PENNSYLVANIA'S APPLICATION OF PROBABILITY-BASED SAMPLING FOR STATEWIDE SURFACE WATER ASSESSMENTS

presented by

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NWQMC

NATIONAL WATER QUALITY MONITORING COUNCIL
Working Together for Clean Water

Pennsylvania Water Quality Monitoring Factoids

- 83,000+ Stream Miles
- WQ monitoring focused on Point Source impacts and control
- Well-established fixed station network for large basin monitoring
- Regional emphasis on localized problem areas

- Historically, little emphasis on Non-Point Sources
- Legal challenges of EPA's WQ Program oversight in Pennsylvania regarding:
  - Incomplete Statewide Water Quality Assessment
  - Lack of attention to Non-Point Source problem areas.

In 1997, Pennsylvania implemented

STATEWIDE SURFACE WATER ASSESSMENT PROTOCOL (SSWAP)

SSWAP - *A strategy using a "census" (or targeted) approach – with the following objectives:*

- **Assess all surface waters within 10 years;**
- **Assess quickly and effectively as possible to:**
  - **Identify impaired stream segments;**
  - **Document non-point source impairment conditions state-wide;**
  - **Identify Sources and Causes.**

RANDOM – DESIGNED SURVEYS: THE GREATEST THING SINCE _____ ? ? ?

- Random or Probabilistic-Based survey design concepts were coming “in vogue” at the beginning of SSWAP program

- Early on, EPA strongly encouraged statewide randomized monitoring for the usual good reasons:

  - Statistically defensible results
  - Useful to track trends
  - Useful in identifying probable extent of sources & causes on a statewide scale
  - May provide data comparative on a national scale
  - *“Miracle – cure”* for ailing monitoring programs

PENNSYLVANIA'S RESPONSE ?

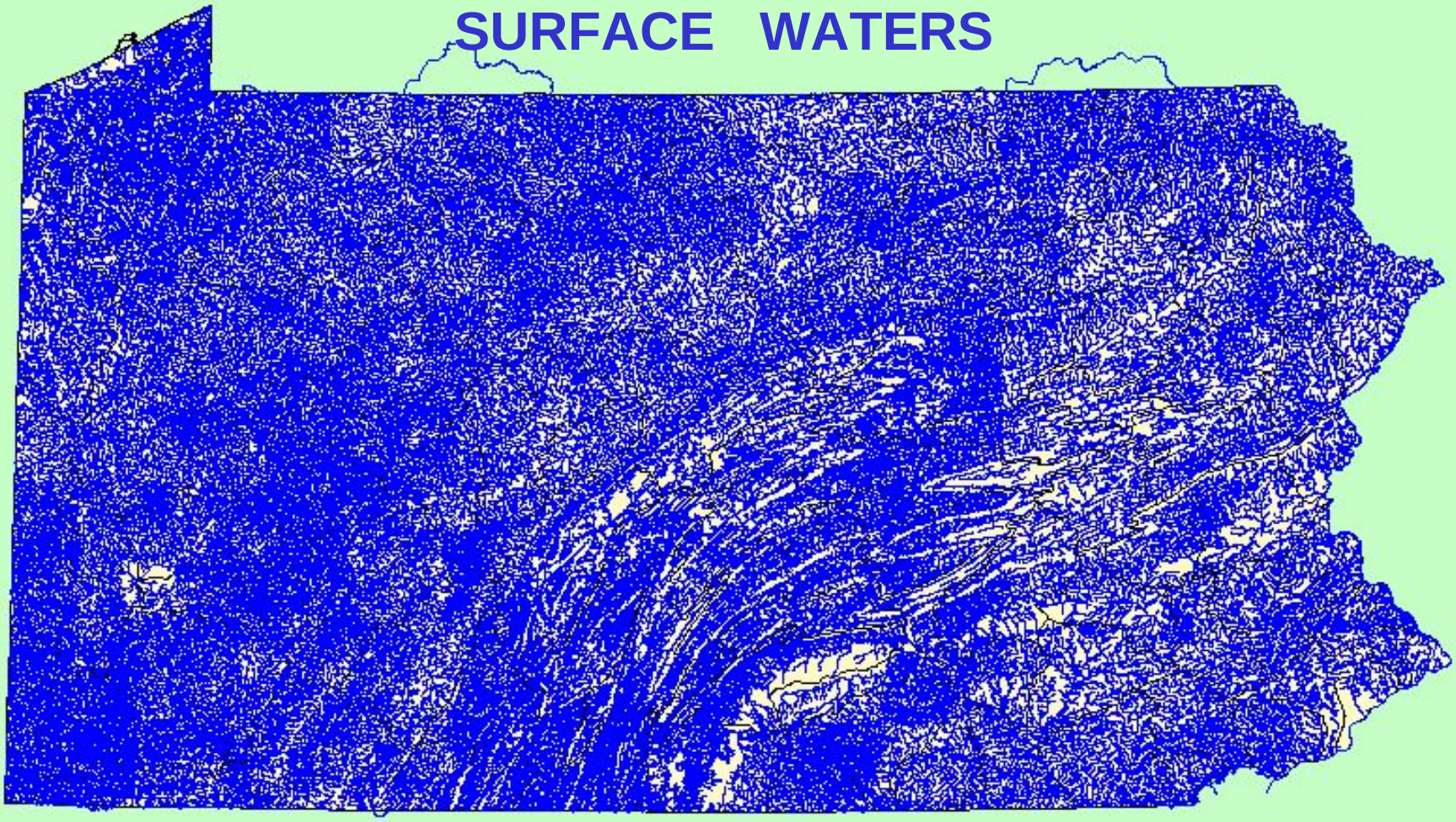
NO!

The Reasons Were Many:

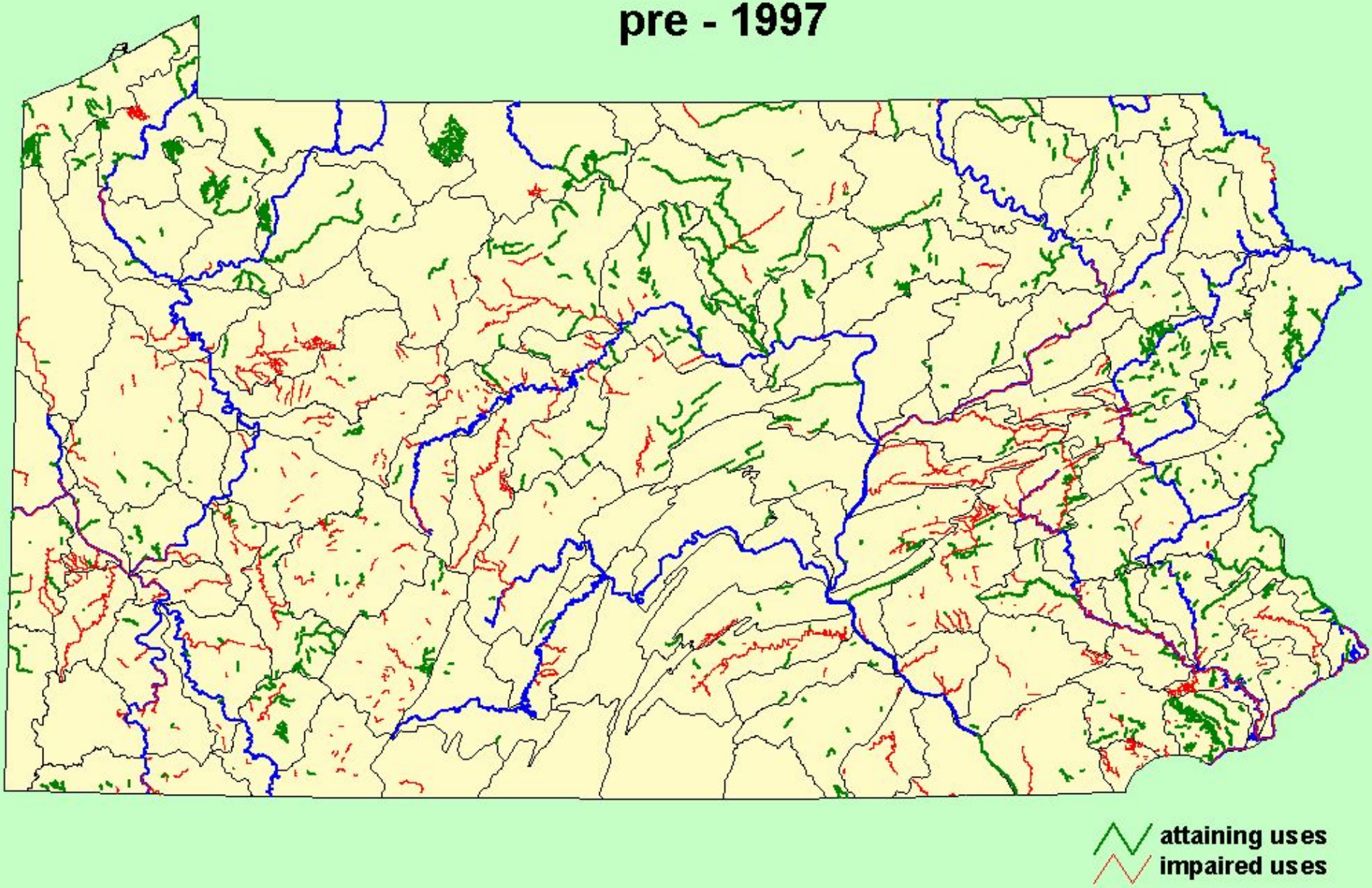
- Random designed surveys are not very suitable for PA's Integrated Listing Report Needs (305b/303/d):
  - No sight-specific data beyond the randomized stations
  - No defined Assessment Limits – for listing / de-listing purposes.
- Demands standardized national assessment protocol (such as EMAP) for National scale applicability
- Existing State Biologist staff already overloaded with specific regional obligations

- Targeted SSWAP Program has mandated time frame:
  - New staff dedicated to the Targeted SSWAP Program
  - No interest or need for probabilistic information on a state or smaller scale
- EPA Grant Support:
  - If not long-term? – cannot support “Probabilistic” positions
  - Governor’s hiring freezes would prevent use of Grants
- Targeted SSWAP Program was designed to meet our immediate needs:
  - sight-specific information
  - segment-defined assessments for TMDL remediation
  - monitoring starting points

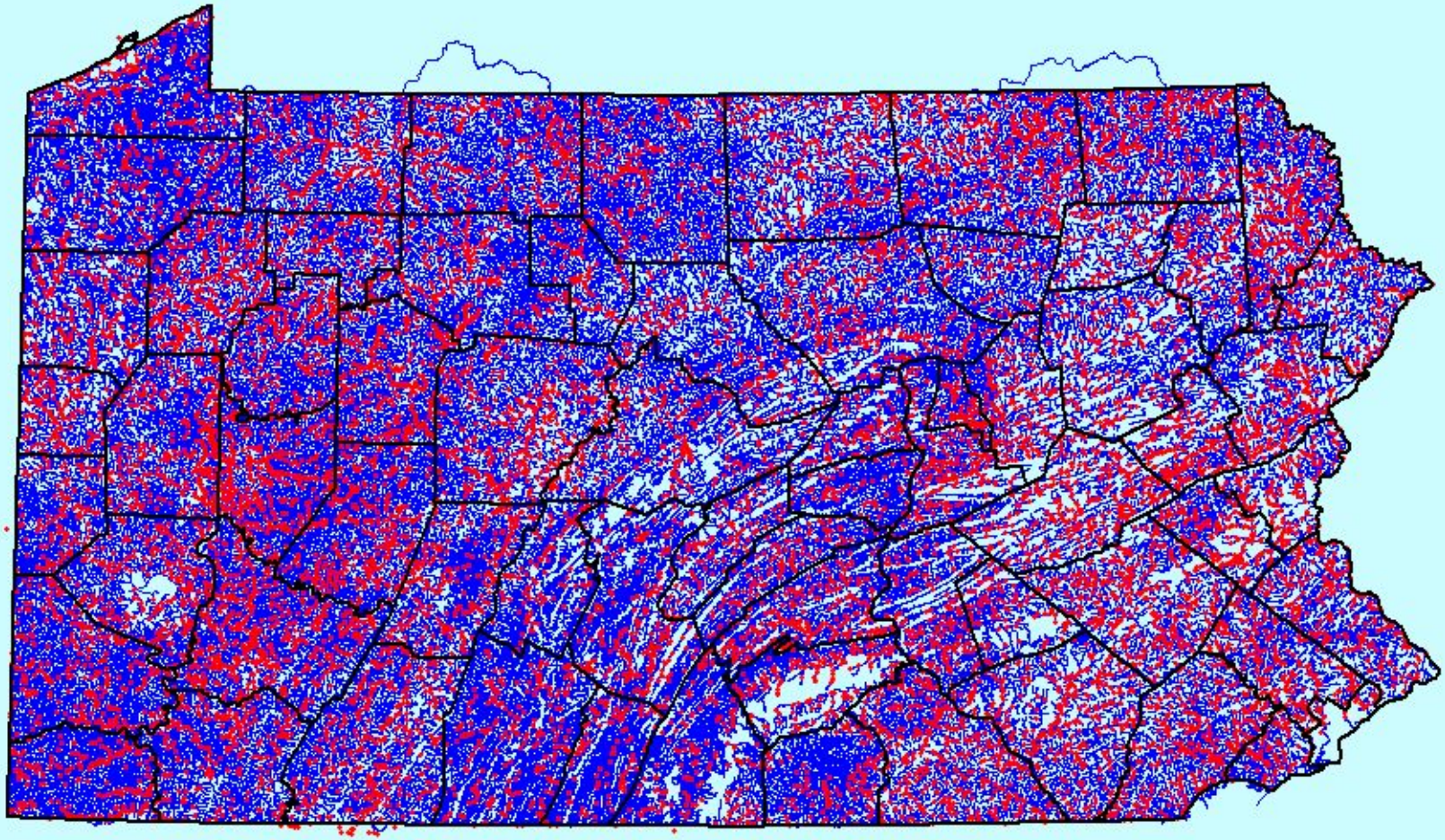
PENNSYLVANIA'S STATEWIDE SURFACE WATERS



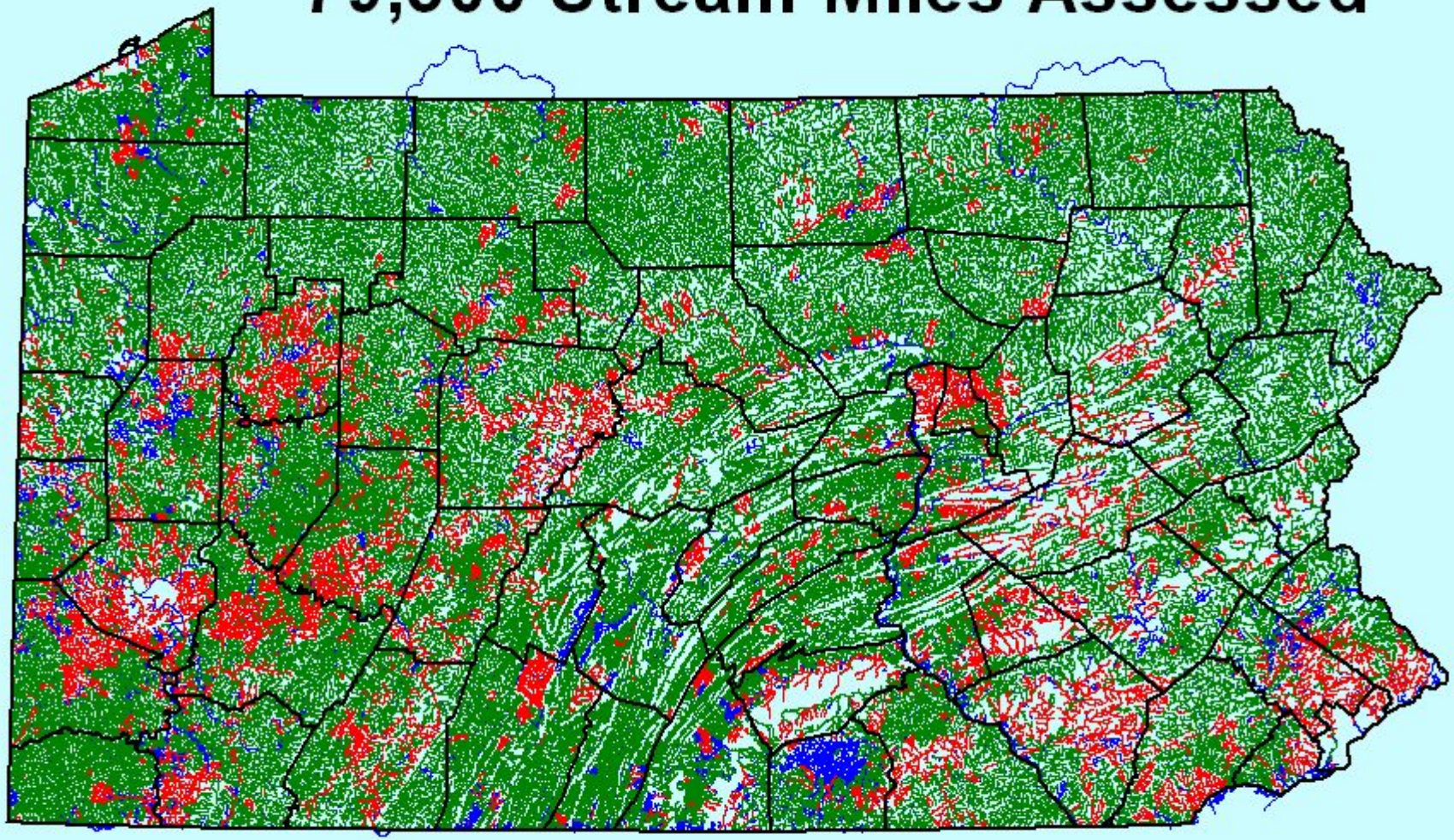
PENNSYLVANIA'S ASSESSED WATERS
pre - 1997



1997-2005
15,700 Stations Assessed



1997 - 2005
79,500 Stream Miles Assessed



1997 – 2005 Summary

Total Stream Miles :	**83,161**
Assessed:	**79,617**
Supporting:	**65,974**
Impaired:	**13,643**
Unassessed:	**3,544**
Total Stations:	**15,700**
Assessed Miles / Station:	**5.1**

ACCOMPLISHMENTS

- First Complete Statewide Assessment
- Non-Point Source Impairments "Exposed"
- Integrated Listings (305b & 303d)
- TMDL Waters Identified
- Extent Of Abandoned Mine Drainage Updated & Confirmed

NEXT TIME
(Cycle 2 Assessments)

- Converting to a more rigorous RBP-based Biological Assessment
- Targeting Priorities Based on TMDL Needs and “At Risk” Status
- Probabilistic Approach to “Attained” Waters

Probabilistic – Design Concept Reconsidered

Changes in " *Random Atmospheric Conditions*":

- Random Monitoring can "complement" 305b/303d reporting
- EPA's 2003 *"10-Element Monitoring"* guidance pushes use of Probabilistic-Designed monitoring
- Biological Methods Comparability Considerations – Data & Assessment Applicability at different scales

Evolving PA Monitoring & Assessment Program needs:

- Growing Assessment Complexities

Are there any direct benefits for Pennsylvania to consider Probabilistic – Design Applications?

Yes.

Pennsylvania's Monitoring & Assessment Program has evolved - Revisions, Enhancements, & Changing Needs

- *Methods Comparability*
- *SSWAP > RPB-based Transition*
- *Macrinvertebrate IBI Validations*
- *Rotating Basin Monitoring*

Methods Comparability

National Wadeable Stream Assessment Efforts

Encouraging State & Tribal Participation to gather monitoring data applicable on a National / Regional scale

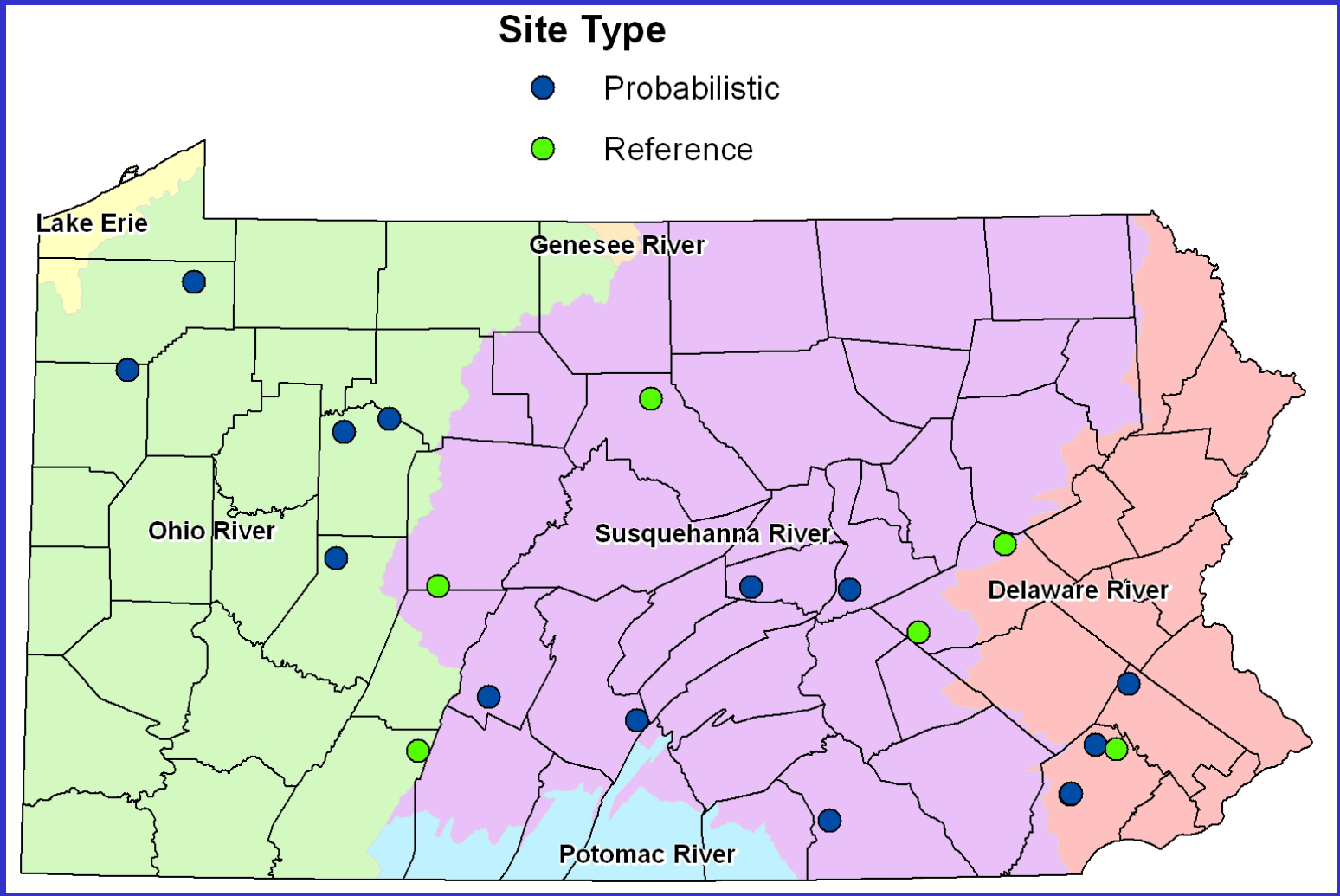
Pennsylvania Reluctance

- Staff Shortage and Existing Commitments
- No significant benefit on a State or smaller scale
- No application for WSA's "EMAP – style" Assessment Methods

However . . . .

- Pennsylvania saw benefit in comparing State & WSA assessment results . . . . and participated in EPA's National WSA project on a limited level :

  - Accepted EPA Grant for "pass-through" funding to contract WSA sampling of PA's probabilistic sites
  - Assisted in sight selection and verification process.
  - Coordinated with WSA contractors to collect "side-by-side" samples at 20 PA sites


Site Type
Probabilistic
Reference
Lake Erie
Genesee River
Ohio River
Susquehanna River
Delaware River
Potomac River

Pennsylvania & the National Wadeable Stream Assessment

Direct Benefits

- State represented in the National WSA dataset
- State and EMAP Methods Comparison (under analysis)
- "Testing the [Probabilistic] waters" . . . relatively "painless"

SSWAP > RPB-based Assessment Transition

SSWAP was designed as a basic biological screening tool

- Not a “rigorous” asssessment protocol
- Simple “impaired or not” decisions
- Limited in assessing Tier 1 designated uses

To address these concerns, SSWAP was replaced with more rigorous RBP-based assessments

Transition Needs

- "Validate" old SSWAP Results
- Validate Macroinvertebrate IBI Scoring Thresholds

REMAP Grant:

“Killing Two Birds With One Stone”

Primary REMAP Objective:

Validate IBI scores that were developed for RBP Aquatic Life Use Assessments

Additional Application of the data:

Check Accuracy of SSWAP Assessments

Project Approach:

IBI Score Validation (105 Stations)

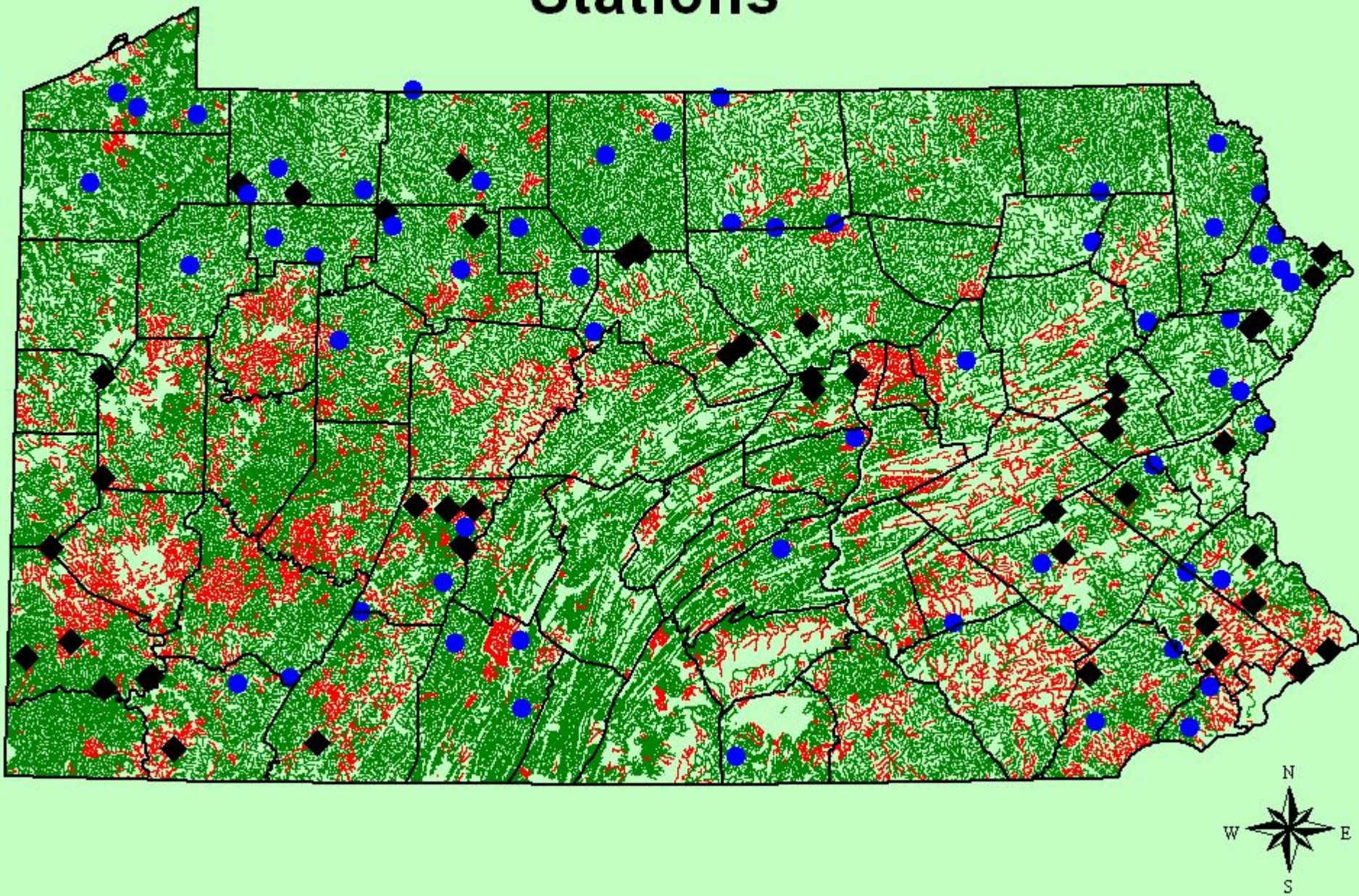
35 Stations/ Major Drainages **(DELAWARE, SUSQUEHANNA, OHIO)**

- 20 Random Sites
- 15 Targeted (Reference, Stressed, ’93-’96 MAIA-EMAP Sites)

SSWAP Assessment “Validation”

- The 60 Random REMAP Sites from survey were selected from “Attaining” SSWAP Sites

Probabilistic & Targeted Stations



Rotating Basin Monitoring

Ready to start 2nd Statewide Assessment Cycle

- 10 years too long – 5 years too short?
- RBP sampling is more rigorous and labor intensive
- Cycle 2 RBP sampling cannot assess at the same intensity as Cycle 1 SSWAP (5+ assessed miles/station) in 10 years.

Assessment Cycle 2 requires a completely different approach

Possible Solution?

Incorporate a Probabilistic Element

into Monitoring Design

Blending Probabilistic & Targeted Monitoring

Rotating Basins – One per 6 Regional Offices

- 30 Probabilistic Sites / Rotating Basin
- Attained SSWAP segments

Targeted Sites

- Supplement Probabilistic Watersheds
- “Low SSWAP achievers”
- Source / Cause needs for TMDLs
- TMDL Monitoring
- 303d Delisting
- Cause & Effect Surveys

Pennsylvania “Attaining Stream” Survey Design

Target population: All streams and rivers identified as “attaining” aquatic life use within the 6 PA DEP Regional Rotating Basins.

Two Stage Survey Design:

Stage One: Segments selected using a Generalized Random Tessellation Stratified (GRTS) survey design for a finite resource.

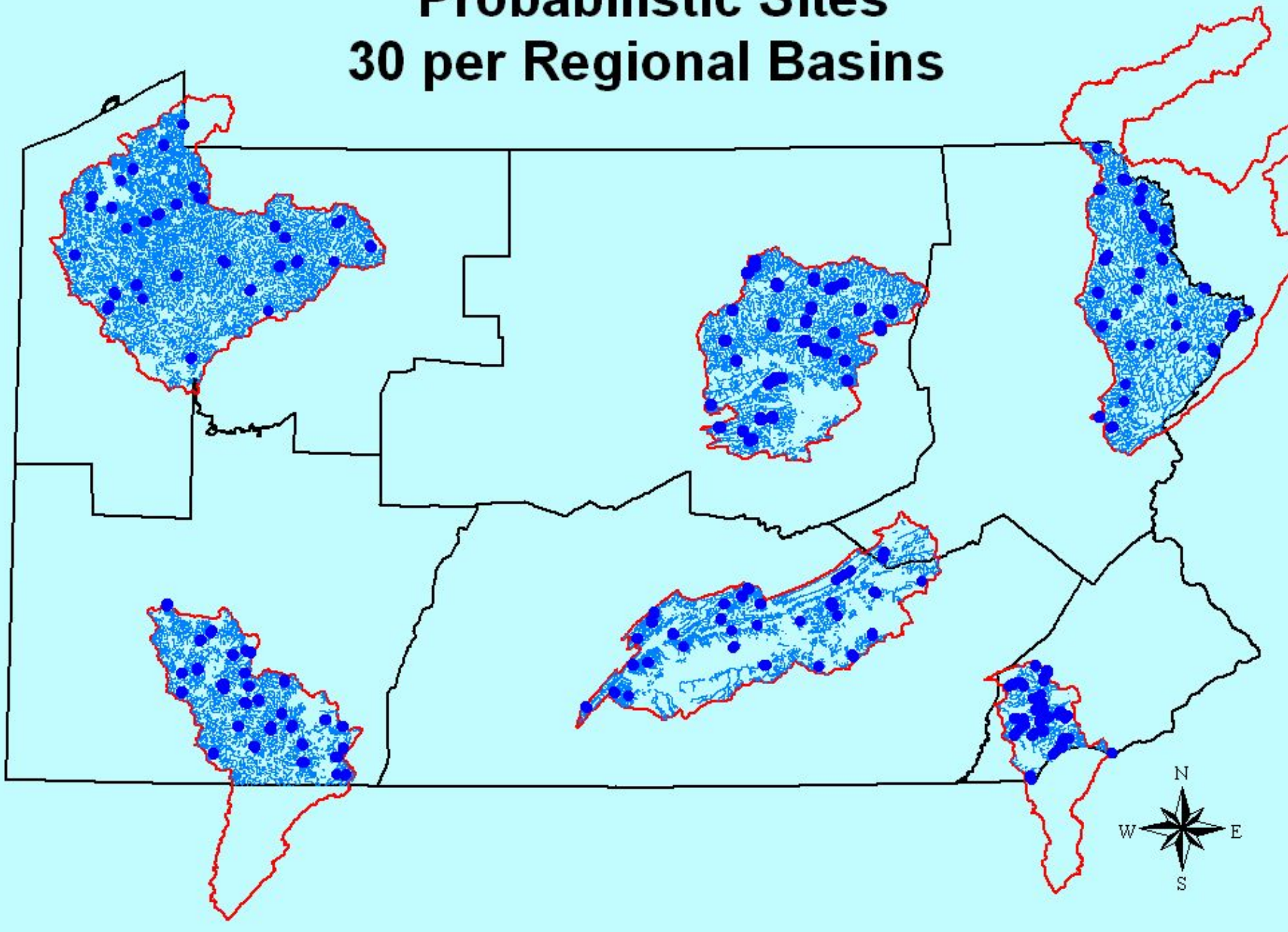
Stage Two: Sample Sites selected within each Stage One Segment using a GRTS survey design for a finite resource.

Both designs include reverse hierarchical ordering of the selected segments and sites.

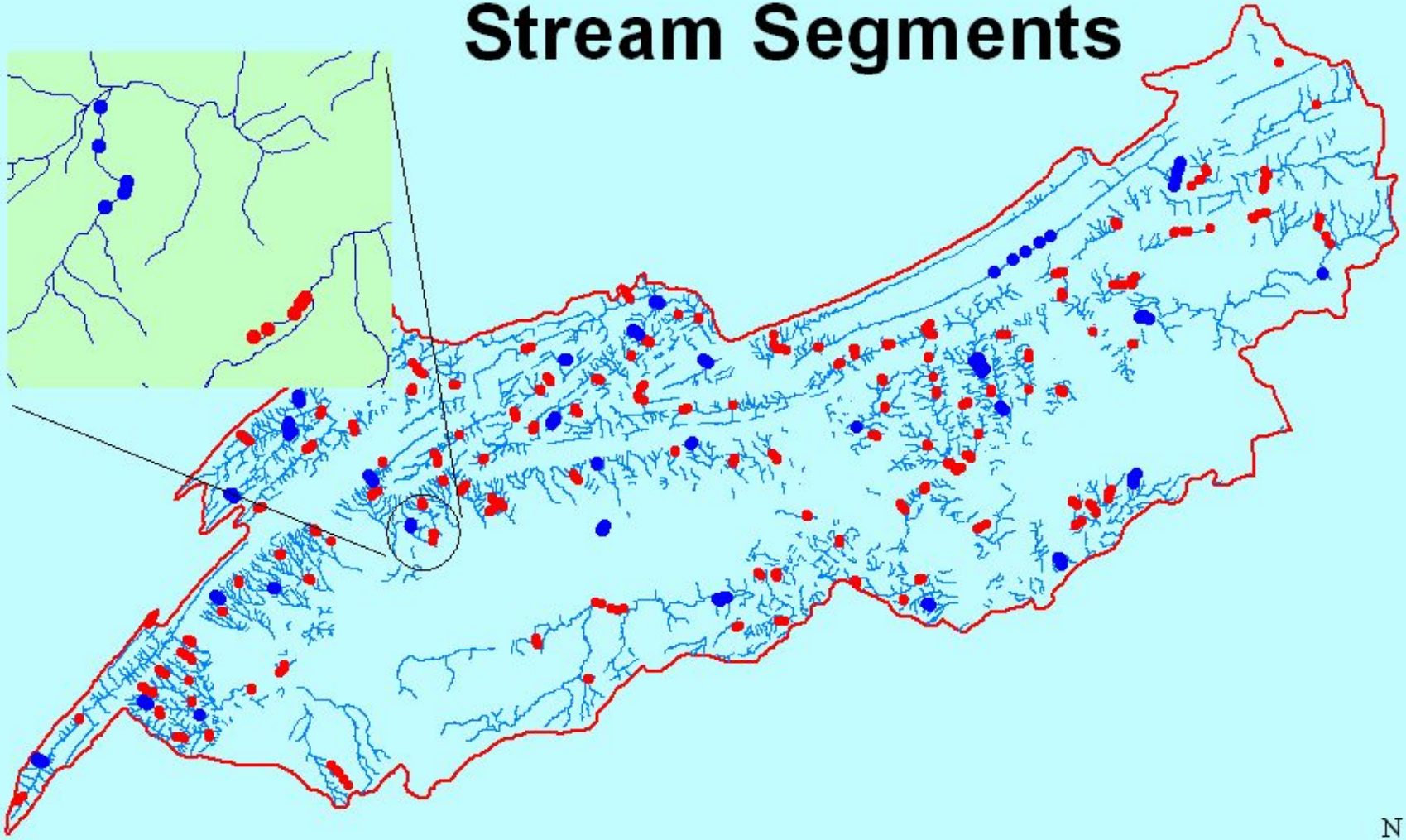
Expected sample size: Expected sample size 30 segments per basin for Stage One and 5 sites per segment for Stage Two.

Over sample: 120 oversample segments for each basin.

Probabilistic Sites
30 per Regional Basins



Primary & Backup Stream Segments



30 Primary / 120 Backup Segments
1 Primary / 4 Backup Sites per Segment

Is Pennsylvania “Jumping on the *[Probabilistic]* Bandwagon”?

Not really –

- There still are significant obstacles for application on a Statewide Scale
- Lack of long term Funding and Staff Resources

However -

- Preliminary Results of current Probabilistic efforts are encouraging
- Will consider future Random Design Applications where direct State Monitoring Program benefits can be realized.

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