Surface Water / Groundwater Interaction & Source Water Protection Planning
Brodhead Creek Regional Authority - Monroe County, PA

PA AWWA Annual Meeting – April 25, 2013
Hershey, PA

Chris Finton, P.G., Jay Lynch, P.G. - Meiser & Earl, Inc.
Ken Brown, Manager & Patrick Lambert, Chief Operator - BCRA
Michael Reisenwitz, Source Water Protection Educator/Operator - BCRA

Outline of Presentation

1. Description of BCRA's Water Supply Sources
2. BCRA's Supply & Hydrogeologic Setting
3. Description of Dye-Tracing & Wellfield Studies
4. Source Water Protection (SWP) Team
5. Source Water Protection Goals
6. Source Water Protection Plan (SWPP)
7. BCRA Action Items & Accomplishments

BCRA – Water Supply Sources

- Authority serves (2008 statistics)
  - Population of ~21,000 (5,312 accounts); average daily water use of 2.23 MGD
  - 5 municipalities, PA 611 corridor including Sanofi Pasteur
- Active Sources – Brodhead Creek Watershed
  - Intake on Brodhead Creek (3.2 MGD)
  - Groundwater Wells PW-1 and PW-2 (2.88 MGD, 30-day avg)
- Groundwater Well 3 – McMichael Creek Watershed
  - Well completed and put into service April 2010
  - 0.96 MGD
- Filtration Plant – design capacity of 2.5 MGD
  - Treats water from Brodhead Creek intake
- Backup Sources – Brodhead Creek Watershed
  - Stokes Mill Spring (1.0 MGD)


Brodhead Creek


Well #1


Well #2


Well #3

Area of Contribution

BCRA intake & Wells PW-1 and PW-2

~ 130 Square Miles

12 Municipalities in 2 Counties

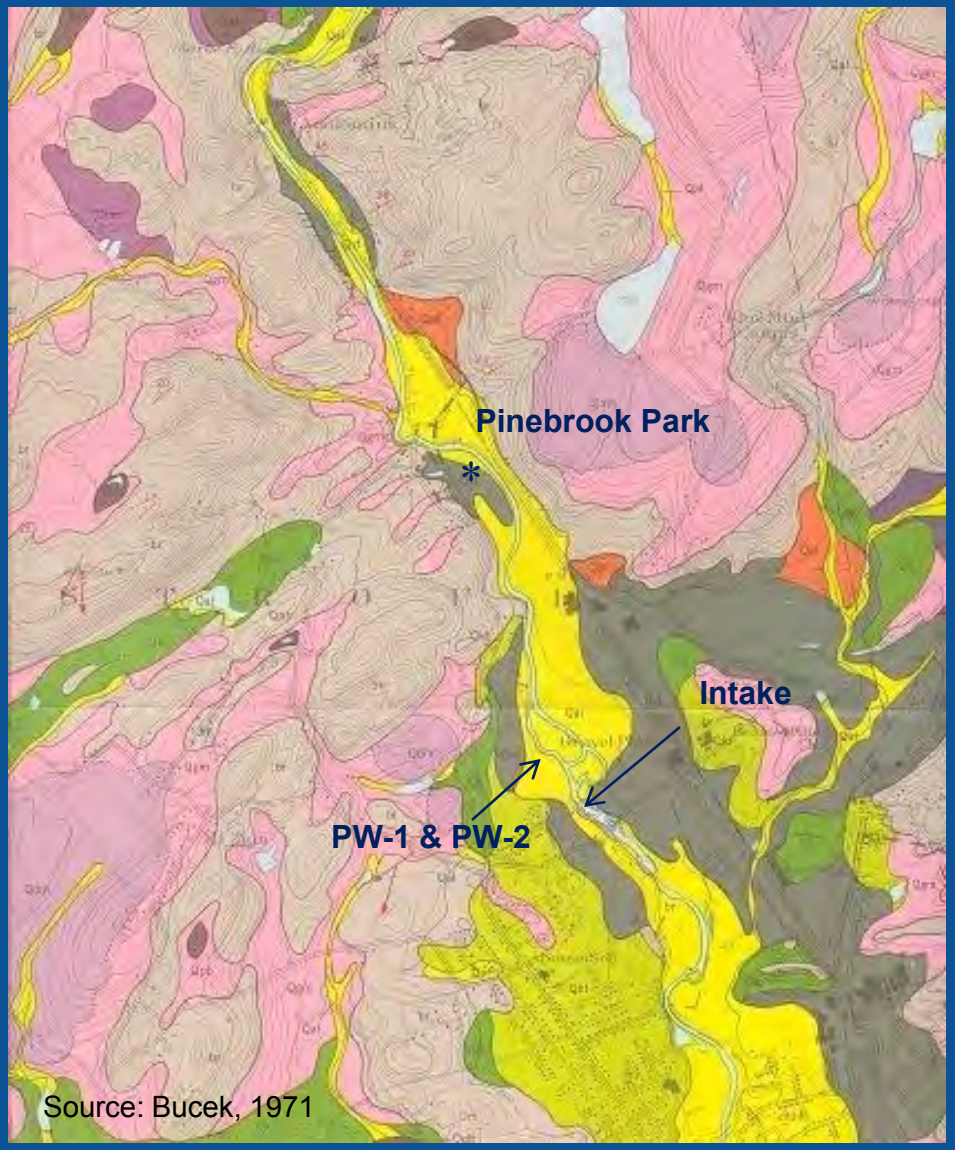
5 out of the 12 municipalities are in the BCRA service area

Description of BCRA Projects & Studies

- Evaluation of Wells PW-1 and PW-2 – 2007 thru 2009
  - Dye test(s) and Well-Field Pumping Test (part of SWP scope)
  - Updated surface water influence evaluation (quarterly MPAs)
- Brodhead Creek Hydrologic Study – 2007 through 2012
  - Installation of stilling wells & stream flow measurements
  - Evaluation of Lower Brodhead Creek Watershed
- Aquatic Resources Study – "Fish Study"

Source Water Protection Efforts – funded by BCRA and, in part, by a PADEP Growing Greener Grant

Hydrogeologic Setting



Source: Bucek, 1971

Buried bedrock valley
- incised valley in underlying shale
- partially filled with sediment

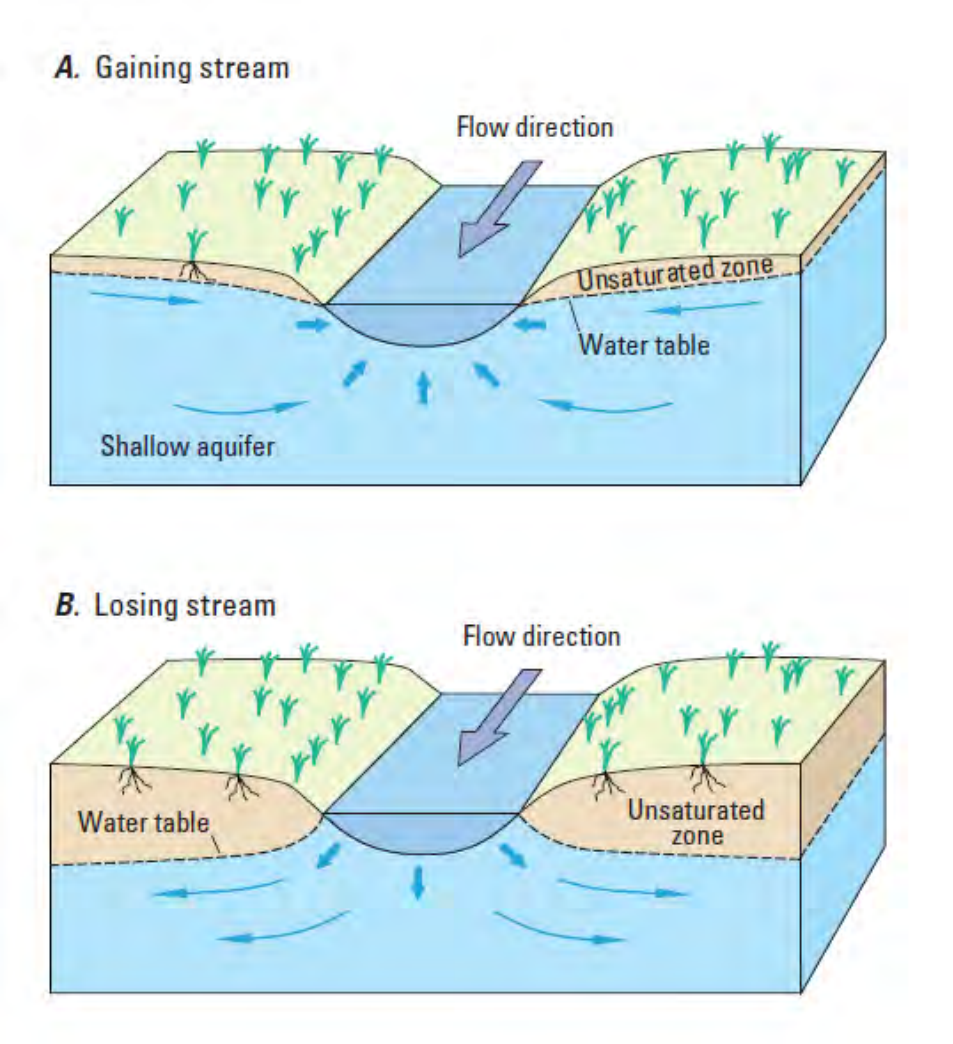
Glacial/alluvial sediment
- silt, sand, gravel & cobbles
- prolific aquifer, high storage

Wells PW-1 and PW-2
- completed in glacial/alluvial sediment
- 59 and 62 ft total depths, respectively

Brodhead Creek – braided & losing
- stream braided below Pinebrook Park
- very dynamic, flow shifts btw braids
- stream realigned in the 1960s
- valley broadens and deepens

Common setting with glacial outwash deposits partially filling bedrock valley

Gaining & Losing Stream Conditions



Source: Barlow & Leake, 2012. U.S. Geological Survey Circular 1376

Dye Tracing Tests – 2007 & 2008

Purpose:

- To determine in-stream travel times to the BCRA intake and into the groundwater flow system
- To better understand the interaction between stream water and the subsurface groundwater flow system

Dye tracing test plans submitted to PADEP for review

Fluorescent dyes, monitored with charcoal dye receptors & sampling

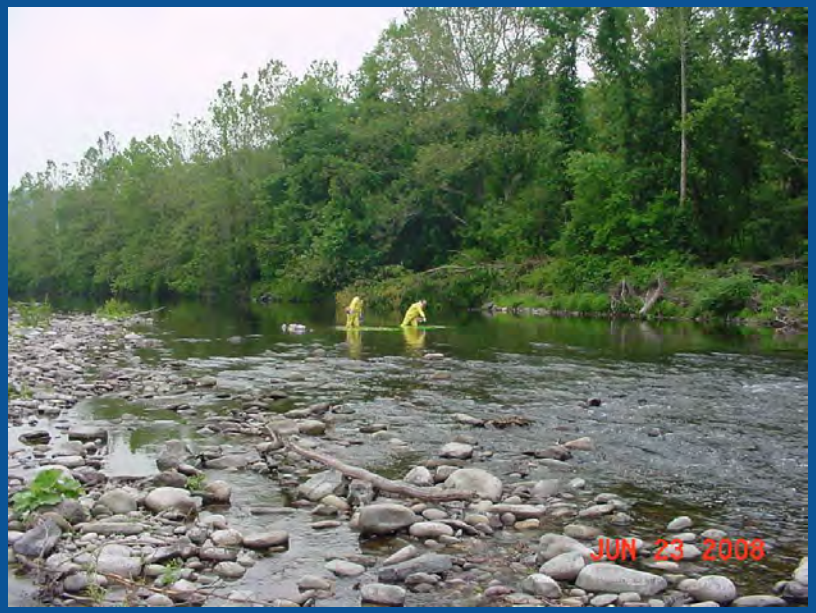
2007 Test (Aug – Oct, 2007; operating conditions = normal, low flow)

- Fluorescein (10 lbs) released into stream at Pinebrook Park
- Sulphorhodamine B (SRB; 2 lbs) released into 2 piezometers in west braid of Brodhead Creek adjacent to wellfield

2008 Test (Jun – Aug 2008; operating conditions = wells off, mod flow)

- Fluorescein (15 lbs) released into stream at Pinebrook Park
- Eosine (2.5 lbs) released into piezometer in west braid of Brodhead Creek adjacent to wellfield

Source Map for Presentation


JUN 23 2008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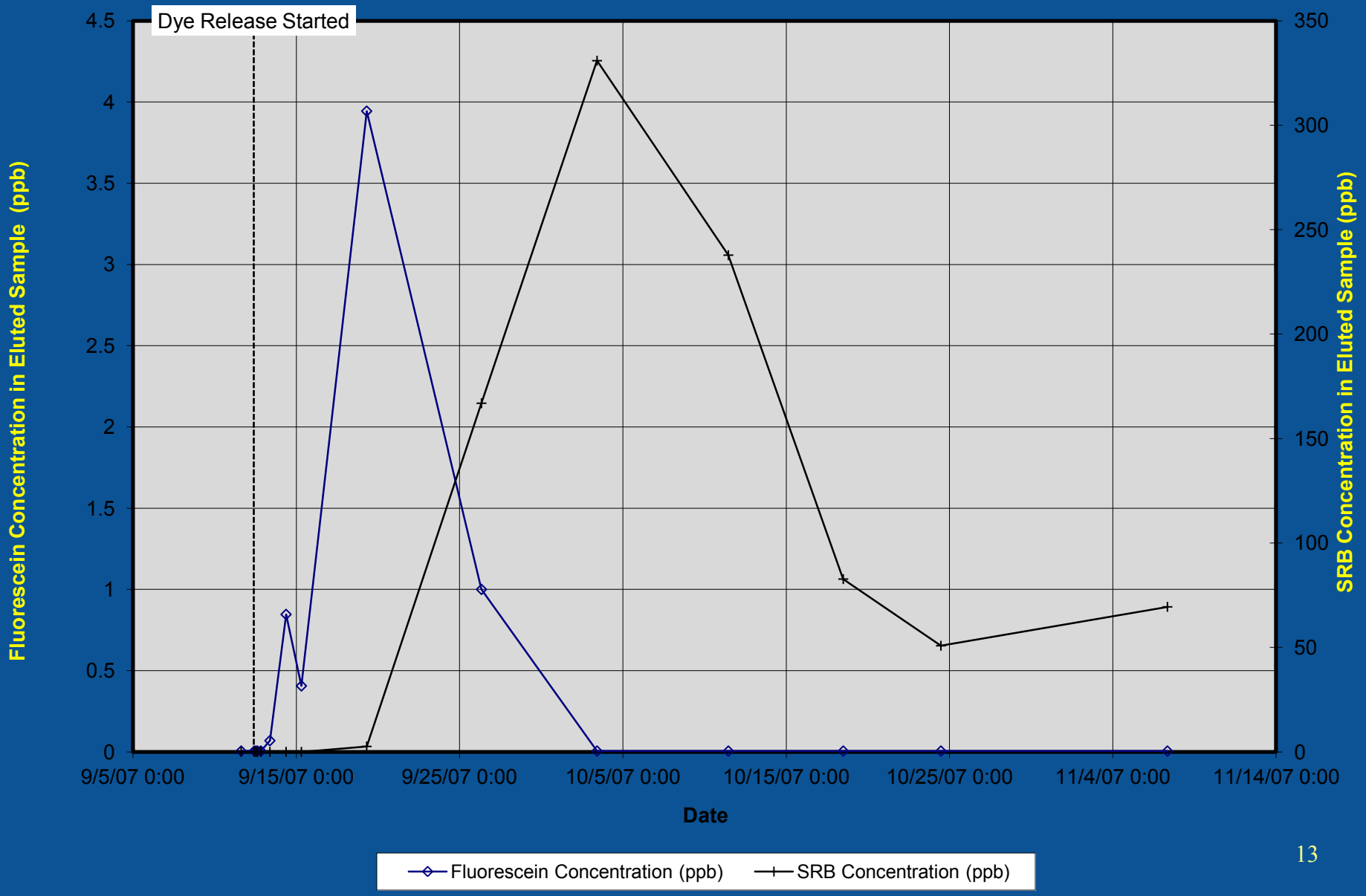
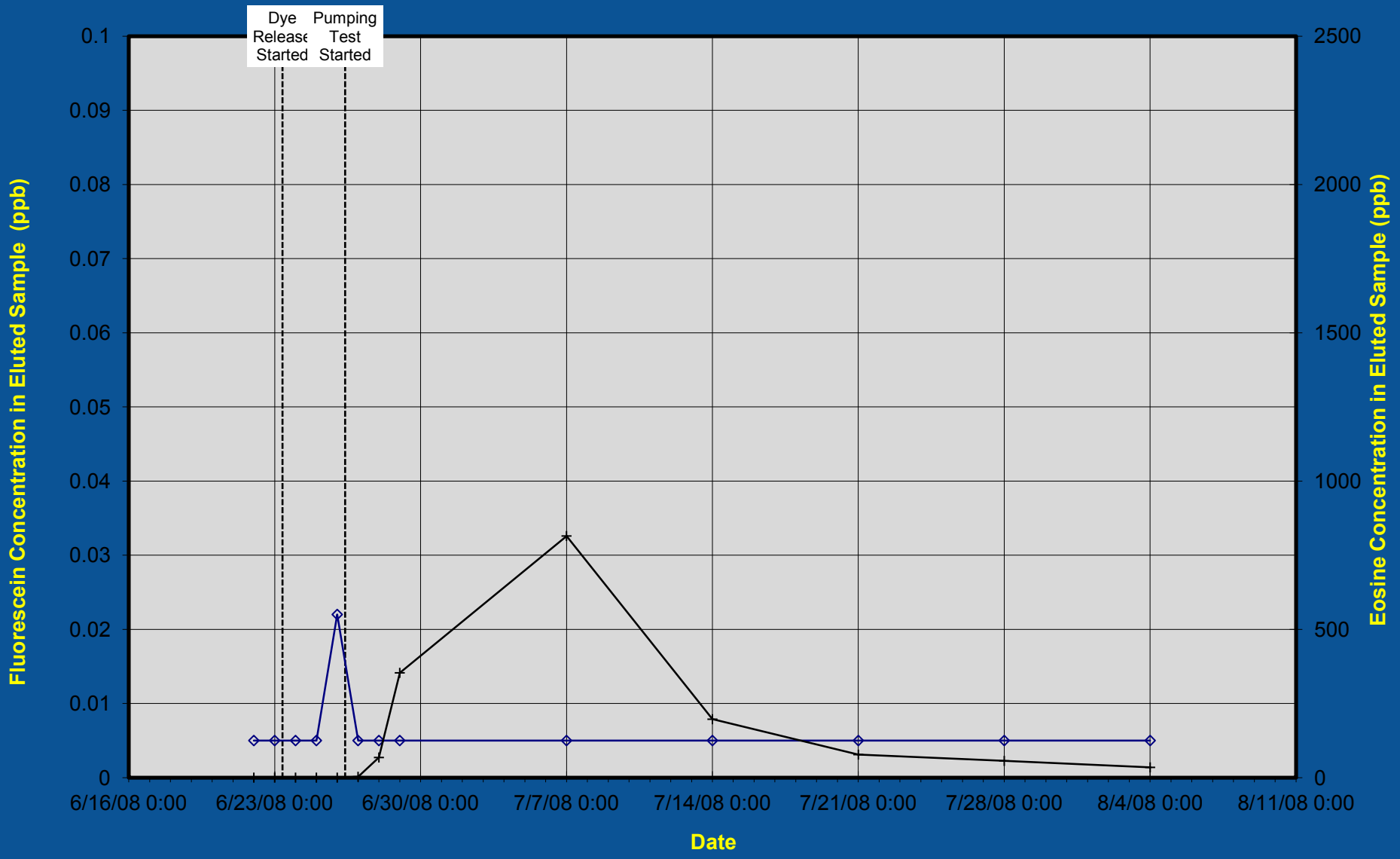
SEP 15 2007


23 11:52AM

2007 Test – Well PW-1
Brodhead Creek Regional Authority - Dye Tracing Test
PW-1 Dye Receptor - Fluorescein & SRB Detections



2008 Test – PW-2
Brodhead Creek Regional Authority - Dye Tracing & Pumping Test
PW-2 Dye Receptors - Fluorescein & Eosine Detections



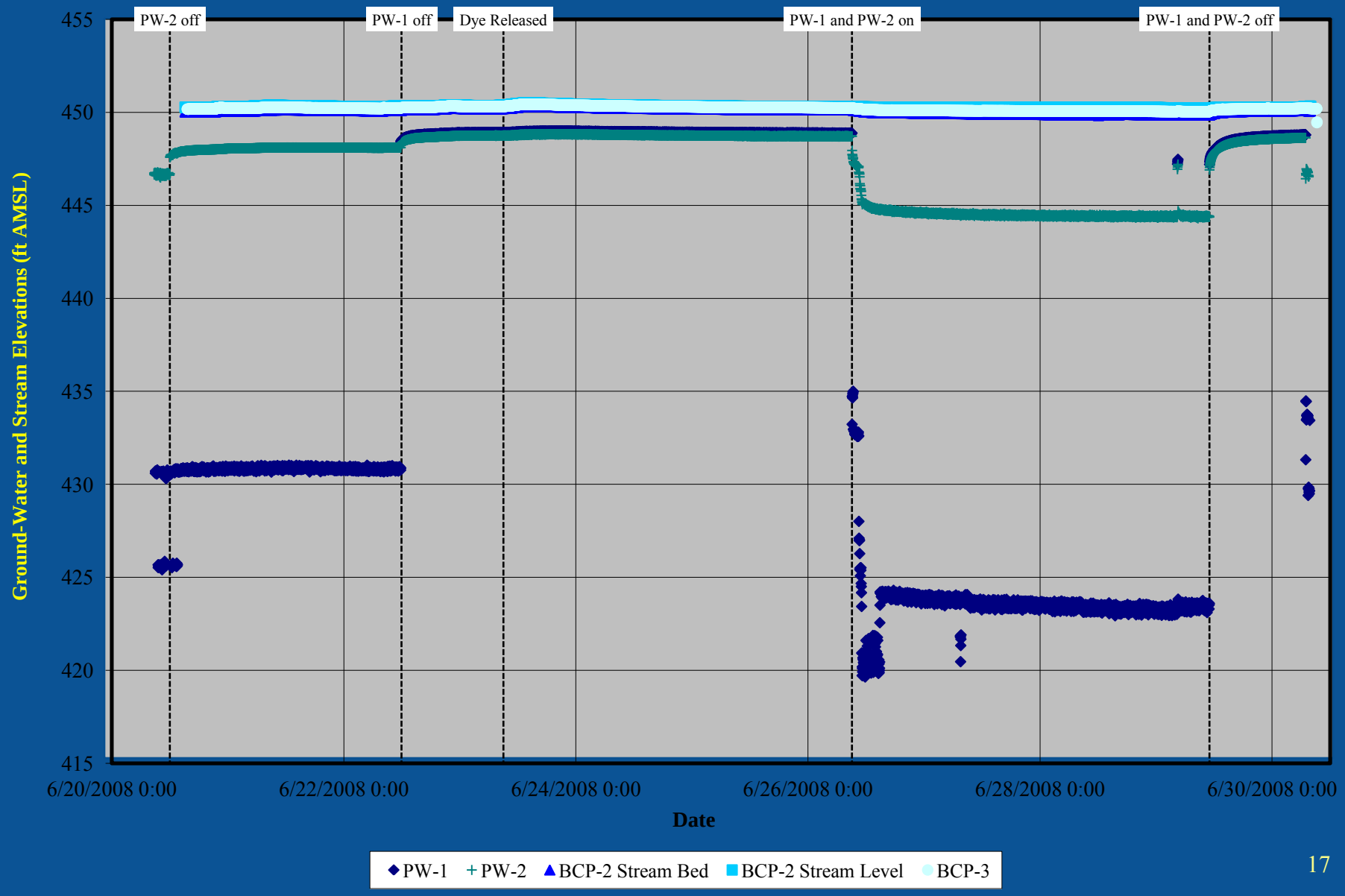
NOTE: PQL in Eluent: 0.005 ppb
PQL in Water: 0.01 ppb

Well-Field Pumping Test

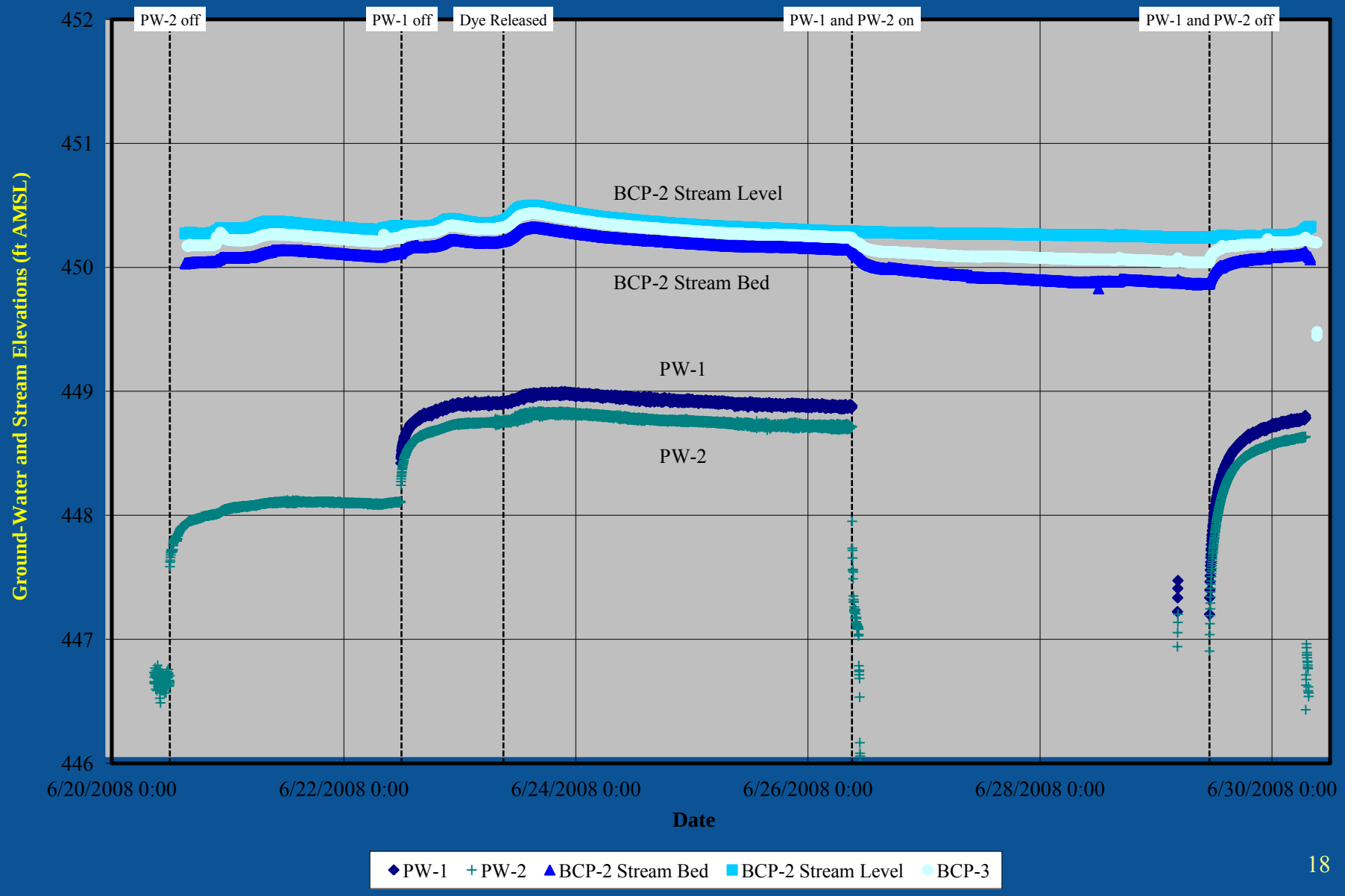
- ~74 hour, constant-rate pumping test performed at or near permitted capacity of well field
  - PW-1 pumped at ~900 gpm (to maintain constant rate)
  - PW-2 pumped at 1,000 gpm
  - Discharged into the BCRA system
- Monitoring Network – automated and manual water level meas.
  - Production Wells
    - PW-1 and PW-2
  - 8 Monitoring Wells
    - TW-1, TW-2, TW-4, P-2, P-8, P-4*, P-7*, MW-2
  - Piezometers
    - BCP-1, BCP-2 (stream and streambed), BCP-3
  - Weir on Stokes Mill Spring
  - Stilling Wells – Pinebrook Park & Stokes Mill Dam

N

2008 Well Field Pumping Test
Brodhead Creek Regional Authority - PW-1/PW-2 Pumping Test
Ground-Water and Stream Elevations



2008 Well Field Pumping Test
Brodhead Creek Regional Authority - PW-1/PW-2 Pumping Test
Ground-Water and Stream Elevations (Modified Scale)



Findings

- Instream travel times (1 ¼ to 1 ½ hr – release location to intake)
  - Info to be used in Emergency Response Planning and SWP efforts
- Dye tracing
  - Pumping conditions - 2007
    - Fluorescein detections in wells <24 hrs (PW-1) and between 24-48 hrs (PW-2), SRB delayed
    - Results contrary to previous estimates of aquifer travel times
  - Non-pumping conditions - 2008
    - Low level fluorescein and eosine detections in PW-1 prior to initiating pumping
    - Eosine detections in PW-1 and PW-2 increased significantly following pumping
- PW-1 and PW-2 in hydrologic communication with Brodhead Creek
  - Limited locally but likely laterally extensive based on drawdown and dye response
  - No direct impact on stream stage in Brodhead Creek
- Significant downward hydraulic gradient btw stream and aquifer
  - Under both non-pumping and pumping conditions – indicates losing stream
  - Elevation of stream higher than the ambient water level in wells
  - MPAs – both wells low risk

Why is understanding the Surface Water – Groundwater interaction important?

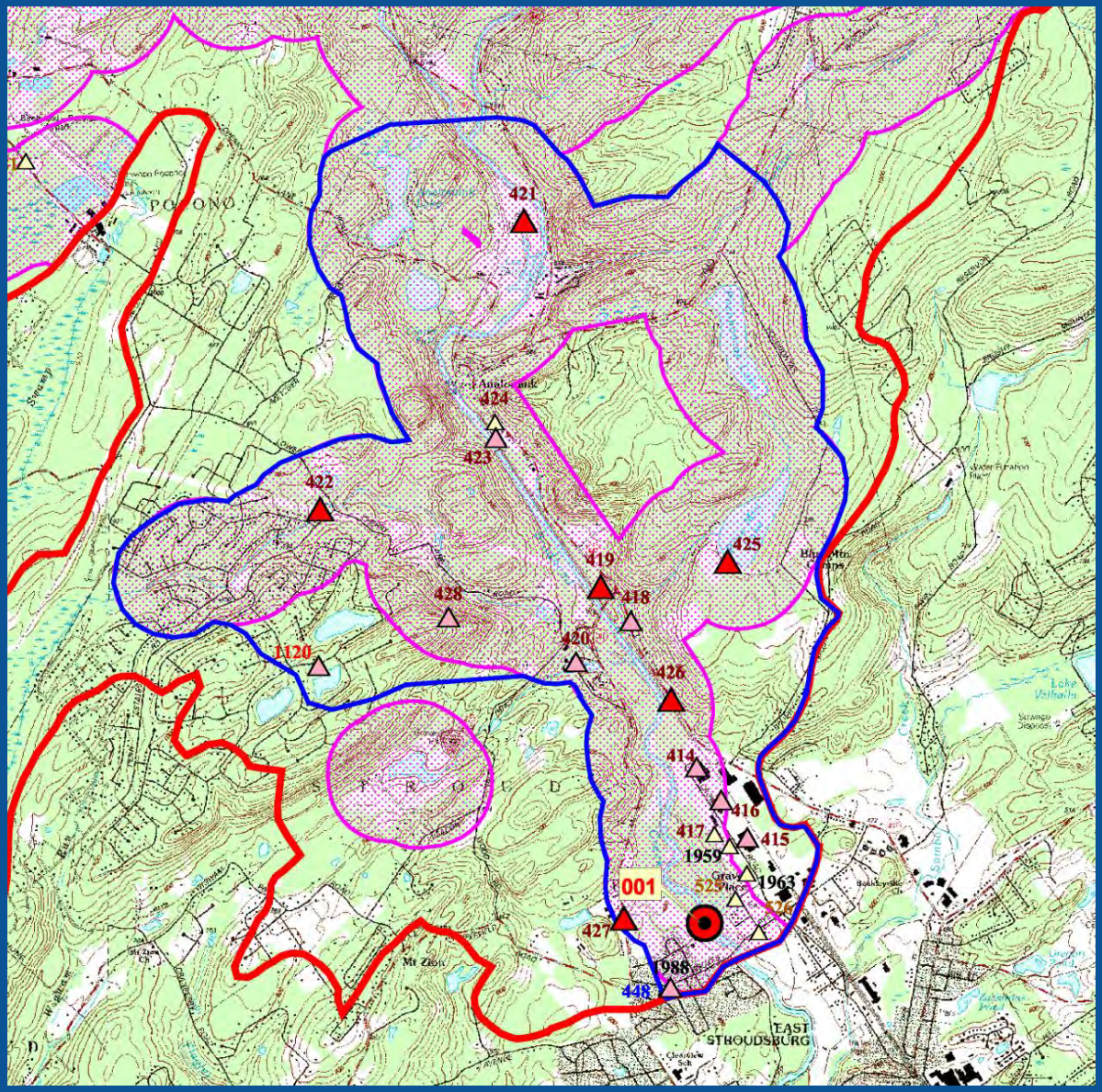
Paulsboro Train Derailment – Nov. 30, 2012
Mantua Creek – tributary to Delaware River
23,000 g of vinyl chloride released (photo: US EPA)

- Need to understand risks & PSOCs
- Emergency response to spills – operational plan for sources
- Source water protection planning

Critical Area & PSOC Inventory

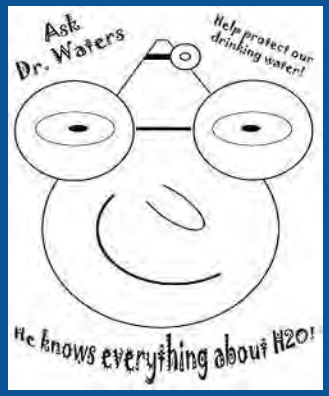
A-ranked PSOCs

- Golf course
- Salt/cinder storage
- Auto “Junk yard”
- WWTP
- “Package Plant”
- Railroad
- State roadway
- & industrial park



Source Water Protection Team

BCRA	Ken Brown	Manager
	Michael Reisenwitz	Source Water Educator/Operator
	Patrick Lambert	Chief Operator
	Chris Finton, P.G.	Meiser & Earl, Inc.
	Jay Lynch, P.G.	Meiser & Earl, Inc.
	Russ Scott IV, P.E.	RKR Hess / UTRS



Brodhead Watershed Association	Edith Stevens	Board Member
	Carol Hillstad	Member
Greater Pocono Chamber of Commerce	Jim Becker	Committee Member
Monroe County Conservation District	Craig Todd	District Manager
	Trish Attardo	Watershed Specialist
Monroe County Emergency Management	Bruce Henry	Deputy Director
Monroe County Planning Commisssion	Sean Anlauf	Environmental Planner
PADEP Representative	Eric Bartolacci	Sanitarian, PADEP Pocono District Office

Goals

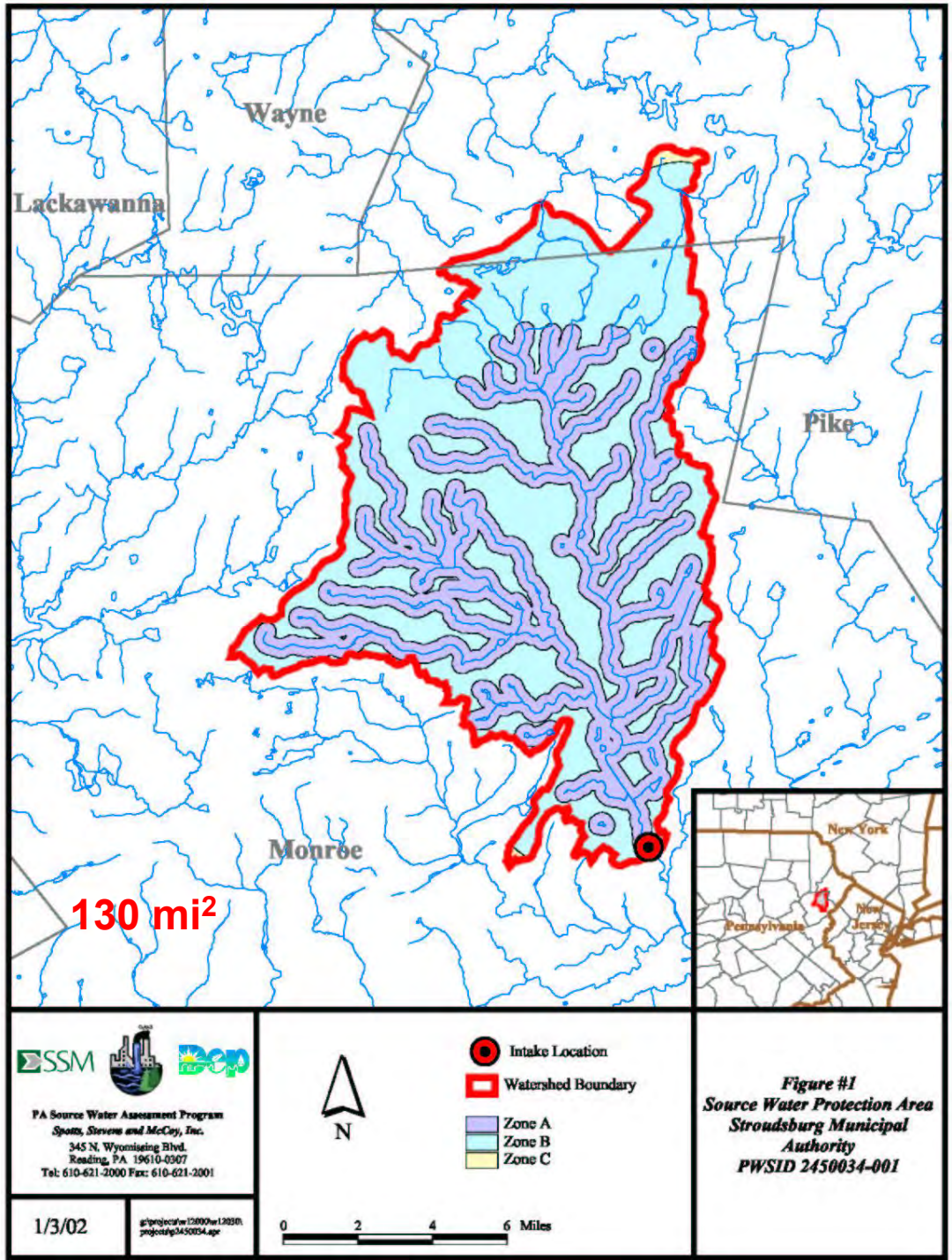
- Cooperation between BCRA & municipalities to sustain a high-quality water supply for BCRA customers and the Brodhead Creek area
  - A sustainable & high-quality water supply is an important part of retaining & attracting businesses and their employees
- Ensure that Brodhead Creek remains a healthy stream
  - Everyone in the watershed has a vested interest, not just BCRA customers
  - Our quality of life, economic well-being, and the natural environment depend on it!

Source Water Protection Plan

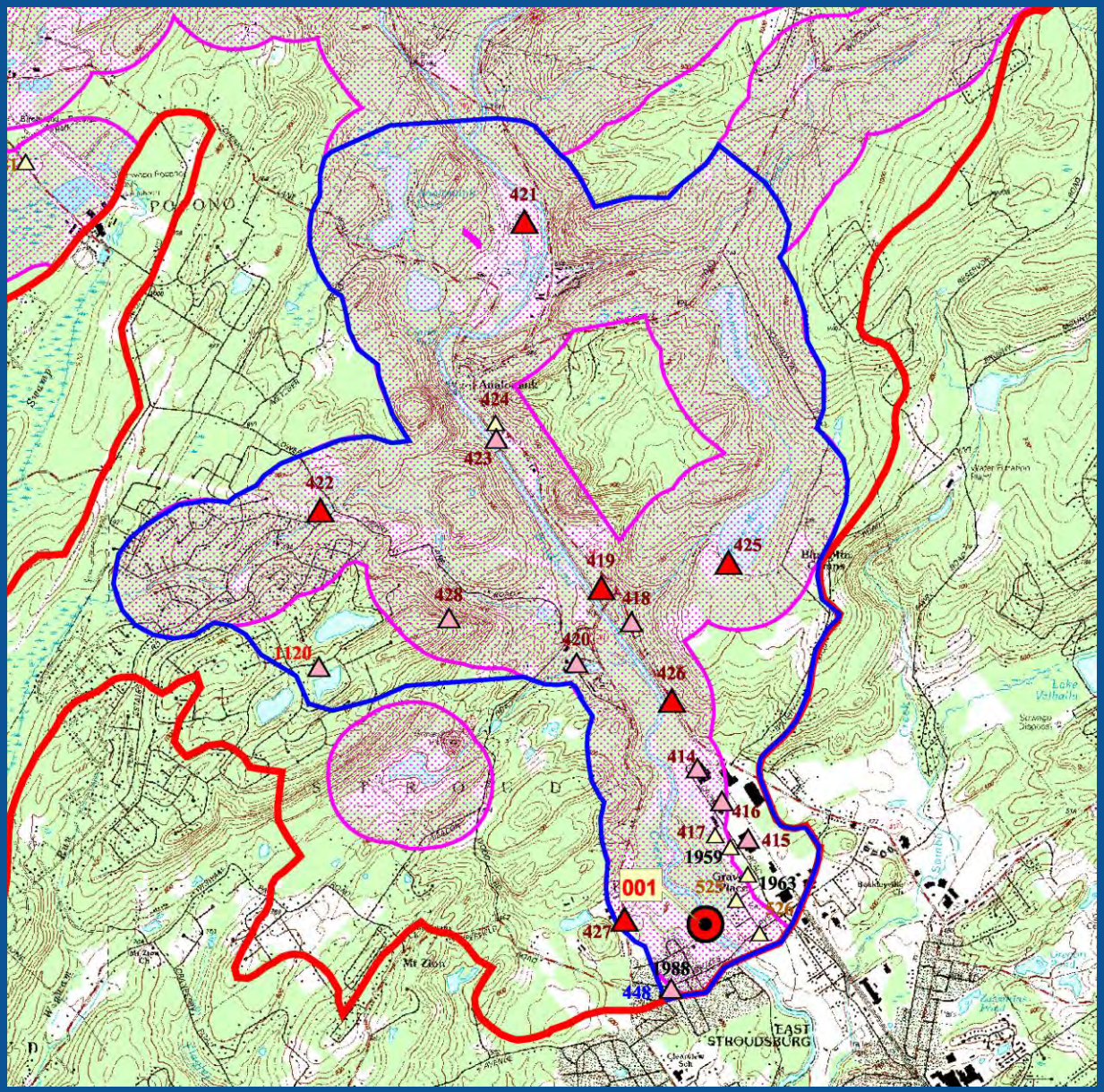
- Maps
- Zones of Protection
- Potential Sources of Contamination Inventory
- Stormwater Concerns
- Vulnerabilities & SWP Matrix – any threat to use of sources, not just quality
  - Water Quality – Point Sources
  - Water Quality – Non-Point Sources
  - Water Quantity
  - Regulatory & Community
  - Each concern assigned a goal, action plan/strategy, implementation plan , assigned team members, timeframe, est. budget, and tracking status

Zones of Protection & Potential Sources of Contamination

- Zone 1 – 400 ft radius from wells
- Critical Area
  - Defined by land use and PSOCs – 5 hr TOT
  - Includes Zone 1 of Wells
- Zone A – ¼ mile on either side of Brodhead
  - from withdrawal point upstream to 5-hr TOT
- Zone B – 2 miles on either side of Brodhead
  - From withdrawal point upstream to 25-hr TOT
- Zone C – remainder of contributing watershed
- Inventory & ranking of PSOCs in Critical Area - SSM


Wayne
Lackawanna
Pike
Monroe
130 mi²
New York
Pennsylvania
New Jersey
SSM
PA Source Water Assessment Program
Spotts, Stevens and McCoy, Inc.
345 N. Wyomissing Blvd.
Reading, PA 19610-0307
Tel: 610-621-2000 Fax: 610-621-2001
1/3/02
N
Intake Location
Watershed Boundary
Zone A
Zone B
Zone C
0 2 4 6 Miles
Figure #1
Source Water Protection Area
Stroudsburg Municipal
Authority
PWSID 2450034-001

Critical Area & PSOC Inventory



SWPP - Water Quality & PSOC Inventory

- Point Source Pollution Sources
  - Industrial Facilities (VOCs, metals, runoff)
  - Transportation/Railroad Corridors (haz mats., fuel)
  - Transportation/Roads & Bridges (fuel, salt)
  - Septic Tanks (nitrates, bacteria, detergents)
  - Fuel Storage Tanks (fuels)
  - Salt/Cinder Storage Facilities (salt, sediment)
  - WWTP/Package Plants (nitrates, bacteria)
  - NPDES Discharges (Process & Stormwater)
- Non-Point Source Pollution
  - Golf Courses, Farms (fertilizers, pesticides, herbicides)

SWPP - Water Quantity

- Not often included in SWP Plans
- Water budget for Lower Brodhead Creek sub-watershed
- Identification of competing uses in sub-watershed
- Drought Contingency Plan – response to drought declarations
- Regulatory approval for withdrawals
- Hydrologic study (budget) for Lower Brodhead Creek watershed being finalized

SWPP - Regulatory & Community Concerns

- Changing EPA & PADEP regulations regarding water supply & water quality (LT2, Groundwater Treatment Rule, etc.)
- PADEP – BCRA Consent Order & Agreement, approval for surface water allocation
- DRBC – responsible agency for changes in withdrawal amounts (surface & groundwater)
- Encouragement of sustainable “smart” growth
- Understand potential limits on growth

SWPP - Stormwater Concerns

- Concerns
  - flooding, erosion, accelerated runoff, water quality of runoff, decrease in recharge & stream baseflow
- PA Stormwater Management Act 167 of 1978
- Model Act 167 Stormwater Management Ordinance - Monroe County (Dec. 6, 2006)
- Adoption of model ordinance by municipalities
- Goals:
  - minimize increases in runoff & erosion through BMPs
  - preserve surface and ground-water quality
  - preserve recharge and stream baseflow
  - minimize additional infrastructure expenses

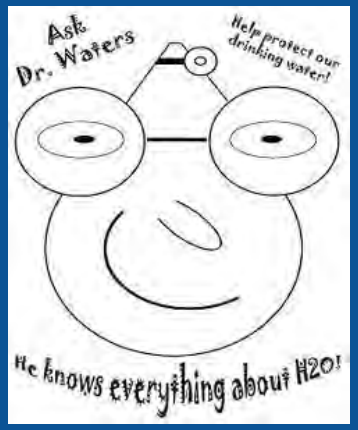
BCRA SWP Actions & Accomplishments

Water Quality

- Monitoring, site visits, & PADEP file reviews for PSOC sites
- Tracking & updates regarding PSOCs in Critical Area

Regulatory & Community

- BCRA personnel meeting with each Municipality in watershed – municipal official newsletter & community outreach events
- Act 167 stormwater ordinance adoptions
- Septic pumping requirements
- Community outreach & school visits
- Monroe County EM – auto notify of spills



Water Quantity

- Assessing water budget for Lower Brodhead Creek

BCRA SWP Actions & Accomplishments

- BCRA Source Water Protection Plan – PADEP approved in 2010
- NEPA Environmental Partnership Award
  - October 2012
  - Source Water Protection Education & Outreach
  - Dr. Waters program for K-12 grades
- Letters of Commendation – Gov. Tom Corbett & PA Senator Lisa Baker

References

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