

# Development of a Water Quality Trading Framework in the Non-tidal Passaic River Basin

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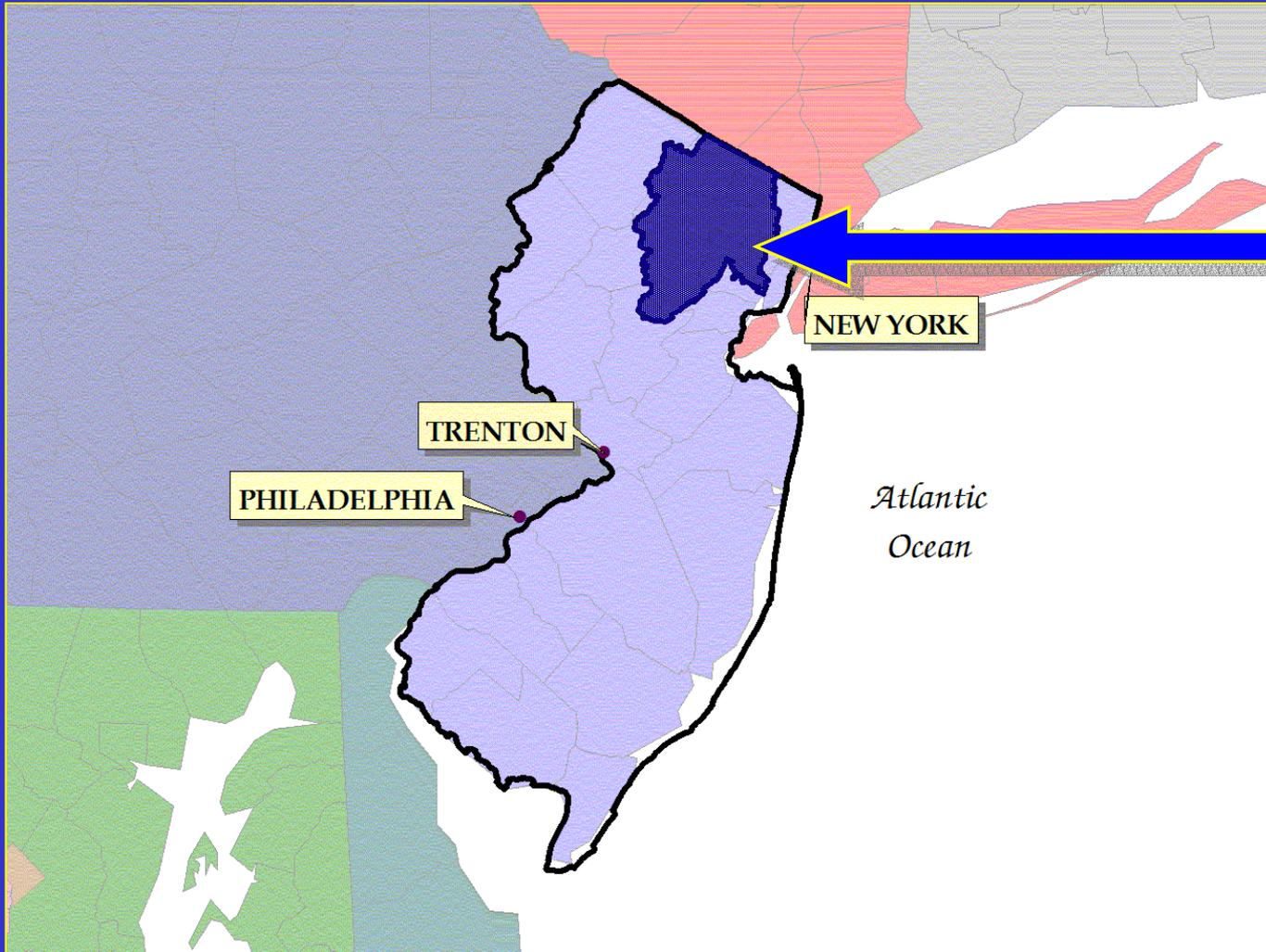
# Outline

- Project background
- Trading framework development
  - Analysis of other trading programs
  - Developing a framework for Passaic trading

# Project Goal

- Develop, implement, and evaluate a Water Quality Trading program for Non-tidal Passaic River Watershed that:
  - *Adheres to USEPA policy on Water Quality Trading*
  - *Meets NJDEP requirements*
  - *Implements TMDL*
  - *Reduces cost of compliance with Clean Water Act*
  - *Establishes incentives for voluntary reductions that could also achieve ancillary environmental benefits such as expedited load reductions*

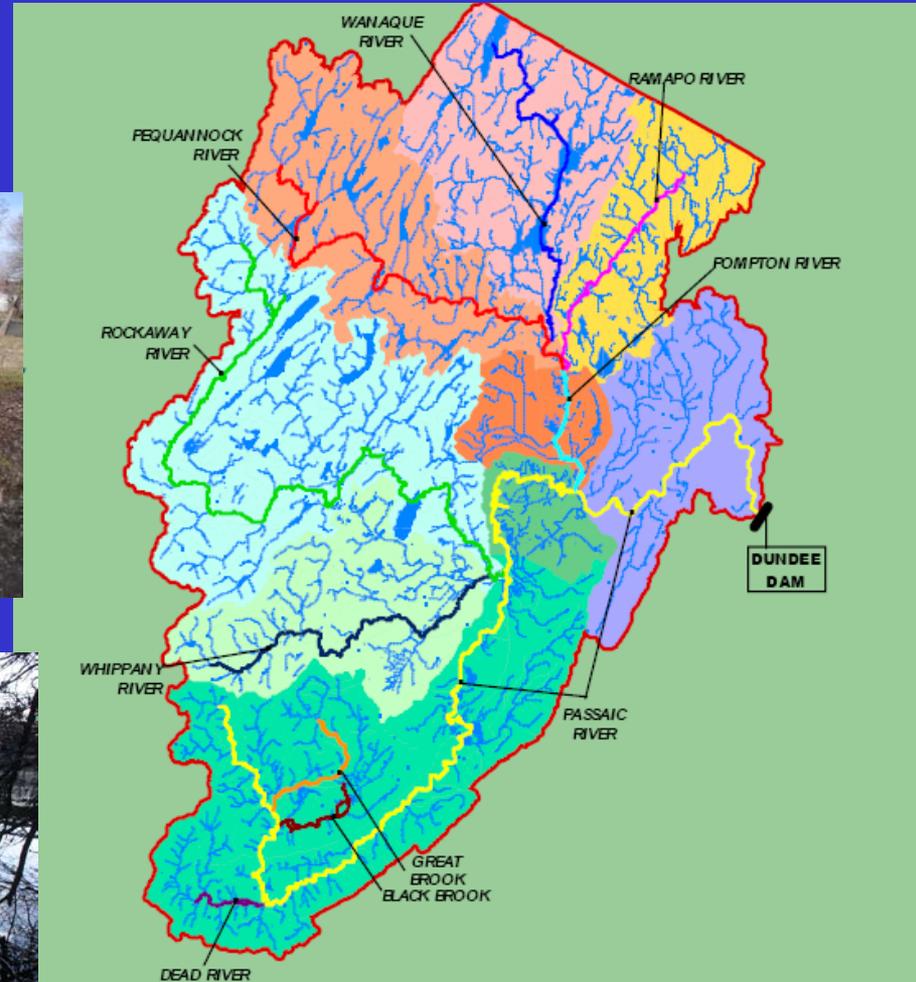
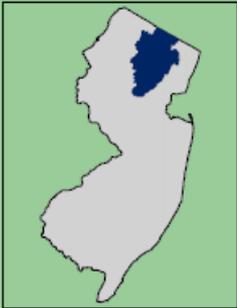
# Project Location



**Passaic  
River  
Watershed  
(NJ portion)**

# A watershed diverse in physical and socioeconomic features

## Non-Tidal Passaic River Basin



# Project Partners

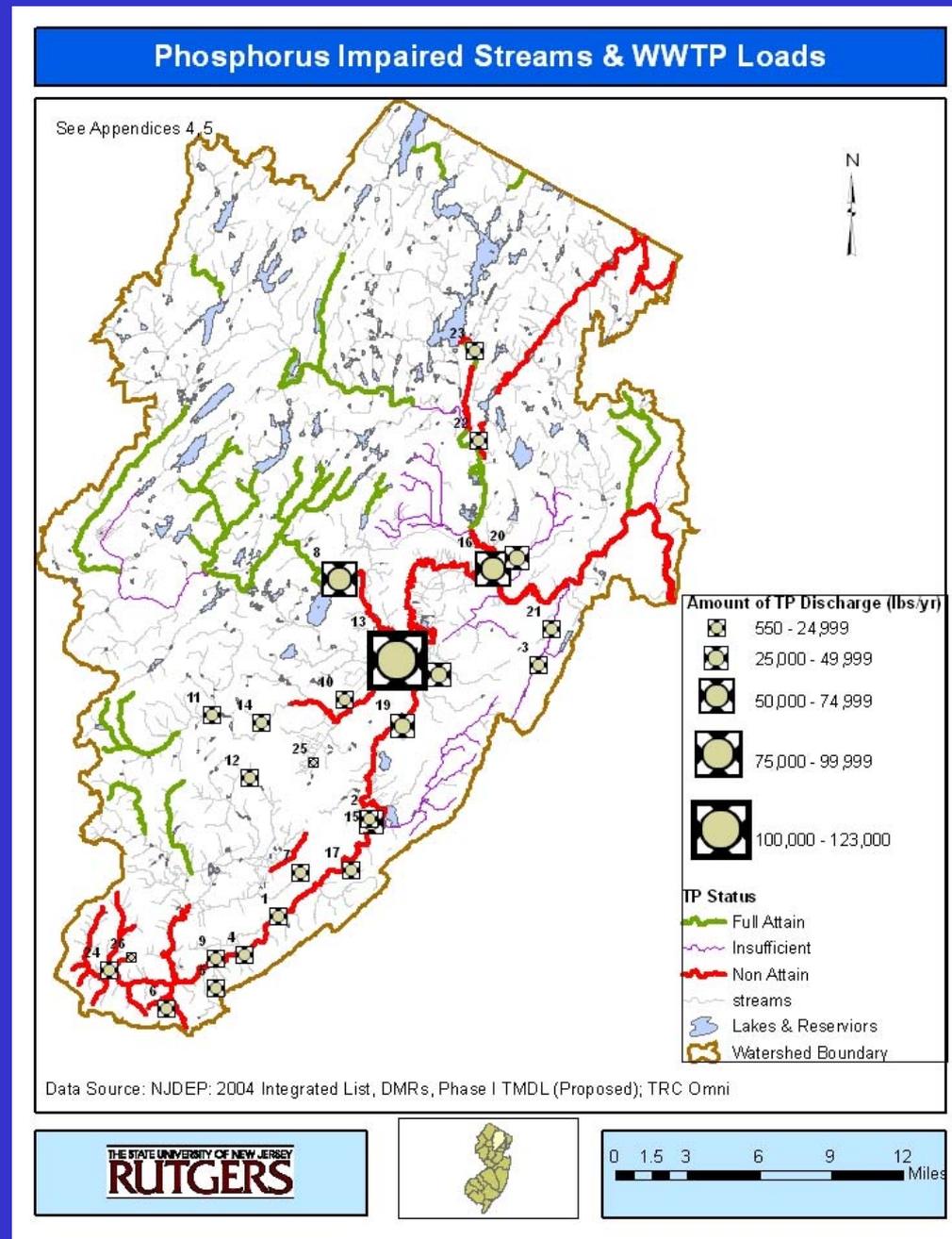
- Multidisciplinary team
  - Rutgers Univ. (science, engineering, policy)
  - Cornell Univ. (economics)
  - NJ Dept of Environmental Protection (NJDEP)
  - Passaic River Basin Alliance (WWTP association)
  - NJ Association of Environmental Authorities
  - NJ League of Municipalities
  - EPA (funding source)
- University presence acts as neutral party and provides research based approach

# Background

- NJDEP Phosphorus Criteria = 0.1 mg/l for streams and 0.05 mg/l for lakes
  - Mitigate eutrophication in Passaic basin drinking water reservoirs
    - Eutrophication Effects: reduced water quality, algal bloom, potential for fish kills in basin
    - Solution requires lower total discharge of phosphorus from all sources
  - 24 Major WWTPs and 84 Municipal Separate Storm Sewer Systems (MS4s) in Upper Passaic Basin
  - A Total Maximum Daily Load (TMDL) is near completion to address the impairments in the Upper Passaic River Basin
  - Possibility of site-specific criteria as alternative to 0.1 mg/l stream standard

# Non-tidal Passaic River Basin

- 1,289 total stream miles
- Approx. 200 stream miles are impaired for Total Phosphorus
- WWTPs are primary source of TP loading
- WWTPs range from 0.15 to 16 MGD in capacity



# Total Phosphorus TMDL for the Upper Passaic River Basin

- A Phase 1 TMDL for the Wanaque Reservoir has been proposed
  - Requires 86% reduction in loads from wastewater treatment plants (0.2 mg/l TP limit)
  - Requires 80% reduction in loads from MS4s
  - Requires 80% reduction in nonpoint source loads
- A Phase 2 TMDL for the Upper Passaic Watershed is near completion
  - More on this later in the presentation....

# Trading framework development

- Analysis of other trading programs
- Identification of key components in trading framework
- Developing a framework for Passaic trading
  - Two proposed frameworks
  - Alignment with TMDL
  - Focus on 3 components in Passaic trading
    - Management area boundaries
    - Trading ratios
    - Eliminate existing hot spots and avoid creation of new hot spots

# Trading framework development

- Definition of trading framework:

*The overall process for executing trades*

- How does a discharger buy or sell credits?
- What is the role of the regulator in permitting or rejecting trades? How does the regulator evaluate compliance?

# Analysis of other programs

- Studied over 40 other trading programs
  - Point to point and point to nonpoint programs
  - Identified key components of framework
  - Found that framework was pitfall for some programs, and important to success of others
    - Balance of simplicity, flexibility, and enforceability is crucial
    - Point to point trading programs that used general permits have simple and clear processes to make trades
  - Problems caused by framework issues
    - Increased transaction costs due to uncertain guidelines or complicated approval process
    - Flawed trading ratio risked creating a hot spot

# Components of a Trading Framework

## Permit system

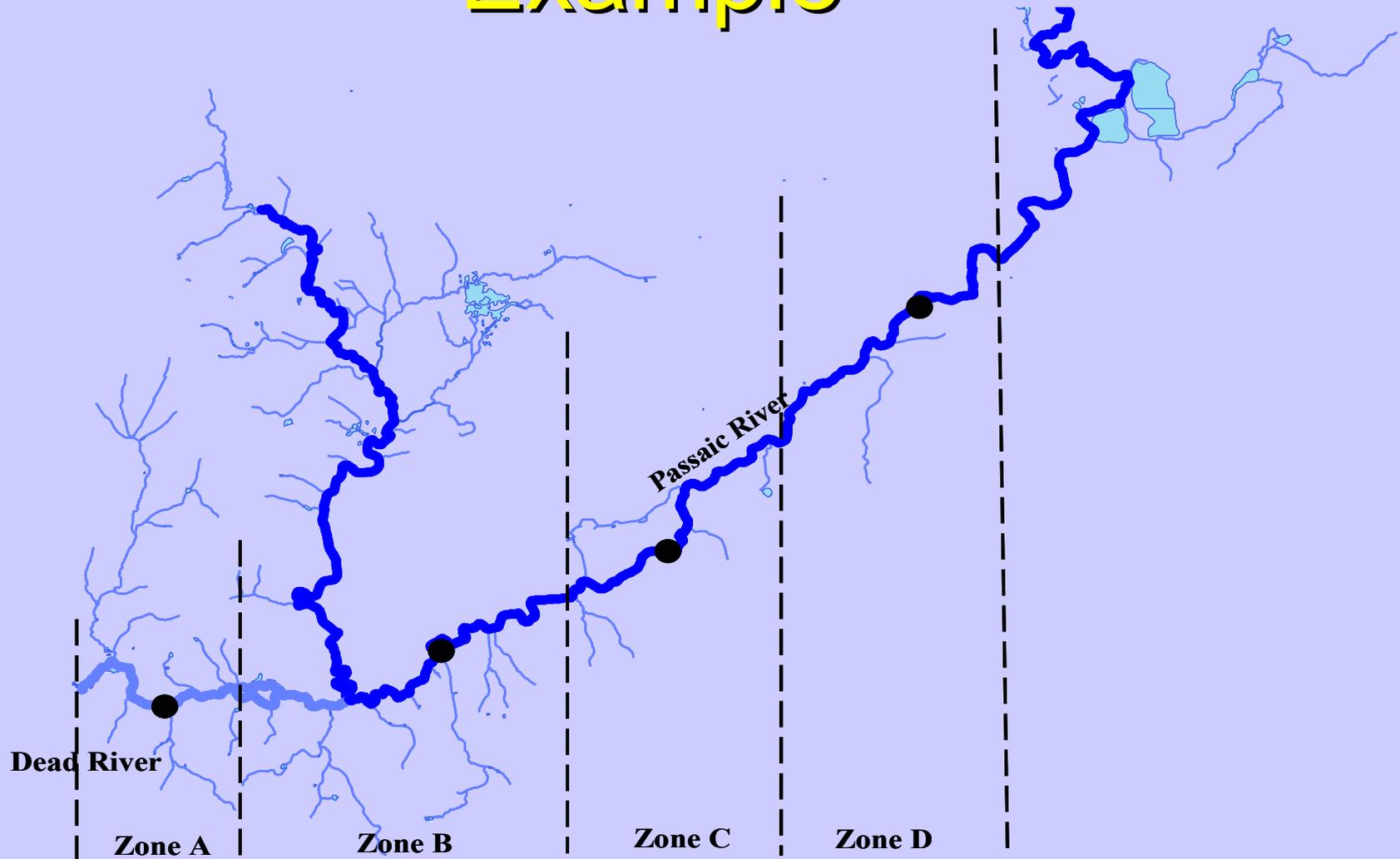
- Define compliance for PS
- Maintain ability for Regulator to enforce against PS noncompliance
- Define trading area boundaries
- Define credits
- Enable communication among credit buyers and sellers
- Clear approval process for trades
- Monitoring and reporting
- Ensure accountability and define liability for pollutant reductions
- Ensure avoidance of hotspots
- Track trades and progress towards WQ goals
- Manage risk among parties to trades
- Provide information to the public and other stakeholders
- **NGO support**

# Passaic Trading Framework #1

- If reducing total phosphorus throughout the entire watershed is the ultimate water quality goal, then apply a conservative approach
  - Designate the area around each PS as a zone
  - Regulatory authority sets zonal effluent caps and transferable discharge permits one-by-one from upstream to downstream
  - Attenuation of TP will occur between zones
    - Basis for trading ratio
  - Apply trading ratio to trades between zones
  - *Only allow trades if the seller is upstream*

# Passaic Trading Framework #1

## Example



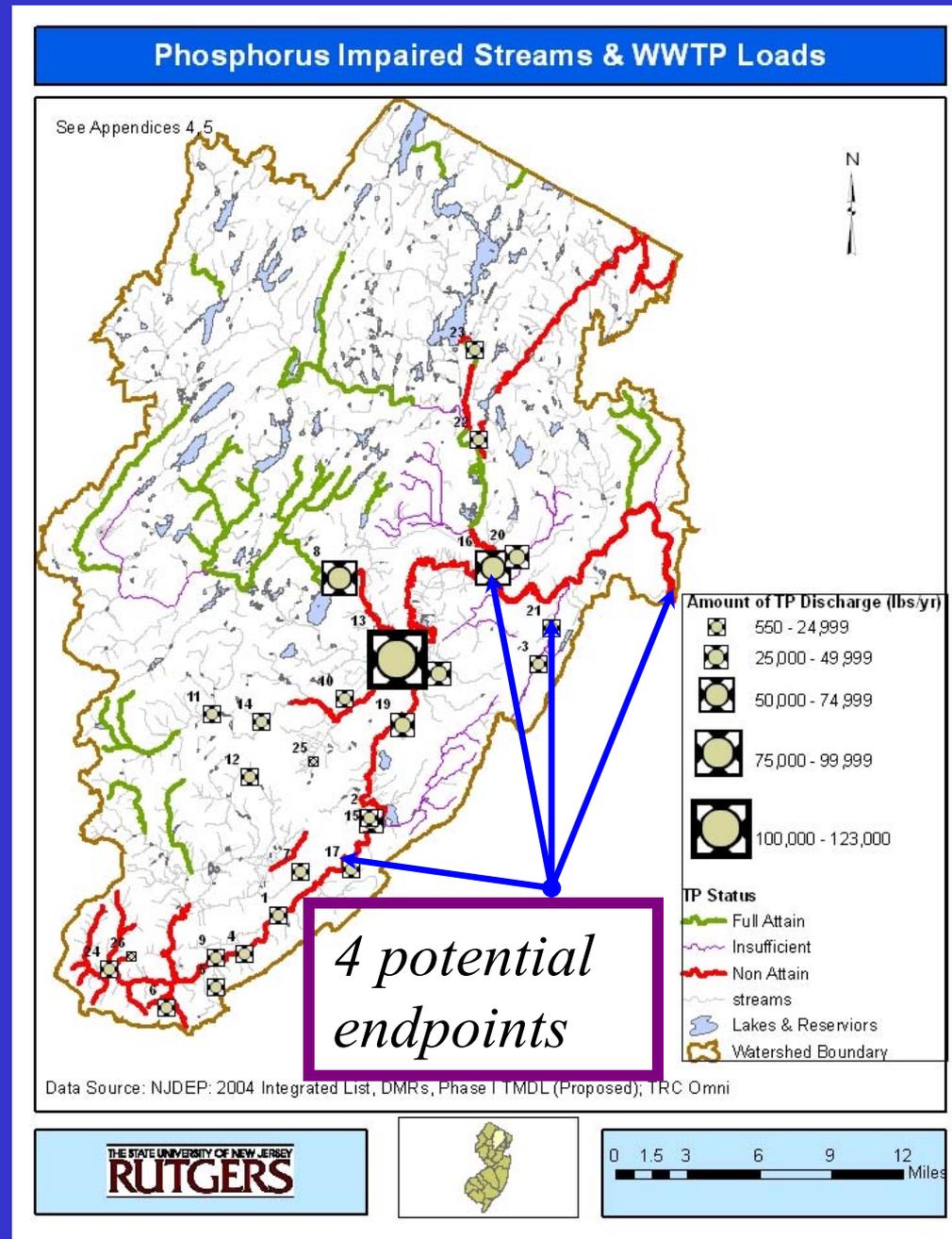
# Passaic Trading Framework #2

## Scientific Background

- Passaic TMDL studies and modeling suggest high TP is not always a problem
  - Main water quality issue regarding TP is its influence on algal growth and diurnal DO swing
  - Studies suggest decreased TP in certain reaches would improve water quality i.e. reduce chl-a levels and diurnal DO swing in summer
    - *However, decreased TP in other reaches would not improve chl-a or DO status*
  - Site-specific criteria may be more appropriate than in-stream state standard of 0.1 mg/l TP

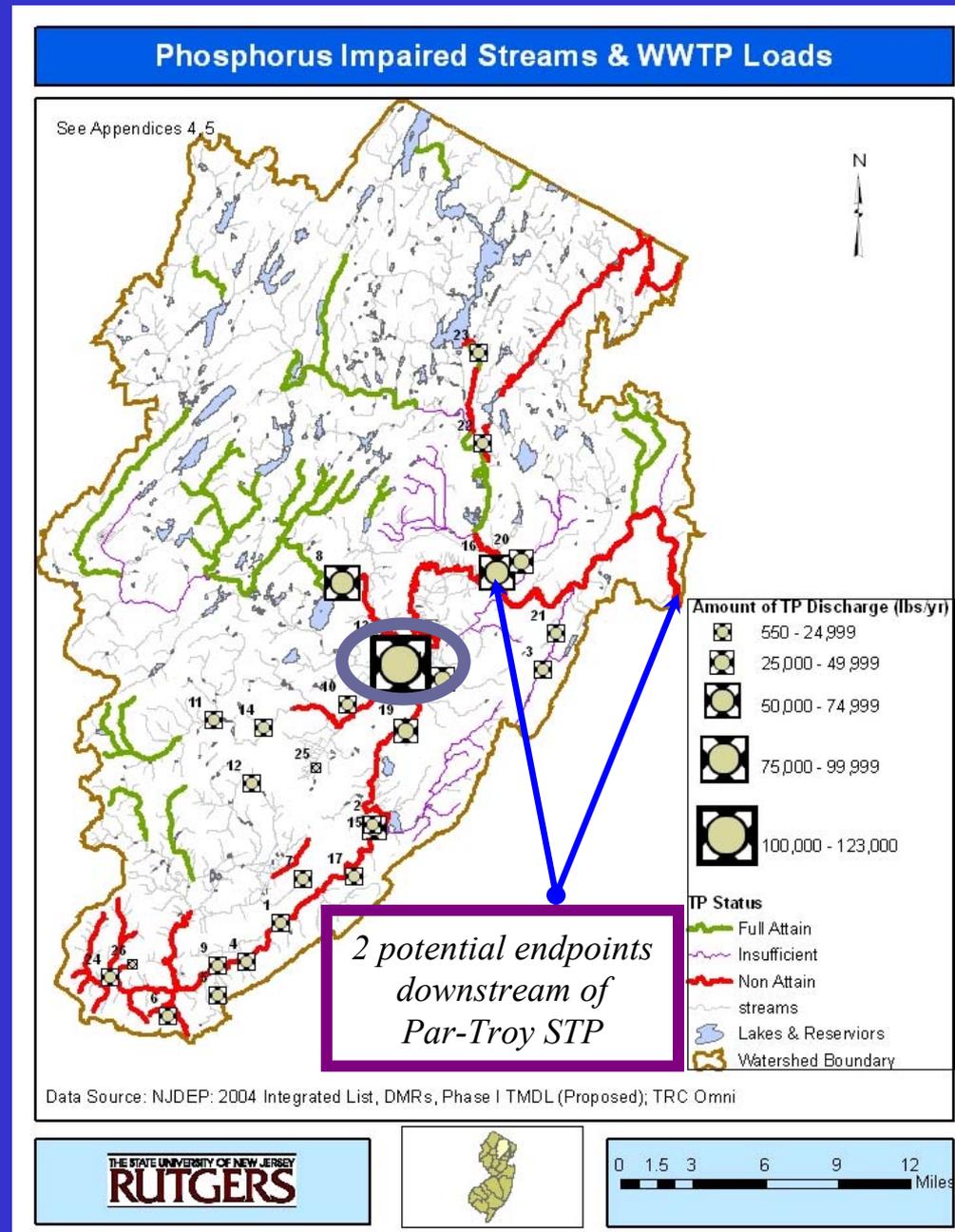
## Passaic TMDL will *potentially* be designed to protect multiple endpoints

- Endpoints are locations where reduced TP will improve water quality i.e. reduce chl-a levels and diurnal DO swing in summer
  - Endpoints are by definition existing hot spots
- For each endpoint, a target reduction in TP load from upstream WWTPs will be calculated
- For each WWTP, a separate cap relative to each downstream endpoint will be calculated
- The WWTP's final cap will be its relative lowest cap.



## Example:

- Parsippany-Troy Hills STP is upstream of 2 potential endpoints.
- Suppose that relative to Wanaque South intake, the plant needs a 0.5 mg/l cap; and relative to Dundee Lake, the plant needs a 0.8 mg/l cap
- The plant cap would therefore be set at 0.5 mg/l, the lower and more conservative number

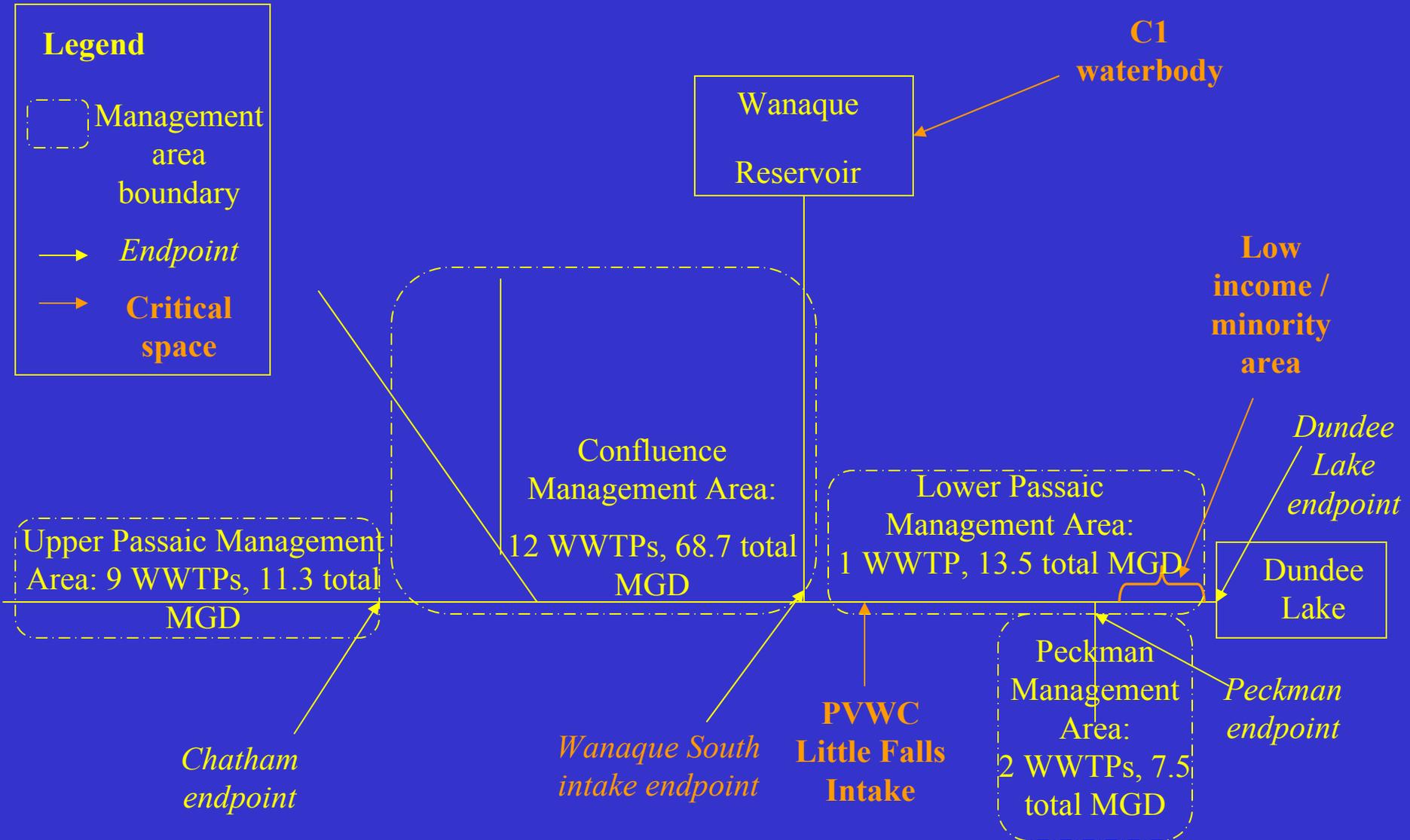


# Passaic Trading Framework #2

## Alignment with TMDL

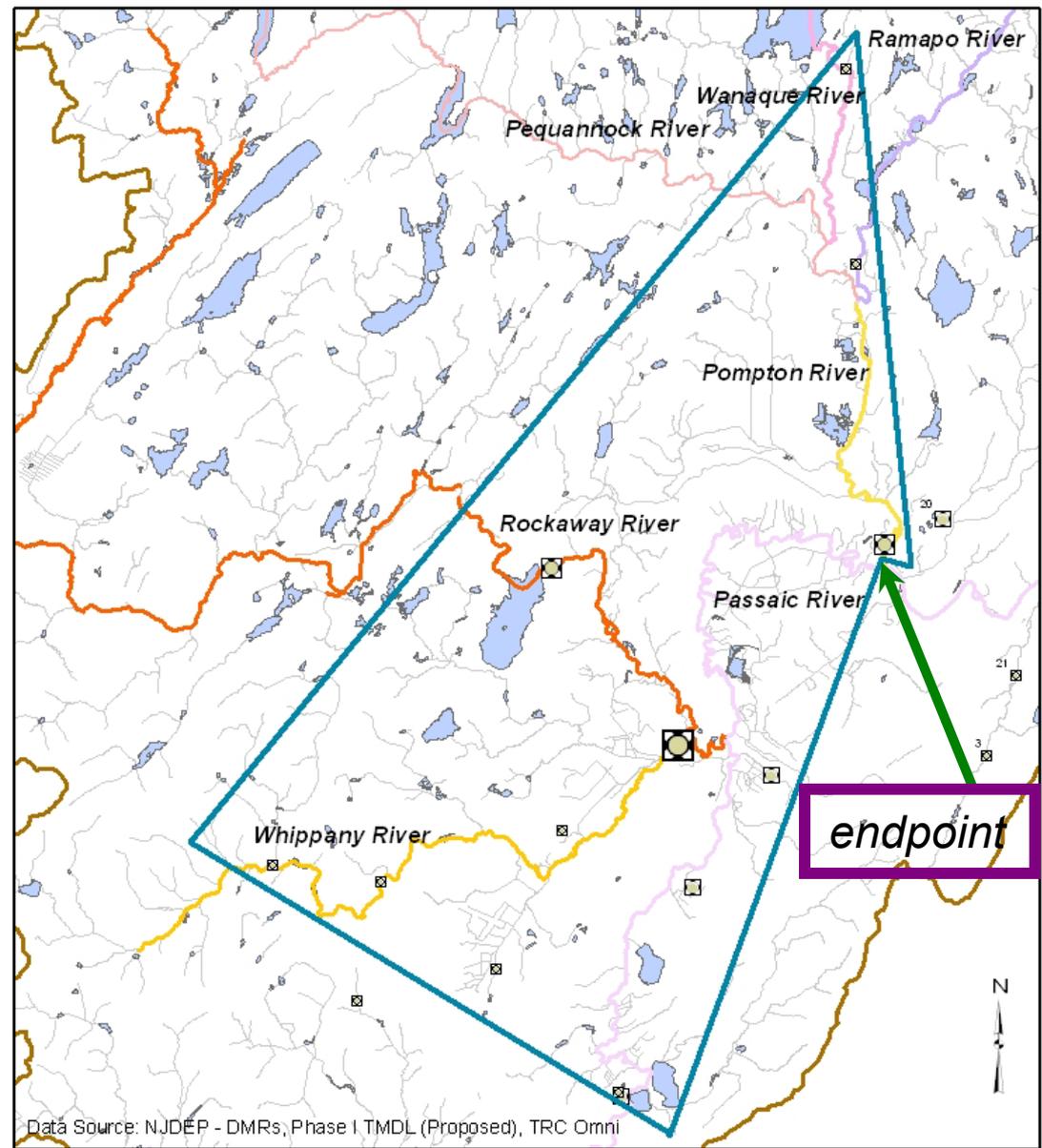
- If TMDL has multiple endpoints, need a trading framework that protects each endpoint
  - Establish management areas and critical spaces
    - **A management area is the area bounded by a TMDL endpoint, i.e. each endpoint has a management area**
      - Endpoint is the only hot spot concern in a management area
    - **A critical space is defined as:**
      - Low income / minority area
      - Reaches directly upstream of drinking water intake
      - Category 1 waterbody
  - Set trading ratios for intra-management area and inter-management area trades
  - Eliminate existing hot spots and avoid creation of new hot spots

# Schematic: Management areas and critical spaces



# Confluence Management Area

- Endpoint is Wanaque South Intake
- Endpoint is only hot spot concern in the Confluence Management Area
- 12 WWTPs with total 68.7 MGD capacity
- WWTP discharge is attenuated as it flows toward endpoint

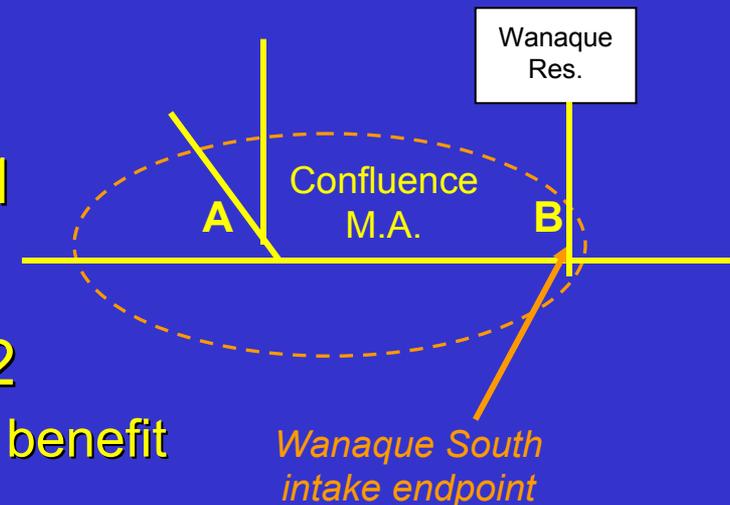


# Trading ratios

- Trading ratio accounts for attenuation between the point sources and an endpoint
  - Establishes water quality equivalence for trade
- Trading ratio = (buyer's discharge transfer coefficient at endpoint) / (seller's discharge transfer coefficient at endpoint)
- A trading ratio "x:y" indicates that for y pounds bought, x pounds need to be sold

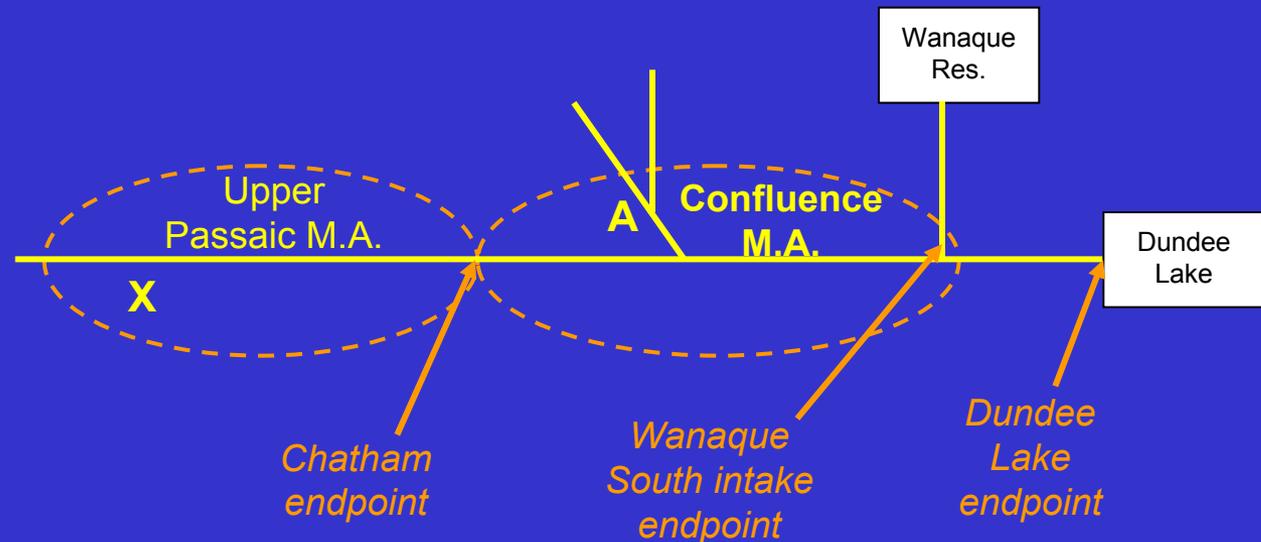
# Intra-management area trading

- Example: A is upstream of B. Relative to endpoint, A's discharge transfer coefficient is 70%, B's discharge transfer coefficient is 85%.
- If B buys and A sells
  - Trading ratio =  $85 / 70 = 1.2:1$
- If A buys and B sells
  - Trading ratio =  $70 / 85 = 1:1.2$ 
    - Could choose 1:1 for more WQ benefit
  - No hot spot concern
    - Management area is delineated so that endpoint is only potential hot spot



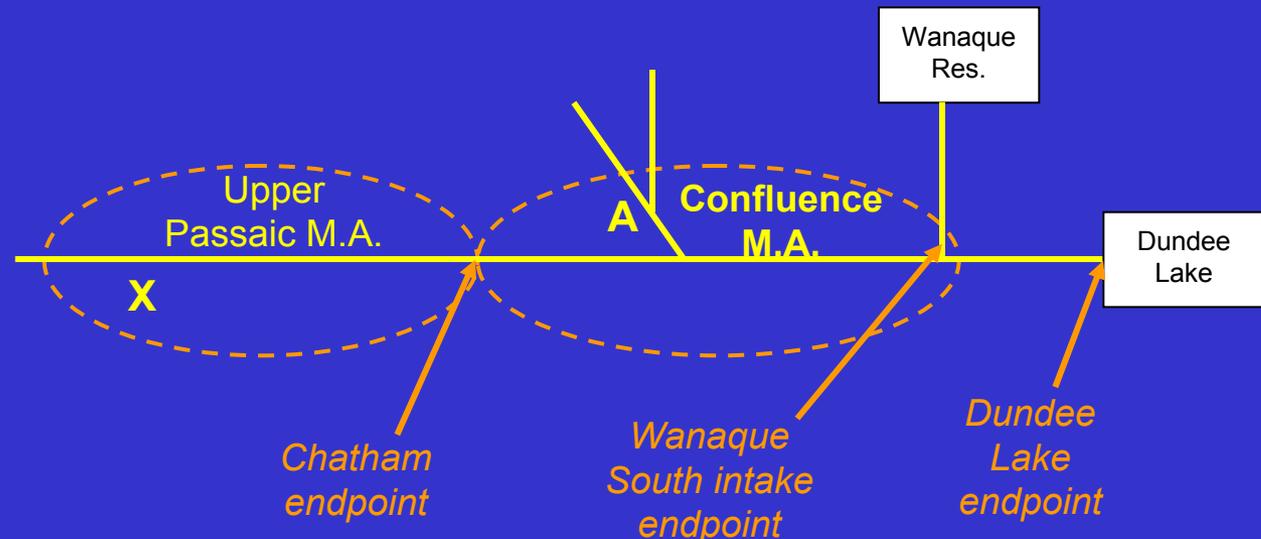
# Inter-management area trading

- Example: X is upstream of A. Relative to WS intake endpoint, X's discharge transfer coefficient is 40%, A's discharge transfer coefficient is 70%.
- If A buys and X sells
  - Trading ratio =  $70 / 40 = 1.75:1$

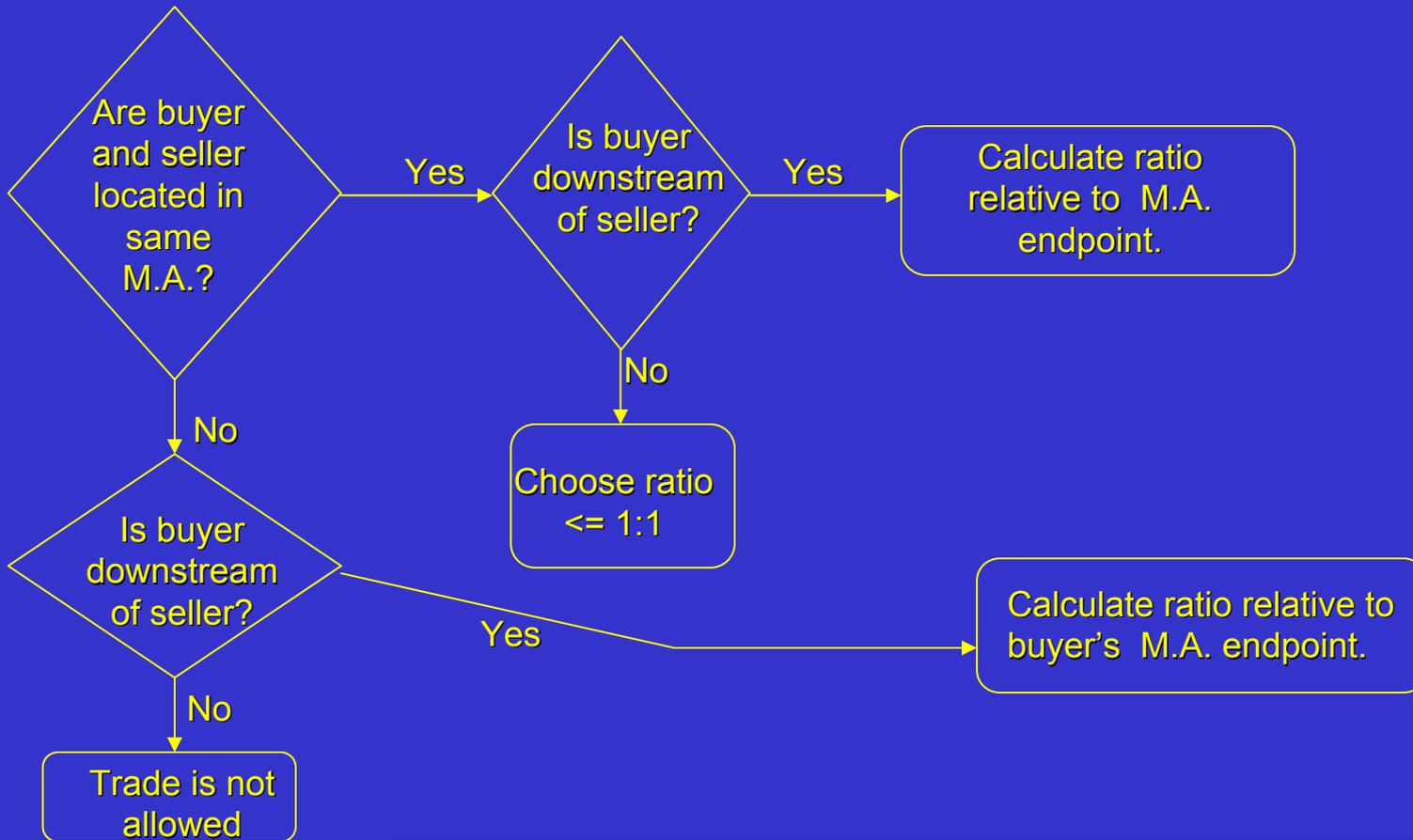


# Inter-management area trading

- What if X wants to buy credits from A?
  - No trade allowed: hot spot concern



# Passaic Trading flowchart: considers multiple endpoints

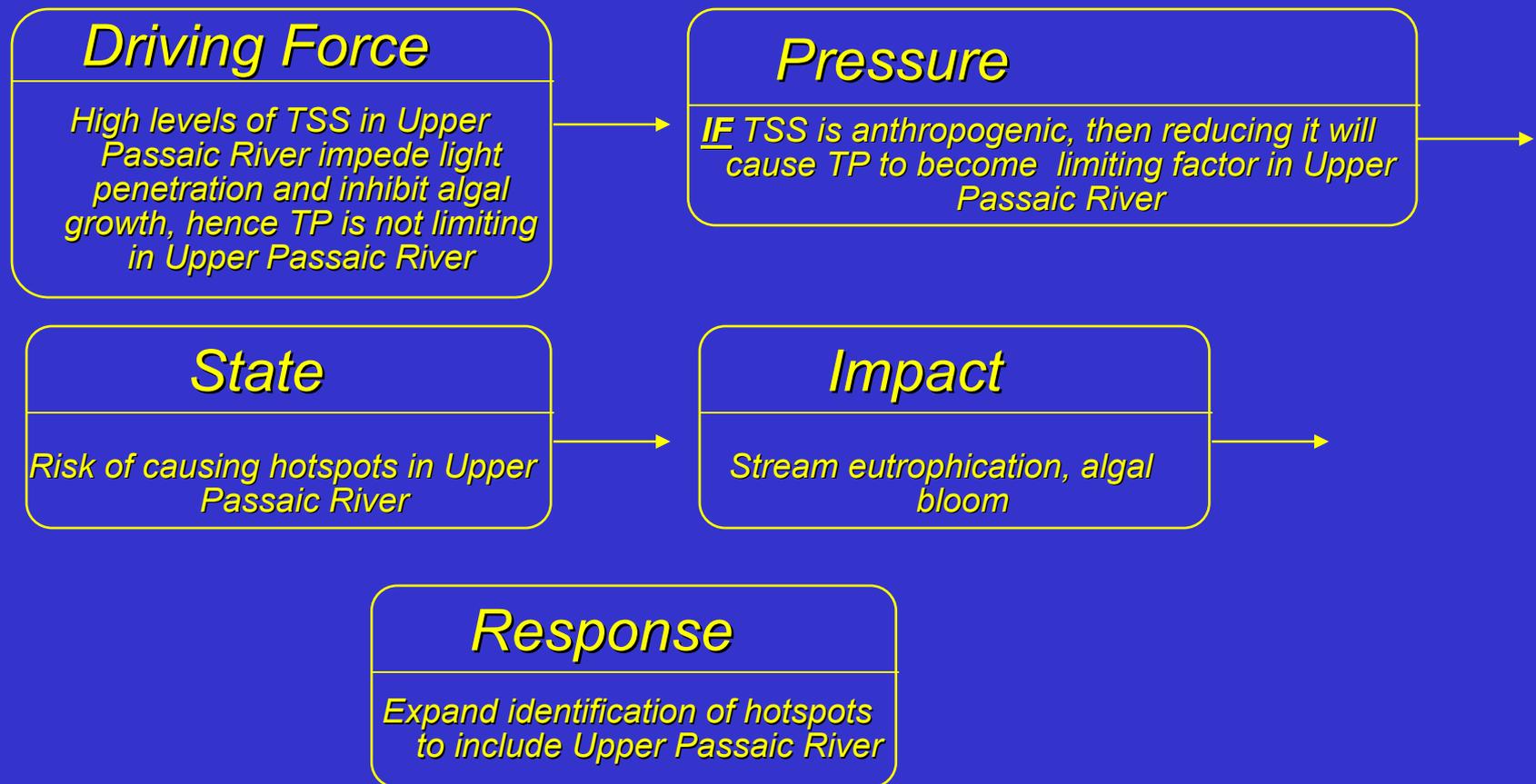


*Buying from downstream can take place within a management area, but not between management areas.*

# Value of Decision Support System (DSS) to Trading

- DSS is tool to analyze problem and systematically consider solutions
- DSS was developed to identify hot spots
  - Broader applications to trading and water quality management
- Passaic TMDL studies only considered impact of TP on algal growth and DO swing
  - TMDL studies applied method (NJDEP “off ramp method”) not designed to consider whole ecosystem effect on algal growth
    - Did not evaluate high TSS in Upper Passaic, which impedes light penetration and inhibits algal growth
- Need for analytical framework that considers all factors affecting algal growth
  - Better way to identify potential hot spots

# Driving Force-Pressure-State-Impact-Response (DPSIR) Method in Decision Support System Framework



# Value of DSS to Trading

- DSS provides choice regarding which method to use to identify hot spots
  - Off ramp method
  - DPSIR method
- If in this watershed it is found high TSS in Upper Passaic is natural condition, then off ramp method is appropriate
- In other watersheds, if high TSS is anthropogenic and impeding algal growth and TP is high
  - DPSIR method is appropriate
  - Expand trading program to target reduction of TSS and TP

For more information:

[www.water.rutgers.edu/Projects/trading/WQTrading.htm](http://www.water.rutgers.edu/Projects/trading/WQTrading.htm)