DATA FORUM

2011 Season

Great Miami River Watershed

Citizens' Water Quality Monitoring Program

Citizens' Water Quality Monitoring Program

is Run by Rivers Unlimited and FOGM and supported financially or with facilities

RIVERS UNLIMITED

FRIENDS OF THE GREAT MIAMI

UNIVERSITY OF Cincinnati
Center for Field Studies

HAMILTON COUNTY
Storm Water District

OXBOW, Inc.
FOUNDED 1985

HAMILTON COUNTY
soil and water
CONSERVATION
DISTRICT


18.05.2007

Registering samples

Turbidity

Total Phosphorus

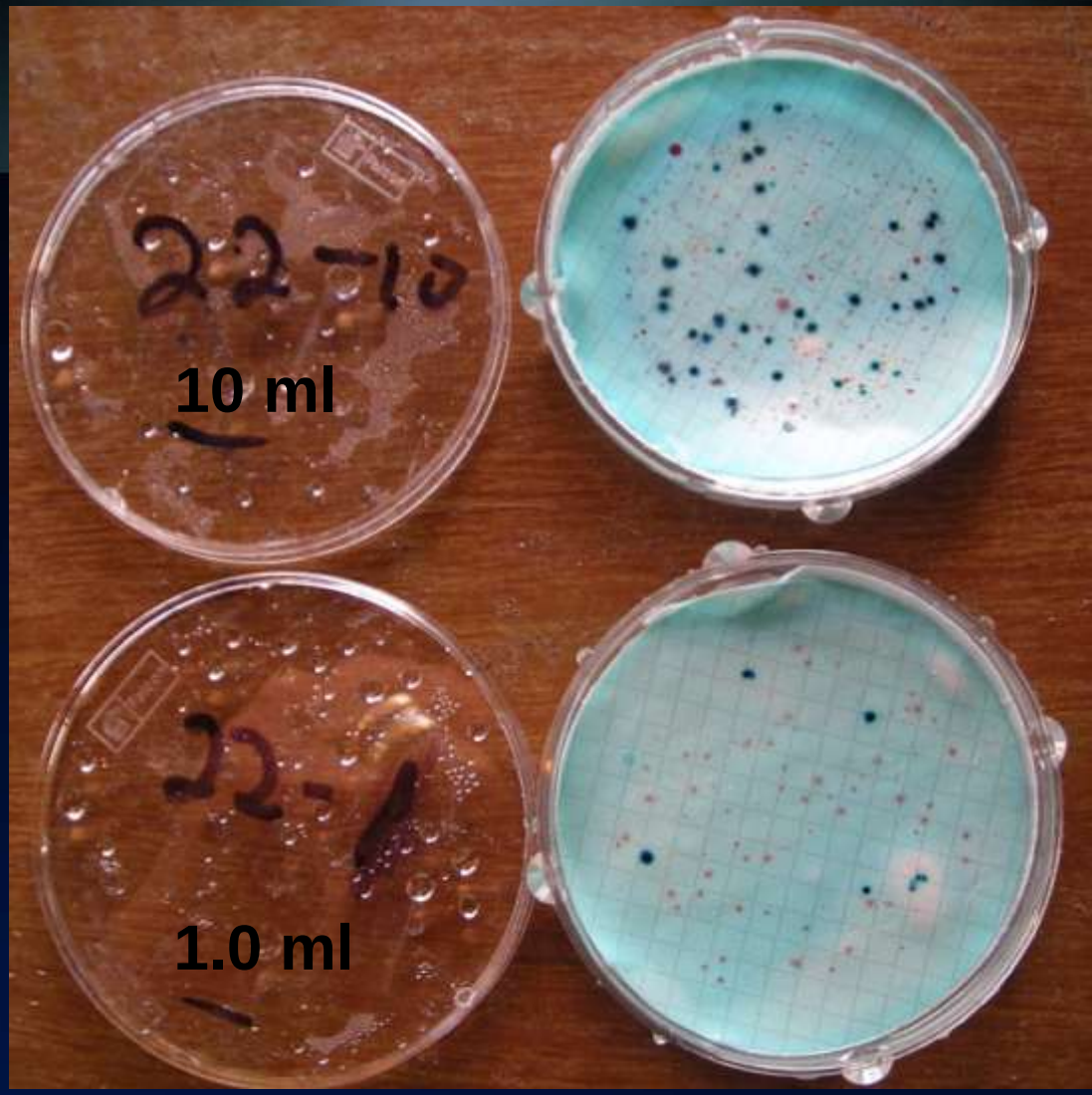
Nitrate

Citizens' Water Quality Monitoring
Great Miami River Watershed

Fecal Coliforms

Conductivity meter

For 2011 we switched to a HACH priority medium that identifies E.coli (blue) and coliforms (red).



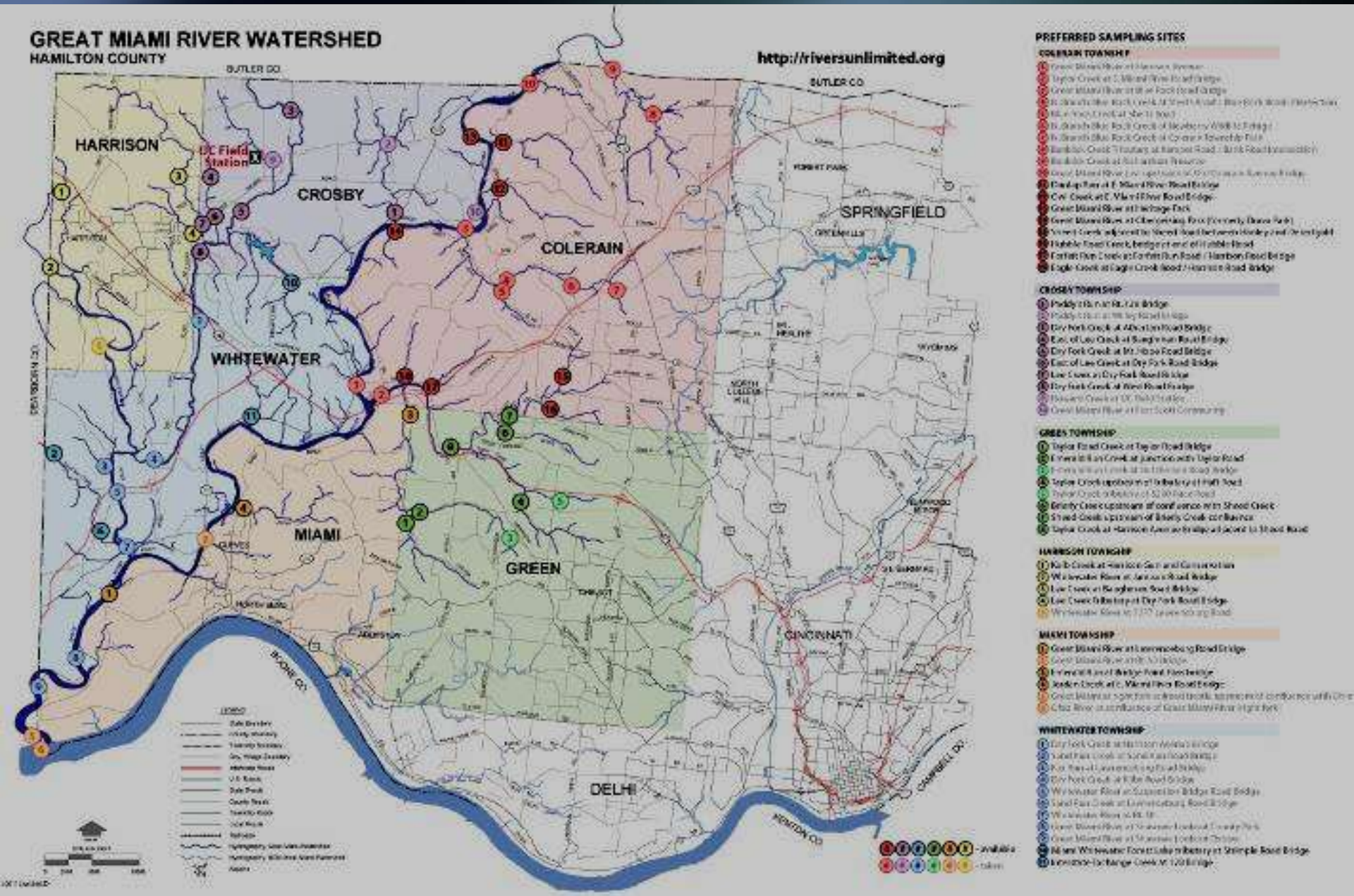
From Idea to Program

Collaboration Makes the Program Work

Waterway Sampled	Number of Sample Sites (73 Total)
Banklick Creek	2
Banklick Creek tributary	1
Blue Rock Creek	1
Brierly Creek	1
Dry Fork of Whitewater River	5
Dry Fork of Whitewater River tributary	1
Eagle Creek	1
Forfeit Creek	1
Fox Run	1
Great Miami River	12
Great Miami River tributaries	2
Howard Creek	1
Indian Creek	1
Jameson Creek	1
Jordan Creek	1
Kolb Creek	1
Lee Creek	1

Waterway Sampled	Number of Sample Sites (73 Total)
Lee Creek tributaries	2
Mullen Creek	1
North Branch Blue Rock Creek	3
Ohio River	3
Owl Creek	1
Oxbow Ponds	5
Paddys Run	3
Sand Run	2
Sheed Creek	3
Sheed Creek tributary	1
Strimple Creek	1
Taylor Creek	3
Taylor Creek tributaries	2
Two-Mile Creek	1
Wesselman Creek	3
Whitewater River	4
Whitewater River tributary	1

Mapping Out Our Work



Hamilton County Soil and Water District now have sampling equipment for big river bridge sampling.

Citizens' Water Quality Monitoring
Great Miami River Watershed

Water Quality Monitoring
Grab Sample Technique

- Sample as far from the stream bank as possible. Use a sampling wand if you have it.
- If entering the stream, enter downstream of where you plan to sample.
- Sample at a point within the regular monitoring reach where the stream is flowing, well mixed and at least 6 inches deep.
- Choose a spot with the least disturbance.
- Triple rinse the bottle prior to gathering sample.
- Do not set the cap of the bottle down.
- Sample midway between the bottom and water surface.
- Fill the bottle completely.
- Place sample bottle on ice or keep it cool as possible.

What Data Do We Collect & Why?

- **Nitrates**
  - Sources: Agricultural and urban fertilizers, manure, septic tanks and vehicle exhaust.
  - Effects: Excessive algal growth, eutrophication (low oxygen conditions), Blue Baby syndrome and brown blood disease in fish.
- **Total Phosphorous**
  - Sources: Excess from WWTP, agricultural and urban fertilizers, manure, septic tanks and soil erosion.
  - Effects: Excessive algal growth and eutrophication (low oxygen conditions).
- **pH**
  - Sources: Natural stream bed minerals ($CaCO_3$, $MgCO_3$), WWTP discharge and soils (NH_3 will elevate pH); elevated by algal photosynthesis.
  - Effects: Low pH allows toxic compounds to become more available to aquatic organisms. High pH is associated with warm waters and lower oxygen.
- **Conductivity (dissolved ions)**
  - Sources: Elevated by WWTP discharge, septic systems, agricultural discharge, road salt and warm water.
  - Effects: Toxic to aquatic organisms at elevated levels. Nature of toxicity dependent upon ionic presence.
- **Turbidity (cloudiness of water)**
  - Sources: Elevated by runoff erosion from row crops, pastures, stream bank erosion, construction sites and high algal content.
  - Effects: Inhibits growth of submerged aquatic plants and food supply of aquatic organisms and affects the ability of fish gills to absorb oxygen.
- **E-coli (bacteria)**
  - Sources: Elevated by human and animal feces from WWTPs, septic systems and storm water runoff.
  - Effects: Gastroenteritis, ear infections and Hepatitis A in humans. Low oxygen due to decomposition.

How Do We Measure the Data Parameters?

- Nitrates
  - Instrumentation: Portable Spectrophotometer
  - Method: Cadmium Reduction Method – Hach 8171
- Total Phosphorous
  - Instrumentation: DR 2800 Portable Spectrophotometer
  - Method: Acid Persulfate Digestion – Hach 8190
- pH
  - Instrumentation: Oakton 650 pH Meter
  - Range: 0-14
  - Accuracy (0.002), Precision (0.001-0.1)
- Conductivity (dissolved ions)
  - Instrumentation: Hach sensION5 Conductivity Meter
  - Range: 0-19,999 uS/cm
  - Accuracy (0.5%), Precision (1 uS)
- Turbidity (cloudiness of water)
  - Instrumentation: Hach 2100Q Turbidity Meter
  - Method: U.S. EPA method 180.1
  - Accuracy (2%), Precision (0.01 NTU)
- E-coli (bacteria)
  - Method: Total Coliform and E-coli screening using Membrane Filtration, Hach 10029, U.S.EPA 1603

2011 Accomplishments

- **Funding Acquired**
  - Hamilton County Storm Water District Grant
  - Oxbow Inc. Grant
  - CSX Grant
  - Season Good Foundation Grant
- **Grants Applied For**
  - Ohio EPA OEEF Grant
  - U.S. EPA Urban Waters Grant
- **Sample Sites**
  - 73 sites: range 38 (March) – 64 (September)
  - 499 samples total, 55 average per month
  - 2994 sample analyses performed
  - 34 waterways
- **Volunteer/Service Hours**
  - 255 total, 28 average per month
- **Volunteer Hours and Contribution**
  - Approx. 1,020 hours valued at $15,300
- **Data Presentations**
  - Ohio EPA
  - Greater Cincinnati MSD
  - Hamilton County Environmental Action Commission
  - Land Lab for Price Hill Middle School students
  - Oxbow Inc.
  - Green Umbrella
  - University of Cincinnati Planning Students

2011 Results

A. **Analysis of some tributary hot spots**

B. **Summary of tributary outflows to Great Miami R.**

C. **Summary of Great Miami River Mainstem longitudinal data 2011**

D. **Summary of three points on GMR and Whitewater River 2006-2011.**


18.05.2007

Water Qualtiy Parameters

- **Nitrates—excess from row crops**
- **Total Phosphorous—excess from WWTP, row crops soil erosion.**
- **pH—elevated by algal photosynthesis**
- **Conductivity—elevated by WWTPs & septic systems**
- **Turbidity-elevated by runoff erosion from row crops and construction sites.**
- **Fecal Coliforms—elevated by human and animal feces.**

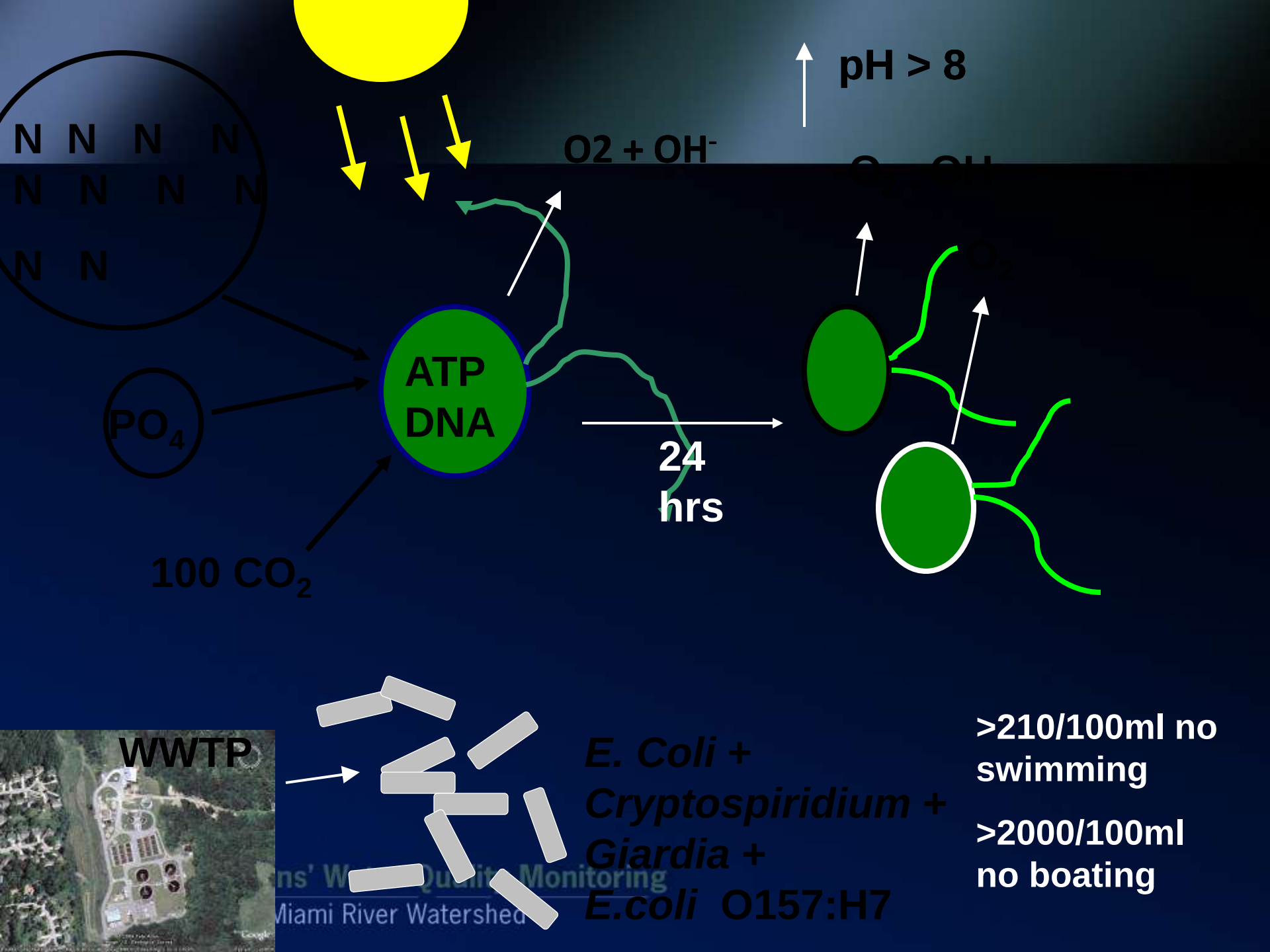
Great Miami River Watershed = 4,124 mi^2

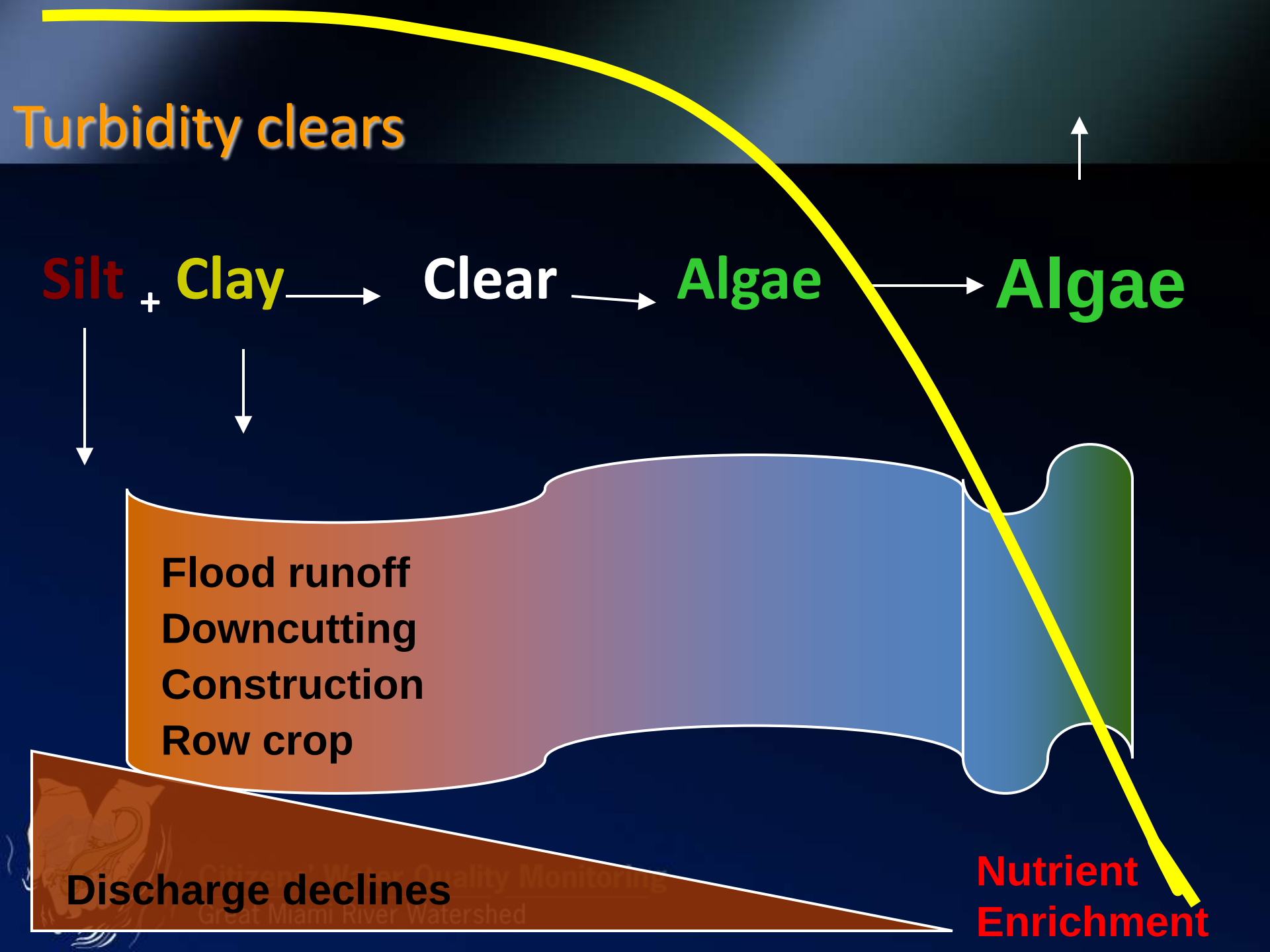
Discharge 2010 = min 461 cfs, avg. = 3441, max = 39100

Subwatersheds:

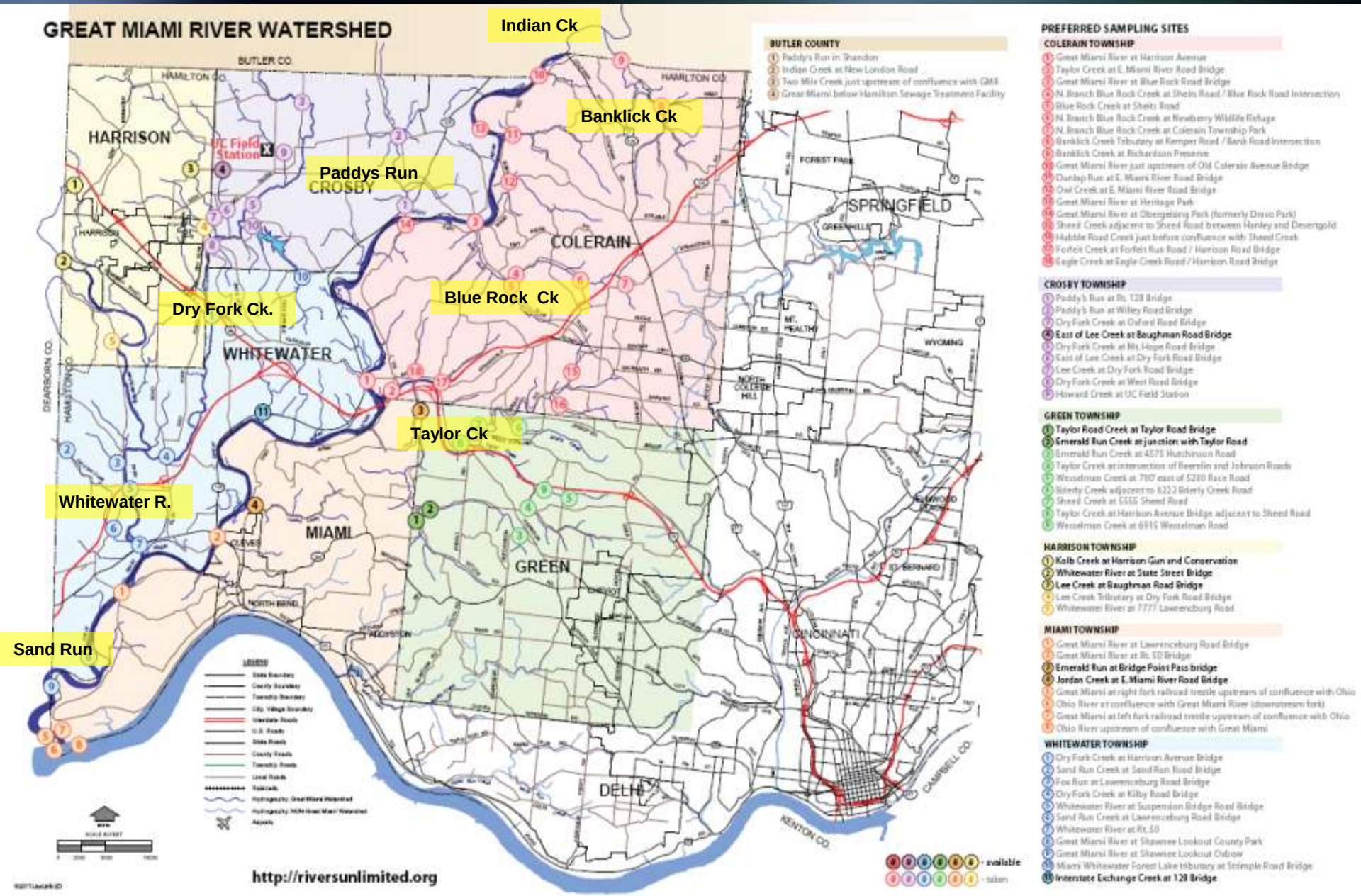
- Whitewater River-- 1,474 mi^2
- Mad River -- 657 mi^2
- Stillwater River -- 676 mi^2

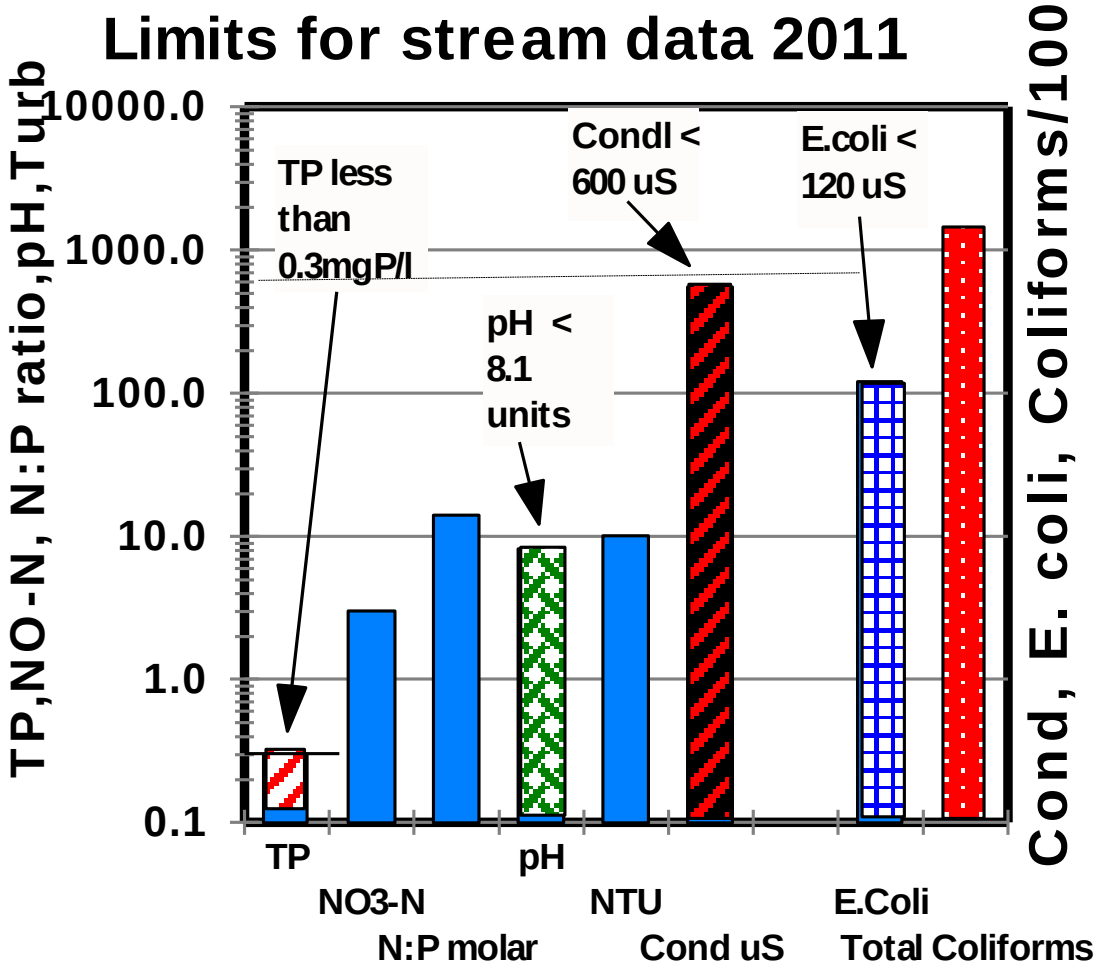
An estimated 2.8 million people lived in watershed in 1995. Major cities are Cincinnati and Dayton, Ohio. Approximately 79 percent of the total land area is used for agricultural activities, primarily row-crop production of corn, soybeans, and alfalfa. Residential, commercial, and industrial land uses comprise 13 percent of the area whereas the remaining area consists of forests (7 percent) and water bodies or wetlands (1 percent)


pH > 8
N N N N
N N N N
N N
O2 + OH-
ATP
DNA
PO4
100 CO2
24
hrs
WWTP
E. Coli +
Cryptospiridium +
Giardia +
E.coli O157:H7
>210/100ml no swimming
>2000/100ml no boating


Turbidity clears
Silt + Clay
Clear
Algae
Algae
Flood runoff
Downcutting
Construction
Row crop
Discharge declines
Nutrient Enrichment

Sample locations on mainstem and tribs of GMR

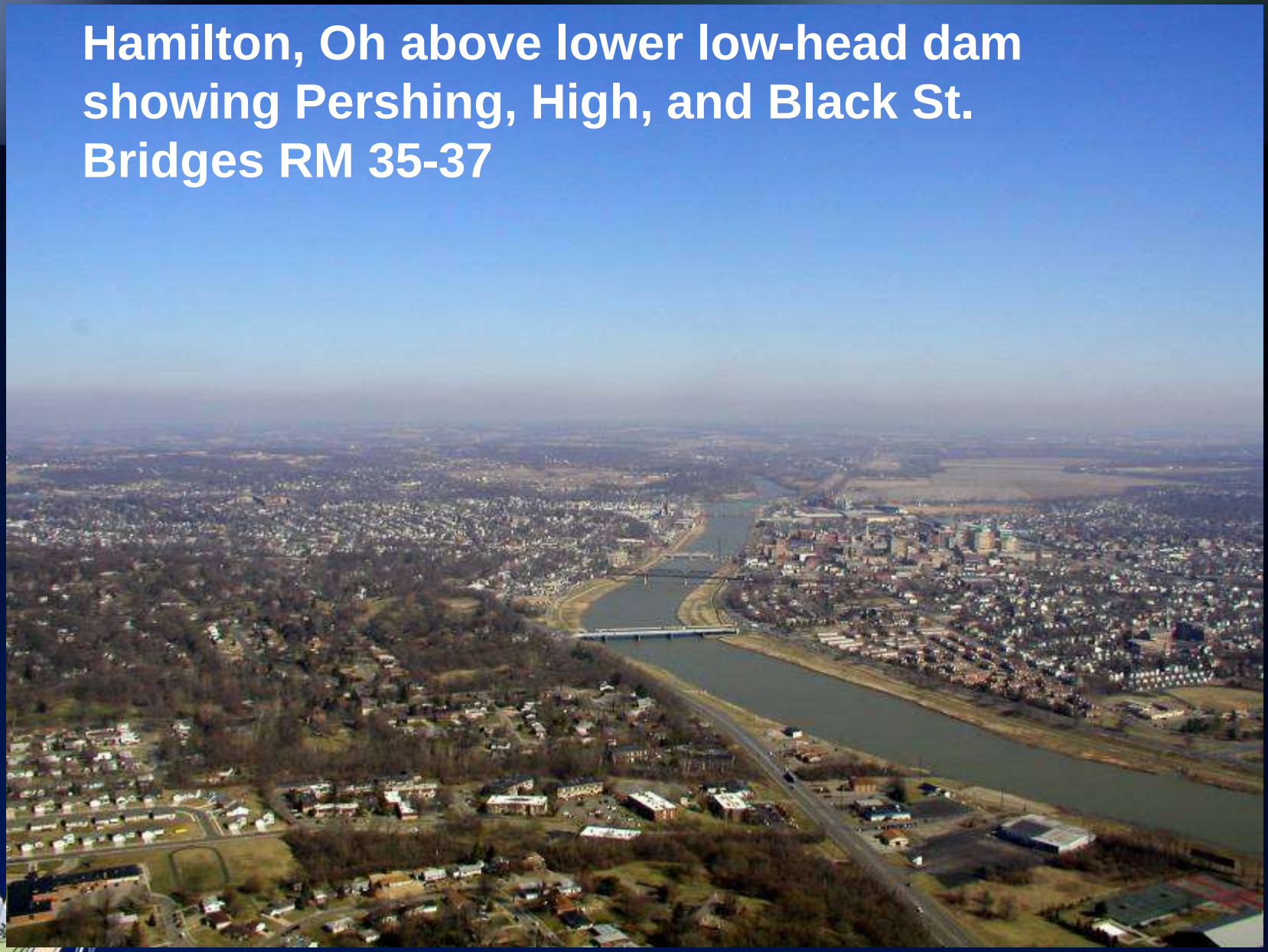


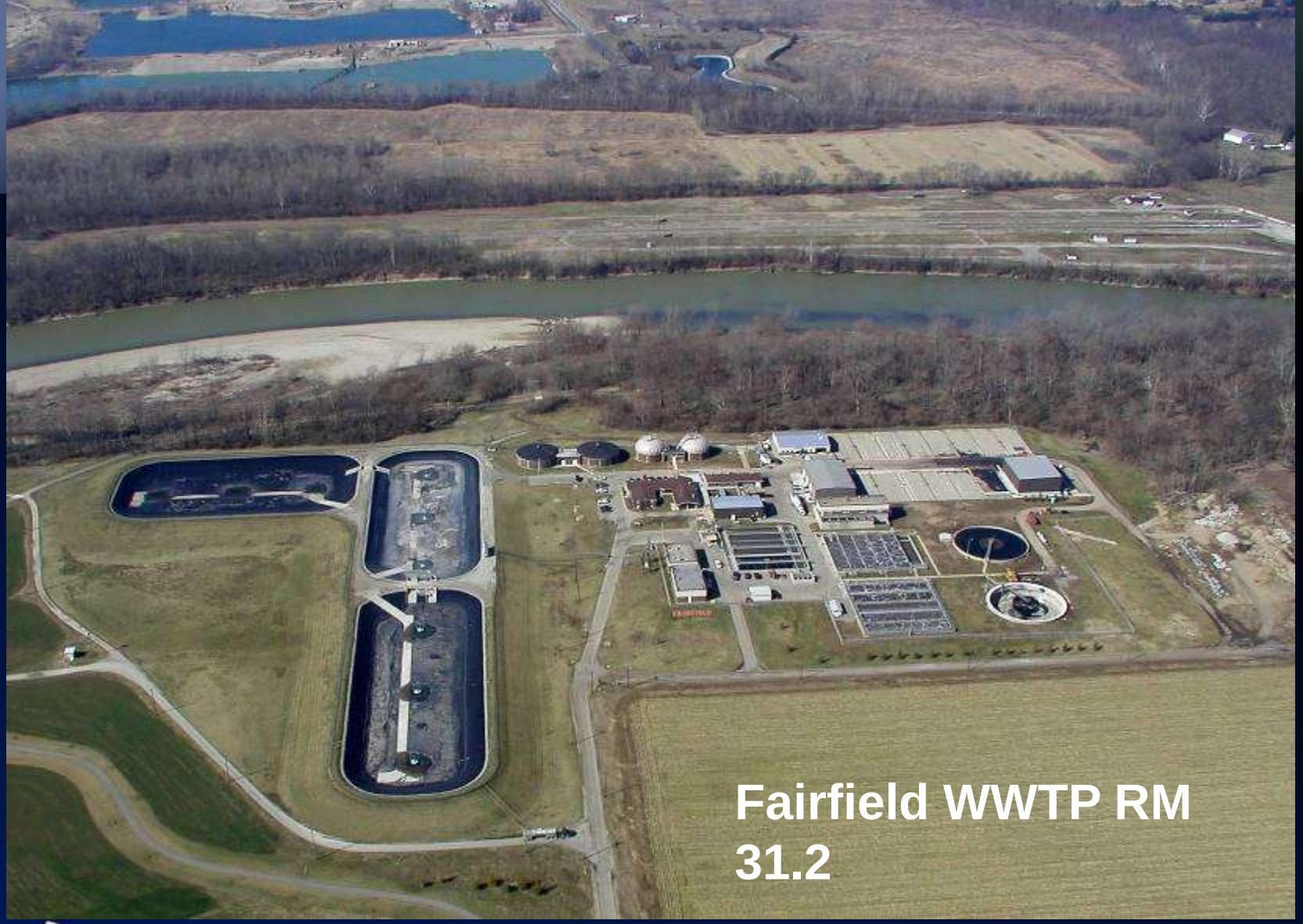


Expectations for Stream Chemistry.

1. TP < 0.3 mg P/l OEPA to control algal growth.
2. NO3-N mg/l < 3.0 mgN/l to control algal growth.
3. N:P ratio = 14 or higher to avoid cyanobacteria.
4. pH < 8.1; if higher driven up by algal growth.
5. Conductivity < 600 uS for dissolution of limestone; higher = effluent.
6. E. coli < 120/100 ml for drinking water.

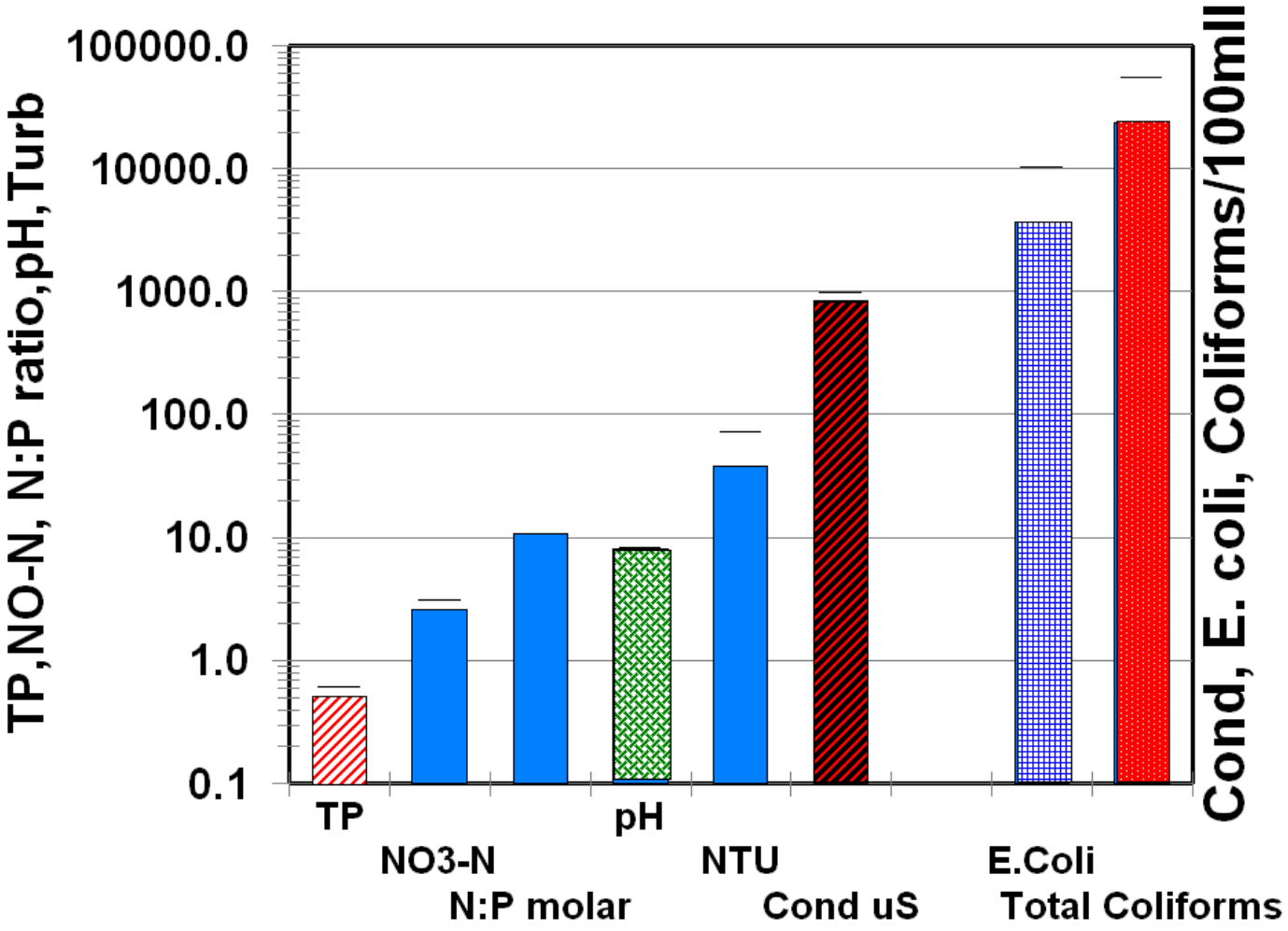
Hamilton, Oh above lower low-head dam showing Pershing, High, and Black St. Bridges RM 35-37





Citizens' Water Quality Monitoring
Great Miami River Watershed

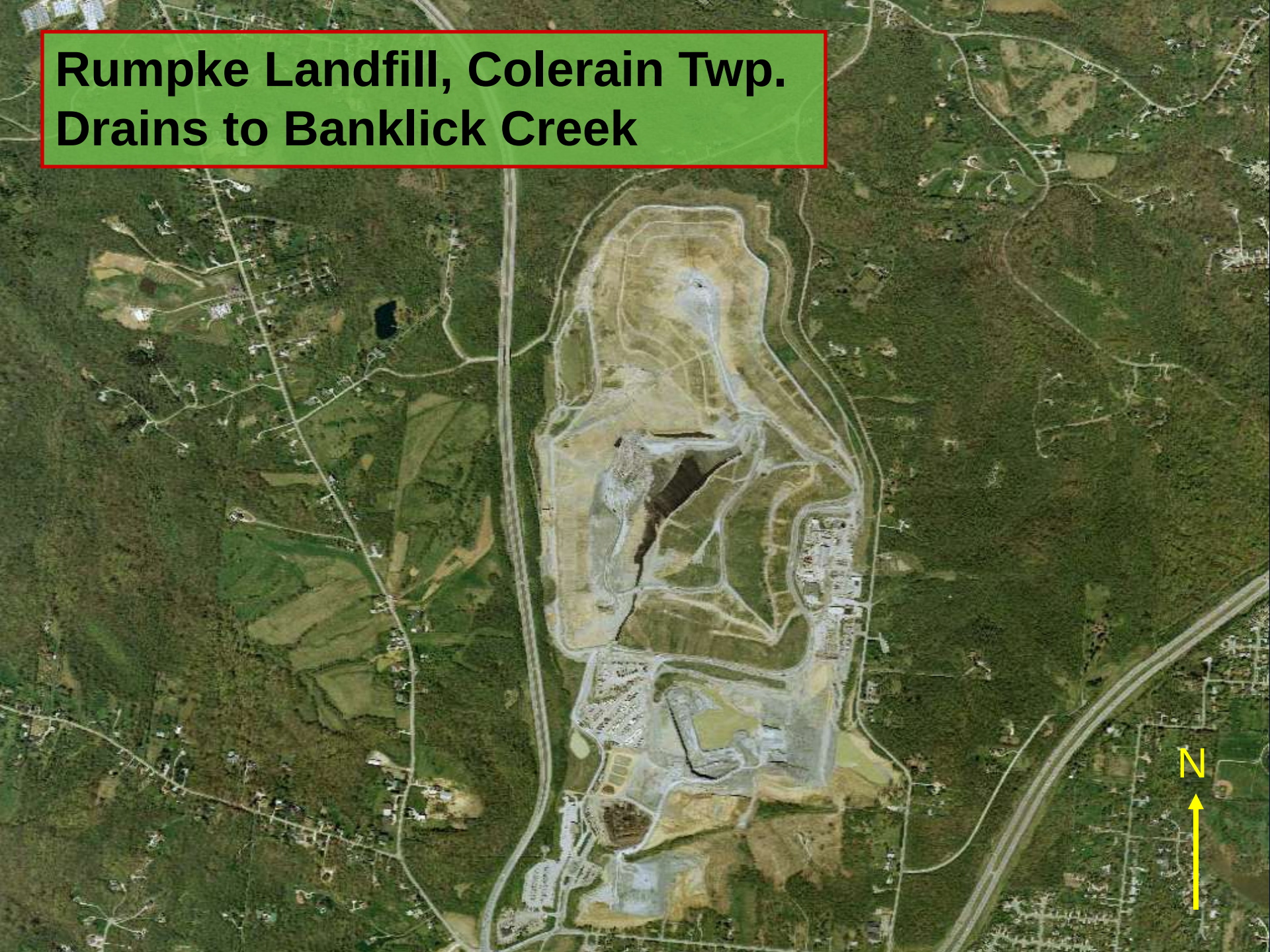
GMR below Hamilton 2011



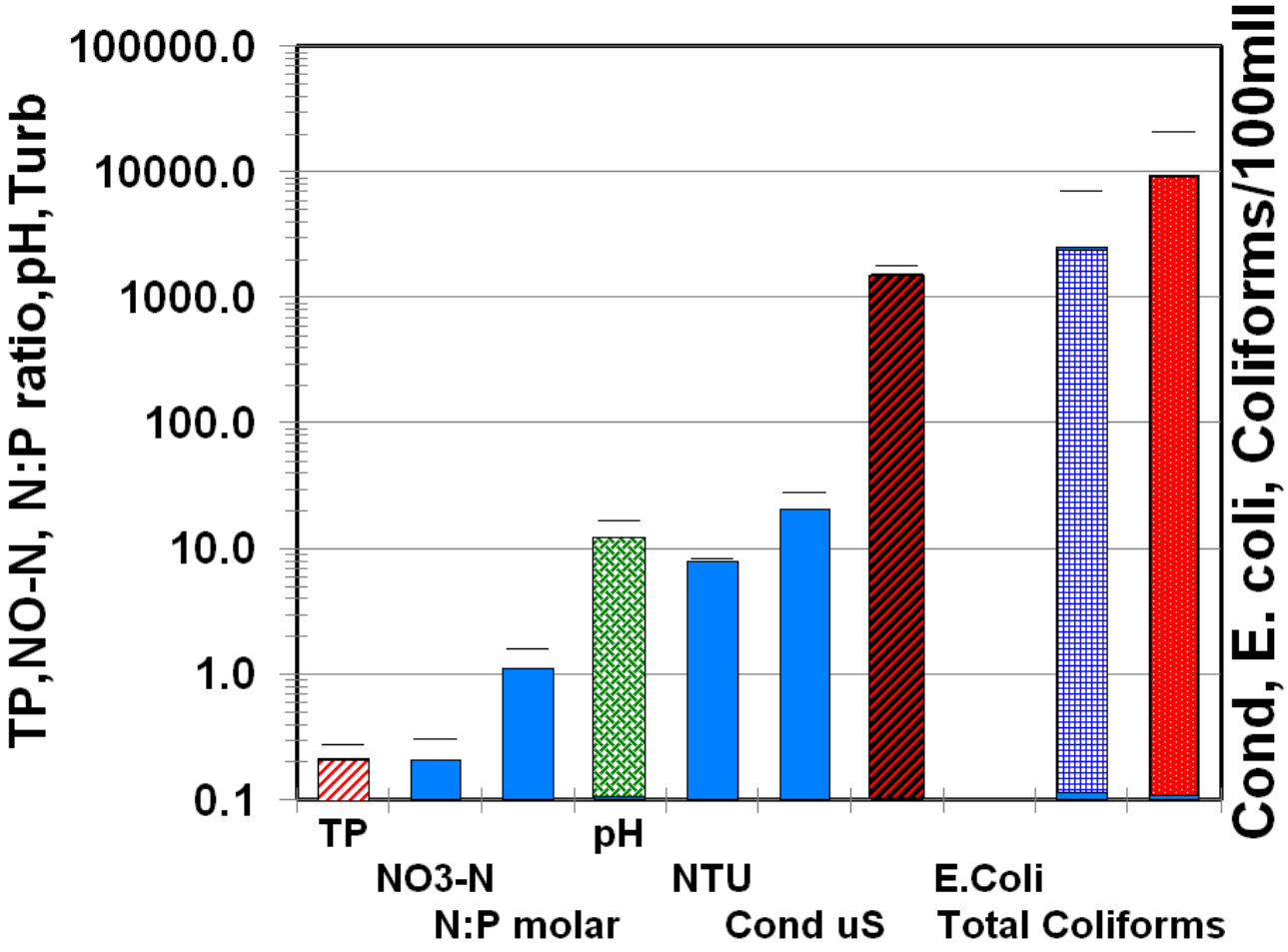
Graphs are plotted with data a log10 and horizontal line above bar is 1 standard deviation of variance over the year.

Mouth of Banklick Creek
RM 28.4

Citizens' Water Quality Monitoring
Great Miami River Watershed


Rumpke Landfill, Colerain Twp.
Drains to Banklick Creek
N

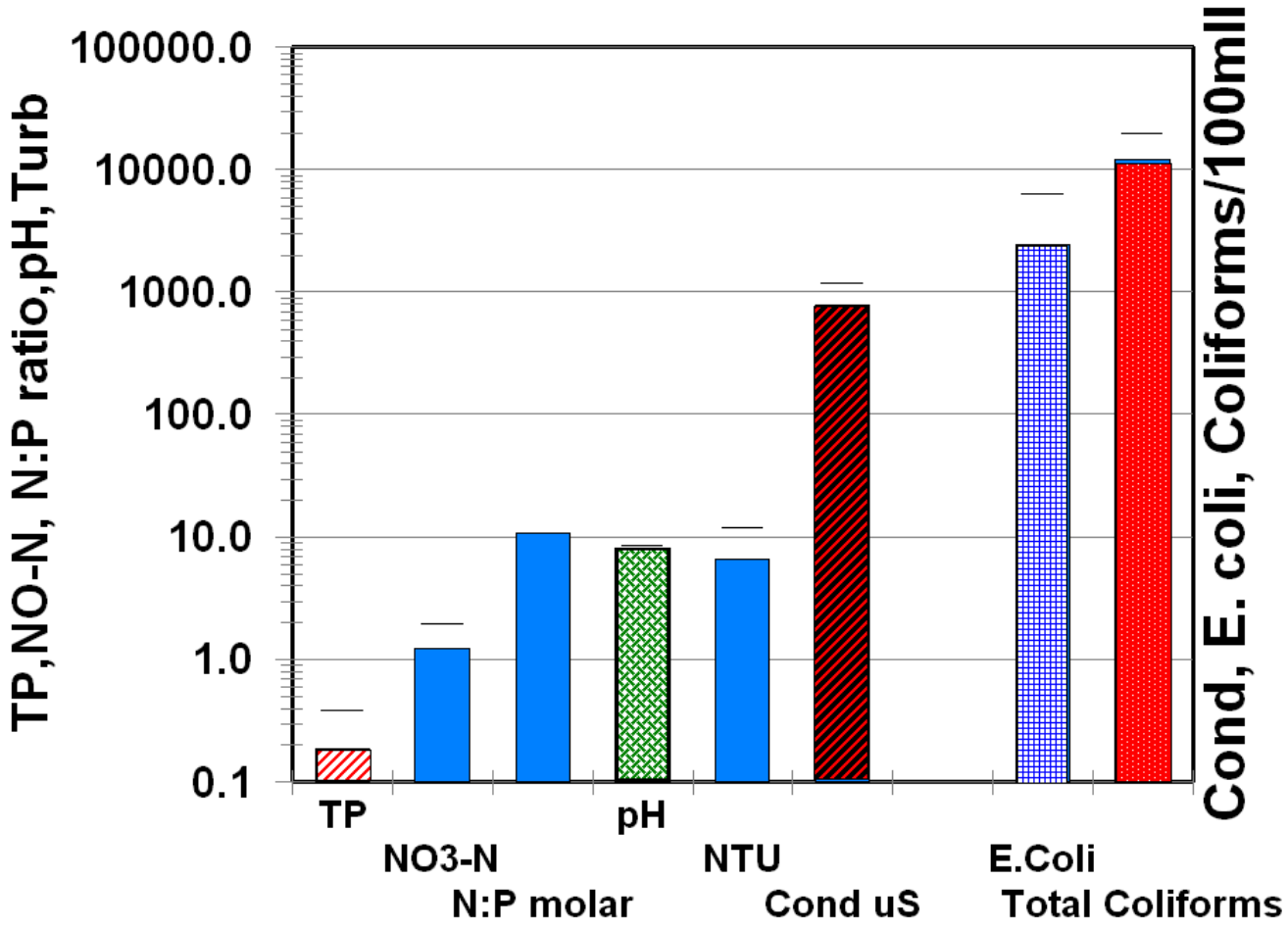
Banklick Ck 2011



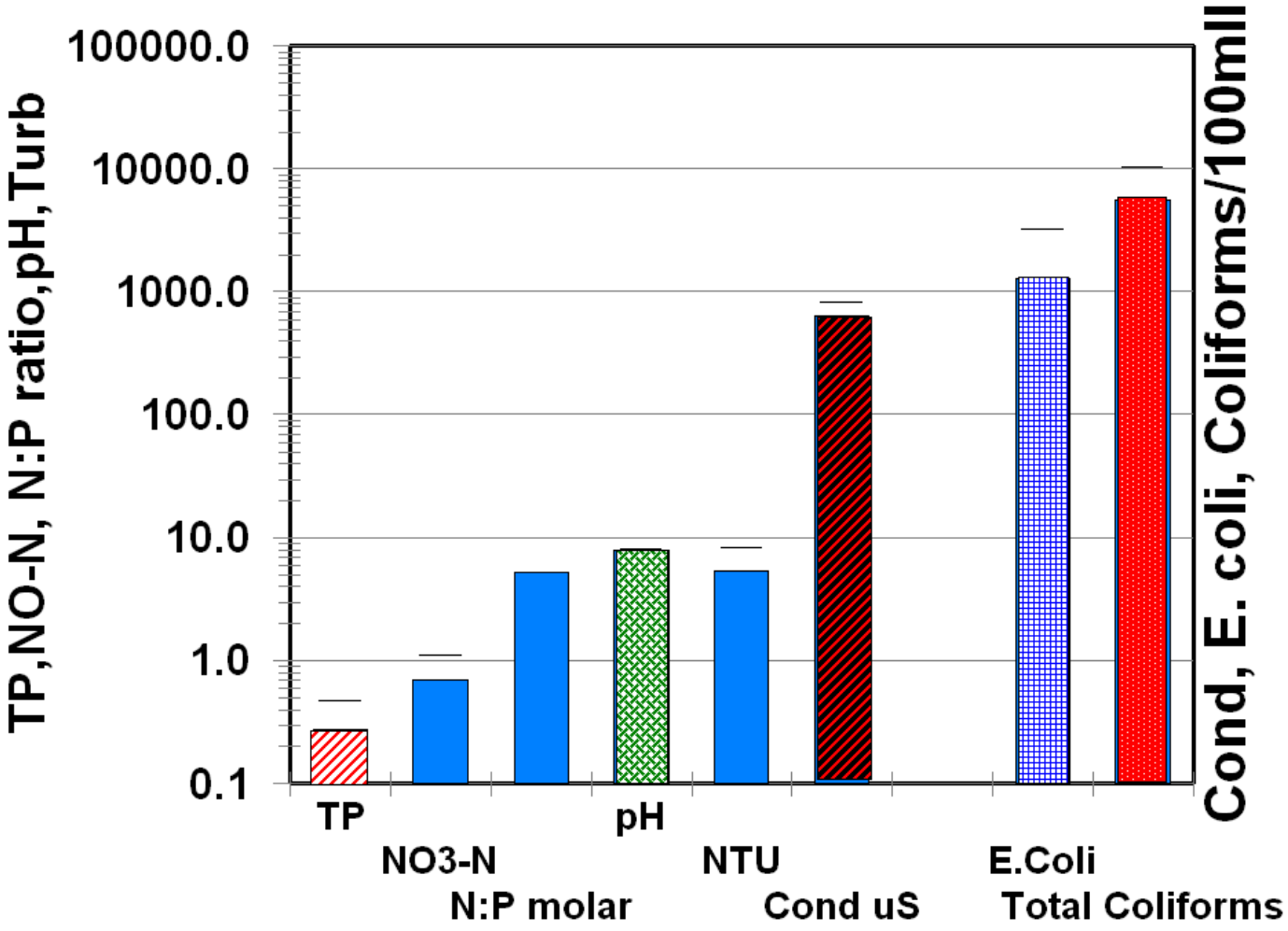
Mouth of Indian Creek N of US 27

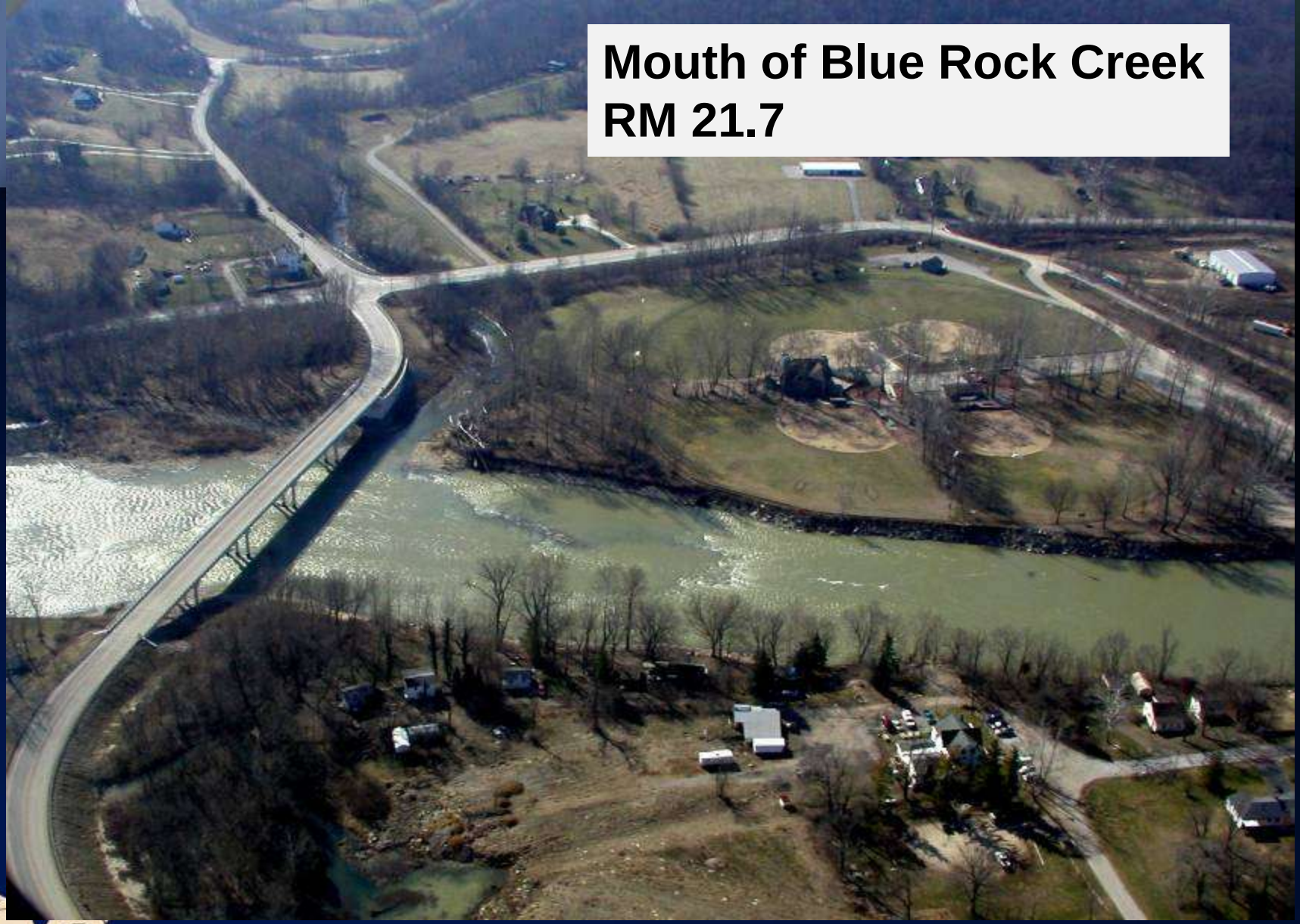
RM 27.7

Indian Ck 2011



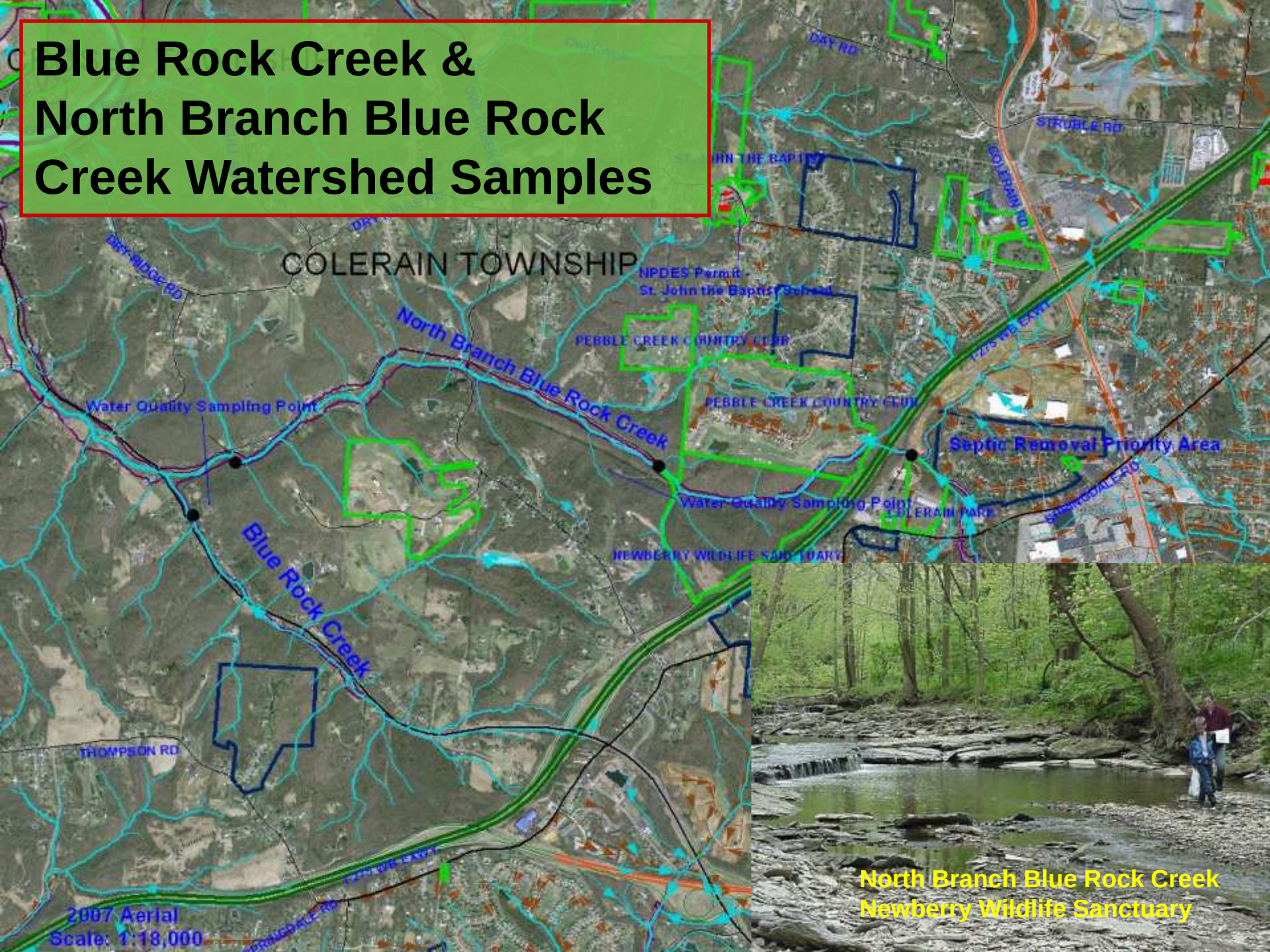
Two Mile Ck 2011





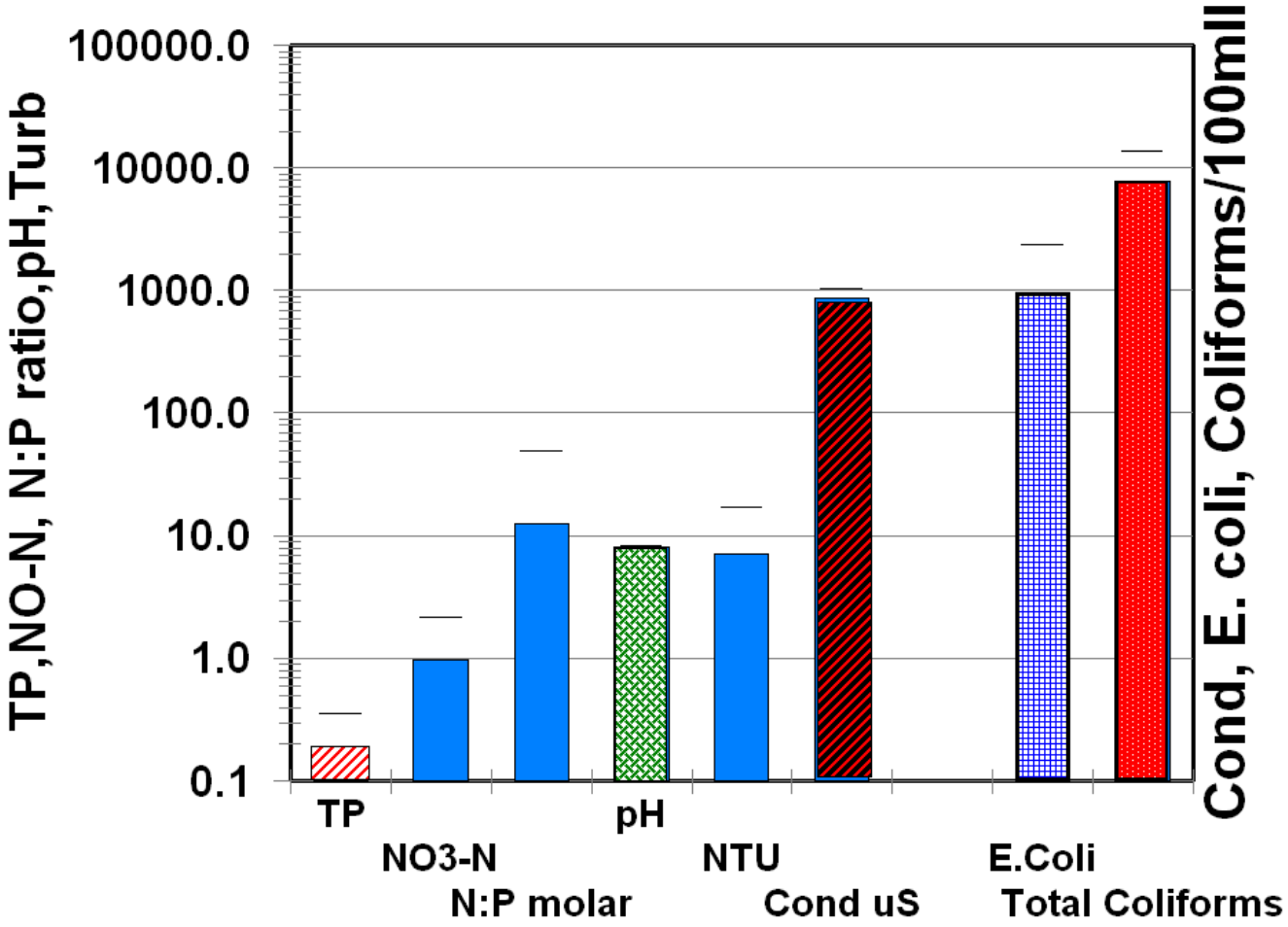
Mouth of Blue Rock Creek
RM 21.7

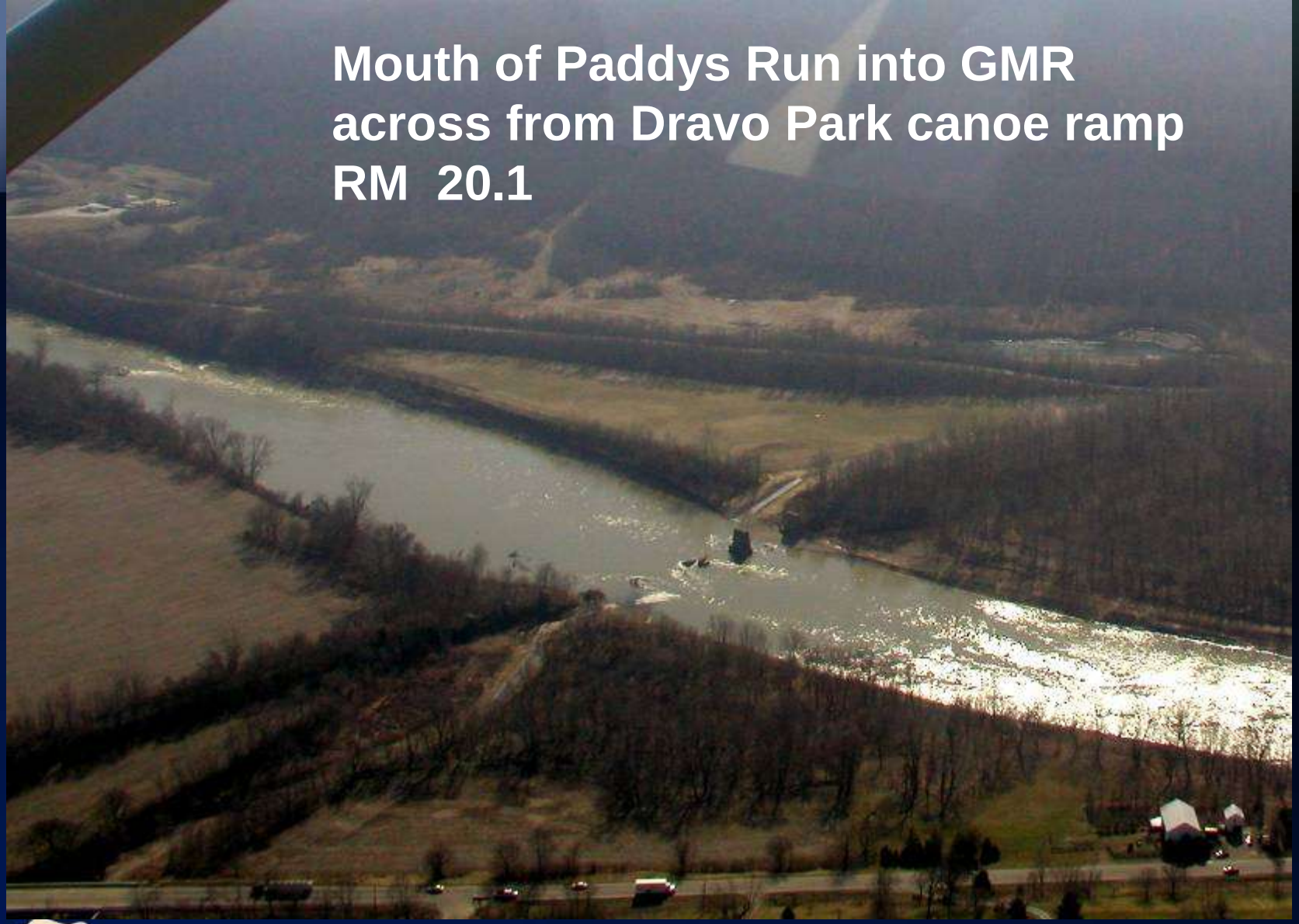
Blue Rock Creek & North Branch Blue Rock Creek Watershed Samples



North Branch Blue Rock Creek
Newberry Wildlife Sanctuary

Blue Rock Ck 2011





Mouth of Paddys Run into GMR across from Dravo Park canoe ramp RM 20.1

Paddys Run Watershed

CROSBY TOWNSHIP

Agricultural Conservation Practices
Grass Waterways Installed

NPDES Permit - USDOE Fernald Plant

Water Quality Sample Point

NPDES Permit - PCS Purified Phosphates

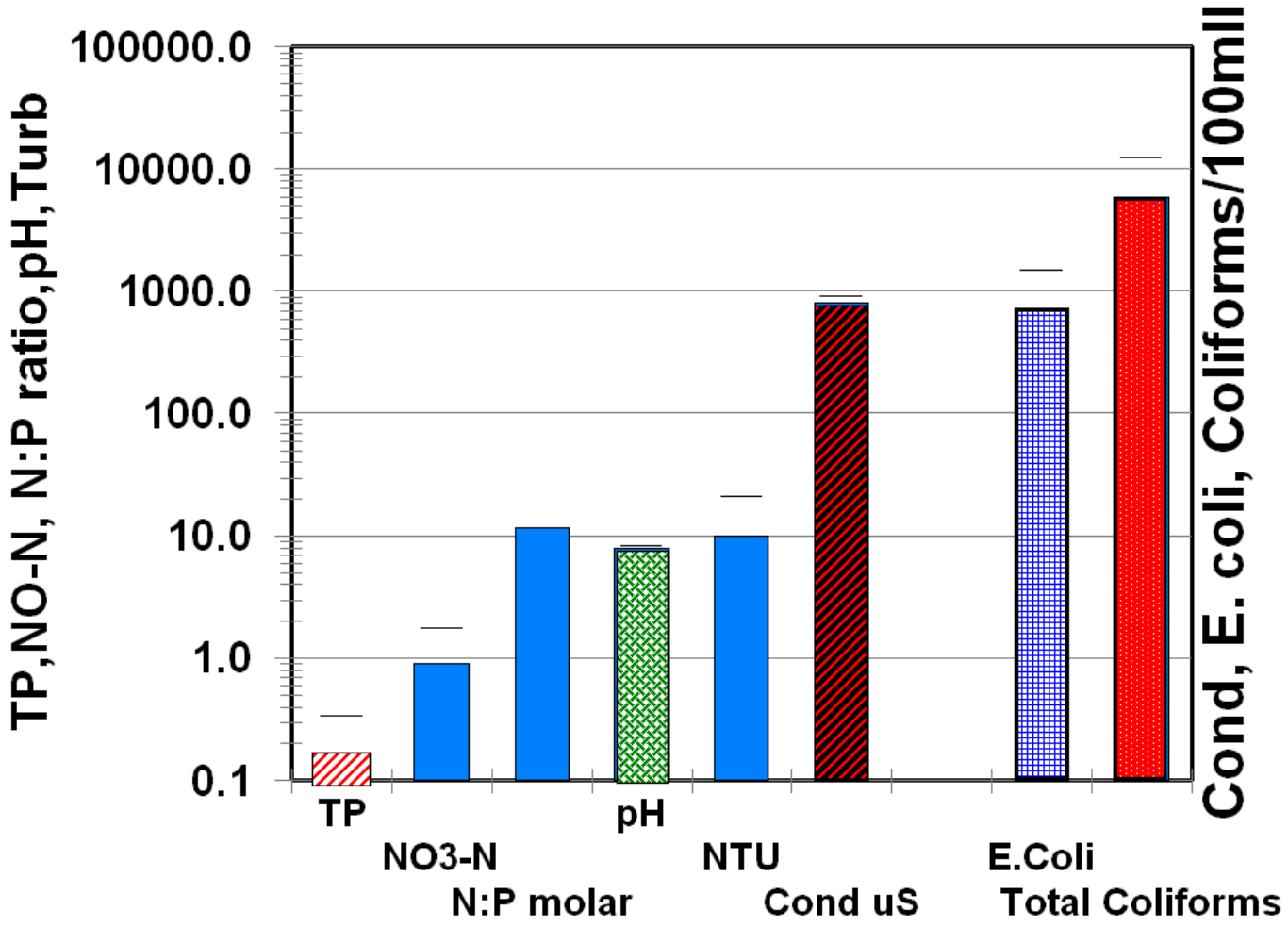
NPDES Permit - Nease Corporation

Water Quality Sample Point

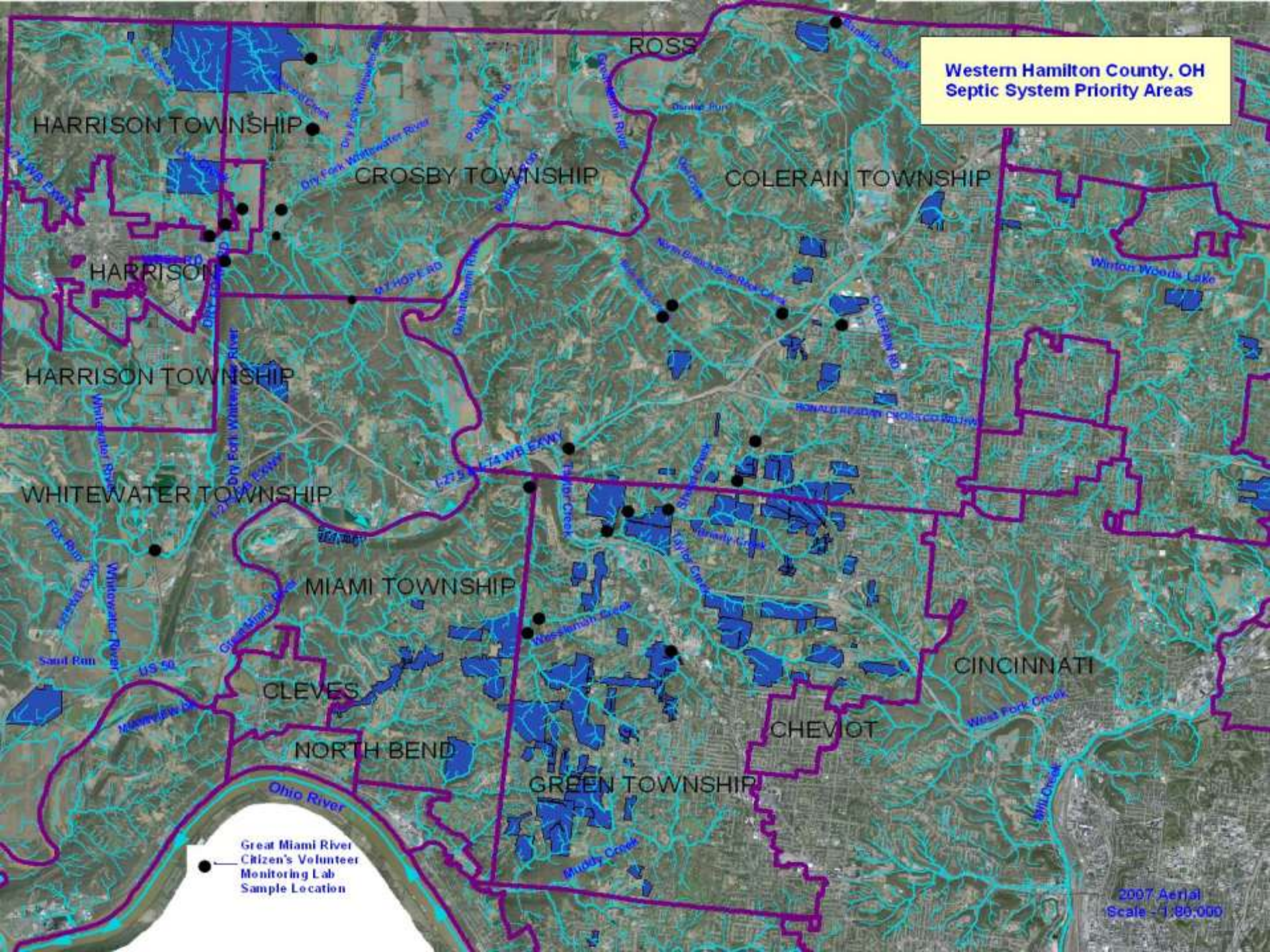
2007 Aerial
Scale 1:24,000

COLERAIN TOWNSHIP

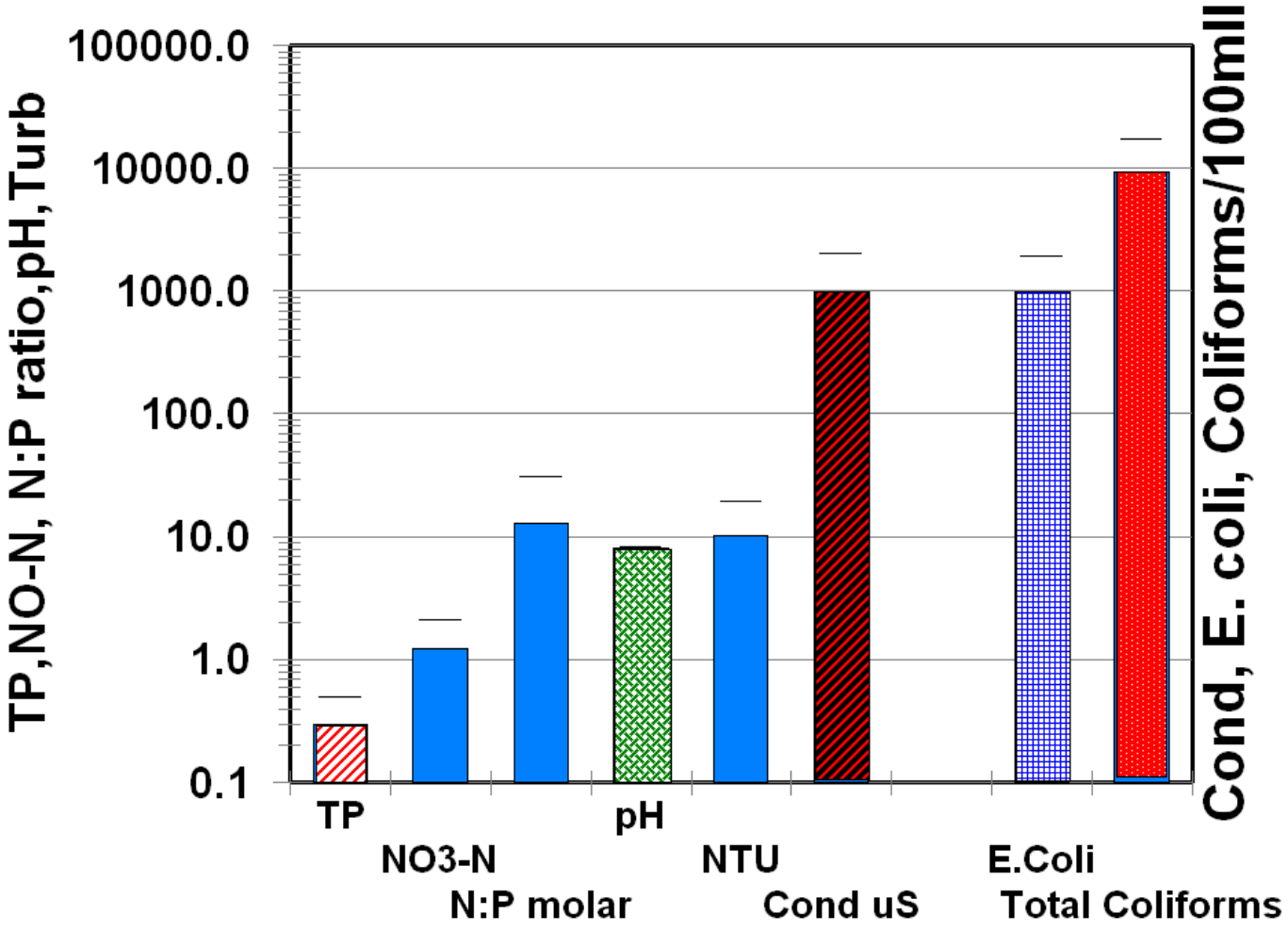
Paddys Run 2011

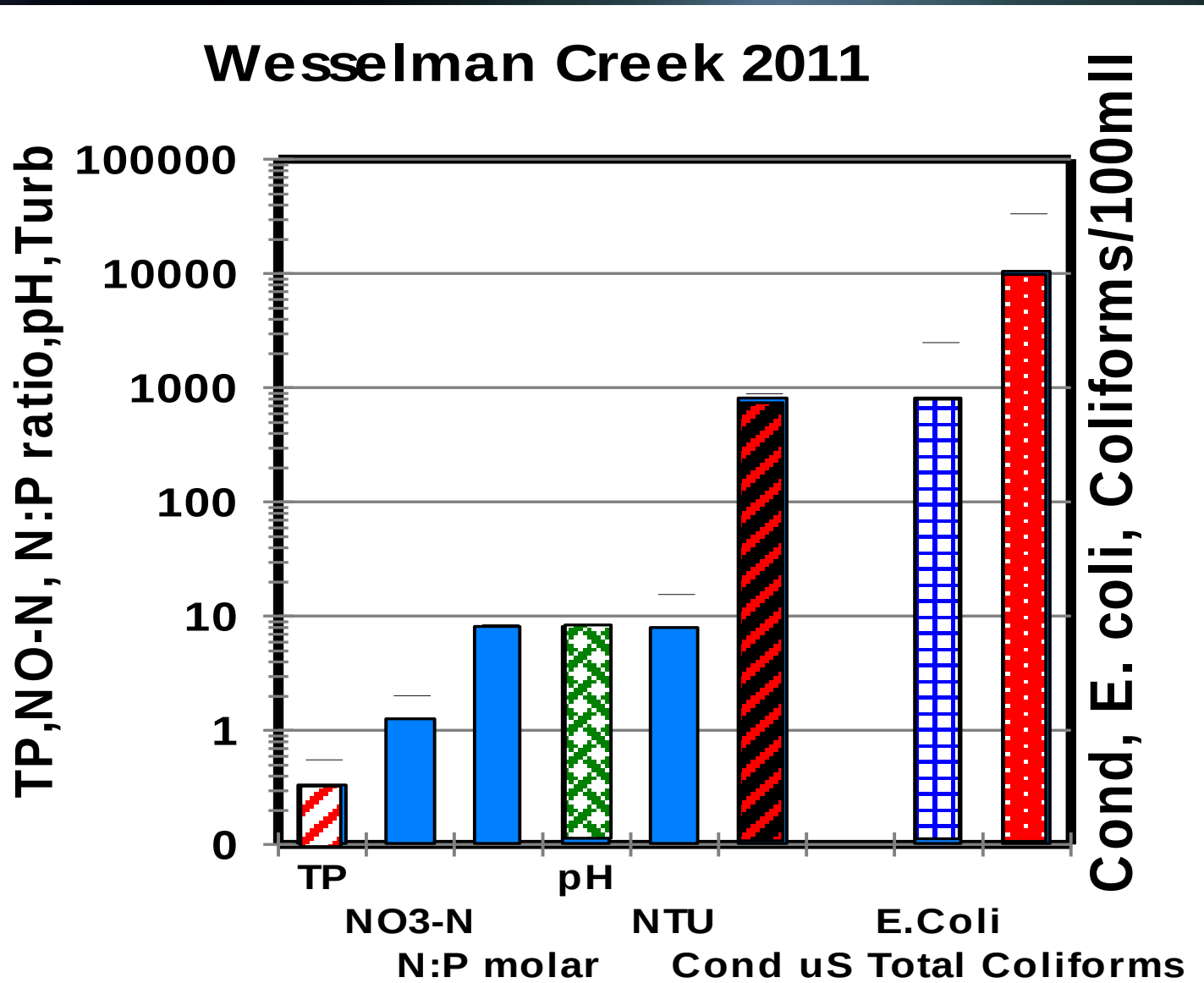


Citizens' Water Quality Monitoring
Great Miami River Watershed


Western Hamilton County, OH
Septic System Priority Areas
ROSS
HARRISON TOWNSHIP
CROSBY TOWNSHIP
COLERAIN TOWNSHIP
HARRISON
HARRISON TOWNSHIP
WHITEWATER TOWNSHIP
MIAMI TOWNSHIP
CLEVES
NORTH BEND
GREEN TOWNSHIP
CHEVIOT
CINCINNATI
Ohio River
Great Miami River
Citizen's Volunteer
Monitoring Lab
Sample Location
2007 Aerial
Scale - 1:80,000

Taylor Creek 2011




Wesselman Creek 2011
TP,NO-N, N:P ratio,pH,Turb
Cond, E. coli, Coliforms/100ml
100000
10000
1000
100
10
1
0
TP
pH
NO3-N
NTU
E.Coli
N:P molar
Cond uS
Total Coliforms

Citizens' Water Quality Monitoring

Great Miami River Watershed

Whitewater River

Sampling Downstream

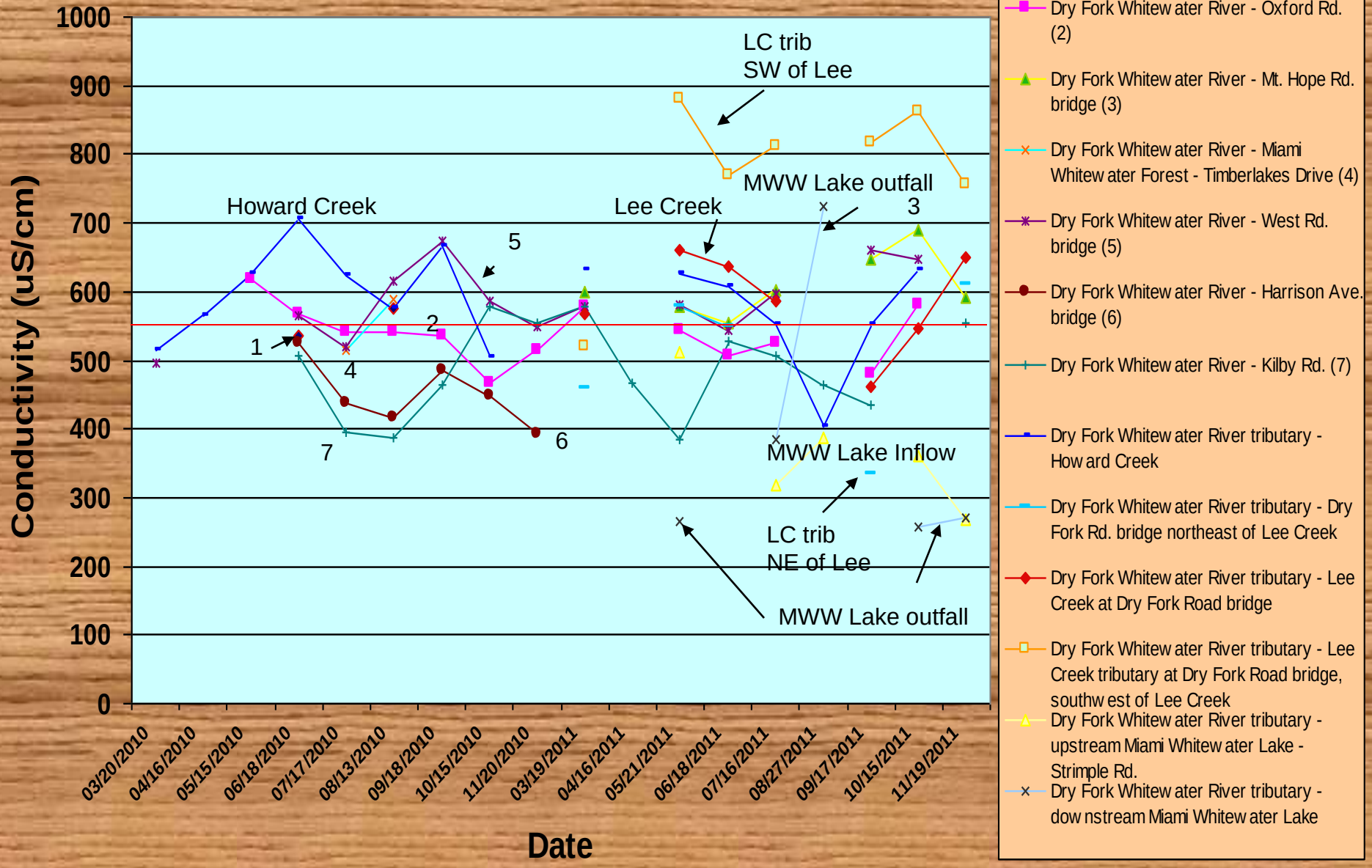
Of 3 NPDES dischargers

- JTM
- Harrison WWTP
- Whitewater Processing

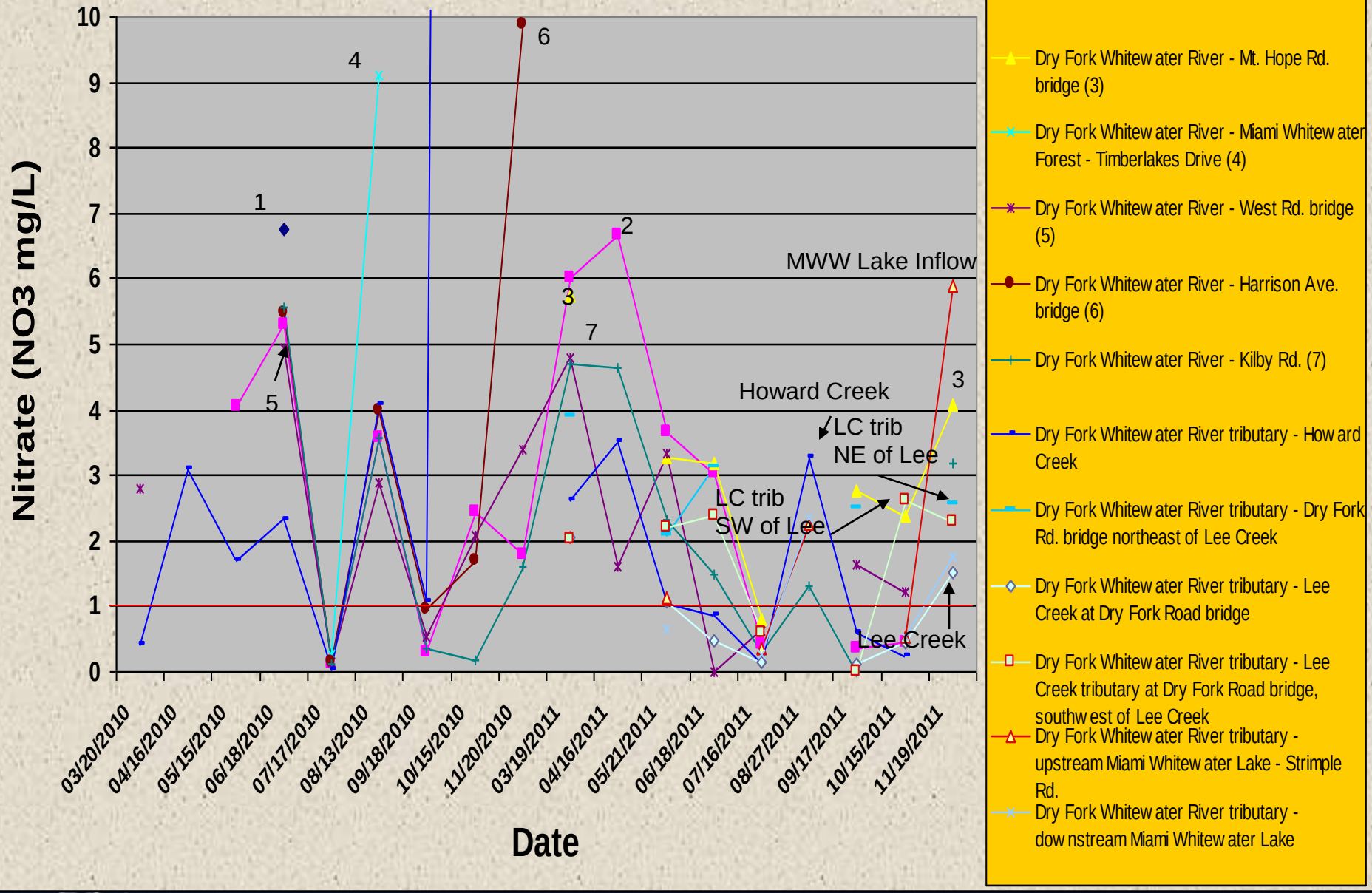
Citizens' Water Quality Monitoring

Great Miami River Watershed

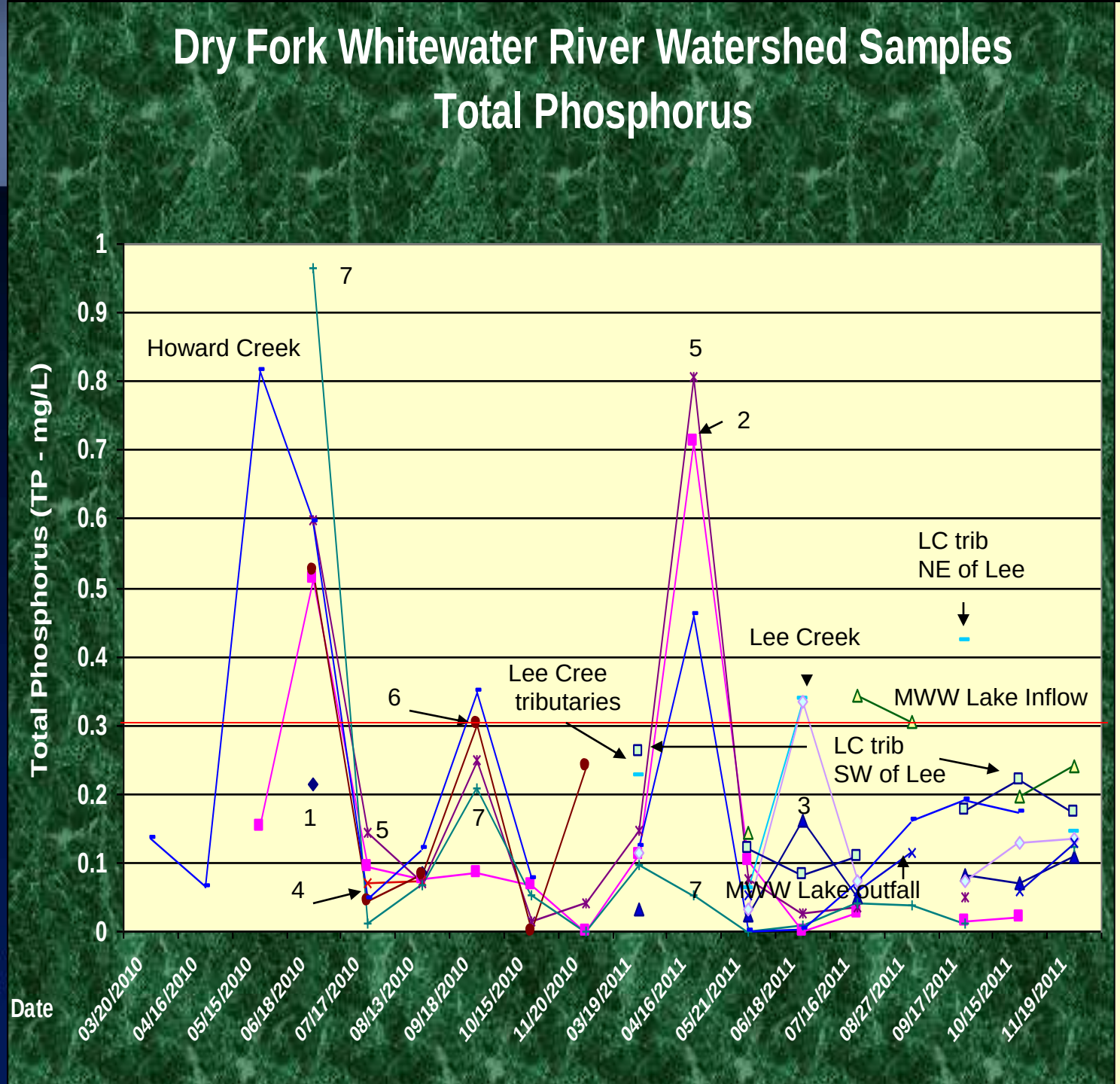
Dry Fork Whitewater River Watershed Samples - Conductivity



Dry Fork Whitewater River Watershed Samples - Nitrate

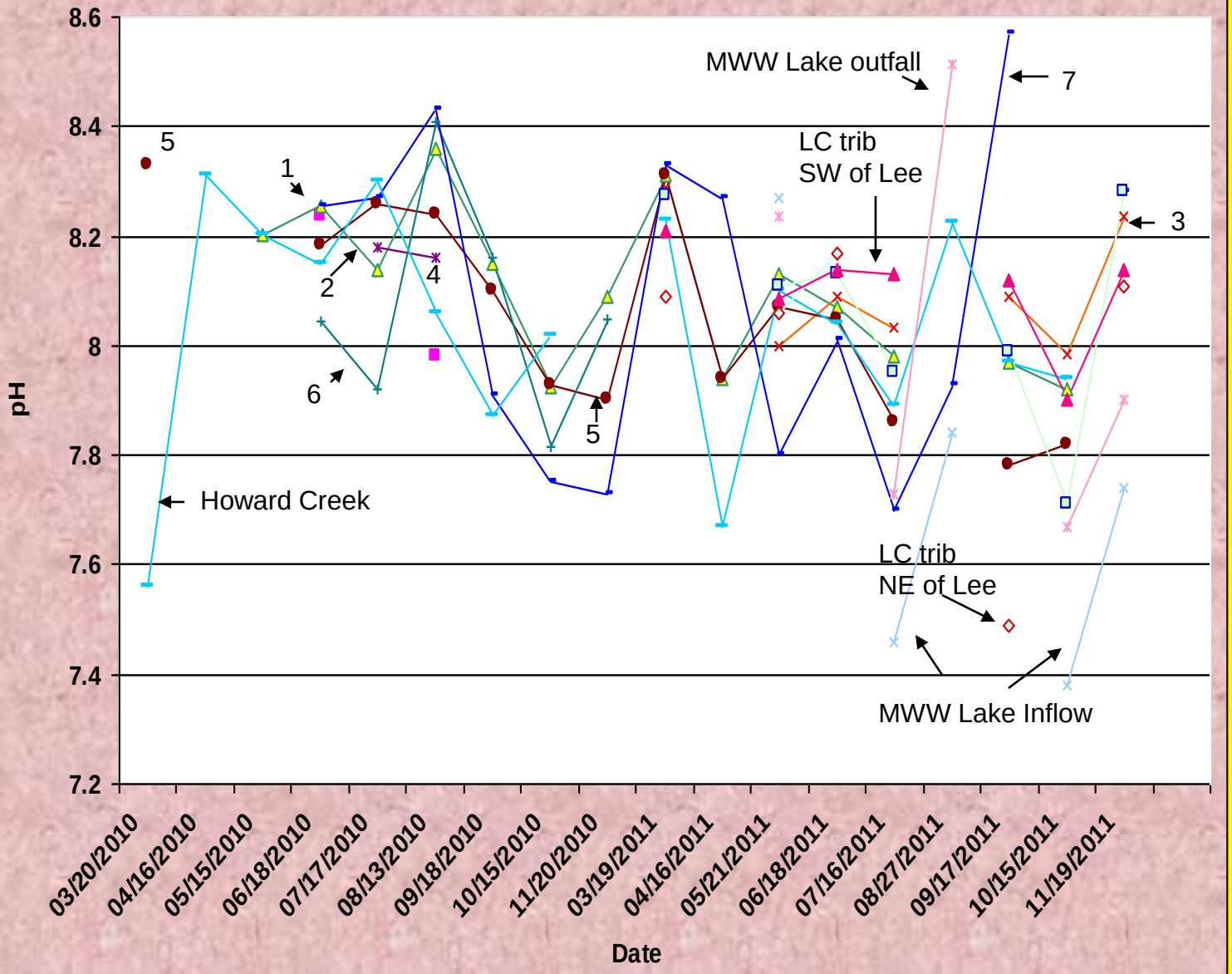


Dry Fork Whitewater River Watershed Samples
Total Phosphorus



- Dry Fork Whitewater River - Hamilton-New London Rd. to Race Line Rd. (1)
- Dry Fork Whitewater River - Oxford Rd. (2)
- Dry Fork Whitewater River - Mt. Hope Rd. bridge (3)
- Dry Fork Whitewater River - Miami Whitewater Forest - Timberlakes Drive (4)
- Dry Fork Whitewater River - West Rd. bridge (5)
- Dry Fork Whitewater River - Harrison Ave. bridge (6)
- Dry Fork Whitewater River - Kilby Rd. (7)
- Dry Fork Whitewater River tributary - Howard Creek
- Dry Fork Whitewater River tributary - Dry Fork Rd. bridge northeast of Lee Creek
- Dry Fork Whitewater River tributary - Lee Creek at Dry Fork Road bridge
- Dry Fork Whitewater River tributary - Lee Creek tributary at Dry Fork Road bridge, southwest of Lee Creek
- Dry Fork Whitewater River tributary - upstream Miami Whitewater Lake - Strimple Rd.
- Dry Fork Whitewater River tributary - downstream Miami Whitewater Lake

Dry Fork Whitewater River Sample Sites - pH



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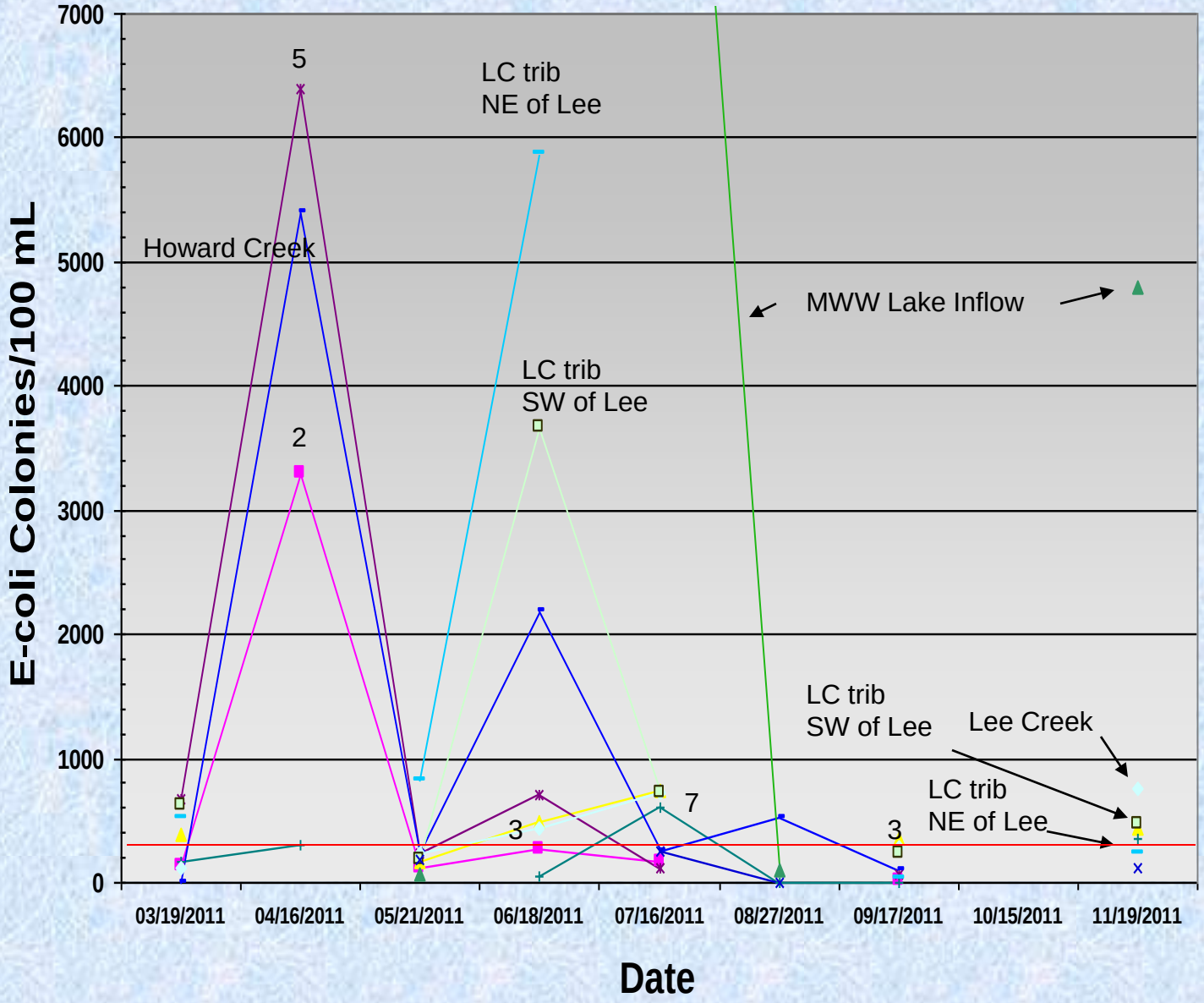
Dry Fork Whitewater River Watershed Samples - E-coli



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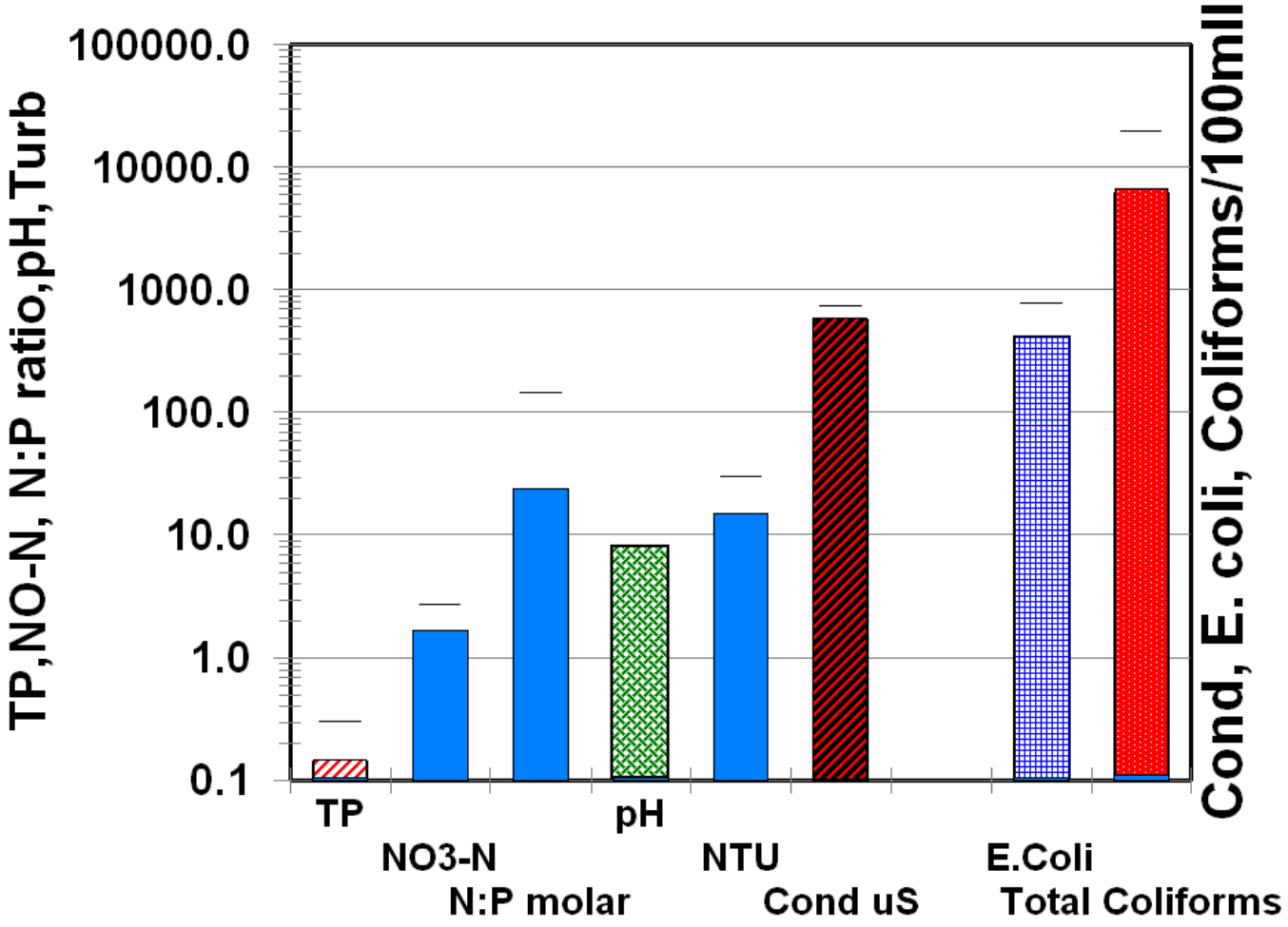
Dry Fork Whitewater River Watershed Sample Observations

1. Excessive spring peaks in E-coli (>6,000 colonies/mL) and total phosphorus (>0.8 mg/L) along the Dry Fork at West Rd. bridge.
2. Elevated spring phosphorous levels upstream of the West Rd. bridge and nitrate levels upstream at Oxford Rd. (6 mg/L) Extremely high turbidity levels (978 NTU) in April 2011.
3. High nitrate levels along the Dry Fork Whitewater River at Timberlake Drive and Harrison Ave. in August and November 2010 correspond to low flow levels compared to 2011 (no samples at West Rd.)
4. Contaminant source above Miami Whitewater Lake at Strimple Rd. were revealed in August and November 2011 due to elevated e-coli, nitrate and turbidity levels.
5. Consistently higher dissolved oxygen levels in the Dry Fork at Oxford Rd. compared to less vegetated sites downstream.
6. Three 3 peaks in pH throughout the year. A high spring peak and a late summer/fall increase with a minor mid-summer peak. The farthest downstream site on the Dry Fork (Kilby Rd.) yielded the highest pH values in 2010 and 2011.
7. Elevated conductivity, e-coli, total phosphorus and nitrates at various locations and times at Lee Creek and/or adjacent tributary sites. Lee Creek e-coli and nitrate data lower than tributaries.

Citizens' Water Quality Monitoring
Great Miami River Watershed

Whitewater River 2011



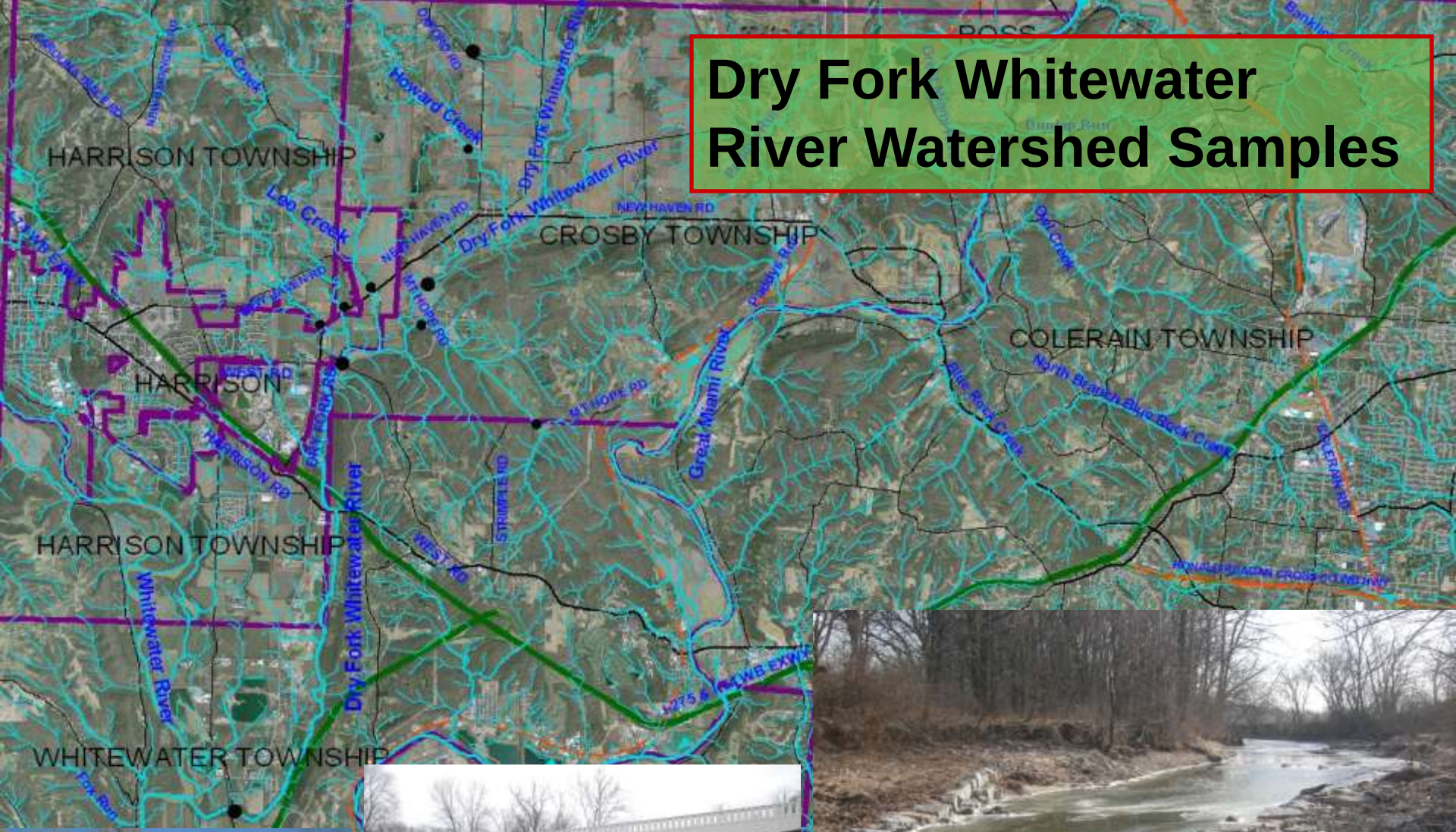
Dry Fork Creek RM

6.3 GMR+ 2.9 Whitewater

Citizens' Water Quality Monitoring

Great Miami River Watershed

Dry Fork Whitewater River Watershed Samples

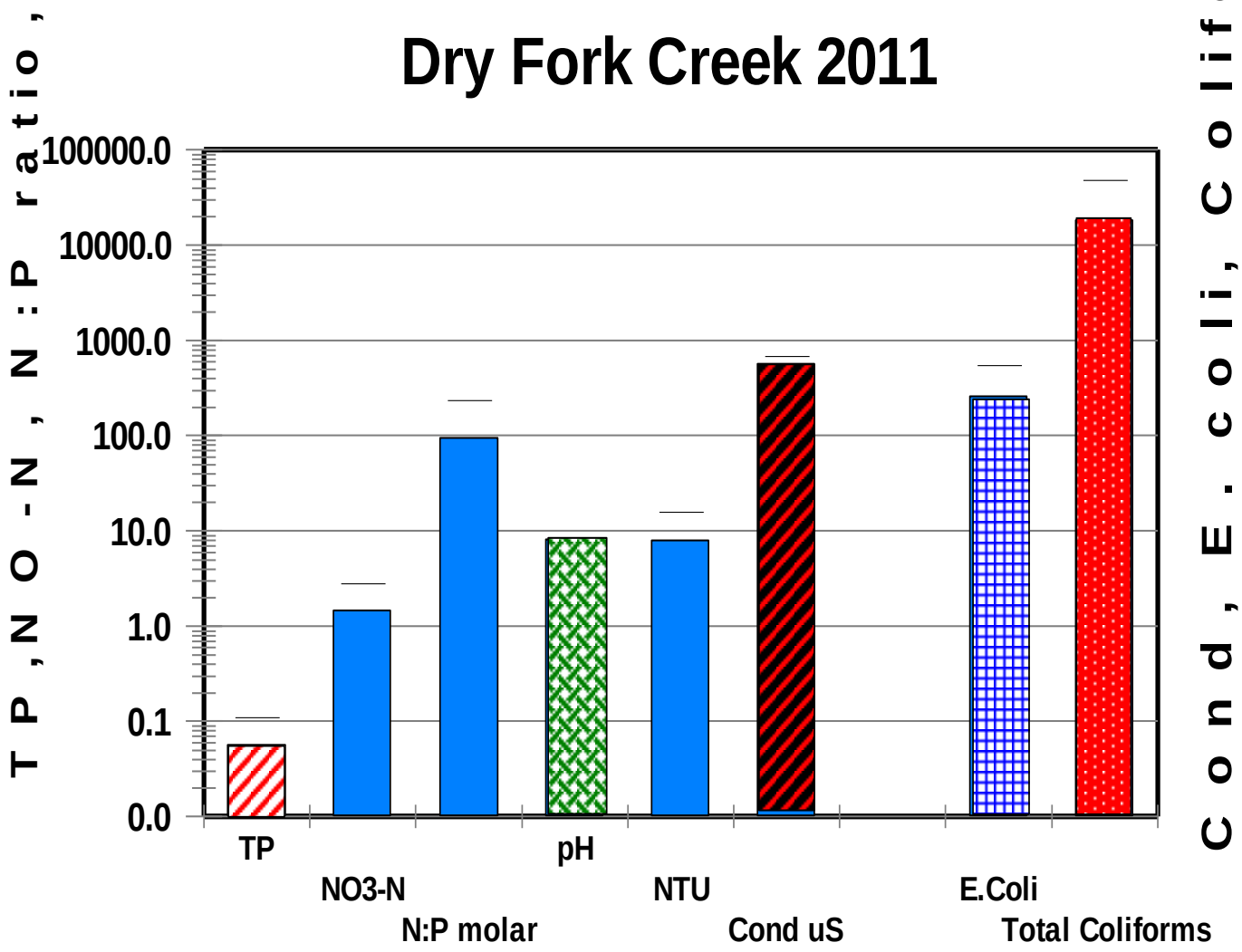


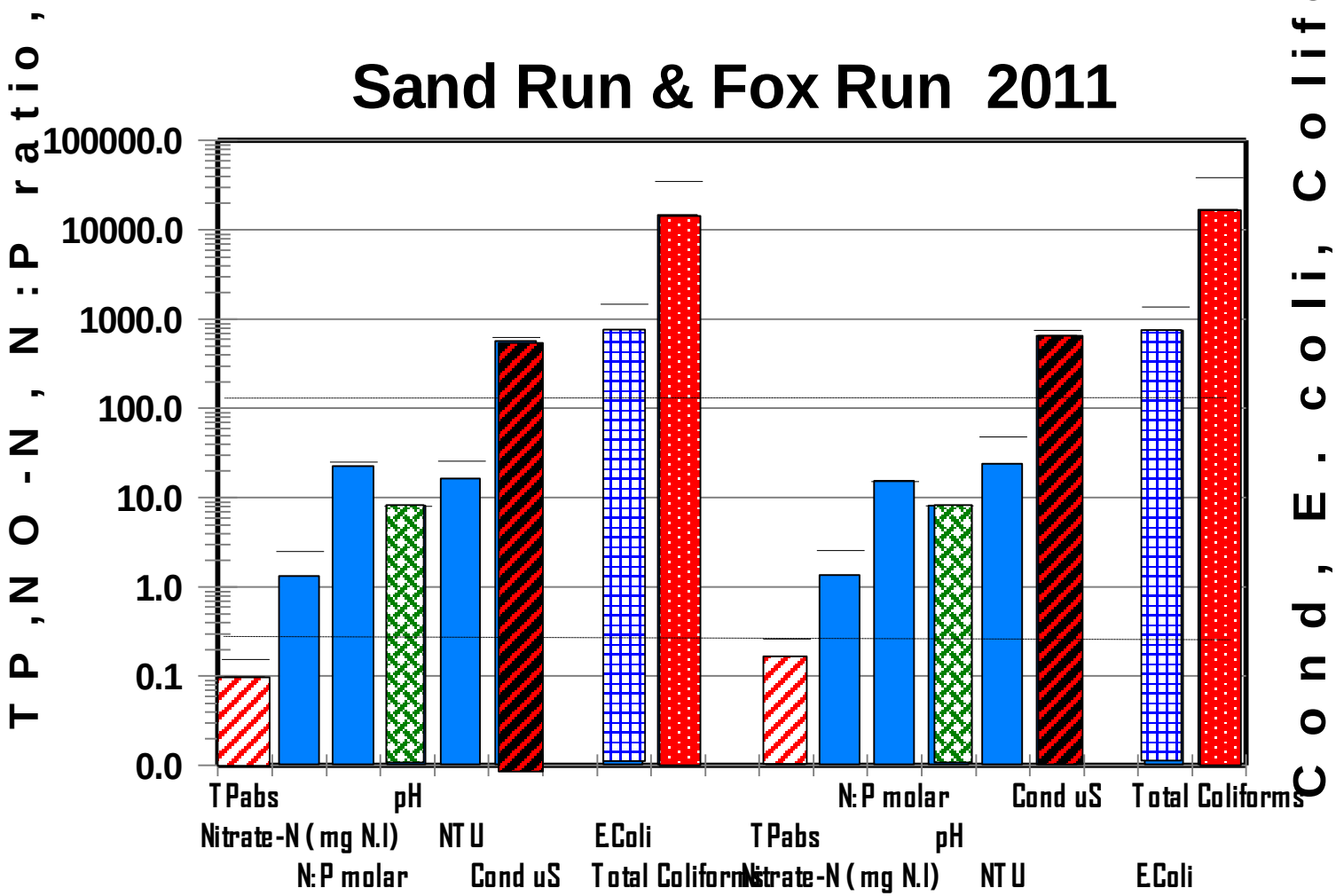
Dry Fork Creek – West Rd.
October 2010

Dry Fork Creek – West Rd.
November 2011

Dry Fork Creek – Oxford Rd.
Stream Restoration Site

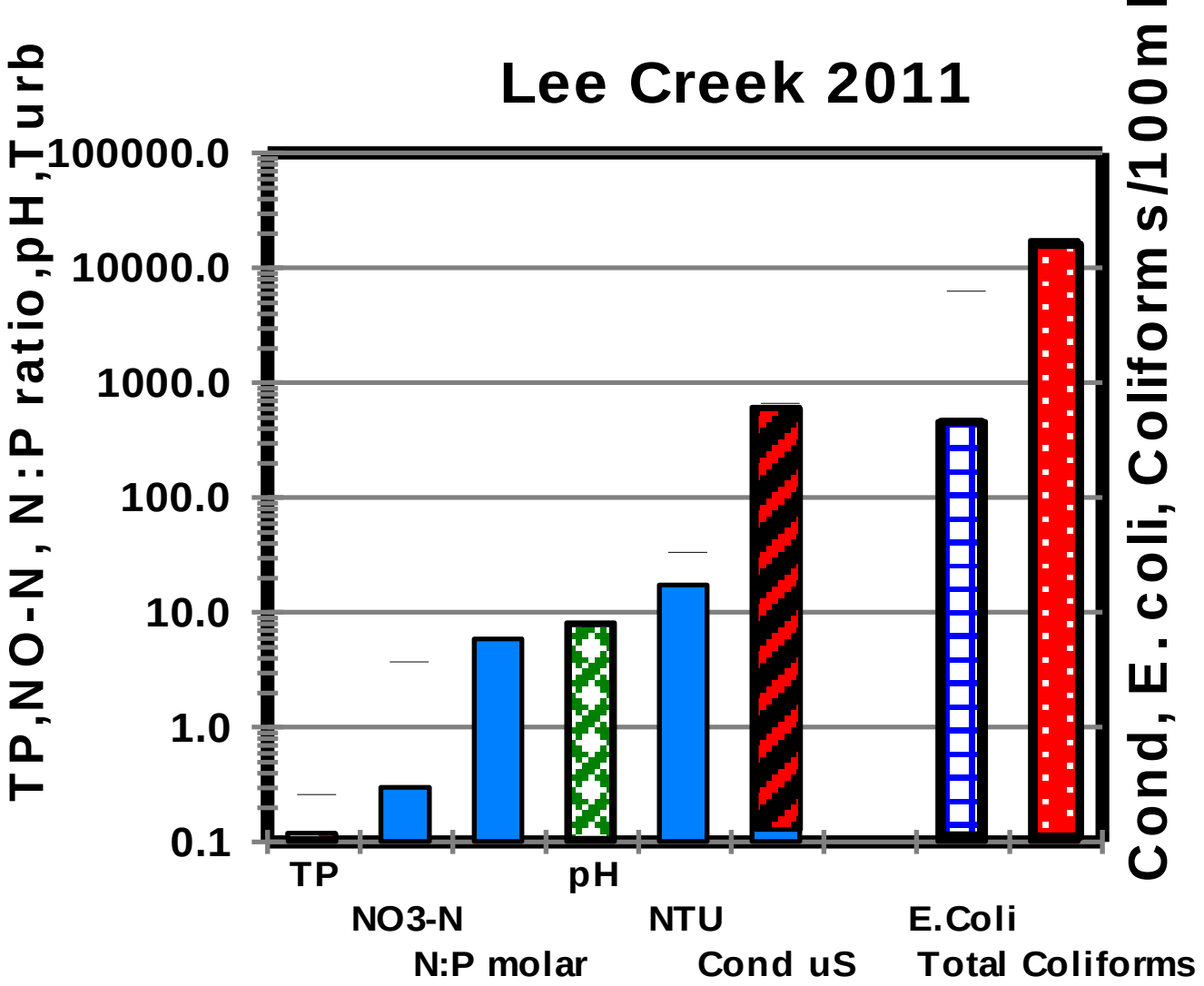
Dry Fork Creek 2011




Sand Run & Fox Run 2011
TP, NO-N, N:P ratio,
Cond, E. coli, Coliform
100000.0
10000.0
1000.0
100.0
10.0
1.0
0.1
0.0
TPabs
Nitrate-N (mg N.l)
N:P molar
pH
NTU
Cond uS
E.Coli
Total Coliforms
TPabs
Nitrate-N (mg N.l)
N:P molar
pH
NTU
Cond uS
E.Coli
Total Coliforms

Lee Creek Watershed Sampling Downstream of Agricultural and Stream Bank Protection Conservation Practices

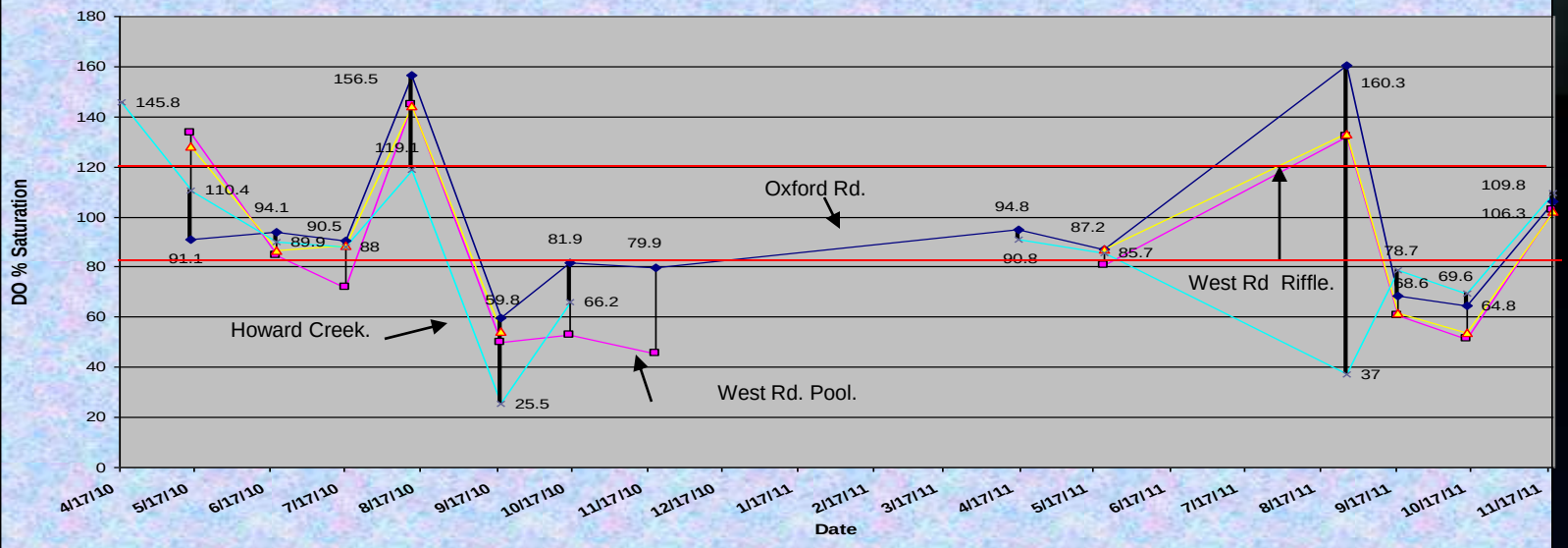
Lee Creek Stream Bank Stabilization



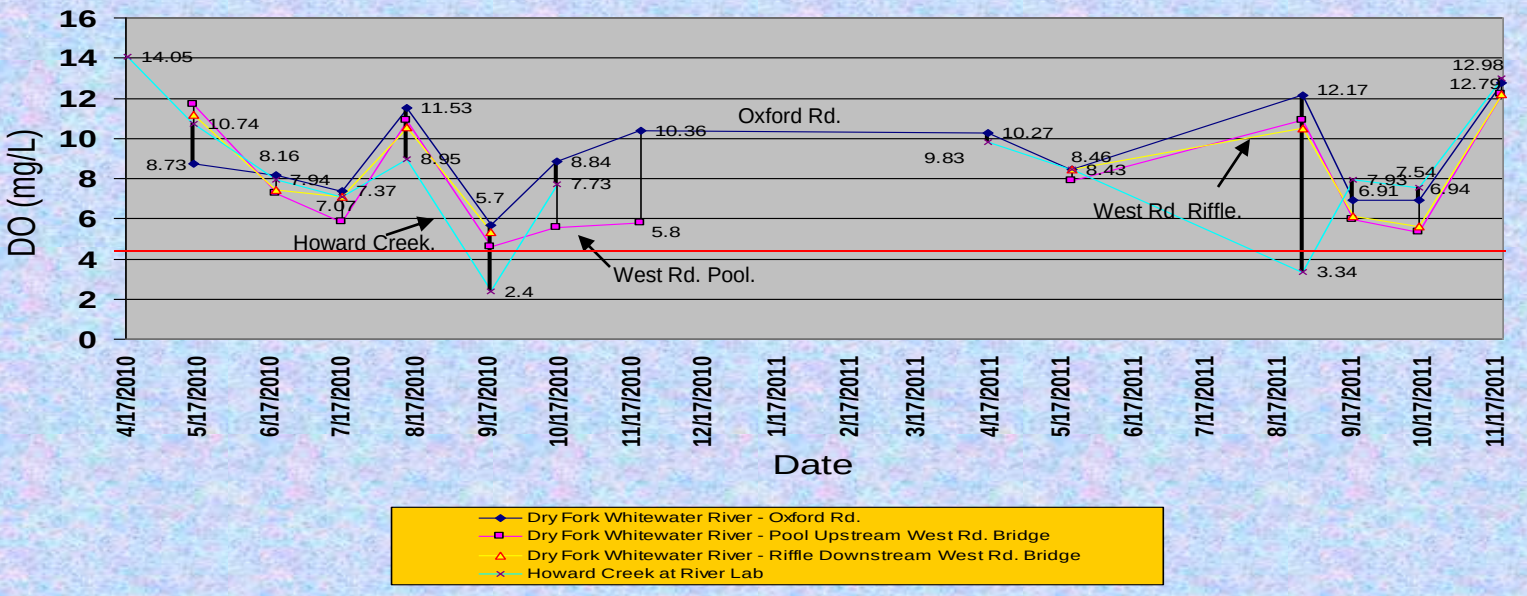
Lee Creek had one of the lowest TP and NO3-N seen. The pH conductivity and E.coli look like bottom land agriculture is not damaging to water quality.

- Howards Creek entering Dry Fork Creek
- RM 10.8 from Whitewater R

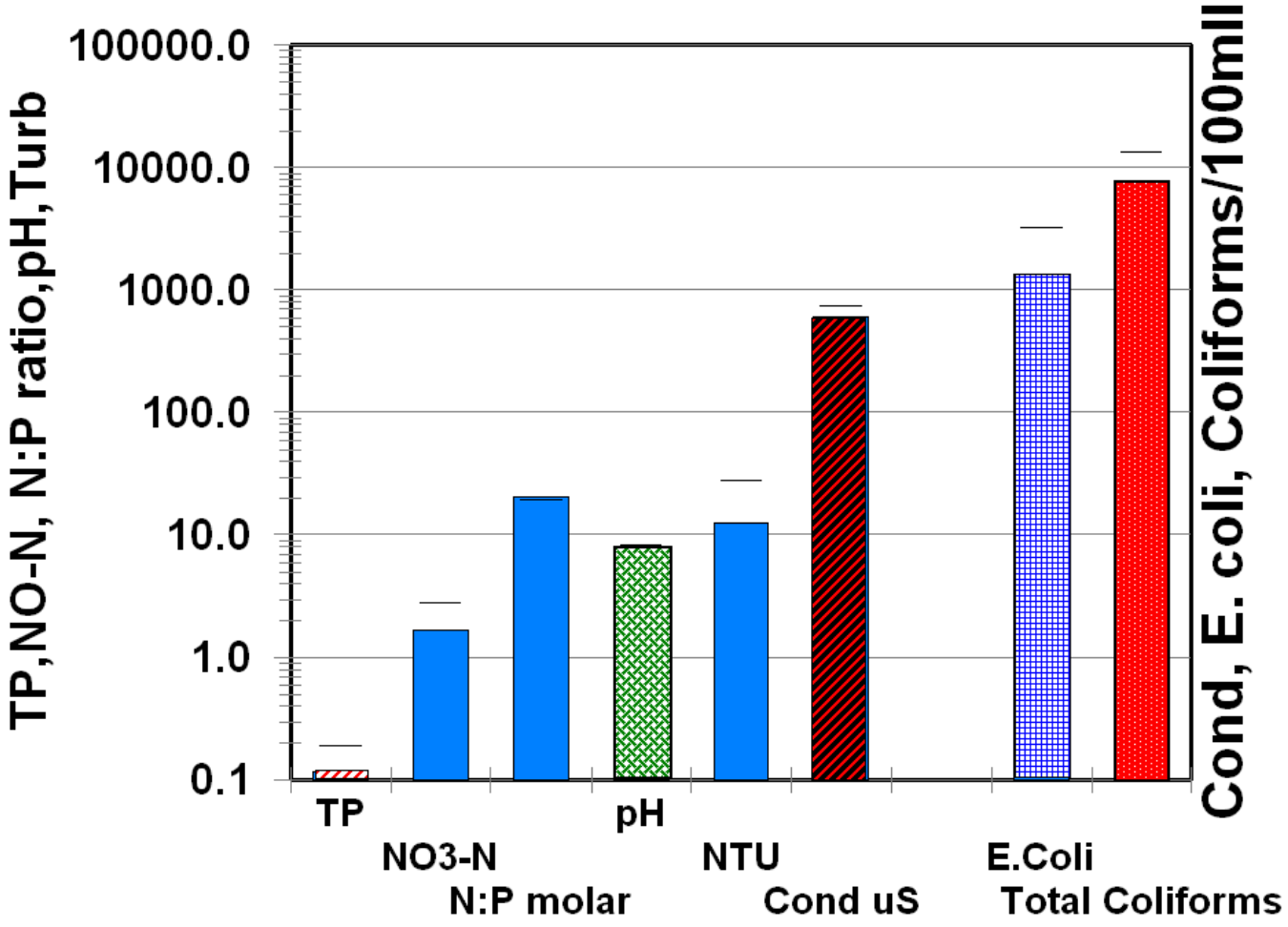
2010-2011 Dry Fork Whitewater River-Howard Creek Dissolved Oxygen (DO) % Saturation



2010-2011 Dry Fork Whitewater River - Howard Creek Dissolved Oxygen (DO) Concentrations

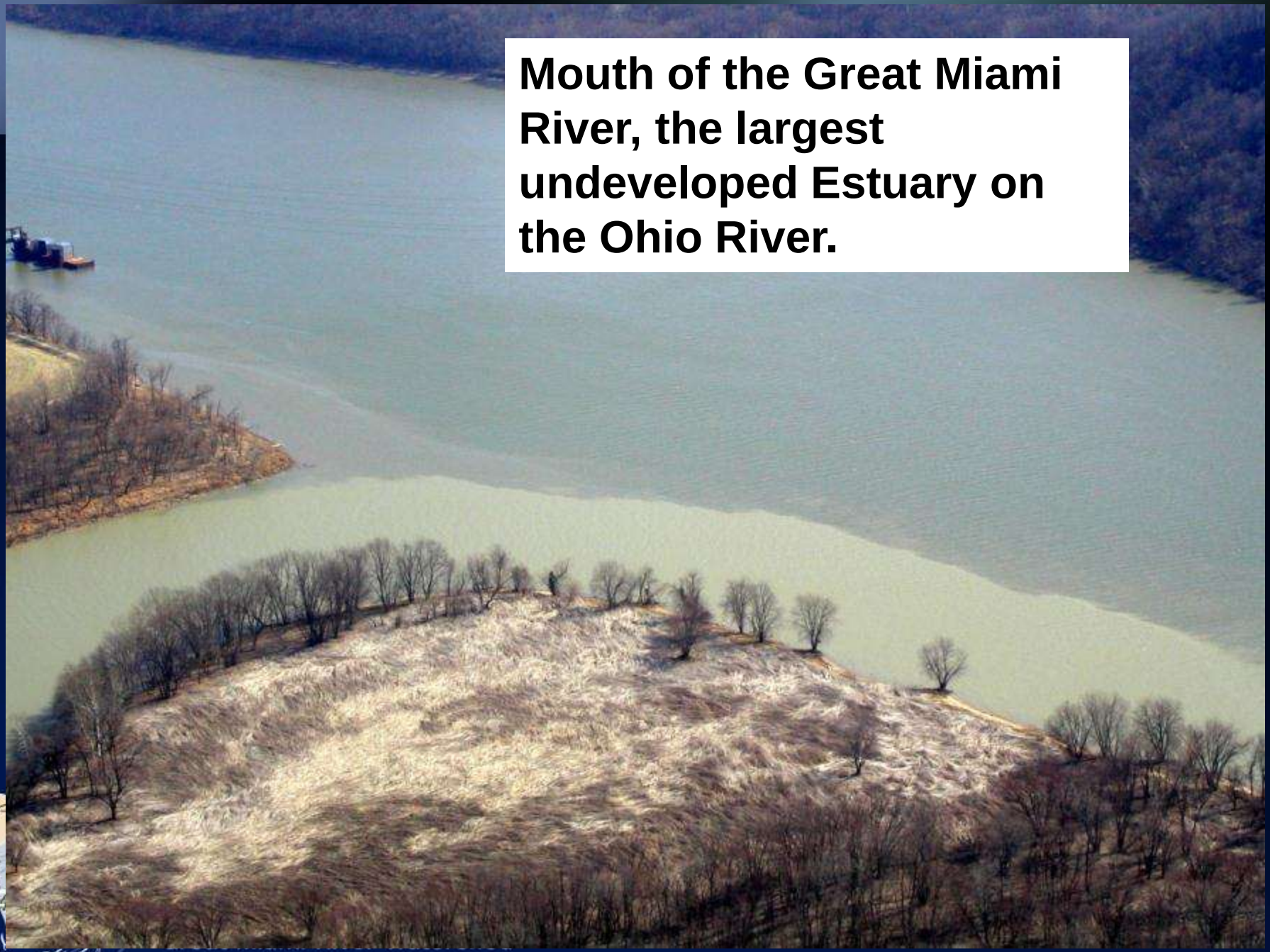


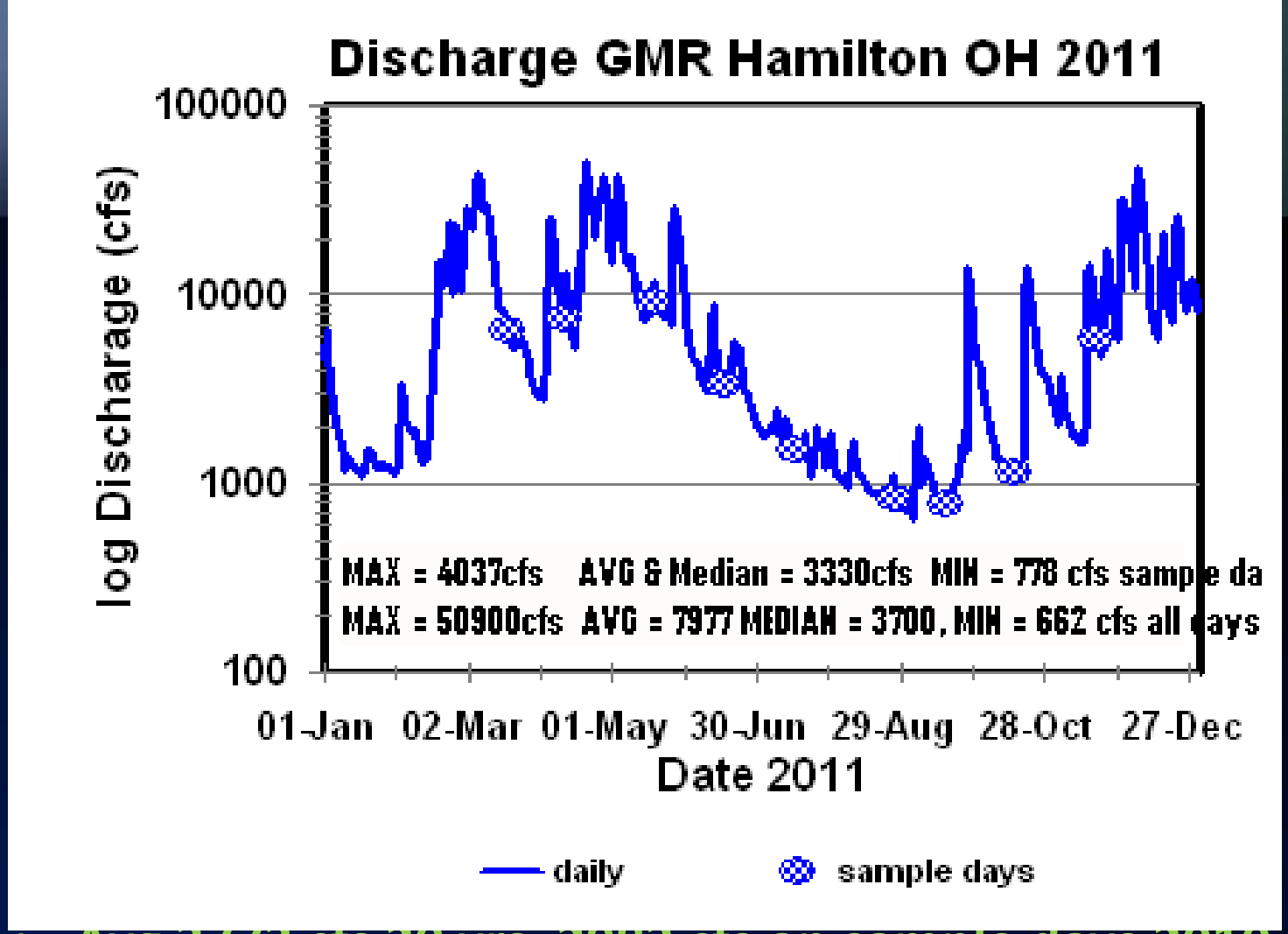
Howards Ck 2011



Citizens' Water Quality Monitoring

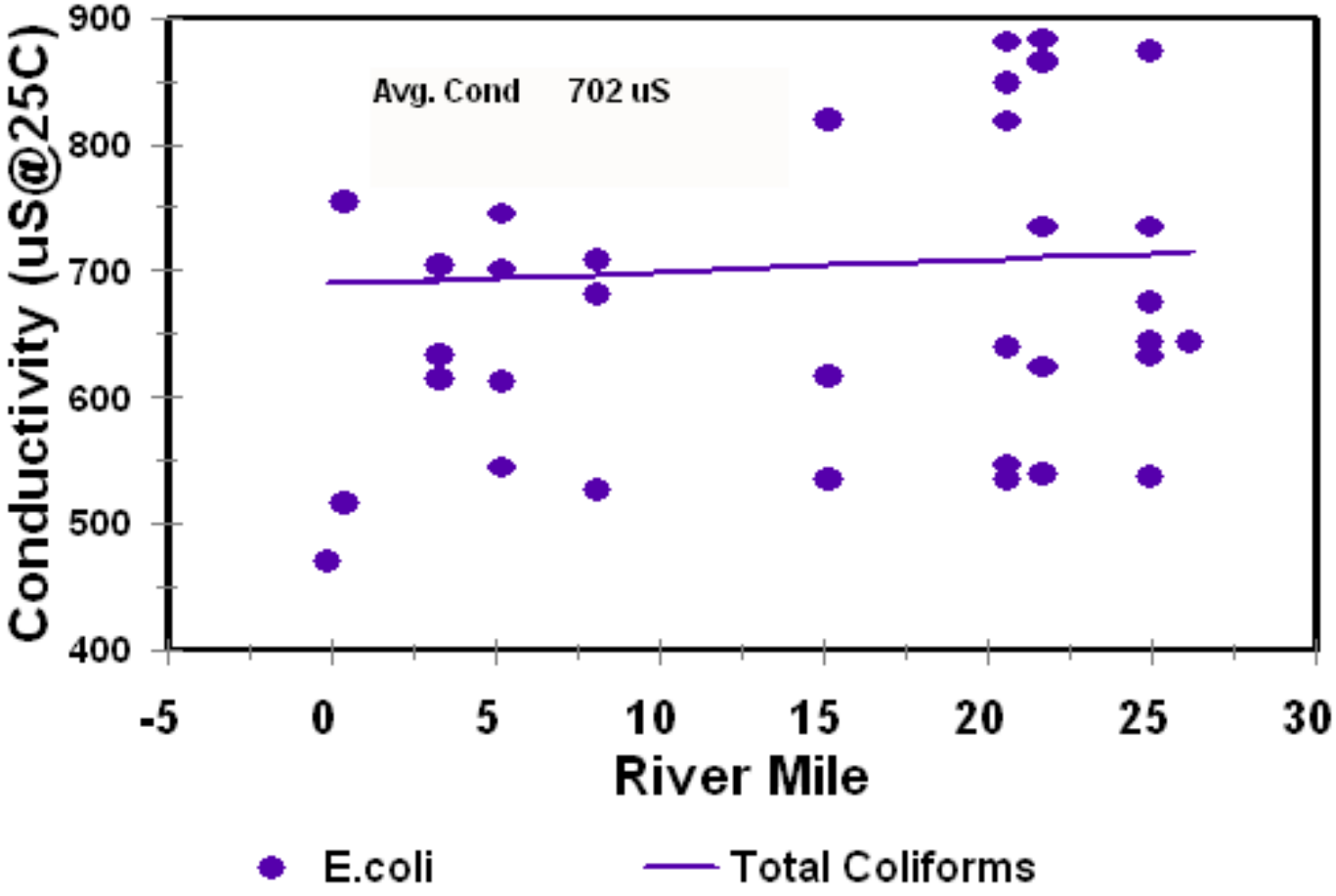
Great Miami River Watershed


Mouth of the Great Miami River, the largest undeveloped Estuary on the Ohio River.



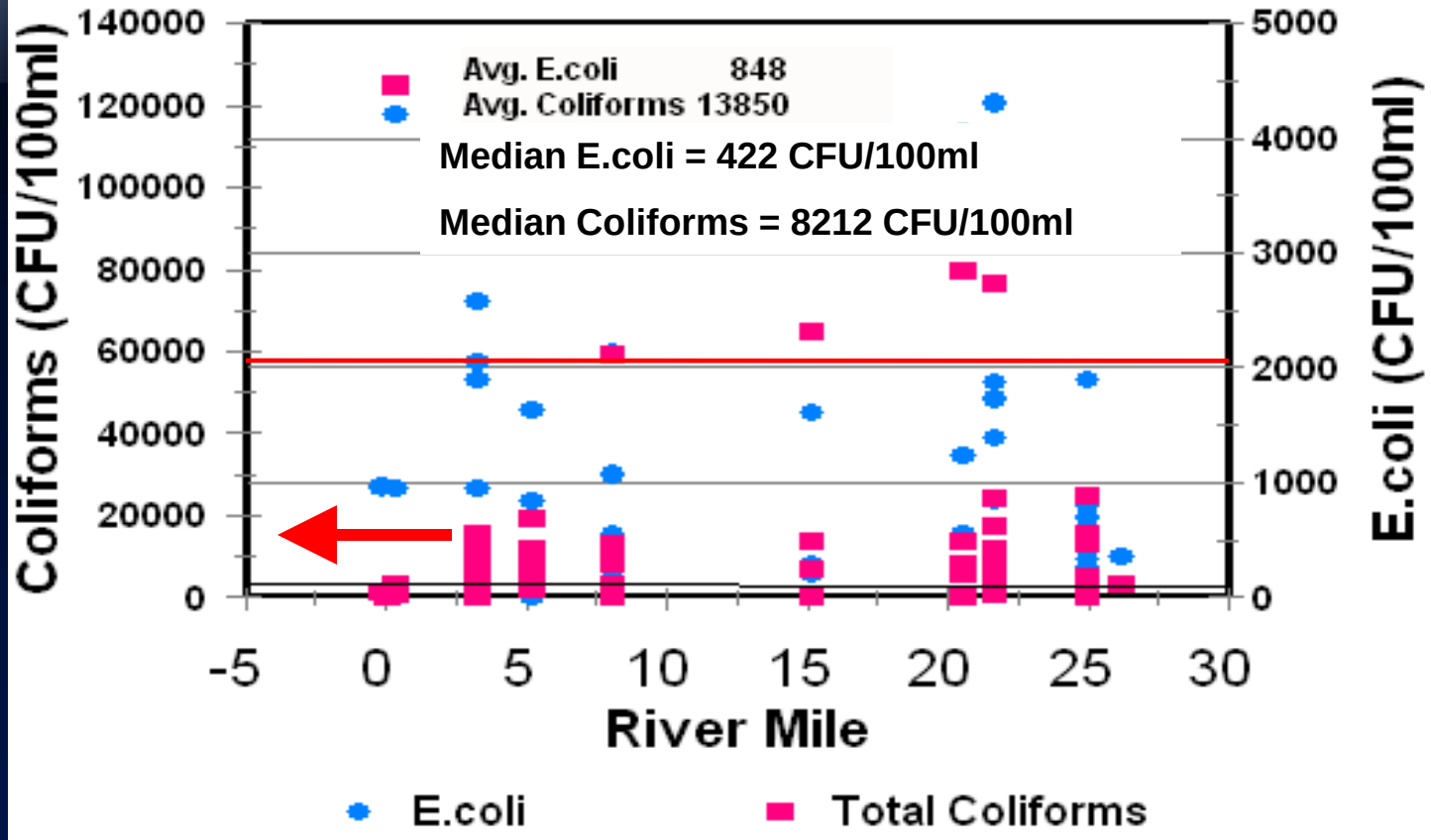
- Avg 3773 cfs 20 yrs, 2983 cfs on sample days 2010. Despite record rain median cfs is only modestly higher

Conducitivity GMR Mainstem 2011

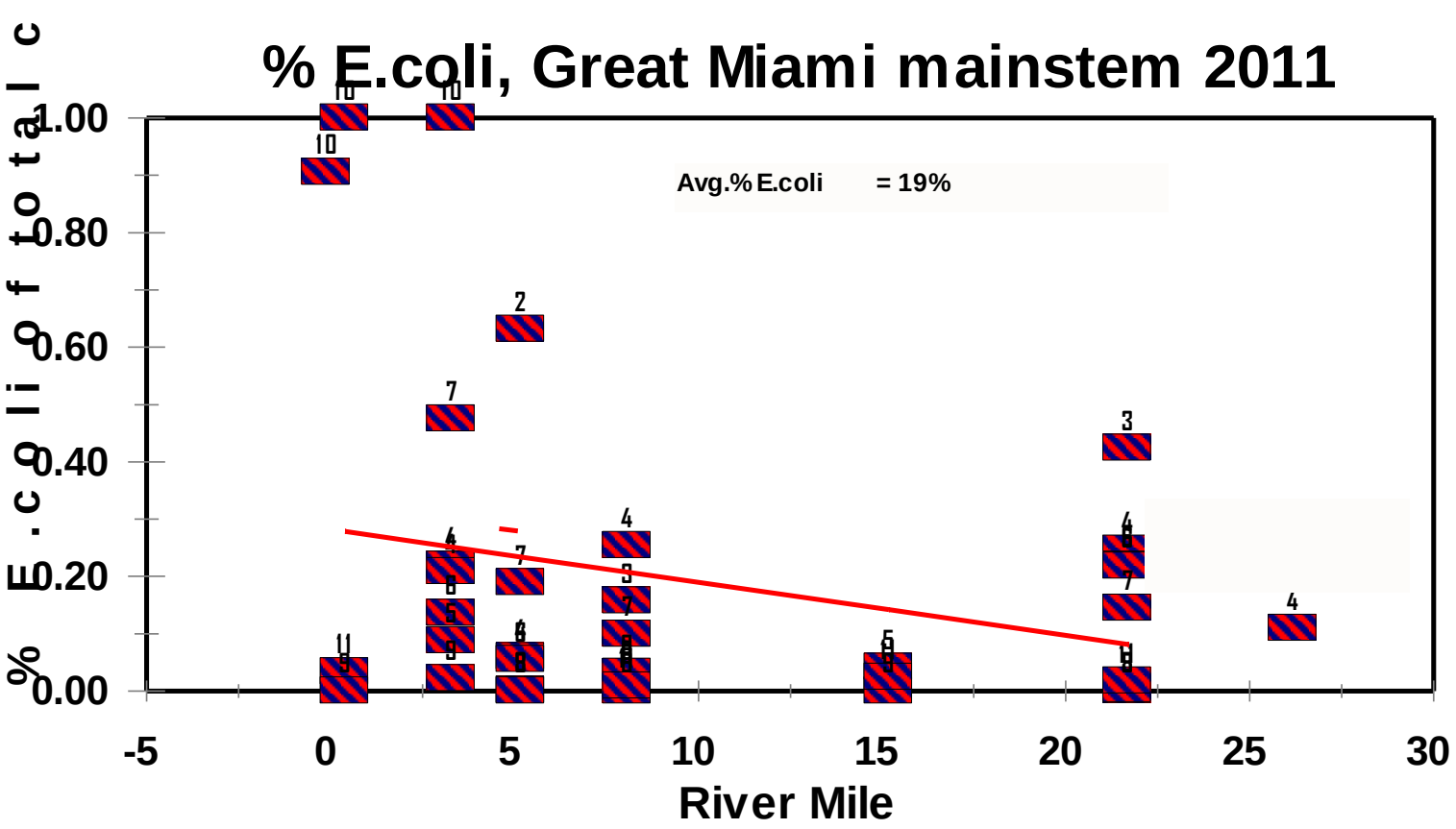


Conductivity may decrease a little from upstream (RM 25) to theOhio River (RM 0) but the values >600 uS show some WTTP effluent loading.

E.coli & Coliforms GMR Mainstem



In 2010 fecal coliforms had a median =100 cfu/100ml Geomean = 114/100ml Avg. 567 cfu/100ml. In 2011 using E. coli the median (422) and average (848 CFU) were higher with the higher flows.



If % E.coli is a measure of human fecal contamination, there is more downriver from urban septic and surface runoff.

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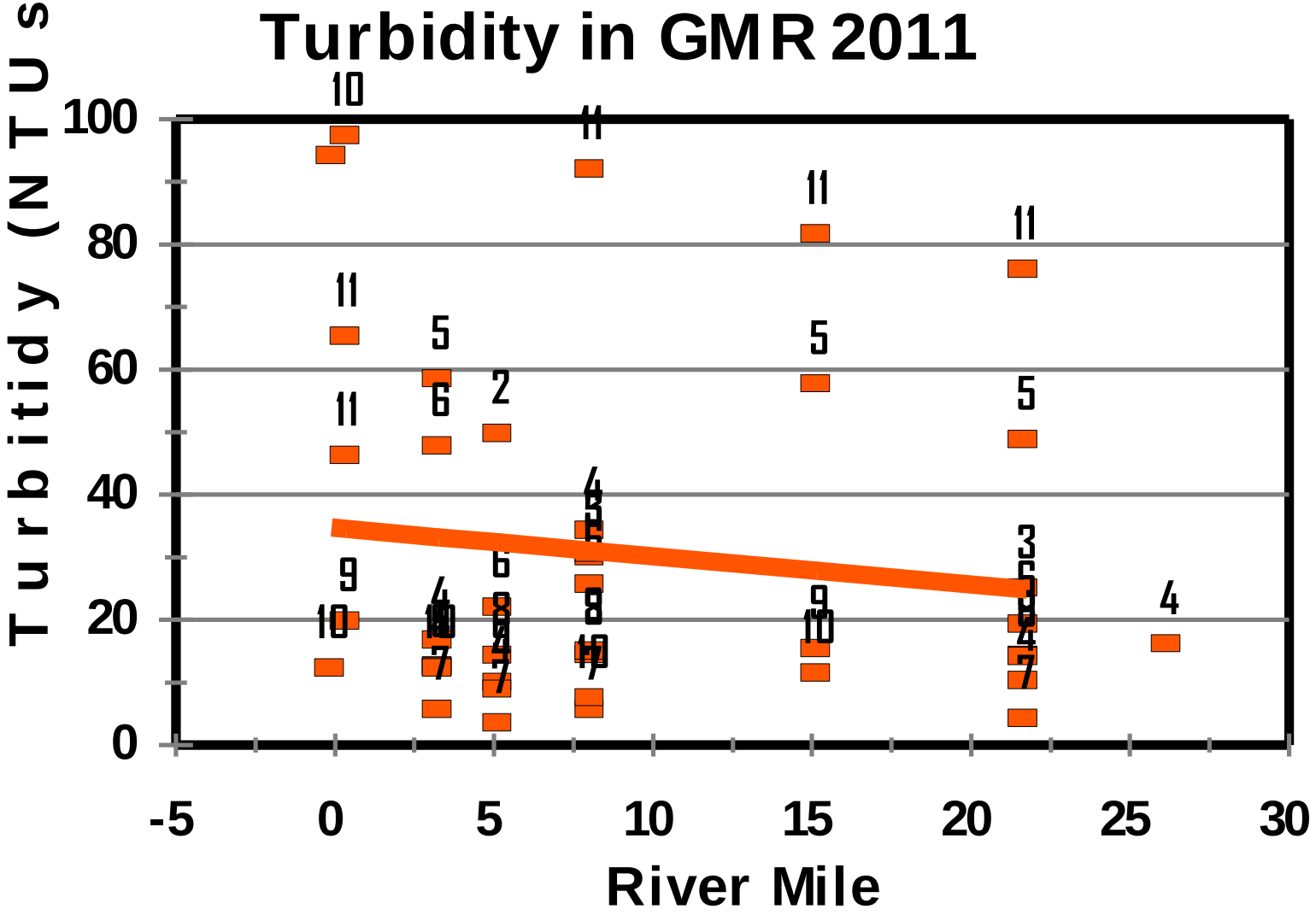
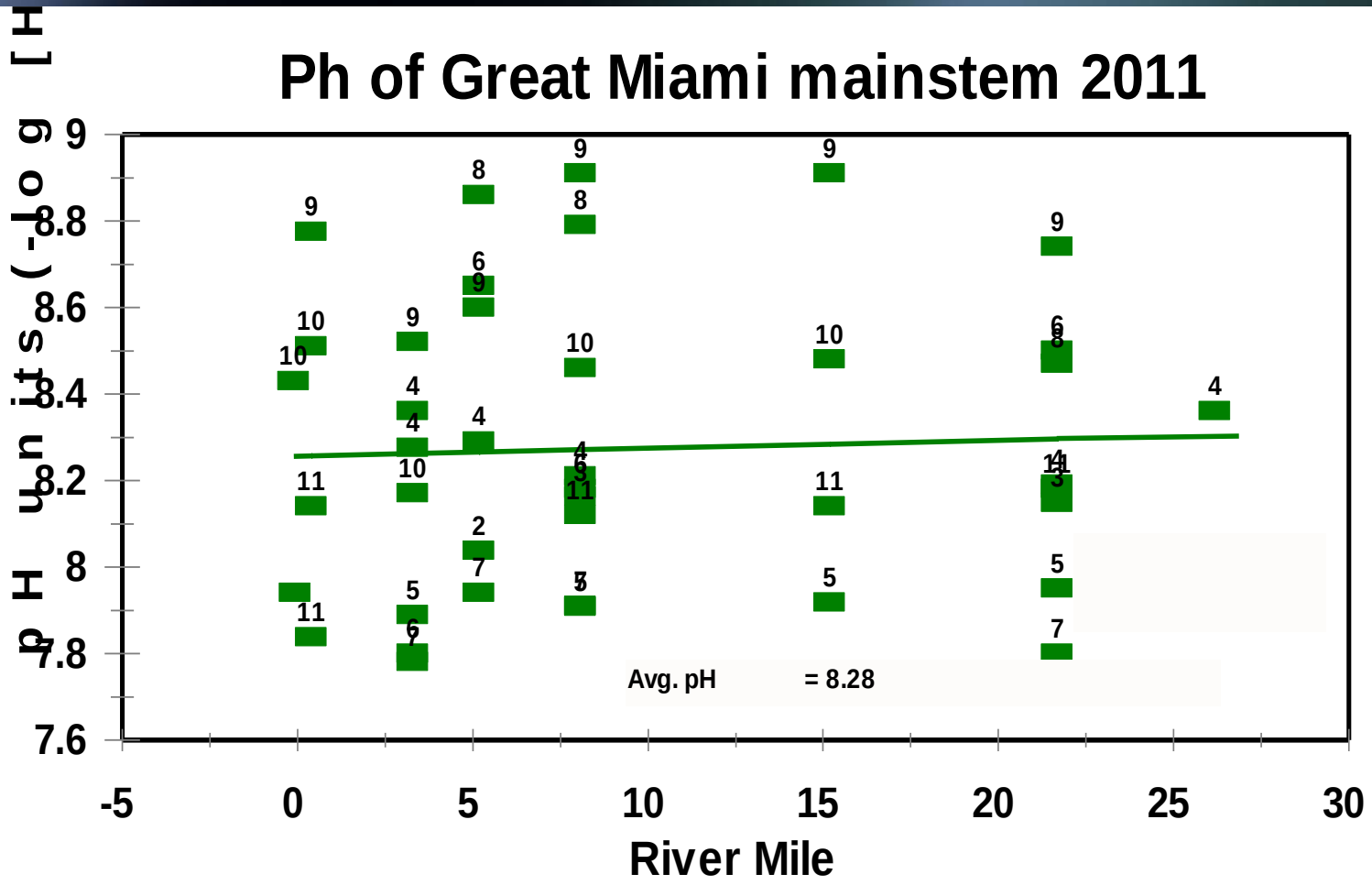
Great Miami River Watershed

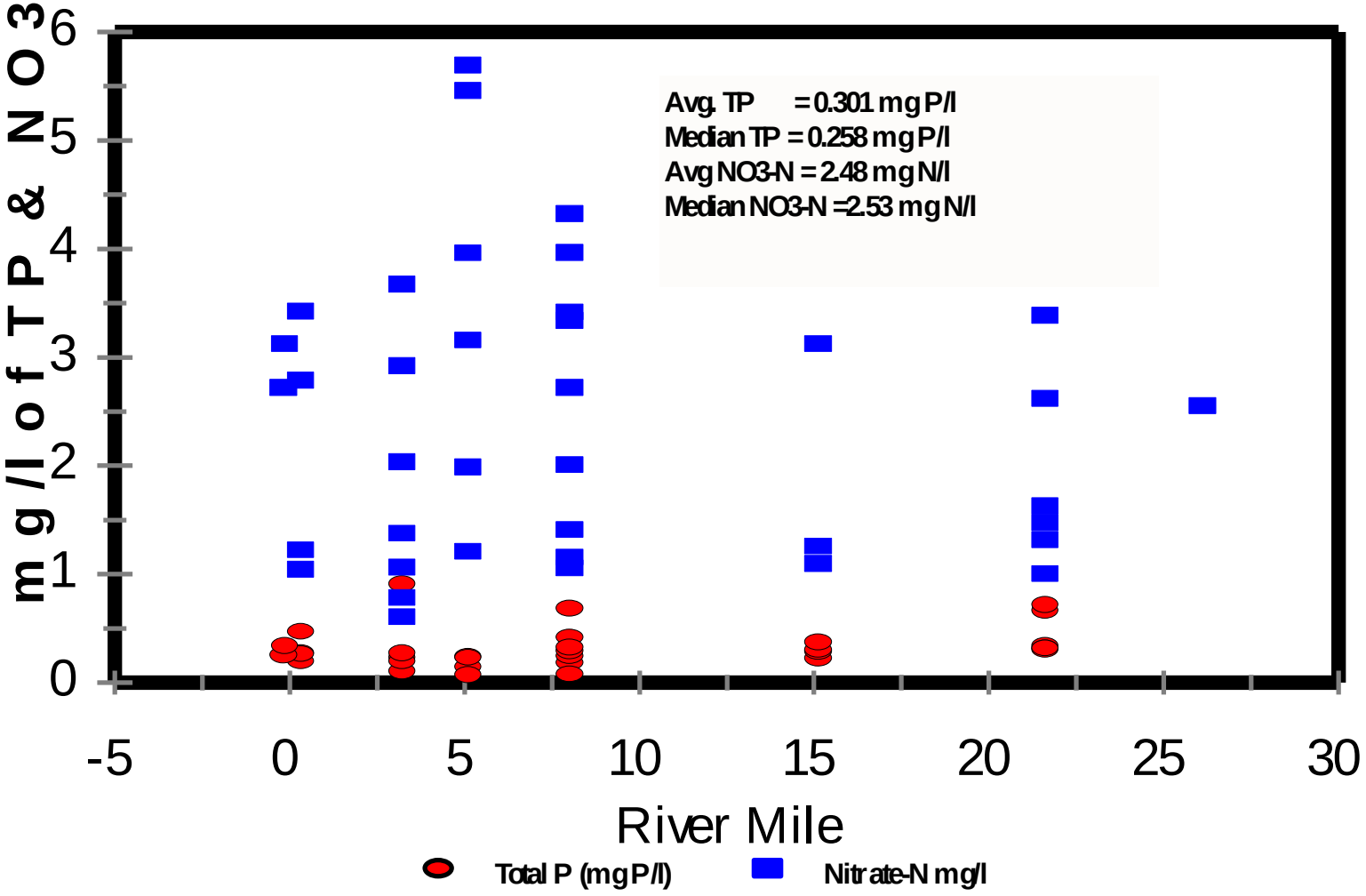


Turbidity was highest in winter from high discharge (Nov) and May (likely algal biomass)

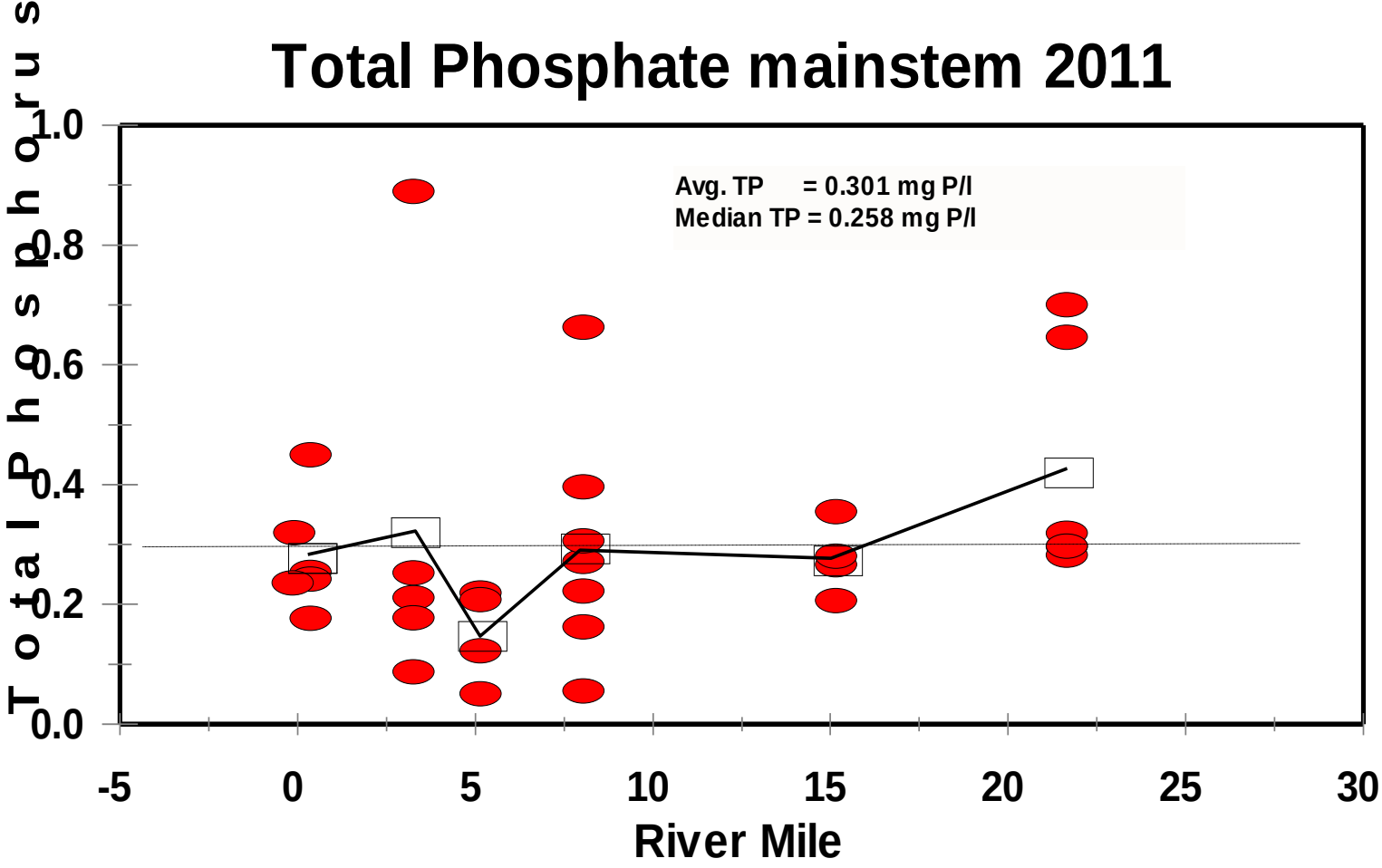


pH has been driven up by photosynthesis > than equilibrium with limestone of 8.2 by extreme photosynthesis from nutrient loading, especially in Aug. & Sept.

Great Miami, N & P mainstem 2011

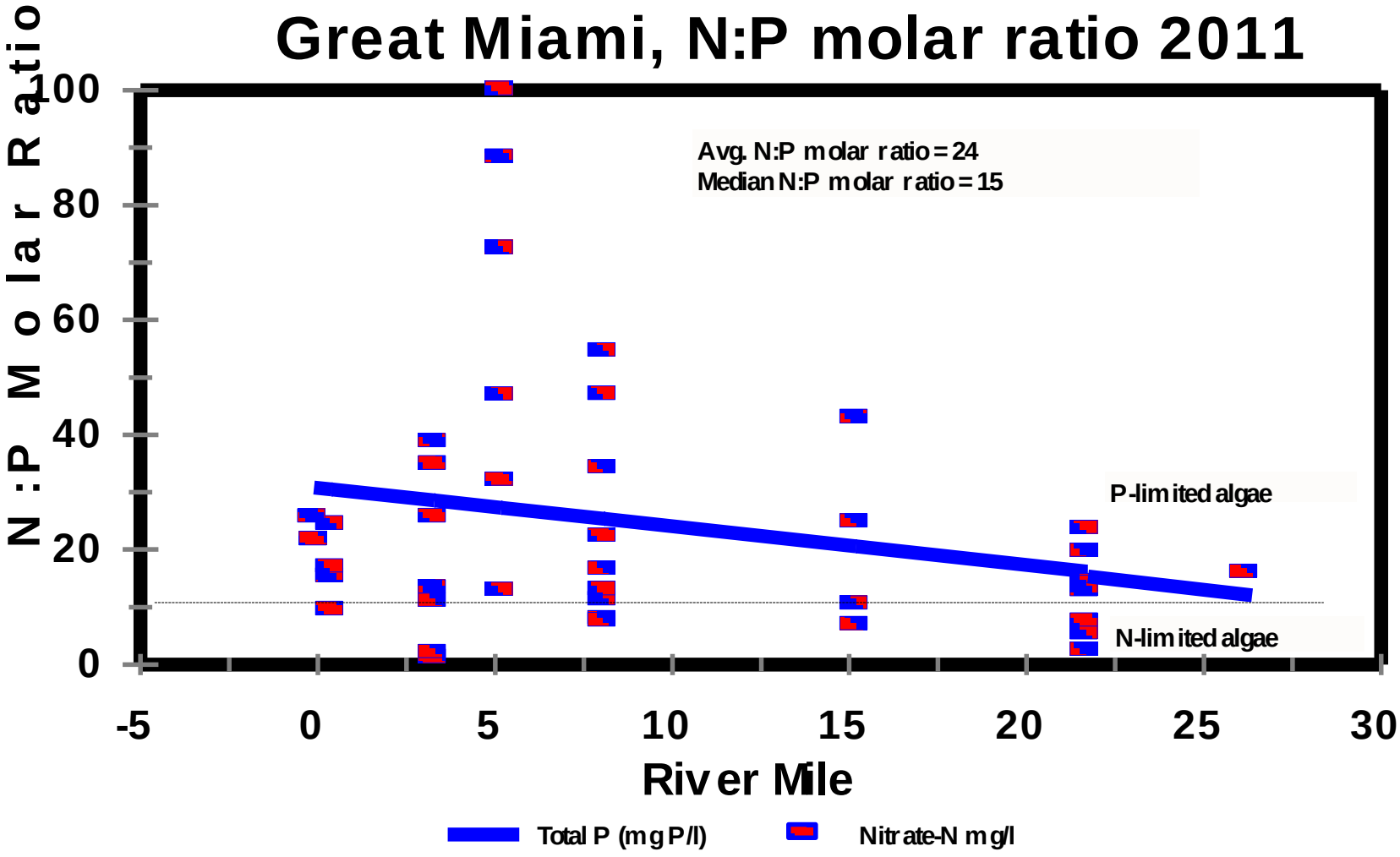


Nitrate-N and TP did not vary much up to down river, but Nitrate-N varied more seasonally.

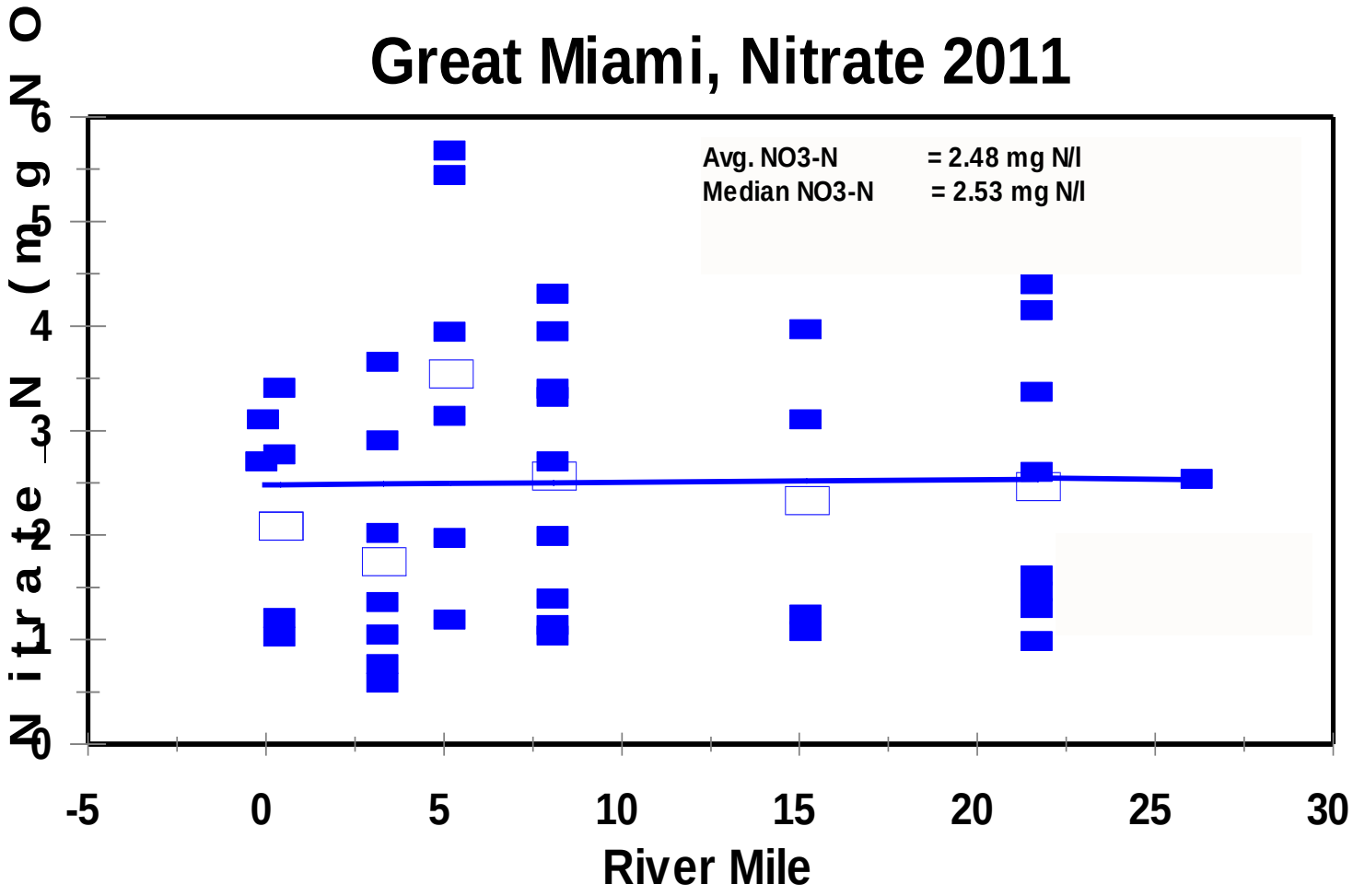


Total P in the mainstem had an average and median that just barely met the OEPA standard for urban rivers. The upstream concentration may have been elevated by WTTP effluents.

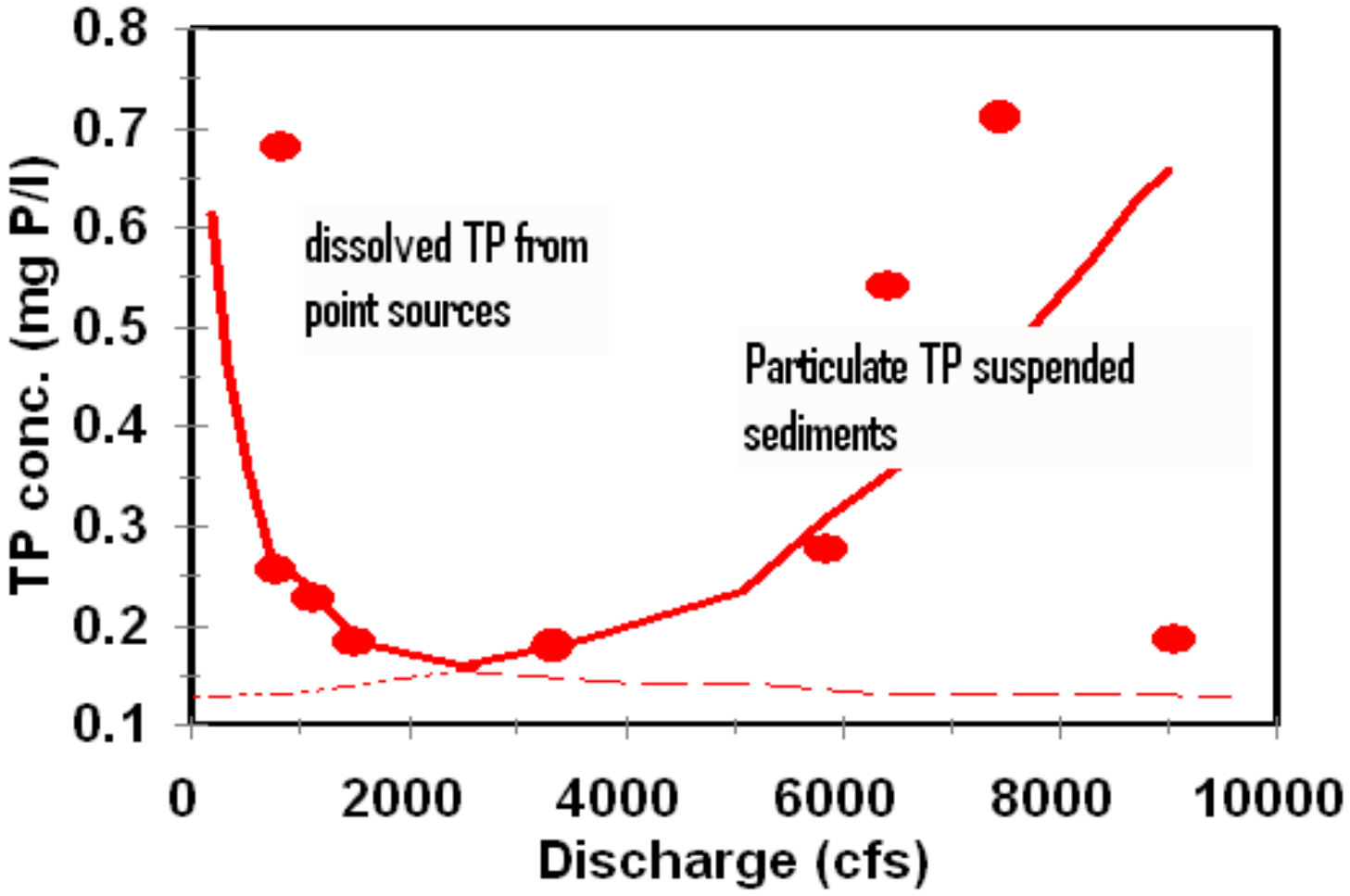
Great Miami, N:P molar ratio 2011



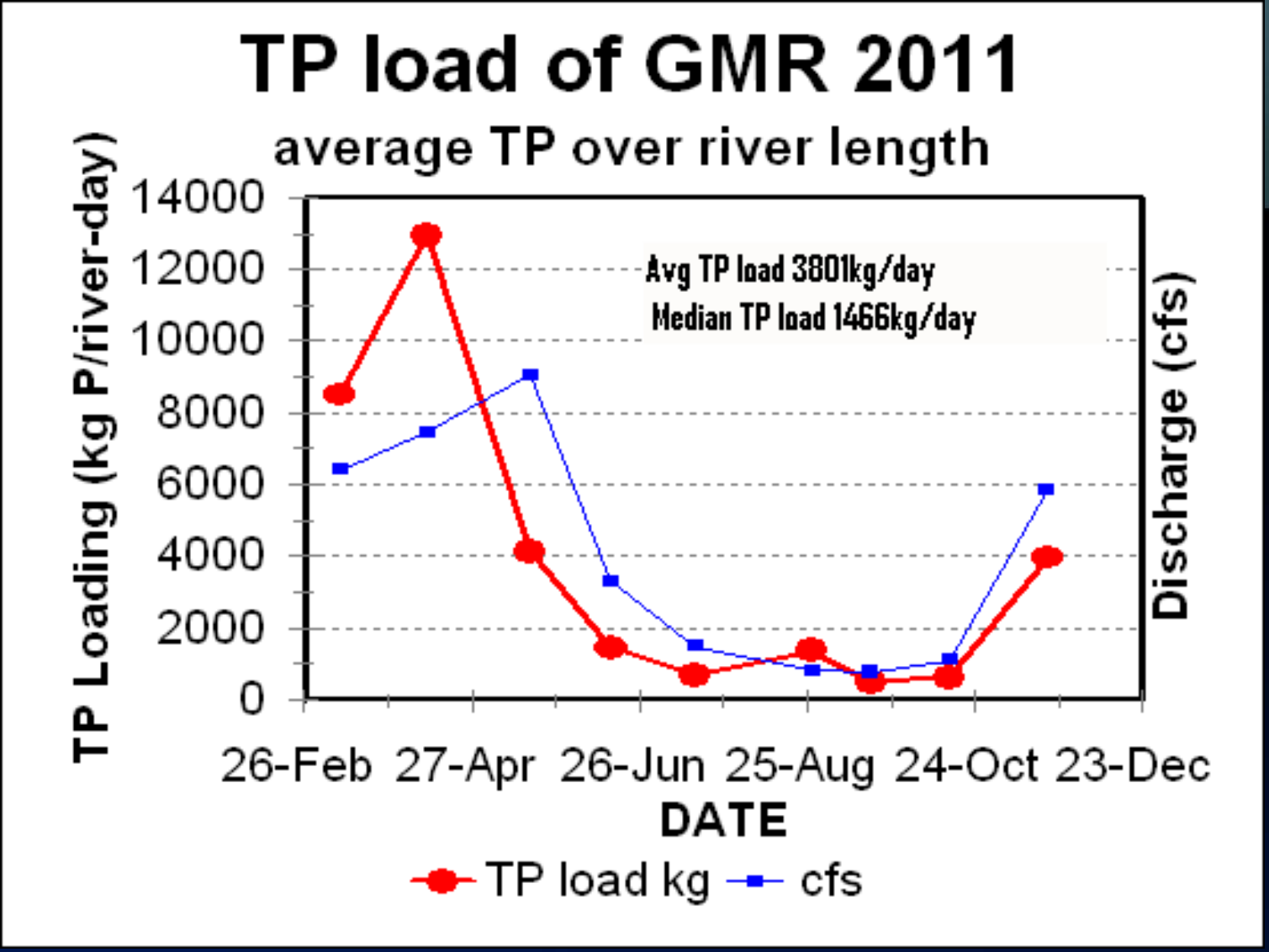
Molar N:P from 10-14 are balanced for algal growth. Normally high [N] concentrations come from up stream agricultural runoff, but in 2011 the source of excess N was from the urban runoff. WWTP effluent is normally P-rich.



Since Nitrate-N does not vary longitudinally, most of the difference in N:P ratio is caused by declining TP downstream, likely from algal assimilation in the deeper pools.



[TP] depends upon discharge, like 2010. At low flow WWTP effluent dominates; at high flow resuspension in muds dominate.



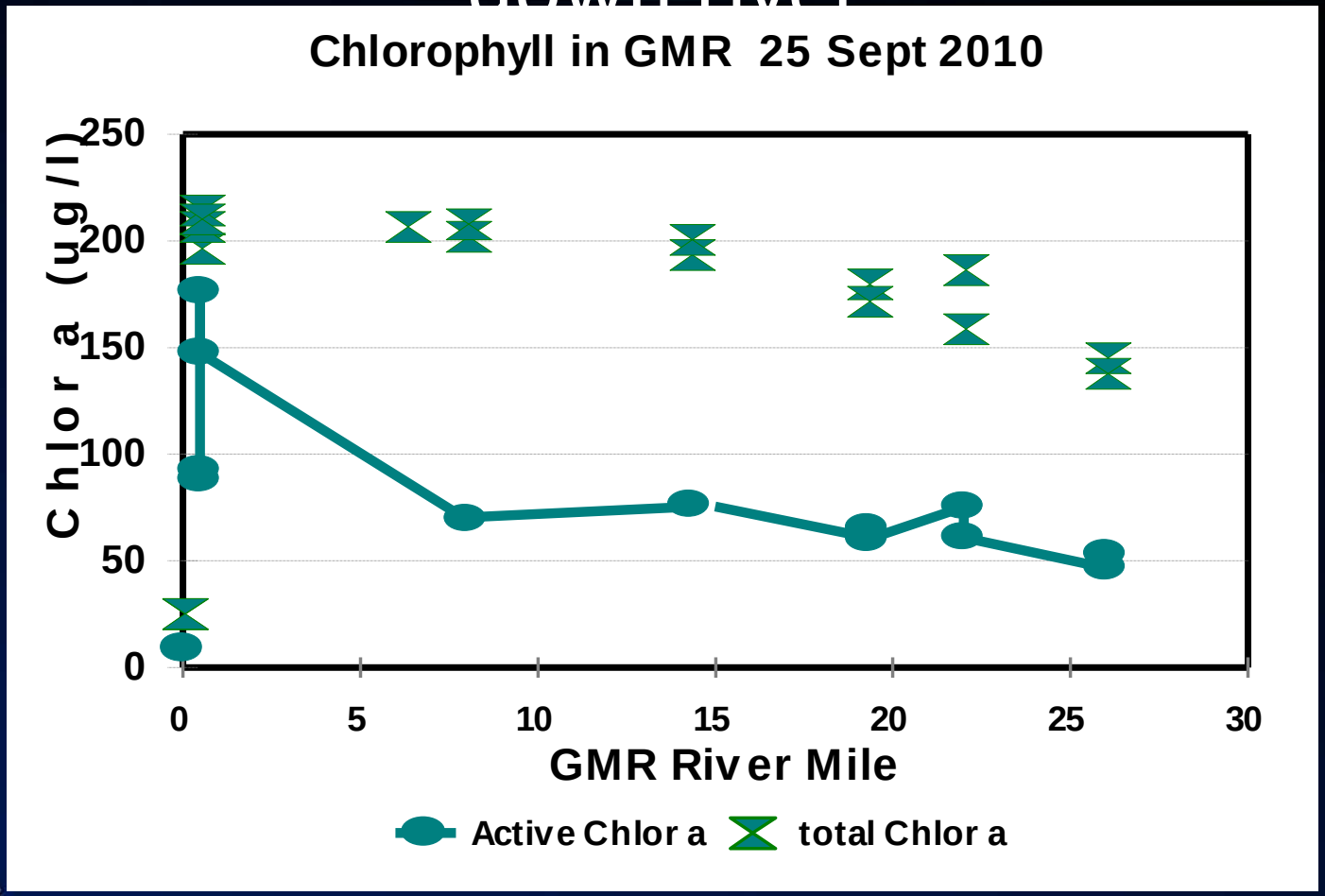
With higher discharge in 2011, TP load was nearly double that in 2010.

Avg TP load 2010 = 3052 kg/d
Median TP load 2010 = 862 kg TP/d

Summary

1. pH is elevated to extremes by severe suspended algal densities avg. pH = 8.4 (max 8.84 units).
2. Total Phosphorus Is low, median 0.258 mg P/l avg. 0.301 mg P/l, less than 0.3 mg/l targeted for urban rivers by OEPA.
3. Nitrate was low 2.5 mg N/l, lower than 4.0 mg N/l in 2010 with no pattern upstream to downstream.
4. N:P molar ratio was 24:1 (avg.) or 15 (median), > Richardson ratio of 14, with excess N. Algae likely P-limited especially towards the mouth of GMR
5. Conductivity = 702 uS > 673 uS in 2010, max 890 uS about normal for limestone bedrock.
6. E. coli bacteria2011 = geometic mean 422 > 114 in 2010, avg. 8212 > 567 in 2010, likely caused by higher discharge.

Suspended algal chlorophyll increases down river

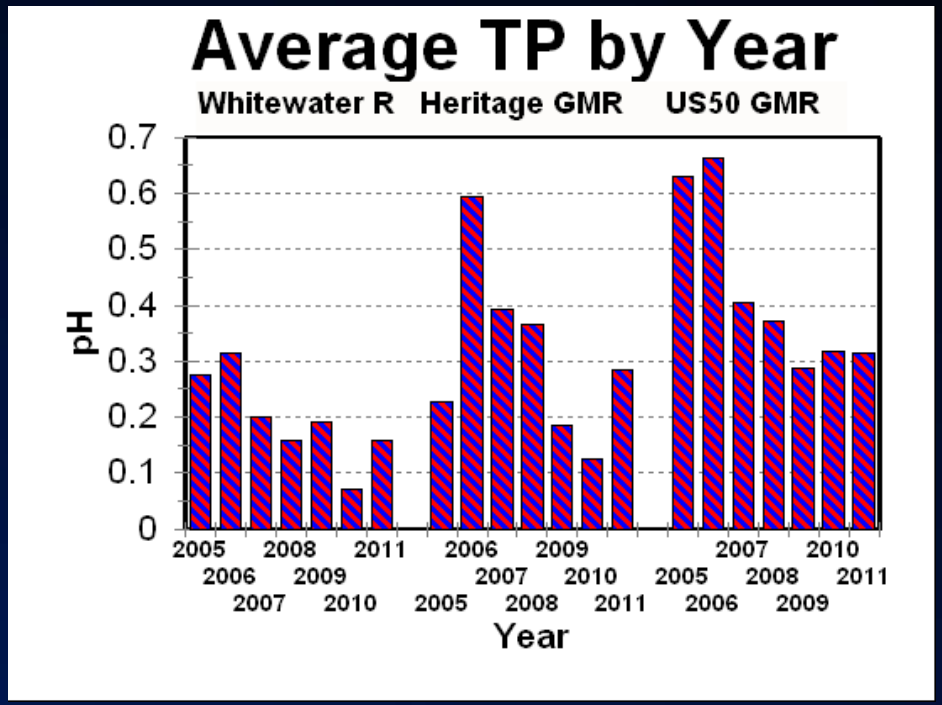


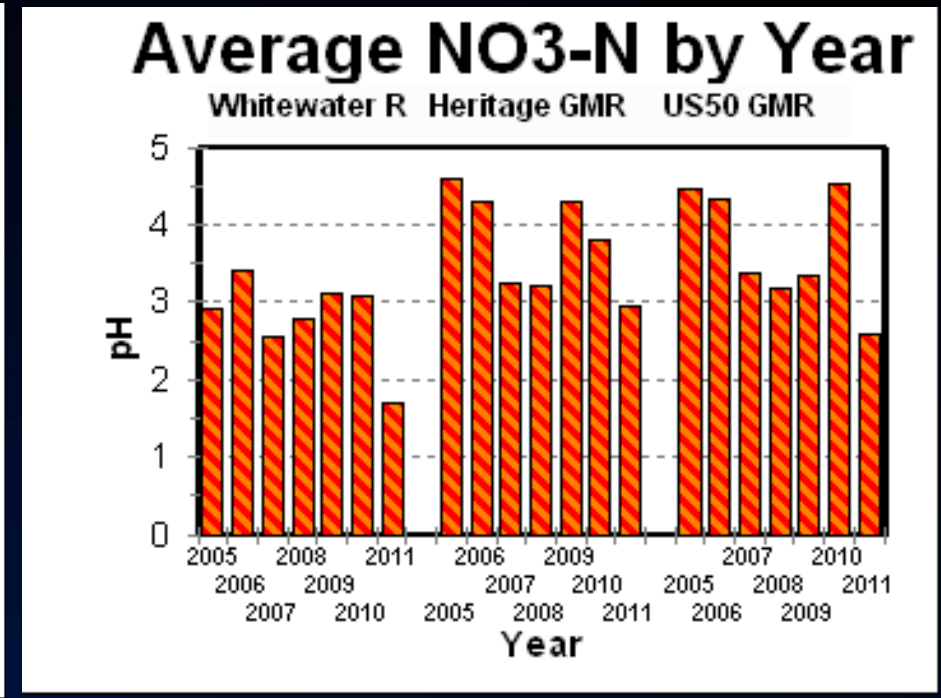
As current slows in dredged river channel, algal assimilation of high nutrients makes the GMR hypereutrophic.

Summary of Longitudinal Study

- Chlorophyll at low flow in the lower river exceeds that in most hypereutrophic lakes.
- Concentration of nutrients did not decline towards Ohio R. in 2011, likely because of higher discharge and faster water turnover.
- Lower river is a recovery zone for up river nutrient loading.

TP has declined in WWR & GMR; NO3-N declining.





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Great Miami River Watershed

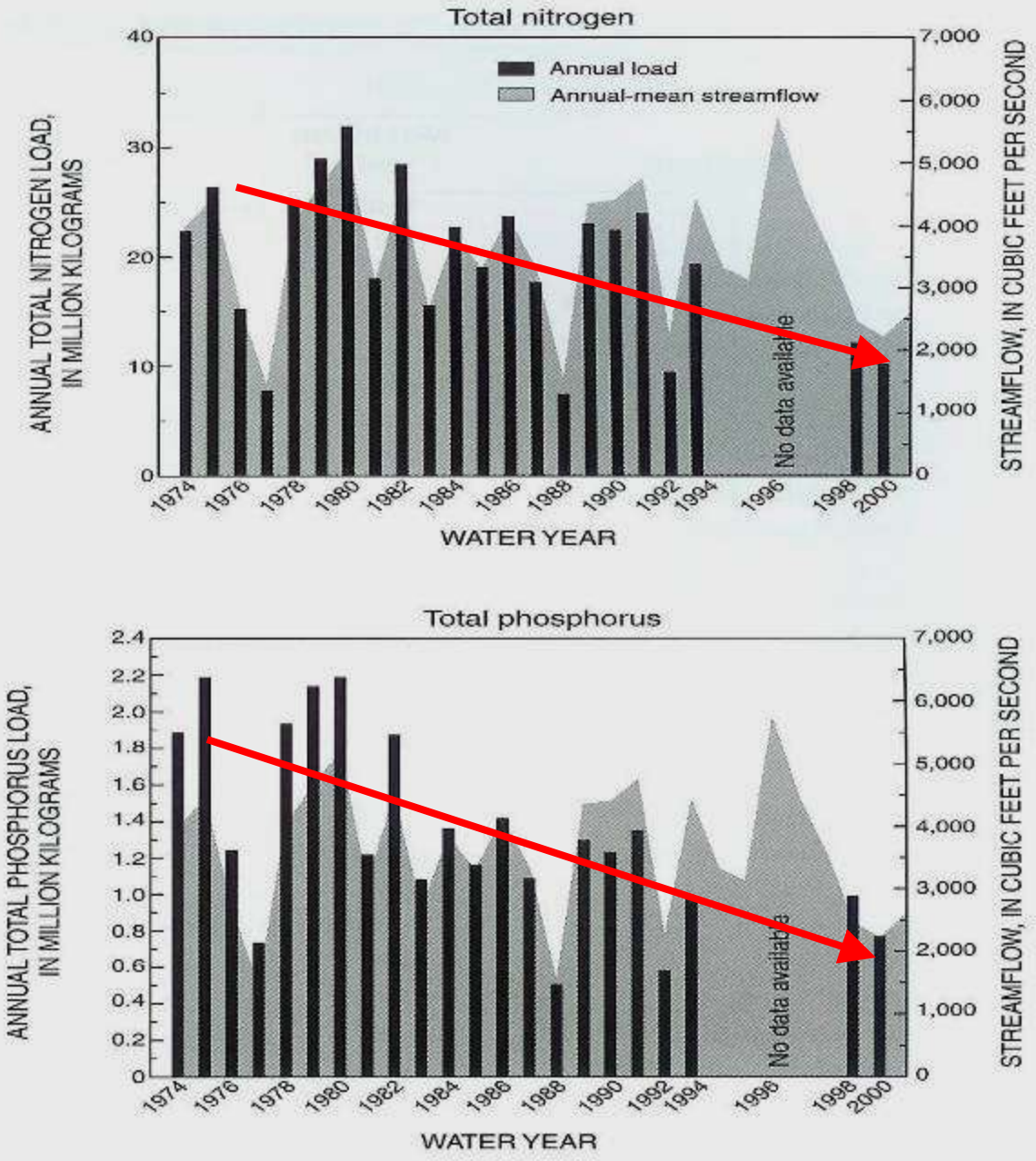
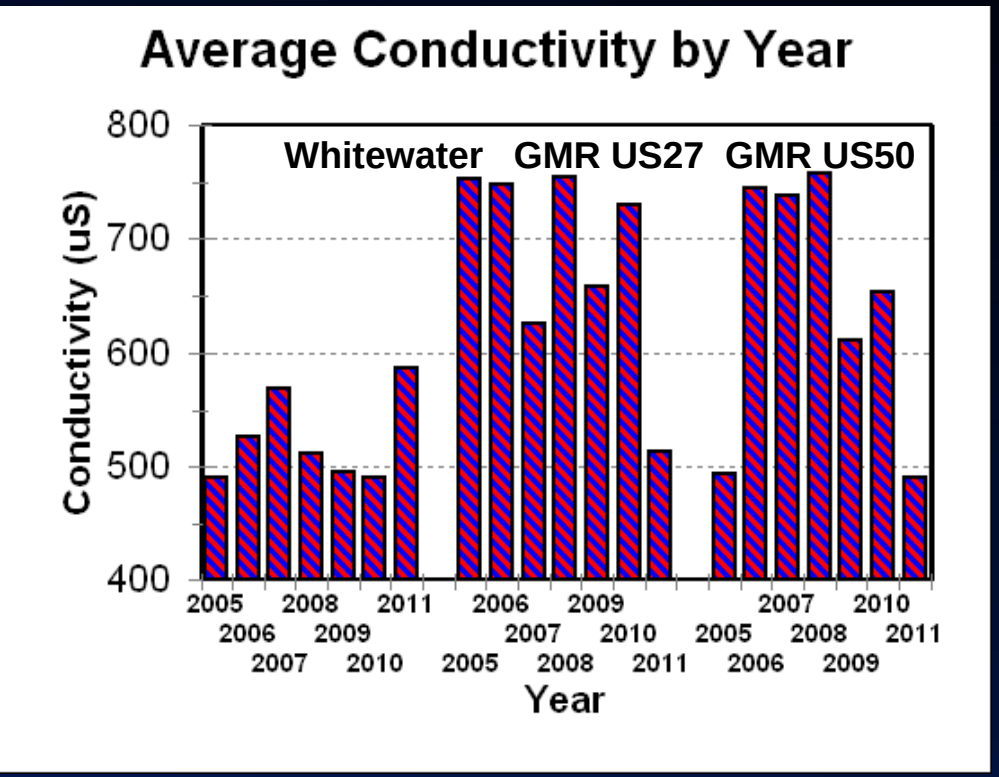
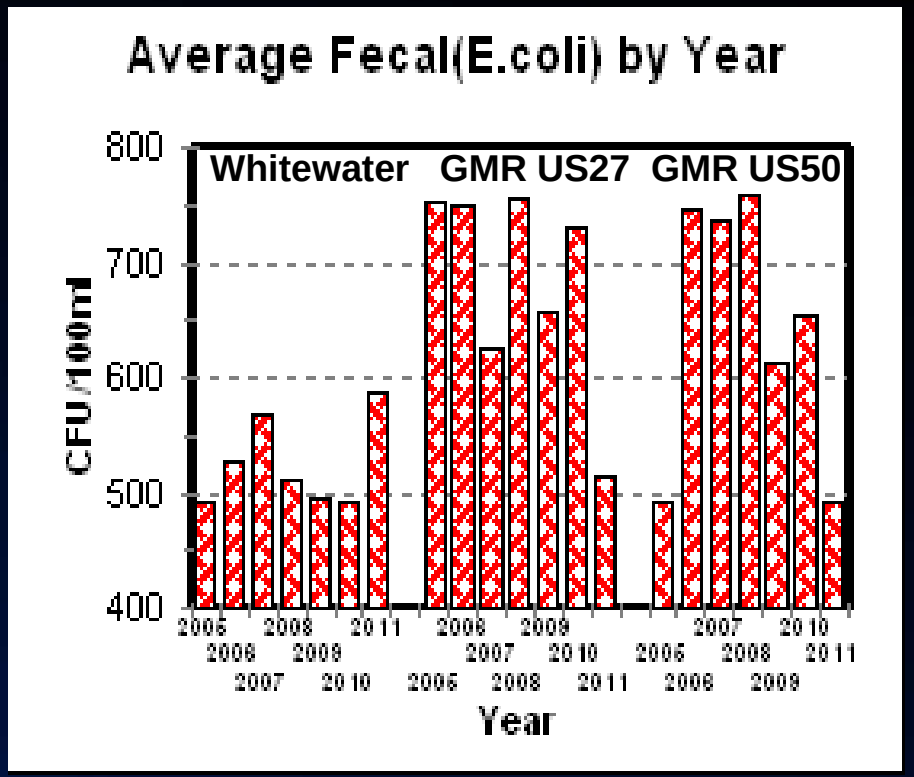


Figure 20. Annual loads of total nitrogen and total phosphorus for the Great Miami River at Hamilton, Ohio, water years 1974 through 2000.

Since most of the load is agricultural, the annual load varies with rainfall discharge and changes in farming practice and water treatment plant efficiency. The decreasing nutrient flux in recent years comes from improvement in WWTP by Clean Water Act funding.

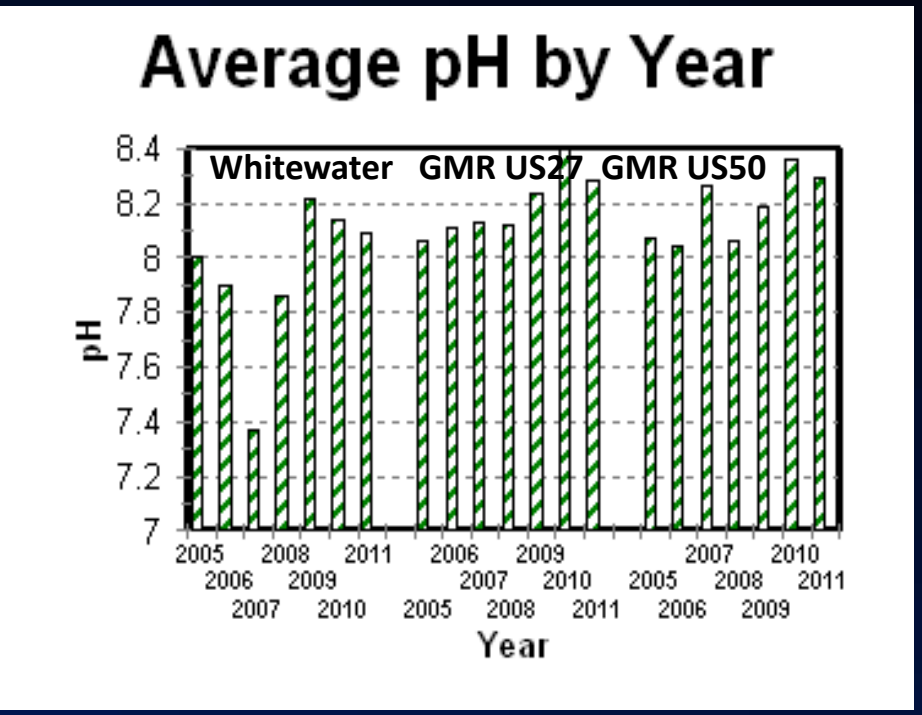
Sewage indicators show no pattern, but WWR lower effluent.

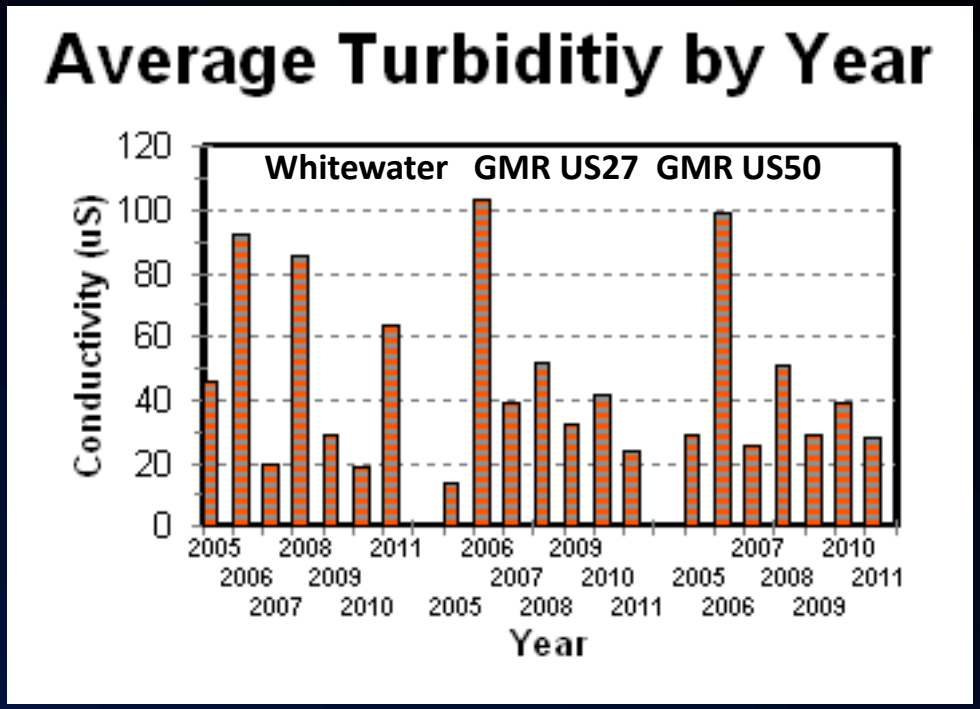




Citizens' Water Quality Monitoring
Great Miami River Watershed

pH in GMR has been increasing as primary production increases.





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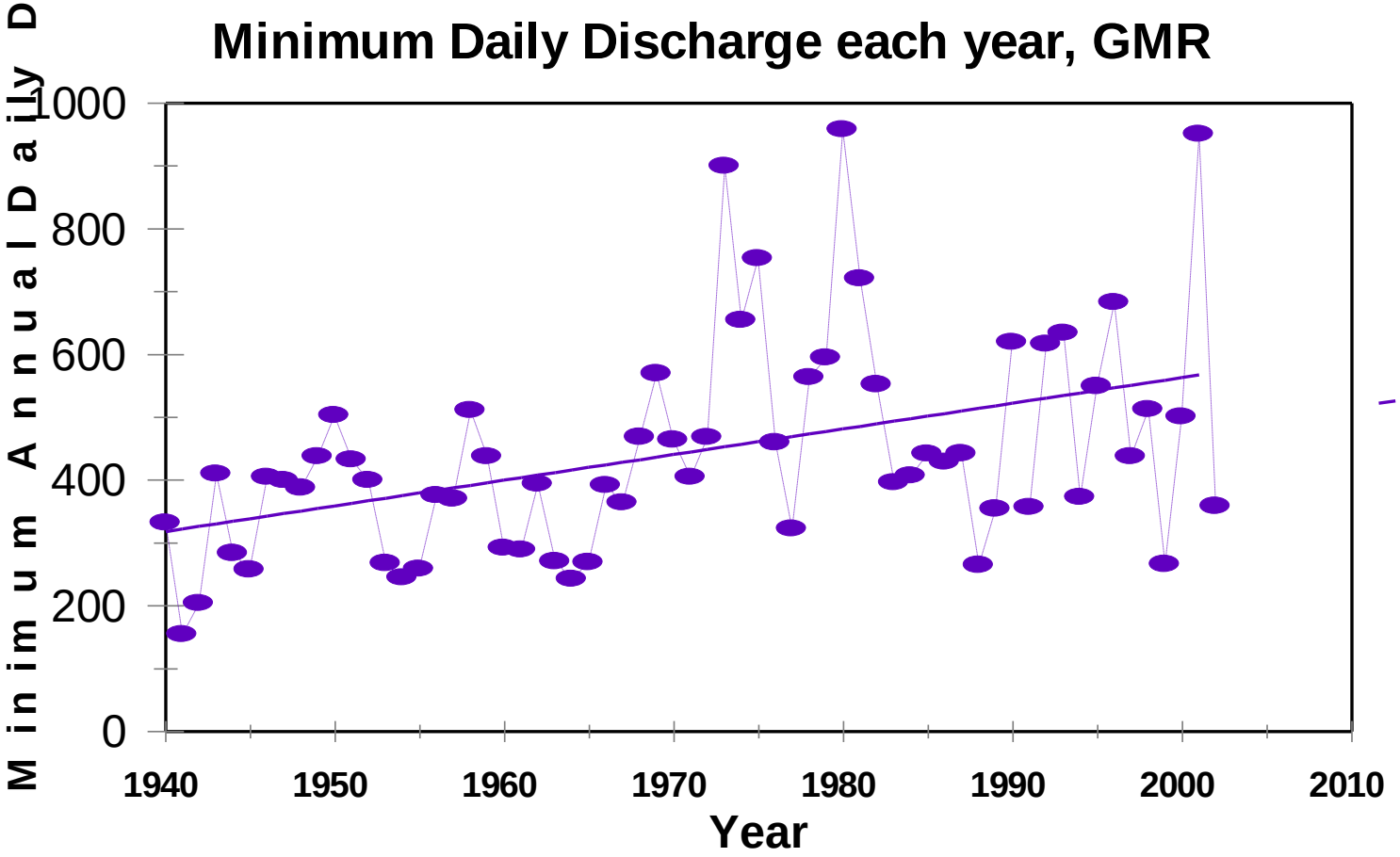
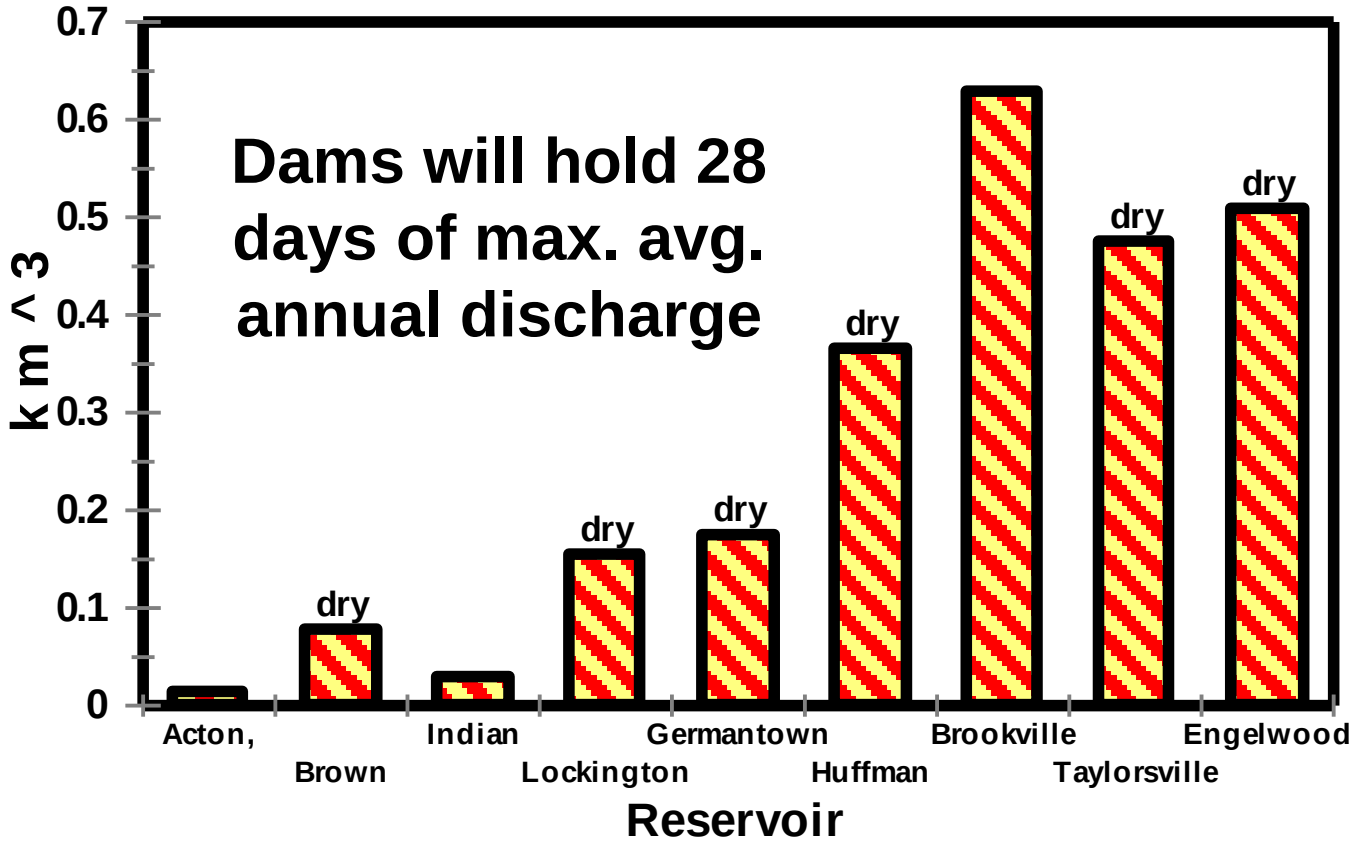
Minimum Discharge at Hamilton has been increasing as WWTP volume increases.



GMR Flood Storage Reservoirs



Floodwater storage in the GMR watershed is very high since the 1913 flood with many dams and weirs as well as 17 low head dams that slow the low water flow rate.

Summary of inter-year comparison.

- **Estimated average TP load on sample dates is average 3801 kg Tp/river-day or median 1486 kg Tp/river-day.**
- **USGS Miami found 73,000 & 37,000 kg/ TP-river-day, respectively 1998-2000. Average TP appears to be dropping in recent years below Cincinnati.**
- **pH is rising as photosynthesis has likely been increasing with dry summers in dredged river bed/ Nitrate has not changed but may be declining.**
- **Fecal coliforms & E.coli may be decreasing, but our methods have changed and are more conservative, and conductivity does appear to be dropping .**
- **Minimum discharge has increased over the past 70 years, likely as WWTP volume increased even with better treatment.**

Hazards to River.

- **Long term problem in the lower GMR is the eutrophication. Productivity is being pulled into the water column, instead of periphyton on bottom rocks.**
- **Water flows have been slowed by instream gravel mining creating pools instead of runs and riffles. The multiple mainstem dams up river ensure planktonic dominance from Dayton south.**