TMDLs, Adaptive Management, and Trading – Are you up to Speed with the new Phosphorus Regulation Implementation Alternatives?

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Outline

- Background and NR 102 WQBEL Criteria
- Example Effluent Limits from Recent Draft Permits
- Tertiary Treatment Technologies to Meet Limits
- Implementation Alternatives
Excessive Phosphorus

Can cause:

• Algae

• Low dissolved oxygen

• Aquatic life impacts

• Loss of tourism and property values

Source: DNR
Sources of P in Wisconsin

Agriculture: >75%

Urban Runoff: <5%

WWTPs: ~20%

Source of image: USEPA. Example: Rock River Basin, WI
## NR 102 Criteria

<table>
<thead>
<tr>
<th>Waterbody Type</th>
<th>Phosphorus Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rivers (listed in NR 102)</td>
<td>0.10</td>
</tr>
<tr>
<td>Streams</td>
<td>0.075</td>
</tr>
<tr>
<td>Reservoirs</td>
<td>0.03-0.04</td>
</tr>
<tr>
<td>Inland Lakes</td>
<td>0.015-0.04</td>
</tr>
<tr>
<td>Great Lakes</td>
<td>0.005-0.007</td>
</tr>
</tbody>
</table>
Revisions to NR 217 – Effluent Standards and Limits for P

- Effective 12/1/10, *partial USEPA approval*
- Procedure for calculating water quality based effluent limits (WQBELs) from NR 102 criteria
- Keeps the technology-based limit (~1 mg/L) if it’s more stringent than the WQBEL
- Several important **OPTIONS**!
WQBEL Calculation

**Upstream**
- $P = 0.03$ mg/L
- $Q_r = 10$ cfs

**Downstream**
- $P = 0.075$ mg/L (= criterion)
- $Q = 11$ cfs

**WWTP**
- **WQBEL** = 0.52 mg/L P
- $Q_e = 1$ cfs
WQBEL Calculation

**Upstream**
- P > 0.075 mg/L
- Qr = 10 cfs

**WWTP**
- WQBEL = 0.075 mg/L P
- Qe = 1 cfs

**Downstream**
- P > 0.075 mg/L
- Q = 11 cfs
Protection of Downstream Waters

Upstream
P = 0.03 mg/L
Q_r = 10 cfs

WWTP
WQBEL = 0.04 mg/L P??
Q_e = 1 cfs

Downstream Non-
Stratified Res.
P = 0.04 mg/L
(= criterion)
WQBELs For Lakes

• Based on lake modeling or total maximum daily load (TMDL) type of approach

• Great Lakes discharger interim limit ~0.6 mg/L until nearshore/whole lake modeling can be completed
Expression of Limits in Permits

• Usually concentration, monthly average

• If WQBEL $\leq 0.3$ mg/L, it is expressed as an annual average. A monthly average limit of $3X$ the WQBEL is also included

• Also mass-based limits in some cases (if discharge to lakes or if a TMDL limit, etc.)
Multiple Dischargers

- Multiple dischargers to the same segment of a river or stream may have special limits calculated by WDNR.
- Similar concept to BOD waste load allocations for the Wisconsin River.
- Prevents penalizing the discharger that is farthest downstream.
NR 217 Compliance Schedules

• Can be up to 7 to 9 years - *permittee must demonstrate the schedule is required*

• Up to 5 years allowed for WQBEL compliance following the watershed adaptive management option
Recent Draft Permits Show Status of WDNR Permitting

• Marinette: WQBEL = 10 mg/L; technology based limit (TBL) remains at 1 mg/L
• St. Croix Falls similar to Marinette
• Ladysmith 2 mg/L Alt P limit & study required
• Two northern WWTPs (lagoon and package plant 0.1 mgd) reissued – new limits not “necessary”
The Next Wave of Permits

- Hartford (Rubicon River in Washington County)
  - 0.075 mg/L annual average WQBEL
  - Interim limit 0.6 mg/L & long compliance schedule
  - Operation and Needs Review 9/30/12
  - Facilities Plan 9/30/14, if needed
  - Startup 9/30/20
  - Subject to change depending on earlier findings, watershed adaptive management, other
  - Rock River TMDL had higher mass based limits for Hartford.

- Lodi (Spring Creek – Lake Wisconsin Watershed, Lower Wisconsin River Basin in Columbia County)
  - Similar schedule and limits to Hartford
  - Interim limit 1 mg/L
Tertiary Treatment Technologies to Meet Low Phosphorus Limits

• Options include:
  – Multi-point chemical addition
  – Tertiary filtration/membrane separation
  – Reactive filtration
Potential Treatment Technologies (~0.5 mg/L P)

*Could include biological P removal (BPR)*
Potential Treatment Technologies (Lowest Limits)

Membrane filter

Continuously backwashing filter (with adsorption)
The Goal and Plan

• Demonstrate that DNR’s analyses underestimated the cost to the state.

• Develop “generic” costs for incremental P removal for “typical” WWTPs:
  - 0.1 mgd, 1.0 mgd, and 20 mgd capacities

• Develop P removal costs at 4 large POTWs >20 mgd (site-specific costs): Green Bay, Madison, Milwaukee, and Racine

• Extrapolate to entire state to develop realistic costs for state-wide cost benefit analyses
Results – Lagoon Plant Example

Present Worth

PW Cost for Conversion of Lagoon Plants
For P Removal, 0.1 and 1.0 mgd

Annual Average Effluent TP, mg/L

Note: the x-axis represents annual average effluent concentrations and not WQBELs.
Results – 20 mgd WWTP

*Incremental Present Worth*

![Graph showing PW Cost for Incremental P Removal at 20 mgd](image)

Note: the x-axis represents annual average effluent concentrations and not WQBELs.
Results – Large Wisconsin POTWs

Incremental Present Worth

Note: the x-axis represents annual average effluent concentrations and not WQBELs.
Wisconsin Statewide Aggregate Costs

August 2008 Results

• ~500 POTWs discharging to surface waters would be impacted
• $3 to $5 billion in capital costs
• $4 to $7 billion in 20-year present worth costs
Putting the Costs in Perspective

• Currently:
  - P Limit = 1 mg/L (effluent ~ 0.6 mg/L)
  - Typically remove 5 – 8 mg/L of P
  - Typical cost ~ $3 to $7 per lb of P

• Proposed:
  - Remove additional ~ 0.5 mg/L of P
  - Incremental cost ~ $200 to $300 per lb of P
Additional Considerations – Biosolids Disposal

**Biosolids Production**
- Chemical sludge
- Improved TSS capture efficiency
- Growth

**Land Availability**
- Development
- Regulatory constraint
  - P indexing
  - Setbacks
- Competition for sites
- Public opinion
Wastewater P May be a Valuable Commodity Some Day

• World supplies of P are dwindling – harvest from wastewater?
What if there is a TMDL?

- USEPA requires that, once a TMDL is approved, the regulatory agency must issue NPDES permits consistent with the TMDL.
- TMDLs consider all phosphorus sources – point and nonpoint.
- TMDLs also affect MS4 discharges.
- Communities that do not have a TMDL in the works and anticipate a low WQBEL may want to push for a TMDL or implement a 3rd party TMDL.
Simple Example TMDL

TMDL = 100 lb/day (Background = 5 lb/day)

Agriculture = 60 lb/day
(MOS = 10 lb/day)

MS4 = 5 lb/day

WWTP = 20 lb/day

TMDL = 100 lb/day
TMDLs Will Be Developed by WDNR for Impaired Waters
Rock River TMDL

- Rock River TMDL for sediment and phosphorus was finalized.

- Potential effluent limits for WWTPs in the watershed include:
  - A
  - B
  - C
Implementation Alternatives

• Adaptive Management
• Variances
• Water quality trading
• 3rd Party TMDL
Watershed Adaptive Management Option

- Available if watershed is nonpoint source/MS4 dominated
- Work with other dischargers to reduce P
- Submit WAM plan with permit application
- Allows two permit terms for upstream load reductions; interim effluent limits apply
- May eventually result in a higher WQBEL
Adaptive Management: WDNR Activities

• WDNR is developing guidance for this option.

• Consider applying for WAM in next permit application, after guidance is published
  • Interim limits are 0.5 – 0.6 mg/L
  • Need to work well with others
Variances

- Wastewater treatment ponds and lagoons have variance procedure in NR 217
- Other variances are available through NR 200 as always
- Usually based on economics
- Good for one permit term (5 years) then need to re-apply
Water Quality Trading

• Partner with other sources of P in watershed for more economical P removal – eg., BMPs
• Other point sources, MS4s, nonpoint sources (ag.)
• USEPA toolkit & handbook is available
Water Quality Trading May Offer Cost Relief