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DES PLAINES RIVER WATERSHED WORKGROUP (DRWW)

NUTRIENT ASSESSMENT REDUCTION PLAN (NARP) RECAP

February 15, 2024

DES PLAINES RIVER WATERSHED WORKGROUP

AGENDA

- Background and Objective
- Monitoring and Data Analysis
- Model Development
- Watershed Management Scenarios
- Implementation Plan
- Questions

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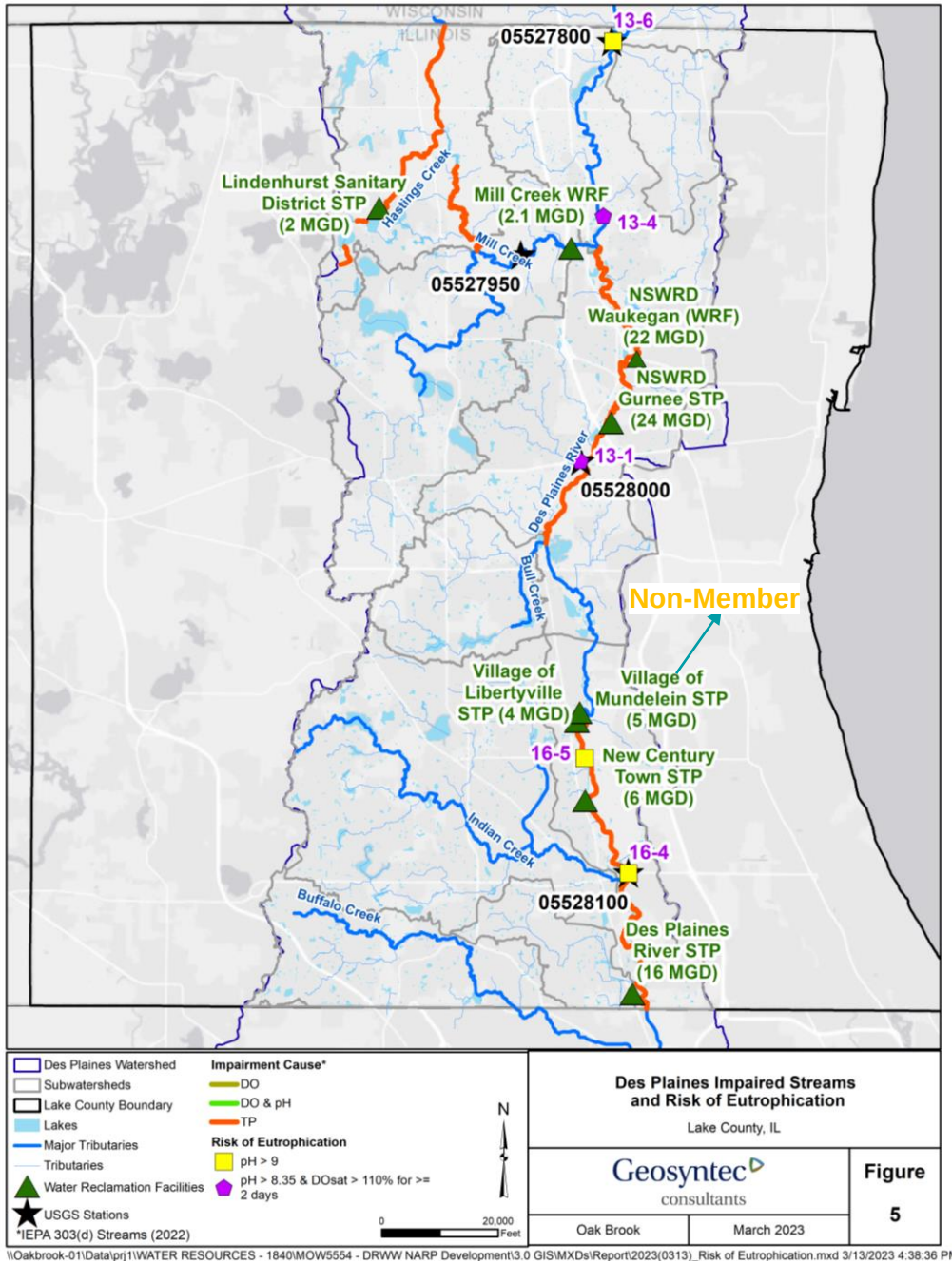
Background and Objective

DRWW NARP Background

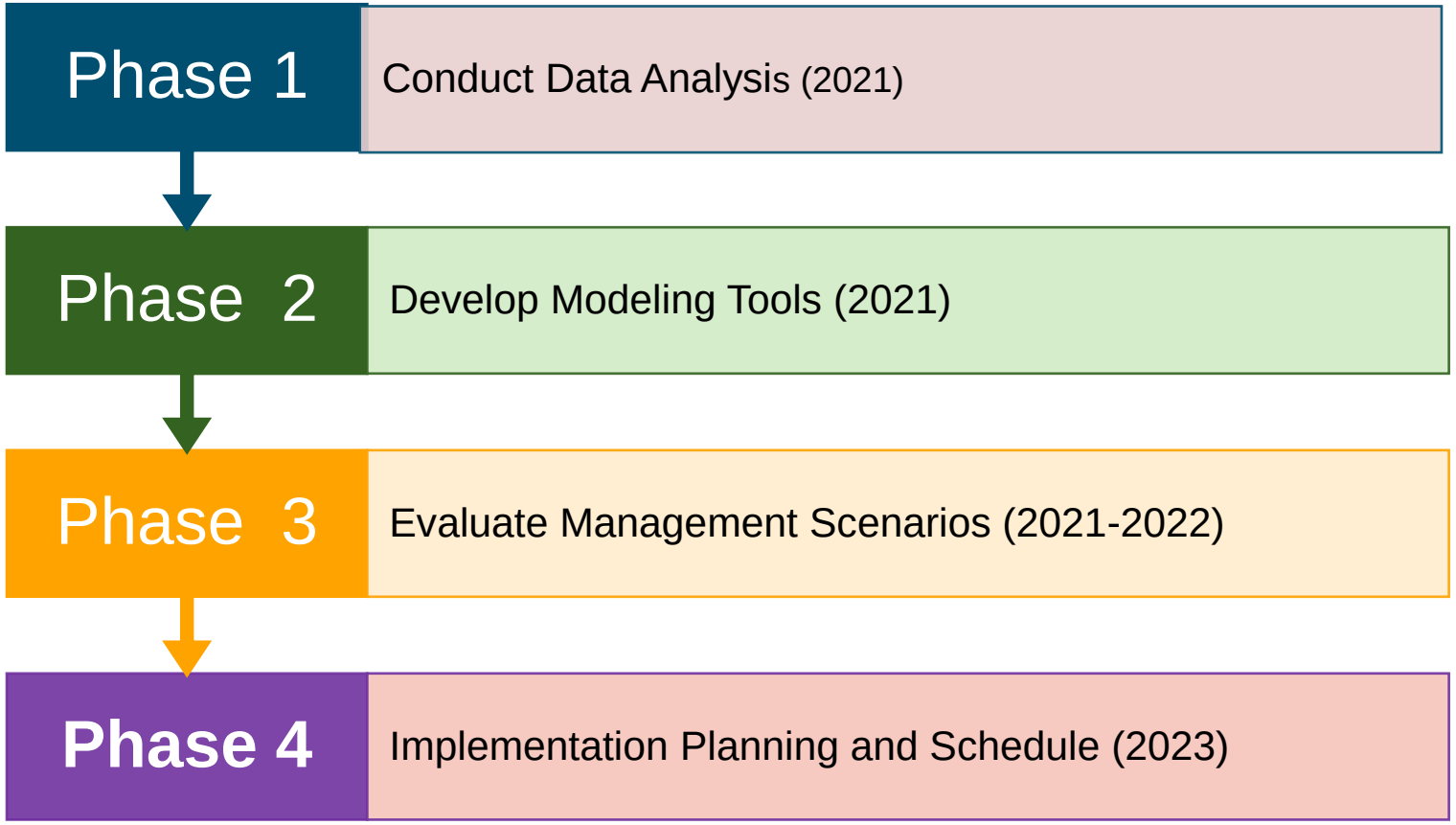
- POTWs discharging to
  - Des Plaines River mainstem (6)
  - Mill Creek (1)
  - Hastings Creek (1)
- NARP due to
  - Phosphorus-related impairments
  - Risk of eutrophication
- DRWW submitted a NARP Workplan in Nov. 2020



Meeting Objectives

- Review the work done on NARP to date
  - Monitoring
  - Data Review and Analysis
  - Model Development
  - Watershed Scenarios Evaluation
- Gain concurrence from Illinois EPA
  - Upstream loading drives the phosphorus-related impairments in the mainstem Des Plaines River
    - Total Phosphorus (TP)
    - Chlorophyll-a (Chl-a)
    - Dissolved Oxygen (DO)
  - Recommended next steps on the NARP

DRWW NARP – Schedule



Illinois EPA NARP Coordination

- March 2019: Workplan coordination meeting
- March 2020: NARP Workplan submission – Met special condition to develop a NARP workplan
- March 2023: NARP update meeting on monitoring, modeling and watershed scenarios
- November 2023 – Meeting to discuss summary of implementation plan

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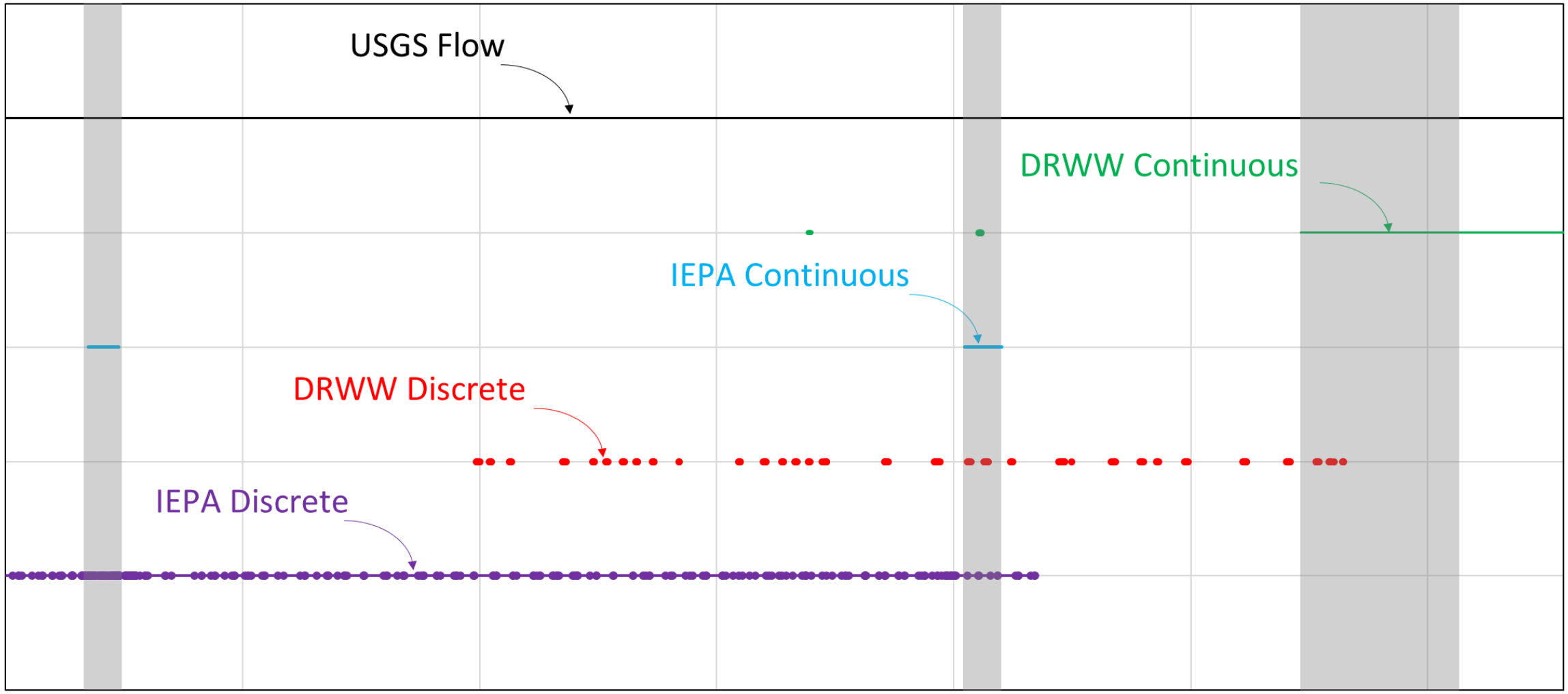
Recap of Activities

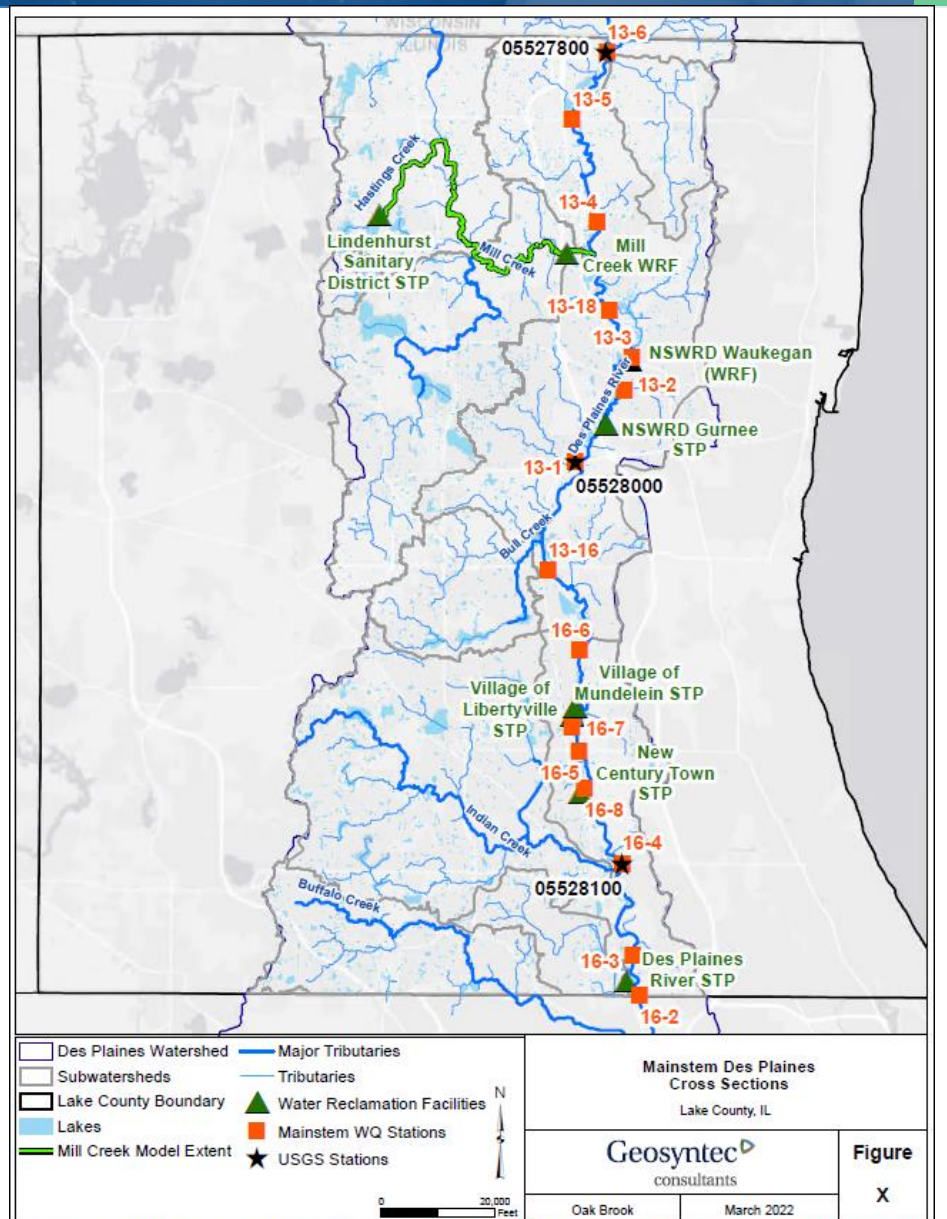
- Monitoring & Data Analysis
- Model Development
- Watershed Management Scenarios
- Implementation Plan

Summary of Available Data

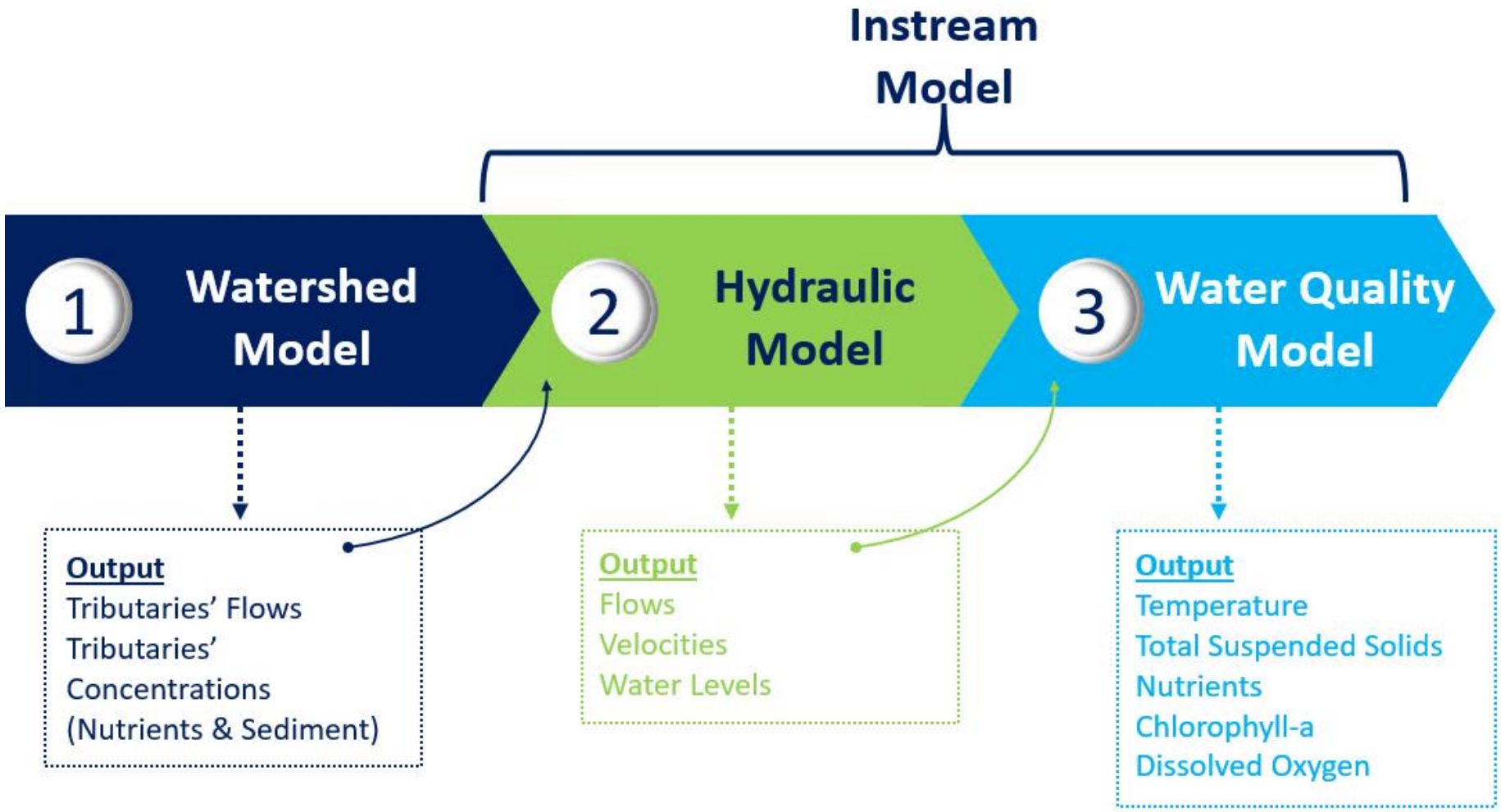


2020 NARP Focused Monitoring

- Water Column Sampling
  - 15 sites on mainstem Des Plaines and 3 sites on Mill Creek
  - Increased summer sampling
  - Nutrients, sestonic Chl-a, benthic Chl-a
- Continuous Monitoring
  - 3 sites
  - DO, temperature, TSS, pH, Chl-a, and conductivity



Modeling Background – Framework



Modeling Background – Overview

Watershed Model

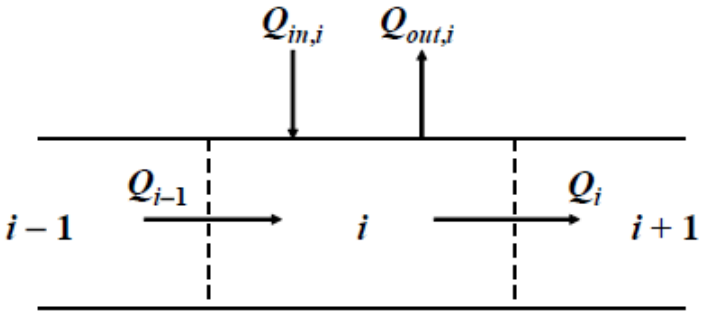
- Simulates the response of water quantity and quality to hydrologic processes

Instream Model

- Simulates hydraulics and water quality condition within a stream or river
- Hydraulic and water quality models

Modeling Background – Overview

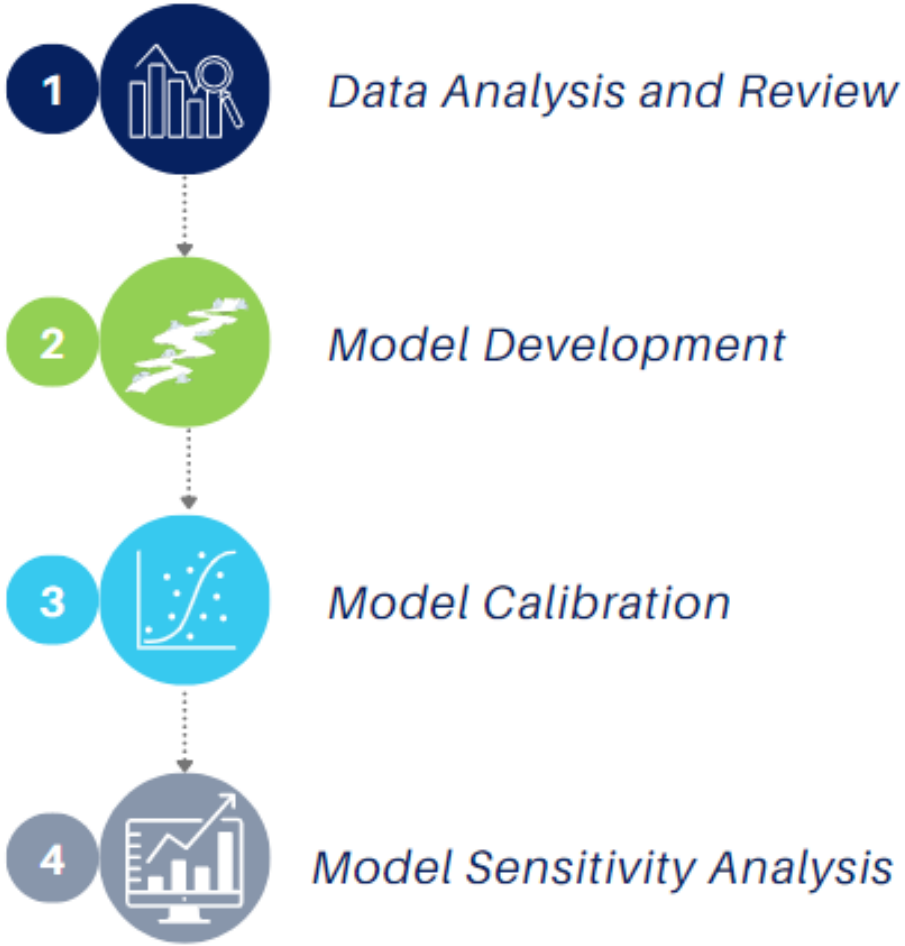
- ## What's a model?
  - A model is a mathematical representation of the physical, chemical, and biological processes in a waterbody.



$$\frac{dc_i}{dt} = \frac{Q_{i-1}}{V_i} c_{i-1} - \frac{Q_i}{V_i} c_i - \frac{Q_{out,i}}{V_i} c_i + \frac{E'_{i-1}}{V_i}(c_{i-1} - c_i) + \frac{E'_i}{V_i}(c_{i+1} - c_i) + \frac{W_i}{V_i} + S_i$$

- ## Why are models useful?
  - Fill the gaps in observed data
  - Have a predictive capability
  - Help with evaluation of management strategies
  - Identify causes of water quality problems

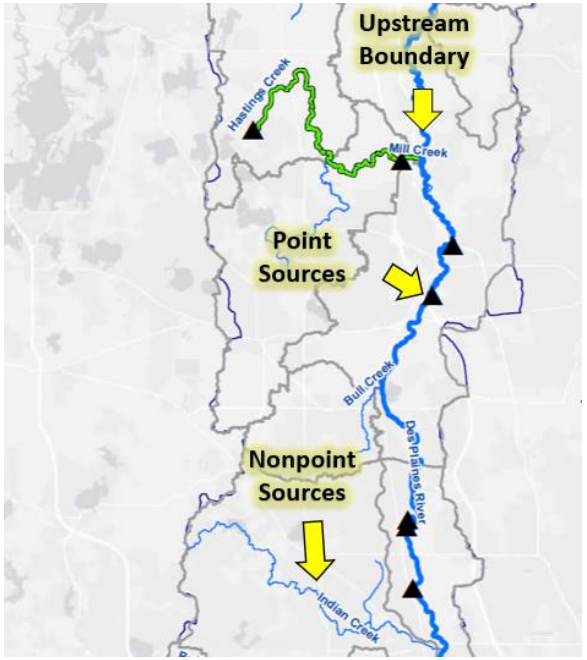
Modeling Process



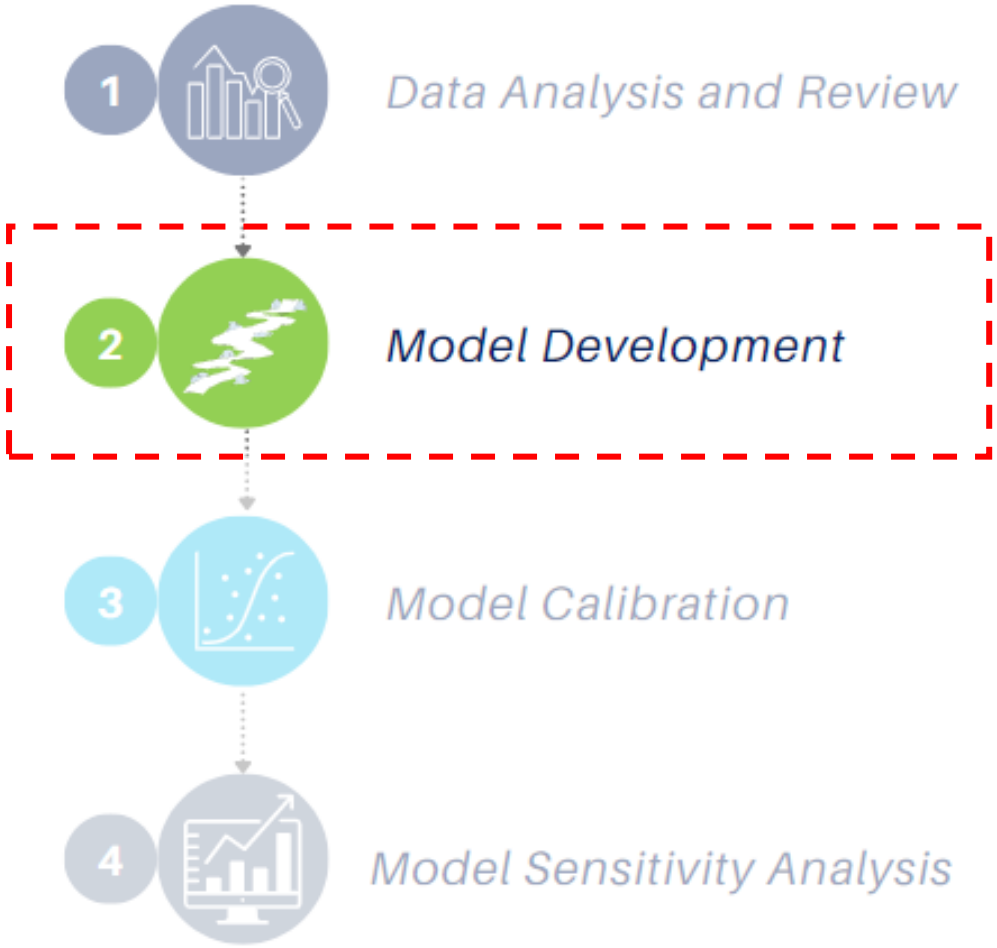
Modeling Process

1. Data Analysis and Review
2. Model Development
3. Model Calibration
4. Model Sensitivity Analysis

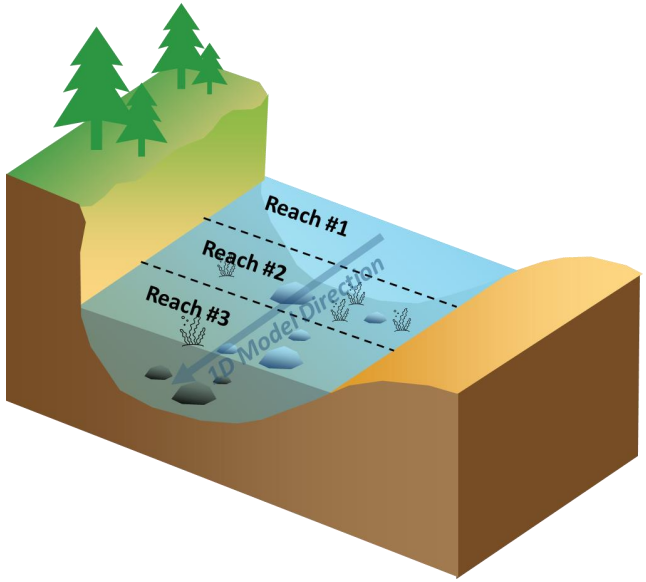
- ✓ Review existing data
- ✓ Identify data gaps
- ✓ Develop and execute a sampling program
- ✓ Determine model spatial and temporal extent



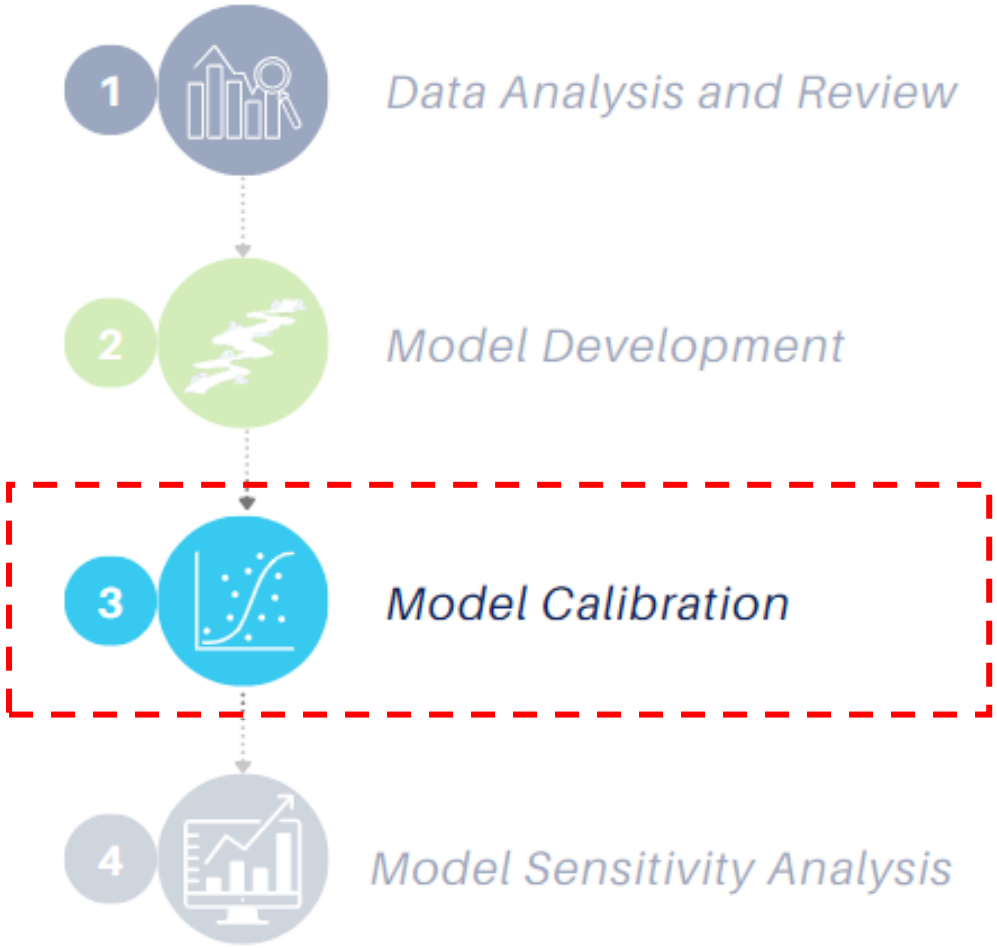
Modeling Process



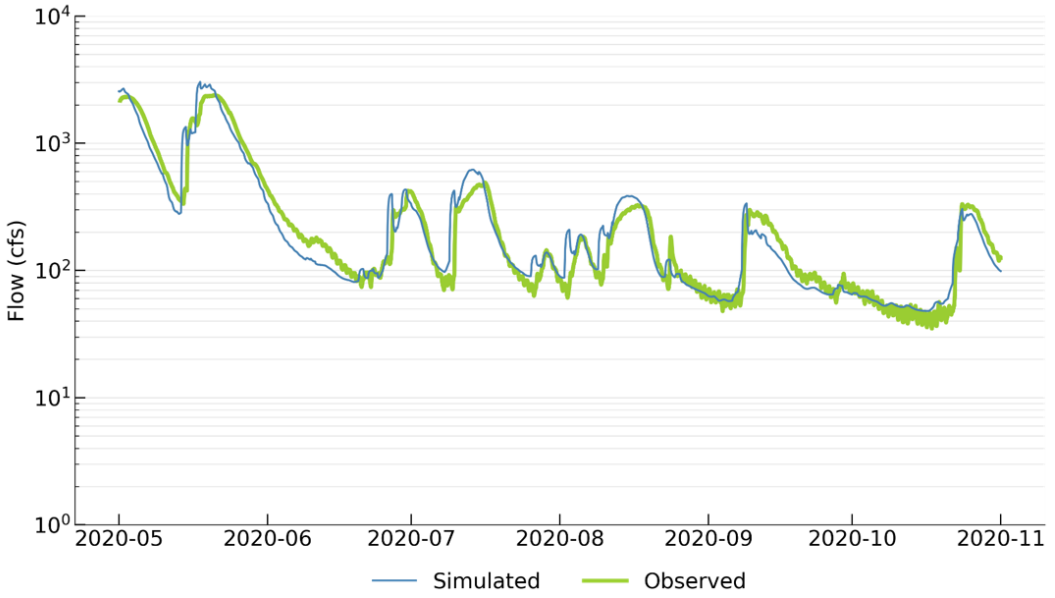
- ✓ Segment the river
- ✓ Preprocess input data
- ✓ Select model parameters
  - Biochemical oxygen demand, algae growth rate, etc.



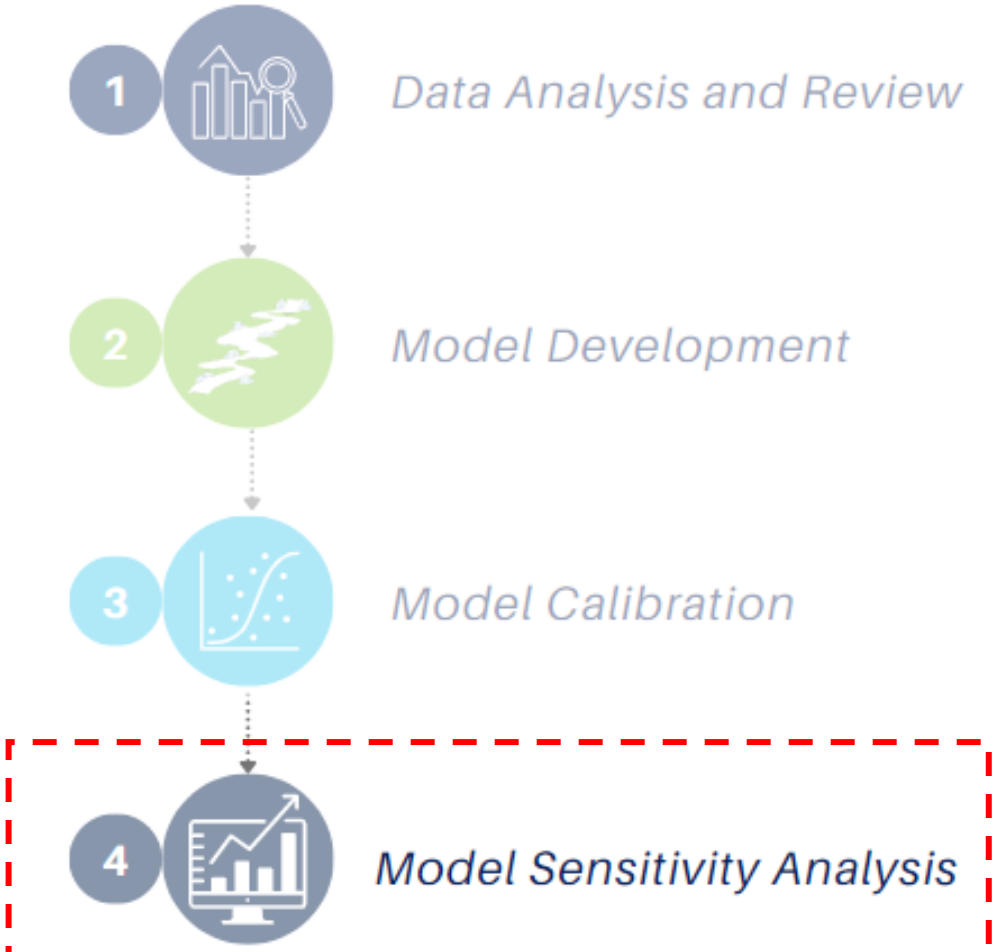
Modeling Process



- ✓ Troubleshoot the model simulation
- ✓ Adjust parameters to match simulated and observed data
  - Use measured data, literature values, or best professional judgement



Modeling Process



✓ Identify the most sensitive model parameters

- Inform the management scenarios choices
- Identify the importance of data gaps

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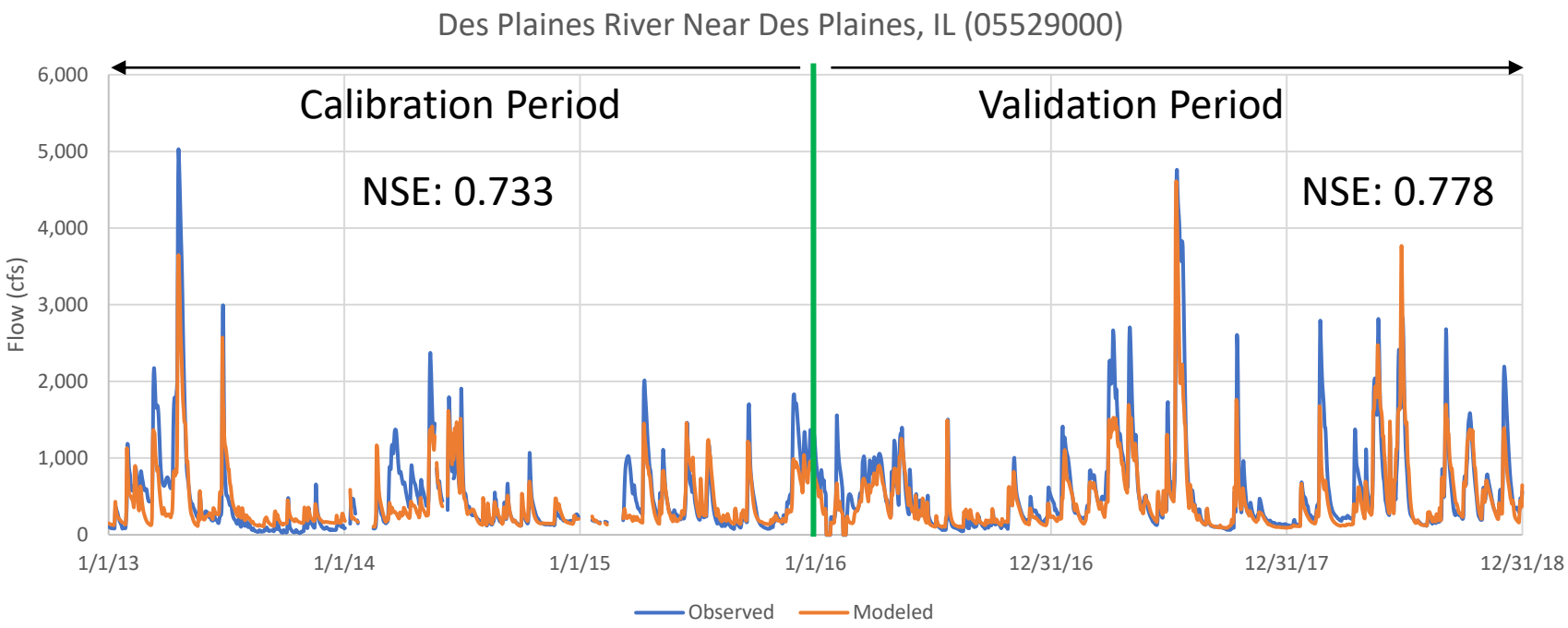
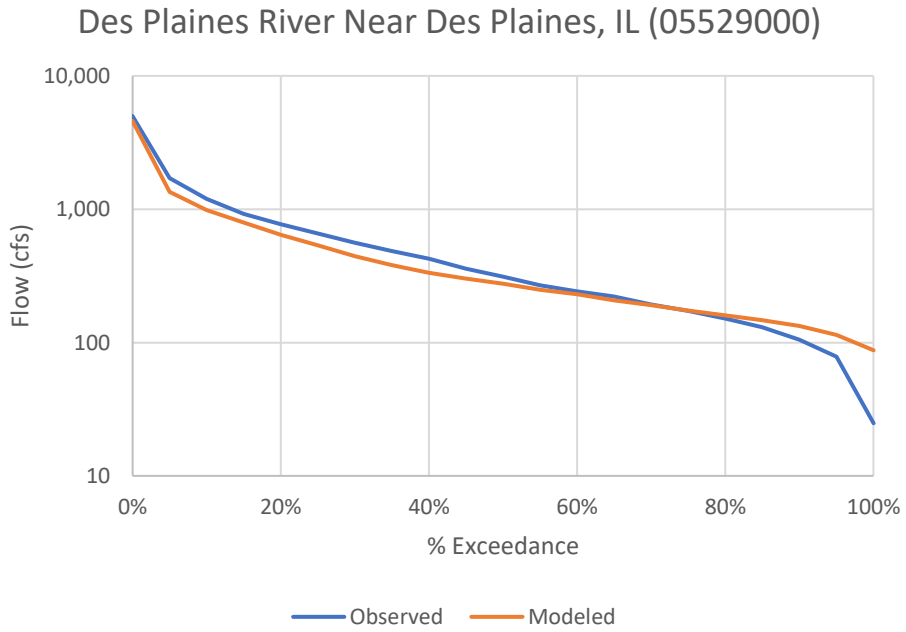
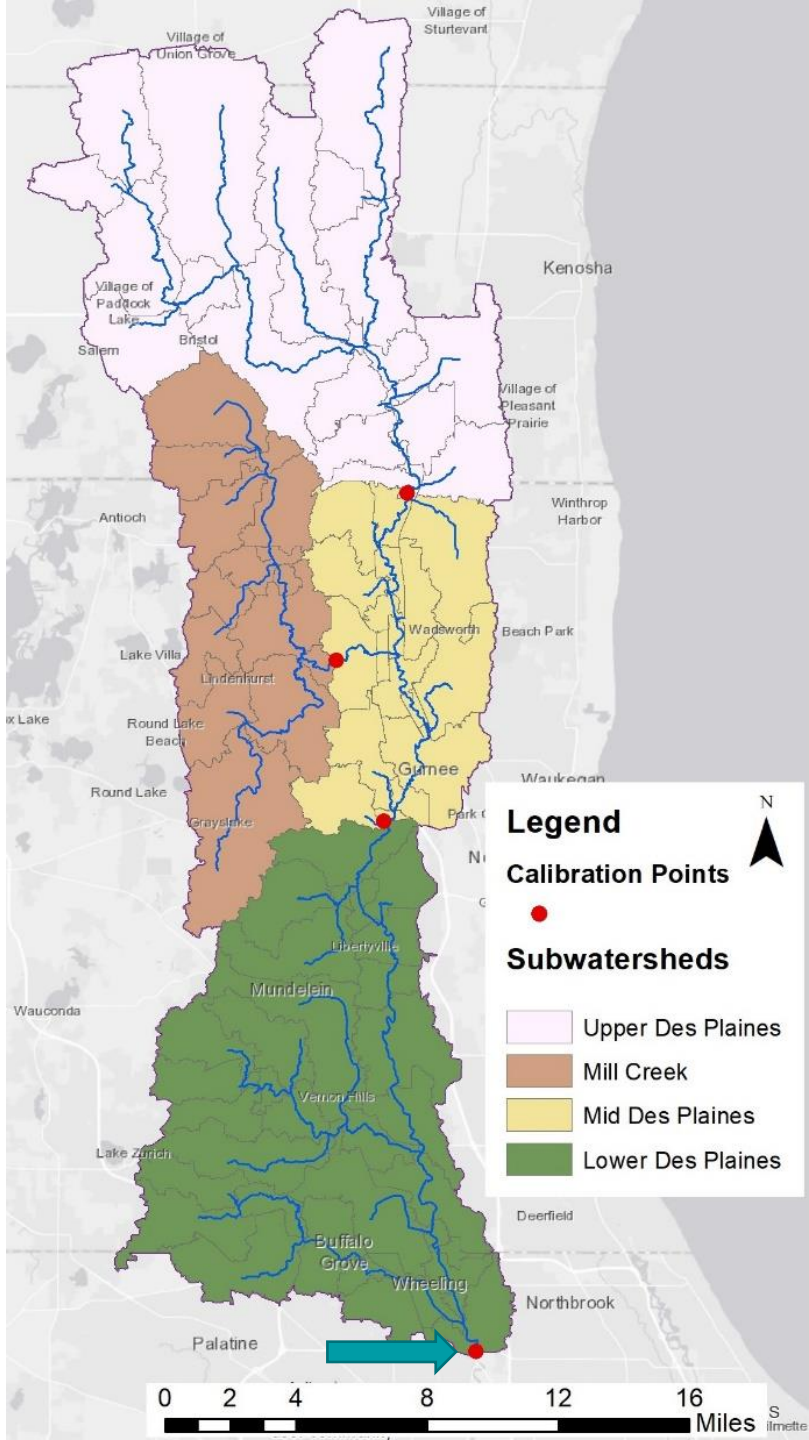
DRWW NARP Model

Setup and Calibration

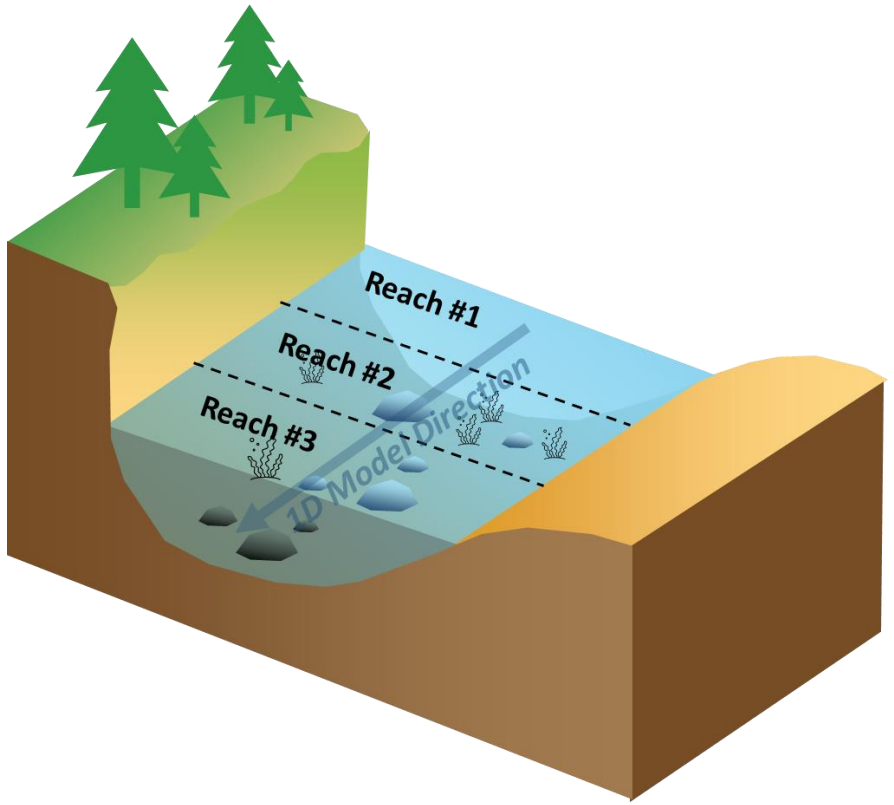

Des Plaines River Near Des Plaines, IL (05529000)
Calibration Period
Validation Period
NSE: 0.733
NSE: 0.778
Flow (cfs)
6,000
5,000
4,000
3,000
2,000
1,000
0
1/1/13
1/1/14
1/1/15
1/1/16
12/31/16
12/31/17
12/31/18
Observed
Modeled


Des Plaines River Near Des Plaines, IL (05529000)
Flow (cfs)
10,000
1,000
100
10
0%
20%
40%
60%
80%
100%
% Exceedance
Observed
Modeled


Village of Sturtevant
Village of Union Grove
Kenosha
Village of Paddock Lake
Salem
Bristol
Village of Pleasant Prairie
Antioch
Winthrop Harbor
Lake Villa
Lindenhurst
Wadsworth
Beach Park
Round Lake Beach
Round Lake
Grayslake
Gurnee
Waukegan
Libertyville
Mundelein
Wauconda
Vernon Hills
Lake Zurich
Buffalo Grove
Wheeling
Deerfield
Northbrook
Palatine
Legend
Calibration Points
Subwatersheds
Upper Des Plaines
Mill Creek
Mid Des Plaines
Lower Des Plaines
N
0
2
4
8
12
16
Miles

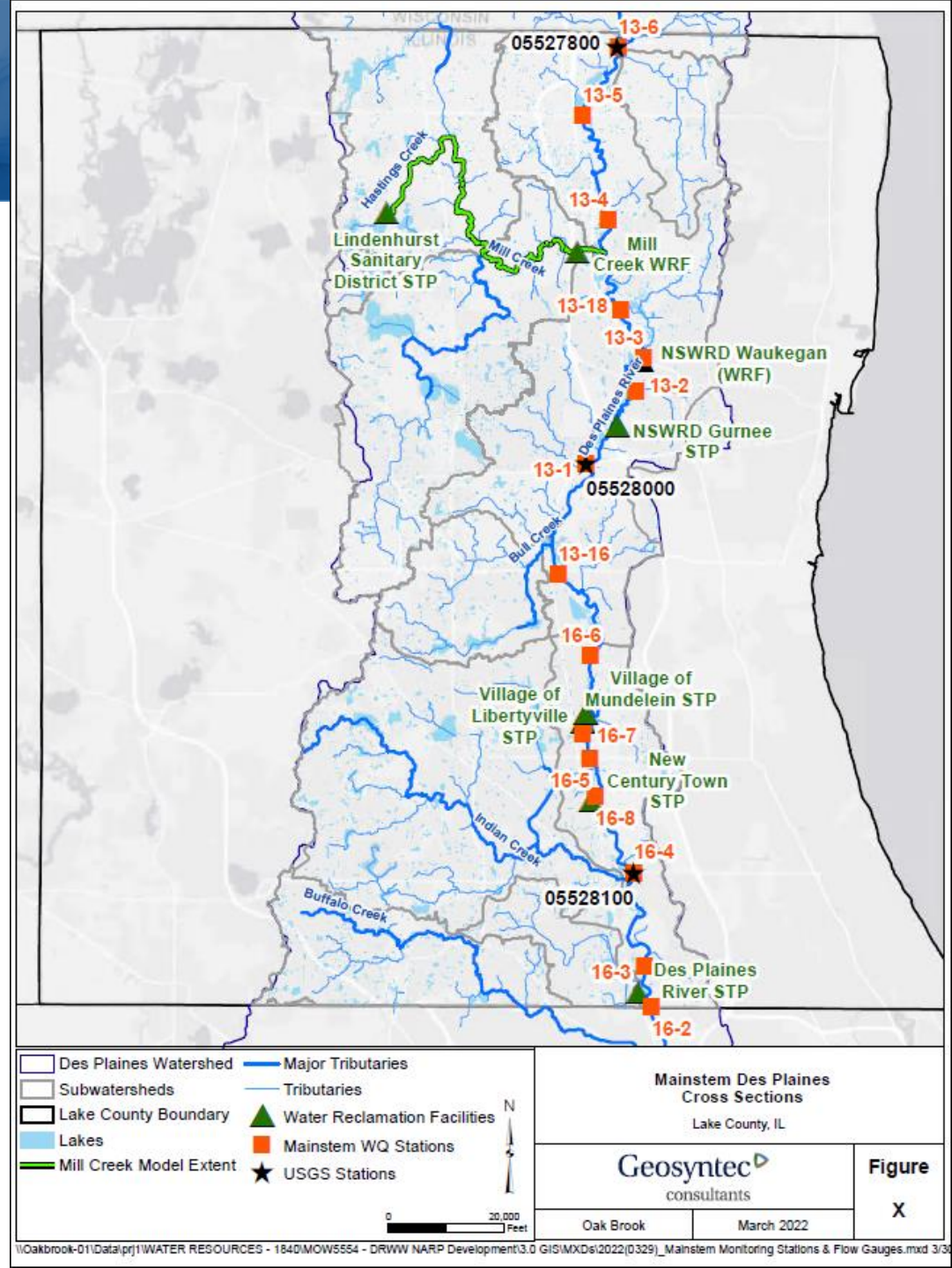
Instream Model – Qual2kw

- Qual2kw is a one-dimensional model
  - Qual2kw 1D model represents a river as a series of reaches with constant hydraulic and water quality characteristics
  - In reality, factors influencing water quality might change in the 2D or even 3D
  - Model simulations might not capture all variations in observed data
  - Observed data depends on where the sondes were exactly deployed within each reach

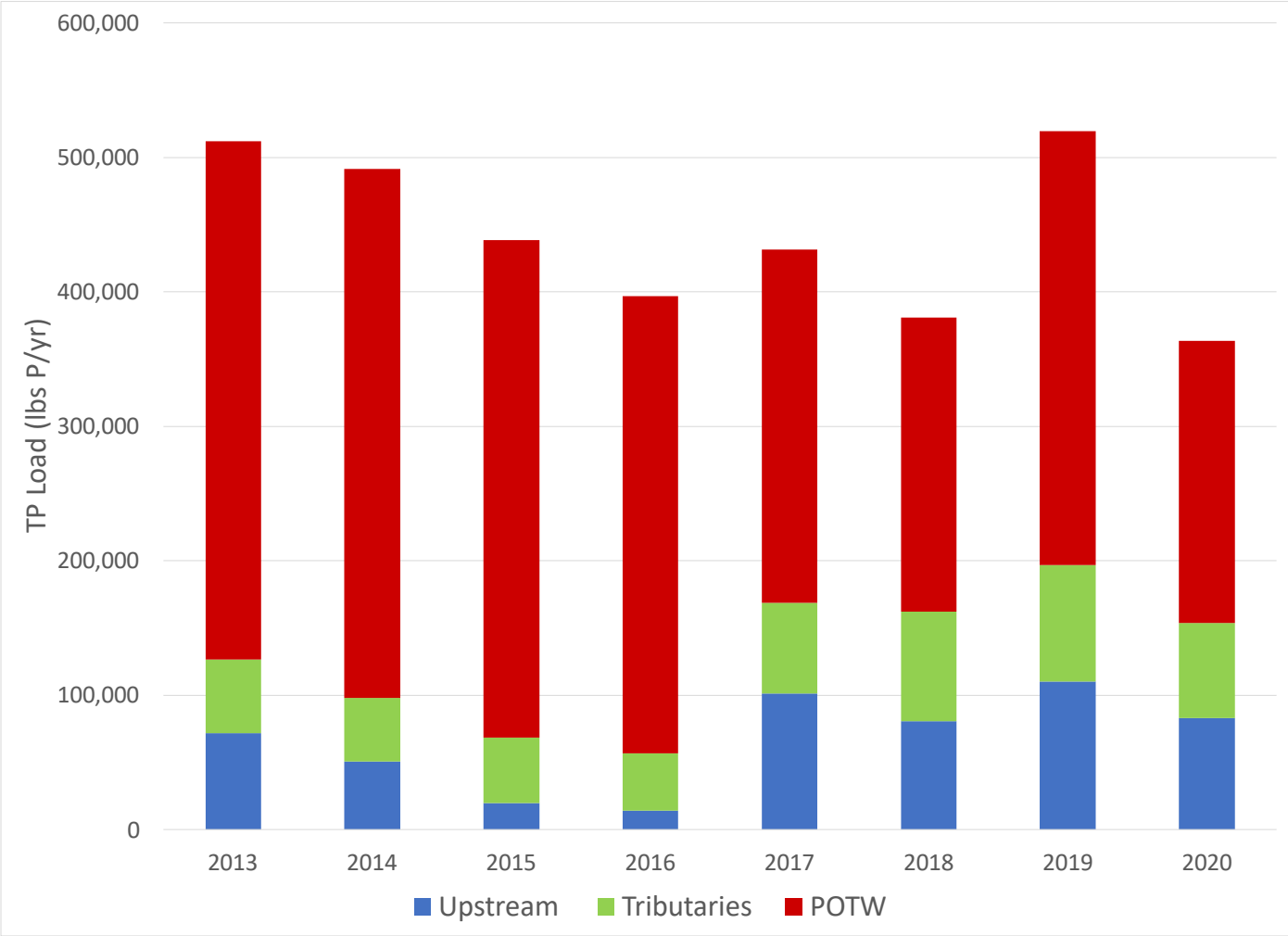


Instream Model Calibration

- 14 water quality stations on the mainstem
  - 2 continuous
  - 11 discrete



Annual TP Load Distribution



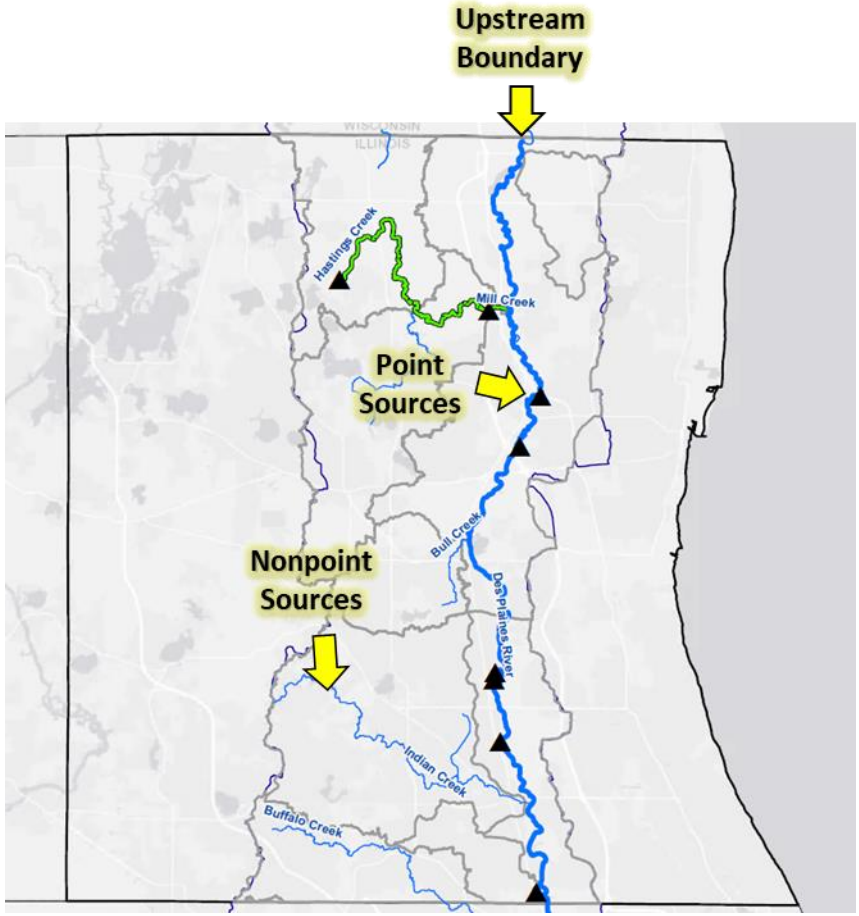
Significant decrease in POTW loads since 2015. High load in 2019 driven by high precipitation.

Watershed Management Scenarios – Individual Scenarios

Upstream Load Reductions
75%

Tributary Load Reduction
75%

POTW Load Reduction
0.5 and 0.1 mg/L



Key Takeaways

- POTW total phosphorus reductions beyond 0.5 mg/L have minimal impact on water quality.
- Upstream total phosphorus reduction reduces sestonic chlorophyll a and improves dissolved oxygen during high flows
- Tributary total phosphorus reductions reduce sestonic chlorophyll a in the mainstem river but have minimal impact on dissolved oxygen.
- A combined reduction in the load from POTWs, nonpoint sources, and upstream improves the water quality in the Des Plaines River.
- Improving upstream dissolved oxygen addresses the impairment in upper reaches of the Des Plaines River.

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IMPLEMENTATION PLAN

NARP Implementation Actions Items

NARP Section 4

Pre 2033 Activities

Post 2033 Activities

NARP Implementation Actions Items

Administrative actions

Actions to address DO and nuisance algae impairments

Actions to reduce nonpoint-source loading

Monitoring and modeling studies

Administrative Actions

- Evaluate role of DRWW in project implementation
- Continue DRWW monthly meetings and annual newsletters

Actions to Address DO and Algae

- Coordinate activities with WI during Des Plaines River TMDL process
- Meet regulatory schedule for POTW effluent reductions to 0.5mg/L

Actions to Address NPS Loading

- Opportunistically explore sector areas with ancillary benefits
  - Urban
  - Agricultural
  - Restoration
- Support project partners
- Provide educational opportunities
- Look for ways to improve watershed stewardship

Monitoring and Modeling Activities

- Establish future monitoring program
- Continue to assess MS4 data
- Works with watershed partners to track implementation
- Work with USGS for establishment of future monitoring locations

Questions

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