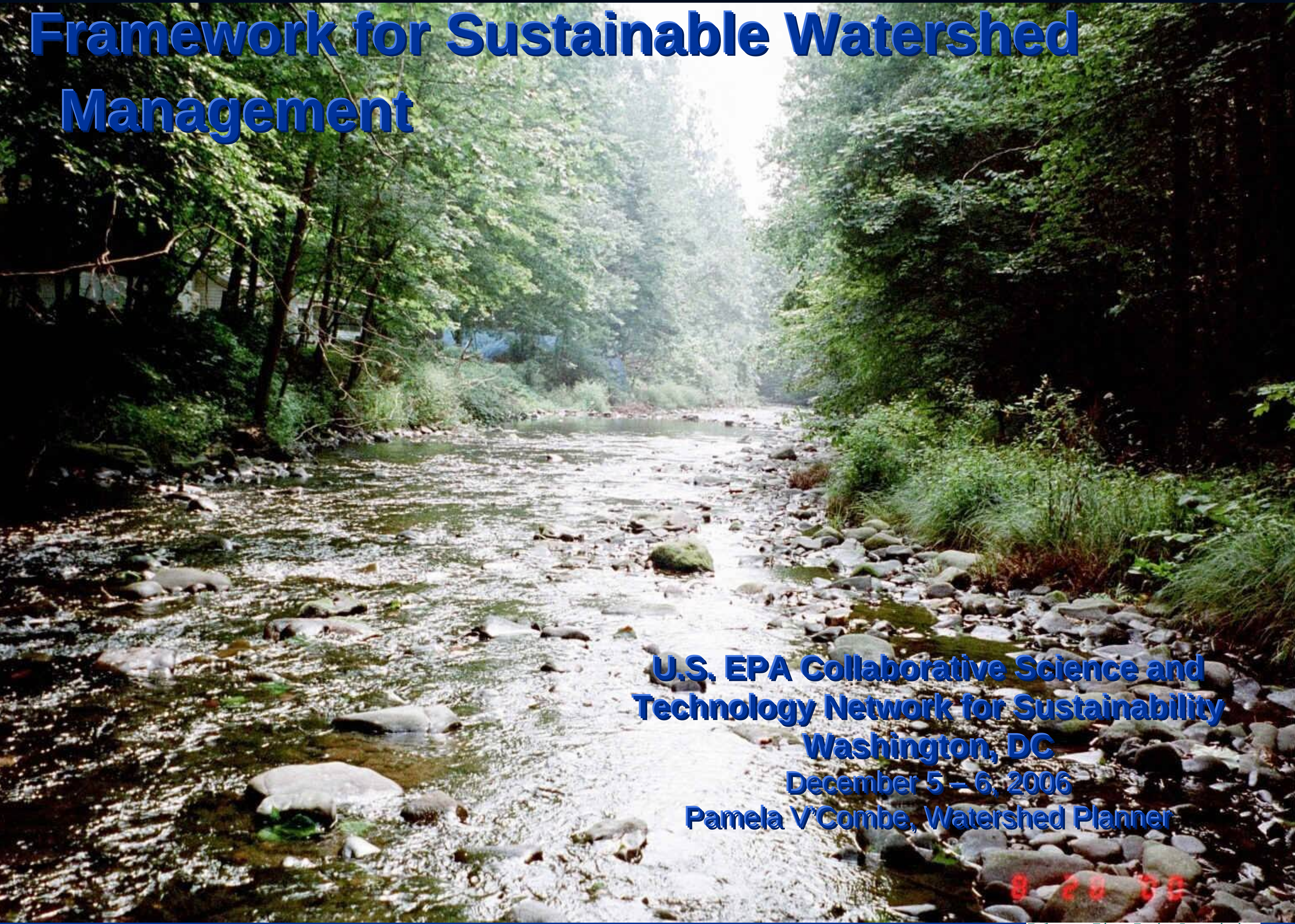
Framework for Sustainable Watershed Management



U.S. EPA Collaborative Science and Technology Network for Sustainability
Washington, DC

December 5 – 6, 2006

Pamela V'Combe, Watershed Planner

Delaware River Basin

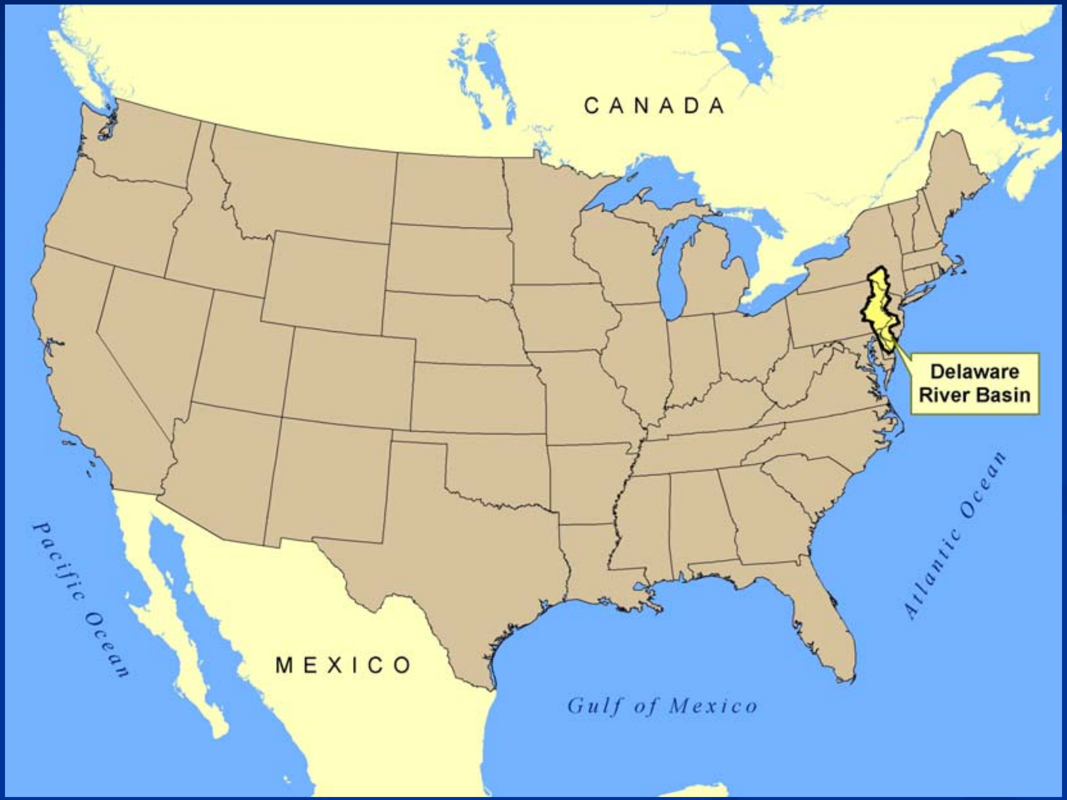
Longest Un-dammed River
East of the Mississippi

- 330 miles
- 216 tributary streams
- 4 states,
- 42 counties,
- 838 municipalities
- 2 EPA regions

150 miles is included in the
National Wild and Scenic Rivers System.

Delaware River Basin

- Drains only four-tenths of one percent of the total continental U.S. land area
- Five percent of national water supply – 15 million people



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Basin has Urban Centers with Tall Ships and …

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Historical Significance …

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Important Natural Resources…

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and Outstanding Natural Beauty

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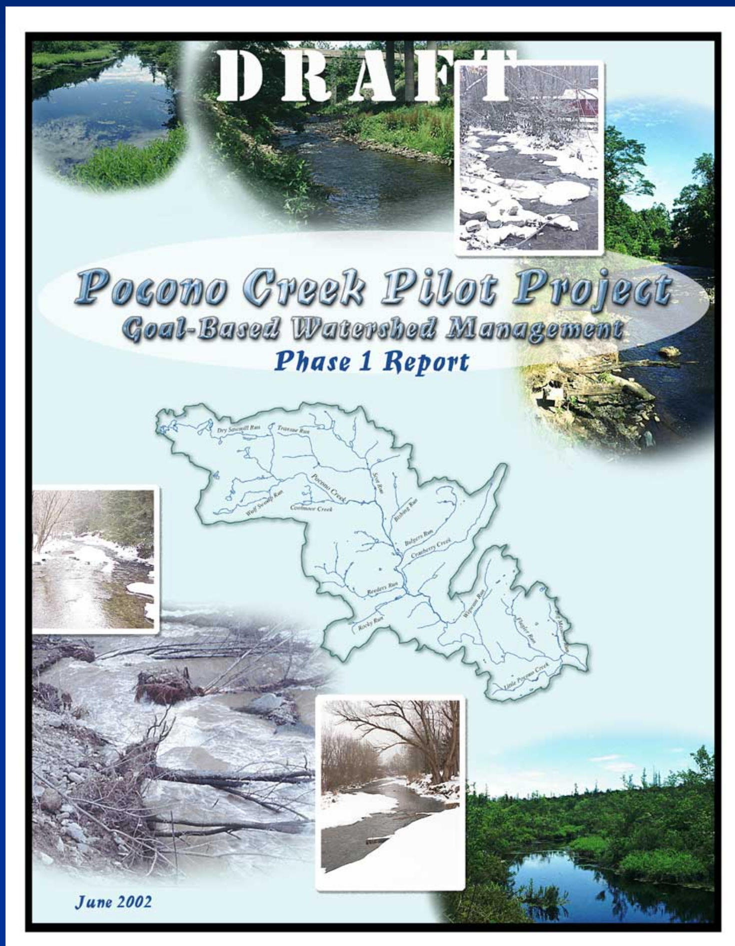
Pocono Creek Pilot Study
2000-2004



Major Water Resources Issues in Pocono Creek Watershed

- 1. Stream Flow
- 2. Water Quality
- 3. Stream Channel Stability
- 4. Aquatic Ecology

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Pocono Creek Watershed

Monroe County PA – 2nd in Growth

Tourism Based Economy

Population Increased > 50% in past decade

More than 50% Undeveloped

90 minute Drive from Philadelphia & NYC

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Pocono Creek Headwaters

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Pocono Creek - Headed Downstream

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Pocono Creek – Cranberry Bog

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Pocono Creek – Downtown

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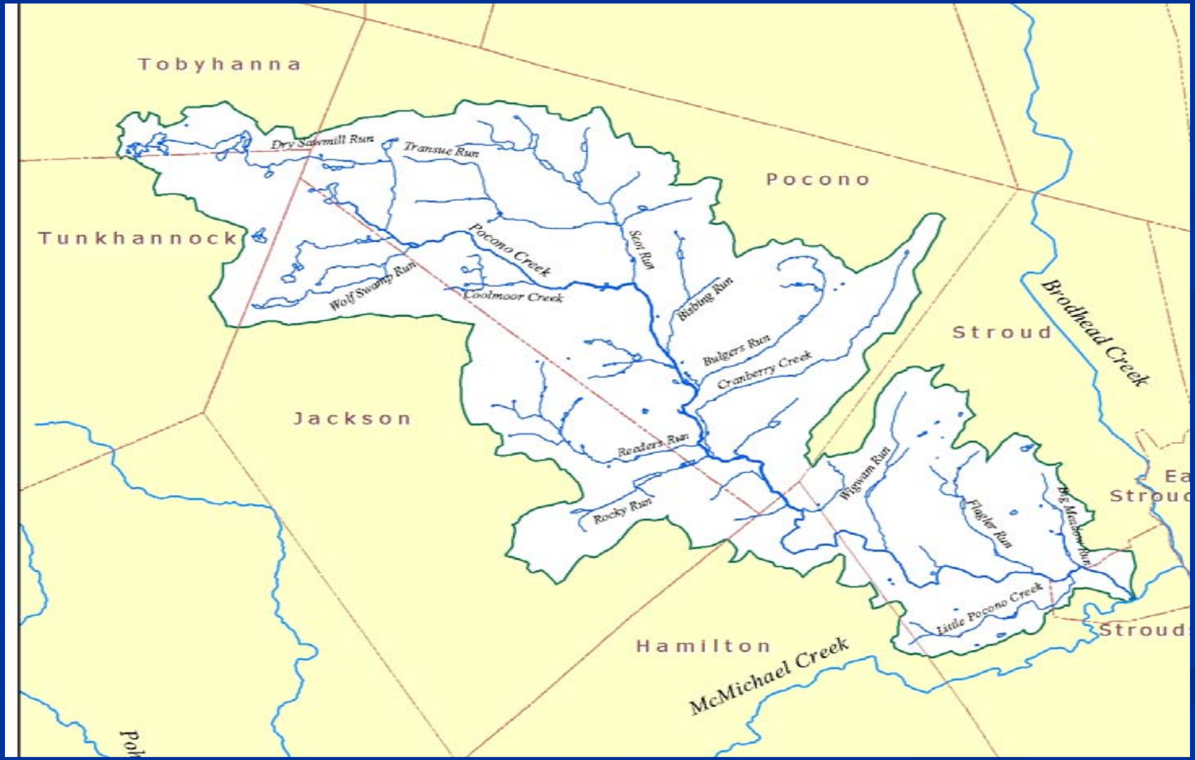
Pocono Creek Watershed

Pocono Creek is 18 Miles - Watershed 46.5 sq. mi.

HQ & EV Cold Water Stream (PADEP)

Class A Wild Trout Stream (PF&BC)



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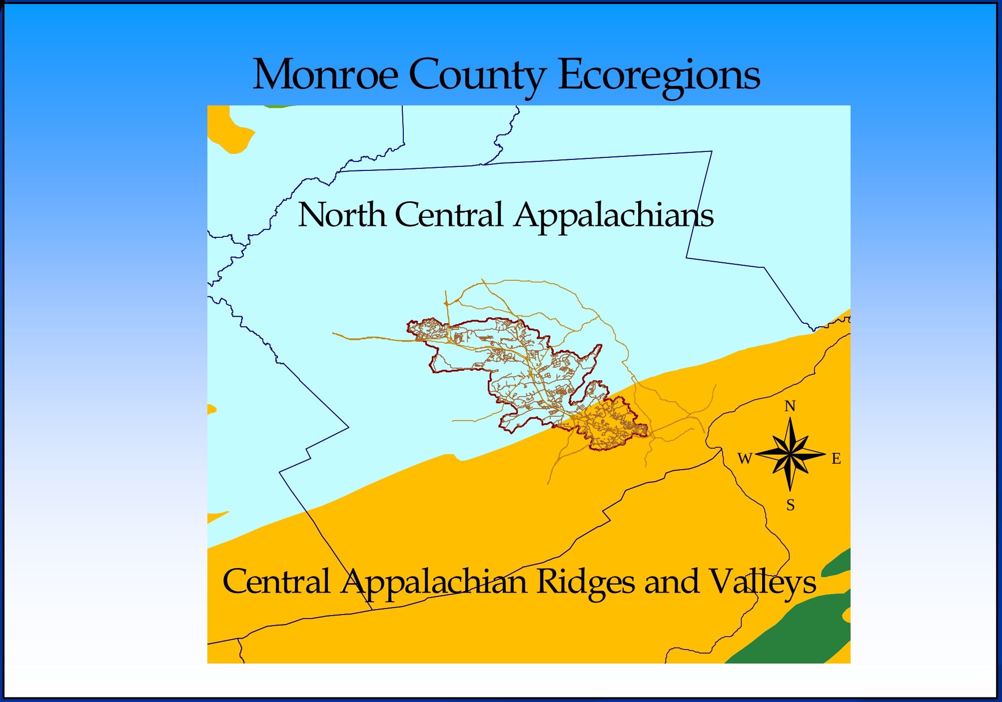
Two Ecoregions

Appalachian Plateau

Ridge & Valley



Pocono Creek Watershed Goals

- Maintain high quality water quality
- Preserve stream corridors and floodplains
- Coordinate watershed planning process with other levels of government
- Maintain existing stream flow
- Develop using village centers conservation design
- Establish an economy compatible the environment
- Preserve open space

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Water Quantity Goals

Maintain existing stream flows

&

Support natural ecosystems

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Framework for
Sustainable Watershed Management

Manage the Water Resources to Meet Current and Future Needs

EPA

This research is funded by
U.S. EPA - Science To Achieve Results (STAR) Program
Grant #

DRBC
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Brodhead · Watershed · Association

Preparing Monroe County for the future... MONROE 2020

MONROE COUNTY CONSERVATION DISTRICT
ENVIRONMENTAL EDUCATION CENTER

USGS
science for a changing world

PENNSYLVANIA FISH & BOAT COMMISSION

Sustainable Watershed Conditions

Water Resources to Support Human Needs & Ecological Habitat

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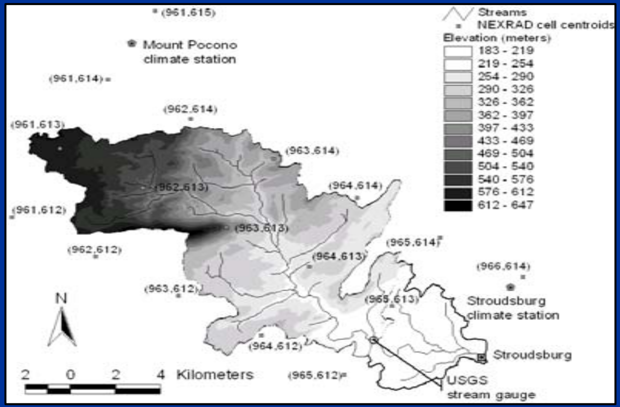
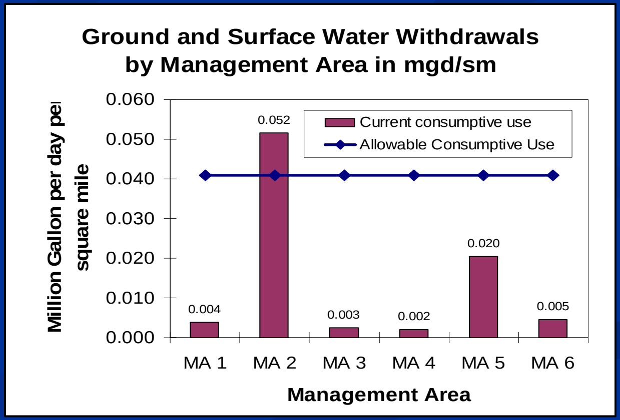
Framework for Sustainable Watershed Management

Approach: To use sound science to develop water resource management strategies and polices that are adopted and implemented by decision makers.

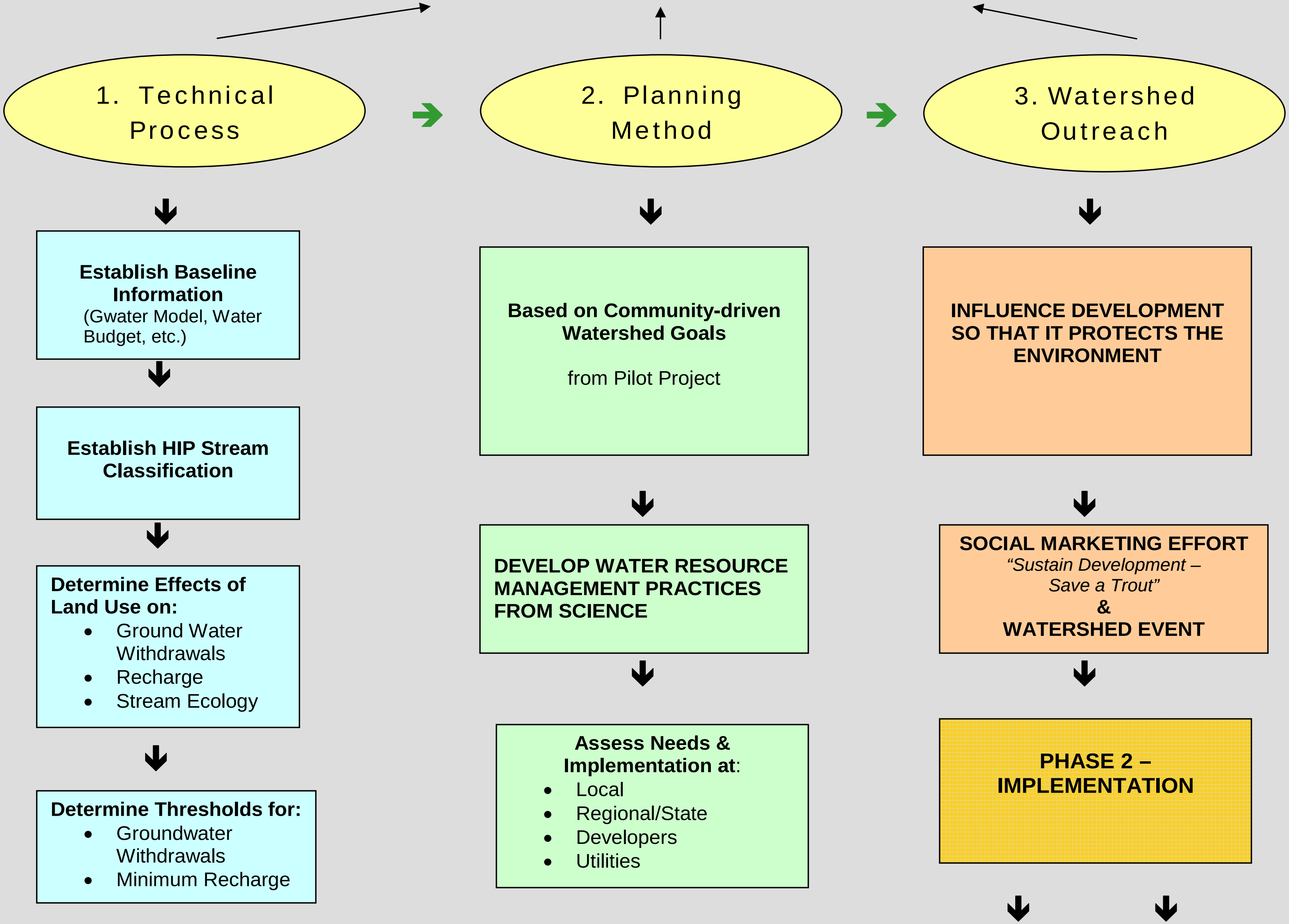




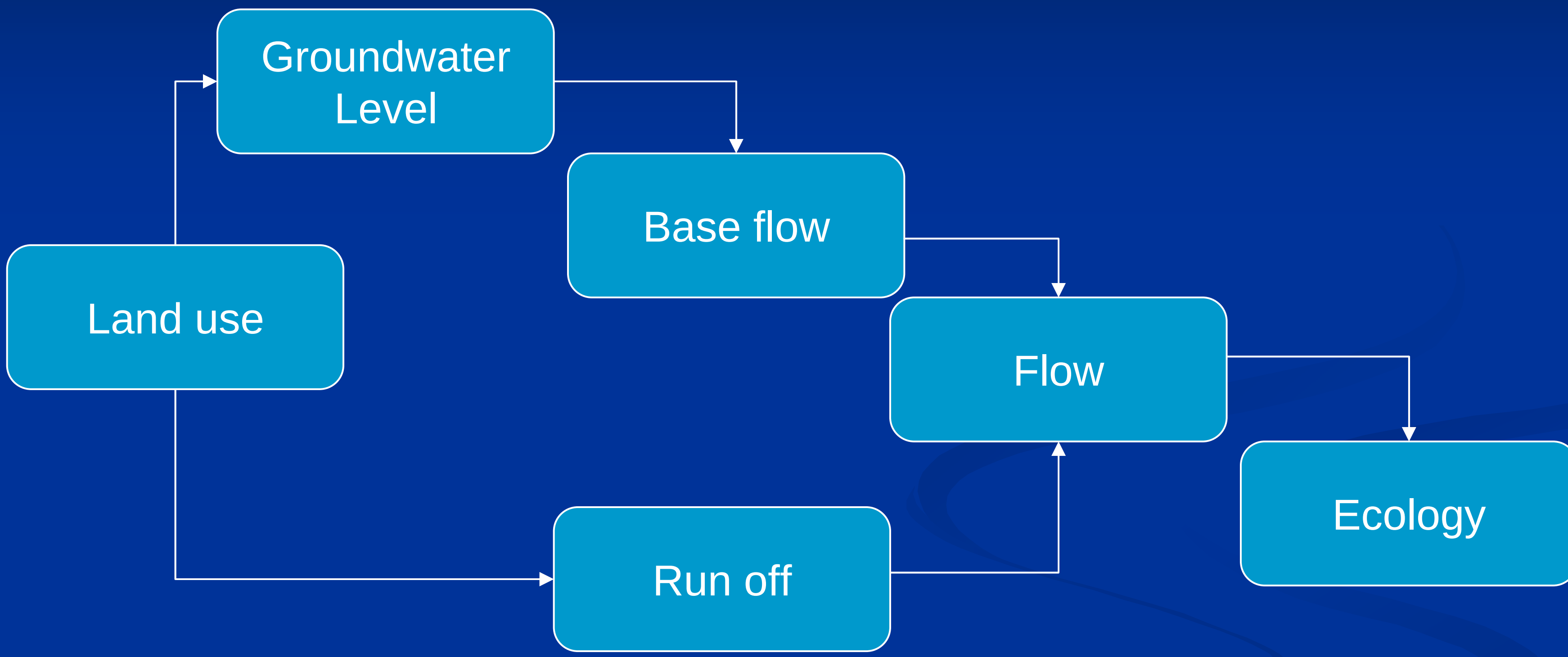
Framework for Sustainable Watershed Management

- Stage 1 – Technical & Scientific Research
- Stage 2 – Development of Management Strategies & Planning Tools
- Stage 3 – Community Outreach

The Framework for Sustainable Watershed Management



Models and HIP Process



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Technical Stage

- Baseline for:

Existing Water Budget
Ground Water/Surface Water Interface
Streamflow Statistics
Hydrologic Conditions
Existing Water Demands

- Determine necessary conditions to maintain sustainable flows in Pocono Creek Watershed
- Characterize hydrologic relationships between baseflows and withdrawals
- Identify stressors for existing habitat

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Technical Stage

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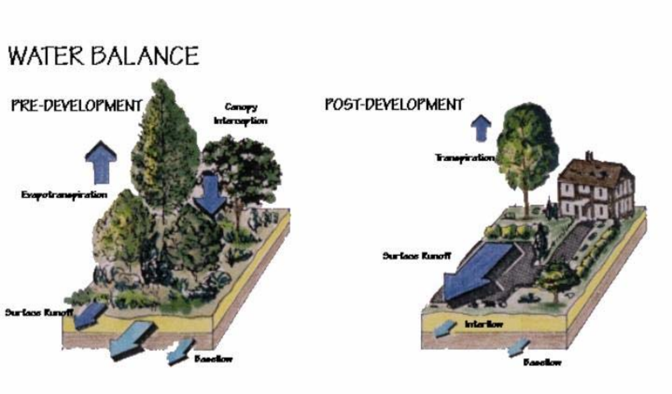
HYDROLOGY MODEL STUDY

RESULTS Based on Projected Build Out -

Recharge reduced in 26 out of 29 recharge areas



Daily Base Flow < 31%
Low Flow 7Q10 < 11%,
Monthly Median Daily Flow < 10%

Monthly Peak of Daily Flows > by 21%
Annual Maximum of Daily Flow > 19%

Watershed-averaged Groundwater Recharge < 31%

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HYDROLOGY MODEL STUDY

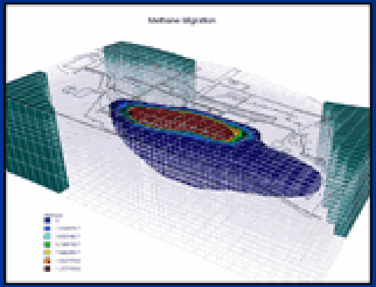
Soil and Water Assessment Tool (SWAT) calibrated and validated for Raingauge & Next Generation Weather Radar (NEXRAD) hourly precipitation data

"The results clearly show that NEXRAD is an effective and economic alternative source of spatio-temporal precipitation, and that future modeling studies in ungauged watersheds may benefit from the use of NEXRAD rainfall data."

TRANSFERABLE!

USGS MODFLOW-2000 Groundwater Flow Model

Measured Effects on Stream Base Flow from



Ground-Water Withdrawals

&

Reduced Recharge from Land Use Change

- Three-dimensional
- Entire Pocono Creek watershed
- Used EPA-ORD hydrology model recharge values for 2000 land use & 2020 land use.

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USGS MODFLOW-2000 Groundwater Flow Model

Model used to simulate base flow for 2000 & 2006

- 2 sets of steady-state simulations were run:

  2.25-mi2 Bulgers Run subwatershed

  6.1-mi2 Scot Run watershed.

- 5 hypothetical wells added to each subwatershed to simulate consumptive pumping.

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USGS MODFLOW-2000 Groundwater Flow Model

Initial Findings:

- Effects of ground water withdrawals are related to drainage area
- Base flows decreased at build-out
- Simulated base flows decreased 38 to 100% at streamflow-measurement sites
- Base flow decreased 31% at streamflow-gaging station
- Groundwater withdrawals and surface water withdrawals equally affect stream flow

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Hydrology Model & Ground Water Model Agree!

The results indicate that…

Kalim A. Bhatti for the New York Times

Traditional Development Patterns in the Pocono Creek Watershed will Decrease Base Flows in Pocono Creek by >30%!

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Hydroecological Integrity Assessment Process

Links Streamflow and Stream Health

Purpose is to:

- Sustain or Restore Stream Communities

- Sustain or Restore Stream Integrity

In order to maintain healthy aquatic ecosystems in streams

Hydroecological Integrity Assessment Process (HIP)

"Streamflow is ..."master variable" … Limits the distribution, abundance, and diversity of many aquatic plant and animal species."

Conducts hydrologic classification of streams,
Addresses instream flow needs, and
Assesses past and proposed hydro-logic alterations on;

- streamflow and
- ecosystem components.

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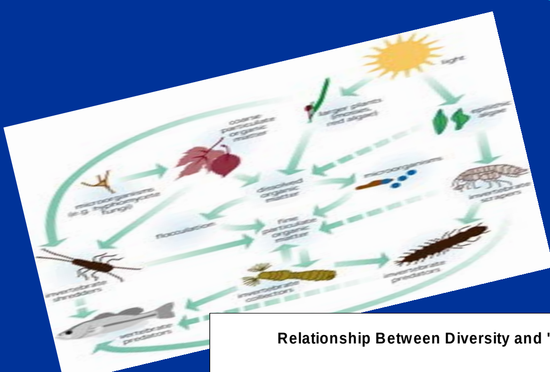
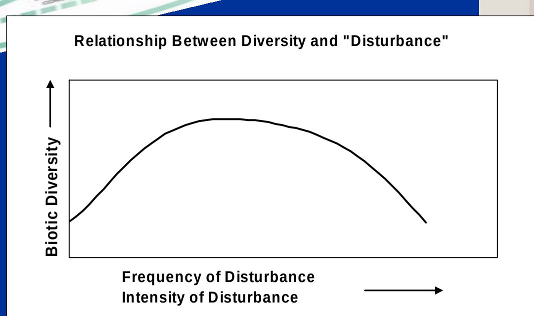
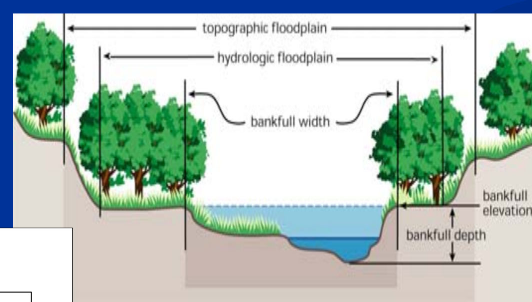
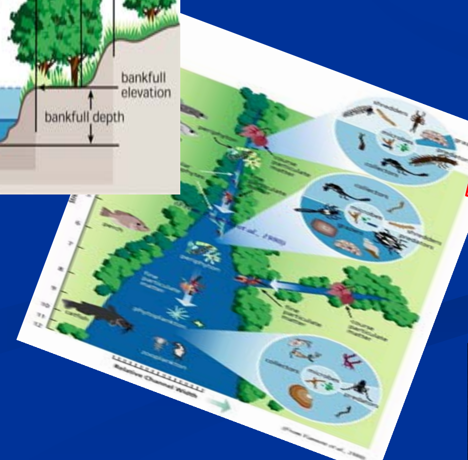
Natural flow regime paradigm

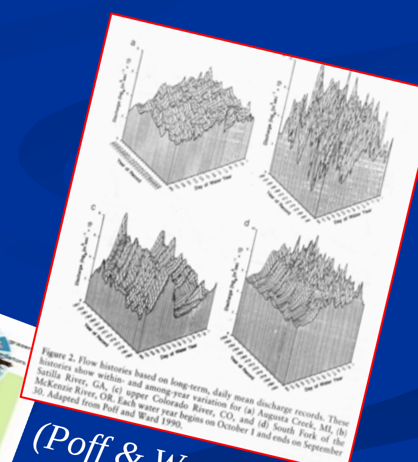
- River continuum concept *(Vannote 1980)*
- Flood pulse concept *(Bayley 1991)*
- Hierarchical, multi-scale *(Frissell 1986)*
- Network dynamics hypothesis *(Benda et al. 2004)*
- *Intermediate-disturbance hypothesis (Ward & Stanford 1983)*





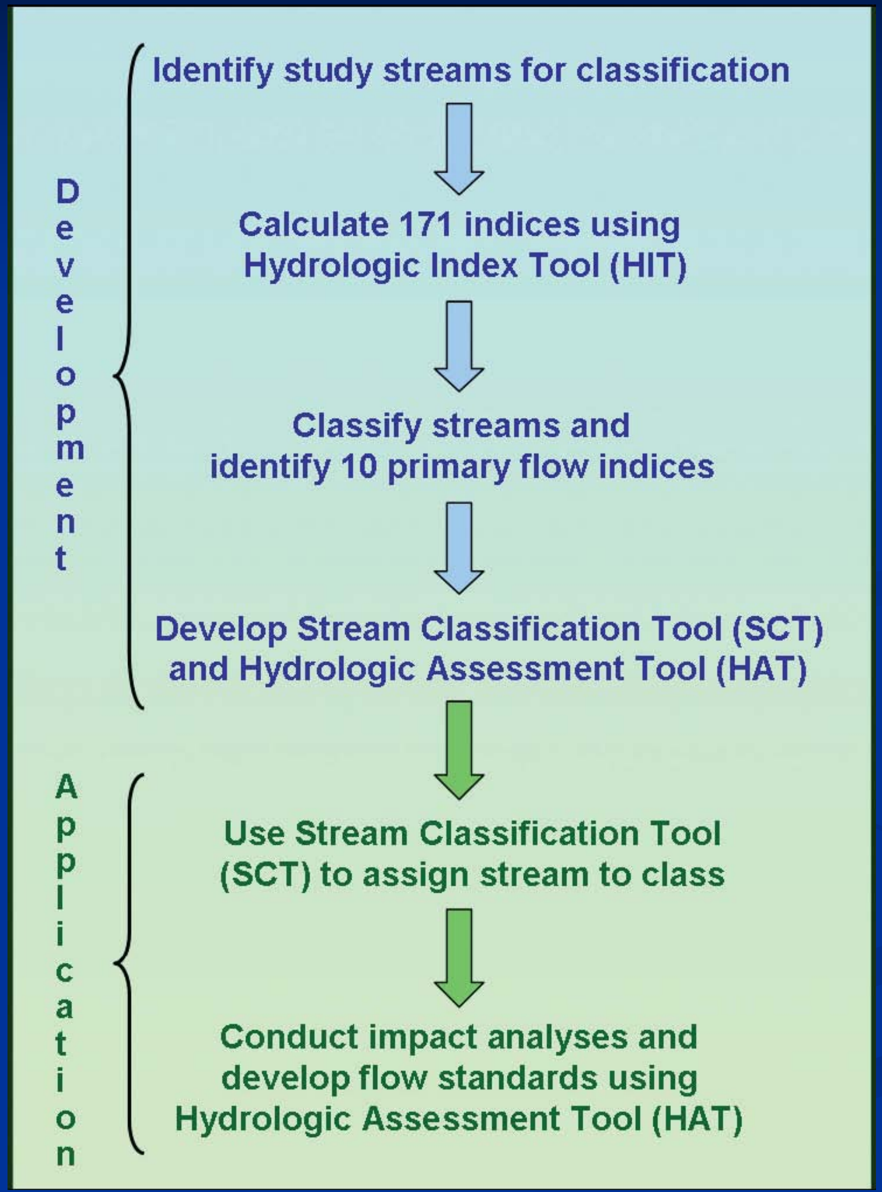






(Poff & Ward 1990)

HIP PROCESS



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SURPRISES!

- **Experiencing Technical Difficulties!**

  Selected Methodology Didn't Work -
  - IFIM Model replaced by HIP
  - Product deliverable changed from Flow Curves for Trout to HIP Stream Classification
  - Will Attempt to Apply HIP to Habitat Species
  - New Partners

- **New Infrastructure Coming to Town!**

  Local Partners Concerned with Impacts, Distracted by "Battle"

- **Social Marketing as Outreach!**

  EPA R-3 Workshop Re-energized Watershed Group

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Contributions towards Sustainability are…

A 3-Staged **Framework for Sustainable Watershed Management** that Allows Development while Protecting Ecological Flows

Technical Process

- Understanding Limit of Resource

Planning Method

- Development of Management Strategies Based on Science

Community Outreach

- Influence Development that Protects the Environment

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Partners' Updates & Transferable Products

- **US EPA**

  Hydrology Model, Water Quality and New Flow Data, Statistics
- **Delaware River Basin Commission**

  SPECIAL PROTECTION WATERS Regulatory Guidance Manual
- **Monroe County Conservation District**

  Stormwater Management Plan Adopted by PADEP
- **Brodhead Watershed Association**

  Social Marketing Training
- **Monroe County Planning Commission**

  Active Regional Planning Groups
- **USGS**

  Application o HIP to Ecology
- **PA DEP**

  Statewide Interest in IMIP & HIP

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EPA TRUE PARTNER

This research is funded by
U.S. EPA - Science To Achieve Results (STAR) Program
Grant #

GOAL MADE POSSIBLE:
To Establish a Collaborative Community Process to Develop Sustainable Watershed Practices Based on Sound Science.

EPA Funded Project: USGS and DRBC

EPA – ORD Edison NJ and Cincinnati OH: Developed tools that will be useful in other watersheds; Provided training, equipment, and technical support.

EPA – ORD, EPA Region 3 and EPA – ORD CNS: Excellent support and collaboration, No-Cost Extension, networking opportunities, patience and good humor.

New Linkages with **PA DEP, USGS** Science Center, Ft. Collins CO

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PEER FEEDBACK

1. What are good examples of stream flow statistics and/or stream classifications being applied to stream ecology or habitat?

2. How can we ensure that the non-technical effort needed after completion of the technical stage retains project momentum?

Delaware River Basin Commission

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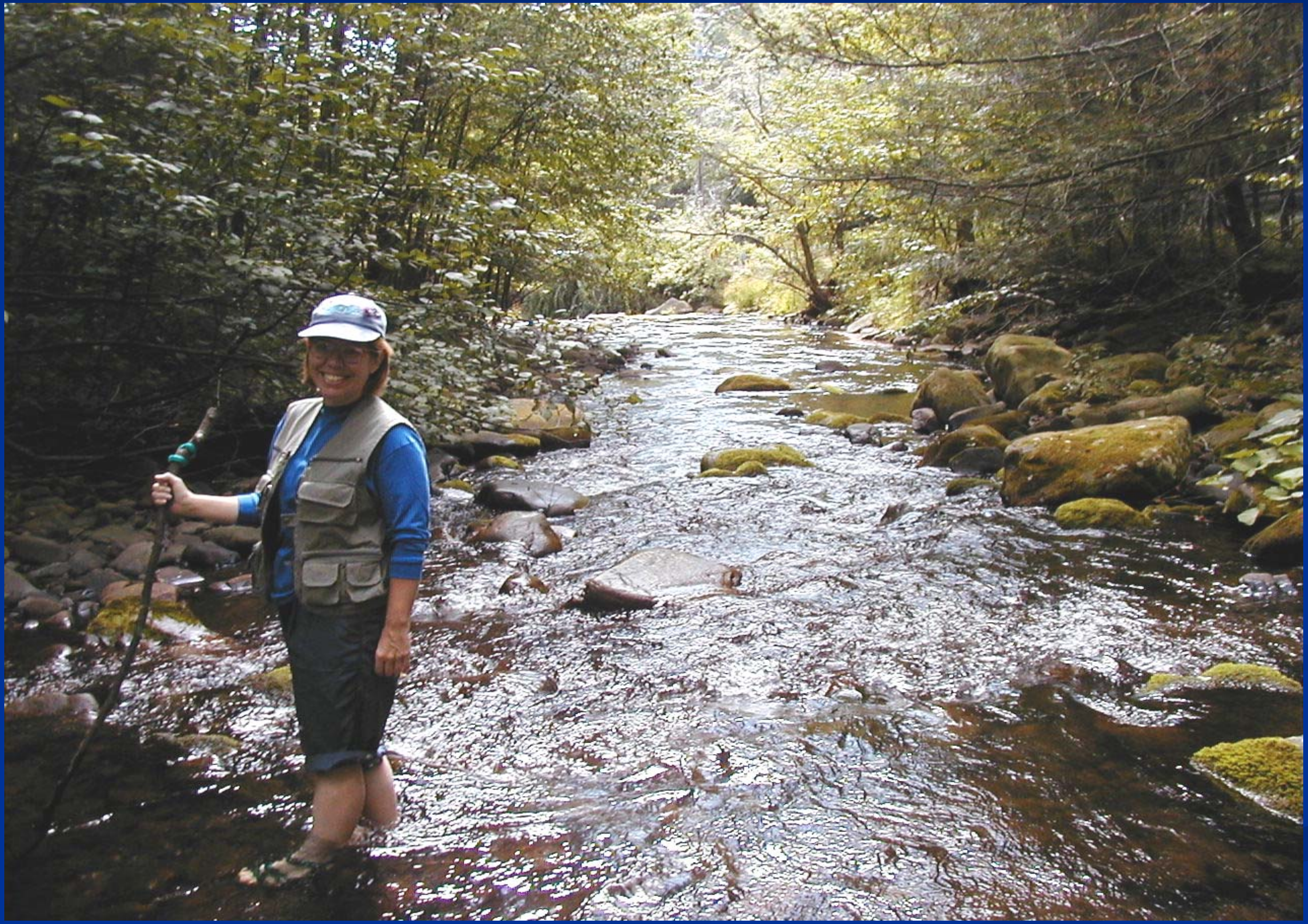

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