approach for restoring the lake (WH)
- Describe the consequences of inaction (JW)

Responses

The TMDL implementation plan will be developed collaboratively with Ecology and the local governments. Local governments will have front-line responsibility for the implementation, so they must be involved. This report sets the goal to help determine how much needs to be done. Ecology needs to allow local governments to propose how they will accomplish the goals. The suggestion to use developed acres as a surrogate focuses implementation on restoring natural hydrologic functions in the developed areas of the watershed; however, the local governments will select how the TMDL goal in their jurisdictions can be met.

The purpose of this report is to present the technical analysis and establish the goal which local governments must meet. Information on how to implement the TMDL will be included in the final TMDL submittal report and in a Detailed Implementation Plan that will follow.

Ecology is prepared to help local governments select appropriate implementation measures. Ecology recognizes that (1) there are other strategies besides the restoration of natural hydrologic functions to achieving the TMDL goals, and (2) sites around the watershed differ. Both the city

and the county have extensive knowledge that will be important to identify appropriate locations for implementation of the different best management practices (BMPs). The historic cooperation around management of Lake Whatcom provides promise that a unified strategy across jurisdictional boundaries will be in place to the extent that it is practical.

The purpose of the TMDL is to meet the requirements of state and federal law to correct water quality impairments, but more than that, Ecology wants to work with local governments to solve real water quality problems. If no action were taken to implement a TMDL and control phosphorus loading to the lake, continued deterioration of the lake will occur. This could lead ultimately to conditions that make use of the lake for drinking water, recreation, and fisheries difficult, such as blue-green algae blooms and fish kills.

Implement existing laws and new regulations; describe responsibilities, incentives, and penalties

Comments

- Other state and federal laws must be enforced (WH)
- Because the TMDL documents the limits of Best Available Science, the potential violation of the Growth Management Act should be recognized (WH)
- Citing a list of possible incentives and penalties applying to residents, based upon what has worked/not worked elsewhere, could help local governments with implementation (JW)
- Ecology should recognize interests who impact the lake other than the City (COB)
- Cooperation is good, but City and County responsibilities need to be clearer (COB)
- Focus should be mainly on load reductions and other improvement strategies, less on TMDL compliance (COB)
- Note challenges in areas already developed and focus of new regulations on new development (WC)

Responses

It is acknowledged that many of the impacts humans have on the environment can be minimized through enforcement of existing laws. Ecology expects compliance with existing laws to be enforced but acknowledges that some non-compliance will always exist.

This TMDL study and subsequent lessons from TMDL implementation will add to the body of knowledge that guides plans developed using best available science. As those plans are updated, the lessons learned will be incorporated. In this way we will stay in compliance with the Growth Management Act.

Ecology has shared with local government staff lessons we have learned from our own experience and from the experience of other local governments. This will continue as we develop the implementation plan and as we implement the TMDL.

Ecology is required to provide *reasonable assurance* that pollutant loading from the nonpoint sources will be reduced to meet TMDL targets, if the expectation of such reduction is used to

establish wasteload allocations for the point sources. This requirement is discussed in more detail in the section on Process for Determining Load and Wasteload Allocations.

The loading targets established in this TMDL are predicated on reducing the pollutant loading from human activities throughout the watershed. The portion of the allocation that is covered by stormwater permits (wasteload allocations) is therefore dependent on reductions from the privately owned areas outside of the city and county stormwater collection systems (load allocations).

Ecology recognizes that there are limits to what both the city and county can do to guarantee changes to existing privately owned development. However, the local governments have the best tools for providing the reasonable assurance that reductions from nonpoint sources located within their jurisdictional boundaries will be met through their land use control authority. The assumption that the city and county will use these tools by passing ordinances that require BMPs or treatment of discharges from private storm drainage systems is considered an essential part of the reasonable assurance that nonpoint source reductions will be accomplished.

The TMDL technical study does not separate city and county allocations. However each will be responsible for meeting reductions. The distribution of allocations will have to be based on the projected future development. The city, the county, and Ecology will have to work together to define that projected future development.

Ecology recognizes that improving water quality is the goal. That is why we will work with local governments to develop an implementation plan that will ensure that TMDL compliance will achieve water quality improvements. However, to have a TMDL approved by EPA, Ecology must submit a TMDL that meets Clean Water Act requirements.

Ecology acknowledges that there are difficulties with existing development. However focusing only on new development will not address the impairment that has been caused by existing development. The two rollback scenarios demonstrate that existing development must be reduced more if additional development is to be accommodated.

Effects of forest practices

Comments

- Clear cuts not significant source (TP)
- Natural conditions are not the same as managed forest (verbal)
- Study does not account for impacts from clearcuts (CT)
- Study incomplete due to focus on cleared land (CT)
- Logging has caused loss of fish habitat (BP)

Responses

Ecology acknowledges that a natural forest would have less impact than a commercial, managed forest. However, the difference between a managed forest and a natural forest is very small

compared to the difference between developed area and a forest. Therefore most attention has been focused on developed land. The managed forests are evaluated on a basin scale, and the effects of parcel level details are not apparent.

Ecology worked with Washington Department of Fish and Wildlife to determine what data would be necessary to document that the streams tributary to Lake Whatcom should be listed as impaired for the loss of fish habitat. The necessary data have not been submitted. The Lake Whatcom TMDL was not designed to address fish habitat.

Monitoring

Monitoring to refine models and document success

Comments

- Suggest next steps for additional monitoring (JW)
- Monitor sediments for toxics if sediment monitoring is conducted (PFPS)
- Monitor reductions in toxics from the watershed as part of TMDL implementation (PFPS)
- Identify sources of toxics in the watershed if monitoring doesn't show reductions (PFPS)
- Agree with better monitoring and want to partner on that effort (WC)

Responses

As identified in the Adaptive Implementation section, there are many areas of uncertainty that can be reduced with additional study. Those areas are described in the report. Specific details like sampling locations or frequency are best addressed through Quality Assurance Project Plans for any monitoring. It is expected that both Whatcom County and the City of Bellingham have an interest in continuing their monitoring programs and coordinating with Ecology on any new monitoring.

It is likely that the monitoring and modeling for this TMDL can help with future efforts to control toxic compounds. Ecology encourages the county and city to address toxics issues in their monitoring plans. As noted in the report, addressing impairment due to toxics will likely proceed through different approaches other than the TMDL program.

Uncertainty

There is sufficient information to move forward

Comments

- Don't delay implementation (RM)
- Need to refine model during implementation (COB)
- Retain clear language connecting development with phosphorus loading (WH)

Responses

The Clean Water Act requires TMDLs to move forward in the face of uncertainty using the best available information. Uncertainty can be addressed either through a more stringent margin of safety, or though adaptive implementation. Ecology believes the phosphorus reductions needed are large enough that implementation should proceed focusing on the readily available approaches. On a separate track, model refinement should also proceed, but not at the expense of phosphorus-reduction efforts.

Ecology believes the connection between development and land-use practices and phosphorus loading to the lake is a critical element of this TMDL, and makes every effort to explain that connection clearly and accurately.

More detailed information is needed to address areas of uncertainty

Comments

- Changes in fish species have changed algal consumption and composition (BP)
- The lake was better when Georgia Pacific was using more water because it flushed the lake – effect not included (BP,DC)
- Need to identify phosphorus pathways (WC)
- Phosphorus infiltration, subsurface, and groundwater processes poorly understood (WC)
- Relationship between land uses and phosphorus loading is poorly understood. (WC)
- Relationship between pervious developed area and impervious area needs better definition (WC)
- Address uncertainty before submission to EPA (WC)
- Need to refine model before implementation (WC)

Responses

The scope of this study did not allow investigation of fishery species changes and the impact on water quality. Nonetheless, available fisheries information (http://lakewhatcom.wsu.edu/display.asp?ID=33 for example) does not indicate that fisheries management practices are likely to be impacting lake water quality.

Withdrawals from the Georgia Pacific (GP) mill over time have been analyzed and a discussion added to the report. Before GP reduced their water demand, the city had agreed to voluntarily keep enough water in the Middle Fork of the Nooksack River to support salmon. If GP had continued to demand the high levels of water they had in the past, the lake surface would have been much lower. However, their demand decreased shortly afterward. In the period that is being modeled, GP did continue to use considerable quantities of water (about 2/3 of what the rest of the city used). The only additional flushing that is really feasible is to reduce water consumption and increase flows in Whatcom Creek from the lake.

The model was run to examine the question: What if GP had shut down prior to 2002, and the water they had used was spilled over to Whatcom Creek? The change was very small. There

was about a 0.02 mg/L increase in dissolved oxygen at oxygen levels below where the Base Scenario is deficient. For comparison, the Base Scenario requires additional 1.07 mg/L oxygen to meet criteria in the same range.

Concerns about the linkage between development and phosphorus loading were raised. It is true that the pathways are not completely understood and there may be some refinements possible. The relative contribution of impervious surface and developed pervious surface was also questioned. The data to make a more refined separation of the sources and more refined model of the pathways are not available. The model used best estimates to separate residential developed area into pervious and impervious. The model was calibrated to measured values near the mouths of the streams where all sources are mixed. The results are in the expected range for each land cover, and cumulative tributary values are within the range of measured values.

Other suggestions for improvement in the analysis have been presented. Although there is technical merit to the suggestions, they are beyond the scope of the current TMDL technical study. The existing models have been demonstrated to be well developed using credible data and are adequate for TMDL development. The Clean Water Act and EPA regulations are clear about the need to move forward with the best available evidence. Uncertainty in modeling is generally addressed by a margin of safety, and in this report the margin of safety is linked to adaptive implementation. The proposed modeling enhancements may be addressed in the future as part of development of final TMDL allocations or of implementation, depending on the availability of funding, time, and other resources.

The knowledge gained in recalibrating the model and examining the areas of uncertainty that remain indicates that aggressive implementation will be required. The implementation necessary is so aggressive that over the next decade all resources available will be necessary. If the TMDL targets were considerably less stringent or more stringent, the same resources would still be necessary. At the end of the first decade of implementation, we will be in a much better position to refine the models and reevaluate how much more work will be necessary to complete implementation.

Delaying implementation of the TMDL exposes Lake Whatcom to the risk of an irreversible downward slide. As noted, a significant source of phosphorus is released from sediments during the period when the hypolimnion is anoxic. This sets up a positive feedback loop. Phosphorus released from the sediments fertilizes the lake making it more productive. This increases the rate at which oxygen is depleted after the lake stratifies. Currently this phenomenon is primarily active in Basin 1 and 2, a relatively small volume of the lake. If the lake were to decline to the point where it was a major factor in Basin 3, the lake may take much longer to recover.

Need better understanding of uncertainty

Comments

- Describe how Hydrolab DO variations were taken into account (WC)
- Describe Regression information (WC)

- Were lake sediments collected, and what uncertainty does lack of lake sediments cause? (WC)

Responses

Hydrolab dissolved oxygen (DO) data were used in the calibration, but DO is but one of many parameters to which the model was calibrated. DO does vary considerably over the course of a day, and near the metalimnion it may vary quite significantly over shorter periods. The purpose of the comparison of the DO measurements to DO predictions is to ensure the general pattern is reliably predicted. The model was calibrated to a very large data set of DO values, so the overall pattern of DO was captured, and variability around any given data point was minimized.

Also, the method of comparing two model scenarios using the difference between two cumulative DO volumes puts more emphasis on the changes in DO due to loading than on the absolute DO values. Since the variability in DO results is similar in both model scenarios, the variability around the differences between the distributions of results will be relatively small. The regressions were only used for parameters other than phosphorus which have little effect on model results. Therefore, a detailed analysis of the variability of those regressions isn't warranted. Appendix G shows all the statistical measures of variability for any reader interested in those matters.

Lake sediment samples were not analyzed for the water quality study, and direct measurements of sediment decay or nutrient release rates were not made. However, water column nutrient concentrations are affected by the nutrient flux from the sediments, and the model's ability to replicate water column nutrient data is due to accurately simulating this flux and sediment nutrient concentrations. Therefore, uncertainty in sediment concentrations, decay rates, or nutrient fluxes to the water column is small, because the values chosen need to accurately predict water column nutrient concentrations.

More modeling is needed using additional existing data sets

Comments

- Need to run model(s) for additional period of time (one more year, or through 2007) for validation, account for inter-annual variation, incorporate new data (WC)
- Need to run another model as a check (WC)
- Need sensitivity analysis, for example with wind-sheltering (WC)

Responses

Simulating additional calibration years is always desirable in terms of helping build confidence in the model as a tool. The expected benefit from simulating another year must then be balanced with available funds for the effort. Ideally, the model would be calibrated for a large number of years (equal to or greater than the residence time of the lake), but for this study there were not enough time and resources available. The CE-QUAL-W2 model does a reasonable job of predicting lake conditions for the two calibration years. Even though an additional calibration

year may increase the effectiveness of the model, to significantly improve the model many additional years would have to be calibrated. This would require additional data on land cover conditions; these data are not available at this time.

Lake Whatcom is a complex system, as the development of the CE-QUAL-W2 model has shown. It would not be useful to run a simpler model to compare results. It is highly unlikely that a simpler model would provide the same results, and any differences would be difficult to interpret. It is difficult to imagine how a simpler model could show how to improve a more complex model. Therefore, the additional expenditure of time and resources to run and evaluate a second model is not justified. Since Ecology does not concur with this suggestion, it is not referenced in the report.

Wind is one of the most critical factors in calibrating a hydrodynamic lake model. Wind strength and direction control the depth that surface energy penetrates the lake. Unfortunately, wind conditions at the lake's surface are also a factor for which we have relatively poor information.

Wind sheltering coefficients were set for extended periods of time as part of model calibration. These are the coefficients that are necessary to set up the metalimnion at the correct depth. A rule that would predict wind sheltering coefficients based on season or other factors has never been apparent. For the period modeled, these are the best estimates of the appropriate wind sheltering coefficients. Additional data collection may help find a rule to predict wind sheltering coefficients, but the variability seen over the lake does not provide much promise. A sensitivity analysis at this point would provide little useful information, as actual wind velocity is not controllable and the selected values match with the metalimnion depths.

A full sensitivity analysis can be resource-intensive, especially for models as complex as HSPF and CE-QUAL-W2. For that reason, comprehensive sensitivity analyses have not yet been conducted for these models. However, if resources become available in the future, sensitivity analysis could be a useful tool to better understand the models and the watershed and lake processes contributing to lake dissolved oxygen dynamics.

Uncertainty about sources because of the scale of analysis

Comments

- Study focuses too much on development (DC)
- Study does not consider septic, leaking Sudden Valley sewer, pet waste, clear cuts, landslides (CT, DC)
- Analysis should include relations between phosphorus, land use, soils, and slopes at a smaller scale (WC)
- Mixed Forest is not an adequate definition for Historic Conditions because of sub-basin differences (WC)

Responses

The focus on development comes as a result of the study, not as an assumption. The study design itself looked at nutrient concentrations in the tributaries and their impact on dissolved oxygen in the lake. Sources other than residential and commercial development were taken into account, such as industrial activities and agriculture, but the Lake Whatcom watershed has few of these kinds of sources. The phosphorus loading from different land uses were determined from scientific literature and then adjusted to Lake Whatcom conditions through the model calibration process. The answer that resulted from the analysis was that the primary source of phosphorus loading in the Lake Whatcom watershed are human activities in developed areas.

In the models that are used to generate the phosphorus loading estimates, individual actions and sources (such as septic systems, leaking sewers, and pet waste) are not evaluated. They are however integrated as part of the land cover sources through the calibration process. As part of developed land, there will be some leaking sewer, some failing septic systems, and some problems with pet waste disposal. As the TMDL is implemented, sources associated with runoff processes will be mitigated. Diligent enforcement of other laws will be necessary to control other sources. Landslides occur on a timescale longer than the timescale addressed by the models in this study.

No significant landslides occurred in 2002-2003 and so are not included in the model. It is recognized that the Lake Whatcom watershed under both natural and managed conditions is subject to landslides. The prescriptions of watershed analysis for all lands, and of the landscape plan for lands controlled by DNR, are sufficient to ensure the change in landslide frequency and intensity is not significant.

The scale of drainage areas was selected as part of the Quality Assurance Project Plan process. Whatcom County and the City of Bellingham participated in that process. Early in the process, the selection of models was discussed at a joint meeting, and it was agreed that the project would use the drainage basin delineation defined by the WRIA 1 Watershed Management Project.

The selection of HSPF as an alternative model represents a refinement from the proposed multiple linear regression at drainage scale. HSPF simulates different drainages than those defined by the WRIA 1 Watershed Management Project, which allows the use of more uniform soils and slopes within each model unit. The HSPF results were translated into the WRIA drainages to allow input into the lake model.

The definition of historic and future land cover was also defined through the 1 Watershed Management Project. Results for Mixed Forest do vary across the watershed based on soil and precipitation.

Over time, additional data may be available to help refine the models, and evaluation of smaller scales may be indicated.

Bacteria Issues

Fecal coliform bacteria analysis

Comments

- Can the fecal coliform section be user friendly for laypeople? (WH)
- Variability in bacteria levels makes "measurably increase" difficult to discern (WC)
- How are low geometric means consistent with source control? (WC)
- Use microbial source tracking for bacteria (WC)

Responses

The sections of the report regarding bacteria were revised for clarity. The sentence referring to "measurably increase" has been deleted since it is not relevant to this study.

Bacteria source control will reduce the geometric mean of measured levels. The draft report language regarding this point was confusing and has been revised.

Microbial source tracking is a potentially useful tool to help identify sources of bacteria. The field is developing rapidly, and Whatcom County and the City of Bellingham are encouraged to use the tools that will best help them meet TMDL targets.

Editing Suggestions

Text revision suggestions

Comments

- Executive Summary and Figure ES-2 should refer to EPA's Massachusetts study (WC)
- Define "developed acres" clearly (WC)
- Amend Table 5.5 to include external loadings? Explain better interaction of internal and external loading (WC)
- Explain why loads from pervious developed acres are higher than from impervious developed acres (WC)
- Example referring to "road or roof" seems to contradict higher loading from pervious development (WC)

Responses

The report has been revised to improve clarity in the areas noted. Text has been added to describe the relationship of external and internal loading (watershed sources versus sediment phosphorus release), and external loading rates have been added to Table 5.5 (numbering from draft report) as a point of comparison. Discussion of the differences in phosphorus loading between impervious and pervious developed areas has been added.