Lake Winnipesaukee Watershed Management Plan

Phase I: Meredith, Paugus, Saunders Bays

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1. What is phosphorus?

Phosphorus (P) is a naturally occurring element and a major nutrient required for biological productivity. It is found in all living plants and animals, including people. It is present in soils, especially topsoil. Although its existence is widespread in nature, it may not be *naturally* abundant. Phosphorus is usually the limiting nutrient in most New Hampshire freshwater ecosystems and therefore a necessary nutrient for aquatic productivity. Algae and cyanobacteria are free-floating aquatic organisms whose growth is usually phosphorus limited.

2. Why is phosphorus a problem?

Increased P levels in freshwater, along with other environmental conditions may result in increased biological productivity, causing increased phytoplankton and cyanobacteria cell production in the water column. This can cause:

- Decreased water clarity
- Increased Chlorophyll a levels
- Increased turbidity levels
- Accelerated lake eutrophication
- Decreased oxygen concentrations
- Undesirable shifts in relative abundance of aquatic species

Increased levels of P in freshwater *may* result in:

- Decline in property values
- Economic loss from decline in tourism due to decline in water clarity
- Public health risk due to potential of increased occurrence of cyanobacteria blooms
- Decline in swimming, fishing and boating use
- Increase in public expenditures to address water quality impairments

3. What are potential sources of phosphorus?

Phosphorus loading is accelerated through human activities in the watershed. Human and animal waste, residential and agricultural fertilizers, and atmospheric deposition are the major sources of P. P is found in organic and inorganic ("orthophosphate") compounds. It is bound in soil by adhering to the surface of soil particles. Erosion and sediment transport, including eroding streambanks, roadway runoff, and exposed soil on construction sites are all potential phosphorus sources. High intensity rain events result in untreated stormwater transported from the land and the road network to storm drains and catch basins which discharge directly and indirectly to surface waters.

4. Is there a State Standard for Phosphorus?

In New Hampshire, designated uses and the water quality to protect those uses are regulated through the Water Quality Standards, which include RSA 485-A:8 - the Classification of Water, and Env-Wq 1700 - the Surface Water Quality Regulations. RSA 485-A:8 establishes that all New Hampshire surface waters are classified as either Class A or Class B waters, and specifies certain minimum surface water quality criteria for each classification. The Surface Water Quality Regulations further protect and maintain New Hampshire's waters through the identification of designated uses, antidegradation provisions, and

additional numeric and narrative water quality criteria. The designated uses for New Hampshire waters are:

1. Aquatic Life
2. Fish and shellfish consumption
3. Drinking water supply
4. Primary and secondary contact recreation (swimming and boating)
5. Wildlife

The State of New Hampshire has set water quality standards for nutrients based on the aquatic life designated use of the waterbody. The total phosphorus and chlorophyll a criteria for supporting aquatic life designated use are:

TP and Chl a Criteria for Aquatic Life Designated Use

Trophic State	TP (ug/L)	Chl a(ug/L)
Oligotrophic	< 8.0	< 3.3
Mesotrophic	<= 12.0	<= 5.0
Eutrophic	<= 28	<= 11

5. How is Lake Winnipesaukee classified?

Lake Winnipesaukee is currently legislatively classified as a Class B waterbody and biologically, categorized as Oligotrophic (low productivity) and identified as high quality water per NH Department of Environmental Services (NHDES). Antidegradation provisions apply to high quality waters.

6. How was the state standard derived?

For specific information on how the State Standard of 8 ug/L for Oligotrophic lakes was derived, please refer to the NHDES website at http://des.nh.gov/organization/divisions/water/wmb/wqs/index.htm where you can find the "Assessment of Chlorophyll-α and Phosphorus in New Hampshire Lakes for Nutrient Criteria Development" document. It is listed as the second PDF under the Publication section at the top of the page.

7. Why are the communities being asked to set local water quality goals for phosphorus?

One of the primary concerns of the Lake Winnipesaukee Watershed Management Plan is phosphorus loading from the land into the lake and its impact on lake water quality. One of the difficulties of discerning problems with excess P loading for Lake Winnipesaukee is that, due to its size and volume, in-lake effects of P loading like reduced clarity and algae blooms are slow to appear. It is clear from data collected primarily by UNH LLMP that P levels are generally increasing lake-wide, and this should be cause for action. These long term trends are likely to continue unless cities and towns in the lake's watershed act to adopt land use best management practices that reduce P loadings to the lake.

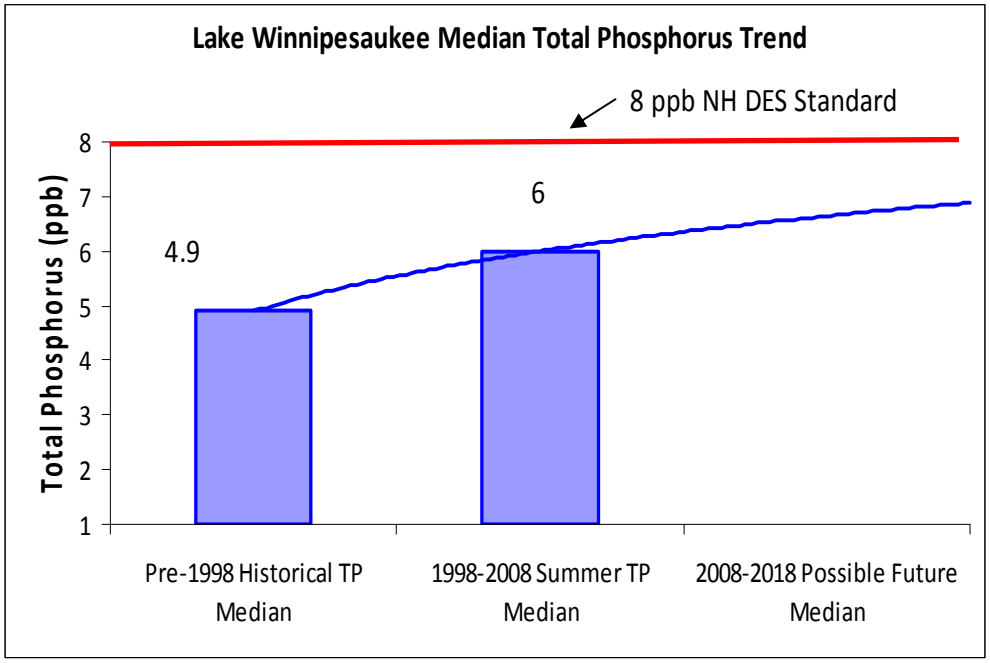


Figure 1: Long term trend analysis of phosphorus data for Lake Winnipesaukee

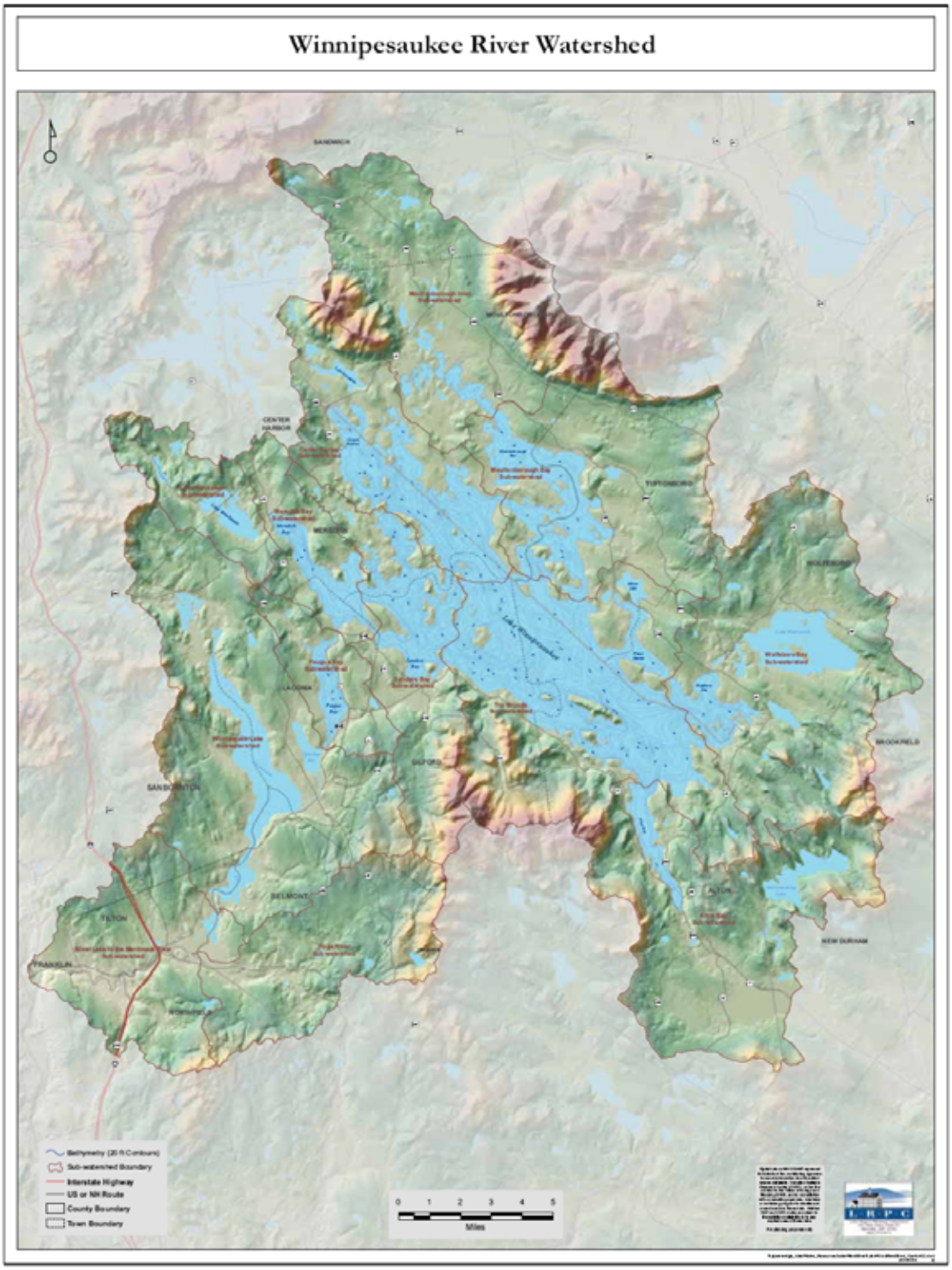
An objective of the plan is to establish local water quality goals for phosphorus for each Lake Winnipesaukee Assessment Unit (AU) that either meet or exceed the State Standard for phosphorus, in order to protect the water quality health of Lake Winnipesaukee for the long term. In general, local water quality goals could be no increase in-Lake P concentration, no increase that would violate state water quality criteria, or something in between.

8. What is an assessment unit?

Assessment Units (AU) are the basic unit of record for water quality assessments that use all available data to report on if a waterbody is meeting standards . Rivers and streams, lakes and ponds, and wetlands, and segments or sections thereof, each have individual assessment unit IDs. Water quality is tracked by assessment unit for the purpose of reporting to the public.

9. How many assessment units are there for Lake Winnipesaukee?

Currently Lake Winnipesaukee is listed as one assessment unit; however, beginning with the next assessment period (2012), Winnipesaukee will be divided into 10 assessment units (AU).



10. What is antidegradation?

Antidegradation is a concept embodied in the Clean Water Act that essentially says that impaired waters cannot be further degraded and establishes limits to allowable degradation of waters that meet water quality standards. For information regarding antidegradation provisions, refer to the NHDES Fact Sheet

WD-WMB-23 "What is Antidegradation?" at:
http://des.nh.gov/organization/commissioner/pip/factsheets/wmb/documents/wmb-23.pdf

11. When towns are asked to adopt a water quality goal for phosphorus, what does that really mean from a practical and legal point of view? Does NHDES have criteria or approval protocols that a town must follow to make an official designation?

The state phosphorus nutrient criterion of 8ug/L applies to all oligotrophic lakes. If a waterbody does not meet this criterion, it is considered impaired. Therefore, a local water quality goal set by the towns should, at a minimum, meet the state phosphorus nutrient criteria. Another, more protective option would be for a town to request designation of Lake Winnipesaukee or one of its Assessment Units as a high quality water of special significance under antidegradation rules. This is explained further below.

It makes sense that municipalities set a goal to preserve their high quality waterbody by setting water quality goals more protective than the nutrient criteria. For example, instead of setting the in-lake phosphorus concentration goal at 8ug/L (the state nutrient criterion for oligotrophic lakes), the municipalities may want to set a water quality goal of 7ug/L. Even though the municipal water quality goal is 7ug/L, the state nutrient criterion of 8ug/L remains. Once a water quality goal is set, an in-lake phosphorus concentration of 7.2 ug/L, for example, would convey that the town water quality goal was not met and the local specifications and requirements for best management practices developed to achieve the water quality goal should be re-examined. A waterbody (Assessment Unit) would only be identified as impaired, and subject to the regulatory requirements for impaired waters when it does not meet the state criteria.

Under state water quality standards (WQS), there are two "enforceable" setpoints. One is the nutrient criteria (8 ug/l for oligotrophic assessment units), the other is antidegradation. Under antidegradation, no individual discharger or project can use more than 20% of the remaining assimilative capacity of the lake. In addition, if the lake or a lake Assessment Unit is designated by DES as being a high quality water of special significance, it would mean that, for the purposes of antidegradation, all projects proposing to increase phosphorus loading would be considered "significant" projects under the antidegradation rules. This means that they would need to perform an alternatives analysis for lesser polluting alternatives, an economic and social analysis to justify the increase in phosphorus loading, and would need to solicit public input.

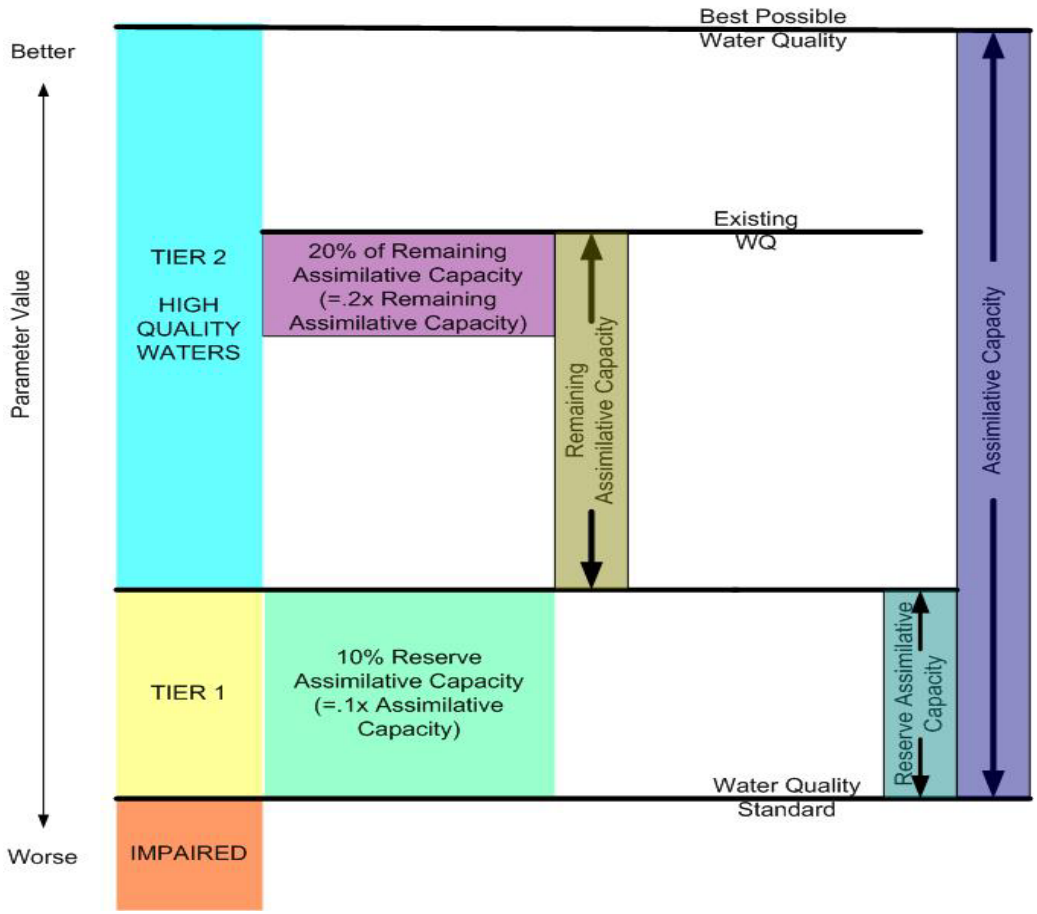
Although the rules are in place, DES has not developed official protocols for designating a high quality water of special significance. Maine provides similar designations that may be used as a model to allocate a certain amount of increased phosphorus loading to landscape change, and keep track on a watershed basis.

12. What data or information do the communities need to set a local water quality goal for phosphorus?

a. Assimilative Capacity Analysis (NH DES has created a Standard Operating Procedure (SOP) for this analysis for high quality waters projects)

Assimilative Capacity (AC) for Total Phosphorus (TP)
Total AC = (Water Quality Standard (8 ug/L TP) - Best Possible WQ (0 ug/L) = 8.0 ug/L TP
Reserve assimilative capacity = 0.10 x Total AC = 0.8 ug/L P
Remaining assimilative capacity = Water Quality Standard - Existing WQ – Reserve AC

CONCEPTUAL DIAGRAM FOR TIER 1 AND TIER 2 WATERS ESTIMATION
(not to scale)



	Median WQ (ug/l)	Reserve AC (ug/l)	Remaining AC (ug/l)
Tier 2: High Quality Waters	**0.0 - 7.2**	**0.8**	**>0**
Tier 1:	**7.2 - 8.0**	**0 to 0.8**	**0**
Impaired:	**> 8.0**	**0**	**< 0**

b. Current water quality data – how good is the data?

All water quality data used in the analysis has been entered in the NH DES Environmental Monitoring Database (EMD) and has been through quality assurance/quality control procedures.

c. Options for a local water quality goal for Phosphorus:

Set the local goal equal to the State Standard of 8 ug/L
Set the local goal equal to the current median P value of the assessment unit
Set the local goal lower than the current median P value but less than 8 ug/l

13. If towns set a goal for P at a level lower than 7.2 ug/L - who/how is it enforced? State? Town?

The communities are setting water quality goals, not a water quality standard to be enforced by NHDES. Nutrient water quality criteria by trophic class have been developed and will be used in determining if the waterbody meets state standards and if a violation of state water quality standards has occurred.

There is neither state enforcement of the municipality "goal", nor local enforcement unless such measures are adopted in local land use regulations, together with best management practices to meet the goal. For example, prior to issuing a development approval, the municipality could require a phosphorus loading determination and require best management practices to be built into the development design to reduce P loading so that the phosphorus goal is not exceeded.

14. Are the communities responsible for monitoring the phosphorus level in the assessment units?

No; however, if the communities set local water quality goals, then they should monitor water quality to track changes in phosphorus levels. They could do this by continuing to participate in volunteer monitoring programs with technical assistance from the state. The watershed management plan also requires some method of evaluating and monitoring results from implementation of best management practices or restoration projects.

15. If the communities choose to set up a monitoring program:

- **How many sites need to be monitored for adequate representation of the AU?**

  Single sites established at the deep spot within each of the newly designated Assessment Units will be adequate for making assessments according to the DES Consolidated Assessment Listing Methodology (CALM). Details on the CALM can be found at: http://des.nh.gov/organization/divisions/water/wmb/swqa/index.htm

- **How often should a site be sampled?**

  Weekly sampling for chlorophyll-a is recommended by the UNH Lakes Lay Monitoring Program, and biweekly sampling for phosphorus.

- **What is the sampling period?**

  Phosphorus data obtained for the period of May 24th through September 15th is used to determine the summer median value of in lake phosphorus.

- **What is the depth sampled?**

  Samples are collected from the epilimnion (upper surface layer) during stratified conditions within each assessment unit/subwatershed basin.

- **How many data points are needed to determine the in lake Phosphorus concentration? And over what time period?**

  At least five data points are required during the index period (May through September). As long as there are 5 samples collected on different dates at any time within the index period - that will be sufficient for making an assessment. However, 5 samples collected in June will not statistically reflect P conditions for the summer months. May and June P results are likely being influenced by hypolimnetic P mixing.

- **Are data from shallow site stations included in the determination of in lake P?**

  In general, no. Only samples and the corresponding data collected from the epilimnetic layer at the deepest point of the lake are used in determination of the median P value. During the stratified season on Lake Winnipesaukee (May through November?), three distinct layers of water are

established within the lake. The upper layer or epilimnion, the middle layer (metalimnion or thermocline), and the bottom layer (hypolimnion) become established when water temperatures increase during the late spring and summer. The significant temperature differences between the epilimnetic, metalimnetic, and hypolimnetic layers create density barriers between each layer that limits water mixing from layer to layer. The barriers between the three thermal layers in lakes reduce phosphorus mixing throughout the water column during the stratified season. Therefore, when sampling lake phosphorus at the deep spot from the epilimnion is considered to be representative not only of the surface waters over the deepest point in the lake, but also representative of the shallow sites along the entire shoreline. Waters of the epilimnion are constantly circulating and mixing throughout the stratified season and although there may be isolated concentrations of nutrients near tributary inlets, or adjacent to land use practices that contribute runoff, the phosphorus will circulate freely within the surface waters of the epilimnion during the summer. For that reason, epilimnion sampling for phosphorus is considered representative of shallow sites around lakes since they are located within the epilimnion, and are constantly mixing with other waters of the epilimnion.

16. **How many seasons of data showing consistent median values of "P" higher than 8 ug/L are needed before NHDES declares that waterbody impaired for phosphorus?**

    It could be as little as one season if there are 5 independent sampling dates for the waterbody indicating exceedances of the standard.

17. **If a waterbody becomes impaired, and a project does not trigger the AoT permit (under 100,000 square feet of disturbance), how will NHDES or the town make sure the developer demonstrates no additional phosphorus loading to the waterbody?**

    When a waterbody becomes impaired for P, DES will do a TMDL (Total Maximum Daily Load) study to quantify the sources of the impairment, and can then require stormwater treatment and other best management practices to fix the impairment by reducing P loads until the lake water quality is once again less than 8 ug/l. It is much better (and cheaper in the long run) to reduce P loads before impairments develop.

18. **Does DES have or know of a phosphorus reduction index associated with the proper installation and maintenance of best management practices?**

    Here is a link to the BMP removal efficiency table that is in the stormwater manual and is currently being used by the 401 program for pollutant loading analyses. These numbers may be modified in the future when more data becomes available, but this is what we're currently using. http://des.nh.gov/organization/divisions/water/stormwater/documents/wd-08-20a_apxe.pdf . There is also a section in the manual and an interim guidance on loading analysis that Gregg Comstock prepared that discusses how to model BMPs in series.

19. **We realize we are keying in on Phosphorus for this project, however municipalities may want to know what other testing parameters they could/should be thinking of for water quality problem identification and protection. Can DES help us identify those other parameters affecting public health?**

    For Antidegradation related to land development and stormwater runoff, DES has proposed permit applicants run a loading analysis for TP (total phosphorus), TN (total nitrates) and TSS (total suspended solids). This obviously doesn't cover everything that a municipality would be concerned with, but it represents the parameters that DES has significant data to have some confidence in the modeling.

    For stormwater / landscape change, BMPs that control phosphorus are generally effective for the full suite of stormwater pollutants, to a greater or lesser degree. The major exception is nitrogen, which is more difficult to control.