Monitoring and Implementation in the Fox River Basin

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Sierra Club, Illinois Chapter

Chair, Fox River Study Group
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
Fox River From Chain O Lakes to Dayton

47% of River Miles Impounded

55% of River Surface Area is Dam Impoundment

Source: Fox River Fish Passage Feasibility Study
Mainstem of Fox River in Illinois suffers from nutrient-caused impairments

- Algae is over-fed by nutrients
- Algal blooms suck oxygen out of water
- Low oxygen harmful to aquatic life
- Algae causes taste and odor problems for drinking water
Listed Impairments

- State’s 303(d) list includes multiple impairments
- Multiple reaches are listed for DO, phosphorus and algae impairments

<table>
<thead>
<tr>
<th>Reach ID and Description</th>
<th>Length (mi)</th>
<th>Listed Cause of Impairment</th>
<th>Downstream River Mile</th>
<th>Upstream River Mile</th>
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</thead>
<tbody>
<tr>
<td>IL_DT-35</td>
<td>5.03</td>
<td>aquatic algae</td>
<td>110.1</td>
<td>115.1</td>
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<tr>
<td>IL_DT-23</td>
<td>7.77</td>
<td>aquatic algae</td>
<td>97.7</td>
<td>105</td>
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<tr>
<td>IL_DT-22</td>
<td>7.86</td>
<td>aquatic algae</td>
<td>98.2</td>
<td>97.7</td>
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<tr>
<td>IL_DT-06</td>
<td>8.06</td>
<td>DO, aquatic algae</td>
<td>84.55</td>
<td>92.6</td>
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<tr>
<td>IL_DT-20</td>
<td>9.95</td>
<td>DO</td>
<td>74.6</td>
<td>84.55</td>
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<tr>
<td>IL_DT-18</td>
<td>5.8</td>
<td>DO</td>
<td>68.8</td>
<td>74.6</td>
</tr>
<tr>
<td>IL_DT-09</td>
<td>7.9</td>
<td>total phosphorus, aquatic algae</td>
<td>60.9</td>
<td>68.8</td>
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<tr>
<td>IL_DT-58</td>
<td>3.76</td>
<td>DO</td>
<td>59.5</td>
<td>63.25</td>
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<tr>
<td>IL_DT-69</td>
<td>4.51</td>
<td>total phosphorus, aquatic algae</td>
<td>55</td>
<td>59.5</td>
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<tr>
<td>IL_DT-38</td>
<td>12.3</td>
<td>total phosphorus, aquatic algae</td>
<td>42.7</td>
<td>55</td>
</tr>
<tr>
<td>IL_DT-03</td>
<td>7.1</td>
<td>DO, total phosphorus, aquatic algae</td>
<td>35.6</td>
<td>42.7</td>
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<tr>
<td>IL_DT-11</td>
<td>4.6</td>
<td>total phosphorus, aquatic algae</td>
<td>31.0</td>
<td>35.6</td>
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</tbody>
</table>
Managing a Multi-Purpose Resource

- Drinking water for 300,000+ Illinoisans
- Wastewater and stormwater conveyance
- Recreation for inhabitants and visitors
- Habitat for aquatic and terrestrial species
- Aesthetic value
Mission: To bring a diverse coalition of stakeholders together to work to preserve and enhance water quality in the Fox River watershed

Scientific Tools
Extensive monitoring of Fox River (monthly since 2002, low flows, storms)
Computer models of watershed runoff and Fox River mainstem
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
    - Completed 2012
  - Storm event monitoring
    - Completed 2011
  - Refinement of Planning Tools
  - Initial evaluation of management options (scenarios)

**Phase IV:** 2013-
- Implementation
  - Fox River Implementation Plan
    - In works
  - Evaluate, propose & promote management actions
  - Additional monitoring to investigate issues and track progress
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 Fox River-Johnsburg to Yorkville
* Sleepy Hollow Creek
* Tyler Creek
* Silver Creek
* Indian Creek
* Crystal Creek
* Ferson Creek
* Blackberry Creek
# Monthly Water Quality Monitoring

## Fox River Water Quality Study

**Sample Date:** June 16, 2015

<table>
<thead>
<tr>
<th>Test Parameters</th>
<th>1 Chapel Hill</th>
<th>2 Sleepy Hollow</th>
<th>3 Silver Creek</th>
<th>4 Rawson Br.</th>
<th>5 Crystal Creek</th>
<th>6 Algonquin</th>
<th>7 Tyler Creek</th>
<th>8 South Elgin</th>
<th>9 Ferson Creek</th>
<th>10 Fabyan</th>
<th>11 Indian Creek</th>
<th>12 Mill Street</th>
<th>13 Route 47</th>
<th>14 Blackberry Cr.</th>
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</thead>
<tbody>
<tr>
<td>TSS (mg/L)</td>
<td>19</td>
<td>NS</td>
<td>18</td>
<td>18</td>
<td>25</td>
<td>23</td>
<td>123</td>
<td>70</td>
<td>95</td>
<td>109</td>
<td>94</td>
<td>128</td>
<td>170</td>
<td>170</td>
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<tr>
<td>Fecal Coliforms (#/100mL)</td>
<td>70</td>
<td>NS</td>
<td>220</td>
<td>220</td>
<td>800</td>
<td>150</td>
<td>1500</td>
<td>1500</td>
<td>2700</td>
<td>5300</td>
<td>4400</td>
<td>3500</td>
<td>10000</td>
<td>1300</td>
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<tr>
<td>TKN (mg/L)</td>
<td>1.52</td>
<td>0.64</td>
<td>1.44</td>
<td>0.93</td>
<td>1.5</td>
<td>1.99</td>
<td>1.66</td>
<td>1.5</td>
<td>1.79</td>
<td>0.91</td>
<td>1.85</td>
<td>2.2</td>
<td>1.45</td>
<td>0.04</td>
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<tr>
<td>Ammonia N (mg/L)</td>
<td>0.15</td>
<td>NS</td>
<td>0.15</td>
<td>0.07</td>
<td>0.17</td>
<td>0.13</td>
<td>0.14</td>
<td>0.07</td>
<td>0.12</td>
<td>0.05</td>
<td>0.12</td>
<td>0.12</td>
<td>0.12</td>
<td>0.04</td>
</tr>
<tr>
<td>Nitrate N (mg/L)</td>
<td>0.48</td>
<td>NS</td>
<td>0.05</td>
<td>0.57</td>
<td>0.78</td>
<td>0.43</td>
<td>0.36</td>
<td>1.63</td>
<td>1.28</td>
<td>0.48</td>
<td>1.24</td>
<td>1.51</td>
<td>1.51</td>
<td>1.51</td>
</tr>
<tr>
<td>Organic N (mg/L)</td>
<td>1.37</td>
<td>NS</td>
<td>0.51</td>
<td>1.28</td>
<td>0.88</td>
<td>1.33</td>
<td>1.68</td>
<td>1.52</td>
<td>1.43</td>
<td>1.67</td>
<td>1.73</td>
<td>2.08</td>
<td>2.08</td>
<td>2.08</td>
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<tr>
<td>Chlorophyll a (ug/L)</td>
<td>45.4</td>
<td>NS</td>
<td>&lt; 4</td>
<td>38.8</td>
<td>29.6</td>
<td>52</td>
<td>11.4</td>
<td>40.6</td>
<td>9</td>
<td>39.8</td>
<td>11.4</td>
<td>35.2</td>
<td>39.8</td>
<td>16.6</td>
</tr>
<tr>
<td>Chlorophyll a corr. (ug/L)</td>
<td>37.4</td>
<td>NS</td>
<td>&lt; 4</td>
<td>34.8</td>
<td>24</td>
<td>50.6</td>
<td>&lt; 4</td>
<td>42.0</td>
<td>&lt; 4</td>
<td>34.8</td>
<td>5.4</td>
<td>24</td>
<td>10</td>
<td>10.0</td>
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<tr>
<td>Estimated biomass (mg/m²)</td>
<td>3.048</td>
<td>NS</td>
<td>&lt; 300</td>
<td>2,694</td>
<td>1978</td>
<td>3,484</td>
<td>762</td>
<td>3,322</td>
<td>602</td>
<td>2,672</td>
<td>790</td>
<td>2,364</td>
<td>2,672</td>
<td>1119</td>
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<tr>
<td>Total P (mg/L)</td>
<td>0.12</td>
<td>NS</td>
<td>0.06</td>
<td>0.14</td>
<td>0.13</td>
<td>0.19</td>
<td>0.39</td>
<td>0.31</td>
<td>0.37</td>
<td>0.41</td>
<td>0.28</td>
<td>0.61</td>
<td>0.60</td>
<td>0.33</td>
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<tr>
<td>Dissolved P (mg/L)</td>
<td>0.04</td>
<td>NS</td>
<td>0.03</td>
<td>0.06</td>
<td>0.06</td>
<td>0.07</td>
<td>0.16</td>
<td>0.10</td>
<td>0.16</td>
<td>0.12</td>
<td>0.10</td>
<td>0.17</td>
<td>0.13</td>
<td>0.13</td>
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<tr>
<td>Chloride (mg/L)</td>
<td>113</td>
<td>225</td>
<td>110</td>
<td>229</td>
<td>134</td>
<td>72.4</td>
<td>118</td>
<td>32.7</td>
<td>93.9</td>
<td>125</td>
<td>81.7</td>
<td>86.7</td>
<td>86.7</td>
<td>86.7</td>
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<tr>
<td>Turbidity (NTU)</td>
<td>16</td>
<td>5.7</td>
<td>15</td>
<td>21</td>
<td>19</td>
<td>90</td>
<td>90</td>
<td>75</td>
<td>90</td>
<td>80</td>
<td>120</td>
<td>140</td>
<td>140</td>
<td>140</td>
</tr>
</tbody>
</table>

**Cell Color Key:**
- Main Stem Sampling Point
- Tributary Sampling Point

**Abbreviations:**
- NS = No Sample
- AF = Analysis Failure
- TNTC = Too Numerous to Count
- ND = Not Determined
- CG = Confluent Growth
- OUT = Outlier
Web Mapping

View GIS data and print maps for the Fox Watershed with the **Fox River Watershed GIS Data Viewer**

Minimum browser requirements: Internet Explorer 5+, Netscape Navigator 6+. (Opens in a separate browser window)

**Fox Watershed GIS datasets**

Download GIS datasets developed for the Fox River Watershed Investigation, as well as state-wide datasets of interest to Fox watershed users.

Download detailed watershed delineation GIS data developed for Fox River tributaries.

**Environmental Database**

Download the **FoxDB environmental database** (updated 7/1/2014) developed during the Fox River Watershed Investigation. The FoxDB (MS Access, 15 MB zip format) database file contains the complete water quality, sediment quality, habitat, and biological database. The structure of the relational database is described in **Phase I Report: Water Quality Issues and Data** (water and sediment quality data) and **Analyses of Biological Data** (database expanded to include biological and habitat data). The database compiles all available data from various sources and studies within the Fox River watershed (starting in 1956) and serves as a primary depository for the FRSG monitoring data (2002-present). The Access database can be used with the Data Loader/Viewer to add and view sample records. The Data Loader/Viewer is a viewing and editing tool designed to work with the water quality database. A **user’s manual** is also available.

*The Fox River Study Group has worked with the Illinois State Water Survey to compile water chemistry data for the Fox River watershed. Those data are available through this database. Interpretation of the data by other parties does not represent the opinion of the Fox River Study Group or the Illinois State Water Survey (Data Disclaimer).*

**NPDES Dischargers downstream the Stratton Dam**

Information on NPDES discharges was obtained from the USEPA EnviroFacts Data Warehouse. Locations were checked against description and corrected to better represent the described location if necessary. A 1996 dataset on NPDES provided by the IEPA was used for additional verification. The dataset was submitted to the FRSG for comments and updates. An Excel file (**NPDESdsSTRATTON.zip**) has been prepared listing the identified NPDES discharge sites. The USEPA 5-digit parameter codes are listed in (**epacodelists.zip**).
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**

*Work performed by ISWS*
Intensive Water Quality Monitoring
for model calibration

Water Years 2010 & 2011

* Biweekly and storm events
* 20 sites on Fox River, 8 tributaries and 3 CSOs in Elgin
* 18 water quality parameters
* 7 precipitation gages
* 5 flow gages
* Work performed by ISWS and USGS

June 2012

* 3 days under low flow conditions
* 13 sites on Fox River and 10 tributaries
* Continuous DO, T, pH, conductivity at Fox R sites
* Nutrient-related parameters measured at all sites
* SOD at 3 Fox R sites
* Benthic algae at 5 Fox R sites
* Stage and discharge measurements
* Work performed by ISWS, USGS and Deuchler Environmental
TP During 2002-2013 Sampling (FRSG)

- Tributaries
- Mainstem

Total phosphorus concentration (mg/l)

Fox River Station, Upstream to Downstream

Locations:
- Chapel Hill
- Burtons Bridge
- Rawson Bridge
- Algonquin
- I-90
- South Elgin (State St.)
- Geneva (Fabyan)
- Montgomery (Mill St.)
- Route 47
- Rawson Bridge
- I-90
TP During 2010-2011 Sampling

Fox River Station, Upstream to Downstream

Total phosphorus concentration (mg/l)

- Tributaries
- Mainstem

- Algonquin
- I-90
- At FRWRD
- Elgin (Kimball)
- South Elgin (State St.)
- St. Charles (above dam)
- Geneva (Fabyan)
- Aurora (Illinois)
- Montgomery (Mill St.)
- Route 34
- Fox River Drive
Sources of TP in Fox River watershed

Fox Total, long-term average annual TP load

- Point Sources: 53%
- Agriculture: 26%
- Urban: 9%
- Others: 6%
- Upstream Boundary: 6%

Area between Stratton Dam and Fox River confluence with Illinois River
Determined from calibrated HSPF model runs for 1991-2011
Sources of TP in Fox River watershed by tributary

Goals

- Attain water quality for dissolved oxygen
- Reduce nuisance algae
- Replace a traditional TMDL plan
- Recommendations developed based on good science with input from local decision makers
- Report due to IEPA on Dec. 31, 2015
Model Calibration – Min. Dissolved Oxygen

Model results (line) are significantly higher than data (squares) in several locations, indicating calibration problems.
Dam Removal Scenario – Min. DO & Algae

Note: model results for dissolved oxygen are subject to revision due to uncertainty in the current model calibration; see Section 3.2.3 in FRIP.
Most Aggressive Alternative

![Graph showing total phosphorus and average phytoplankton levels along the Fox River Mainstem River Mile.](image)
Fox River Implementation Plan

Key Findings:

* Summer low flow conditions are critical
* Non-point sources play little role during summer low flow, but are important at other times of the year
* Reducing phosphorus from WWTPs and upstream sources will significantly reduce the amount of phosphorus in the system
* Modeling results for dam removal show some unexpected results
FRIP Implementation – Near Term Actions:

- WWTP effluent TP limits = 1.0 mg/L
  - ~460,000 lbs/y reduction
  - ~35% reduction
- Potential removal of Carpentersville and North Aurora Dams
- TMDLs established for upstream TP
- Model improvements
Future Monitoring

For Model Improvement

* Investigate area downstream of Algonquin dam
* Investigate reaeration coefficients
* Coordinate with IDNR and IEPA on 2017 intensive basin sampling
* Before and after measurements on dam removals

Implementation Tracking

* Continued monthly monitoring
* Reporting of P load reductions by wastewater plants, municipalities and farmers
* Non-point source planning and tracking tools
Non-Point Source Scenario Planning Tool

- Spreadsheet tool to allow “what-if” scenario testing

* Two versions: MS4s and tributary watersheds
**Non-Point Source Project Tracking Tool**

Spreadsheet tool to simplify tracking and reporting of projects by MS4s

### MS4 Non-Point Source Control Measure Tracking Tool

**Fox River Watershed, Illinois**

<table>
<thead>
<tr>
<th>MS4</th>
<th>Project Name</th>
<th>Project Cost</th>
<th>Project Type</th>
<th>Total Area Captured (acres)</th>
<th>% Urban High Density</th>
<th>% Low-Medium Density</th>
<th>% Urban Open Space</th>
<th>Area-Weighted UAL (lb/acre)</th>
<th>Load (lb)</th>
<th>Removal Efficiency</th>
<th>Total Load Removed (lb/yr)</th>
<th>Cost per Pound P Removed ($/lb)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elgin city</td>
<td>Project 2015-01</td>
<td>$100,000</td>
<td>Wet detention</td>
<td>100</td>
<td>10%</td>
<td>25%</td>
<td>30%</td>
<td>0.287</td>
<td>28.67924</td>
<td>68%</td>
<td>19.50</td>
<td>$5,128</td>
</tr>
</tbody>
</table>
Questions?

www.foxriverstudygroup.org