Integrating NPS Modeling into Your Watershed Management Plan

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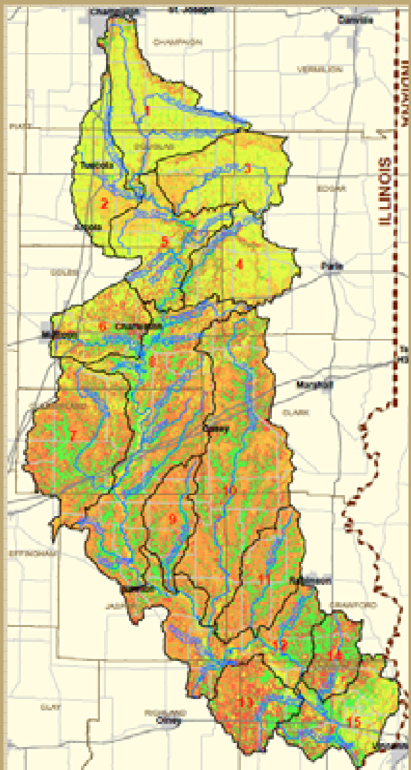
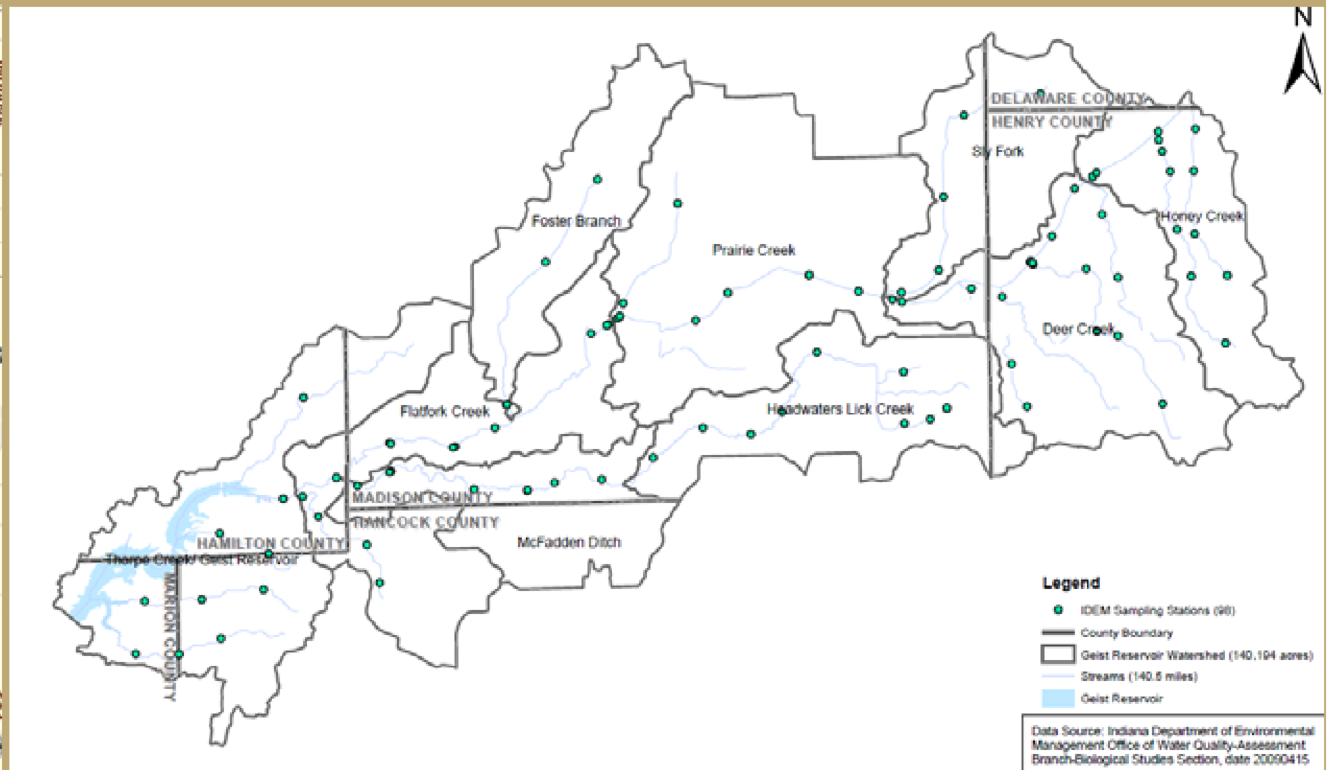




Presented by:

Jessica Spurlock, P.E., CFM, CPESC

V3 Companies

Presentation Agenda

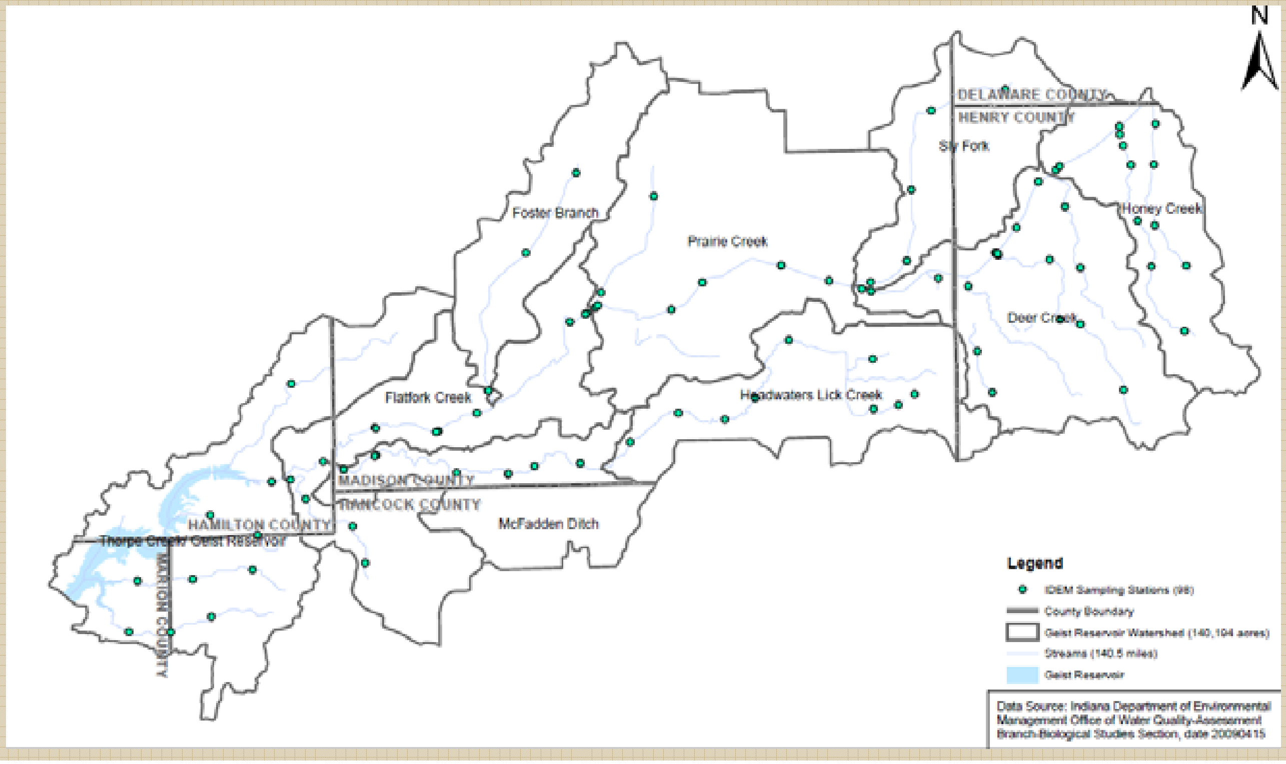
- Why Estimate Pollutant Loads?
- NPS Modeling vs. Monitoring Data
- Modeling Approach
- Implementation Plan
- Case Study
  - Geist Reservoir
  - Lower DuPage River

Why Estimate Pollutant Loads?

- Pollutant load estimates are required for Watershed Management Plans
- Most often missing element from plans
- Generally 2 ways to estimate pollutant loads
  - NPS Modeling
  - Monitoring Data

NPS Modeling vs. Monitoring Data

- Monitoring Data
  - Best suited where detailed monitoring and flow gauging is available
  - Does not attribute loads to particular sources or areas
  - Based on historical data and cannot be used to directly predict how loads may vary in the future



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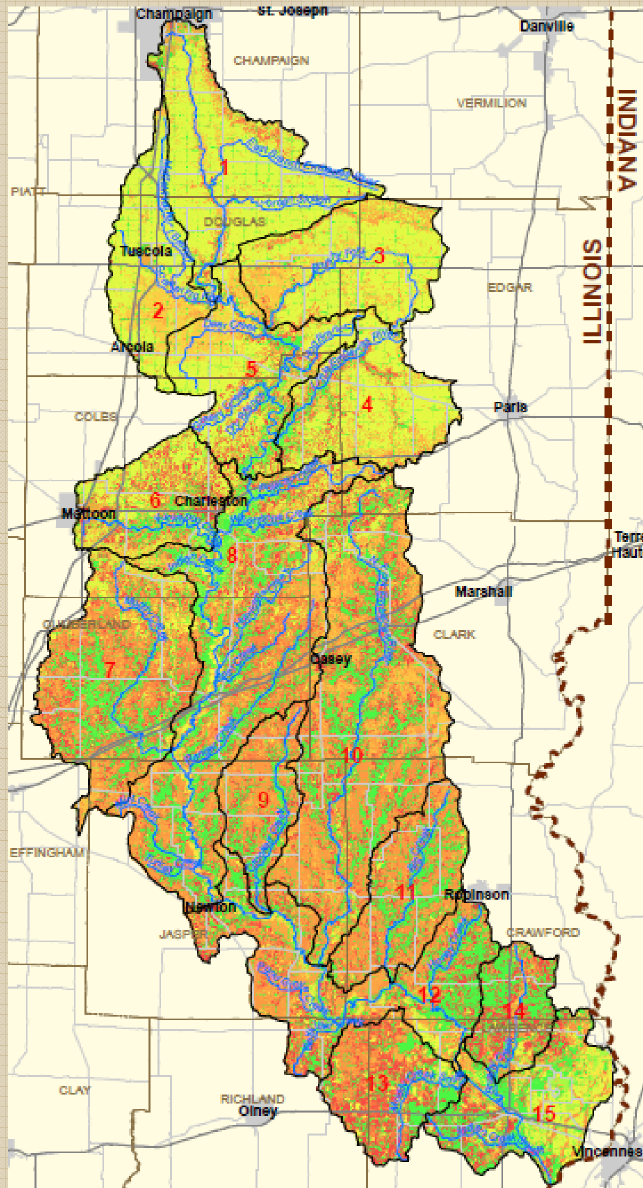
NPS Modeling vs. Monitoring Data



- NPS Modeling
  - Can be used to evaluate the relative magnitude and location of sources
  - Can be used to project future loads
  - Helps plan restoration strategies and target load reduction efforts
  - Can be highly sophisticated or very generalized
  - Can be used to evaluate specific BMPs

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Modeling Approach

- Selecting a Model
- Data Inputs
- Calibration and Validation
- Interpreting the Results

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Selecting a Model

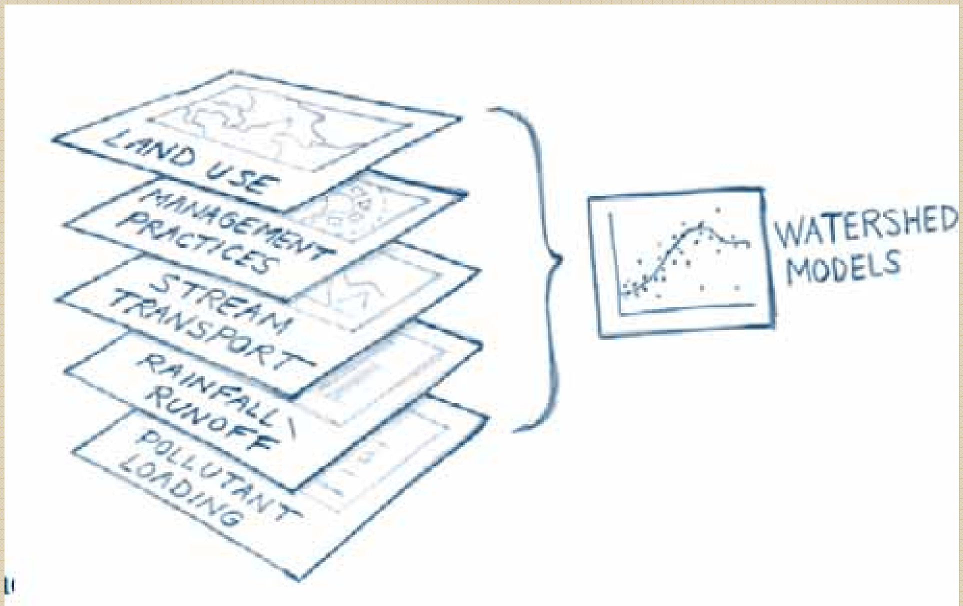
- Relevance
  - Is the model appropriate for your watershed?
- Credibility
  - Has the model been shown to produce valid results?
- Usability
  - Is the model easy to learn and use?
- Utility
  - Is the model able to predict planned changes within your watershed?

Selecting a Model

- Choosing NPS parameters to screen
  - Many models have been designed for specific pollutants
  - 303(d) List: Identifies waters not meeting water quality standards and parameters resulting in the listing
  - TMDL Studies
  - Observed Water Quality Data/Local Knowledge
- Typical Parameters
  - Total Nitrogen
  - Total Phosphorus
  - Sediment
  - Fecal Coliform

Data Inputs

- Land Use
- Soils
- Slope
- Management Techniques



- Monitoring Data
  - Flow
  - Water Quality
- Meteorological Data
  - Precipitation
  - Temperature

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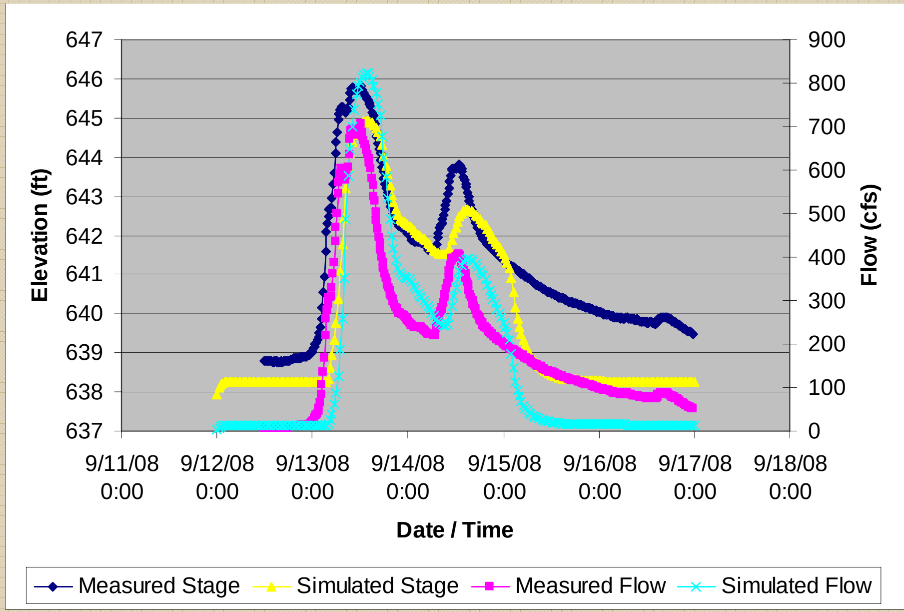
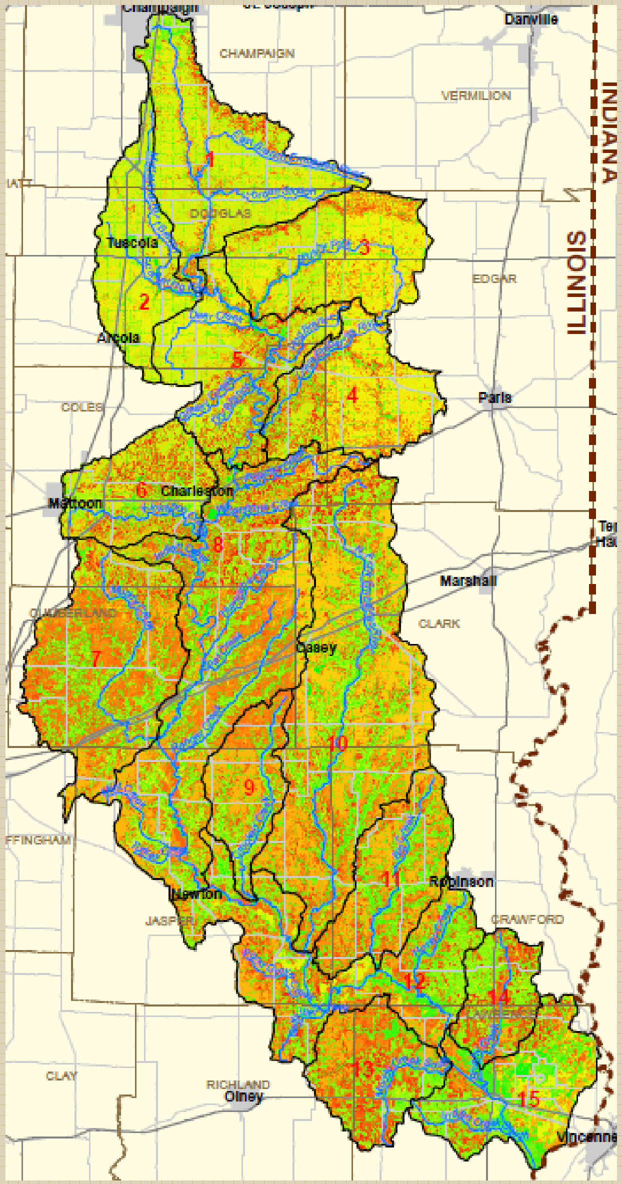
Calibration and Validation

- Give modeling results a “reality check”
- Two separate procedures, therefore require two data sets
  - First data set is used to adjust model parameters until a best fit is observed
  - Second data set is used to test the performance of the model
- If sufficient data is unavailable, compare to literature values
- Without calibration and validation, results can still be useful



Interpreting the Results

- Mapping can help visualize where the “problems” are
- Determine the magnitude of the problem
- Comparison of multiple model runs
  - Existing vs Future conditions
- Applying Results to the WMP
  - Implementation Plan
  - Load Reductions
  - BMP Implementation



Implementation Plan

- Load Reductions
  - Provide a numeric reference to evaluate plan achievement
  - Can be set in several ways – percentage reduction or known targets
- Target Load Sources
  - TMDL
    - What pollutants were considered?
    - Time frame
    - Management efforts
  - Known Water Quality Standards
    - Illinois Water Quality Standards, Title 35: Environmental Protection
    - EPA Guidance Documents (Ambient Water Quality Recommendations)

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Implementation Plan

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- BMP Implementation
  - Choose specific BMPs for specific pollutants
    - Sediment, Nitrogen, Phosphorus, etc.
  - Choose specific BMPs for areas
    - Agricultural vs Urban
  - Use modeling to predict the pollutant removal from the implementation of one or more BMPs

Best Management Practice Load Reduction				
Agricultural/Rural Best Management Practices				
	Estimated Load Reductions			
BMP/Measure	**Sed**	**P**	**N**	***E. coli***
Cover Crops	40%	45%	40%	N/A
Exclusionary Fencing	70%	60%	65%	90%
Grassed Waterways	80%	30%	40%	N/A
No-Till/Reduced Till (Conventional Tillage)	75%	45%	55%	N/A
Urban Best Management Practices				
Bioretention Practices	40%	80%	65%	N/A
Naturalized Detention Basin	80%	55%	35%	N/A
Naturalized Stream Buffer	75%	45%	40%	N/A

Case Study – Geist Reservoir

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- Located in Central Indiana, northeast of Indianapolis
- 140,190 acre watershed of which Geist is 1,900 acres
- Serves as a drinking water supply for the City of Indianapolis
- Toxic Blue-Green Algal blooms kick-started WMP process

Case Study – Geist Reservoir

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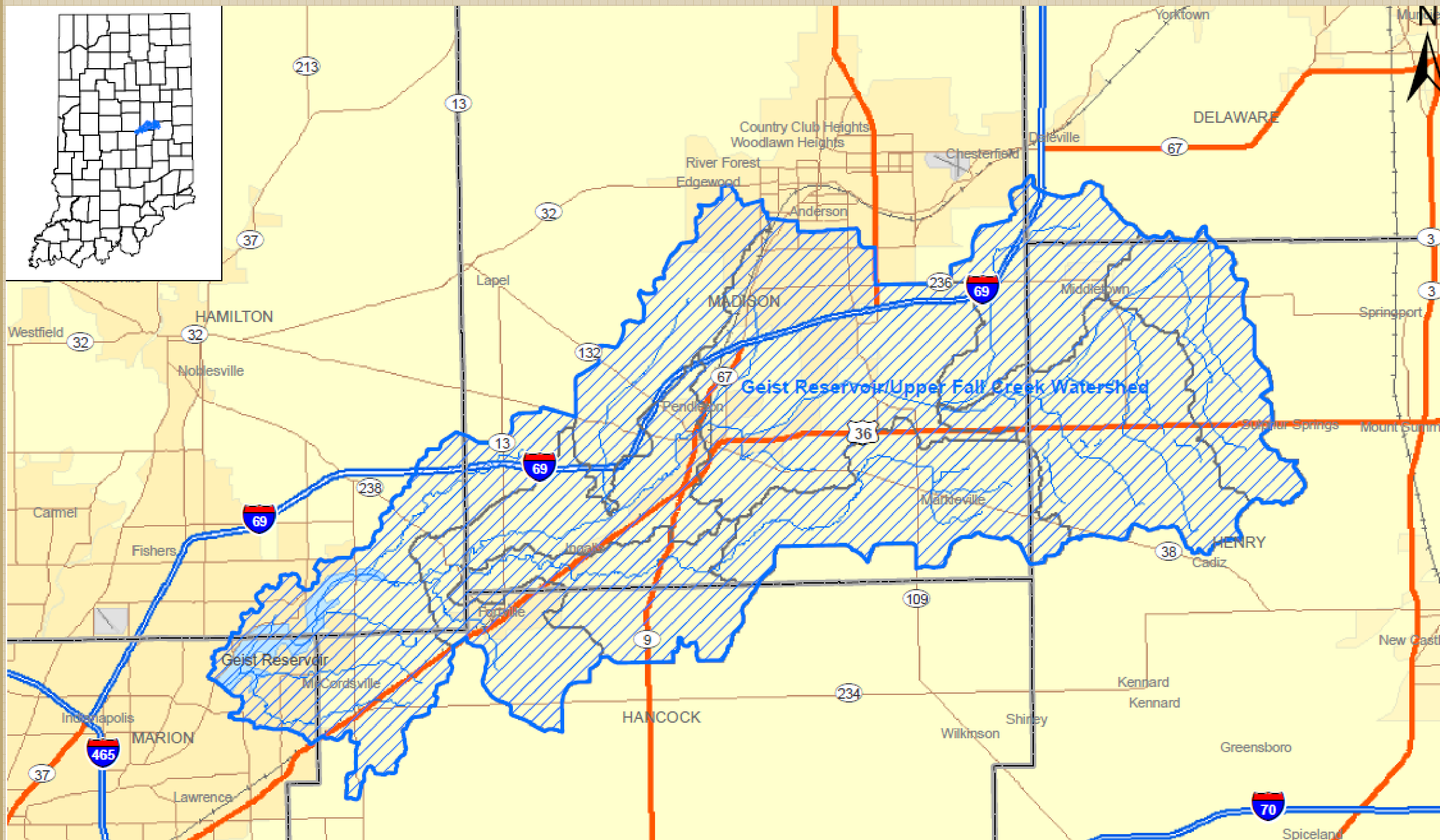


Case Study – Geist Reservoir

- Used STEPL to estimate pollutant loads
  - Spreadsheet Tool for Estimated Pollutant Loads
  - Excel spreadsheet, easy to use
  - Total Nitrogen, Total Phosphorus, Sediment
  - Annual basis
  - Can calculate the effects of BMP implementation

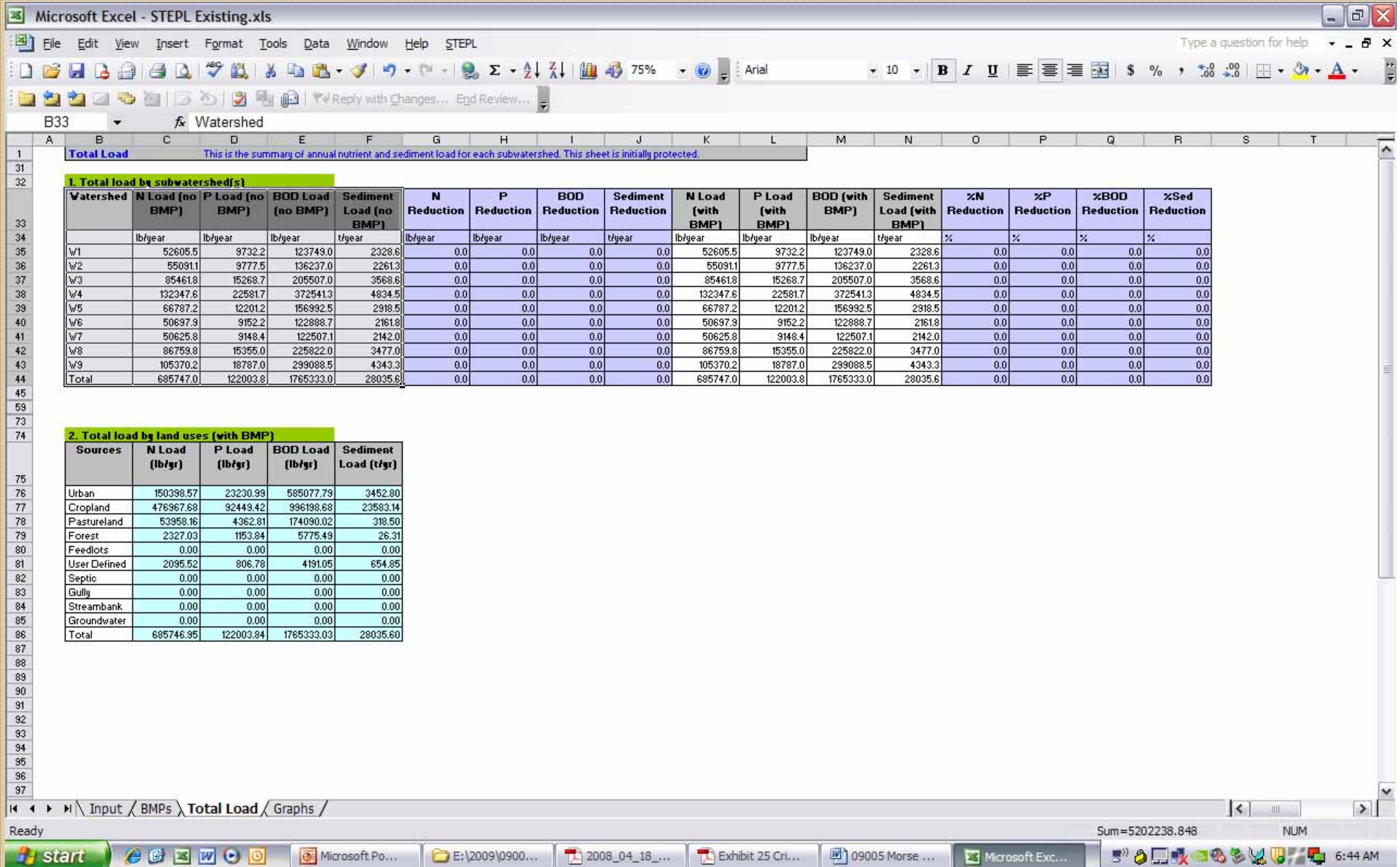
Case Study – Geist Reservoir

Microsoft Excel - NPSmodelinput.xls

	A	B	C	D	E	H	I	J	K
2									
3	**Hydrologic Soil Group B**								
4	Class_name	Acres	CN			Model Input			
5	Alfalfa	106.9	72	Close-seeded or broadcast legumes, SR, good	7696.348		CN*area	Total Area	Composite Cl
6	Corn	57805.5	75	Row crop, SR+CR, good	4335409	Agriculture, composite	7456203	100782.7	74
7	Dry Beans	0.8	72	Small grain, SR+CR, good	55.79442	Residential, composite	998293.2	15012.4	66
8	Fallow/Idle Cropland	1.5	85	Fallow, CR, poor	131.7368	Water/Wetlands, composite	15007.32	168.3	89
9	NLCD - Barren	53.1	85	Fallow, CR, poor	4511.248	Grass/Pasture, composite	249403	4033.5	62
10	NLCD - Deciduous Forest	1370.2	55	Woods, good	75358.34	Forest, composite	129700.4	2082.8	62
11	NLCD - Developed/High Intensity	129.4	85	Residential, 1/8 acre	10995.44			122079.7	
12	NLCD - Developed/Low Intensity	5431.6	70	Residential, 1/2 acre	380215.2				
13	NLCD - Developed/Medium Intensit	716.7	75	Residential, 1/4 acre	53751.98				
14	NLCD - Developed/Open Space	7546.4	61	Open space, good	460327.5				
15	NLCD - Grassland Herbaceous	3802.8	61	Pasture, good	231971.3				
16	NLCD - Herbaceous Wetlands	26.0	85	Wetlands, combination of open space and impervious	2213.608				
17	NLCD - Open Water	44.4	98	Impervious	4347.413				
18	NLCD - Woody Wetlands	36.6	85	Wetlands, combination of open space and impervious	3111.379				
19	Oats	9.8	72	Small grain, SR+CR, good	707.8781				
20	Other Crops	0.8	72	Small grain, SR+CR, good	55.79442				
21	Soybeans	39374.0	72	Small grain, SR+CR, good	2834931				
22	Win. Wht./Soyb. Dbl. Cropped	155.1	72	Small grain, SR+CR, good	11168.84				
23	Winter Wheat	483.2	72	Small grain, SR+CR, good	34792.76				
24									
25	**Hydrologic Soil Group C**								
26	Class_name	Acres							
27	Alfalfa	2.1	81	Close-seeded or broadcast legumes, SR, good	170.8512				
28	Corn	1606.6	82	Row crop, SR+CR, good	131742				
29	NLCD - Deciduous Forest	76.1	70	Woods, good	5325.057				
30	NLCD - Developed/High Intensity	30.2	90	Residential, 1/8 acre	2722.234				
31	NLCD - Developed/Low Intensity	284.3	80	Residential, 1/2 acre	22746.12				
32	NLCD - Developed/Medium Intensit	83.0	83	Residential, 1/4 acre	6891.733				
33	NLCD - Developed/Open Space	612.6	74	Open space, good	45335.7				
34	NLCD - Grassland Herbaceous	170.5	74	Pasture, good	12615.7				
35	NLCD - Open Water	5.7	98	Impervious	556.821				
36	NLCD - Woody Wetlands	0.2	85	Wetlands, combination of open space and impervious	15.6358				

1-EastBranchEmbarras / 2-ScatteringFork / 3-BrushyFork / 4-LittleEmbarras / 5-DeerCreek / 6-KickapooCreek / 7-MuddyCreek / 8-RangeCreek / 9-EastCrookedCreek / 10-NorthF

Case Study – Geist Reservoir



Microsoft Excel - STEPL Existing.xls

Total Load This is the summary of annual nutrient and sediment load for each subwatershed. This sheet is initially protected.

1. Total load by subwatershed(s)

Watershed	N Load (no BMP)	P Load (no BMP)	BOD Load (no BMP)	Sediment Load (no BMP)	N Reduction	P Reduction	BOD Reduction	Sediment Reduction
	lb/year	lb/year	lb/year	t/year	lb/year	lb/year	lb/year	t/year
W1	52605.5	9732.2	123749.0	2328.6	0.0	0.0	0.0	0.0
W2	55091.1	9777.5	136237.0	2261.3	0.0	0.0	0.0	0.0
W3	85461.8	15268.7	205507.0	3568.6	0.0	0.0	0.0	0.0
W4	132347.6	22581.7	372541.3	4834.5	0.0	0.0	0.0	0.0
W5	66787.2	12201.2	156992.5	2918.5	0.0	0.0	0.0	0.0
W6	50697.9	9152.2	122888.7	2161.8	0.0	0.0	0.0	0.0
W7	50625.8	9148.4	122507.1	2142.0	0.0	0.0	0.0	0.0
W8	86759.8	15355.0	225822.0	3477.0	0.0	0.0	0.0	0.0
W9	105370.2	18787.0	299088.5	4343.3	0.0	0.0	0.0	0.0
Total	685747.0	122003.8	1765333.0	28035.6	0.0	0.0	0.0	0.0

Watershed	N Load (with BMP)	P Load (with BMP)	BOD (with BMP)	Sediment Load (with BMP)	%N Reduction	%P Reduction	%BOD Reduction	%Sed Reduction
	lb/year	lb/year	lb/year	t/year	%	%	%	%
W1	52605.5	9732.2	123749.0	2328.6	0.0	0.0	0.0	0.0
W2	55091.1	9777.5	136237.0	2261.3	0.0	0.0	0.0	0.0
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W9	105370.2	18787.0	299088.5	4343.3	0.0	0.0	0.0	0.0
Total	685747.0	122003.8	1765333.0	28035.6	0.0	0.0	0.0	0.0

2. Total load by land uses (with BMP)

Sources	N Load (lb/yr)	P Load (lb/yr)	BOD Load (lb/yr)	Sediment Load (t/yr)
Urban	150398.57	23230.99	585077.79	3452.80
Cropland	476967.68	92449.42	996198.68	23583.14
Pastureland	53958.16	4362.81	174090.02	318.50
Forest	2327.03	1153.84	5775.49	26.31
Feedlots	0.00	0.00	0.00	0.00
User Defined	2095.52	806.78	4191.05	654.85
Septic	0.00	0.00	0.00	0.00
Gully	0.00	0.00	0.00	0.00
Streambank	0.00	0.00	0.00	0.00
Groundwater	0.00	0.00	0.00	0.00
Total	685746.95	122003.84	1765333.03	28035.60

Input / BMPs / Total Load / Graphs

Sum=5202238.848

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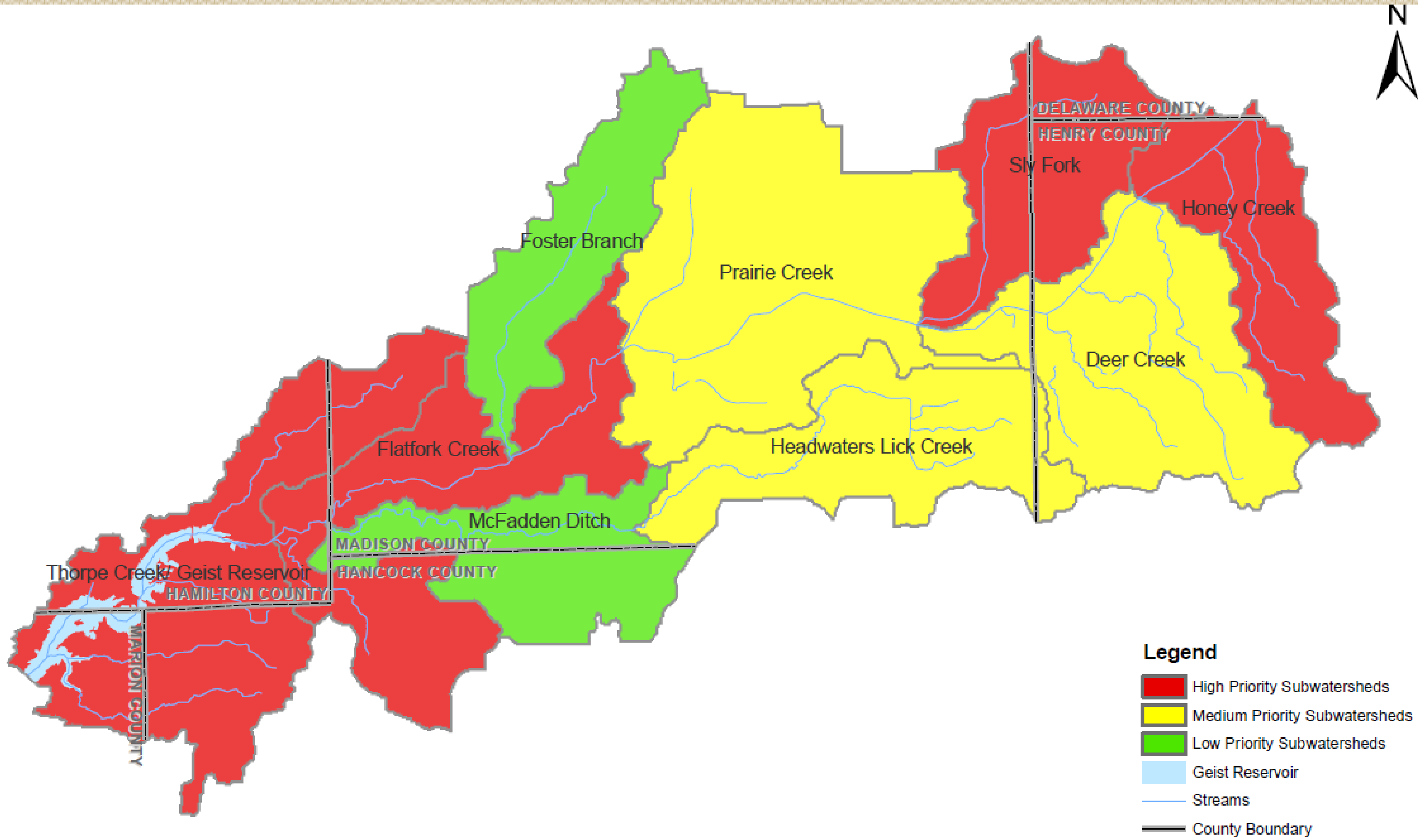
Case Study – Geist Reservoir



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Case Study – Geist Reservoir

- Selected BMPs for each subwatershed based on the specific pollutants

BMP Selection		
Critical Area	**Reason for being Critical**	**Suggested BMP**
High Priority Subwatersheds		
Honey Creek	*E. coli*	Alternative Watering System
		Buffer/Filter Strips
		Education and Outreach
		Exclusionary Fencing
		Nutrient/Waste Management
		Wetland Restoration
	Total Phosphorus	Alternative Watering System
		Buffer/Filter Strips
		Education and Outreach
		Exclusionary Fencing
		Nutrient/Waste Management
		Stream Restoration
		Wetland Restoration

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Case Study – Lower DuPage River

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- Located primarily in Will County
- Approximately 108,000 acres

Case Study – Lower DuPage River

- Customized GIS model
  - Total Nitrogen, Total Phosphorus, Sediment, Fecal Coliform, and Chloride
  - Event Mean Concentrations derived from published values were used
  - Calibration performed based on limited data and professional judgement

Case Study – Lower DuPage River

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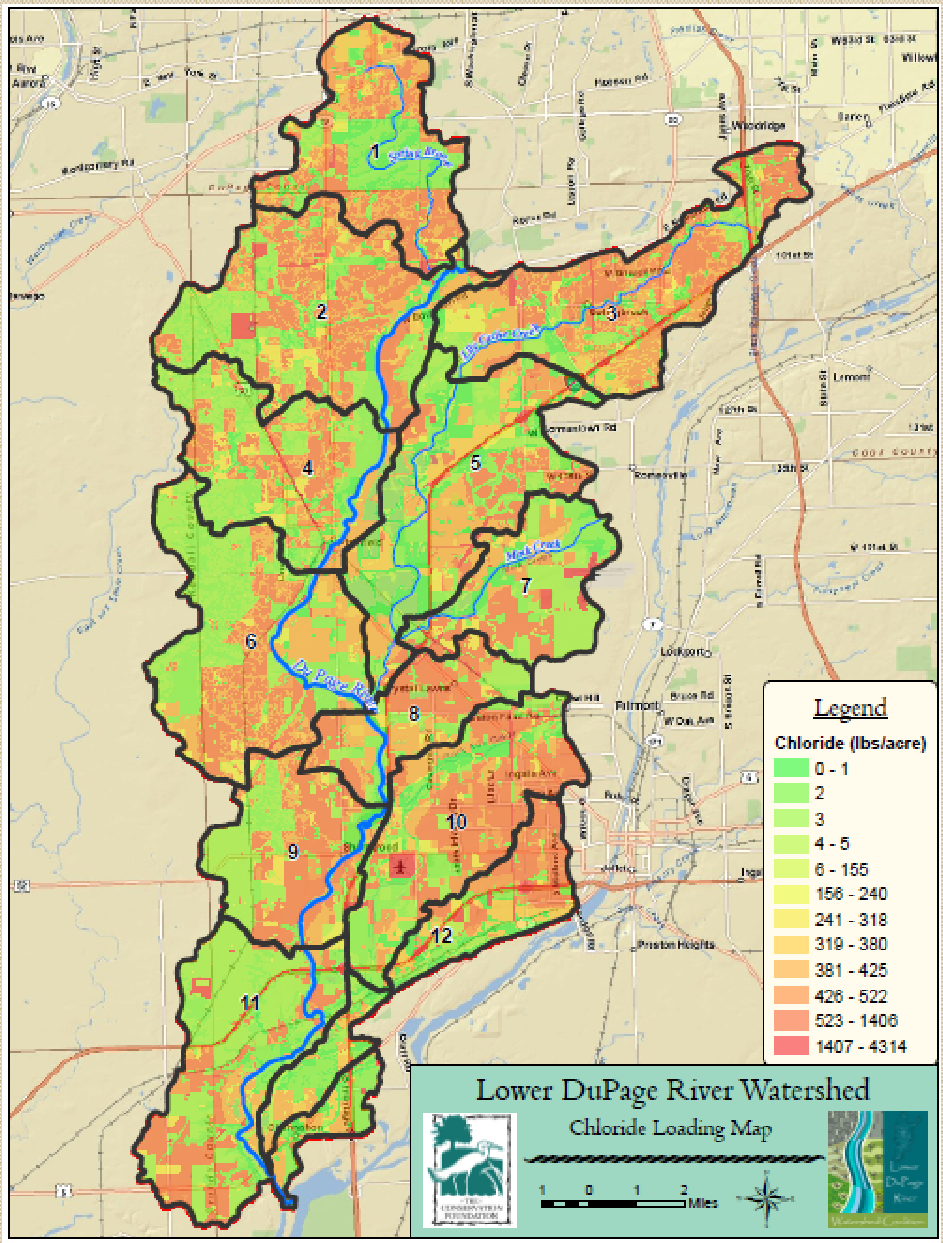

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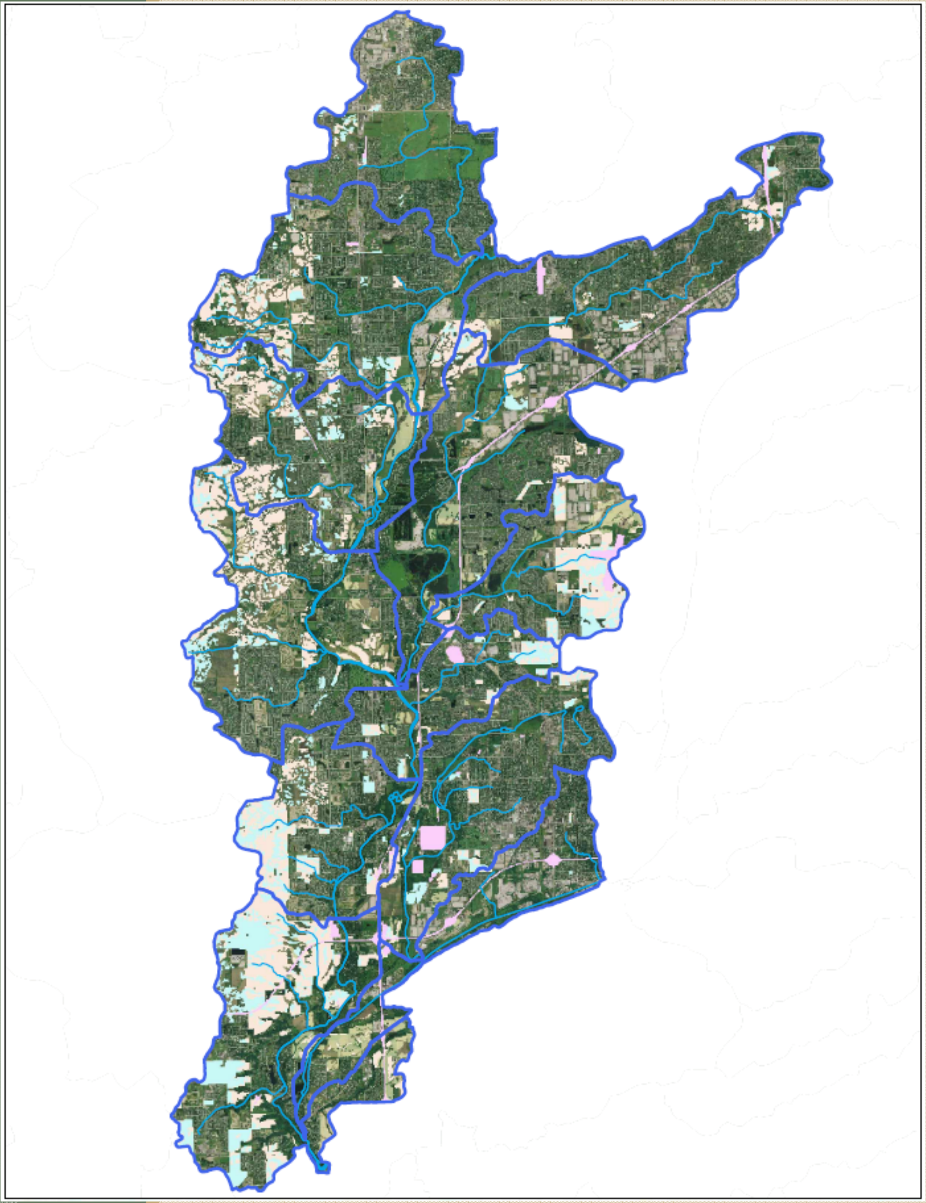

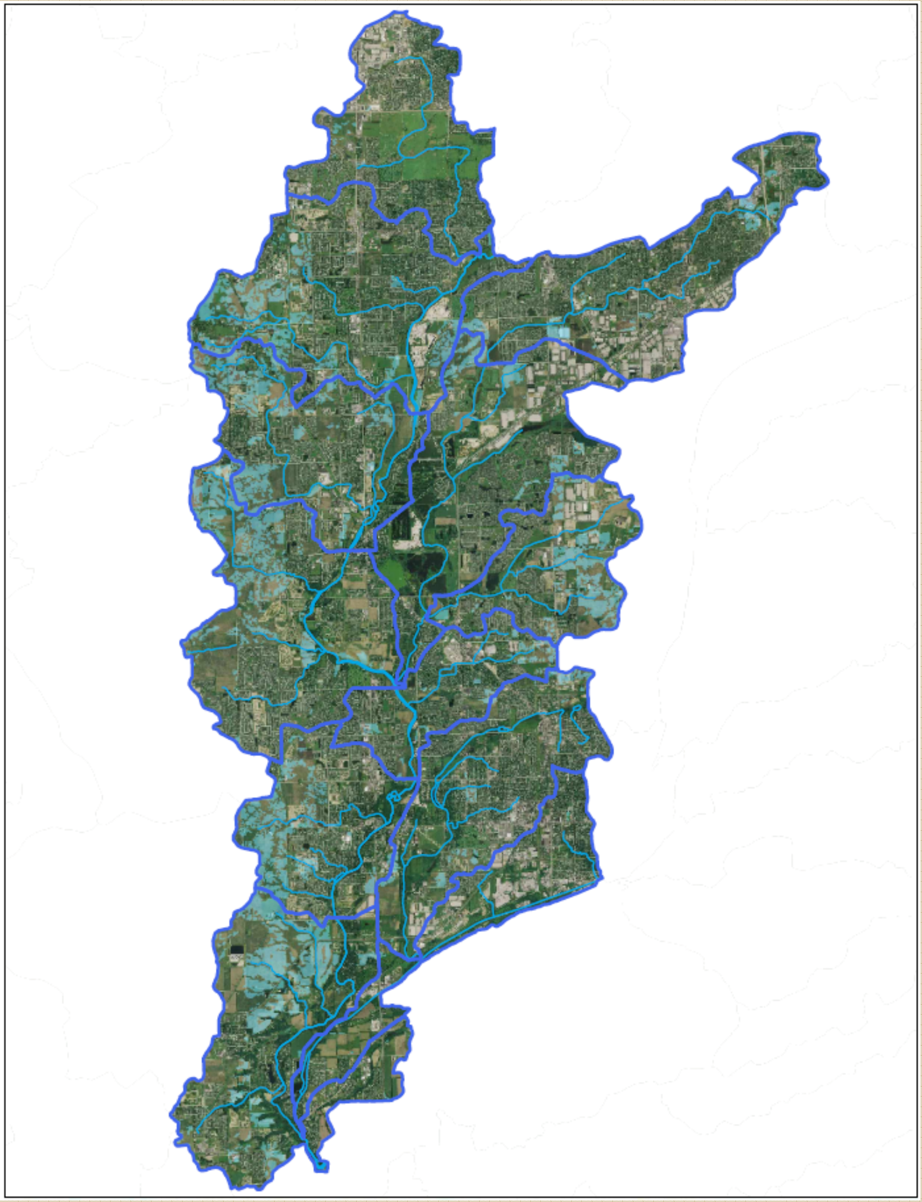

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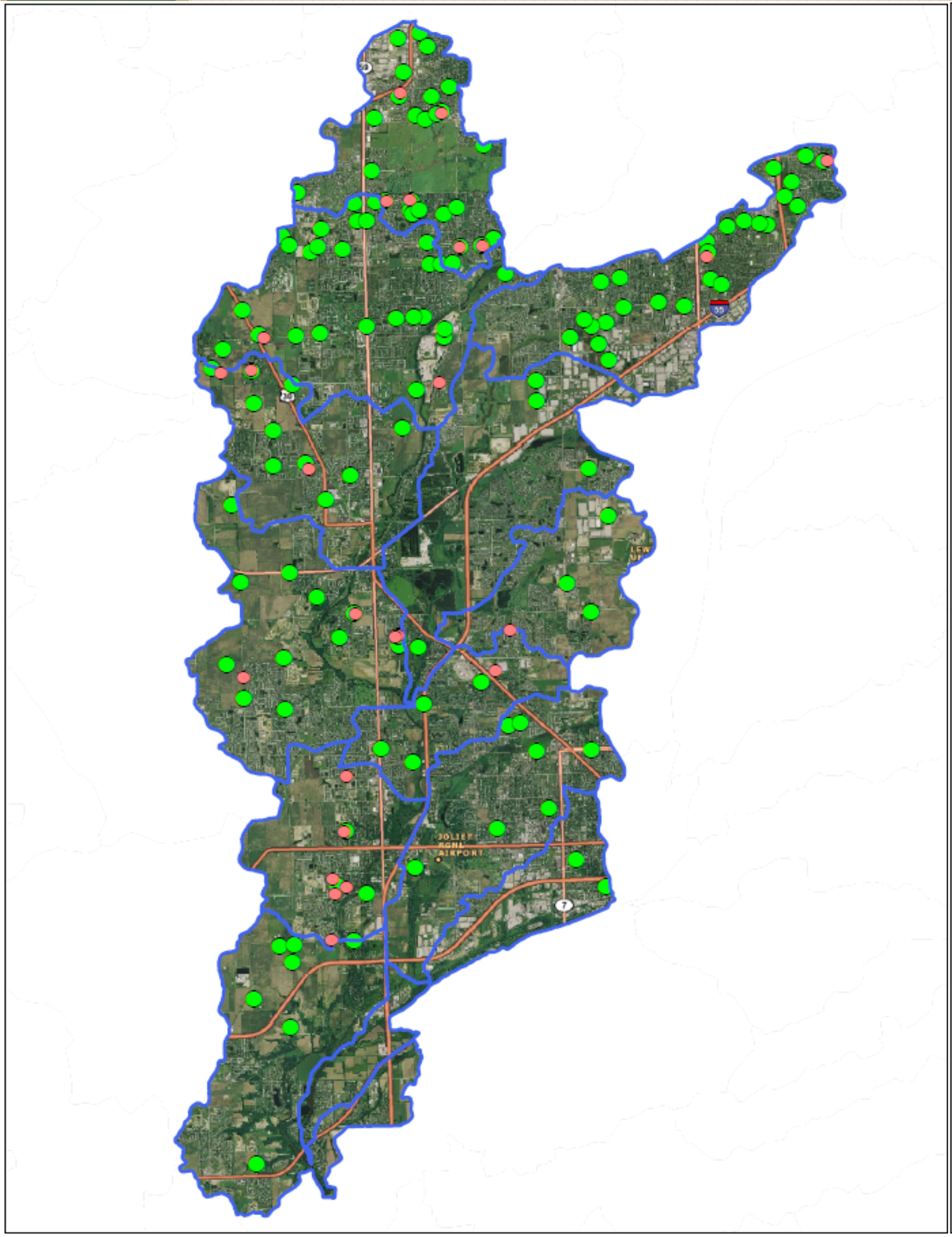

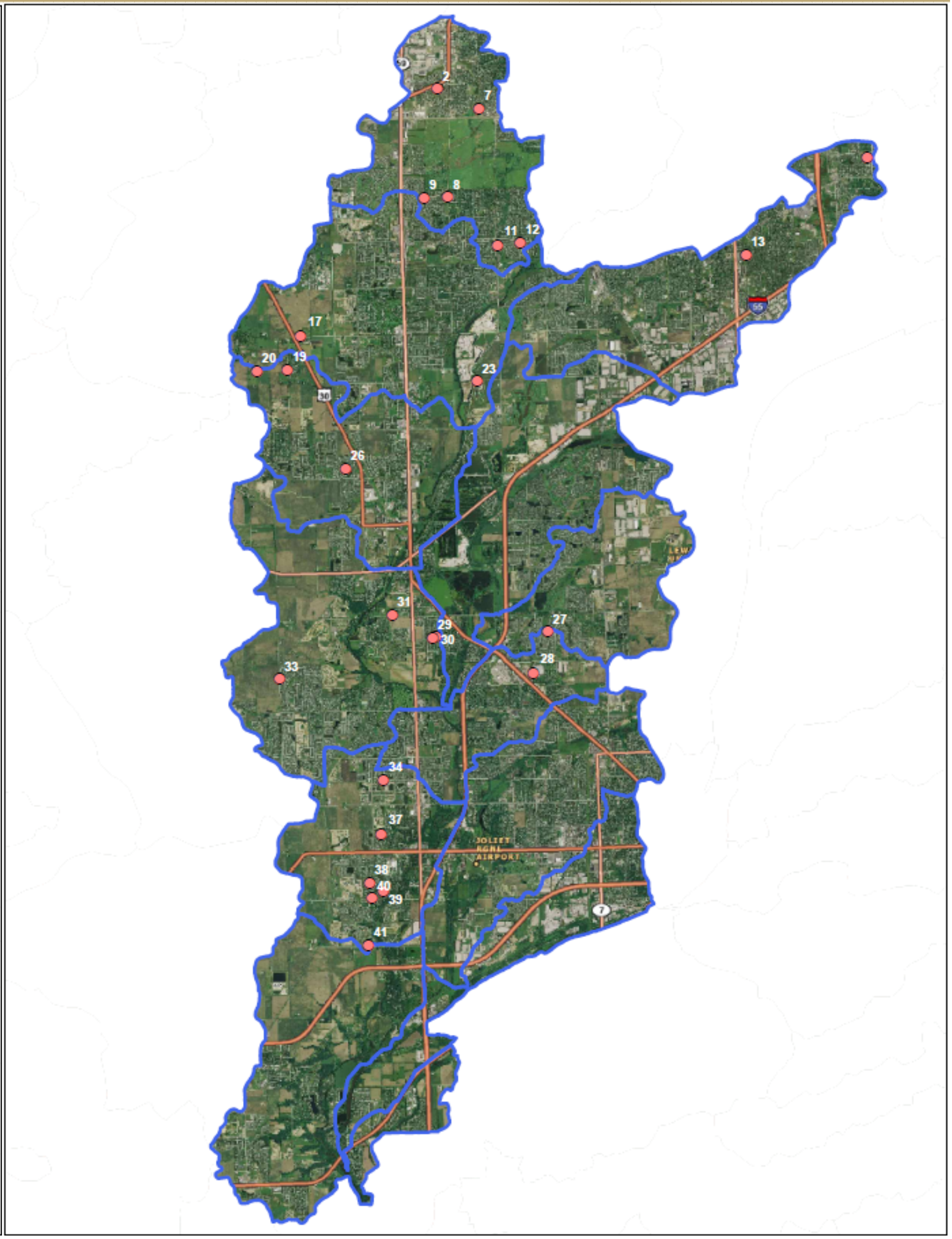

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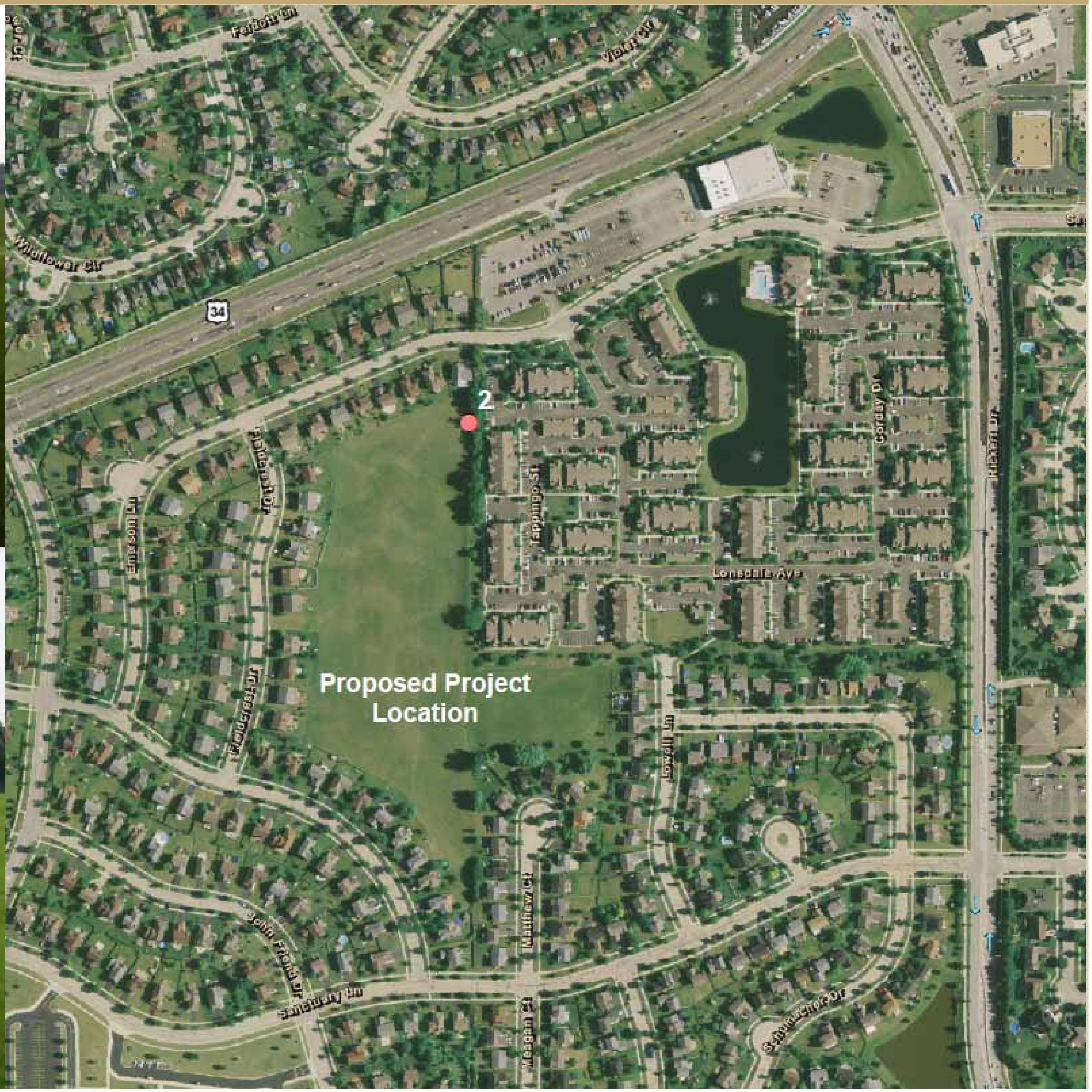

Questions?

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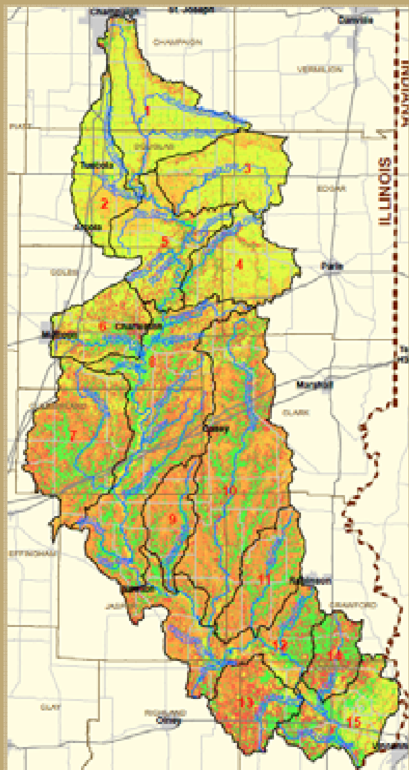

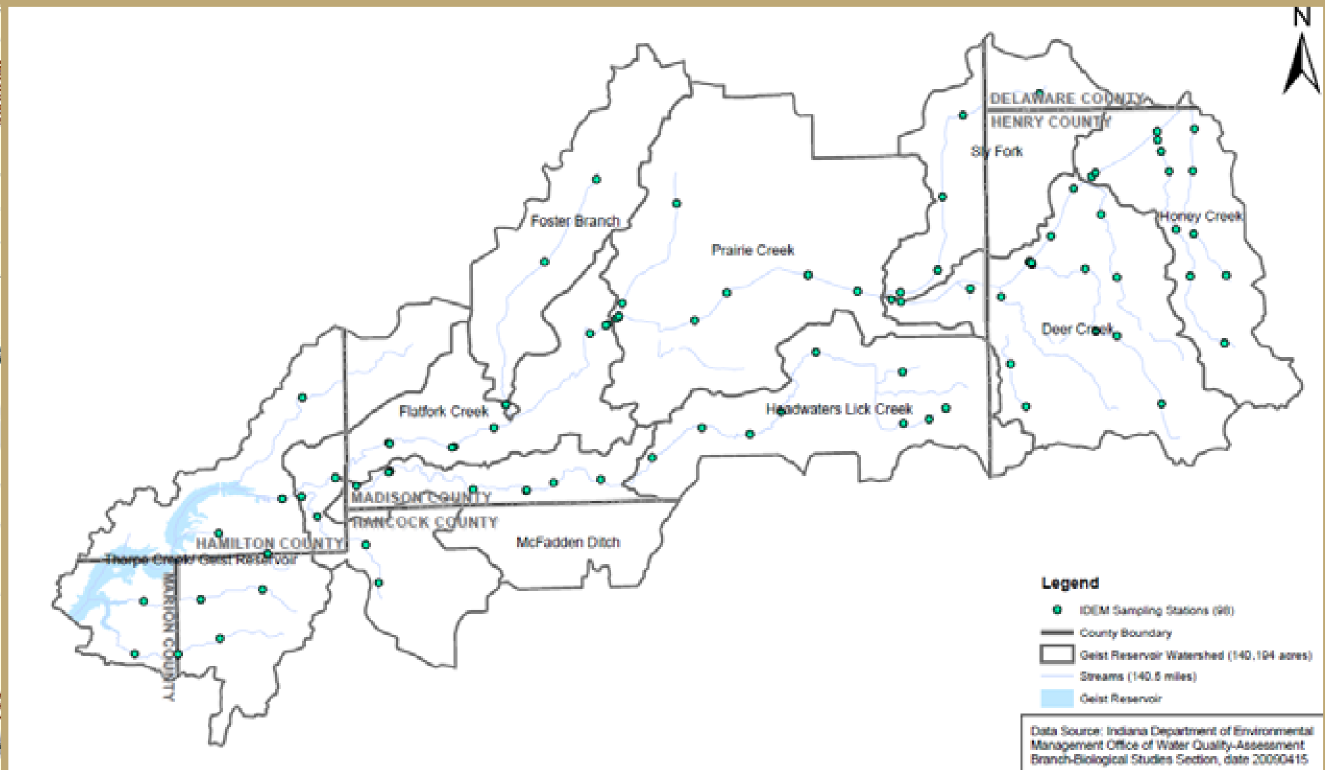

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