Lake Smetana Water Quality Evaluation Using the Use Attainability Analysis (UAA) Process

Nine Mile Creek Watershed District Special Meeting

February 6, 2020

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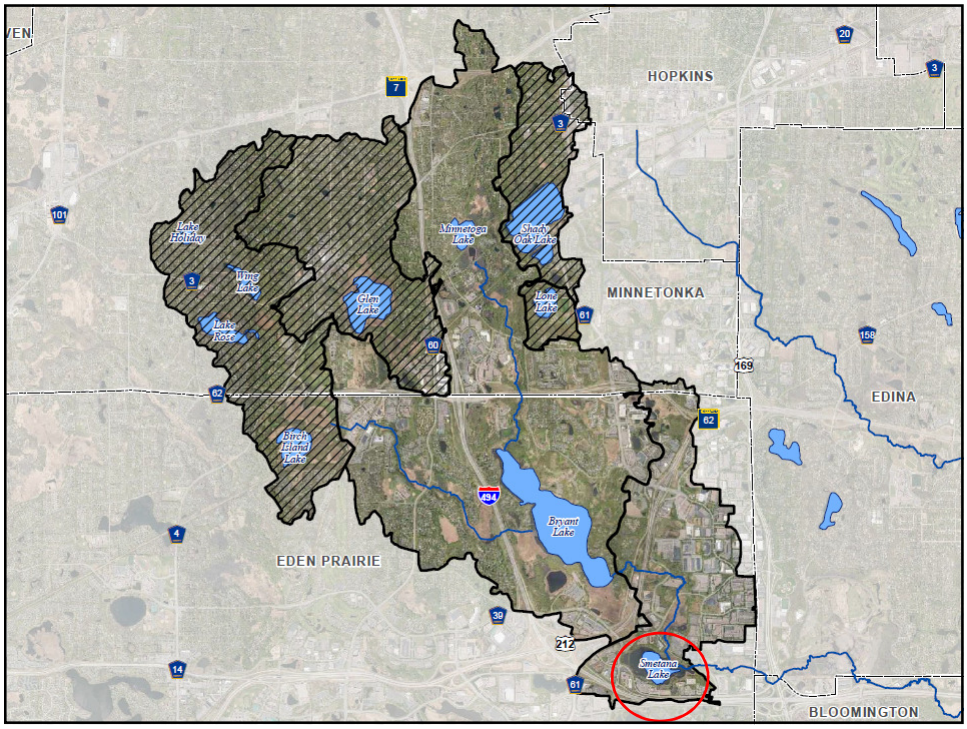
Lake Smetana

- Lake Surface = 56 acres
- Maximum Depth = 10 ft
- Mean Depth = 3.2 ft
- Public ramp access off Smetana Lane
- Lake Use:
  - Aesthetic viewing
  - Walking path
  - Fishing
  - Non-motorized boats



Background

- Previous water quality study in 2003
  - Evaluated lake water quality in comparison with lake management goals
  - Identified management activities to improve water quality

What is a Use Attainability Analysis (UAA)?

- Structured scientific assessment of a water body's physical, chemical, and biological conditions.
- Provides a scientific foundation for a lake-specific management plan
  - to maintain or achieve water quality to support the intended beneficial uses.

Goals of 2019 water quality study

- Re-evaluate Lake Smetana water quality to assess:
  - Water quality impacts from changes in the watershed's land use
  - Water quality improvements from best management practices (BMPs)
  - Sources of phosphorus to Smetana Lake
  - Need for management activities to protect and/or improve water quality moving forward

Holistic Lake Management

Balanced
Phosphorus
&
Nitrogen

Where do nutrients in the lake come from? Internal Sources

External Source

Watershed Runoff

Internal Sources

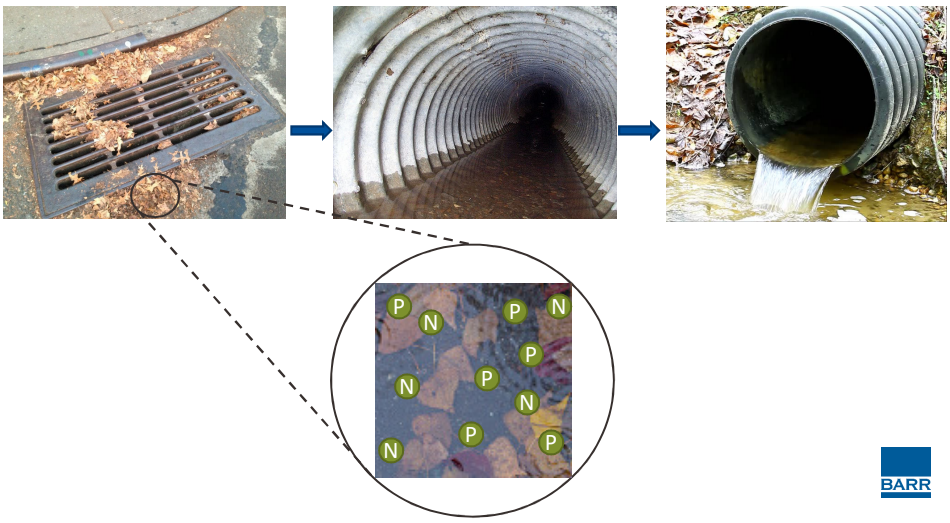
Curly-leaf Pondweed (Invasive)

Nutrient Rich Sediments

Phosphorus
Nitrogen

Lake Clarity
Algal Blooms

Where do nutrients in the lake come from? Stormwater



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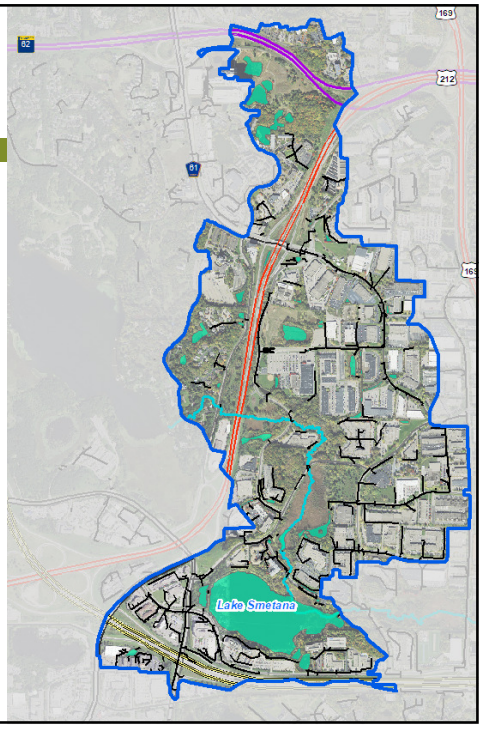
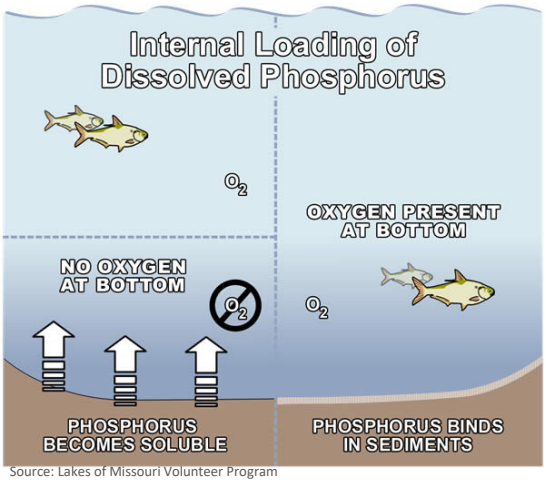
Stormwater flows to Lake Smetana

- Total direct watershed~ 1000 ac
- Major land use types:
  - 36% Industrial
  - 20% Highway
  - 16% Office/Commercial
  - 14% Public/Open Space
  - 8% Residential
- Land use types influence amount of stormwater runoff



Where do nutrients in the lake come from? Internal Sources



Source: Lakes of Missouri Volunteer Program

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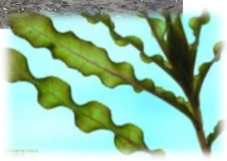
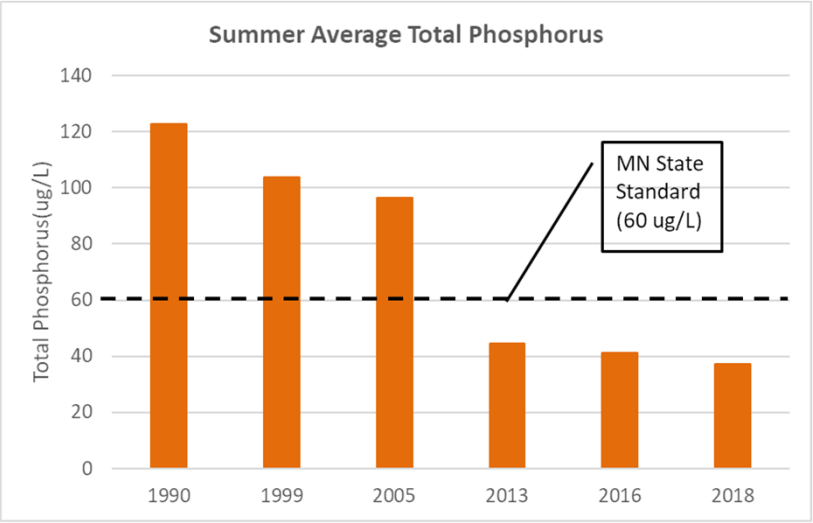


Primary steps of the water quality study

- Intensive monitoring program
  - Water quality, aquatic plants, phytoplankton (algae), zooplankton
- Evaluate historical and current lake conditions
- Watershed and inlake modeling to:
  - determine nutrient sources
  - Evaluate phosphorus cycling and impacts of (or to) aquatic plants and algae
  - Evaluate potential management activities, as appropriate

Historical and Current Water Quality of Smetana Lake



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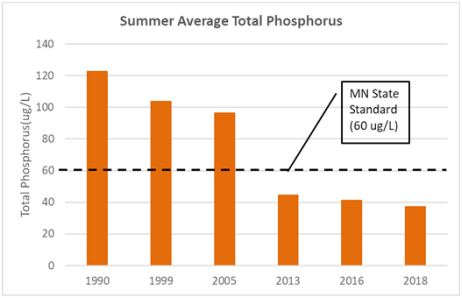

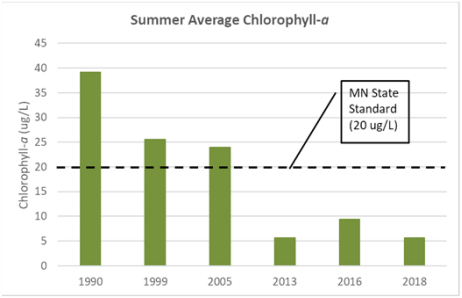

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What Changed: Bryant Lake Alum Treatment

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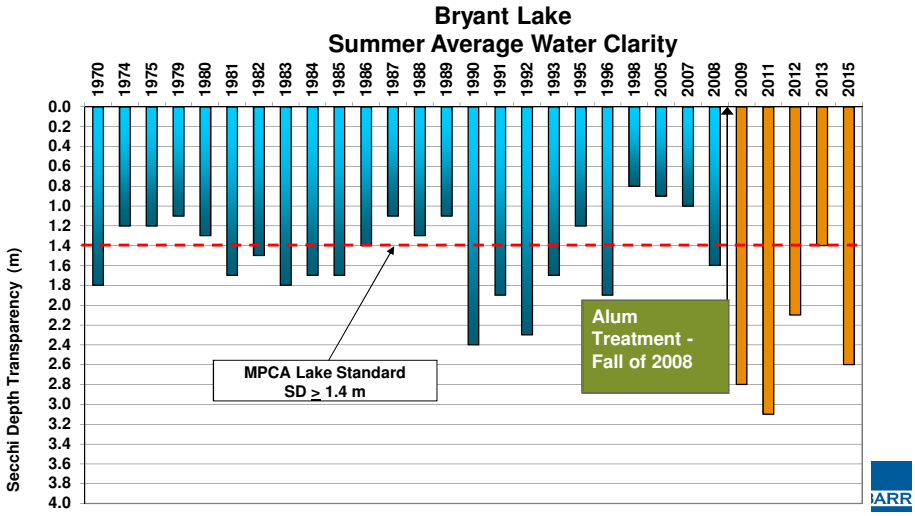
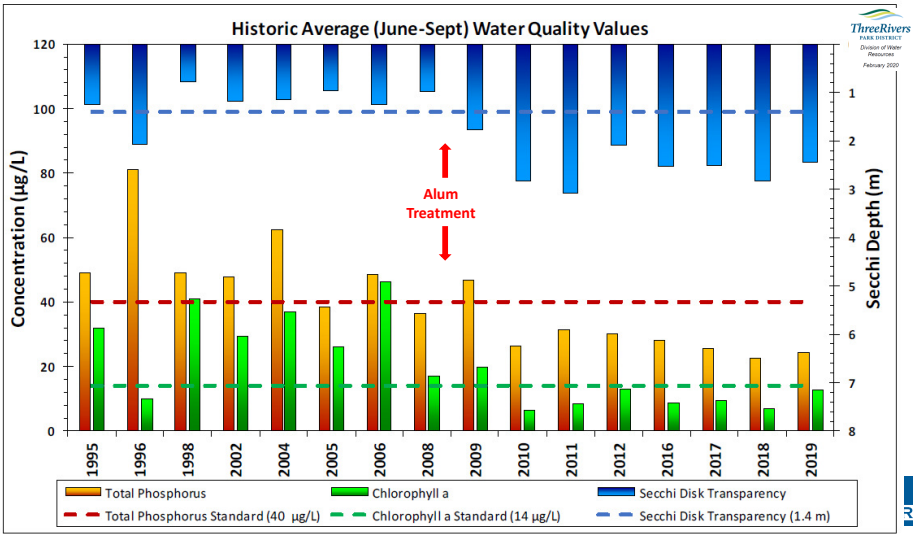
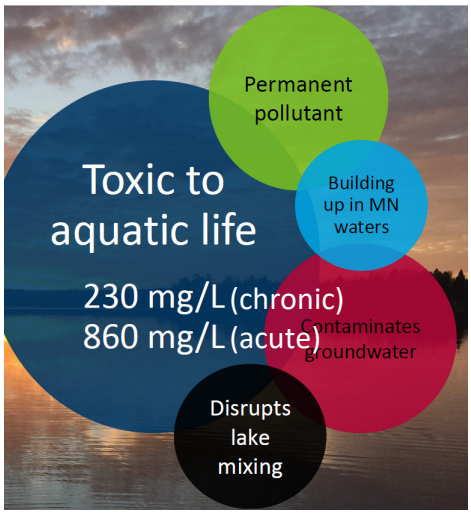


What Changed: Bryant Lake Alum Treatment



High Chlorides in Lake Smetana

- 2018 May Chloride Concentration = 244 mg/L
- 2018 June Chloride Concentration = 264 mg/L

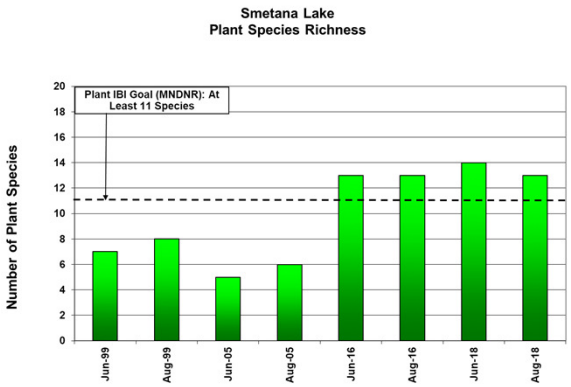


Aquatic Plants

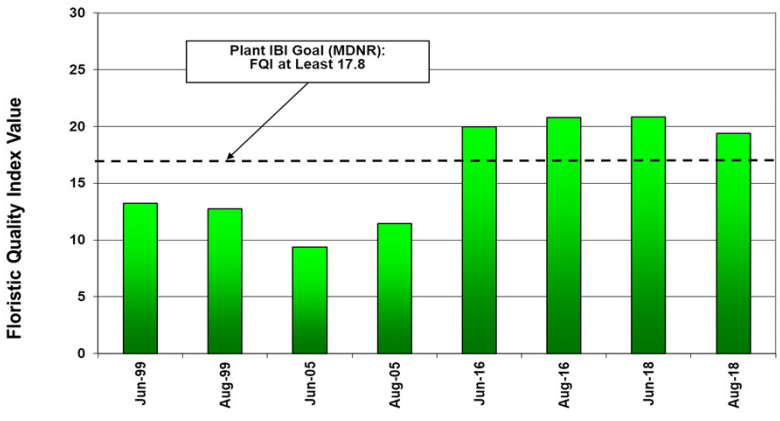
A balanced aquatic plant population provides…

- Habitat for zooplankton and aquatic insects
- Habitat for fish
- Reduces phosphorus concentration in the lake when it grows
- Increases lake clarity
- May hinder specific boating activities

Aquatic Plants – Increase in number of species



Aquatic Plants – improvements in floristic quality index



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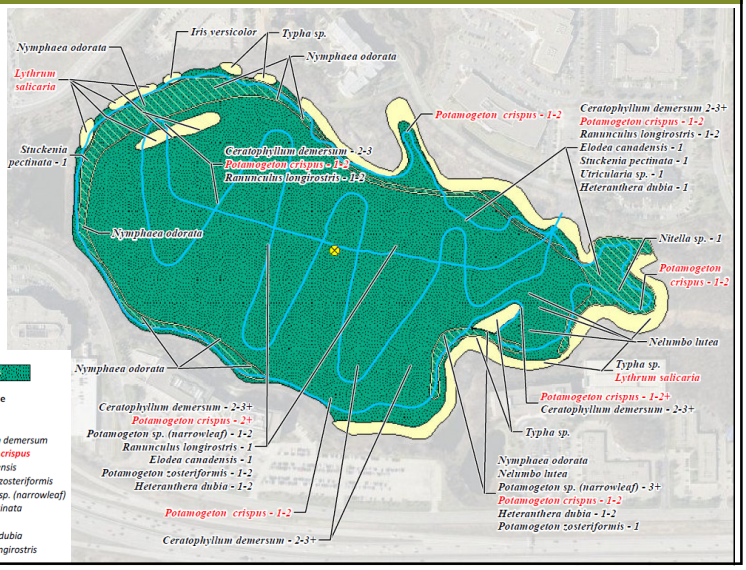
Aquatic Plants – but also evidence of curly-leaf

June 2018 Survey

Curlyleaf is about 8-9% of the total plant biomass in June (2019 data)



Submerged Aquatic Plants

Common Name	Scientific Name
Bladderwort	*Utricularia sp.*
Coontail	*Ceratophyllum demersum*
Curly-leaf Pondweed	*Potamogeton crispus*
Elodea	*Elodea canadensis*
Flat-stem pondweed	*Potamogeton zosteriformis*
Narrow-leaf pondweed	*Potamogeton sp. (narrowleaf)*
Sago pondweed	*Stuckenia pectinata*
Stonewort	*Nitella sp.*
Water stargrass	*Heteranthera dubia*
White water buttercup	*Ranunculus longirostris*

Fish community- good balance!

Species	Gear	Catch Per Unit Effort	Normal Range	Avg Weight	Normal Range	Count
black bullhead	Standard trap nets	**1.56**	**2.5-70.2**	0.4	0.1-0.5	14
black bullhead	Standard gill nets	3.5	8.0-90.0	0.58	0.1-0.4	7
black crappie	Standard trap nets	1.11	1.3-27.7	0.14	0.1-0.4	10
bluegill	Standard gill nets	0.5	N/A	0.07	N/A	1
bluegill	Standard trap nets	6.22	2.8-43.3	0.19	0.1-0.3	56
brown bullhead	Standard trap nets	0.11	0.2-6.2	1.46	0.4-0.9	1
common carp	Standard trap nets	1.56	0.4-2.9	5.58	1.4-4.5	14
golden shiner	Standard gill nets	0.5	1.0-8.5	0.08	0.1-0.1	1
green sunfish	Standard trap nets	0.11	0.4-3.8	0.03	0.1-0.2	1
hybrid sunfish	Standard trap nets	0.33	N/A	0.23	N/A	3
largemouth bass	Standard trap nets	0.11	0.2-1.1	0.21	0.3-1.0	1
northern pike	Standard gill nets	**14.5**	**1.5-9.0**	1.97	1.8-3.7	29
northern pike	Standard trap nets	1.33	N/A	0.75	N/A	12
pumpkinseed	Standard trap nets	0.56	0.8-9.3	0.12	0.1-0.2	5
white sucker	Standard gill nets	0.5	1.0-6.6	2.46	1.0-2.2	1
yellow bullhead	Standard trap nets	0.11	0.3-4.2	0.54	0.5-0.8	1
yellow perch	Standard trap nets	0.11	0.4-3.5	0.08	0.1-0.2	1
yellow perch	Standard gill nets	2	2.5-25.8	0.12	0.1-0.2	4

Source: MnDNR, 2005

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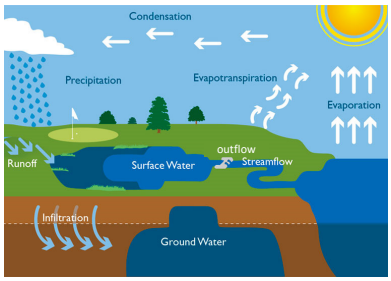
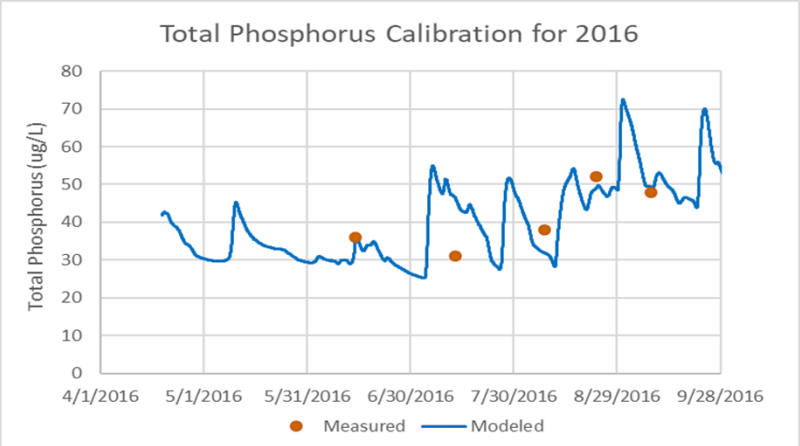
Lake Model

- Water Balance
  - How much water is entering and from where
    - Stormwater runoff from watershed
    - Upstream Waterbodies
    - Precipitation
  - How much water is flowing out (e.g., lake flushing)
- In-Lake Phosphorus Tracking
  - How much P is entering and from where
  - How much P is staying in the lake (e.g., deposit to sediments, uptake to plants)
  - How much P is flowing out



Lake Model- calibration



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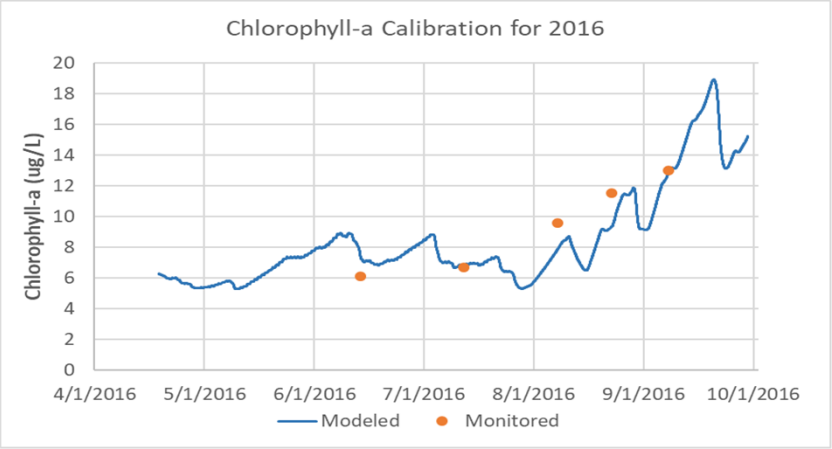
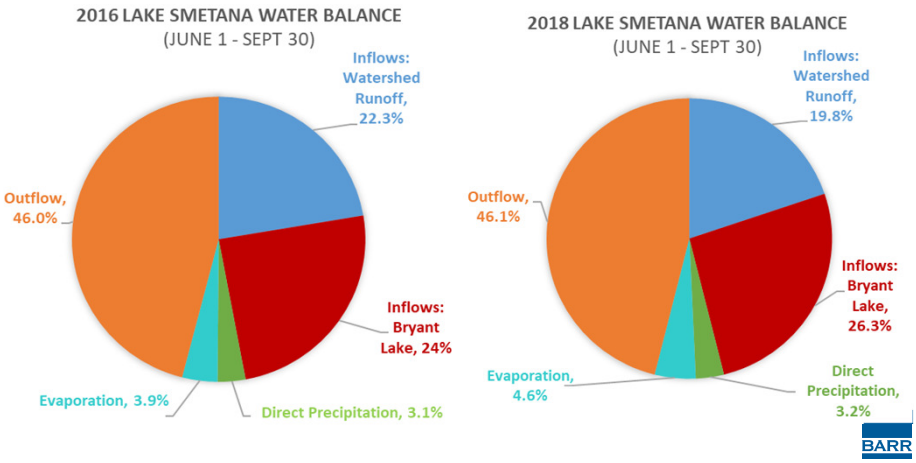
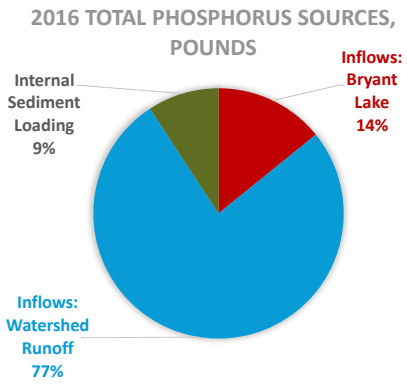
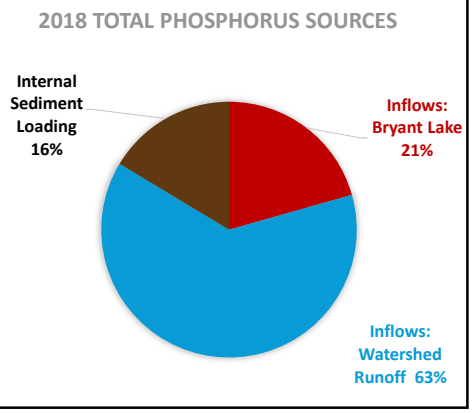


Lake Model Results – Water Balance



Lake Model Results – Phosphorus Source Tracking

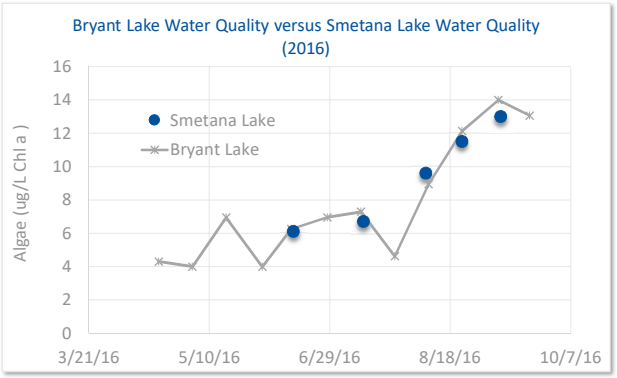




Lake Model Results: Knowledge Gained

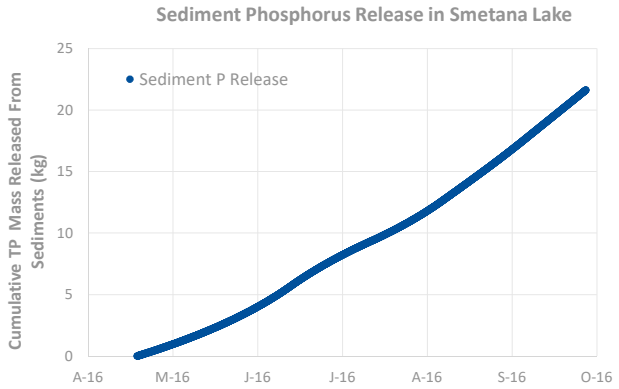
Watershed P load much greater than Bryant Lake P load although water volumes similar

Maintenance of good water quality in Smetana Lake is dependent upon the maintenance of good water quality in Bryant Lake.



Lake Model Results: Knowledge Gained

DO concentrations in Lake Smetana low enough to stimulate P release from sediments from June through September



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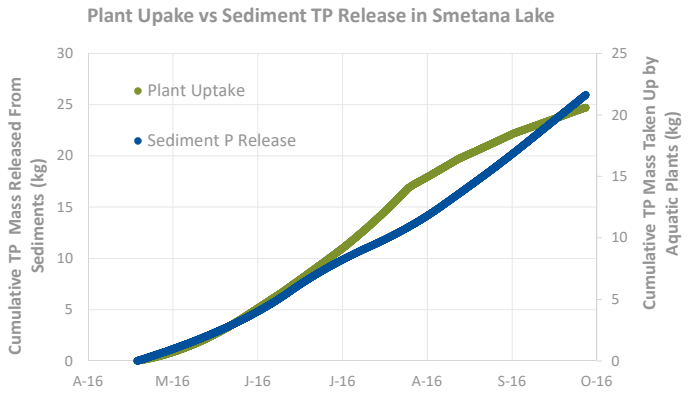
Lake Model Results: Knowledge Gained

But, plant uptake is approximately equal to phosphorus load from sediments

**plant uptake plays an important role in reducing P concentrations in the water column*



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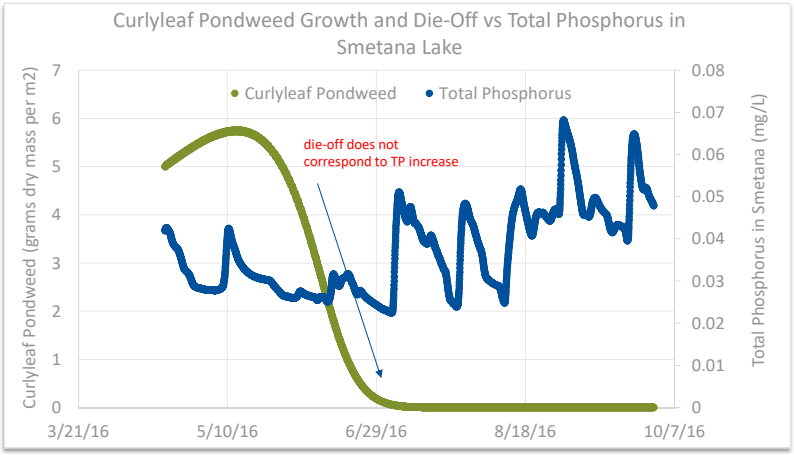
Lake Model Results: Knowledge Gained

Model results indicate that current curly-leaf pondweed population is not having an effect on the water quality of Smetana Lake.



Conclusions

- Lake Smetana water quality improved since early 2010's
  - ☑Summer average phosphorus concentrations < MN Standards
  - ☑Summer average Chlorophyll-*a* concentrations < MN Standards
- WQ improvements due in large part to Bryant Lake alum treatment (and other upstream improvements)
- Largest source of phosphorus load to Lake Smetana comes from watershed runoff
  - Bryant Lake discharge and internal sediment loading also contribute

Recommendations- nutrients

- **Maintain Bryant Lake Water Quality**
  - Alum treatment was applied over 10 years ago, continue to monitor Bryant Lake water quality

- **Reduce Pollutant Loading from Direct Watershed**
  - Seek partnership opportunities for enhanced stormwater treatment as additional development occurs in the watershed
  - Close monitoring/inspection of construction projects within the watershed (e.g., SW LRT)
  - Seek partnership opportunities to address localized erosion issues along Lake Smetana shoreline (e.g., cost share grant program)

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Recommendations- nutrients

- **Continued Monitoring of Lake Smetana**
  - Continue to periodically monitor Lake Smetana water quality (nutrients, chlorides)
  - Continue to track invasive species growth (specifically curly-leaf pondweed)
  - Continue to monitor DO concentrations and potential for sediment phosphorus release in Lake Smetana
  - Update fisheries survey (preferably through MDNR)
- **Work with Stakeholders on Chloride Reduction**

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Discussion/Questions