NOTES

Phosphorus Loading Subgroup
Wednesday, December 2, 2020
1:00-3:00 p.m.
Virtual Meeting

Members: Matt Diebel, Laura Good, Dale Robertson, Dick Lathrop, Paul Dearlove, Mark Riedel, Jake Vander Zanden, Greg Fries, Todd Stuntebeck, Kyle Minks

Lead/Spokesperson: Matt Diebel

Recorder: Paul Dearlove

Charge: From 12/6/19 Steering Team Notes: *"The group will focus on the biophysical side of the issue, and not social impacts. It will address questions such as: How does the system work? What kind of lake responses can we expect with different phosphorus reduction scenarios? What models and assumptions should we be using? The process will start with a system inventory and focus on the science and technical aspects of the problem. The subgroup will not get into the recommendation of specific strategies."*

Meeting Attendance: Matt Diebel, Dick Lathrop, Paul Dearlove, Kyle Minks, Dave Merritt, Dale Robertson, Laura Good, Todd Stuntebeck, Greg Fries, Jake Vander Zanden, Mark Riedel, James Tye, Sam Oliver (USGS)

Agenda Overview & Updates

- Presentations by Lathrop and Diebel: Analyses of seasonal and flow-related patterns and trends in phosphorus loading
- Discussion:
    - How do inferences from the two analyses differ?
    - How do we reconcile the two methods and present a succinct summary for the Yahara CLEAN report?
- Review summary of phosphorus sources from the subgroup's "Water Quality Fundamentals" paper (concept #3), and outline additions needed for the Yahara CLEAN report

During scope-of-work negotiations with SmithGroup, it was decided that the P Loading Subgroup would write and provide the necessary content for the "State of the Science" chapter as described in the proposed Table of Contents. To that end, significant progress has already been made with the drafting and approval of the subgroup's "Water Quality Fundamentals" document. The idea is to now build on that document, include more specifics and figures, and provide content for the additional topics outlined below.

While this represents a fairly big effort, Diebel said he was committed to playing a lead role in the writing of this chapter. He requested the subgroup's help to stay on topic over the next few months so those expected deliverables can be met.

Schedule of Activities

Diebel presented the following "State of the Science" chapter outline with topics spread over four meetings. At each meeting, the subgroup will focus its discussion around those topics and attempt to reach consensus on main points. Diebel will then follow up with the appropriate individuals to flesh out the details and draft sections on those topics. All subgroup members will have a chance to review drafts of each section as they get developed. The goal is to finish a complete draft of the science section by March 1, 2021.

12/2/20
• P loading status and trends
• P loading seasonal distribution
• Sources of P to the lakes

Week of Jan. 4, 2021
• P loading target
• Description of gap between current and target loading
• Description of expected lake conditions across range of loading scenarios (current to target)

Week of Jan. 25, 2021
• Metrics used to gauge lake health and progress toward goals
    - Landscape (i.e., estimated P reductions from practice implementation)
    - In-stream (i.e., P concentrations and loads)
    - In-lake (i.e., P concentrations and loads, clarity, cyanobacteria bloom frequency, beach closures)

Week of Feb. 15, 2021
• Assessment of effectiveness of actions to date
• Recommended actions, including what is needed to accomplish them

Presentations: Seasonal and flow-related patterns and trends in phosphorus loading

Lathrop and Diebel each summarized, for comparative purposes, the methods and findings of their loading-trend evaluations. Subsequent discussion was focused on the pros and cons of each analysis, and whether they were telling the same story for the State of the Science chapter.

Lathrop
Lathrop walked the subgroup through a number of previously-distributed graphs that he and Stuntebeck had prepared:

- *Pheasant Branch Creek Annual Discharge (1976-2019)*. Graph separates daily baseflow and runoff conditions. Good loading data started around 1990, which is the time when a lot of urbanization was occurring along the south fork of the creek. Graph shows increases in both baseflow (85%) and runoff (78%), or an 80% overall increase in runoff measured as mean annual stream discharge between 1990-2007 to 2008-2019.

- *Yahara River (@Windsor) Annual Discharge (1990-2019)*. Graph separates daily baseflow and runoff conditions. Shows increases in both baseflow (44%) and runoff (89%), or a 59% overall increase in runoff measured as mean annual stream discharge between 1990-2007 to 2008-2019. Note: The August 2018 flood event (and related phosphorus loading as shown in a subsequent graph) did not appear extraordinarily large in the Yahara River subwatershed since rainfall amounts were 4 inches in the subwatershed compared to the 11 inches recorded in Middleton, and because the rain fell during the summer when vegetation was present.

- *Yahara River (@Windsor) Annual P Loads (1990-2019).* 57% increase between 1990-2007 to 2008-2019. Shows increases in mean annual P loads in both baseflow (51%) and runoff (58%), or a 57% overall increase in runoff P loads between 1990-2007 to 2008-2019 (14,135 – 22,131 lbs.). It was noted that 82% of the measured P load was in runoff discharge, and 18% was in baseflow discharge.

- *Yahara River Annual Average P Concentration (1990-2019).* Shows a small increase in mean annual P concentrations in baseflow (5%), a signficant decrease in runoff (-23%), and an overall decline (-15%) in P concentrations between 1990-2007 to 2008-2019 (0.323 – 0.276 mg/L). It was presumed that the observed decrease wsa probably due to management action within the contributing subwatershed.

- *Yahara River Annual Suspended Sediment Loads (1990-2019).* Shows increases in annual suspended sediment loads in both baseflow (84%) and runoff (38%), or a 45% overall increase in suspended sediment loads between 1990-2007 to 2008-2019 (2,121 – 3,068 tons).

- *Yahara River Annual Suspended Sediment Concentrations (1990-2019).* Shows decreases in mean annual suspended sediment concentrations in both baseflow (-5%) and runoff (-15%), or a -12% overall decrease in suspended sediment concentrations between 1990-2007 to 2008-2019 (2,121 – 3,068 tons).

- *Yahara River (@ Windsor) Seasonal Runoff Event P Loads (1990-2019).* Most of the P load is in runoff. Broken down by season, 43% of runoff volume occurs Jan-Mar, along with 55% of the P load and 36% of the sediment load. Apr-Jun: 32% runoff volume, 28% P load, 43% sediment load. Jul-Sep: 18% runoff volume, 13% P load, 19% sediment load. Oct-Dec: 7% runoff volume, 4% P load, 3% sediment load.

- *Yahara River (@ Windsor) Runoff Event P Loads (1990-2019).* Jan-Mar: 36 events > 2000 lbs (16 in 1990-2007, 12 in 2008-2019). Apr-Jun: 11 events > 2000 lbs (5 in 1990-2007, 6 in 2008-2019). Jul-Sep: 5 events > 2000 lbs. Oct-Dec: 1 event > 2000 lbs. It was noted that while loads are increasing along with rainfall, rain is not the only driver. Other factors are seasonal timing (winter), movement away from traditional tillage practices that add roughness to the landscape, and expansion of impervious surfaces. The 2018 flood event produced a relatively small change in P load due to the presence of vegetative cover during the late summer season.

- *Yahara River Jan-Mar vs. Apr-Dec Runoff Event P Concentrations (1990-2019).* P concentrations are generally much greater in medium to large runoff events during Jan-Mar compared to the rest of the year (Apr-Dec). Relatively speaking, concentrations do not go up very high during big storm events. Dillution could be an issue.

Take-home points: In the Yahara River subwatershed, well more than half (55%) of its annual phosphorus loading via runoff events occurs during Jan-Mar when the ground is normally frozen. That period is when the highest proportion of phosphorus is dissolved (biologically available), which has a high delivery to Lake Mendota. Winter manure spreading likely exacerbates this high dissolved phosphorus loading. This is in contrast to runoff events in spring (28% of annual loading) and summer (17% of annual loading) when a larger proportion of the phosphorus is particulate (sediment-bound). Particulate phosphorus has a somewhat reduced delivery to Mendota as some of the particulate phosphorus settles out in stream reaches and wetlands; some (but not all) of this phosphorus increases baseflow phosphorus concentrations and loading that enters the lake over longer periods of time. Jan-Mar is also a period when runoff events are normally systemic basin-wide events delivering phosphorus from the entire watershed to Mendota. This is in contrast to runoff events resulting from intense thunderstorms, which normally are not uniform throughout the entire watershed. Unfortunately, typical agricultural management practices are not designed to control dissolved P, especially during the problematic Jan-Mar winter runoff period of high phosphorus loading.

Diebel

Diebel presented a number of graphs using a WRTDS flow-normalization analysis. This analysis applies a partial regression fit using the raw monitoring data. In other words, it shows how P concentrations change over time if stream flow is held constant.

The results show that total phosphorus (TP) has gone up during the winter, while summer TP has gone down, and spring and fall haven't really changed. The analysis looked at Yahara River (@ Windsor) flow events up to 200 cfs. Subgroup input suggested it could be useful to re-run the model up to the 99th percentile vs. 95th of all sample days per season.

The flow-normalized trend in P load at the same Yahara River location shows that 65-70% comes in as runoff. This may be an underestimate since concentrations are likely to be higher in runoff vs. baseflow. Feb-Mar time frames are driving the increases. For Pheasant Branch

Creek, the biggest improvements were over the growing season, perhaps due to management interventions.

Diebel said he feels the flow-normalization method offers the best approach to characterizing trends because it factors out variability in flow. Applying the analysis to Dorn Creek suggests the Suck the Muck project has not changed overall P loads yet. However, Lathrop noted that Suck the Muck allows the stream to access the wetland again which has a positive impact that goes beyond sediment removal.

Take-home points: Runoff delivers 65-85% of the P load to the lakes. Feb-Mar is the biggest problem. While baseflow P concentrations are decreasing or staying about the same, runoff P concentrations have increased in some seasons at some sites.

Post-Presentation Discussion Highlights

- It is time to stop throwing good money after bad. We need to target/prioritize efforts on the problem areas and spend our dollars there. At the same time, we will want to be careful not to cause producers to lose hope and throw up their hands in frustration.
- Addressing late-winter runoff events is going to be key. There is a difference in subwatersheds when it comes to land-use management and water quality impacts. We can learn from those lessons.
- The more we can show what is actually working the more we will be able to foster hope and community buy-in. For example, despite the wetter weather and perceived lack of progress, the data show there was improvement if weather variability was taken out of the equation. We will want to double down on what works, walk away from what doesn't work, and put forth new opportunities.
- We can't simply ask livestock operators to suddenly go to managed rotational grazing to address the manure problem. What strategies do we have in our toolbox to solve the late-winter P loading problem? We have to look beyond the more traditional practices that are designed to mitigate soil movement during the growing season. It comes down to either transformationally changing agriculture or how we treat what is coming off the fields.

ACTION ITEMS

1. Subgroup members will email Diebel their top three impressions regarding the different analytical models and their outputs.
2. Subgroup members will revisit Concept #3 in the "Water Quality Fundamentals" document dealing with P sources. Email Diebel thoughts on what needs to be added to that section based on today's discussion.
3. The subgroup will want to consider sharing its higher-level understandings with the Steering Team to help frame strategy-selection discussions. This could potentially happen in January.