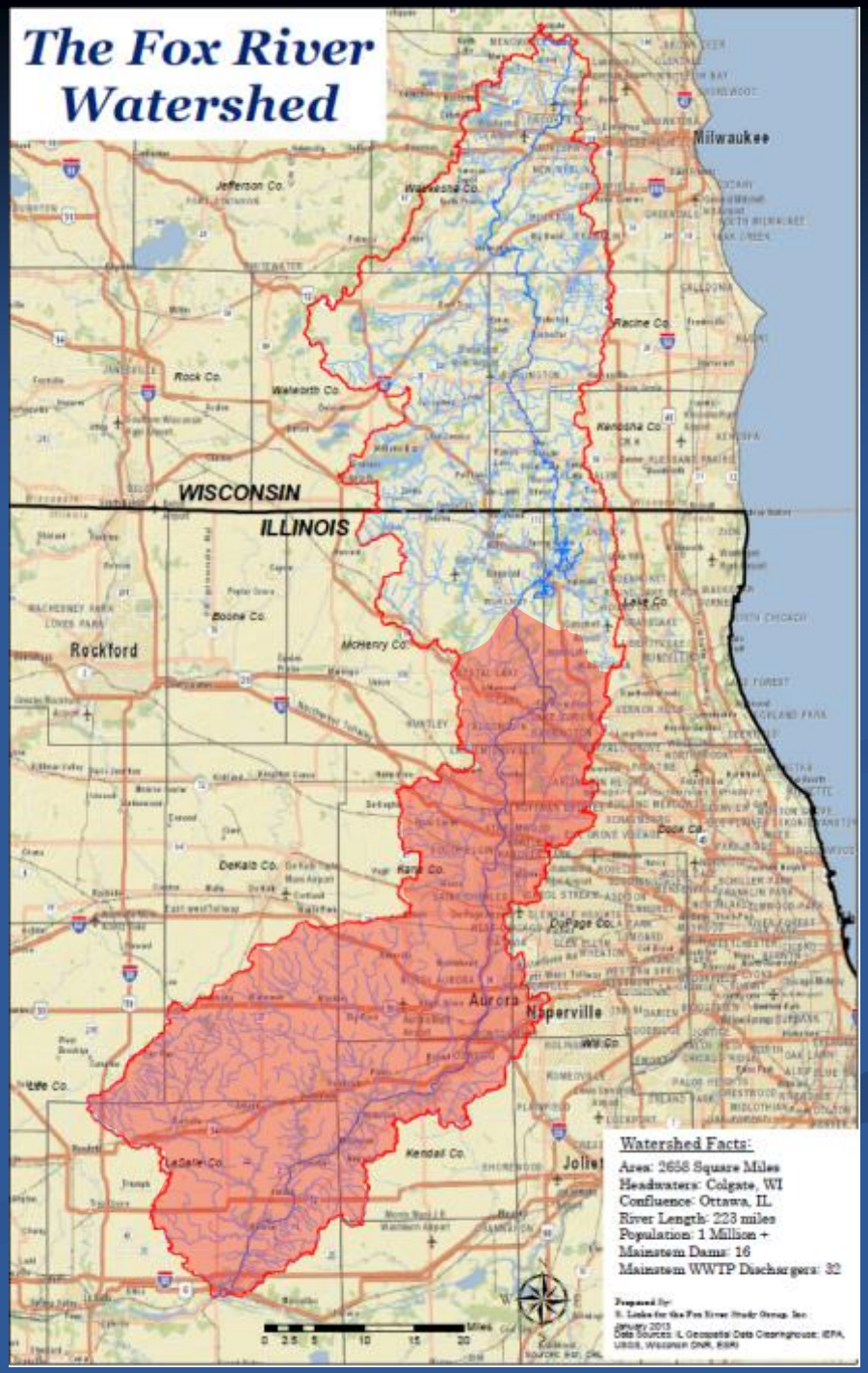
Nutrient Reductions and Dam Removal:
Developing an Implementation Plan to Address Dissolved Oxygen and Algae Problems in the Fox River

March 2014

Rob Linke, P.E., CFM
Board Member
Fox River Study Group, Inc.

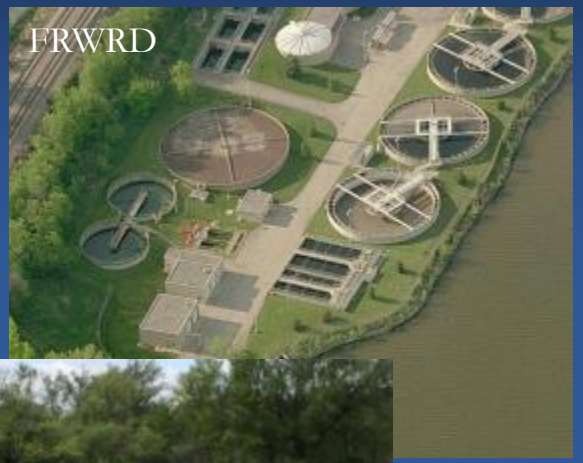
Fox River Watershed

- 2658 Sq. miles
  - 938 Sq. miles WI
  - 1720 Sq. miles in IL
- 223 miles long
- Population > 1 Million
- 16 Dams
- 32 WWTPs on river



Managing a Multi-Purpose Resource

- Drinking water for 300,000+ people
- Wastewater and stormwater conveyance
- Recreation for inhabitants and visitors
- Habitat for aquatic and terrestrial species
- Aesthetic value

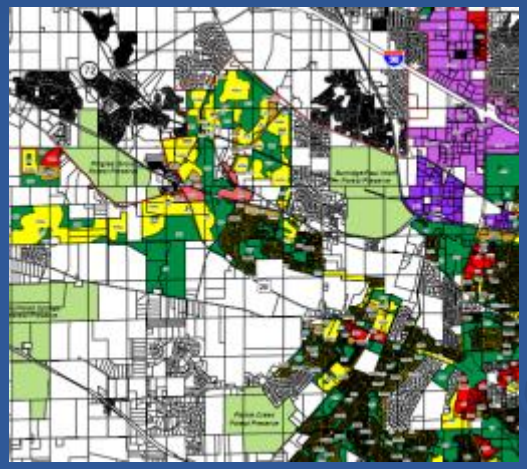


Impacts of Our River Nationally

- Northern Gulf of Mexico Hypoxic Zone
  - 6700 Sq. miles (2011)
  - Impacts $2.8 Billion dollar commercial & recreational fishing industry
  - Caused by excess nutrients (P & N)
- 45% TP reduction needed to meet national goal to address NGOMHZ

In the Beginning…

(1990's & early 2000's)



ILLINOIS INTEGRATED WATER QUALITY REPORT AND SECTION 303(d) LIST, 2012

Clean Water Act Sections 303(d), 305(b) and 314

Water Resource Assessment Information and List of Impaired Waters

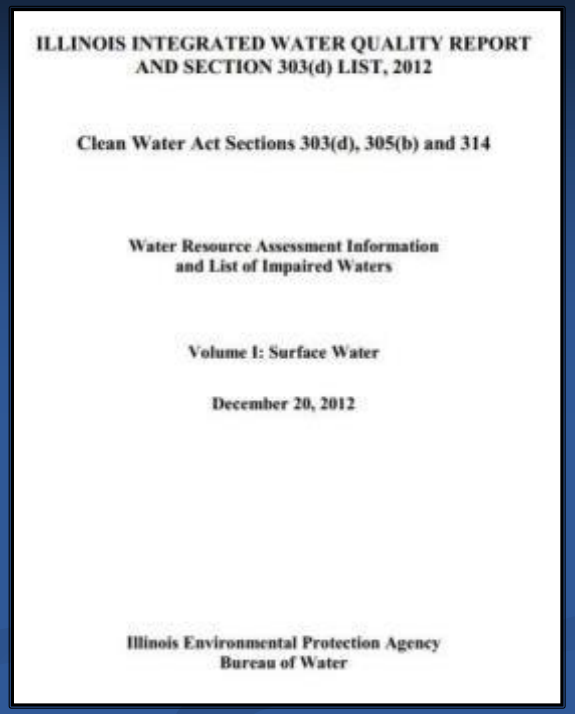
Volume I: Surface Water

December 20, 2012

Illinois Environmental Protection Agency
Bureau of Water

In the Beginning…

- Reports by IEPA list Fox River and several of its tributaries as impaired waters
- Sources:
  - Hydromodification
  - Flow Regulation
  - Urban Runoff
  - CSOs
  - Municipal Point Sources
- Causes
  - Flow alterations
  - Habitat (lack of)
  - Sedimentation/Siltation
  - Dissolved Oxygen
  - Suspended Solids
  - Excess algal growth
  - Total Phosphorus
  - Fecal coliform bacteria
  - PCBs
  - Mercury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- 78% of Fox River mainstem classified as non-supporting for Aquatic Life
- 50% non-supporting for primary contact
- 100% non-supporting for fish consumption

In the Beginning…

- IEPA asks Point Source Dischargers and Environmental Groups to work together to address river quality issues and improve the permitting process for WWTPs
- Stakeholders concerned about a future TMDL by IEPA based on limited WQ data for the Fox River
- Stakeholders begin collecting WQ data in preparation for IEPA-driven TMDL process
- Group discusses using data to create a alternative study to a traditional TMDL to ensure latest monitoring data is used and local input on solutions is maximized.

Fox River Study Group, Inc.

Our Mission:

To bring a diverse coalition of stakeholders together to work to preserve and enhance water quality in the Fox River watershed

Fox River Study Group is born!

- Incorporated as a Not For Profit in 2003
  - City of Aurora
  - City of Elgin
  - Fox Metro Water Reclamation District
  - Fox River Ecosystem Partnership
  - Fox River Water Reclamation District
  - Friends of the Fox River
  - Kane County
  - Sierra Club - Illinois Chapter
  - Tri-Cities (Batavia, Geneva, St. Charles)

Financial Supporters

- USEPA
- Illinois EPA
- IL River Coordinating Council/Lt. Gov. Pat Quinn
- Lt. Gov. Corinne Wood
- Chicago Metropolitan Agency for Planning
- City of Aurora
- City of Elgin
- City of St. Charles
- City of Batavia
- City of Geneva

- City of Plano
- ConAgra Foods
- Dunham Fund
- Fox River Water Reclamation District
- Kane County Riverboat Fund
- The Conservation Foundation
- Village of Algonquin
- Village of Lakemoor
- Village of Port Barrington
- United City of Yorkville
- Yorkville-Bristol Sanitary District

In-Kind Contributors

- Fox River Water Reclamation District
- Fox Metro Water Reclamation District
- IL EPA
- IL State Water Survey
- Northern Moraine Water Reclamation District
- Village of Algonquin
- City of Aurora
- City of Crystal Lake
- City of Elgin
- City of St. Charles
- City of Geneva
- Sierra Club
- Friends of the Fox River
- Environmental Defenders of McHenry County
- Lake in the Hills Sanitary District
- The Conservation Foundation
- Kane County
- Gardner Carton & Douglas
- WE Deuchler Associates

Four Phase Approach

Phase I: 2002-2003

Understand Available Information

- Water quality (FoxDB)
- GIS data
- Literature review and publication database
- How to address the issues

Phase II: 2003-2009

Develop Planning Tools

- HSPF: loads, storm events
- QUAL2K: DO regime during low flows
- Monitoring plan
- Biological data (FoxDB modified)

Phase III: 2006-2013

Integrated Monitoring/ Refine models

- Low flow monitoring
- Storm event monitoring
- Refinement of Planning Tools
- Evaluate management options (scenarios)

Phase IV: 2013-…

Implementation

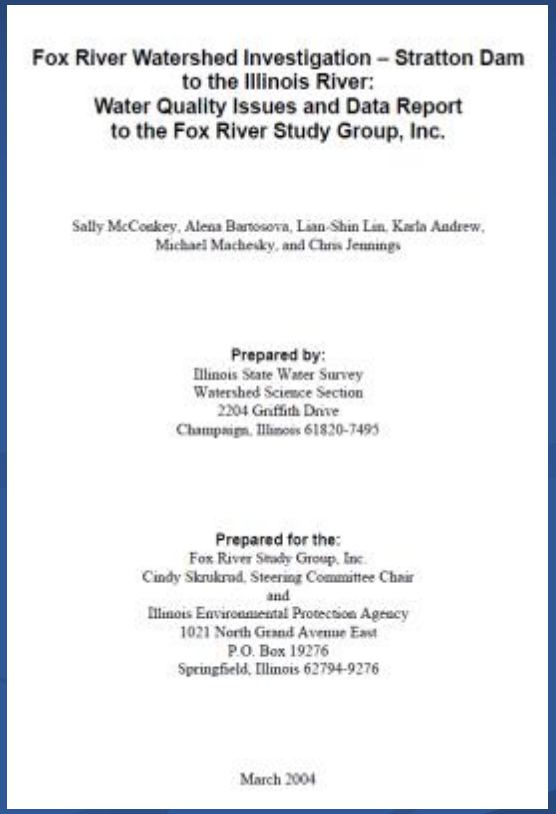
- **Fox River Implementation Plan**
  Propose & promote management actions
- Evaluate planned WWTP expansions, NPDES permits, etc.
- Continued model update & monitoring
- Expand study area to include upper portion

Phase I

Illinois State Water Survey: *Critical Review of Data*

<u>Some parameters exceed standards/recommendations:</u>

- Total Nitrogen
- Total Phosphorus
- Dissolved Oxygen
- pH
- Fecal coliform bacteria



Fox River Watershed Investigation – Stratton Dam to the Illinois River:
Water Quality Issues and Data Report to the Fox River Study Group, Inc.

Sally McCoskey, Alena Bartosova, Lian-Shin Lin, Karla Andrew, Michael Machesky, and Chris Jennings

Prepared by:
Illinois State Water Survey
Watershed Science Section
2204 Griffith Drive
Champaign, Illinois 61820-7495

Prepared for the:
Fox River Study Group, Inc.
Cindy Skrukrud, Steering Committee Chair
and
Illinois Environmental Protection Agency
1021 North Grand Avenue East
P.O. Box 19276
Springfield, Illinois 62794-9276

March 2004

Recommended modeling approach to evaluate management scenarios that would address current WQ problems and prevent future degradation from happening.

Study Completed March 2004
Funded by IEPA
Available at: http://ilrdss.isws.illinois.edu/fox/

Volunteer Water Quality Monitoring

Methods

- Monthly since 2002
- IEPA-approved QA/QC program
- Volunteer collection, transport and analysis
- Samples analyzed by Fox Metro & Fox River WRDs & City of Elgin Water Dept.
- Constituents: Temp, pH, DO, conductivity, BOD, TSS, fecal coliform, TKN, Ammonia N, Nitrate N, Organic N, chlorophyll a, est. biomass, Total P, Dissolved P, Chloride, Turbidity

Sites

- Seven sites on the Fox River- Johnsburg to Yorkville
- Sleepy Hollow Creek
- Tyler Creek
- Silver Creek
- Indian Creek
- Crystal Creek
- Ferson Creek
- Blackberry Creek

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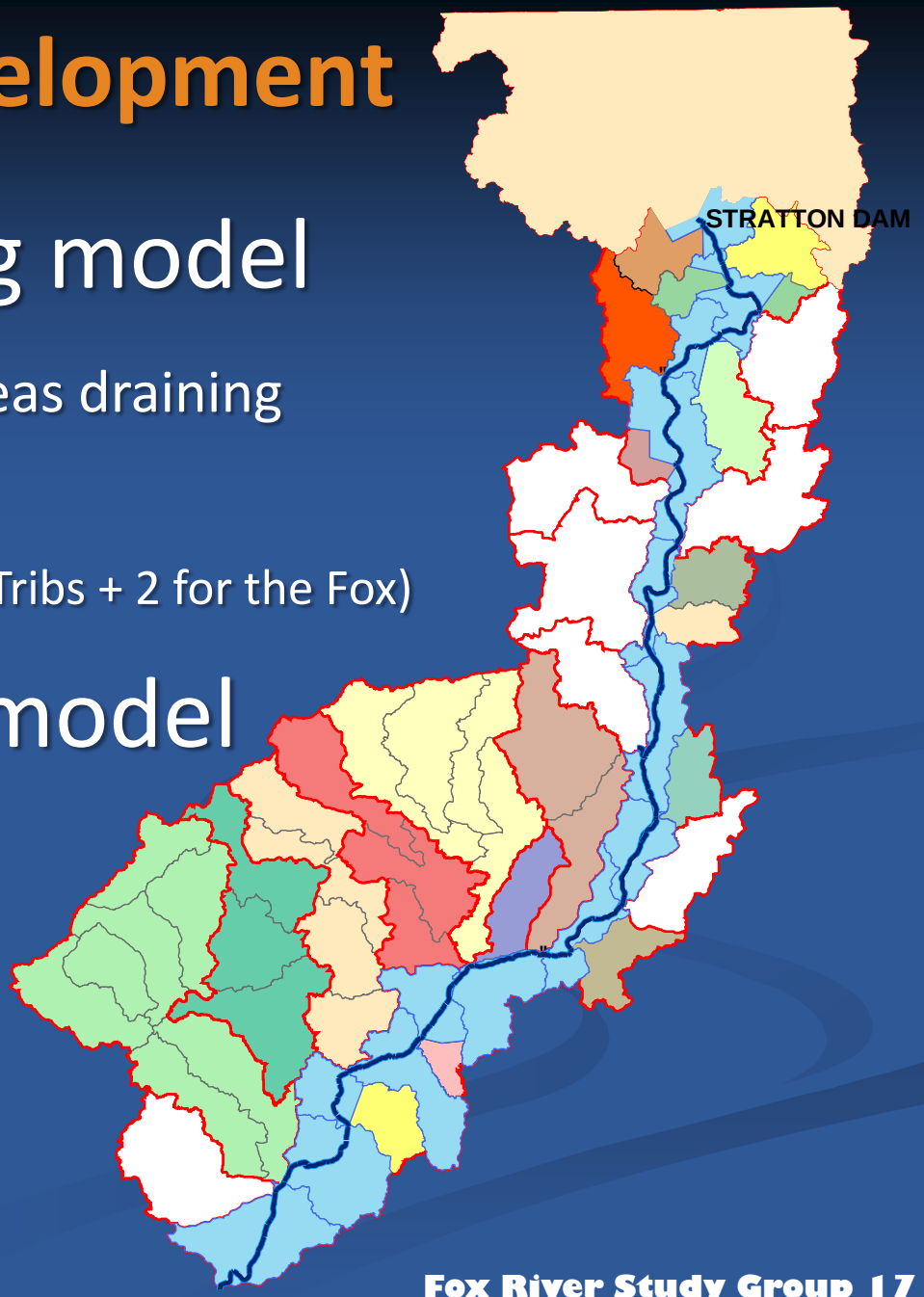
Phase II – Tool Development

- Watershed loading model
  - 31 Tributaries + Areas draining directly to Fox R.
  - 33 HSPF Models (Tribs + 2 for the Fox)
- Receiving stream model
  - QUAL2K (1 model)
  - Steady State



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Phase III: 2006-2013

Integrated Monitoring/ Refine models

- Low flow monitoring

Storm event monitoring

Completed Sept. 2011

- Refinement of Planning Tools
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Phase IV: 2013-...

Implementation

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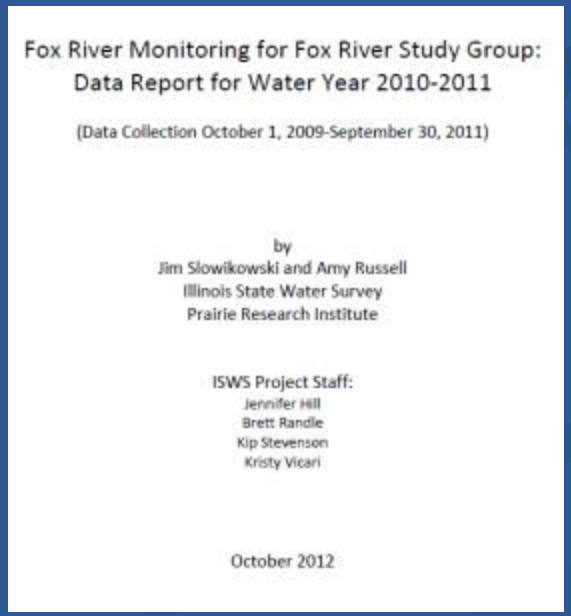
Phase III – Storm Monitoring

- 20 Sites
- 4 Rain Gages
- 4 Stream Flow Gages
  - In addition to USGS gages



Fox River Monitoring for Fox River Study Group:
Data Report for Water Year 2010-2011

(Data Collection October 1, 2009-September 30, 2011)

by
Jim Slowikowski and Amy Russell
Illinois State Water Survey
Prairie Research Institute

ISWS Project Staff:
Jennifer Hill
Brett Randle
Kip Stevenson
Kristy Vicari

October 2012

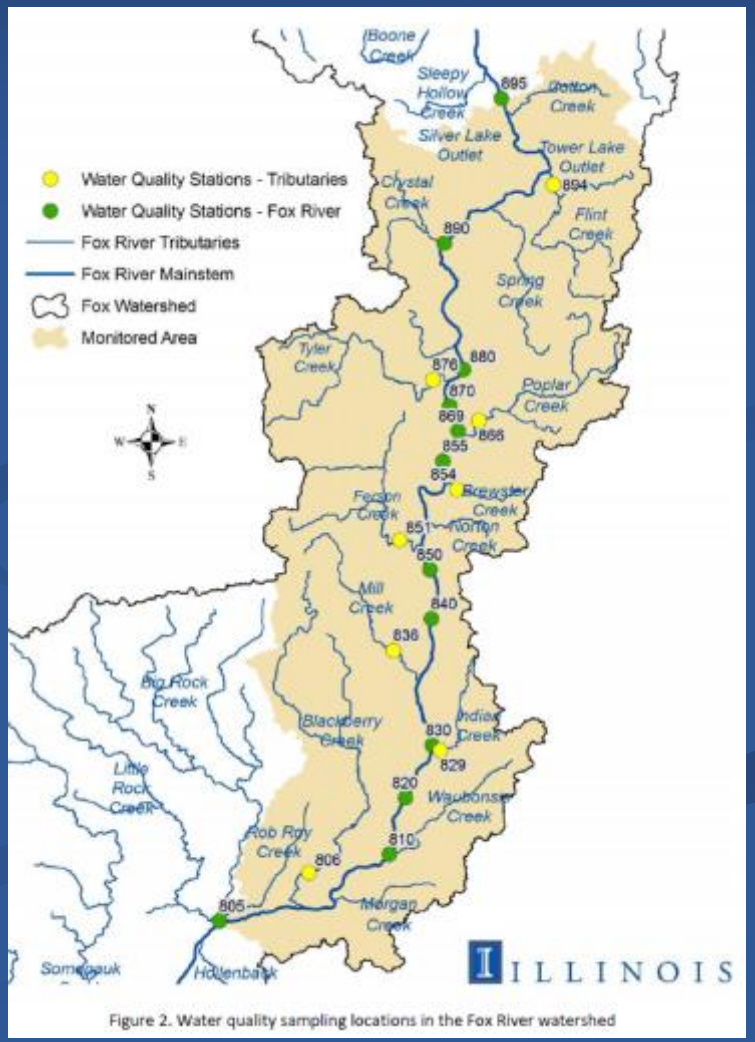


Figure 2. Water quality sampling locations in the Fox River watershed

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Integrated Monitoring/ Refine models

Low flow monitoring

Completed June 2012

- Storm event monitoring
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Phase IV: 2013-…

Implementation

Fox River Implementation Plan

Propose & promote management actions

- Evaluate planned WWTP expansions, NPDES permits, etc.
- Continued model update & monitoring
- Expand study area to include upper portion

Phase III- Low Flow Monitoring

- Originally planned to be completed in Summer 2006
- No “low flows” in river again until Summer 2012.
- Joint effort by ISWS & Deuchler Environmental, Inc.
- Intensive sampling over 72 period once “low flows” are measured at gages.
- Low flow = 360 cfs Algonquin/ 523 cfs Montgomery

Phase III- Initial Management Scenarios

- Best management practices for non-point runoff
  - Ag lands- increase no-till practices for row crops (corn and soybeans) by 100%
    - From 4% of all row crop areas to 8% of all row crop areas
  - Urban area BMPs
    - Applied to 5% of all urbanized area
- Modified point source discharges-reductions in phosphorus discharges
- Dam removal

Phase III- Initial Management Scenarios

- Modified point source discharges
  - Evaluate all major WWTPs at 1 mg/L TP limit
  - Evaluate all major WWTPs at 0.5 mg/L TP limit
  - Evaluate all major WWTPs at 0.1 mg/L TP limit
- Dam removal
  - Evaluate 7 of 12 dams removed
    - Excludes Stratton
  - Evaluate ALL 12 dams removed
    - Including Dayton

Phase III- Initial Management Scenarios

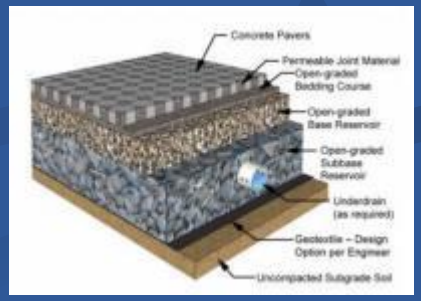
- Combinations of Urban BMPs, Ag BMPs, Point Source Limits, and Dams
- Evaluated impact of upstream influent TP concentration
  - 0.2 mg/L (current)
  - 0.1 mg/L (future)

Phase III- Initial Management Scenario Results

At the level applied in the simulated scenarios:

- Minimum impact from urban BMPs applied to 5% of urban areas
  - Less than 1% reduction in total load from watershed
  - At watershed scale, these site-scale green infrastructure BMPs may not have significant impact on main stem DO issues, but at the tributary stream scale, they likely have a significant impact (reduce flashiness of flows, lower runoff temps, less TSS, less urban pollutants into local streams, etc.)

Blair Remy Architects



Phase III- Initial Management Scenario Results

At the level applied in the simulated scenarios:

- **Tillage practices lower annual sediment loads by 15% and TP loads by 5% in the watershed**

www.nrcca.cals.cornell.edu/

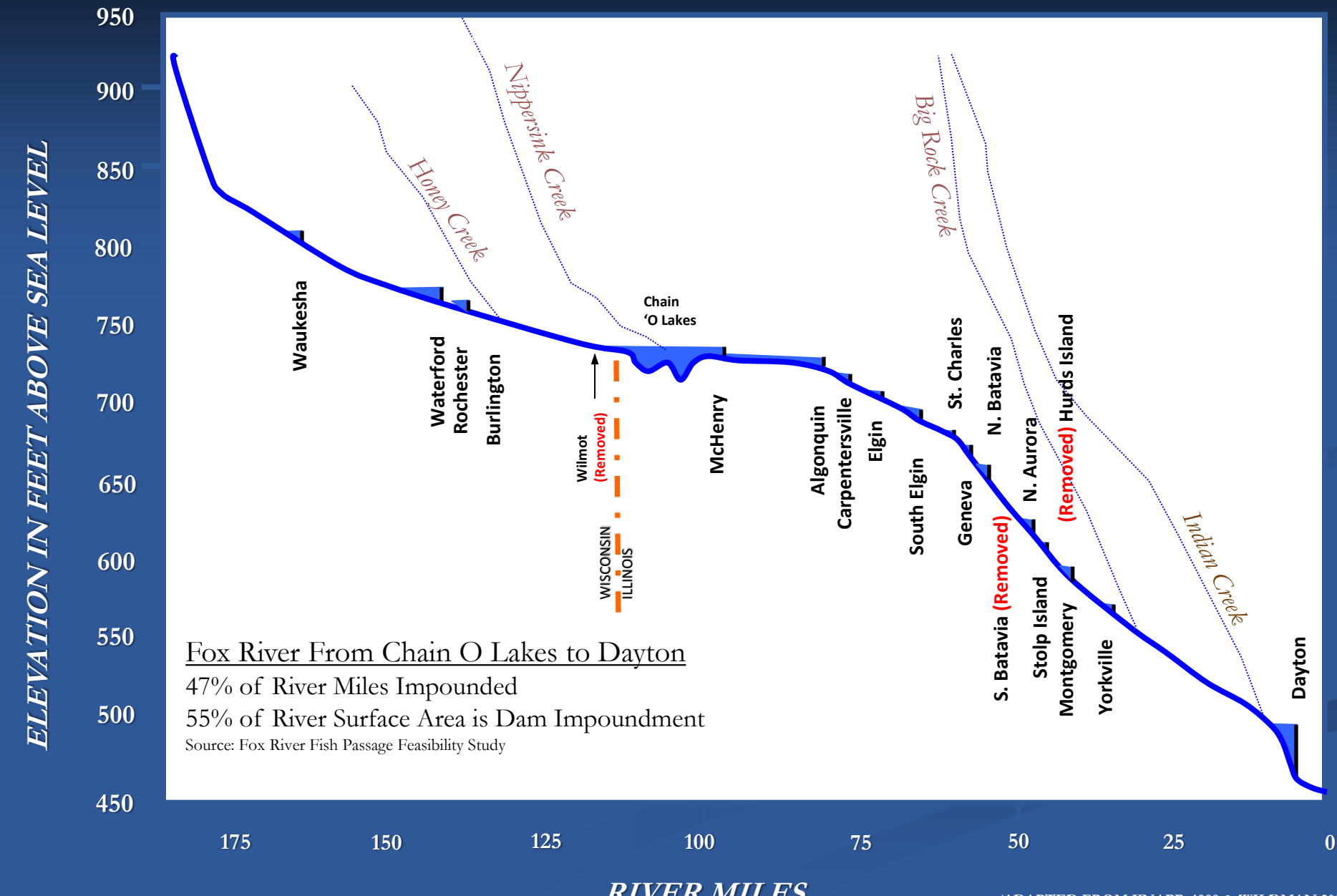
Phase III- Initial Management Scenario Results

- Limiting TP to 1 mg/L at major NPDES facilities reduces annual total TP load by 33%
- Algae levels significantly affected by dams
- Minimum DO affected by presence of dams and algae
- Limiting TP to 0.1 mg/L at WWTPs did not have significant positive impact on phytoplankton & DO concentrations within dam impoundments

Phase III- Initial Management Scenario Results

- Take home: Reducing pollutant loads (i.e. TP, BOD, etc.) alone will not solve the DO and algal impairments on the mainstem.

FOX RIVER PROFILE



(ADAPTED FROM KNAPP, 1988 & WILDMAN 2001)

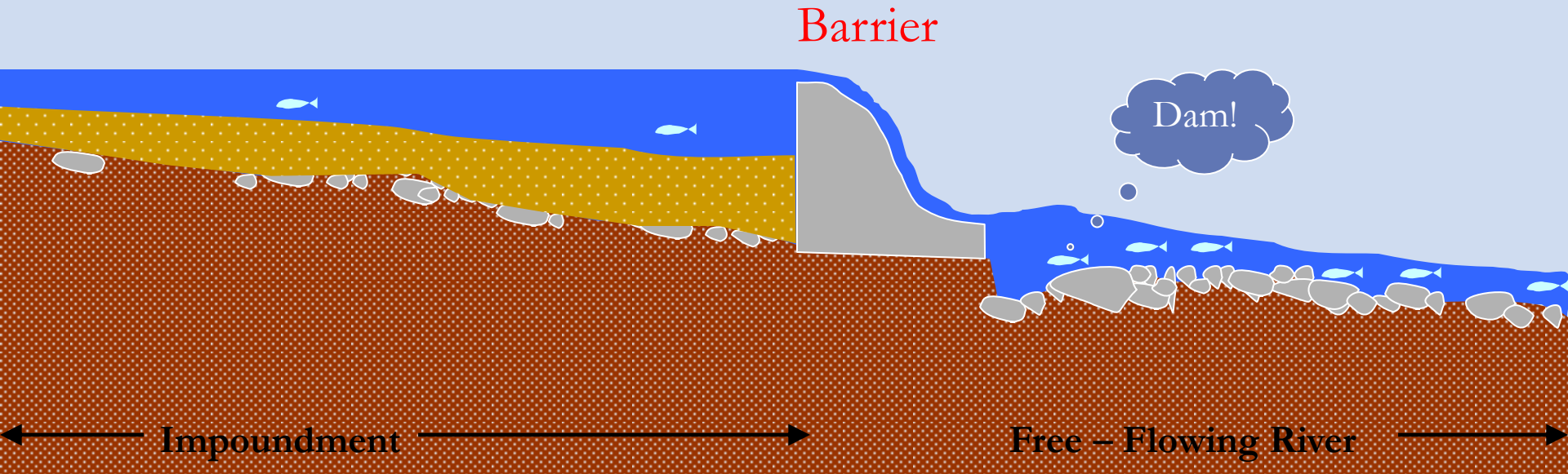
IMPACTS OF DAMS ON THE ECOSYSTEMS

Low Quality Ecosystem

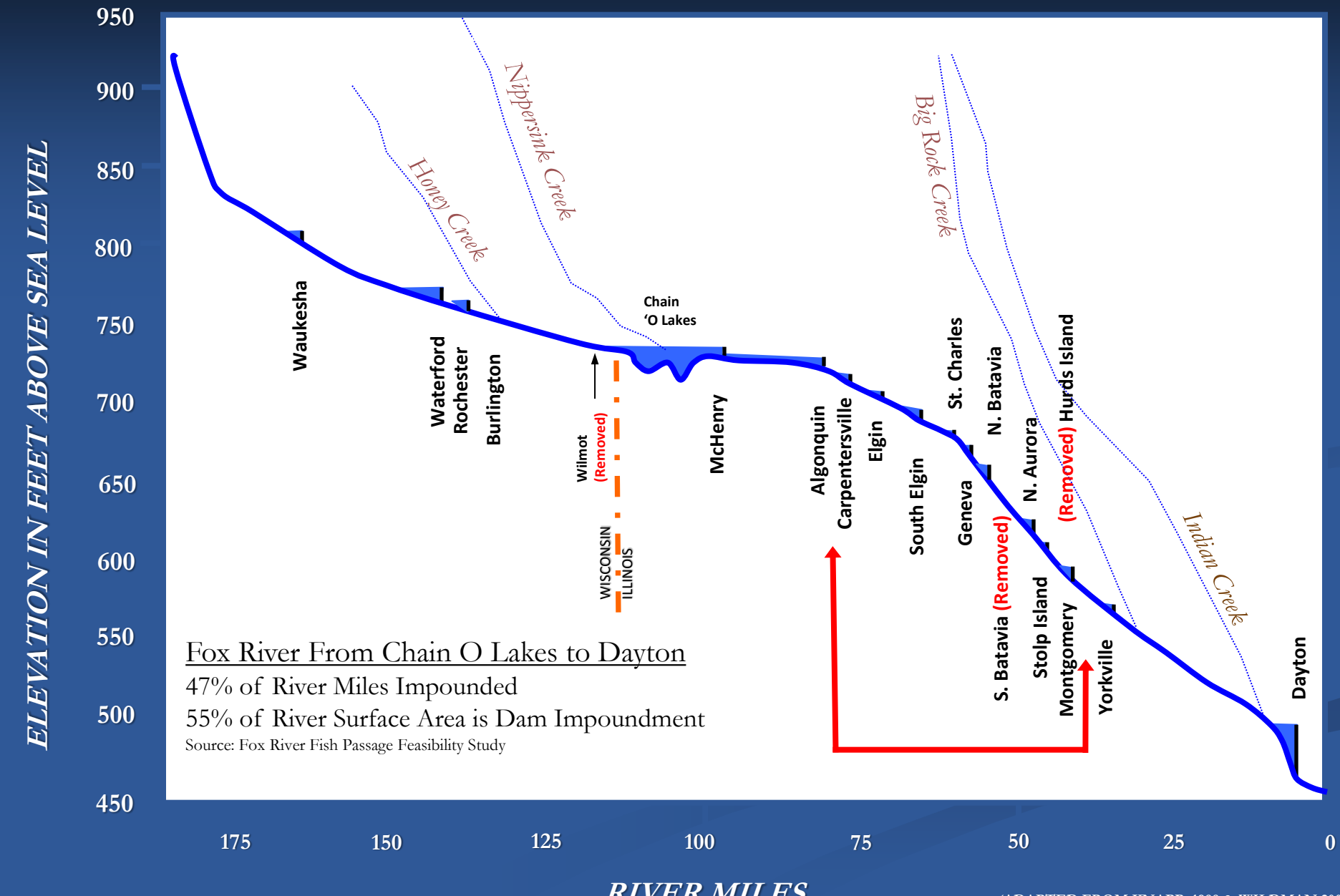
- Enlarged Surface Area, Low Velocity = Increased Water Temp & Nutrient Concentrations
- High Temp + Trapped Nutrients = Excessive Algal Growth & Low DO
- Low velocity, artificially flattened hydraulic gradient = Sediment Transport Reduced
- Little Variability in Substrate, Depth, etc.
- Net Result: Low Biodiversity

High Quality Ecosystem

- Variability in Velocity, Depth, etc.
- Adequate Dissolved Oxygen
- Nutrients Distributed & Assimilated
- Sediment Transport Occurs
- Higher Biodiversity



FOX RIVER PROFILE



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Phase IV- Management Decisions/ Policy Recommendations/Implementation

- Next Steps
  - Efforts incorporated as condition in NPDES permits
  - Major Dischargers (> 1 MGD) to evaluate feasibility of reducing phosphorus discharges to 1 and 0. 5 mg/L levels
  - Further modeling/recommendations
  - Develop **Fox River Implementation Plan** by June 15, 2015

Fox River Implementation Plan

What is the FRSG FRIP?

It will be the roadmap for watershed decision makers that will define the reductions in pollutant discharges needed and in-stream projects to be executed that, when implemented, will improve the water quality of the Fox River.

Fox River Implementation Plan

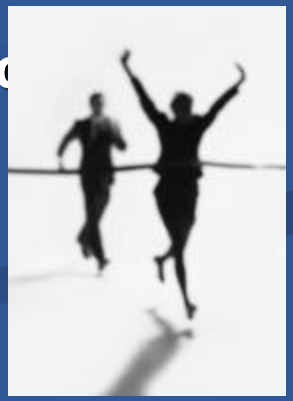
What the FRIP is NOT

- Will NOT address all the pollutants in the IEPA 303(d) Listing
  - Example: Doesn't address PCBs, Mercury, or Fecal Coliforms
- Will NOT identify site-specific NPS BMPs
- Will NOT identify individual, plant-specific capital projects for each WWTP (on the mainstem or tributaries)
- Is NOT being created by Bureaucrats far removed from the watershed

Fox River Implementation Plan

Goals

- Resolve the dissolved oxygen and algal impairments which cause the Fox River to not meet it's Designated Uses as defined by the IEPA [303(d) List].
- Replace a traditional TMDL plan.
- Create a plan that is fair to all stakeholders
- Recommendations developed based on good scienc input from local decision makers.



Fox River Implementation Plan

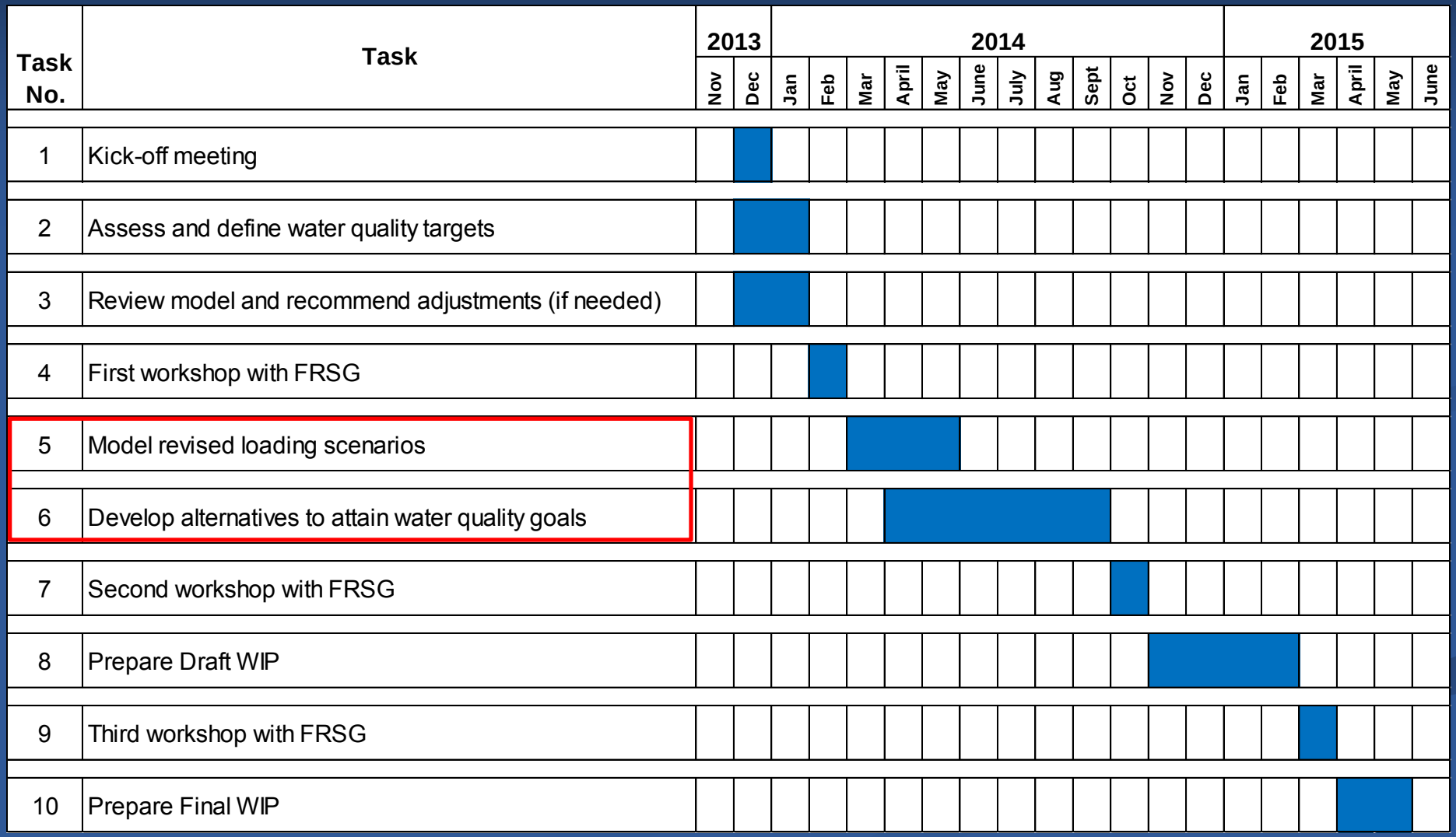
Challenges

- Not all municipalities (MS4s) & point source dischargers are "at the table"
- Dam removal is a sensitive/emotional topic if liability and costs aren't in the discussion.
- Costs of improvements will be in the hundreds of millions of dollars watershed-wide.

FRIP Development Team

- Fox River Study Group Board
- Consultant Team- LimnoTech / Crawford, Murphy, Tilly / Baetis Environmental
- ISWS- Advisory role to FRSG Board
- IEPA Staff
- YOU!

FRIP Schedule



Be Involved

- All municipalities, wastewater treatment plants, watershed groups and ag community will need to do their part!
- Fox River Study Group Meetings
  - 4th Thursday 9:30 AM
  - Fox Metro, Rt. 31 in Oswego
  - 3/27/14 Regular Meeting
  - Special Meetings – see FRSG website for notices or email us to be “on the list”

www.foxriverstudygroup.org

- Science-based planning & decision-making
- Stakeholder involvement

Join Us!