Nutrient TMDLs

Using Duration Curves to Develop Nutrient TMDLs

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TETRA TECH

complex world | CLEAR SOLUTIONS™

Discussion Overview

Points to look for …

- **Problem Solving Framework**
  - ***Practical approaches***
  - ***Partnerships***
- **Targeted Activities**
  - ***Contributing areas***
  - ***Delivery mechanisms***
  - ***Hydrology & duration curves***
- **Adaptive Management**
  - ***Connecting the pieces***

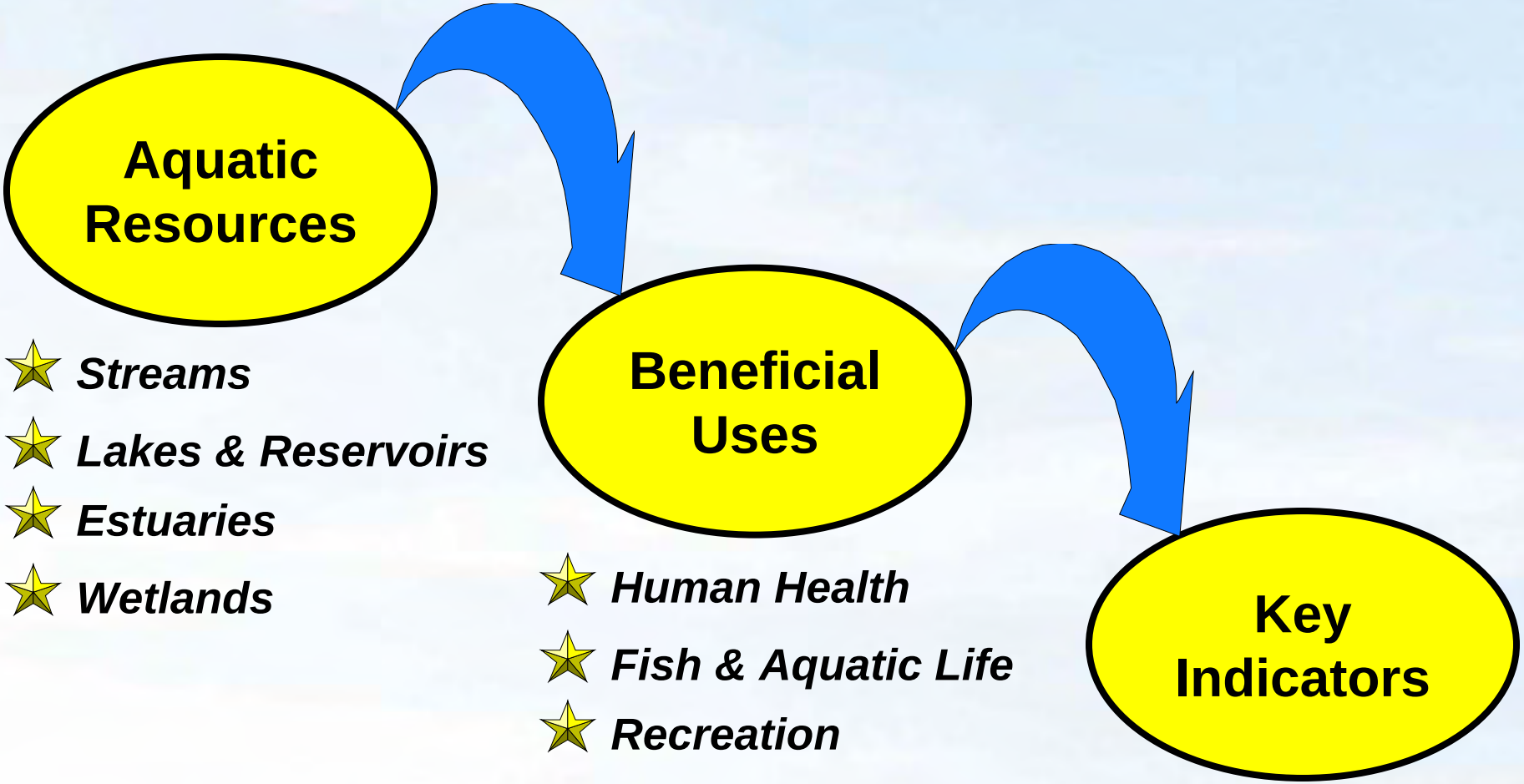
TMDL Development

Problem Solving Framework

- **Practical approach using key questions …**
  - ***WHY* the concern**
  - ***WHAT* reductions are needed**
  - ***WHERE* are the sources**
  - ***WHO* needs to be involved**
  - ***WHEN* will actions occur**

WHY the Concern

Identifying Objectives



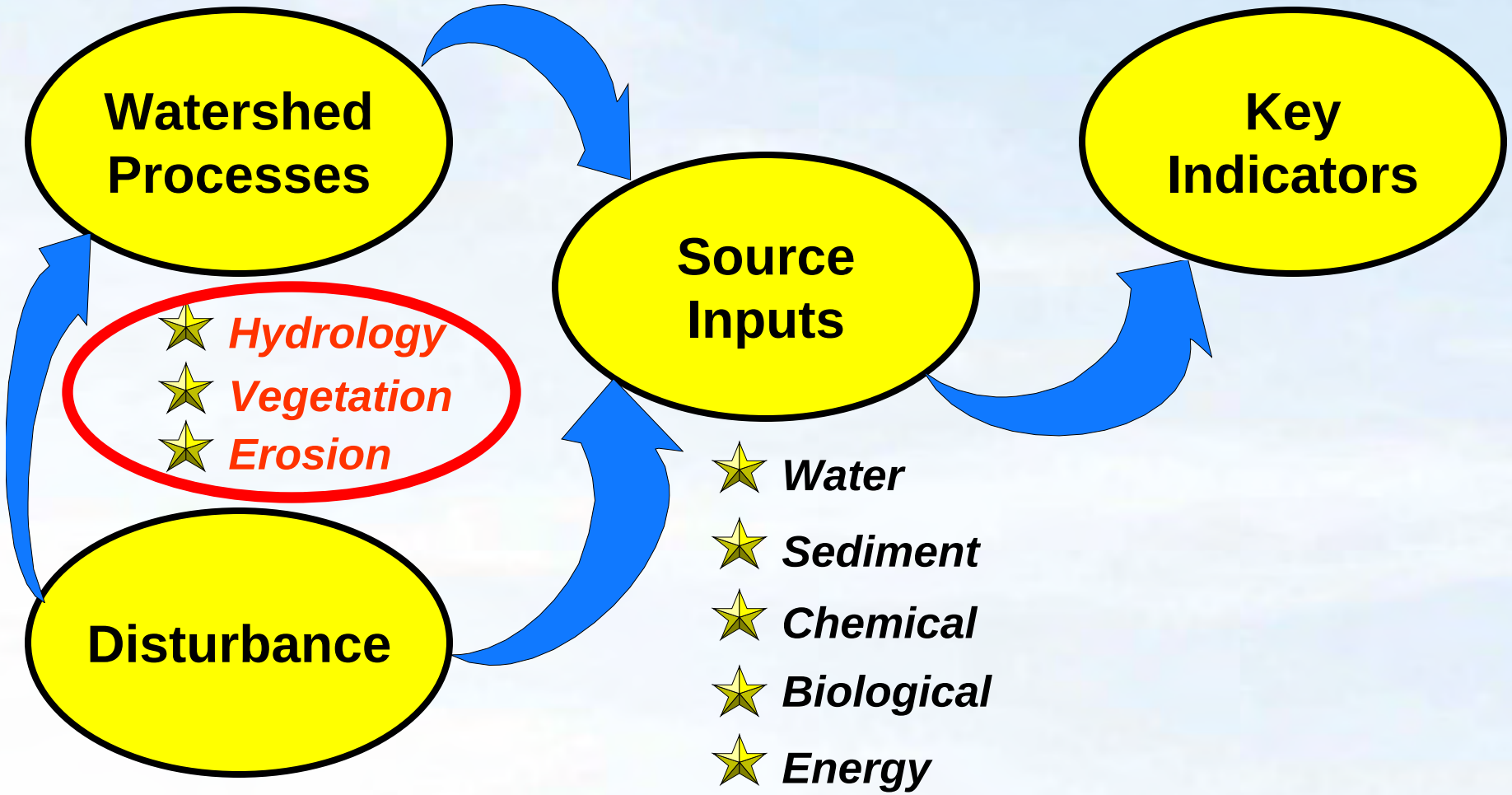
WHAT Reductions are Needed

Challenges

- ***Wide array of concerns +++***
  limited time, data, methods, resources

WHERE are the Sources

"Bottom-up" Focus



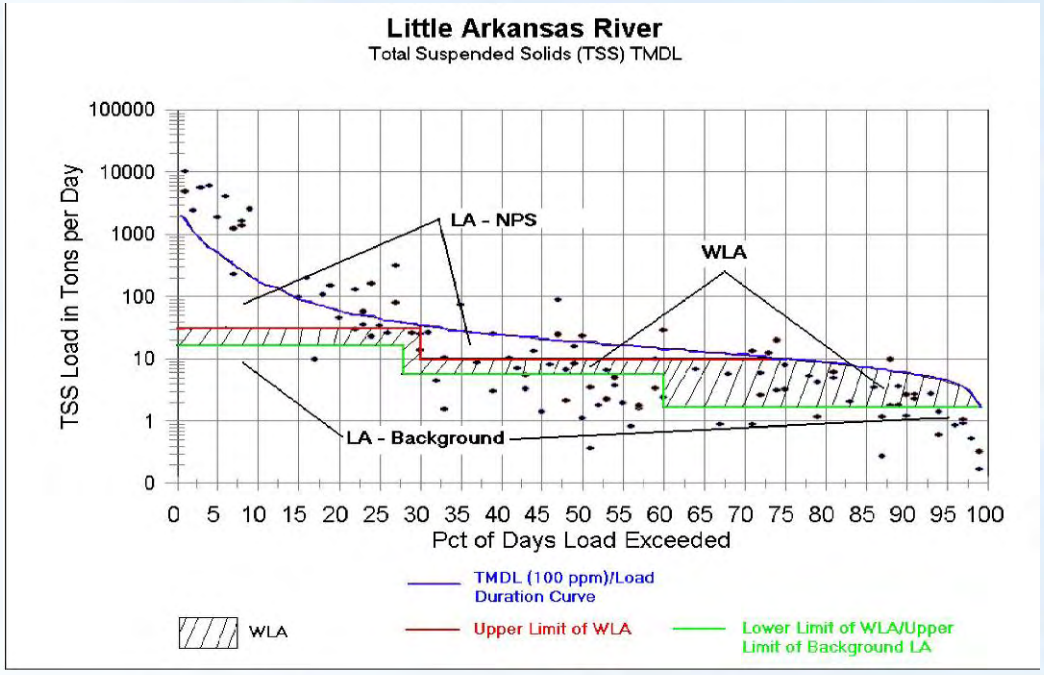
WHERE are the Sources

Hazard / Delivery

Hydrology-Based Framework

Duration Curves

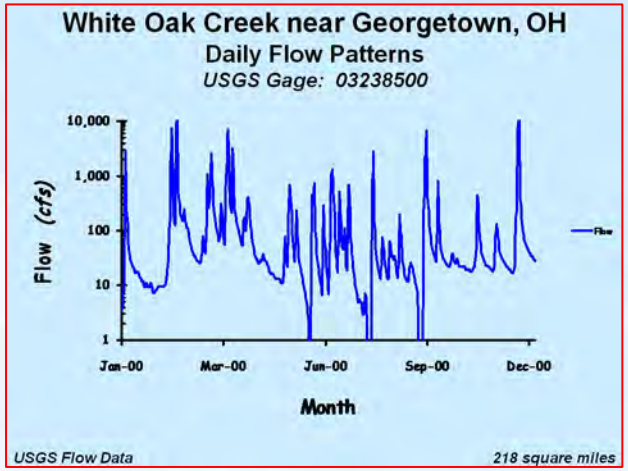
- **Pioneered by Kansas**

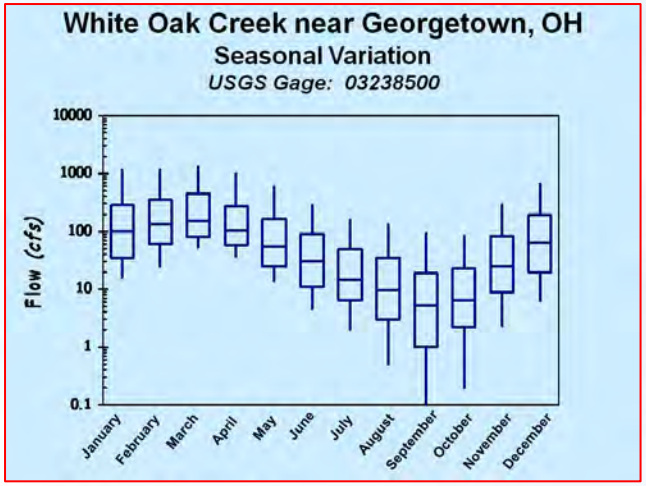


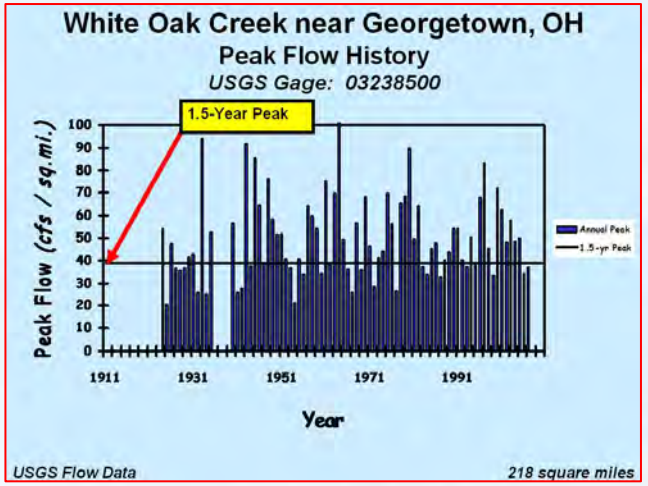
Hydrology-Based Framework

Some Basic Concepts

- ***Daily Average Flows***
- ***Seasonal Patterns***
- ***Annual Variation***
- ***Frequency Distributions***







Flow Duration Curves

Nuts & Bolts

- **Based on Cumulative Frequency Distribution**

  - ***Historic hydrologic record -- daily average flows***
    [e.g. download from USGS NWIS-Web]

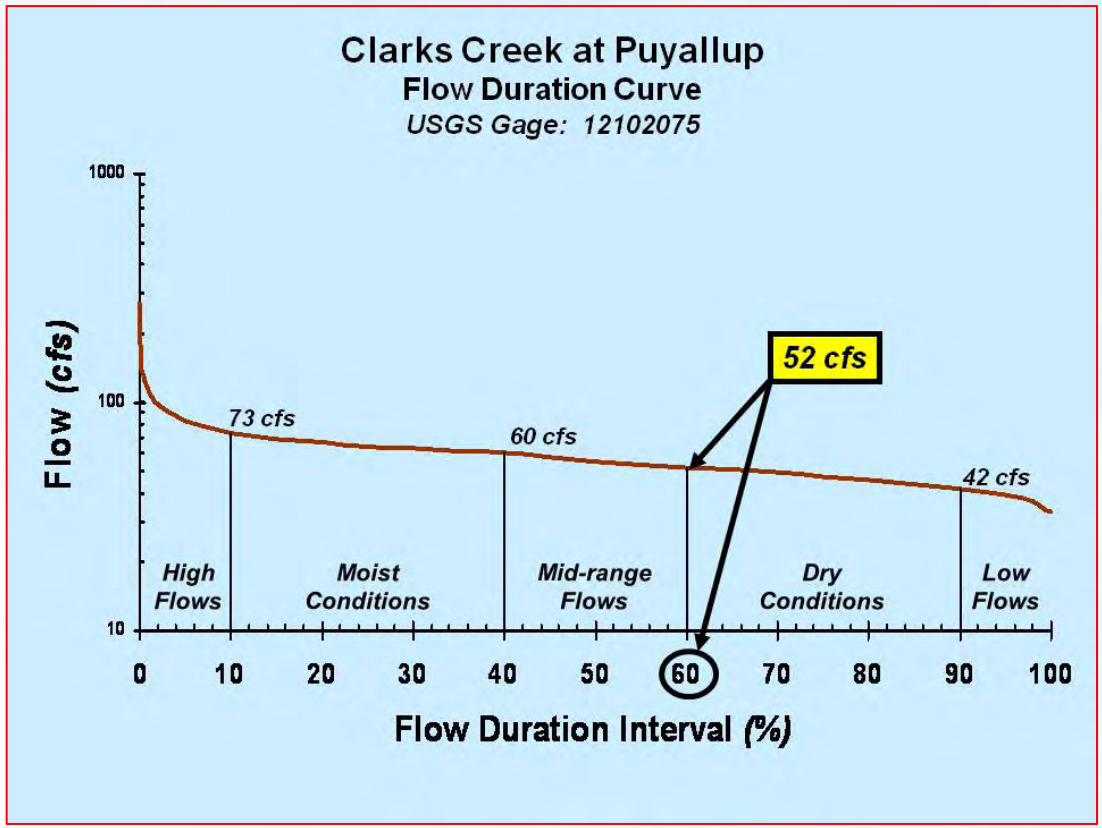
  - ***Developed with statistical software or spreadsheet***
    [e.g. =PERCENTILE(a1:a3650,0.5) in Excel]

  - ***Can also look at other key recurrence intervals***
    [e.g. median flow, 2-year peak, 7Q10]

Flow Duration Curves

Basic Form

- **Cumulative Frequency Distribution**



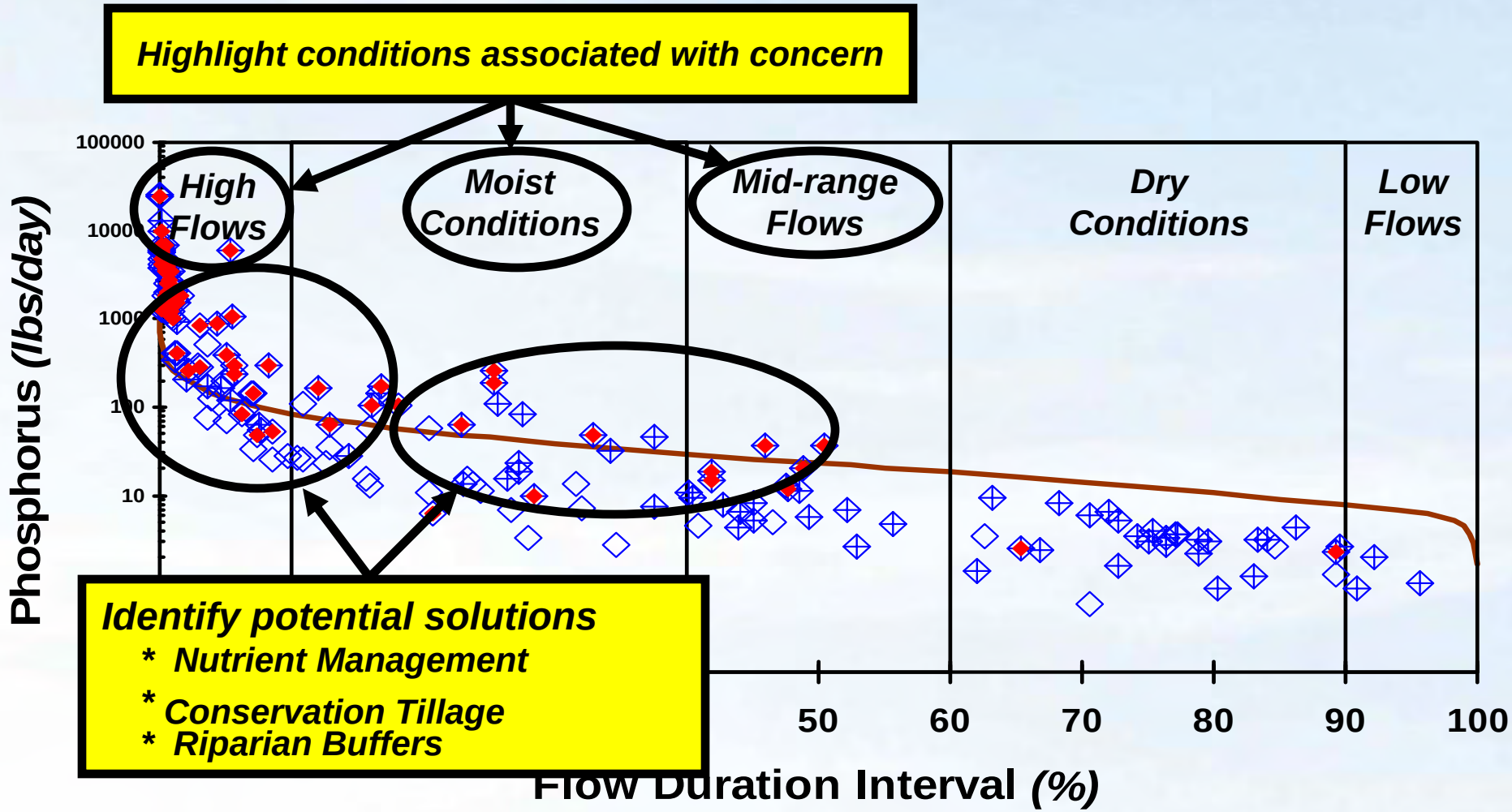
Water Quality Duration Curves

Concept

- **Again, use Cumulative Frequency Distribution**
  - ***Y-axis becomes water quality parameter value [e.g. load or concentration]***
  - ***X-axis position matches flow recurrence interval***
  - ***Curve determined by target concentration and flow associated with recurrence interval***

Load Duration Curves

Basic Form



Duration Curves

Basics

- **Method offers a number of advantages**
  - ***Moves away from single point estimate***
  - ***Easier to explain – fairly simple graphic display***
  - ***Context for looking at monitoring / modeling data***
  - ***Targeting focus – framework to evaluate options***
  - ***Being used as a tool in many States***

Duration Curves

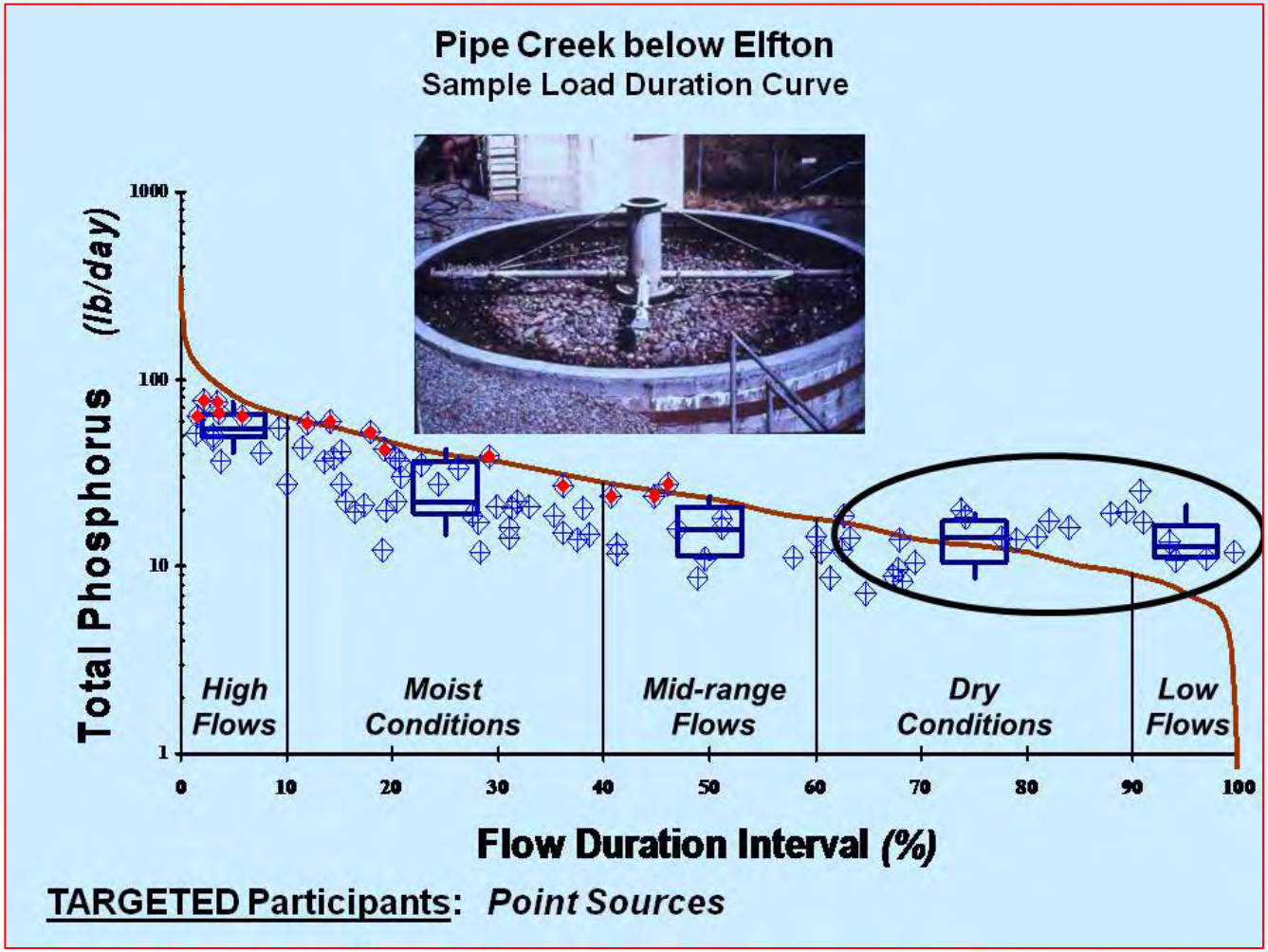
Advantages

- **Pattern analysis to help *interpret* WQ data**
  (source / delivery relationships)

- **Help *guide* implementation**
  - *Targeted* ***Participants***
  - *Targeted* ***Programs***
  - *Targeted* ***Activities***
  - *Targeted* ***Areas***

Duration Curves

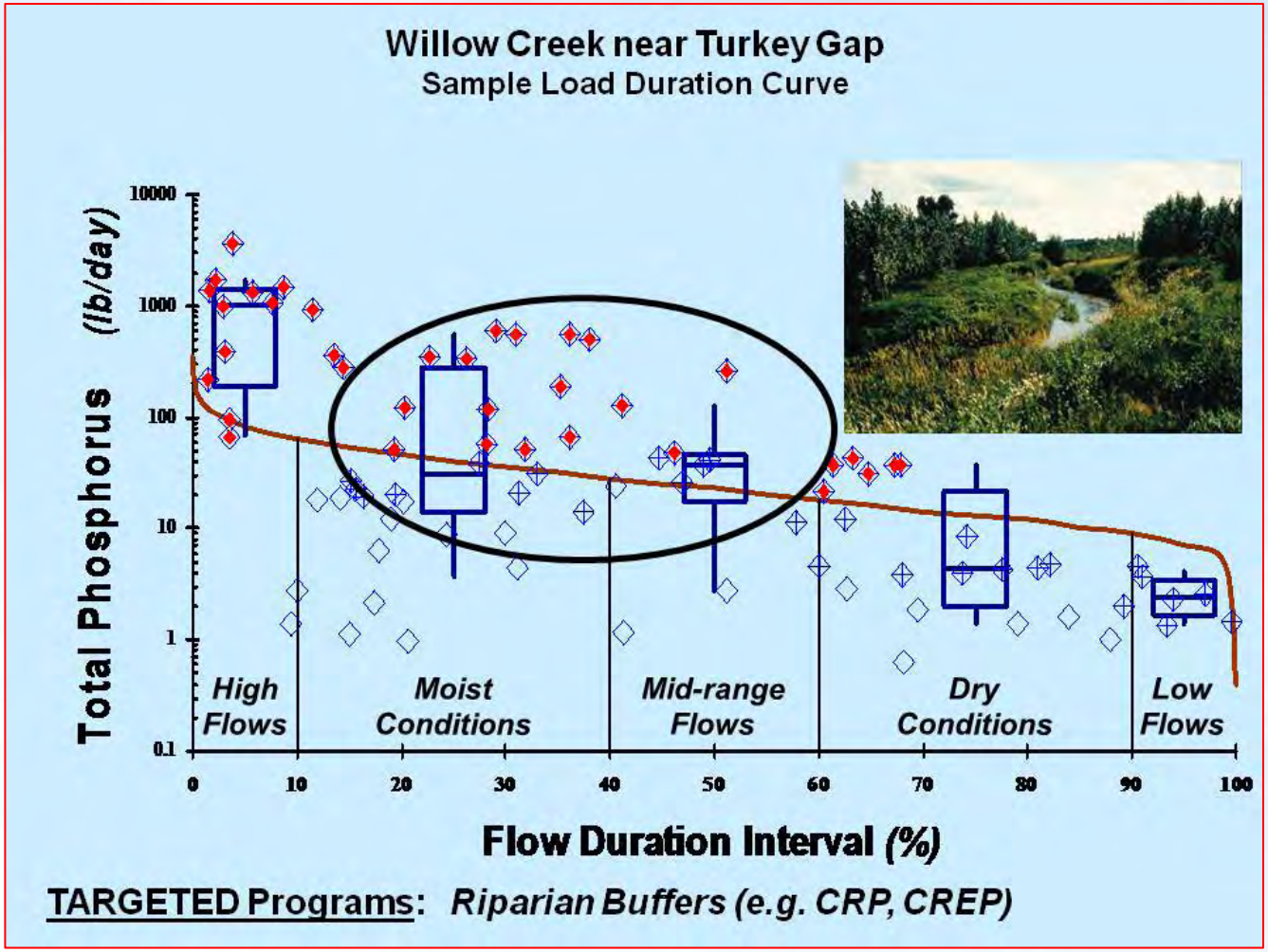
Watershed Condition -- Hydrologic



TARGETED Participants: *Point Sources*

Duration Curves

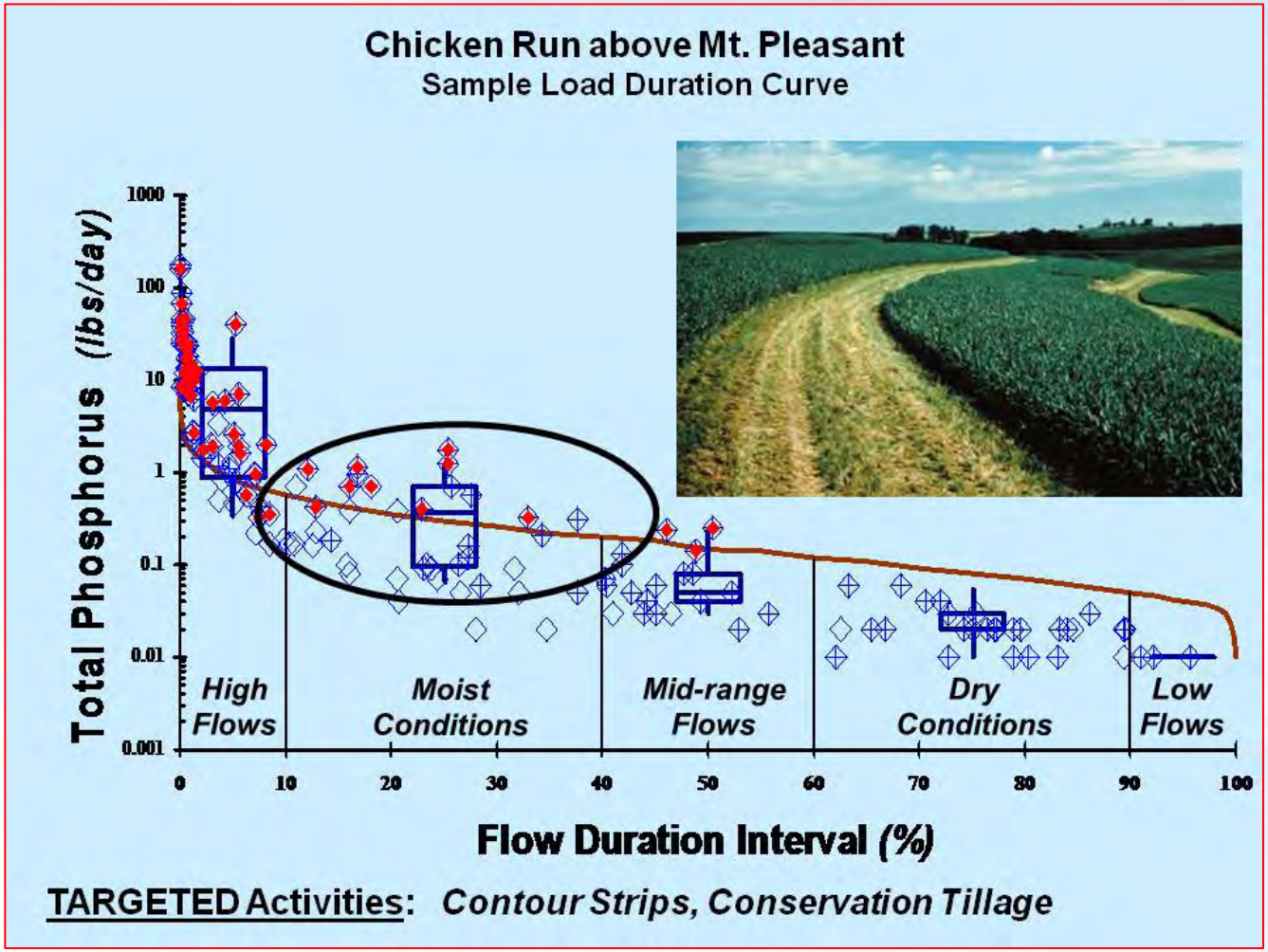
Contributing Areas



TARGETED Programs: *Riparian Buffers (e.g. CRP, CREP)*

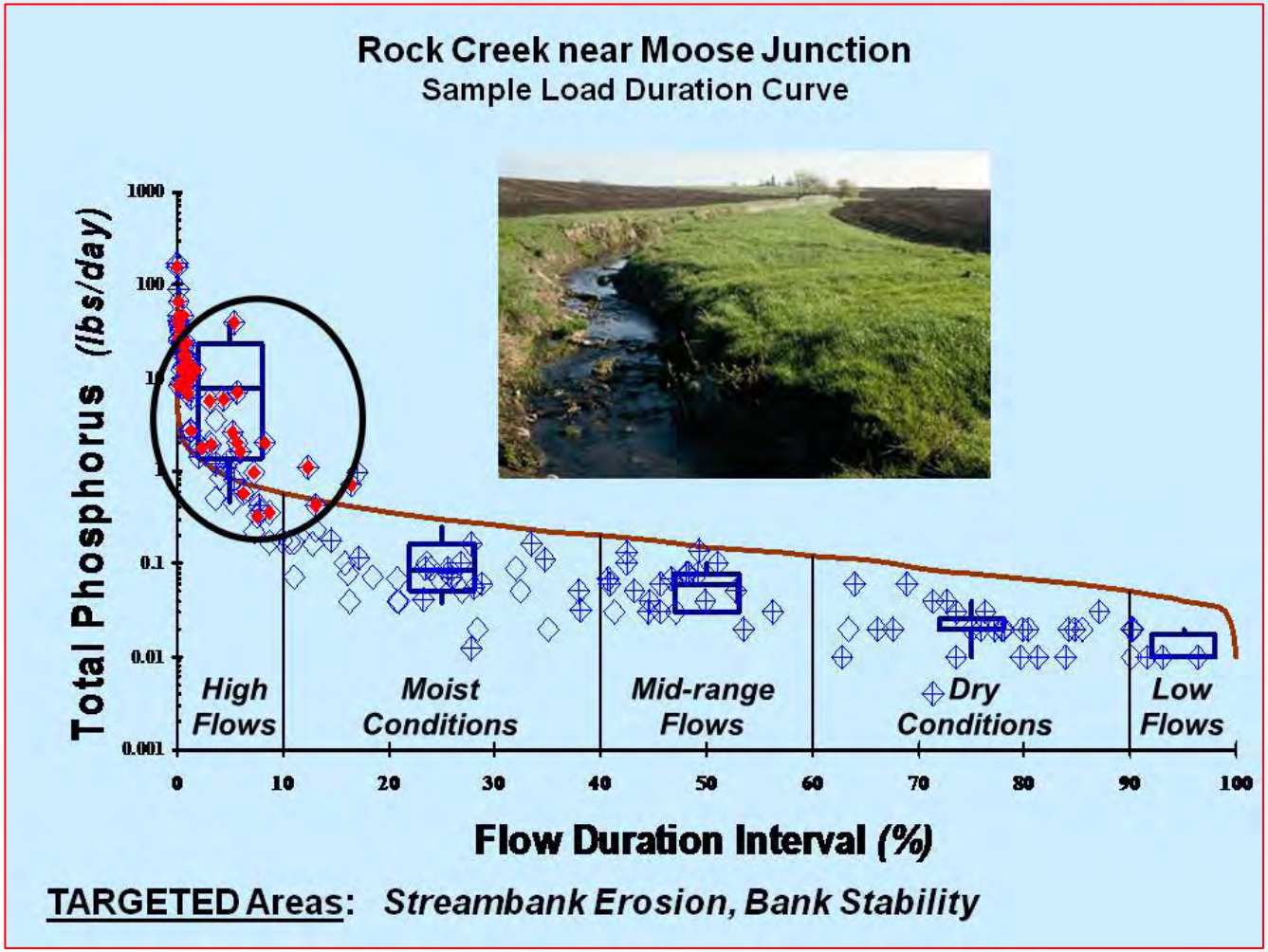
Duration Curves

Contributing Areas



Duration Curves

Delivery Mechanisms



Hydrology-Based Framework

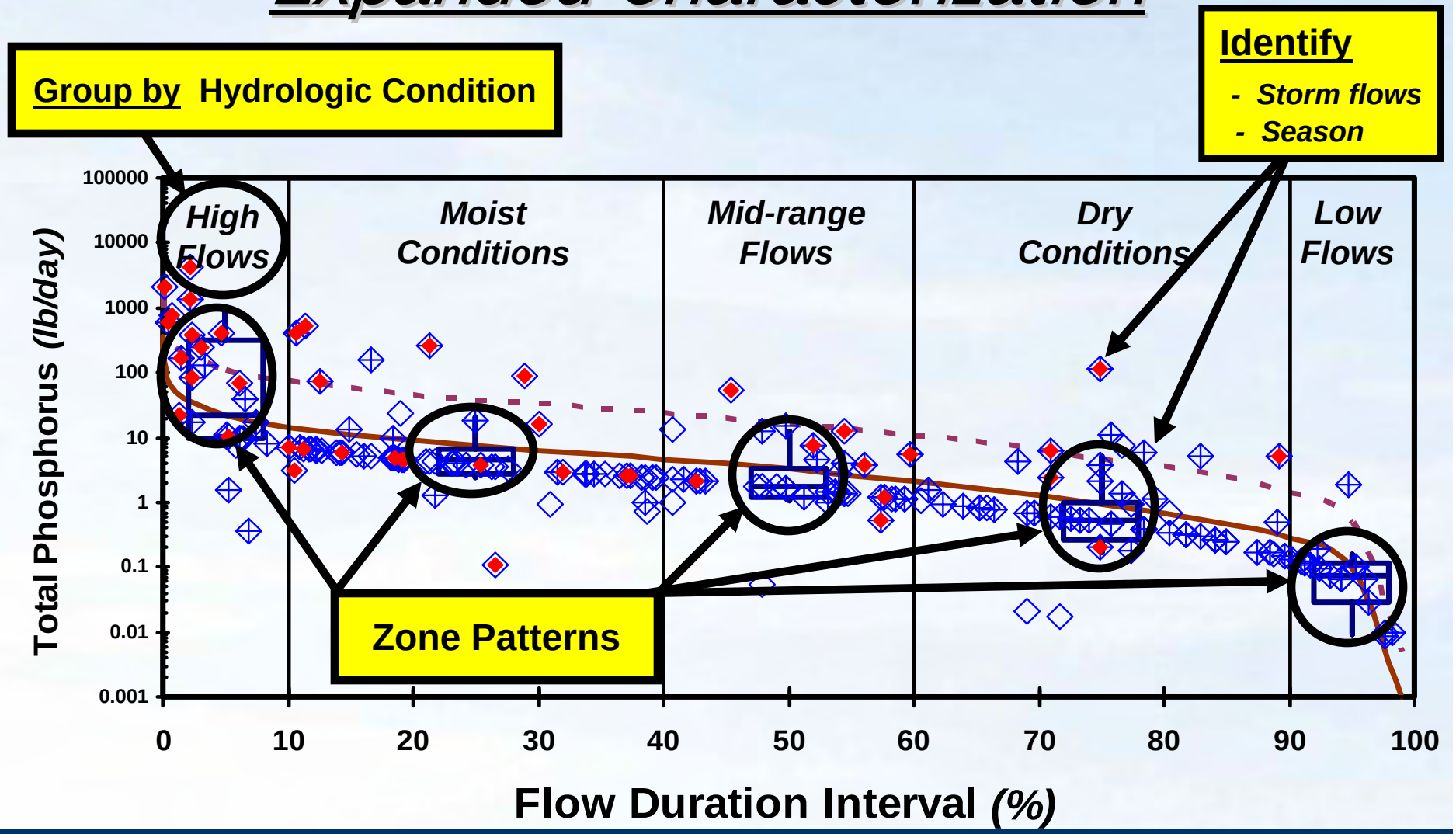
Duration Curves

- **Support TMDL development through …**

  - ***Enhanced description of water quality concerns***
  - ***Improve basic understanding of key watershed processes***
  - ***Focus on solution development***

Hydrology-Based Framework

Expanded Characterization



Nutrient TMDLs

Hydrology-based Framework

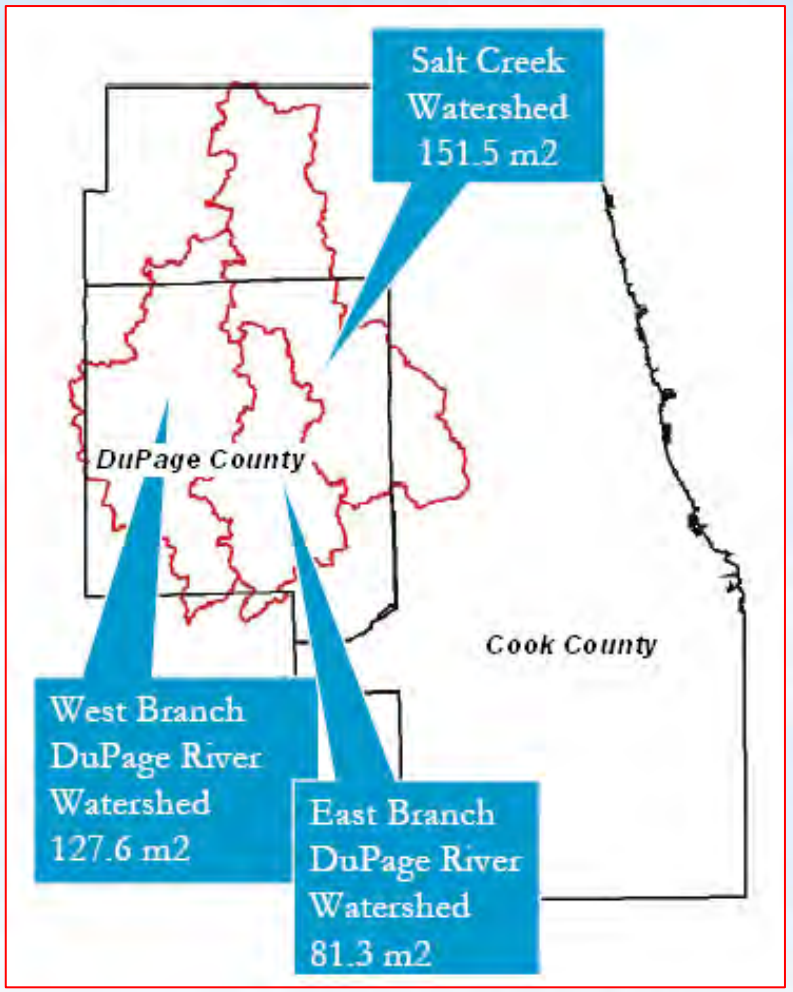
Example Applications

- ***Source characterization through pattern analysis***
- ***Identify key processes using parameter interrelationships***
- ***Develop solutions***
- ***Document results***

Nutrient TMDLs

Source Characterization

Urban Setting

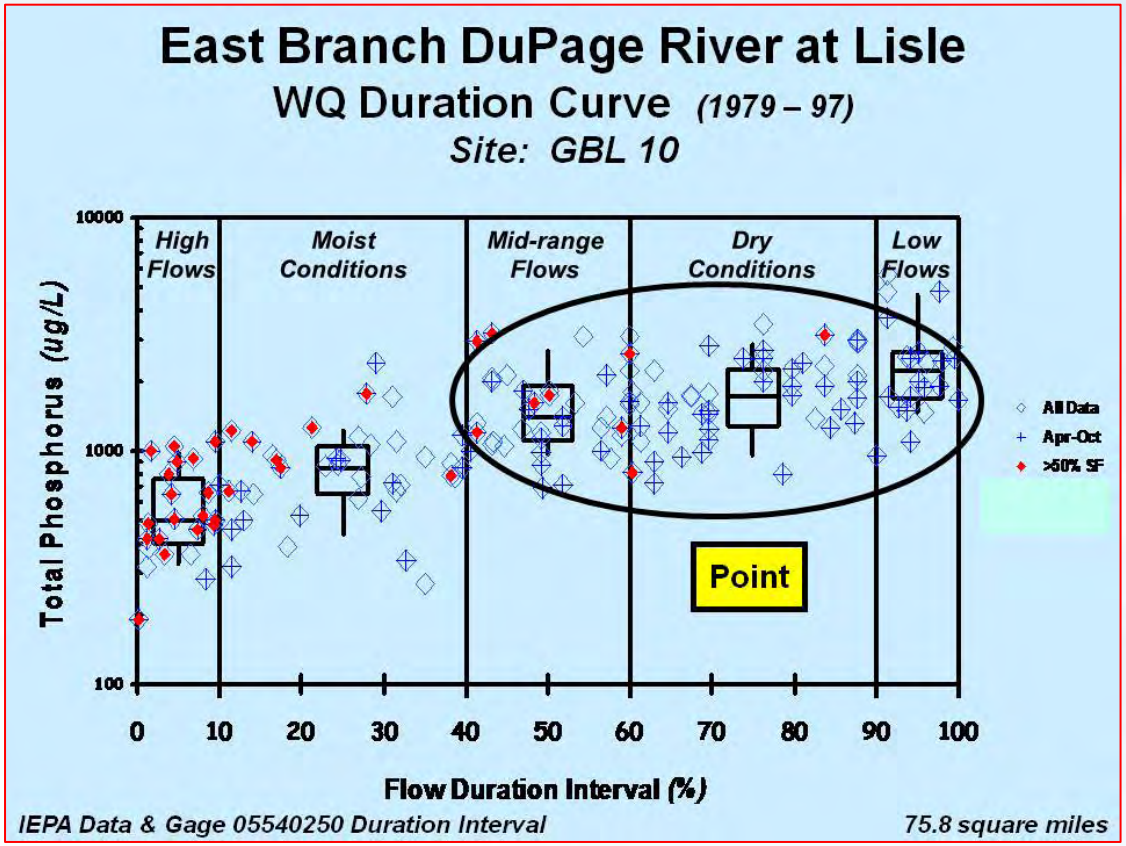



THE DUPAGE RIVER GREENWAY
An Opportunity for Nature Appreciation, Scenic Beauty and Exercise.
CODE OF CONDUCT
1. Please stay on trail in continuous movement.
2. We invite you to rest & relax at Hidden Lakes Historic Trout Farm, 1¼ miles down the trail, where concessions and restroom facilities are available.
3. Respect the rights of all trail users and of adjacent homeowners.
4. Please ride bikes in a single file, keeping to the right side of the trail.
5. Give warning before passing other trail users.
6. Only leashed pets are welcome. Please clean up after them.
7. Unauthorized vehicles are prohibited.
8. Trail hours are 7am to dusk.
Take Only Memories, Leave Only Footprints.

Nutrient TMDLs

Source Characterization

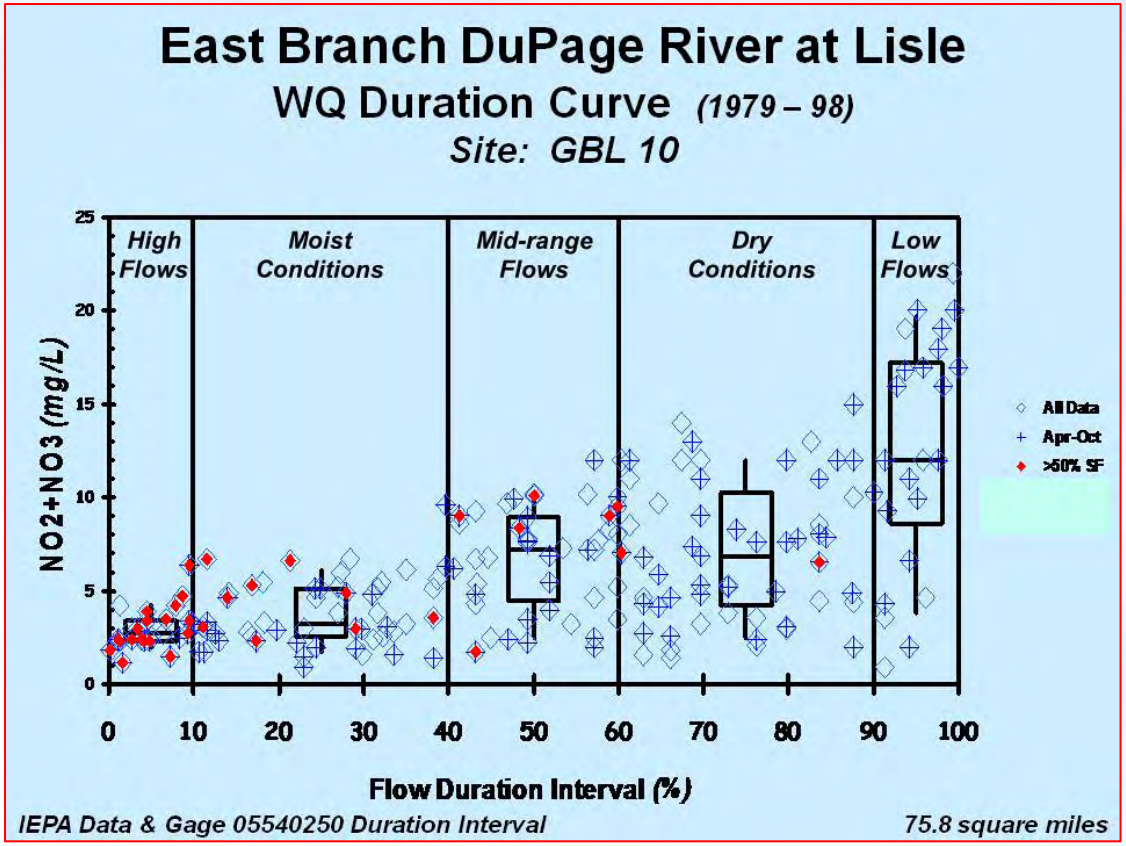
Phosphorus -- *Point*



Nutrient TMDLs

Pattern Analysis

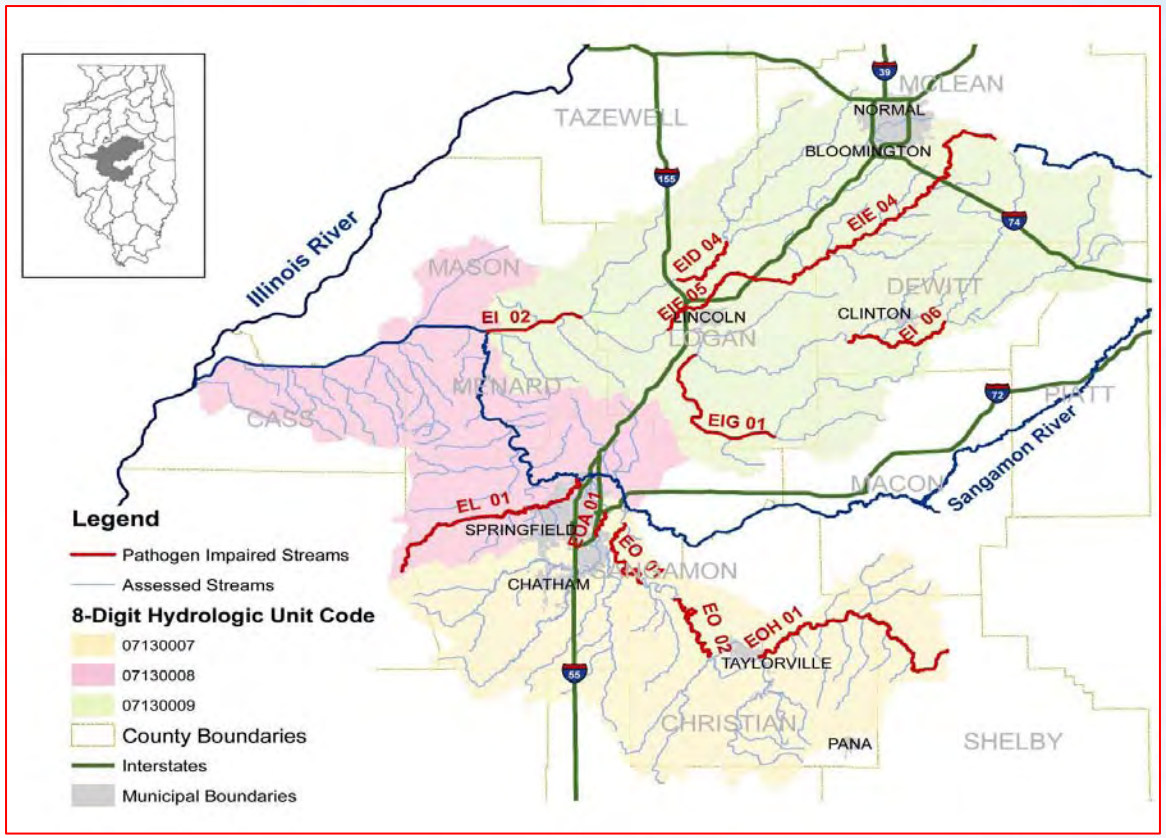
Nitrate -- *Point*



Nutrient TMDLs

Source Characterization

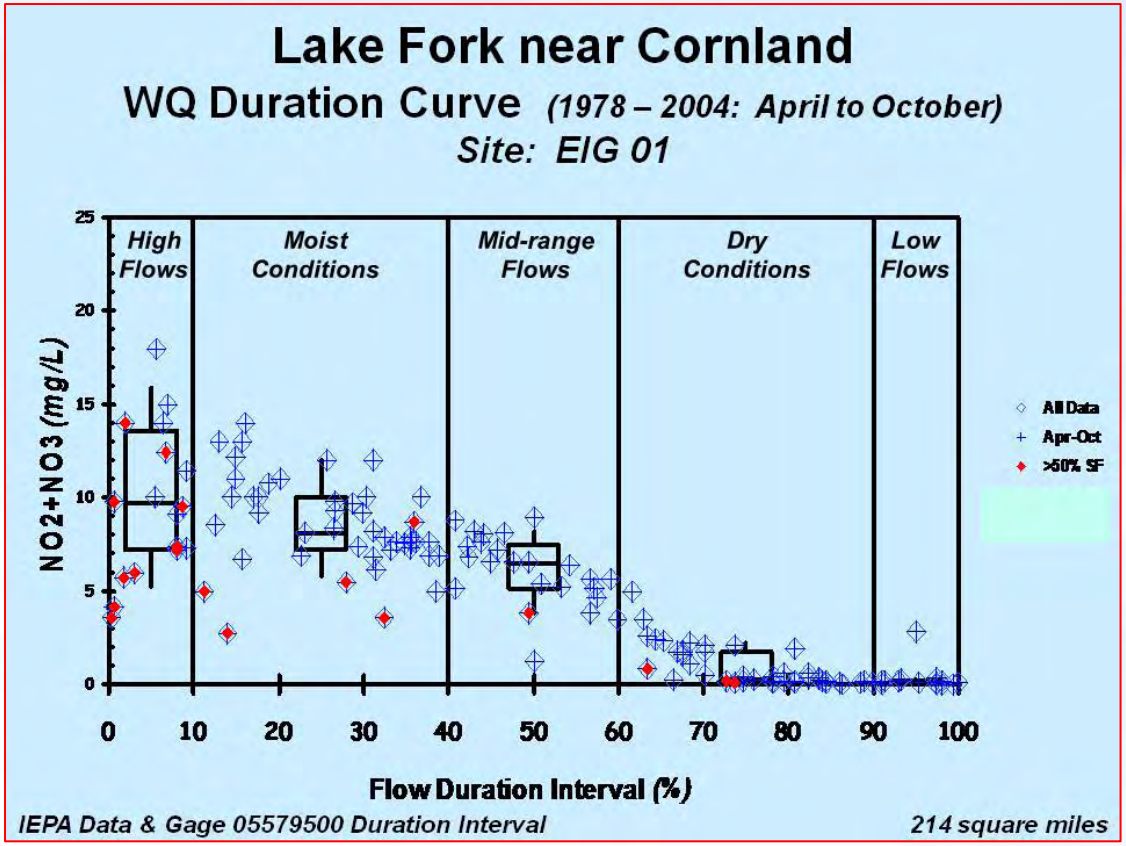
Rural Setting



Nutrient TMDLs

Source Characterization

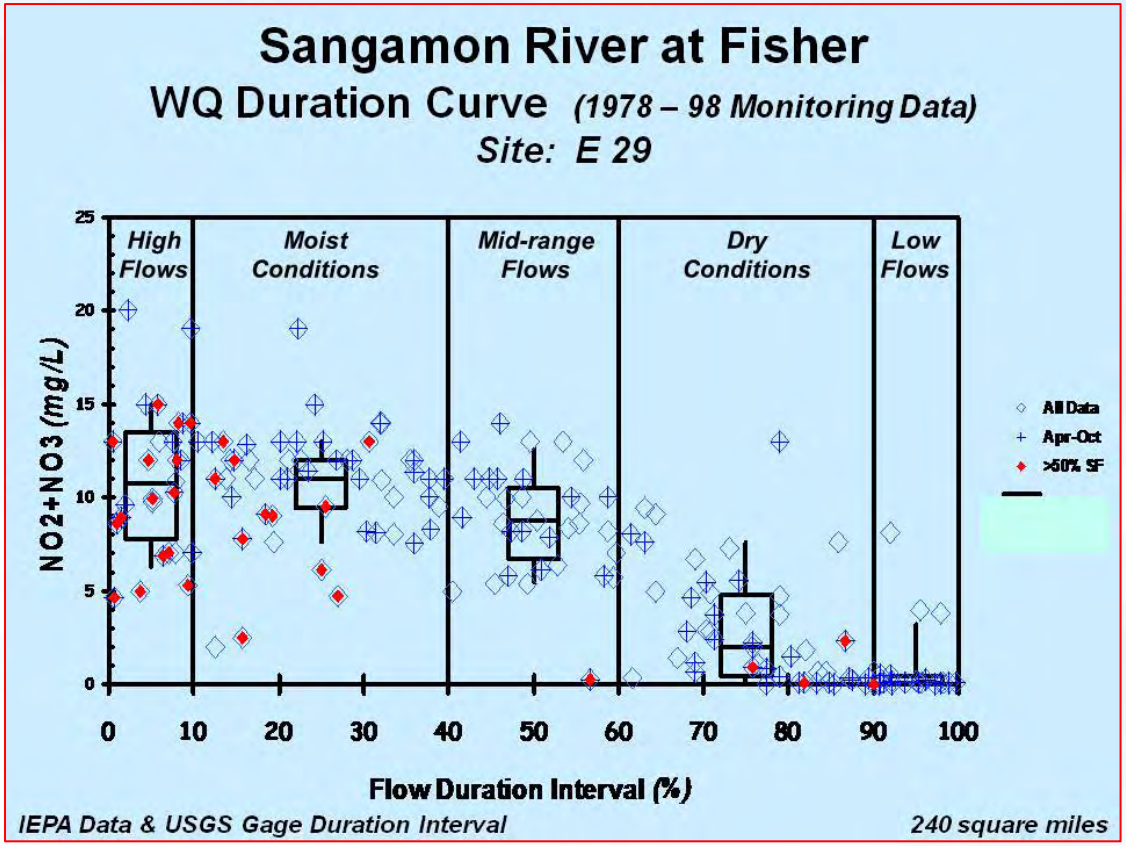
Nitrate -- *Dominant Concerns*

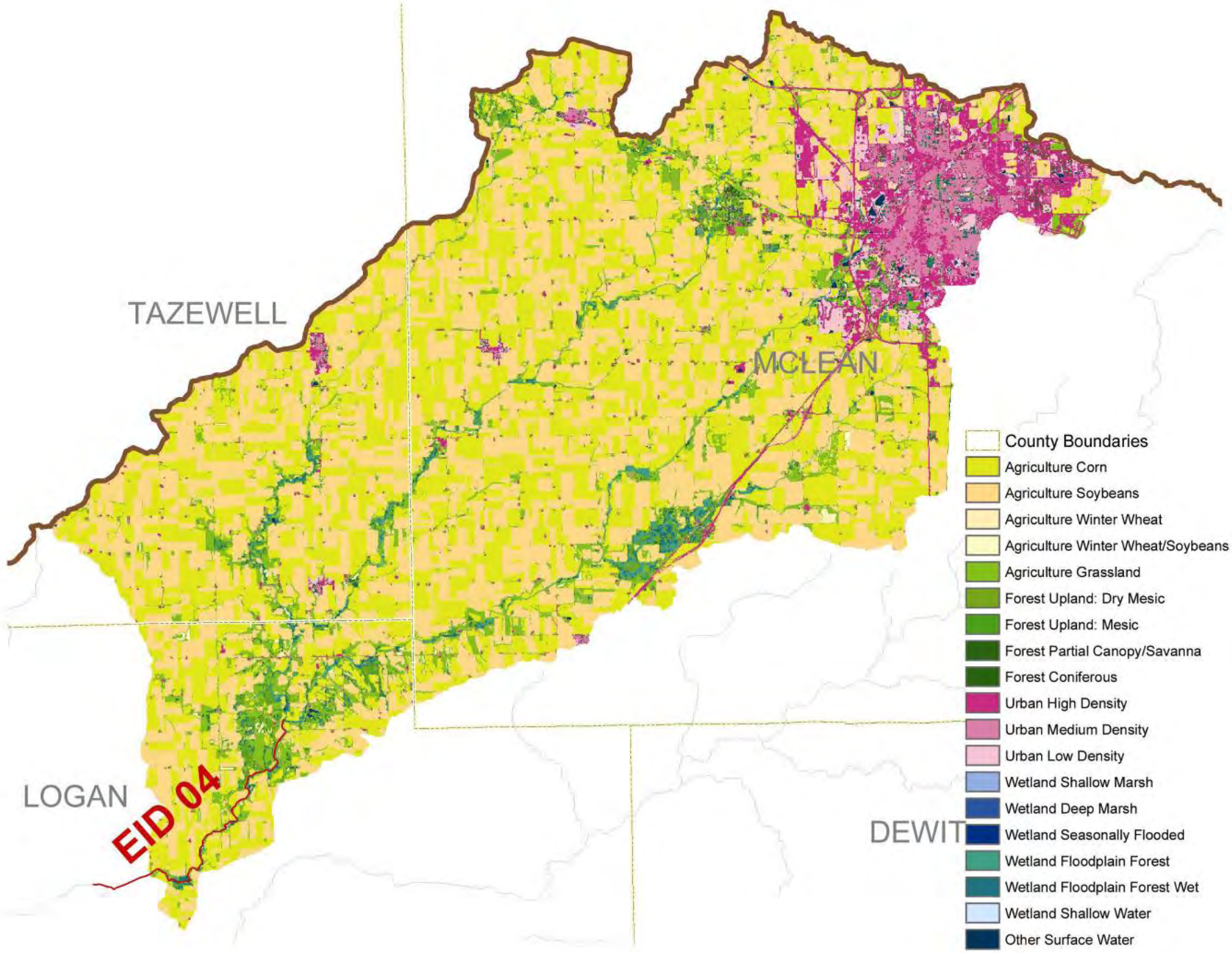


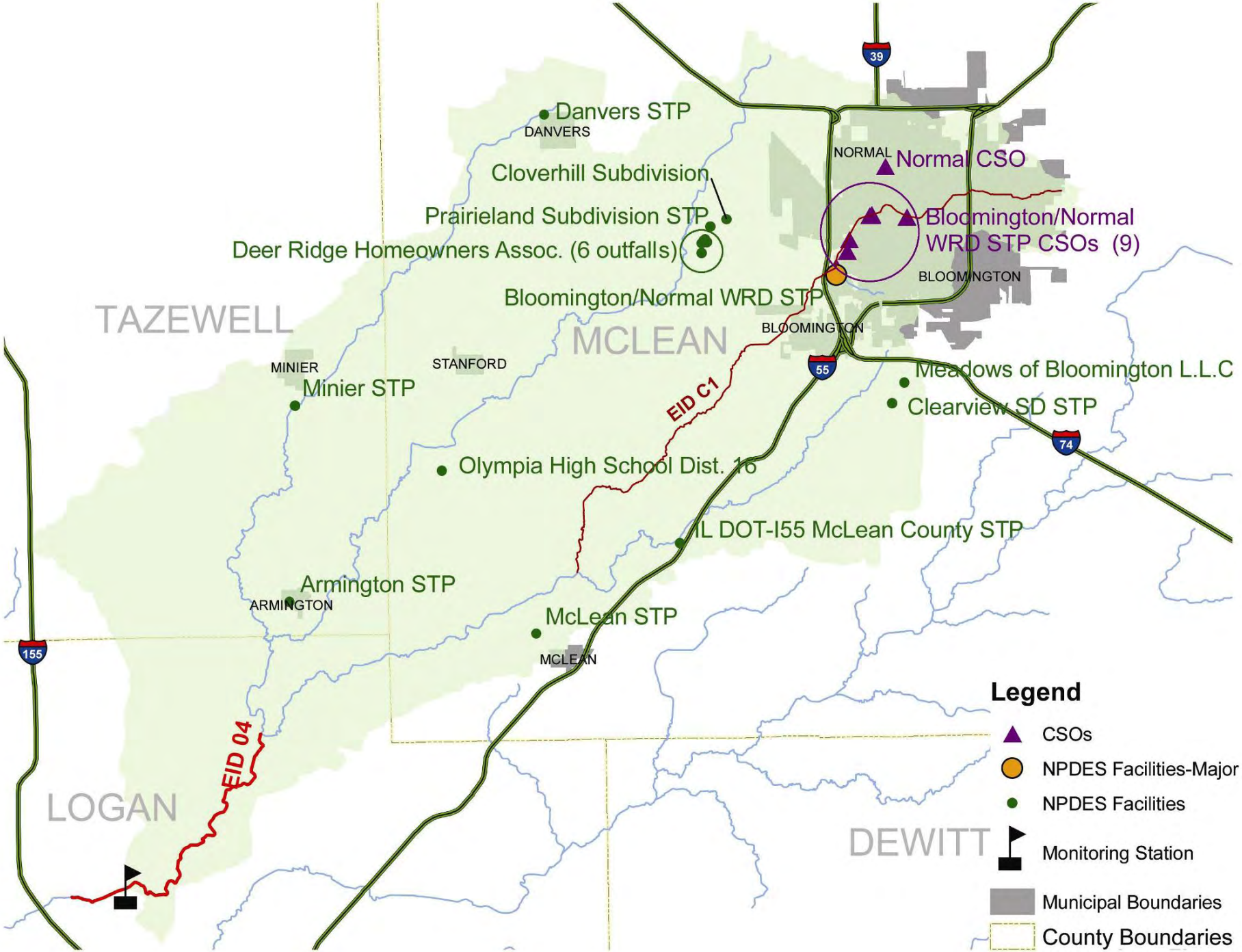
Nutrient TMDLs

Pattern Analysis

Potential Delivery Paths



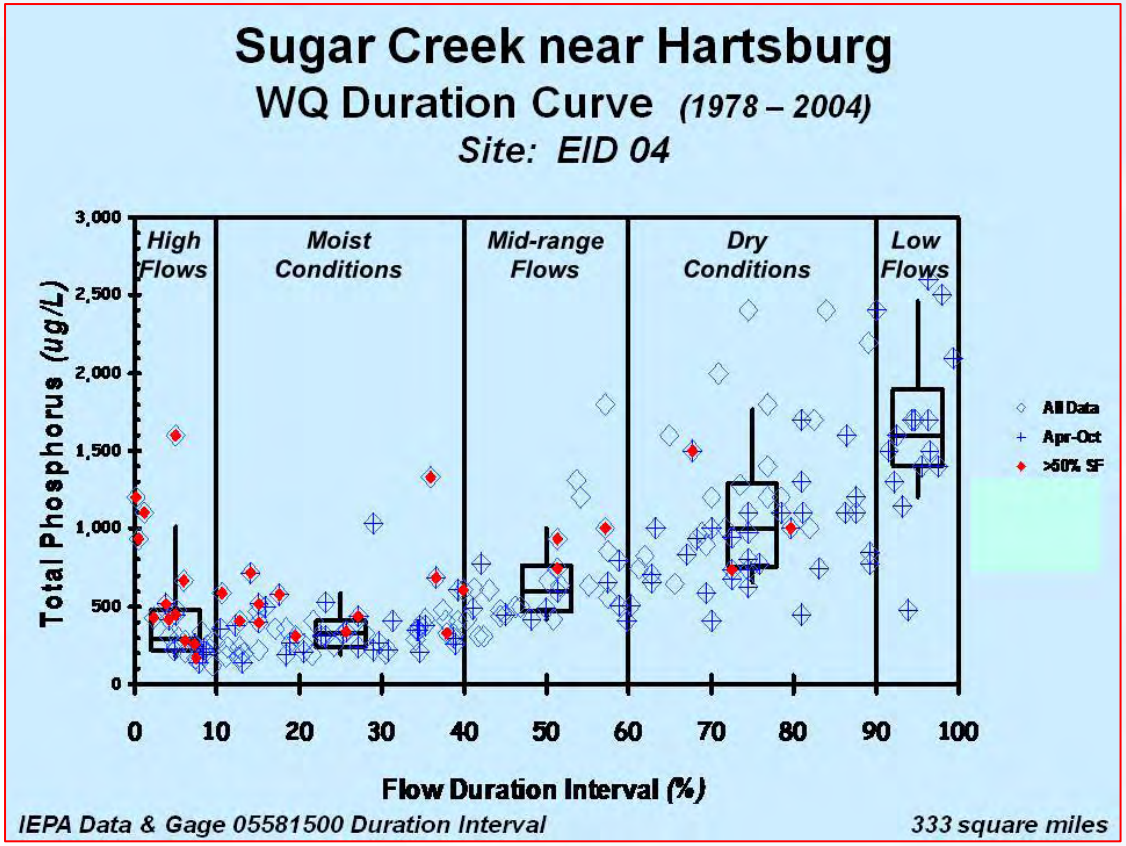

TAZEWELL
MCLEAN
LOGAN
DEWIT
EID 04
County Boundaries
Agriculture Corn
Agriculture Soybeans
Agriculture Winter Wheat
Agriculture Winter Wheat/Soybeans
Agriculture Grassland
Forest Upland: Dry Mesic
Forest Upland: Mesic
Forest Partial Canopy/Savanna
Forest Coniferous
Urban High Density
Urban Medium Density
Urban Low Density
Wetland Shallow Marsh
Wetland Deep Marsh
Wetland Seasonally Flooded
Wetland Floodplain Forest
Wetland Floodplain Forest Wet
Wetland Shallow Water
Other Surface Water

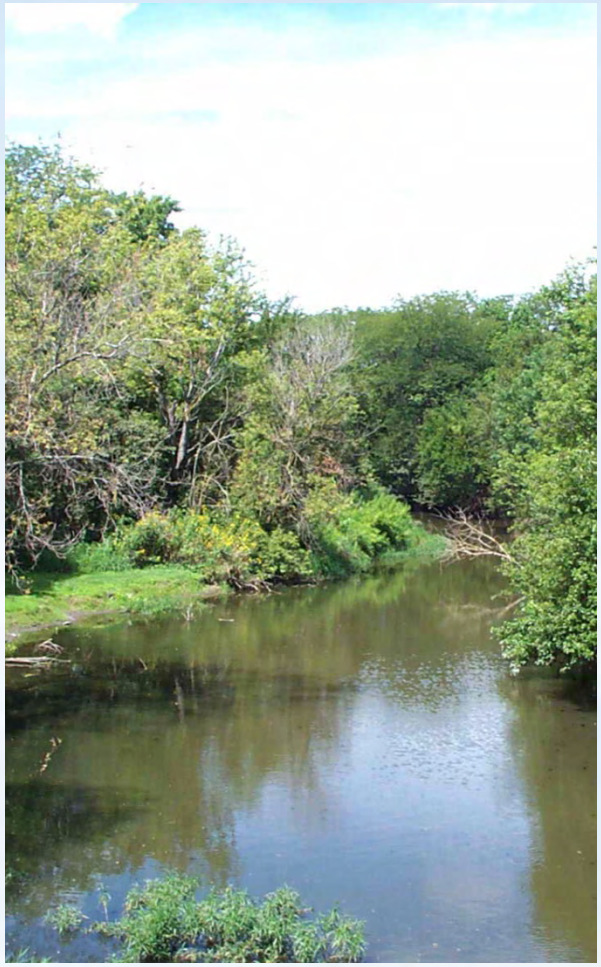

Danvers STP
DANVERS
Cloverhill Subdivision
Prairieland Subdivision STP
Deer Ridge Homeowners Assoc. (6 outfalls)
Bloomington/Normal WRD STP
NORMAL
Normal CSO
Bloomington/Normal WRD STP CSOs (9)
BLOOMINGTON
BLOOMINGTON
TAZEWELL
MCLEAN
MINIER
STANFORD
Minier STP
EID C1
Meadows of Bloomington L.L.C
Clearview SD STP
Olympia High School Dist. 16
IL DOT-I55 McLean County STP
Armington STP
ARMINGTON
McLean STP
MCLEAN
EID 04
LOGAN
DEWITT
39
55
74
155
Legend
CSOs
NPDES Facilities-Major
NPDES Facilities
Monitoring Station
Municipal Boundaries
County Boundaries

Nutrient TMDLs

Source Characterization

Phosphorus -- *Highlight Concerns*





Nutrient TMDLs

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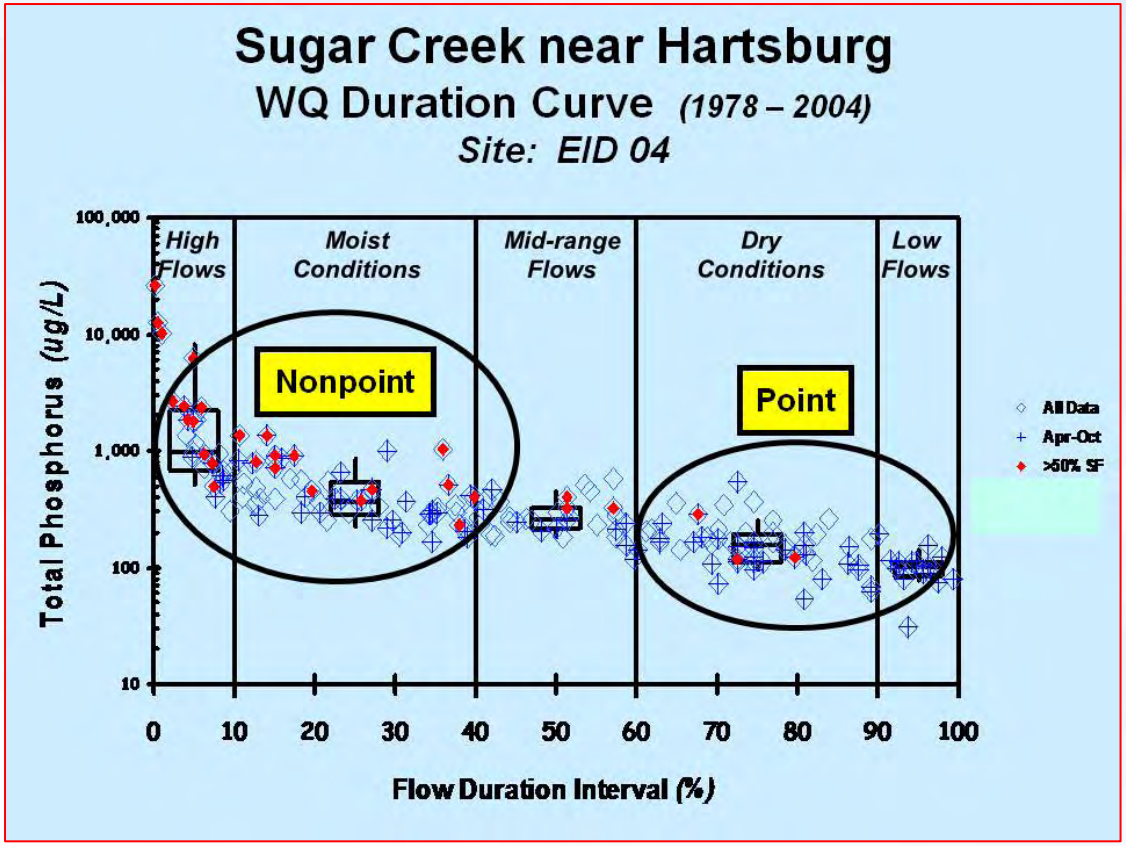
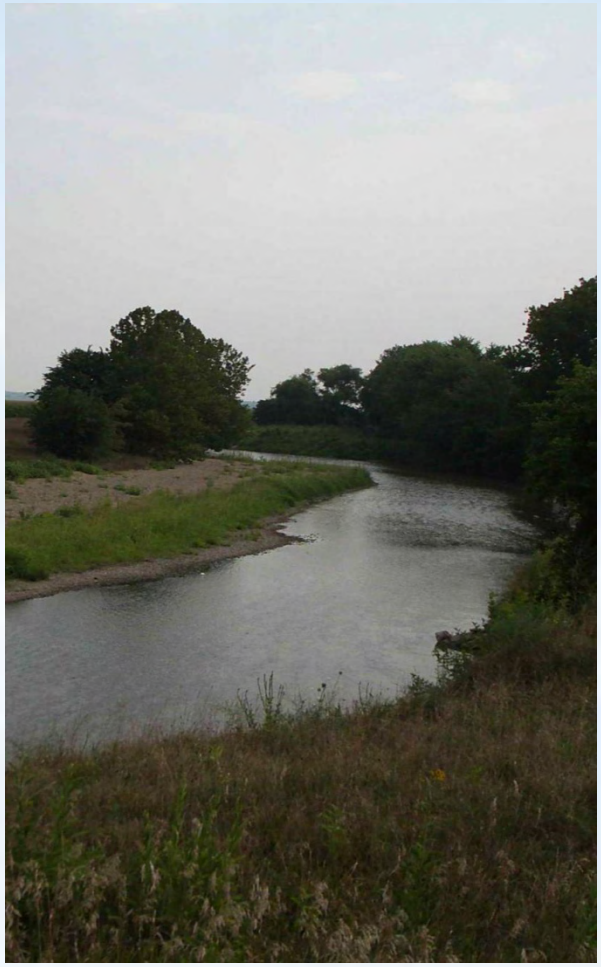
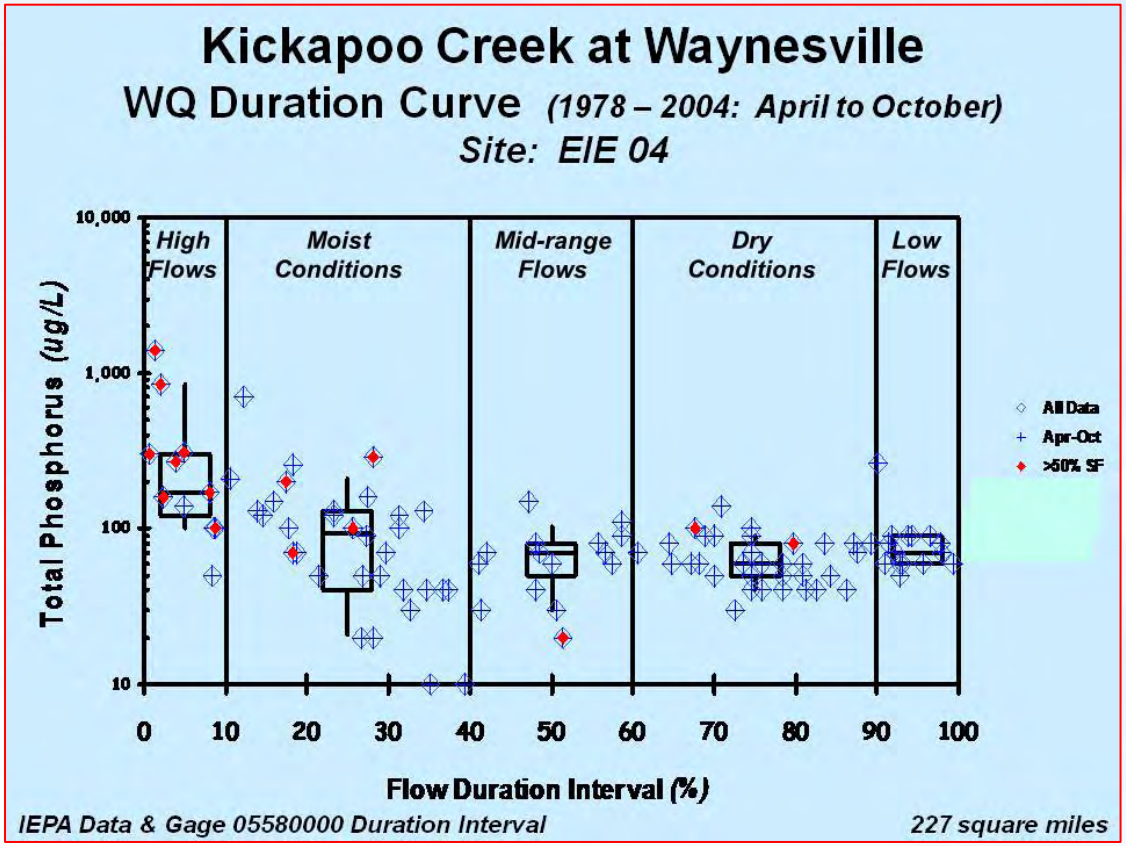




Nutrient TMDLs

Pattern Analysis

Parameter Interrelationships -- *TP & TSS*



Nutrient TMDLs

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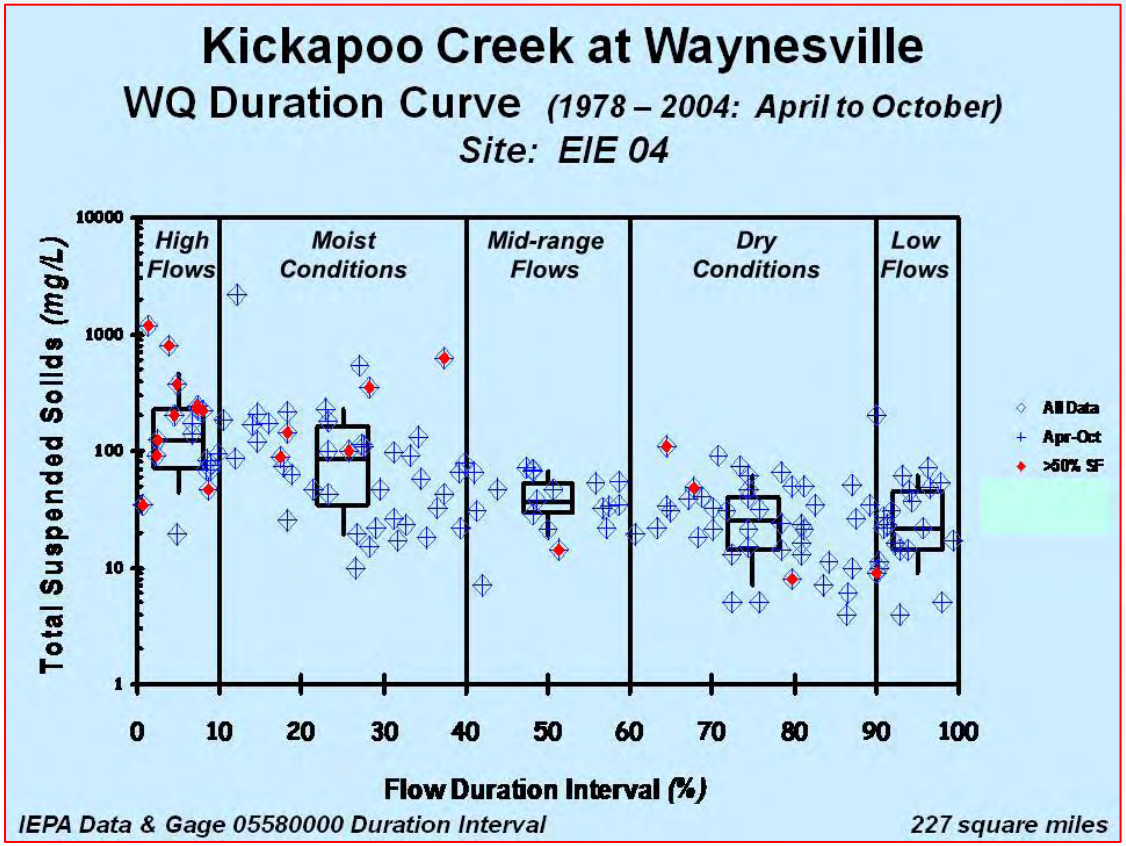
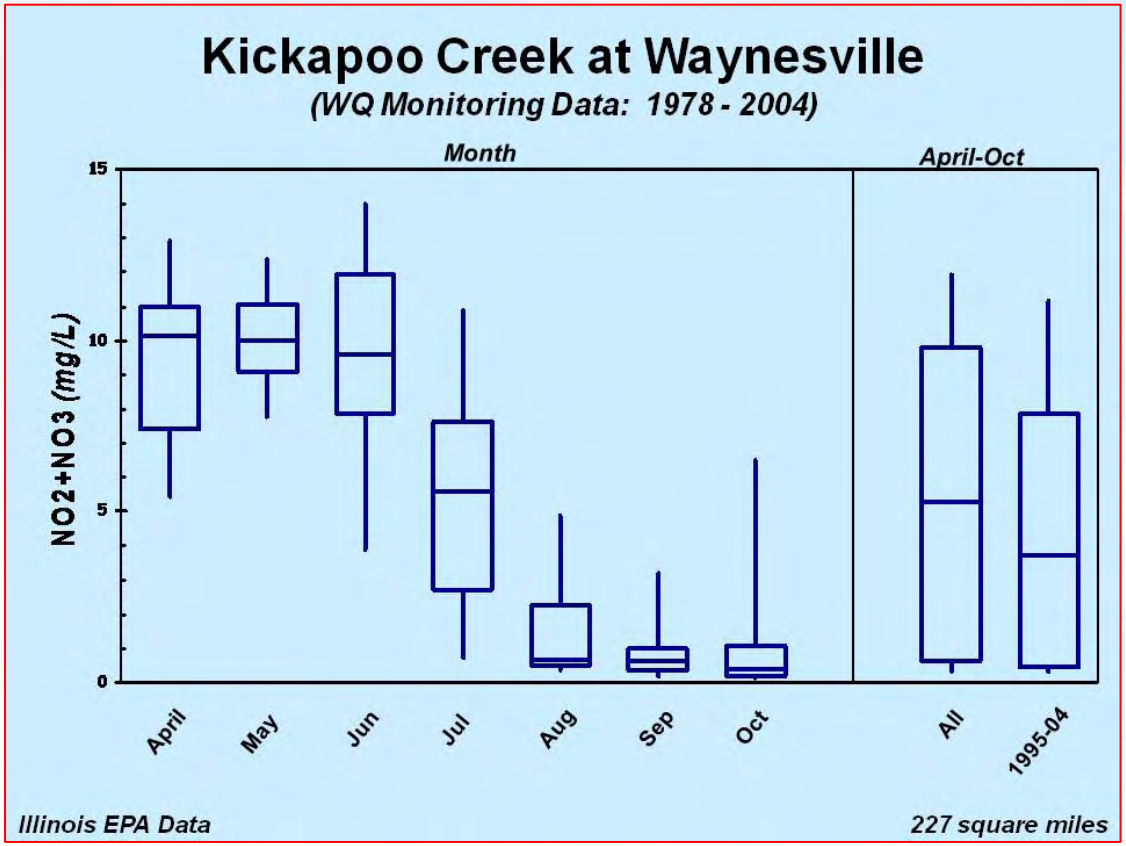
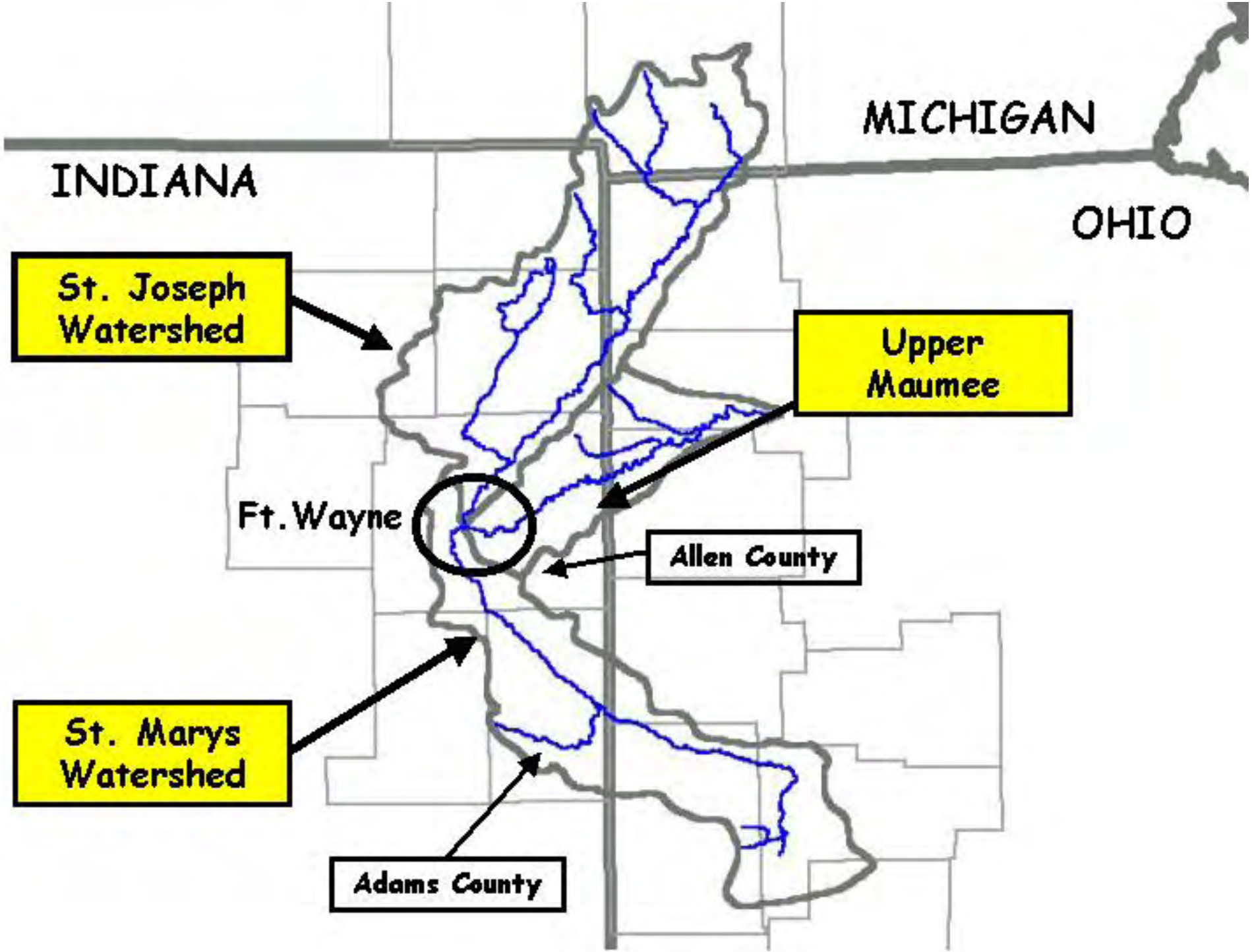


Nutrient TMDLs

Pattern Analysis

Seasonal Considerations

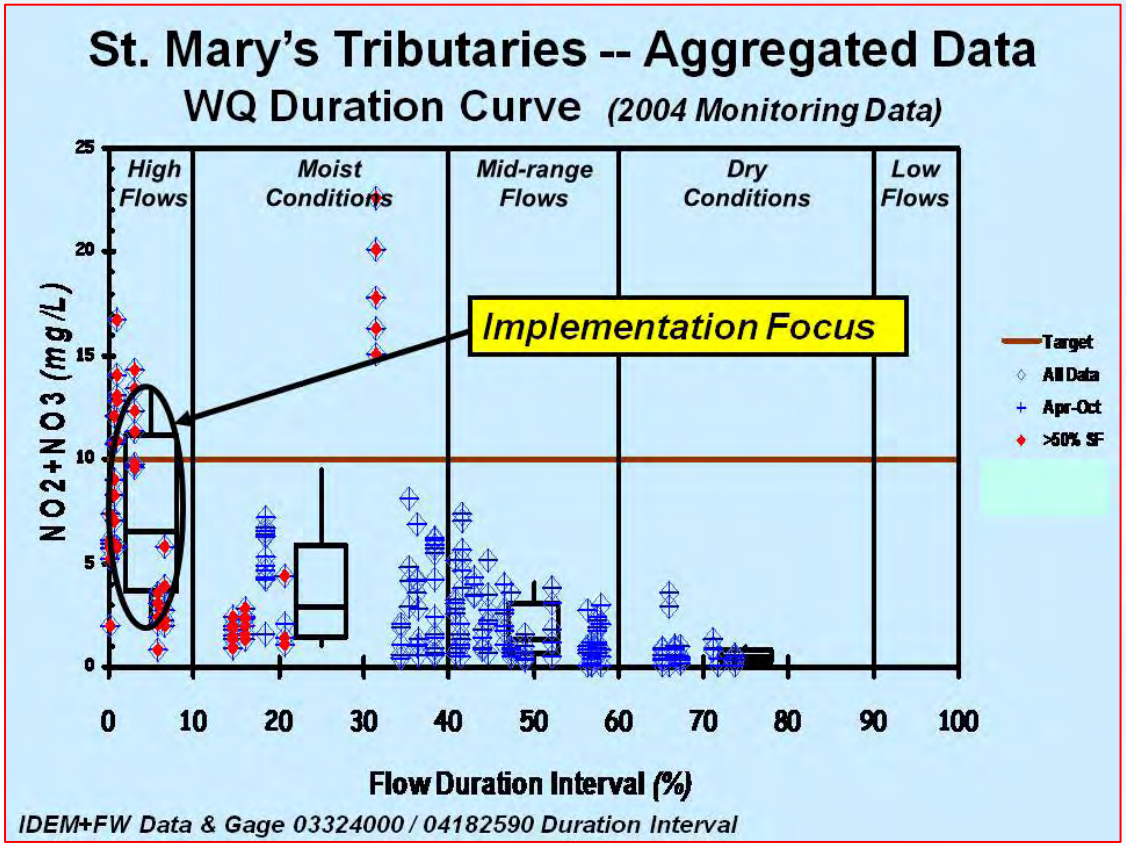



MICHIGAN
INDIANA
OHIO
St. Joseph Watershed
Upper Maumee
Ft. Wayne
Allen County
St. Marys Watershed
Adams County

Nutrient TMDLs

Pattern Analysis

Seasonal Considerations



Nutrient TMDLs

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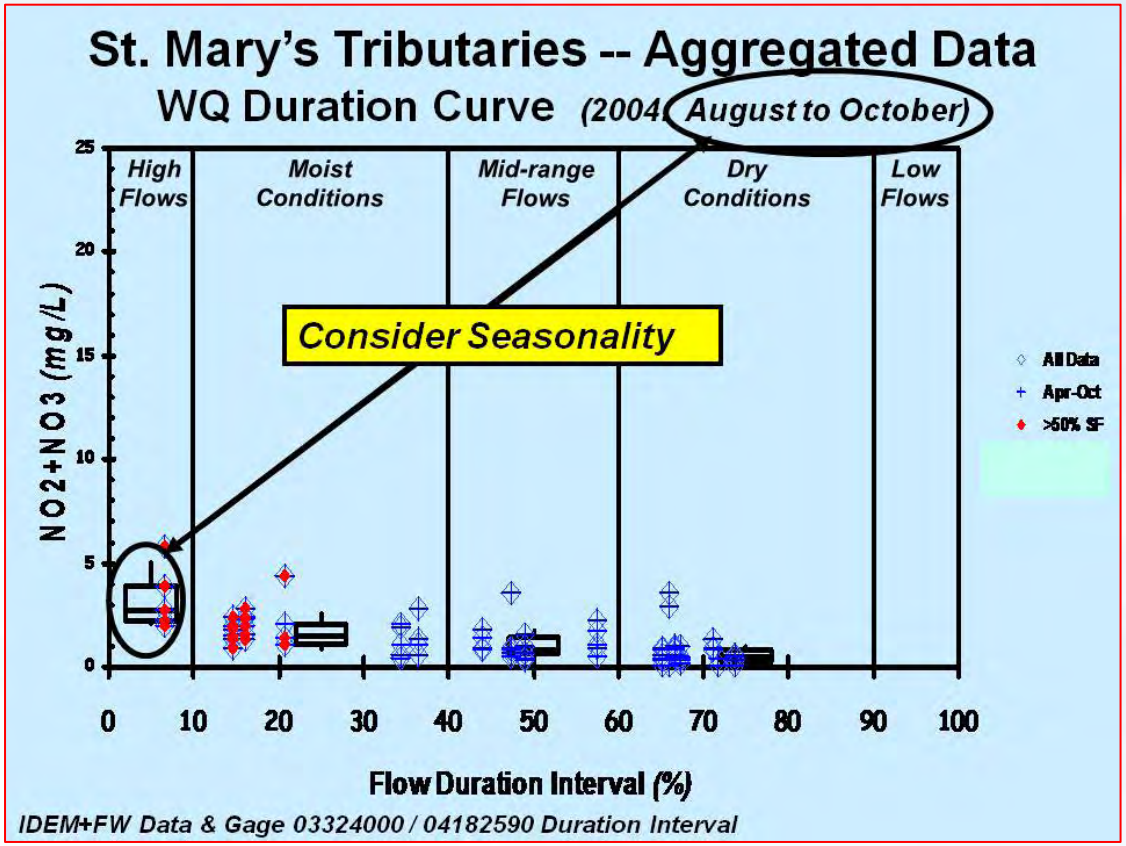
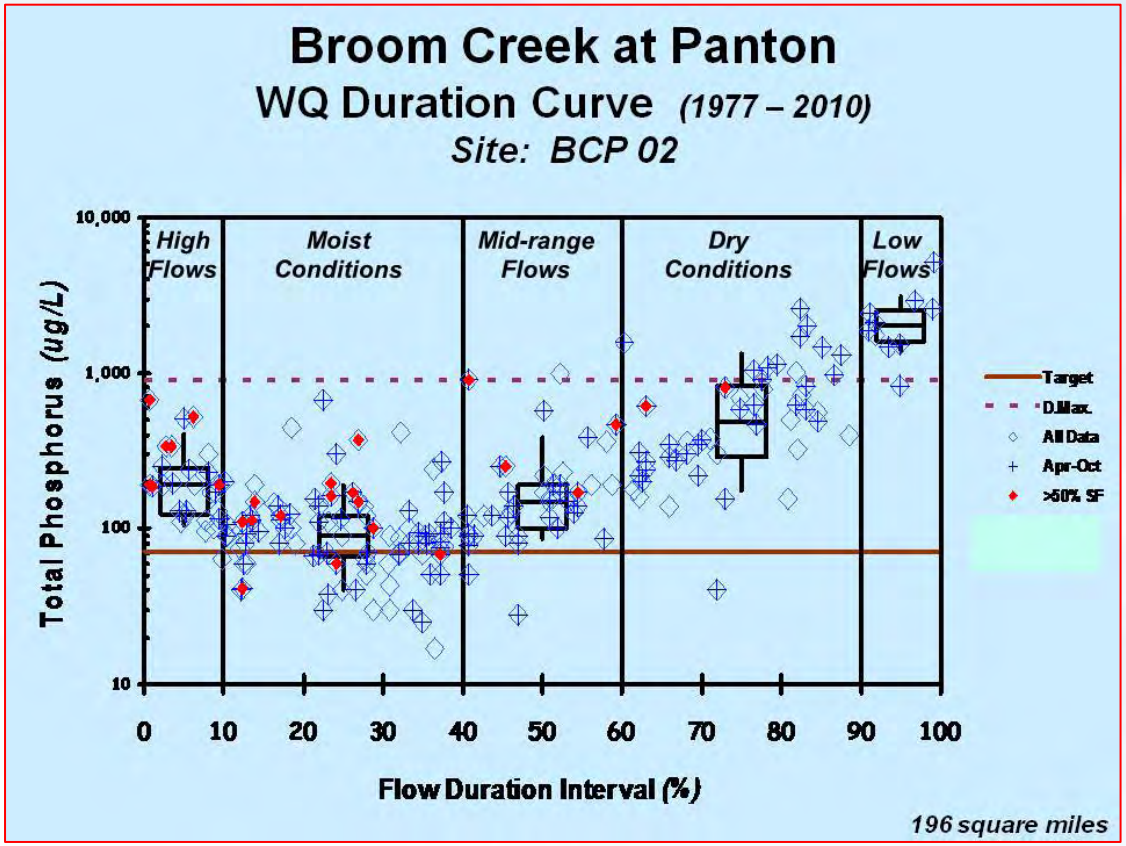
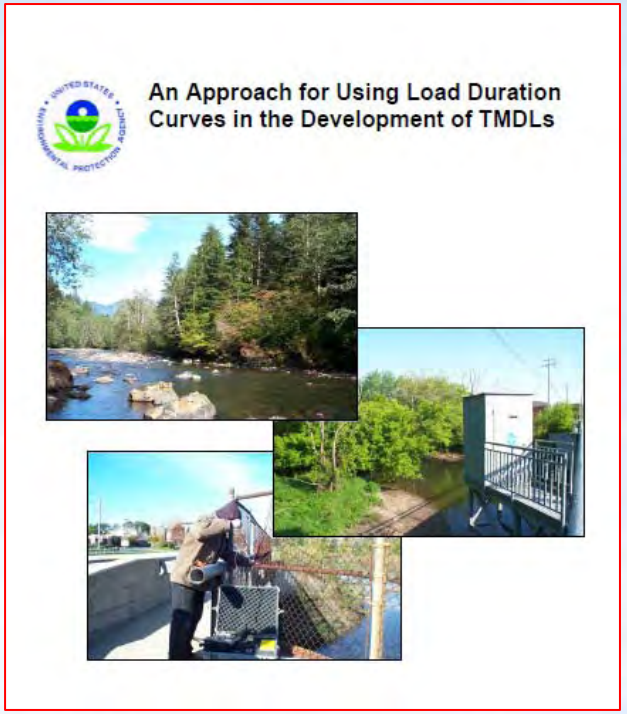


Nutrient TMDLs

Connecting to Implementation

Multiple Averaging Periods





Nutrient TMDLs

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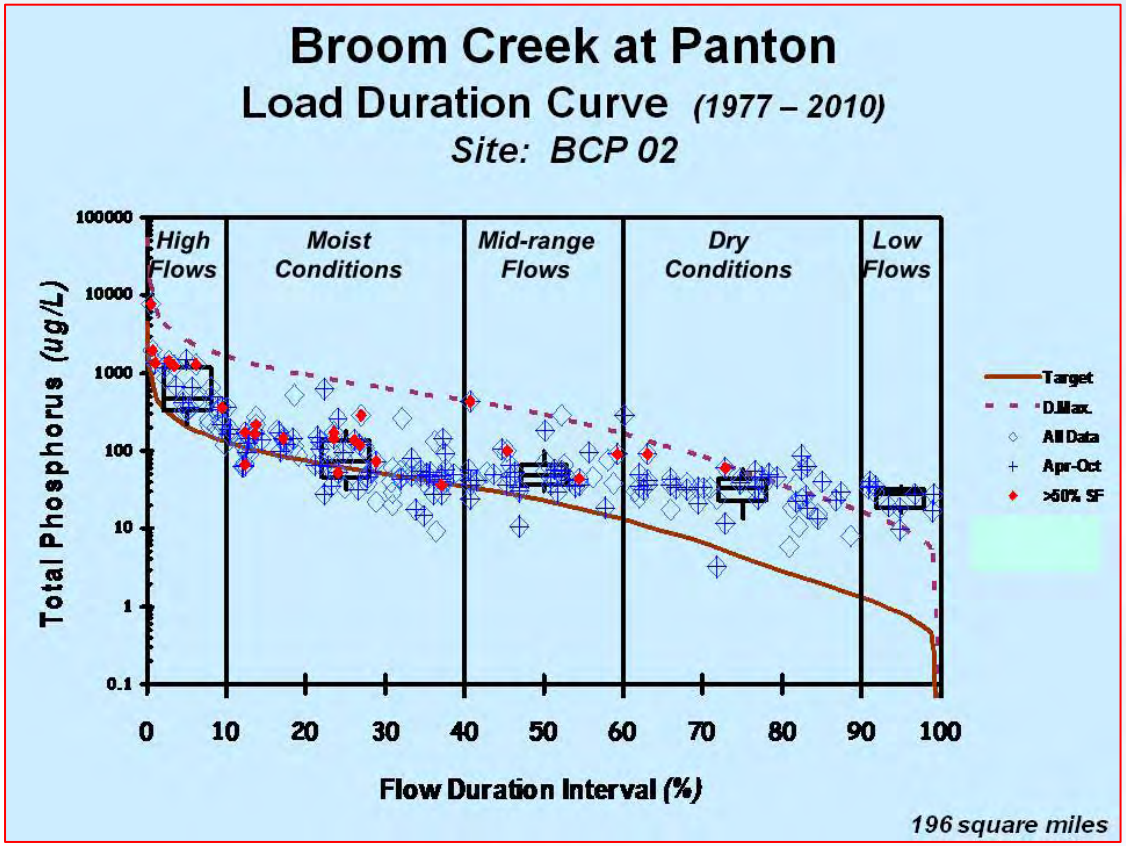


Nutrient TMDLs

Developing Solutions

TMDL SUMMARY	Loads expressed as *(lbs per day)*				
	High	**Moist**	**Mid-Range**	**Dry**	**Low**
TMDL[1]	2,555	746	289	53	10
Allocations	2,425	550	259	48	9.5
Margin of Safety	130	196	30	5	0.5
Benchmark[2]	206	60	23.3	4.3	0.8
Reduction Estimate[3]	57%	19%	52%	87%	97%
Implementation Opportunities	***Post Development BMPs***				
	Streambank Stabilization				
	Nutrient Management Erosion Control Program				
		Riparian Buffer Protection			
			Municipal WWTP		

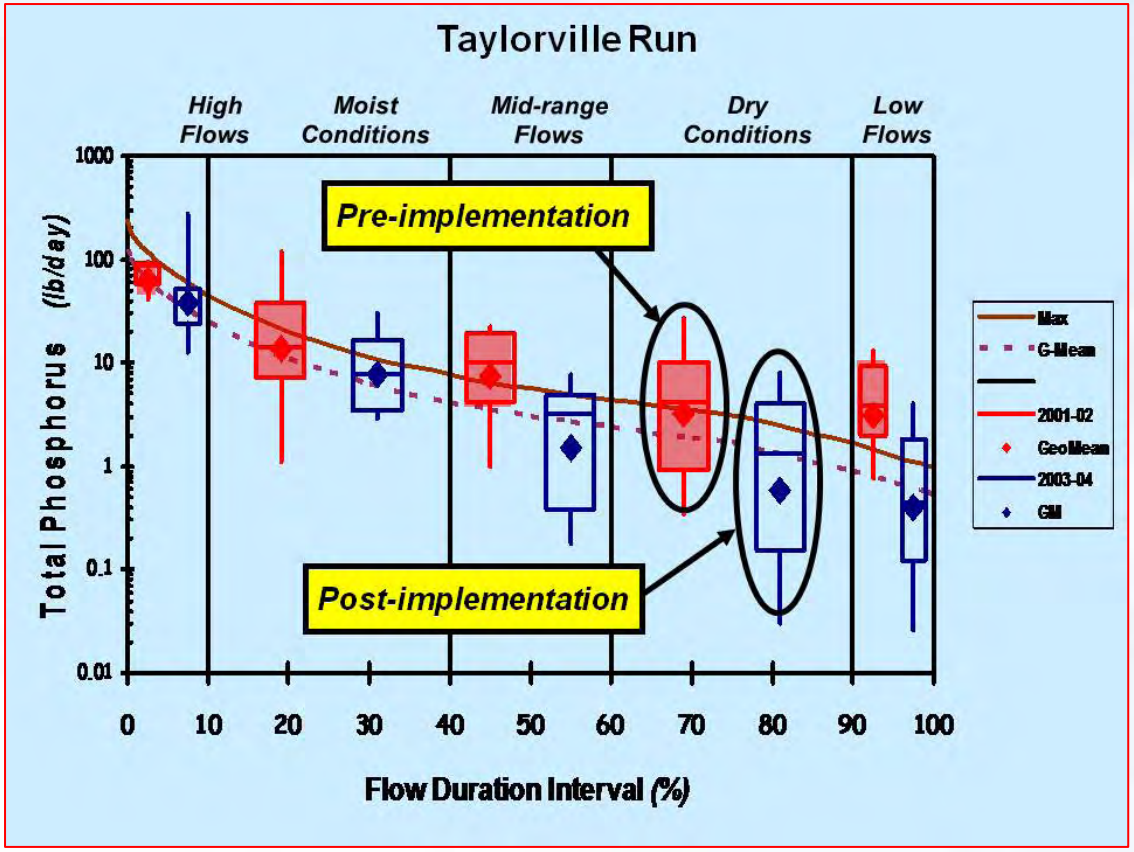
Notes:

1. Expressed as a *"daily load"*; represents the upper range of conditions needed to attain and maintain applicable water quality standards
2. Based on annual average target identified in the applicable water quality standards
3. Developed using long-term fixed station ambient water quality monitoring data

Nutrient TMDLs

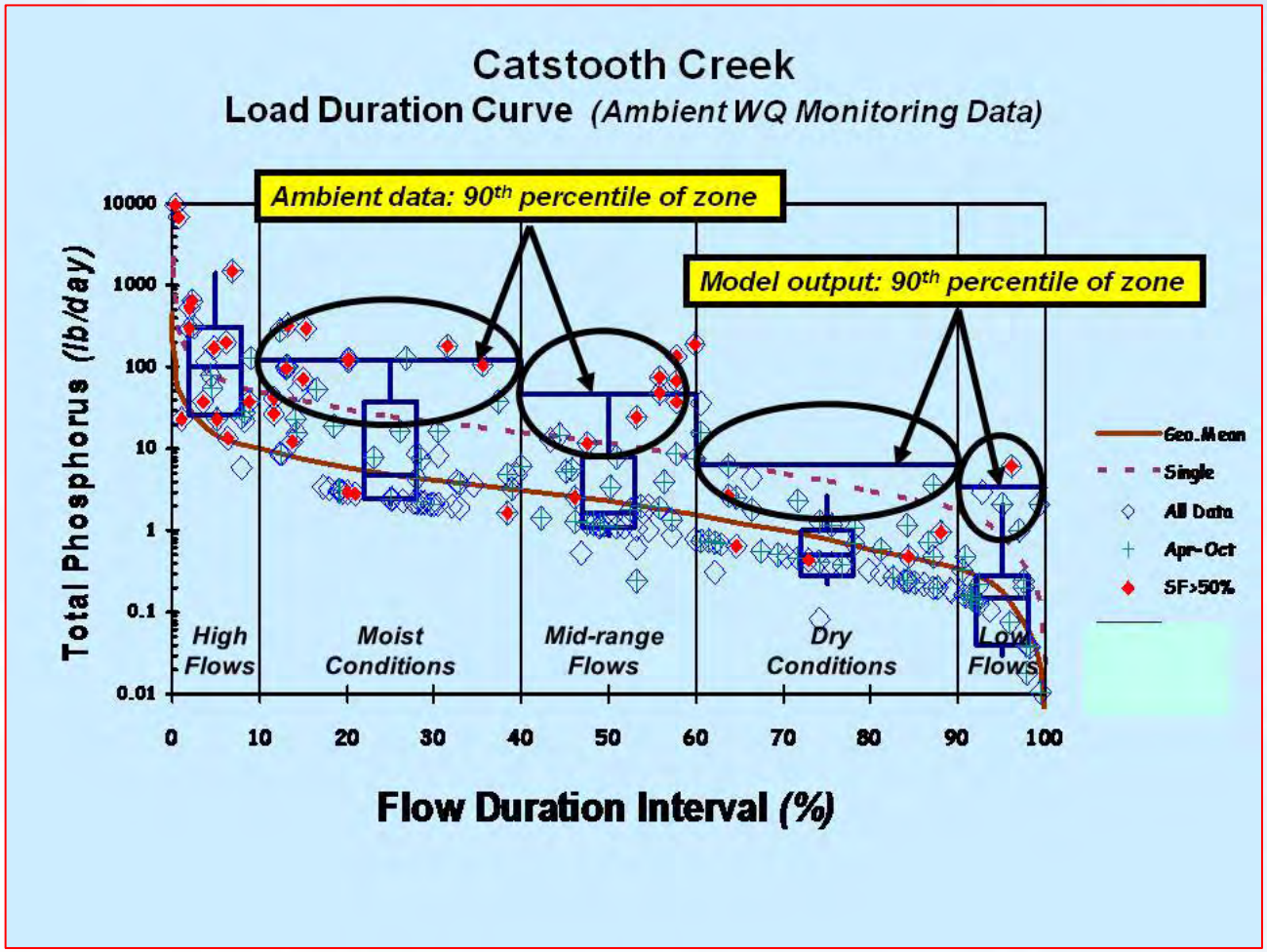
Document Results

- **Highlight improvements**



Nutrient TMDLs

Analysis of Model Output



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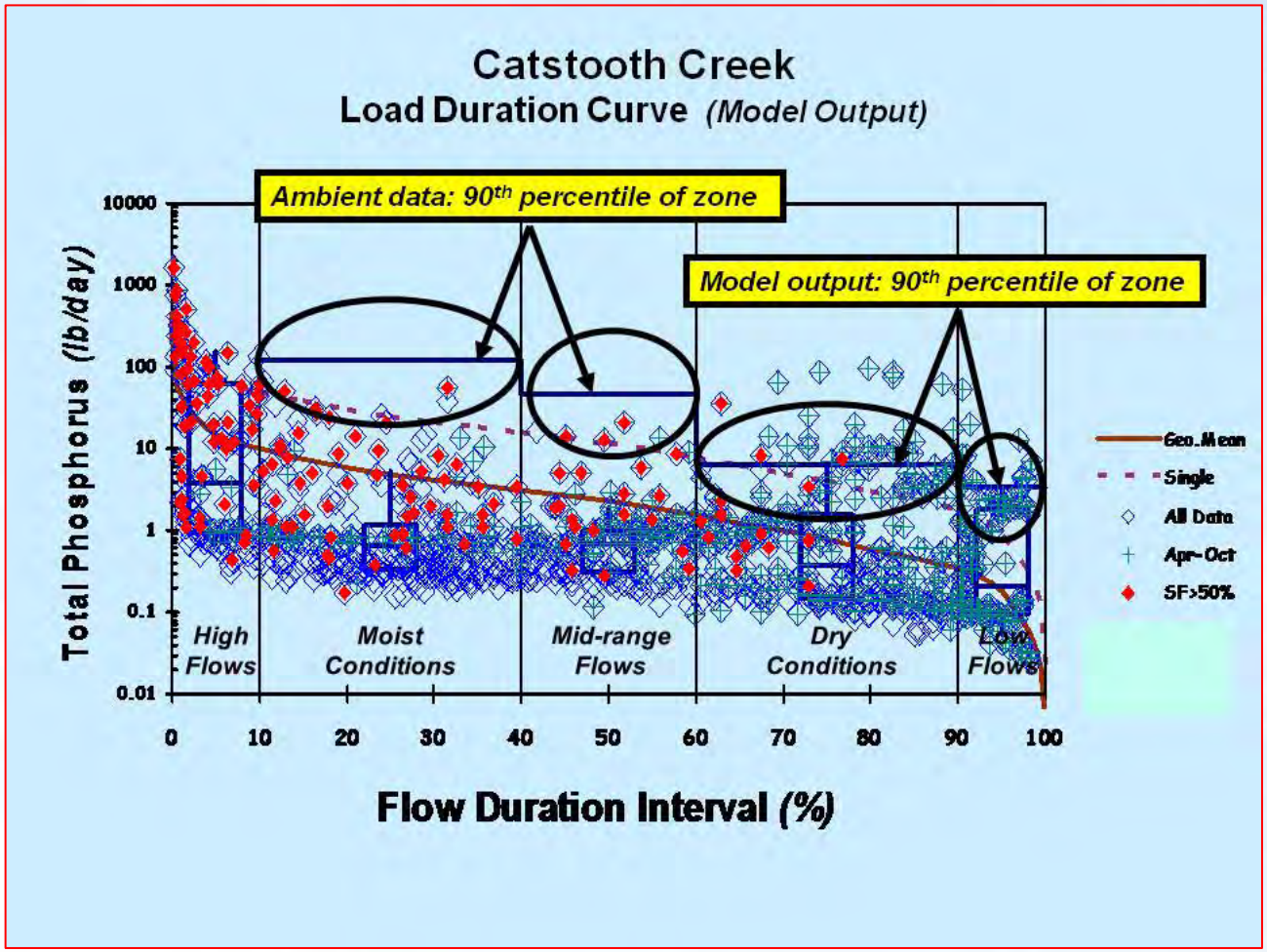

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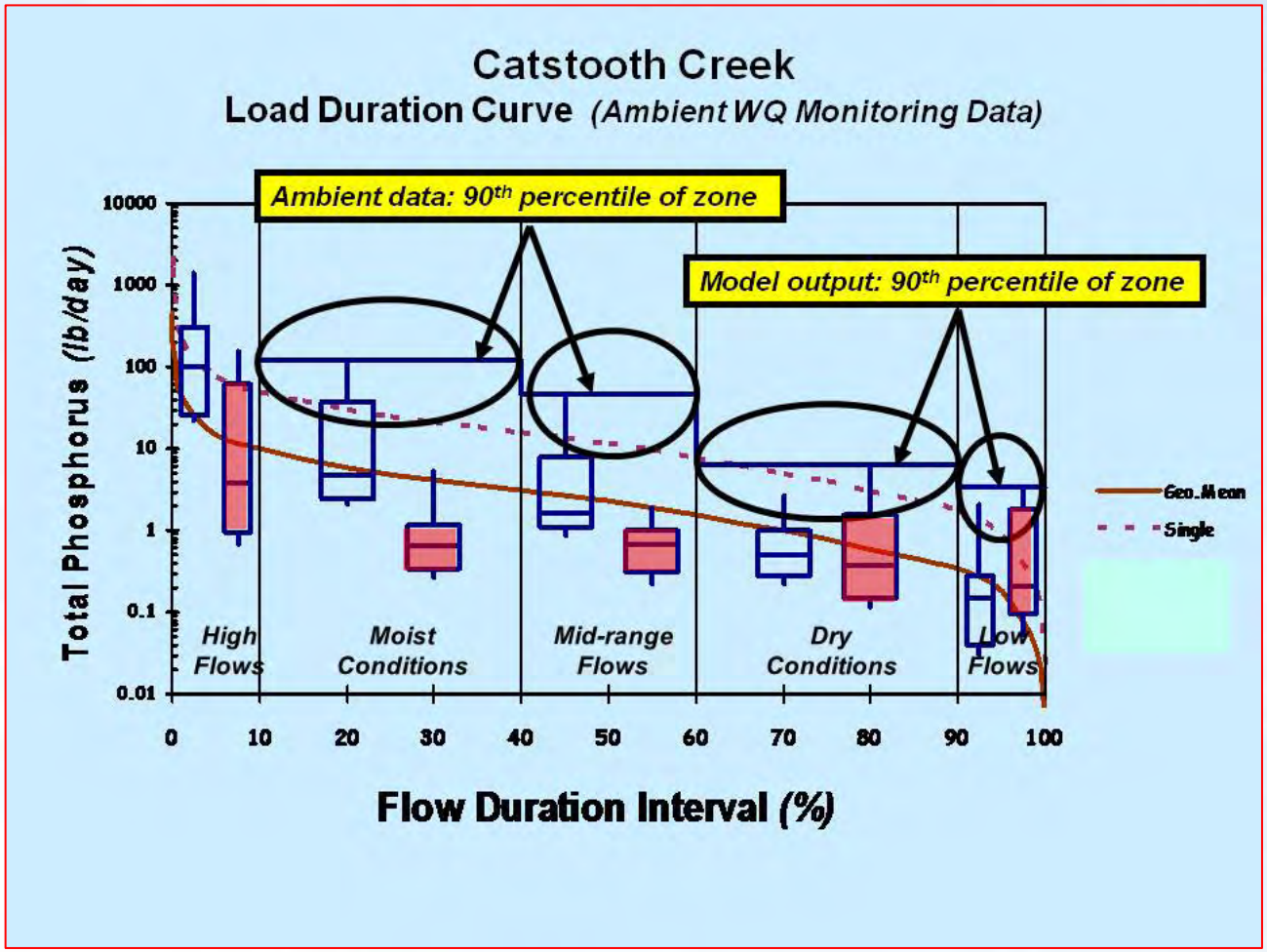

Nutrient TMDLs

Hydrology-based Framework Goals

- **Driving Principles**
  - ***Technically-based (logic path)***
  - ***Meaningful (easily understood)***
  - ***Value-added (connect to implementation efforts designed to solve problem)***