LINKING SALAMANDER OCCURRENCE TO HYDROLOGY

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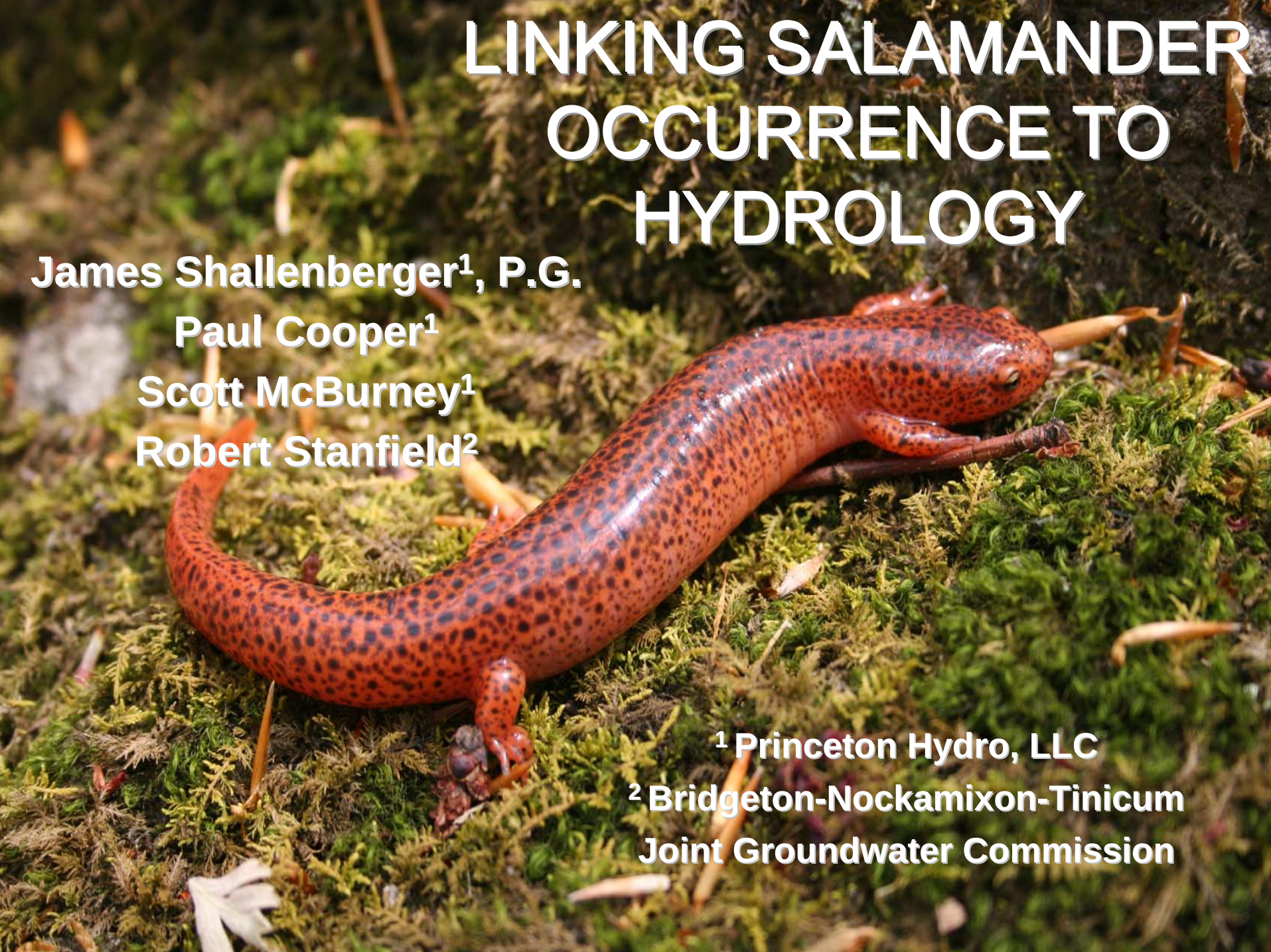


PROJECT OVERVIEW:

- USEPA Grant to Study Physical Hydrology To Better Understand Deep Aquifer Recharge Potential (Funded 2006 – 2007 data collection; reporting in-progress).

- Supplemental “Pilot Study” To Correlate Salamander Occurrence To Hydrology Gradients in Sparsely-Developed Headwaters Catchment (Begun 2008).

INCENTIVES TO ADJUST MUNICIPAL LAND MANAGEMENT STRATEGY

- Northeastern Bucks County is situated between Philadelphia and New York City and land development pressure has intensified.
- Potable water is supplied primarily by groundwater.
- Septic waste management occurs via Individual Subsurface Sewage Disposal Systems (ISSDS).
- Effective management of natural resources is vital for rural character and scenery to persevere.

GEOLOGIC SETTING:

- Diabase *Terrane* ► Jurassic-age sill intruded into sedimentary host rock of Triassic - Jurassic Newark Supergroup (Brunswick & Lockatong).

- Igneous Diabase ► dense, fine-grained, fracture-resistant; weathers to produce rounded boulders and swelling clay (montmorillonite)-rich soils.

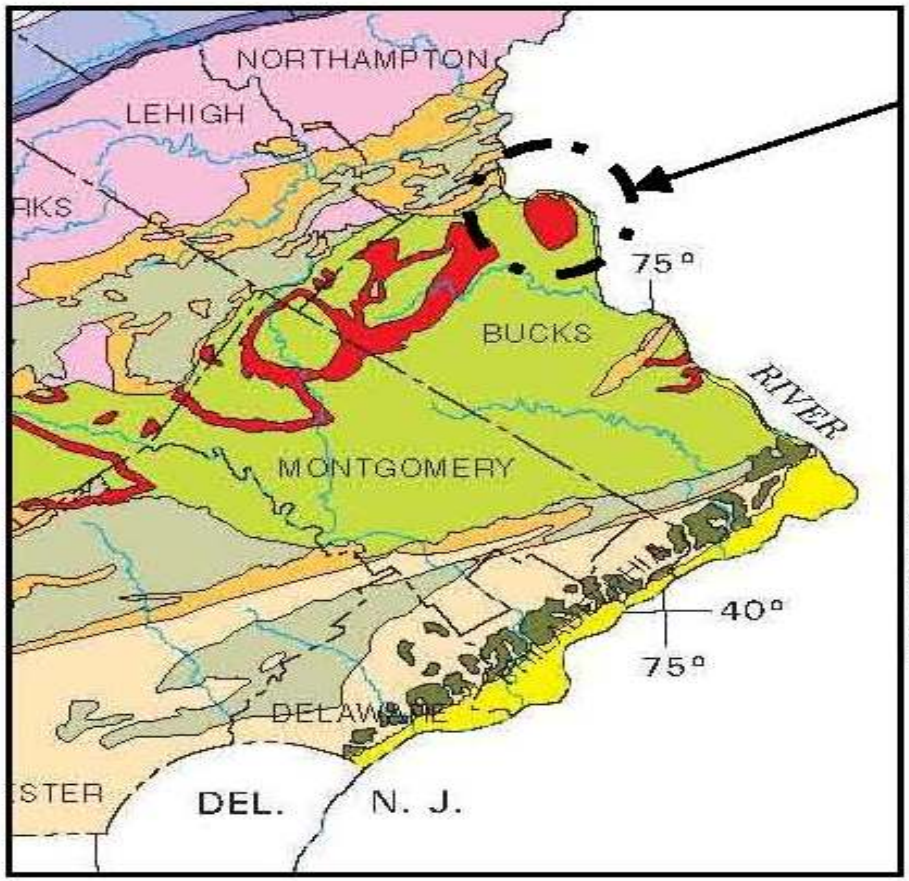
- Coffman Hill Diabase ► 80 to 570 feet thick, prominent oval-shaped landform 3.8 mile x 5 mile surrounded by halo of hornfels-dominated metamorphism.

A R
Diab

GEOLOGIC MAP OF PENNSYLVANIA

SCALE 1:2,000,000

0 10 20 30 40 50 MI
0 20 40 60 80 KM



Study Area

JURASSIC AND TRIASSIC
(144–248 mil. yrs.)
Red sandstone, shale, and conglomerate (green), intruded by diabase (red).
Building stone, iron.

HYDROLOGIC SETTING:

- Rapp Creek ► 7.4 mi ^{2} Exceptional Value (EV) status watershed in the Wild & Scenic portion of Delaware River watershed.

- Study Area ► Wetland and low-order tributary network in second-growth deciduous forest.

- Stream Flow Regime ► Flashy response to rain events; primarily intermittent from May - October.

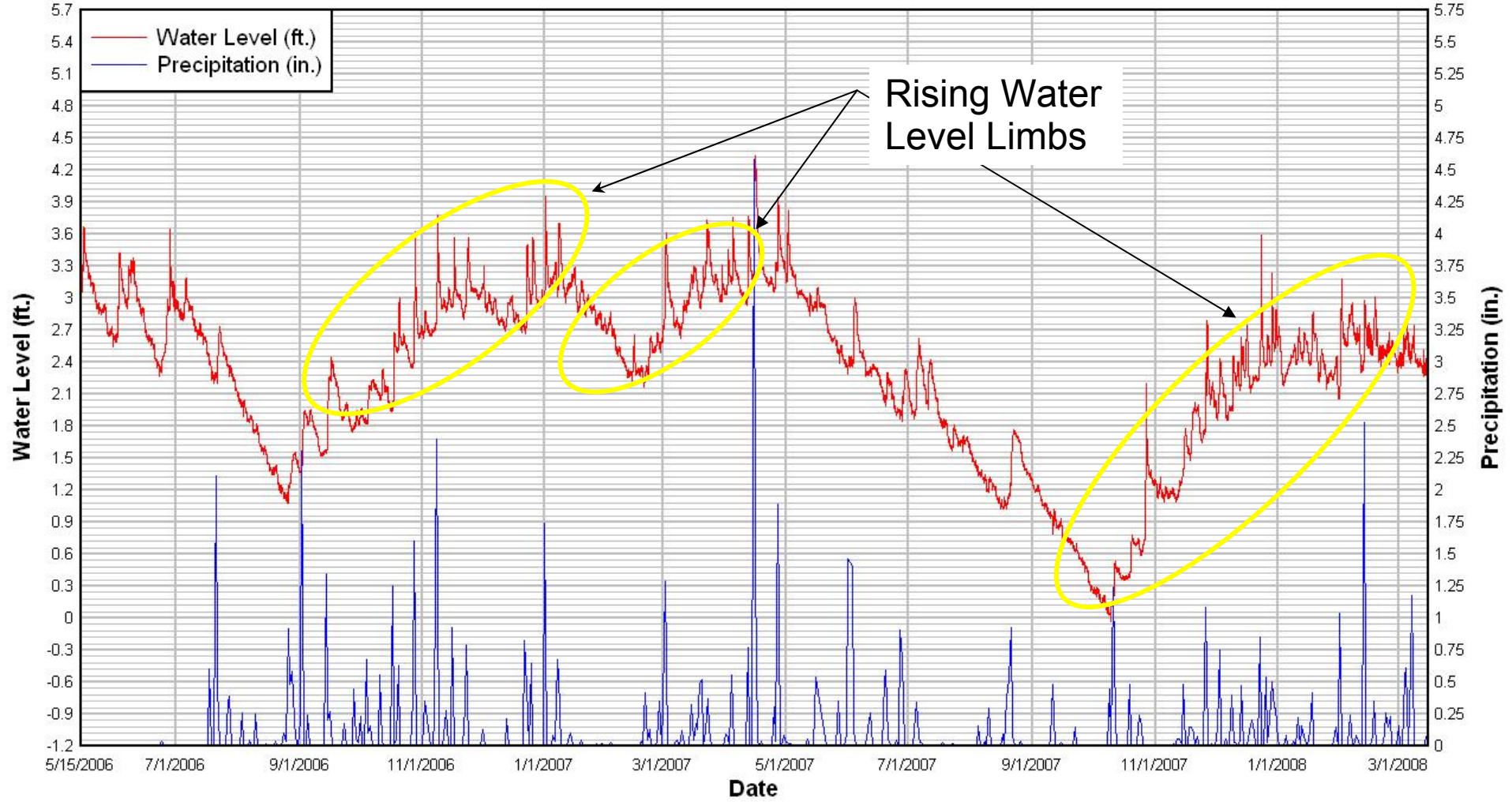
HYDROLOGIC MODEL:

- Surface and shallow groundwater flowpaths dominate.
- Deep aquifer recharge potential <<10% annual input.
- Deep aquifer recharge occurs late autumn to early spring.
- Stream networks exhibit “flashy” response to rainfall.
- Wetlands develop at/below break in slope due to intersection of flowpaths and poorly-drained soils.
- Not much functional difference between wetlands and uplands.

Ground Water Level Time Series

State Game Lands 56

Nockamixon Township, Bucks County, Pennsylvania



Water Budget Result: Deep aquifer recharge occurs when ET demand is low.

CURRENT ISSUE:

We observed apparent “hot spots” for salamander activity in relation to GSI discharges.

Sub-adult northern red salamander

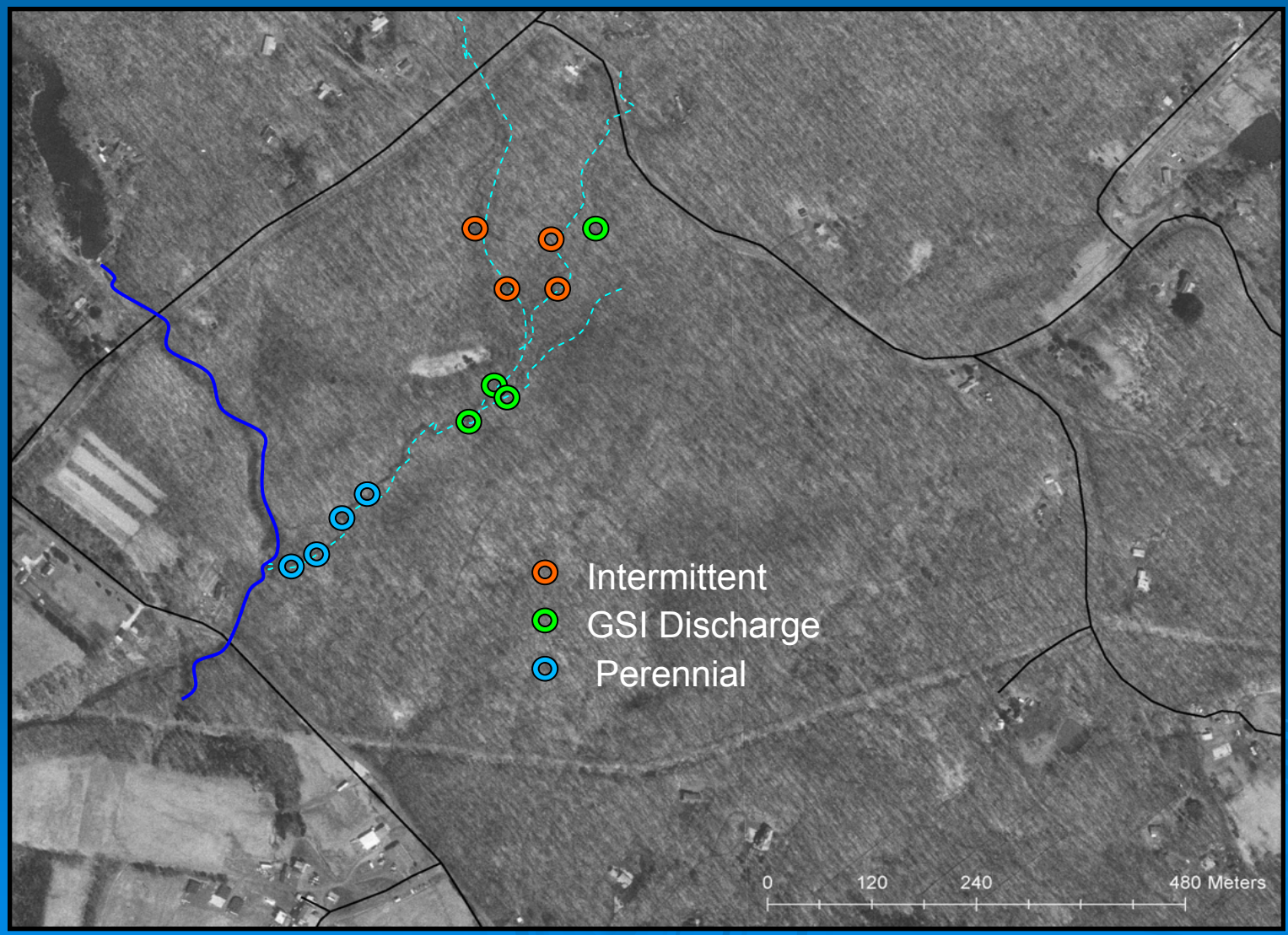
CAN SALAMANDERS SERVE AS A BIOLOGICAL RESPONSE INDICATOR OF HUMAN LAND USE?

- Jurisdictional wetland determination provides certain land use restrictions.
- Upgraded watershed status confers protections for designated uses and water quality.
- EV designation mandates that water quality shall be maintained (anti-degradation) and protected.
- Salamanders represent a possible surrogate biometric to monitor environmental quality (sensitive, varying life history requirements, range of preferred habitats).

STUDY APPROACH:

- Establish survey plots/areas that correspond to 3 categories along a hydrology gradient
  - Intermittent
  - Perennial
  - GSI Discharge
- Standardize search effort and repeat every 2-4 weeks (3 events completed to date).

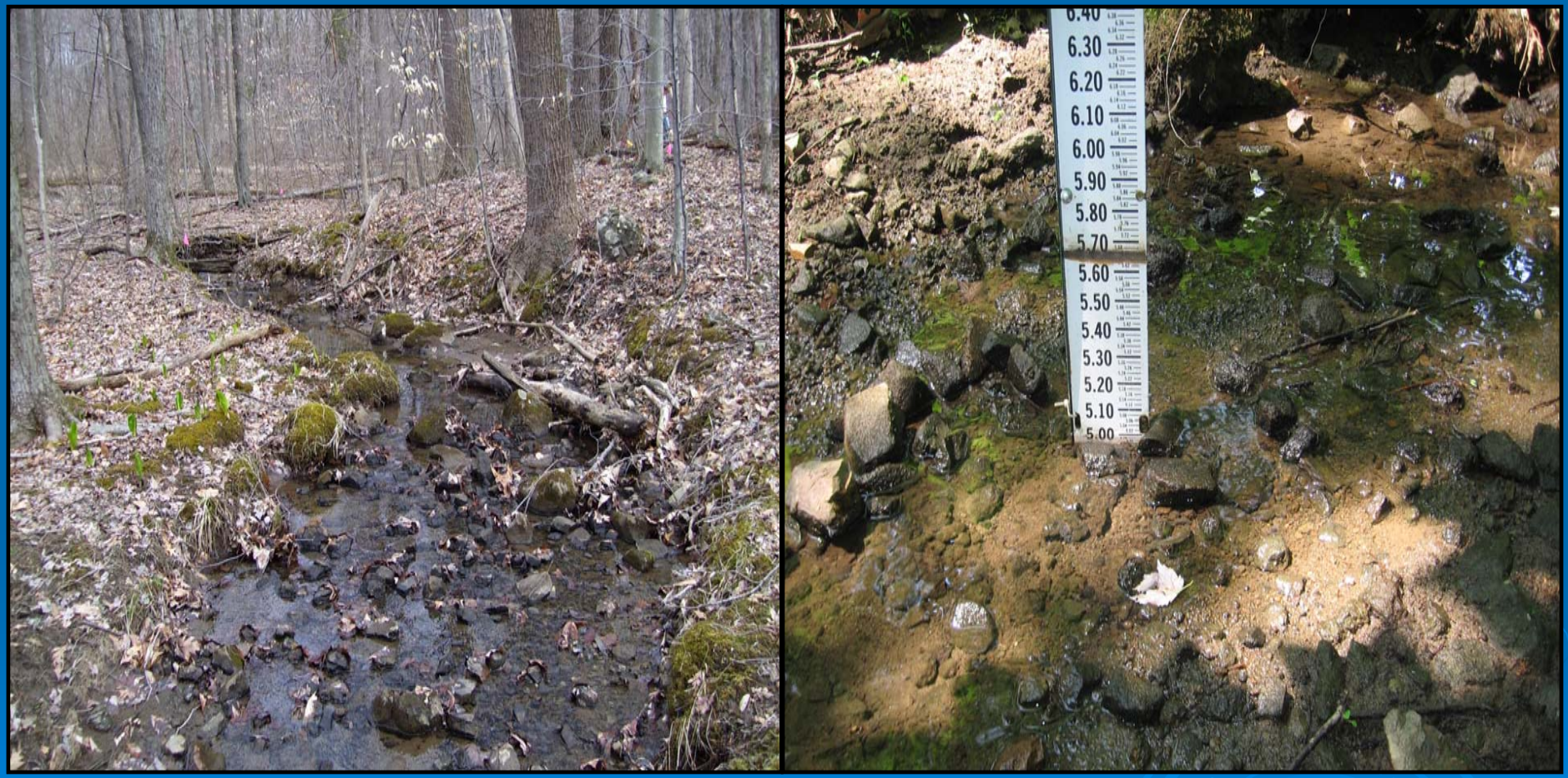
STUDY AREA:



Intermittent Areas

Left: Typical spring flow status (non-rain). Right: Staff gauge upstream after forest canopy development.

GSI Discharge Areas



Left: Typical spring flow status (non-rain). Right: Staff gauge showing summer “base flow”.

Perennial Areas

Left and Right: Typical spring views (non-rain).

Profile:

Terrestrial all life stages; oviposit summer; eggs placed in damp settings beneath objects; female may guard eggs; prefer forests.

Redback (adult) – *Plethodon cinereus*

Profile:

Terrestrial as adults, aquatic as larvae; oviposit generally summer; eggs in recesses in streams/ seeps; prefer headwaters and springs.

Northern Spring (sub-adult) – *Gyrinophilus p. prophyriticus*

Profile:

Terrestrial as adults, aquatic as larvae; oviposit generally spring to summer; eggs in flowing water; prefer forested stream margins.

Northern Two-Lined (adult) – *Eurycea bislineata*

Profile:

Terrestrial as adults, aquatic as larvae; oviposit generally fall to spring; eggs in headwater streams/ seeps; prefer headwater margins and springs.

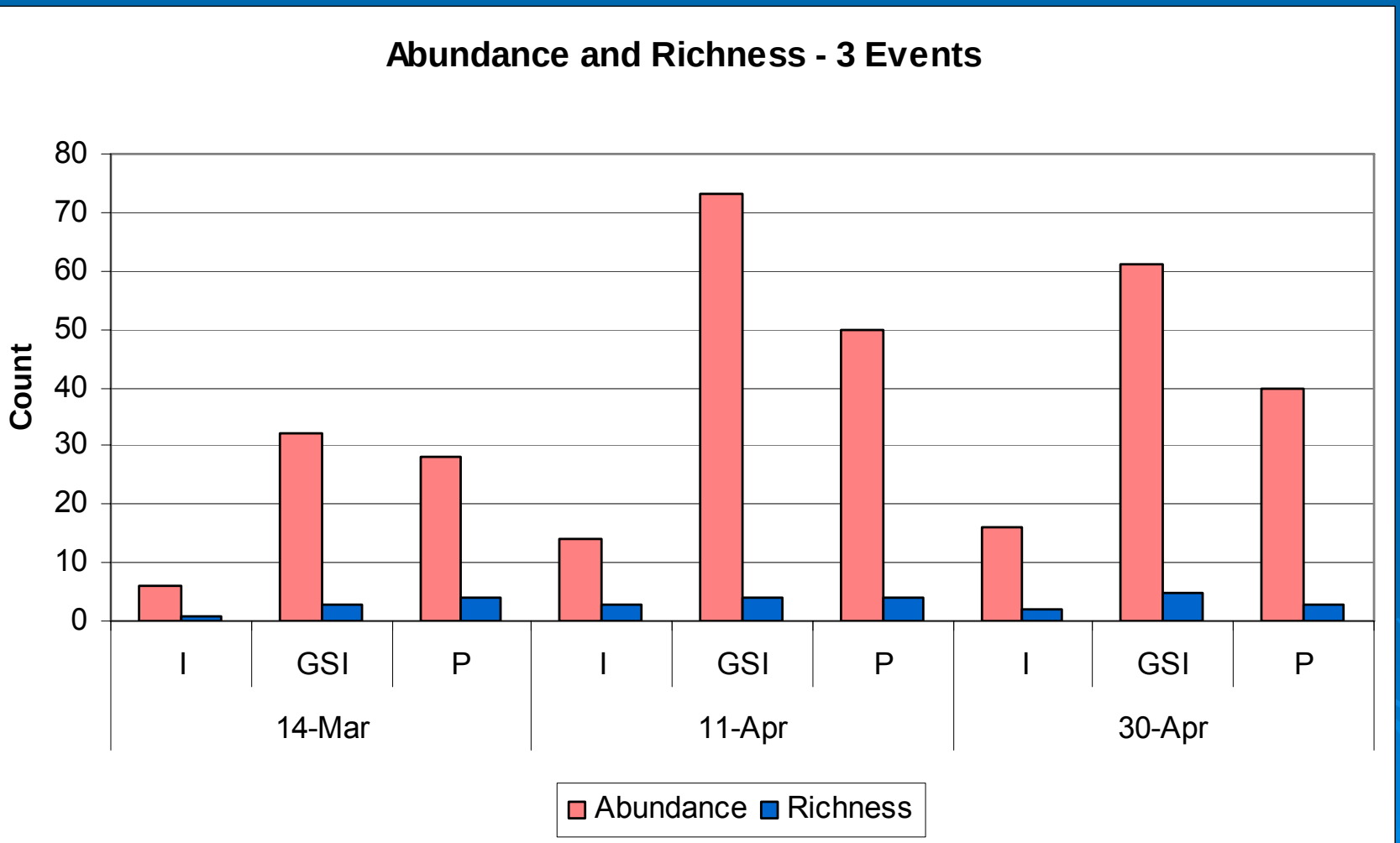
Northern Red (adult) – *Pseudotriton r. ruber*

Profile:

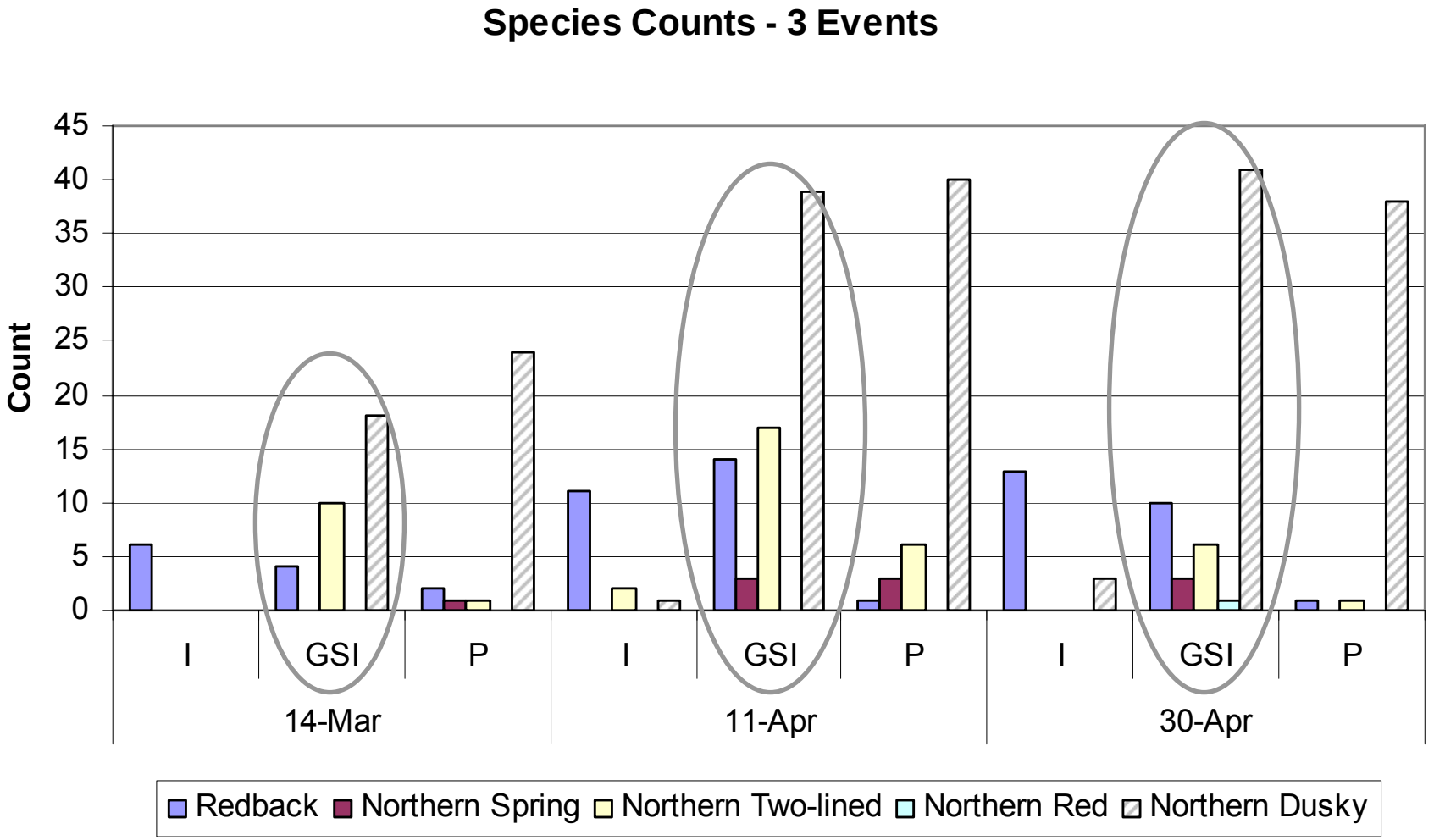
Terrestrial as adults, aquatic as larvae; oviposit generally late spring to summer; eggs placed near aquatic sites; prefer forested stream margins.

Northern Dusky (adult) – *Desmognathus f. fuscus*

ABUNDANCE/RICHNESS vs. HYDROLOGY



SPECIES OCCURRENCE vs. HYDROLOGY



Based on Probable Response to Hydrologic Gradients, Salamanders Appear to be Worthy of Further Study for Use as Biometric Indicators of Watershed Integrity.

Thank You

And thanks to:

Tinicum Creek Watershed Protection Development Program/USEPA Grant no. CD-973082-01-0

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