Monitoring and Protection Program

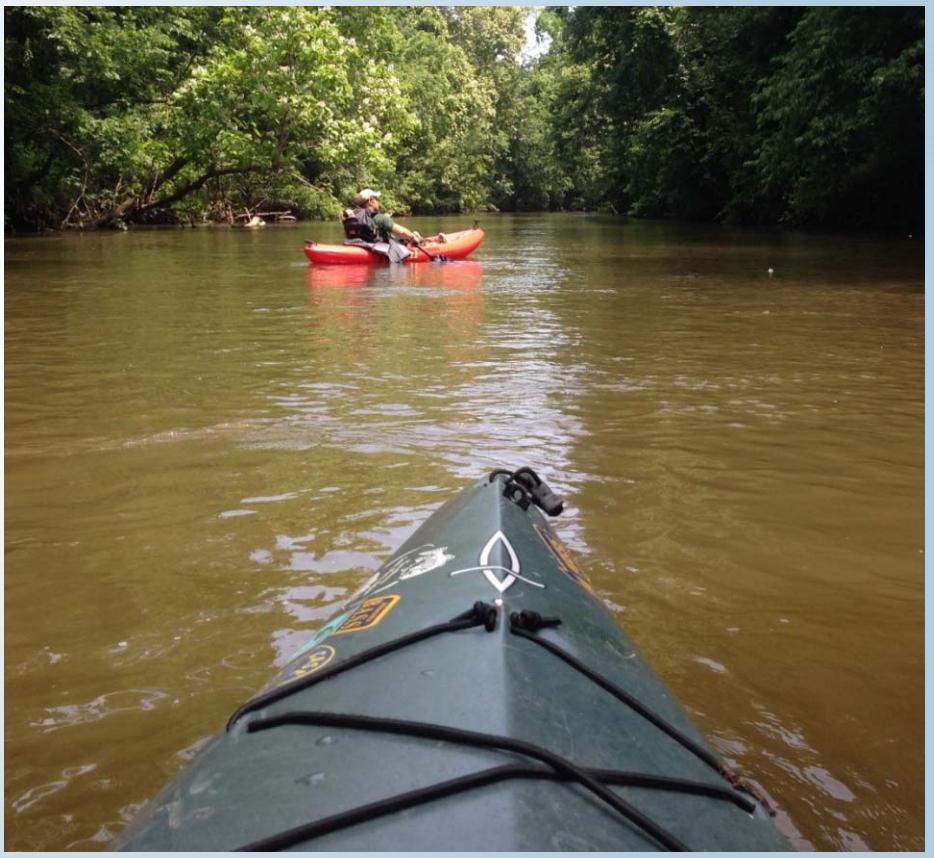
Recent Highlights and Future Directions

Water Quality Advisory Committee Meeting

Harrisburg, PA
December 10, 2014

Overview

- SRBC's Variety of Monitoring Projects
- Highlights from Last Two Years
- Future Emphasis and Direction
- Roundtable Discussion
  - Your recent experiences
  - Upcoming activities
  - Emerging methods

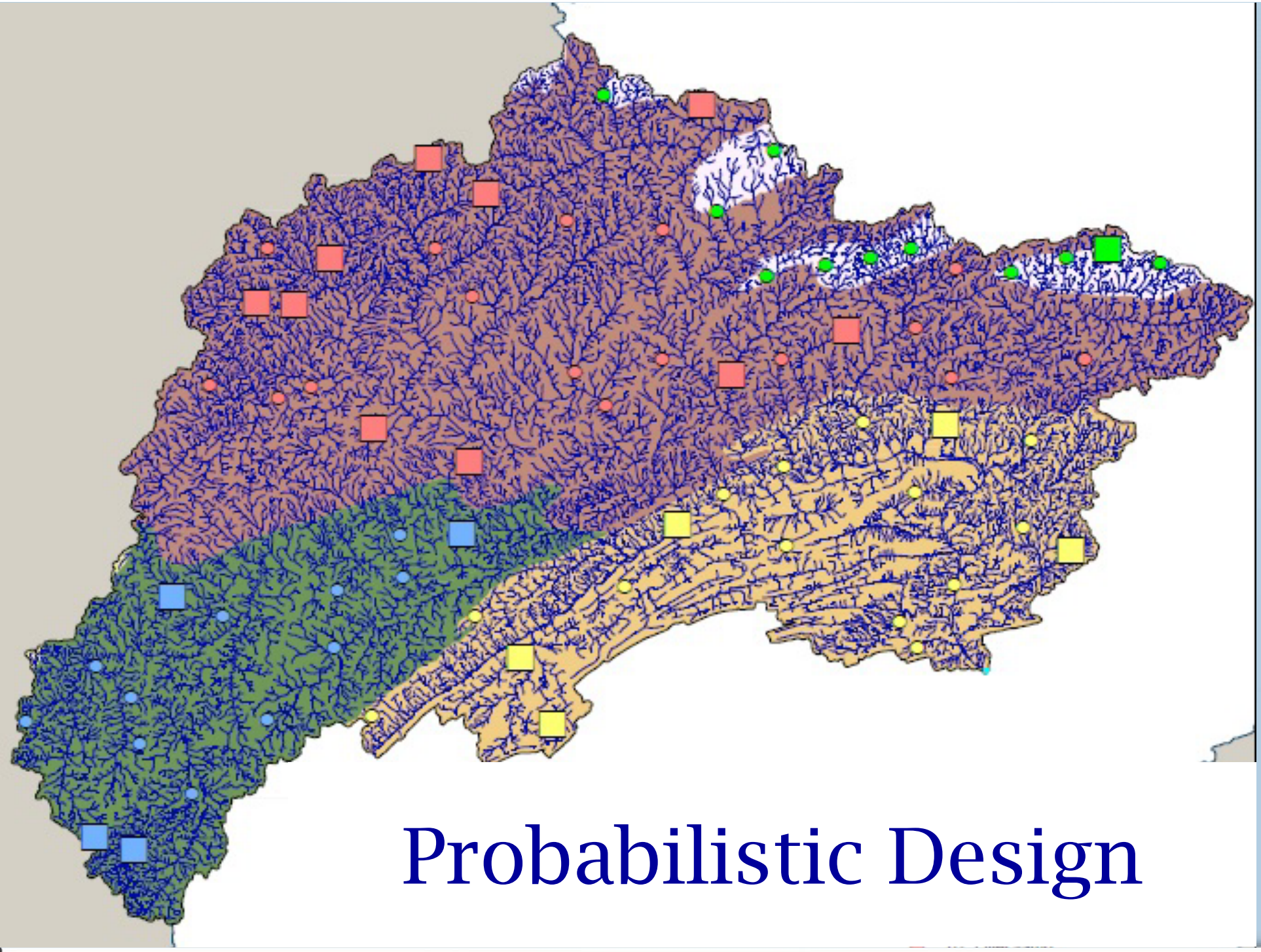


Diversity of Monitoring Projects

- Monitoring for Bay and other EPA-supported Programs throughout the Basin
- On-going support for Total Maximum Daily Load (TMDL) efforts in Lower SusQ
- Assistance to National River and Stream Assessment (NRSA) Program in SusQ and Ohio Basins
- Monitoring for Gas-Drilling impacts in PA State Forests and 58 real-time stations in PA-NY for Remote Water Quality Monitoring
- EPA Regional Monitoring – long term macroinvertebrate data
- Acid Mine Drainage sampling and Recovery monitoring
- Flow Monitoring Network research
- Aquatic Resource Surveys
- Aquatic Invasive Species Research: *Didymo geminata* mapping and Habitat Suitability
- Urban Stormwater BMP design – Cedar Run/Paxton Creek
- Source Water Protection/Early Warning System

Recent Highlights

- Blended Probabilistic Sampling Design with long-term fixed monitoring sites for more statistically robust data and cost savings (eventually): Upper & Middle SusQ Subbasins
- Adopted Standard Baseline Monitoring Parameters for all station visits – instantaneous discharge, dominant ion chemistry, suspended sediment, direct-read: pH, temp, DO, SpC, NTU
- Expanded Fish Sampling – fill data gaps in the Basin; support NRSA; stakeholder participant on SMB issues using CADDIS – share DELT, CPUE, community assemblage, and water quality data sets
- Compared Macroinvertebrate Sampling and IBI Protocols: performed side-by-side surveys with NYSDEC and evaluated PADEP IBI and Chessie IBI



Probabilistic Design

Einzeldarstellungen aus der Limnologie
und ihren Nachbargebieten

Unter Mitwirkung von Prof. Dr. Einar Naumann (Lund)
und anderen Fachgenossen herausgegeben von

Dr. August Thienemann
ordentlichem Professor der Hydrobiologie an der Universität Kiel und
Direktor der Hydrobiologischen Anstalt der Kaiser-Wilhelm-Gesellschaft
zu Plön

Band XII.

Stuttgart 1932
E. Schweizerbart'sche Verlagsbuchhandlung
(Erwin Nägele) G. m. b. H.

Hydrochemische Methoden in der Limnologie

mit besonderer Berücksichtigung der Verfahren
von L. W. Winkler

Von

Dr. Rezső Maucha
Oberadjunkt der Königl. Ungarischen Versuchsstation für Fischereibiologie
und Abwasserbereitigung und Privatdozent an der Königl. Ungarischen
Peter-Pázmány-Universität zu Budapest

Mit 36 Abbildungen im Text und auf 4 Tafeln,
sowie 19 Tabellen

Stuttgart 1932
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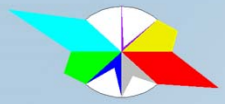
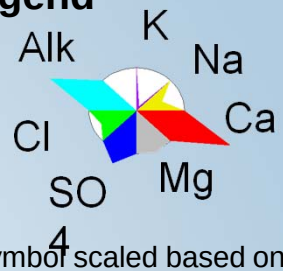
Dominant Ion Symbols



Hammond Ck

Hick's Run

Maucha Symbol Legend



Symbol scaled based on ∑ [ions]

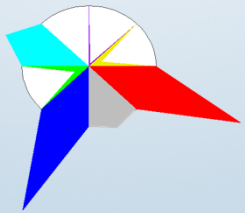
Kettle Ck

Kitchen Ck

Hunt's Run

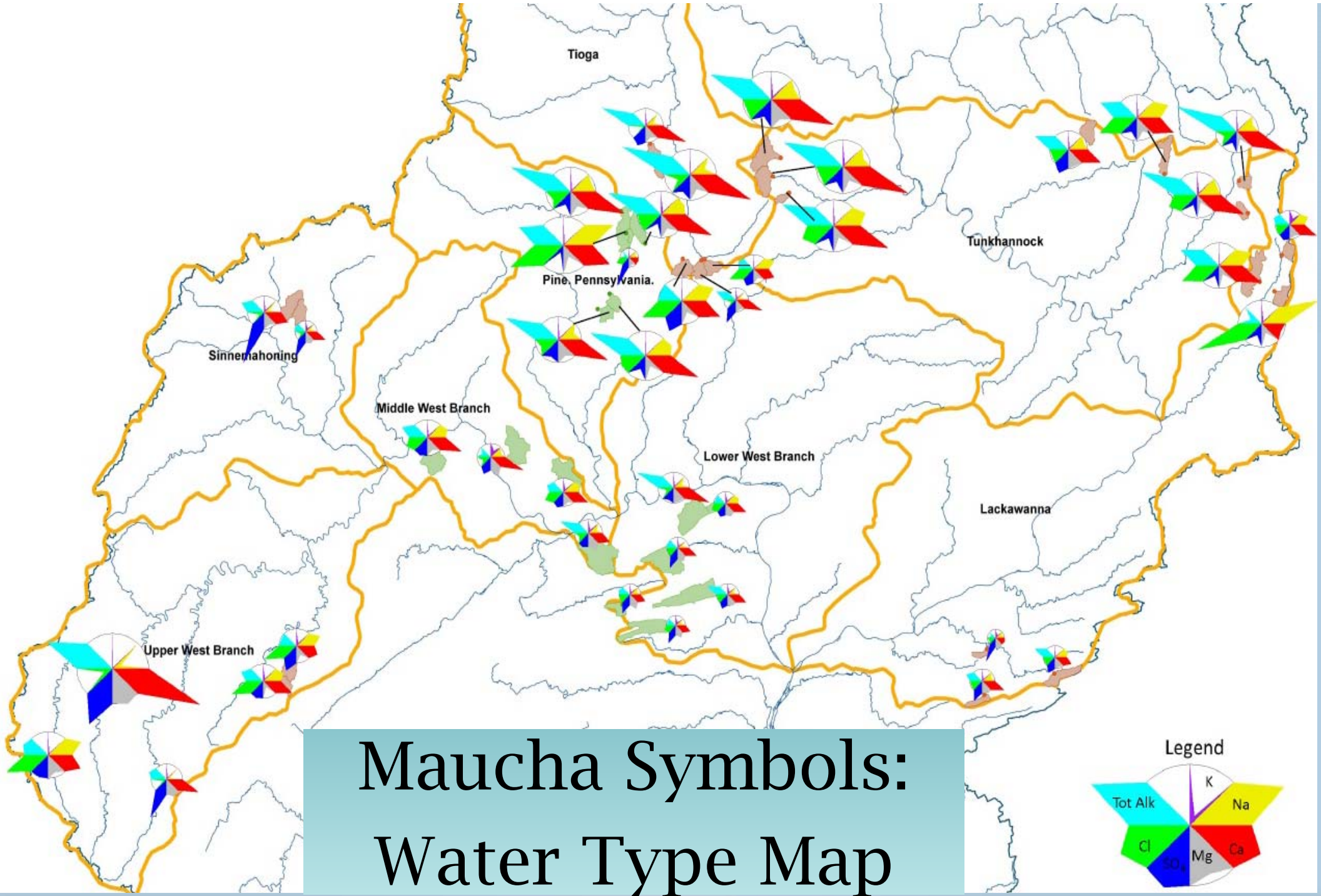
Lackawanna R

Larry's Ck



Little Clearfield Ck

Little Mehoopany Ck



Maucha Symbols: Water Type Map

Fish Deformities and Lesions

Comparing Macroinvertebrate Sampling Approaches

Susquehanna River Basin Commission

www.srbc.net

Site	NYSDEC traveling kick net		SRBC d-frame net
	100-count species	100-count genus	100-count genus
APAL 4.4	8.0	7.4	6.3
CATK 1.4	7.5	6.3	6.8
CHEN 0.9	7.3	7.0	7.6
EBTF 1.6	7.9	7.2	7.4
GENE 10.9	9.1	8.4	8.4
NANT 9.6	7.4	7.0	7.7
SHEN 1.7	8.0	7.8	6.2
SUSQ 442	7.3	6.6	5.9
TIOF 28.7	6.9	5.9	7.1
UNAD 5.4	7.4	6.8	5.0

SRBC-Funded Milestones

- Completed 5th year of Flow Monitoring research project
- Surpassed 3 consecutive years of continuous in-stream monitoring at majority of 58 RWQMN stations
- Aquatic Resource Survey (ARS) Research
- Didymo in Pine Creek Watershed has not expanded
- Initiated Urban Stormwater BMP Demonstration Project

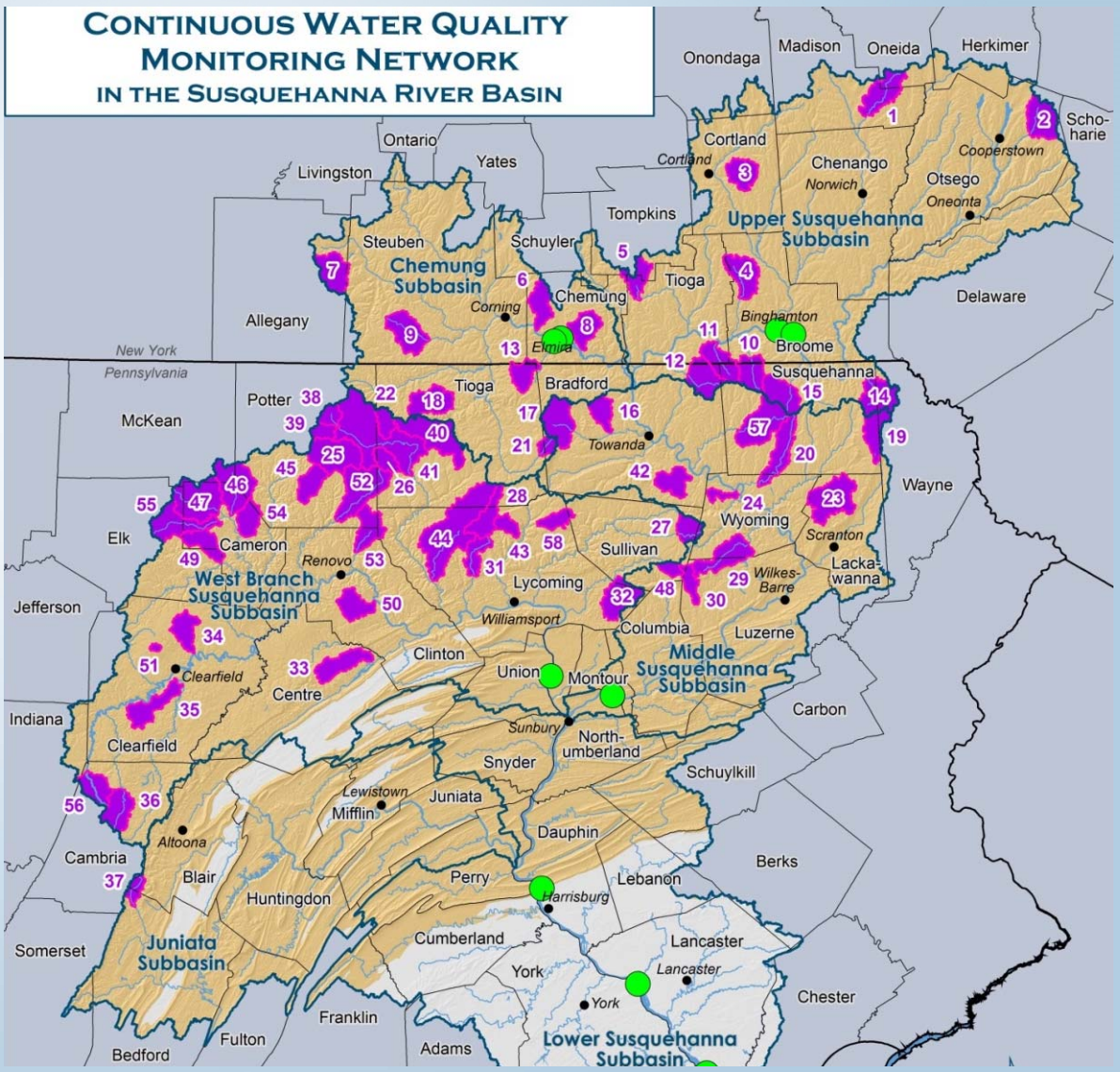
Flow Monitoring Research

Susquehanna River Basin Commission

www.srbc.net

RWQMN/CIM Network Status

- 58 stations operate in real-time throughout Marcellus Shale Region
- Study Intent:
  - Develop baseline data
  - Focus on water supply/ water quality concerns at mid-scale settings
  - Inform future monitoring
- Measure Flow, Water Quality Indicators, Aqueous Chemistry, and Biology
- Develop Drainage Area profiles, Assess Habitat



Website Interface - www.srbc.net

Protecting Your Watershed for Today and Tomorrow

REMOTE WATER QUALITY MONITORING NETWORK

Monitoring Parameters

Information Sheet

FAQs

Overview

The Susquehanna River Basin Commission (SRBC) initiated the establishment of the Remote Water Quality Monitoring Network (RWQMN) in January, 2010. This monitoring network continuously measures and reports water quality conditions of smaller rivers and streams located in northern tier Pennsylvania and southern tier New York. The data helps agency officials track existing water quality conditions and any changes in them on an ongoing, real-time basis.

The stations are operating in areas where drilling for natural gas is most active, as well as other locations where no drilling activities are planned so SRBC can collect control-data. A contribution from East Resources provided the initial funding for the project. In 2010, the New York State Energy Research and Development Authority provided funding for the expansion of the network into the New York portion of the basin. SRBC is covering the ongoing maintenance costs.

The monitoring network provides constant data collection with instruments sensitive enough to detect subtle changes in water quality on a frequency that will allow background conditions and any changes to them to be documented throughout the year. The following five water quality parameters are being measured at each station:

Contact Us

Platform I

Data platform (above); data sonde and protective casing (below)

Aquatic Resource Survey Research

Shank MK, Stauffer JR. 2014. Land use and surface water withdrawal effects on fish and macroinvertebrate assemblages in the Susquehanna River basin, USA. Journal of Freshwater Ecology.

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Journal of Freshwater Ecology, 2014
http://dx.doi.org/10.1080/02705060.2014.959082

Taylor & Francis
Taylor & Francis Group

Land use and surface water withdrawal effects on fish and macroinvertebrate assemblages in the Susquehanna River basin, USA

Matthew K. Shank[a]* and Jay R. Stauffer, Jr.[b]

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(*Received 24 January 2014; accepted 7 August 2014*)

Water withdrawals in the Susquehanna River basin, USA, are increasing due to burgeoning shale gas extraction activities. In order to determine if flow alteration resulting from shale gas industry surface water withdrawals impacts fish and macroinvertebrate assemblages in lotic habitats, data were collected upstream and downstream of 12 withdrawal and three reference sites in headwater, cold water, and large warm water streams. Watershed size ranged from 4 to 517 km^2 and average daily withdrawals ranged from 0.05 to 1.4 million liters. Analysis of withdrawal data indicated that approved withdrawals far exceeded actual withdrawals across all stream types. The largest withdrawals relative to stream size were from headwater streams, where on average 6.8% of average daily flow was withdrawn daily. Fish and macroinvertebrate assemblage similarity at study sites depended largely on stream sampled, rather than position upstream or downstream of withdrawals. Regression techniques were employed to determine if catchment-level variables or withdrawal metrics best described variation in fish and macroinvertebrate metrics shown to be sensitive to flow alteration. The catchment-level variables were responsible for the majority of observed variation in fish metrics. Macroinvertebrate models performed poorly, indicating that the stream sampled or variables not included in the analyses were responsible for the majority of variation. Overall, evidence suggests impacts of shale gas withdrawals within the Susquehanna basin are limited at the present state of flow alteration. Potential reasons include protective measures such as pass-by flow restrictions, which require withdrawals to cease when flows drop below a predetermined low flow threshold, maximum instantaneous and daily withdrawal limits, and recent initiation of withdrawals (1–3 years of operation).

Keywords: fish assemblages; macroinvertebrate assemblages; water withdrawals; shale gas extraction; flow alteration; lotic habitats

Introduction

The extensive influence of the natural flow regime on ecological processes in lotic habitats has been well documented (Poff et al. 1997). Stream flow creates and maintains physical habitat, which in turn influences biological communities in stream ecosystems that have adapted to natural flow regimes (Bunn & Arthington 2002; Power et al. 2008). Unaltered flow regimes are becoming less common as anthropogenic water use continues to increase (Jackson et al. 2001; Baron et al. 2002). Consequently, conflicts between human use and ecosystems arise as flow alteration resulting from impoundments, diversions, and

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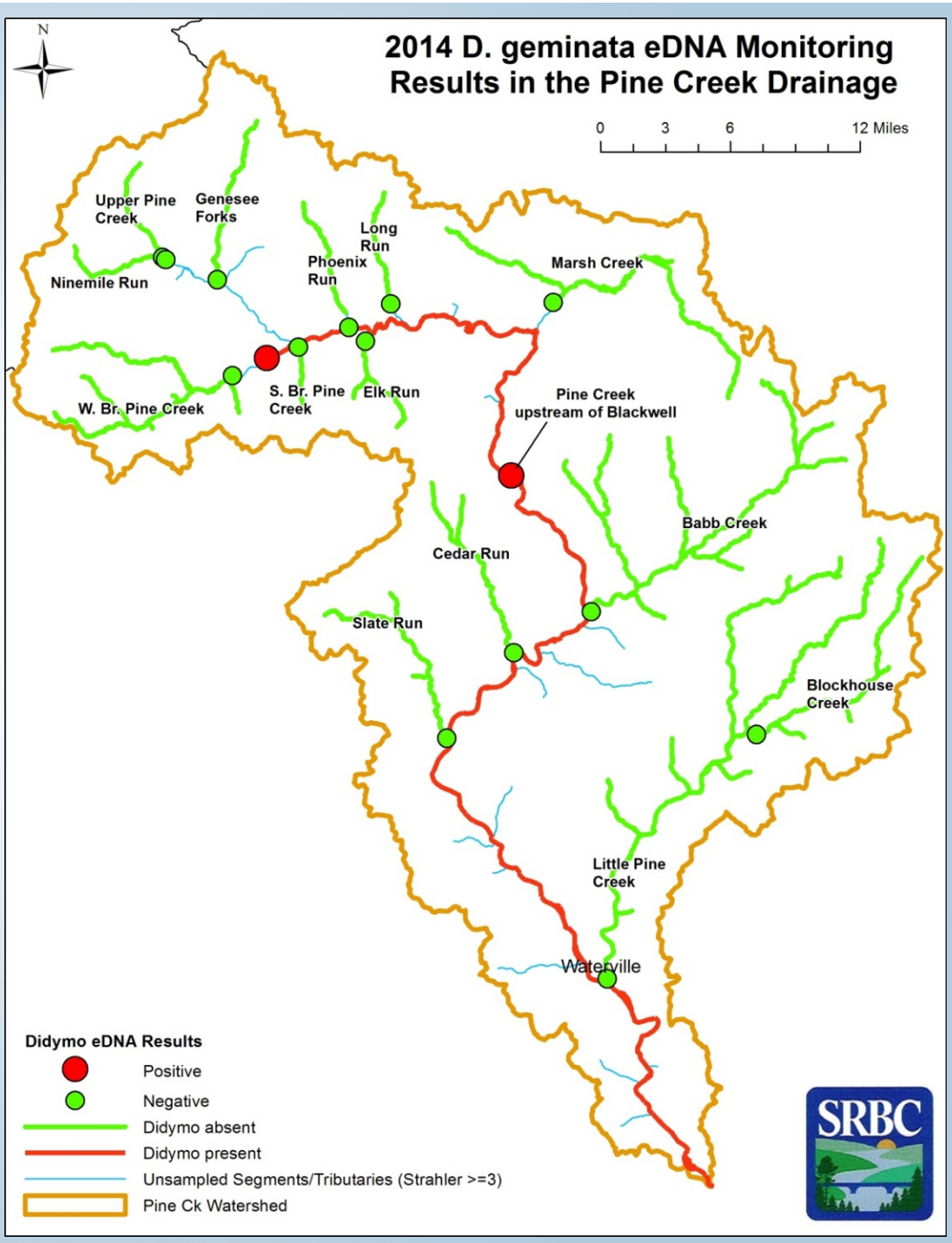
Didymo Research: Pine Creek Discovery 2013

Current *Didymo* distribution Pine Creek

- eDNA results:
  - ONLY 2 positives were where already known
- Low level Phosphorus may be key to bloom



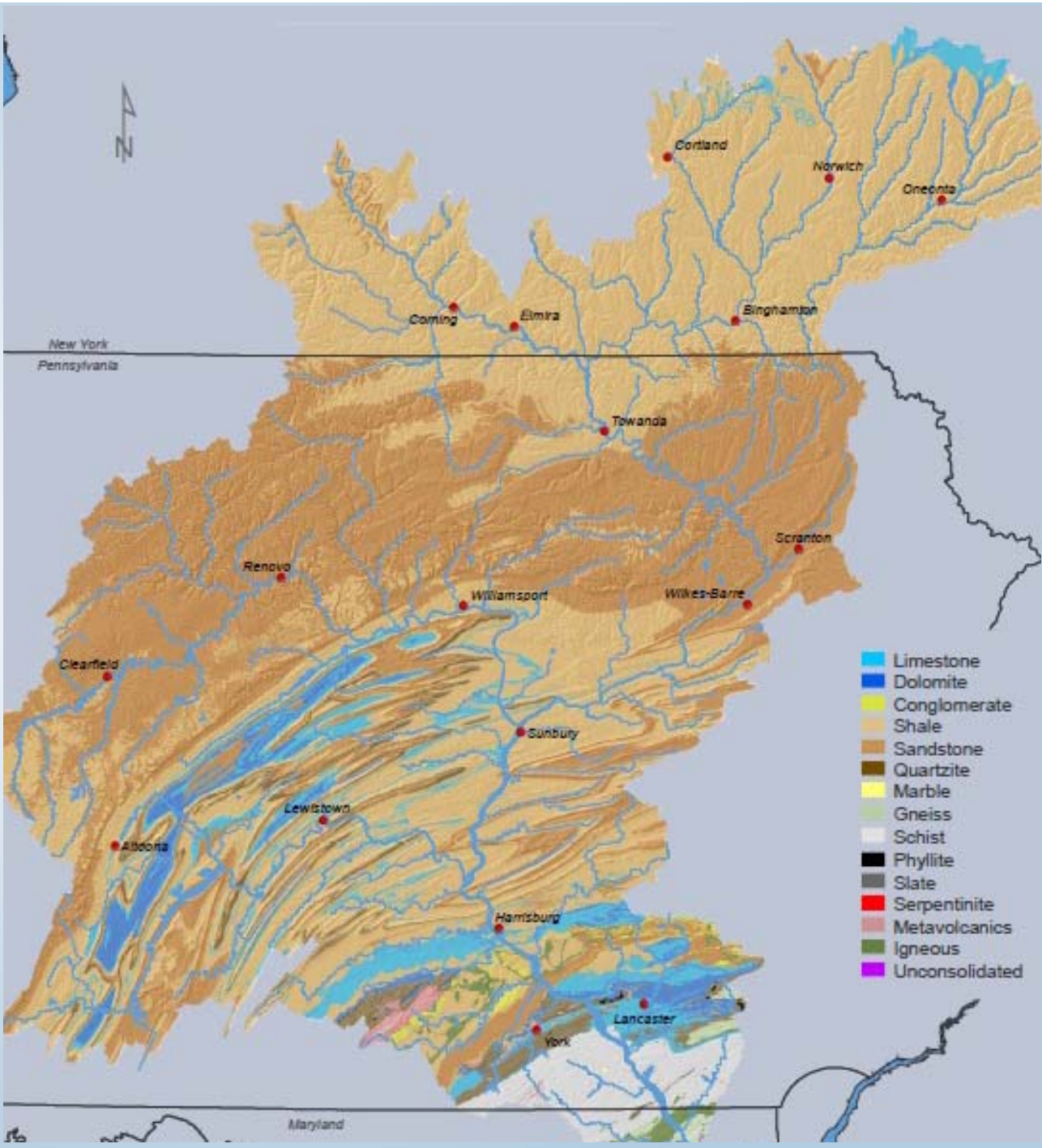
Stormwater BMP Demonstration: Hampden Twp (Cumberland County), PA

Future Directions

- More integration of CIM data, instantaneous flow, climate patterns, and land use activities – NFWF Grant Project
- Review and re-visit project goals, approaches, and findings – RWQM, FMN, ARS
- Adopt formal fish ID protocol including rigorous QA checks; training as-needed
- Coordination and Data Sharing
- Sediment – Turbidity Relationships
- Water Quality Index
- Biostressor

Roundtable Discussions

- Highlights of your recent activities
- Upcoming initiatives or events
- New approaches/ techniques



Remote Water Quality Monitoring Network Update

Water Quality Advisory Committee Meeting

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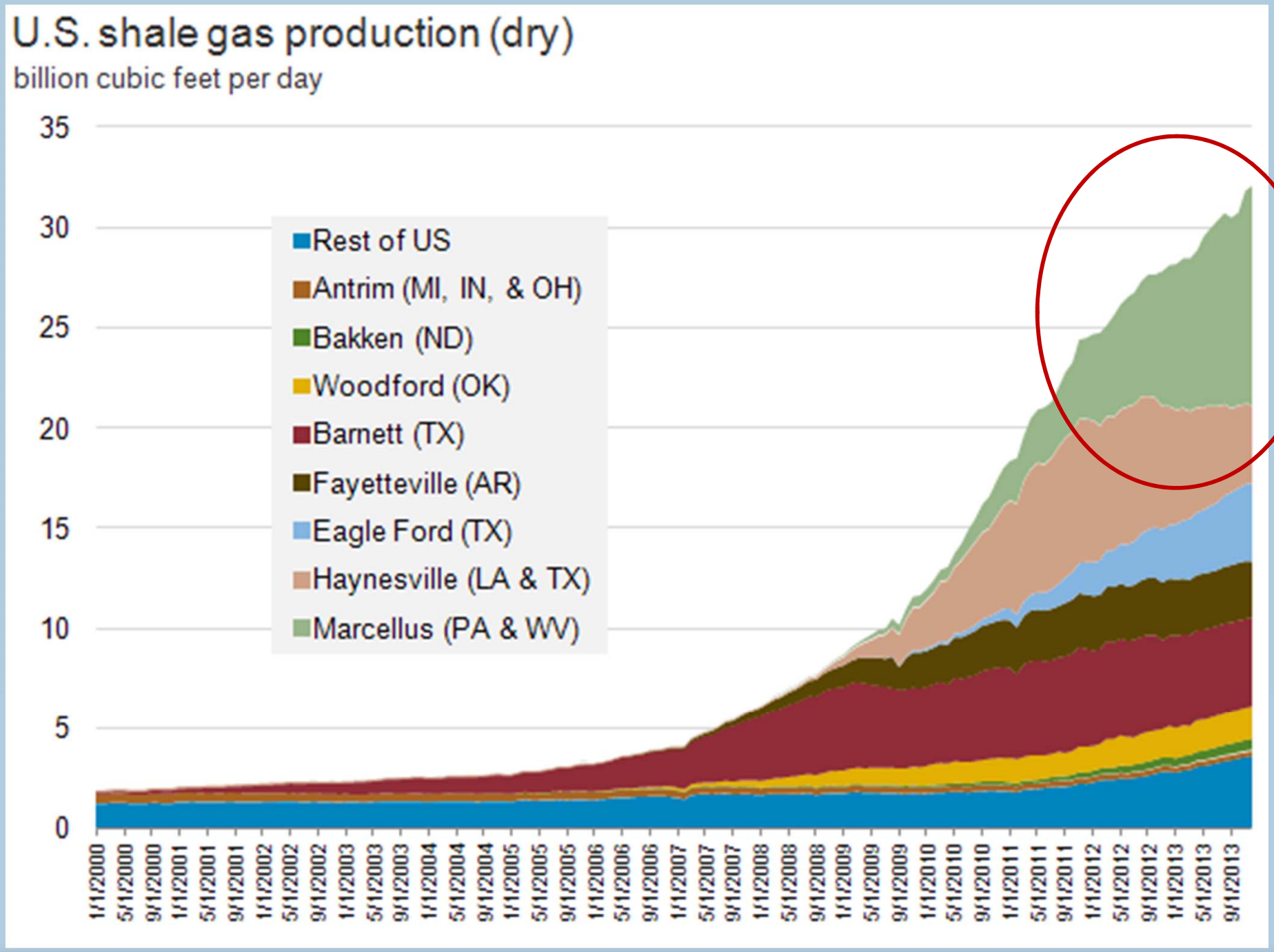
U.S. shale gas production (dry)
billion cubic feet per day
35
30
25
20
15
10
5
0
Rest of US
Antrim (MI, IN, & OH)
Bakken (ND)
Woodford (OK)
Barnett (TX)
Fayetteville (AR)
Eagle Ford (TX)
Haynesville (LA & TX)
Marcellus (PA & WV)
1/1/2000
5/1/2000
9/1/2000
1/1/2001
5/1/2001
9/1/2001
1/1/2002
5/1/2002
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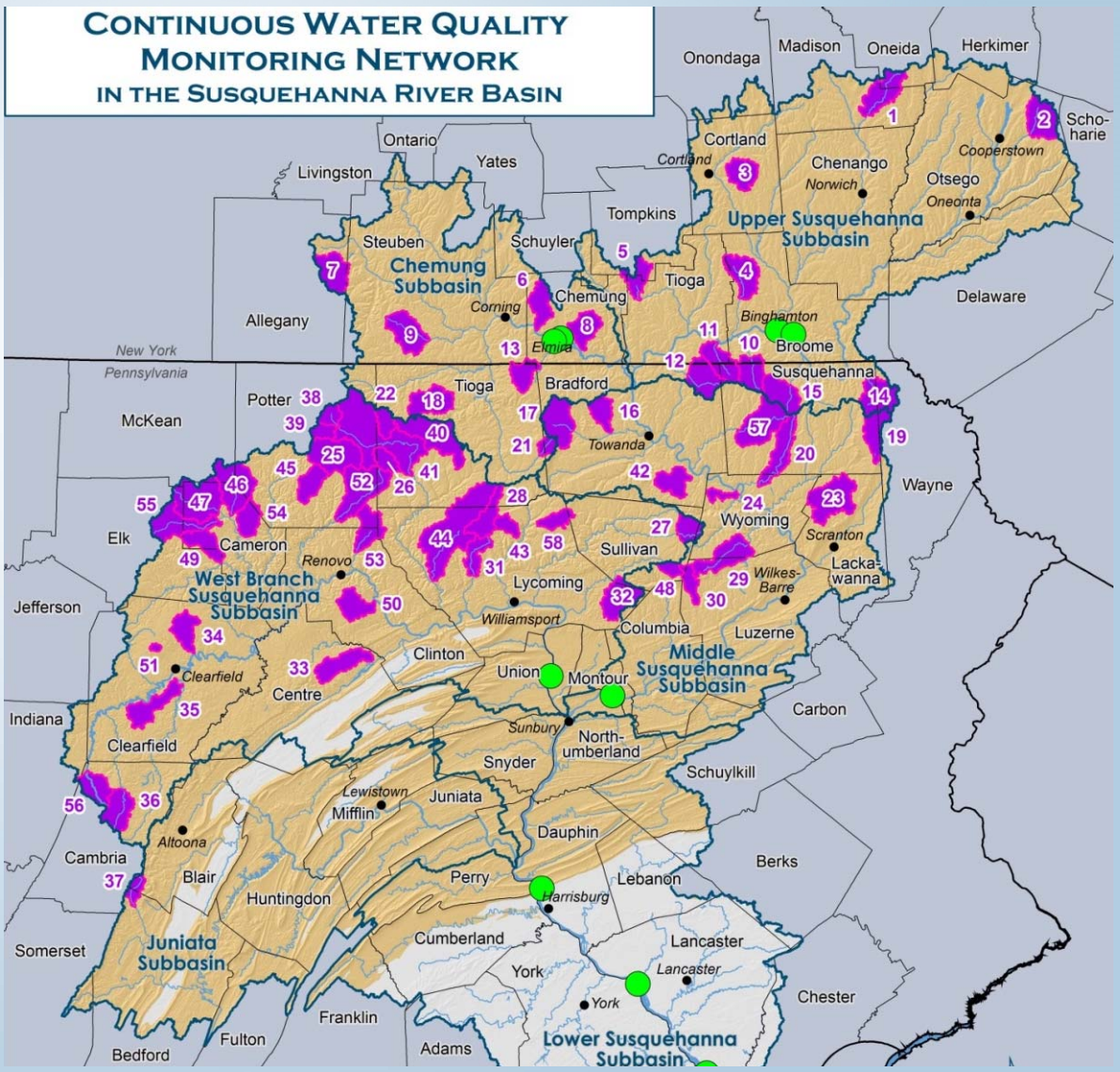

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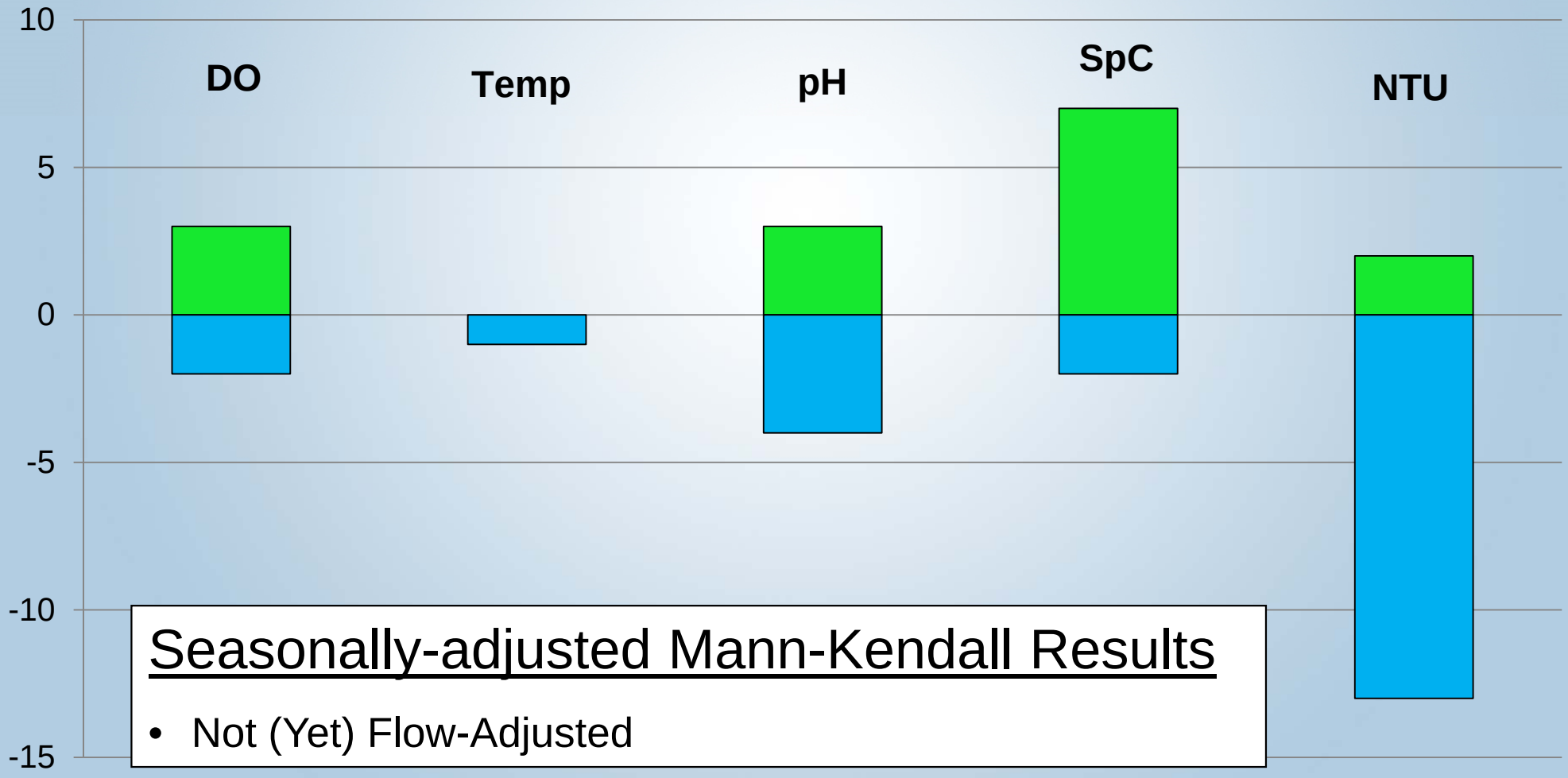
WQ Trends: 35 Stations with at least 3 years CIM data (2013)



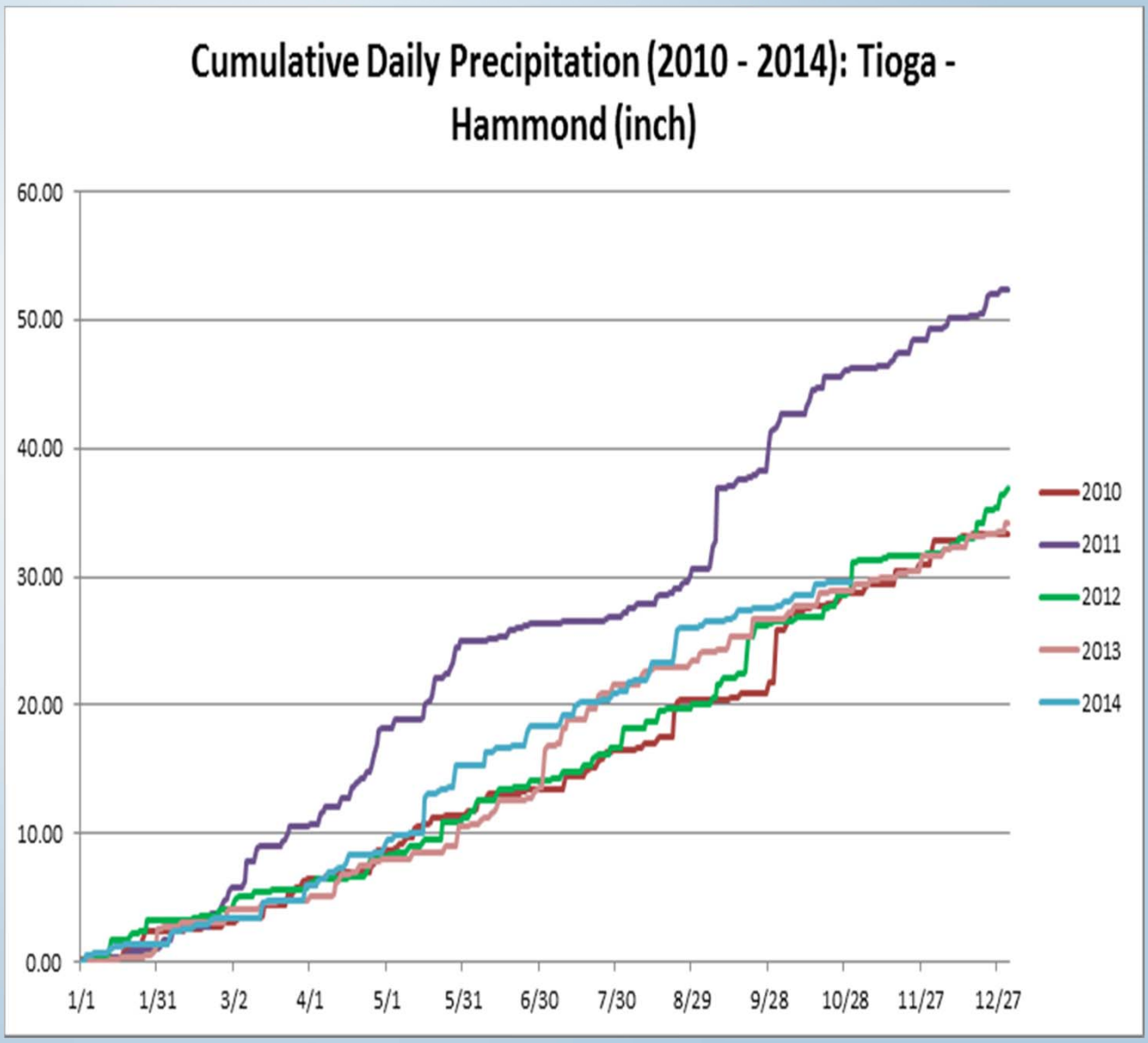
Seasonally-adjusted Mann-Kendall Results

- Not (Yet) Flow-Adjusted

Macroinvertebrate Assemblage

50 Stations sampled 3 years (October)

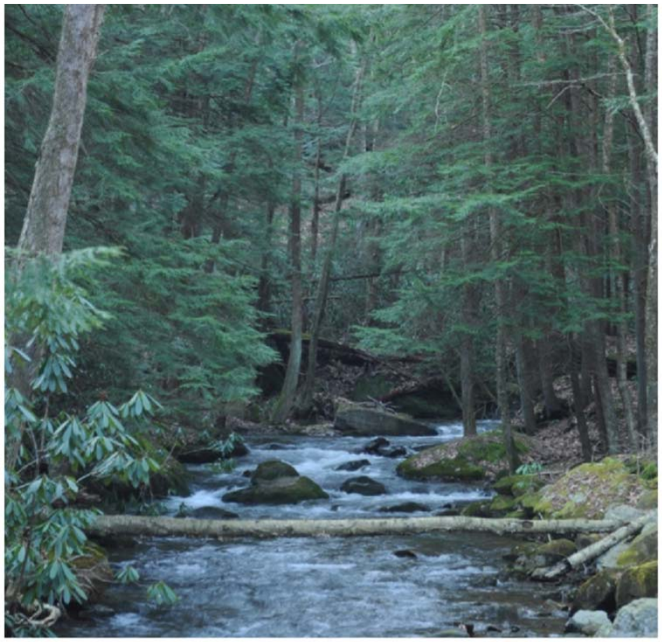
- PADEP Freestone IBI scoring analysis
- Just 5.8% of all samples scored as “impaired”
- No correlation between gas well density and IBI score in any year or all years combined
- Regional annual weather patterns appear to drive community structure

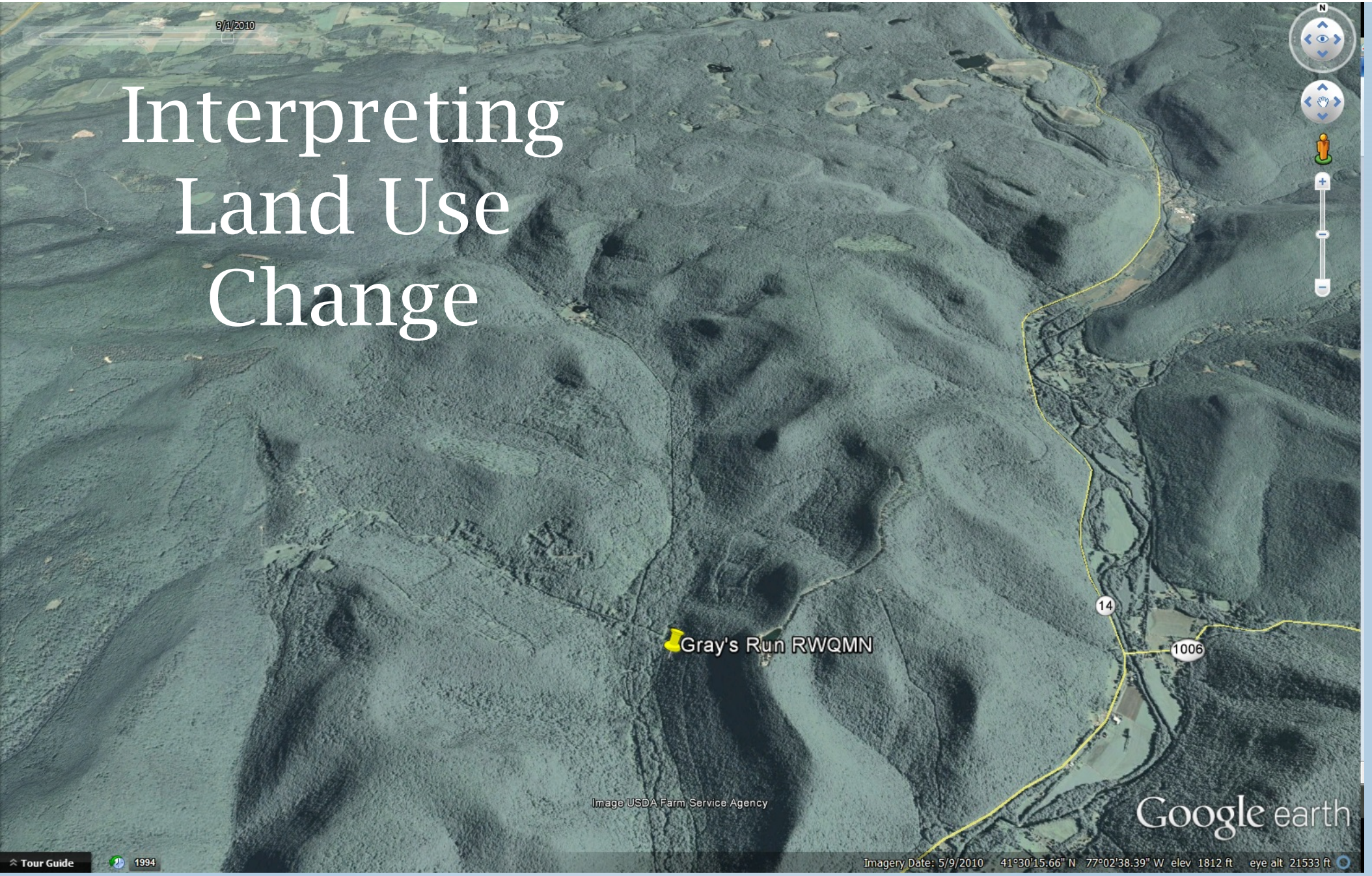


Challenges and Opportunities of CIM Program

- 58 stations operate in real-time throughout Marcellus Shale Region – Expensive capital investment and on-going resource-intensive operation
  - Approx 25 “extra” YSI 6600 sondes for calibration and repair
  - AQUARIUS Software and Dedicated server
  - Real-Time Communications
  - Data Correction – drift, fouling, malfunction
- Lots of Data! (~4 million CIM records/year; AQ Chem, Flow, Biota, Habitat)

Future Aims: Sediment – Turbidity Relationship





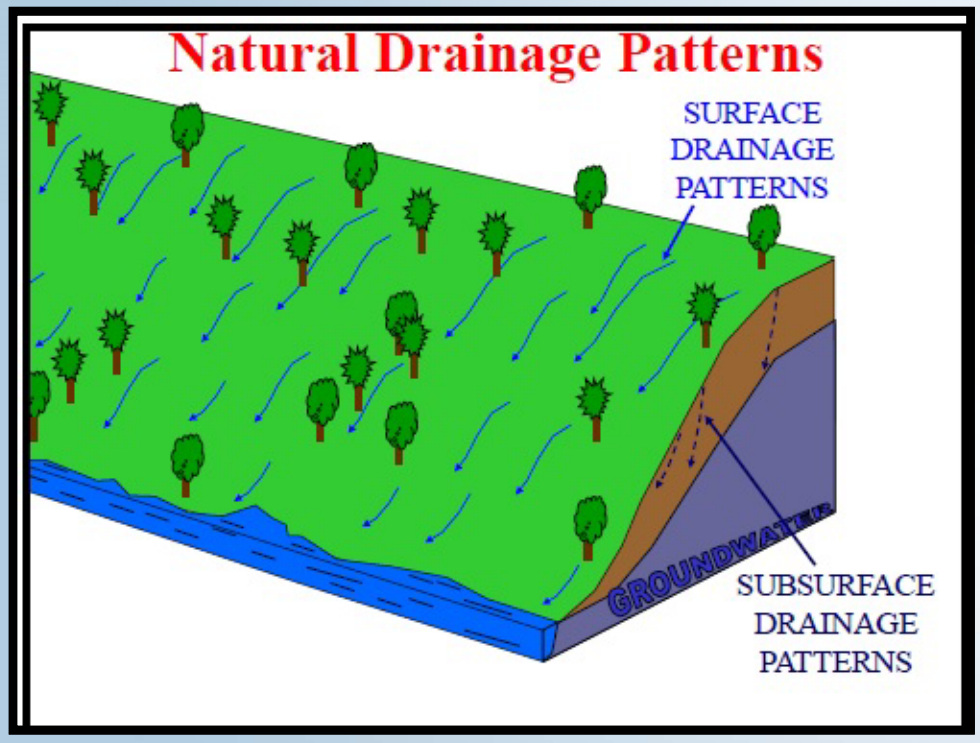
Interpreting Land Use Change

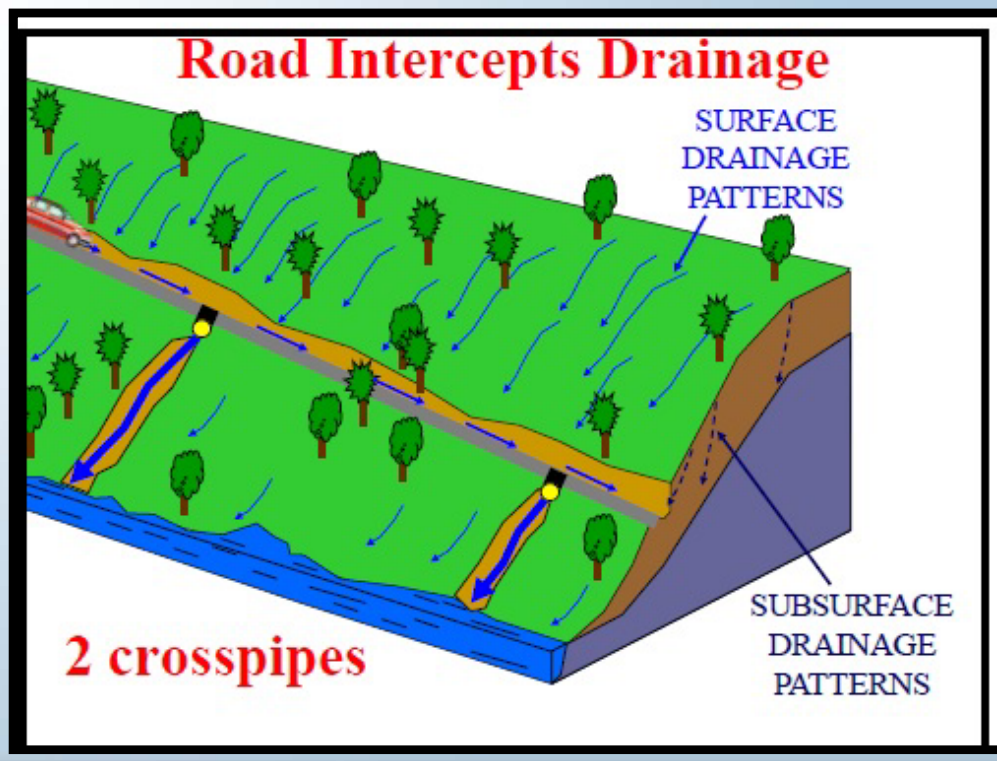
How to Tie Activities on the Landscape to In-stream Observations?


5/4/2013
1993
2013
Google earth
Tour Guide
1994
Imagery Date: 5/4/2013 41°26'00.21" N 77°02'22.96" W elev 2126 ft eye alt 3333 ft

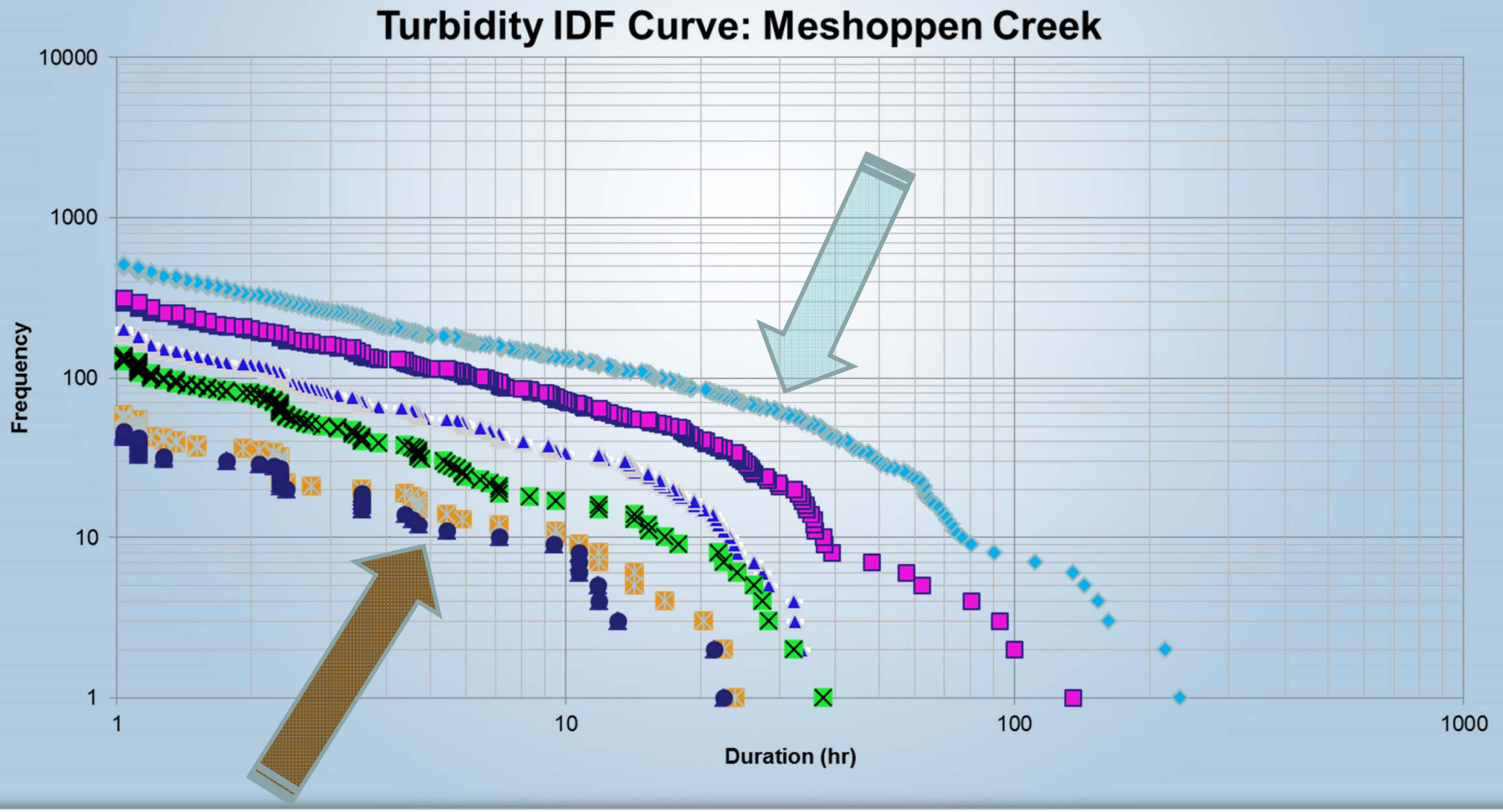
… However, natural gas production is not the only landscape activity

Scaling: Does Size Matter?





Turbidity Data Analysis
Using Intensity – Duration – Frequency



Member Discussion About Continuous Networks