10 Years of Post-Construction Monitoring of Constructed Vernal Pools for the Stewart Airport Interconnector Roadway

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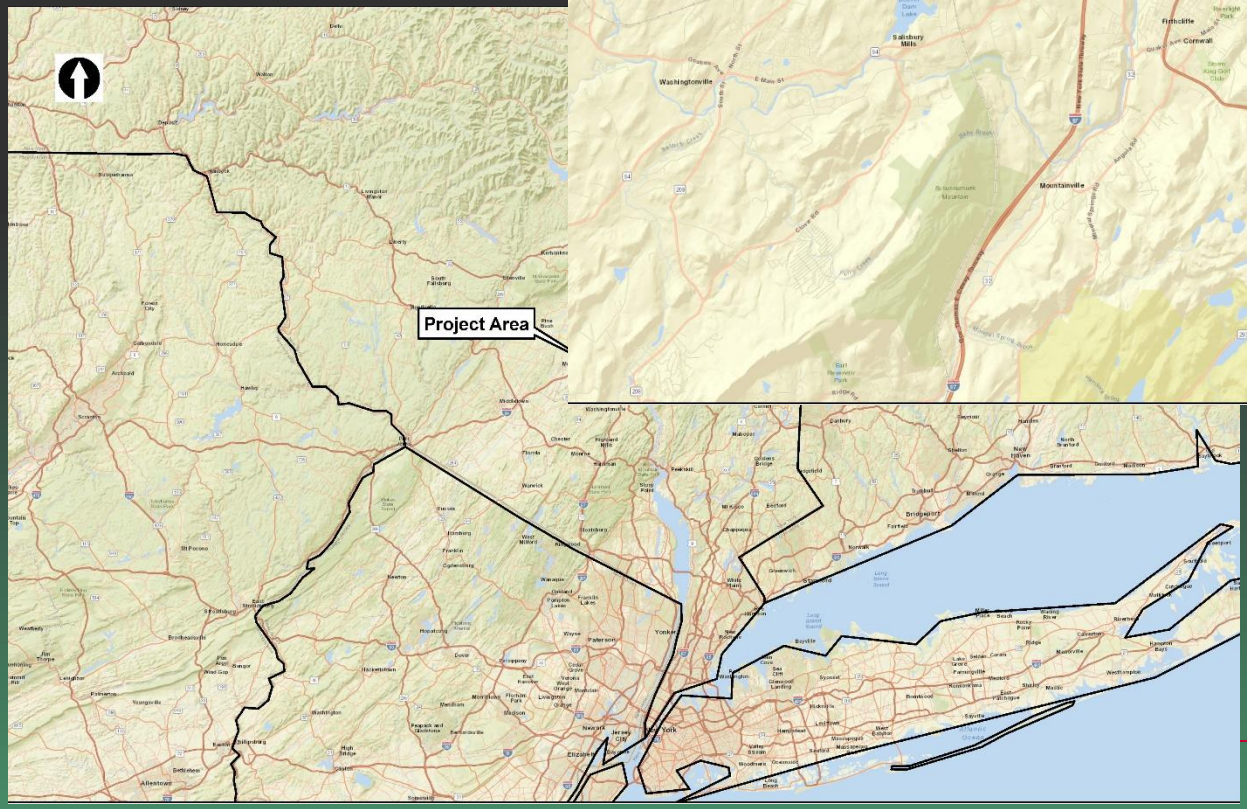
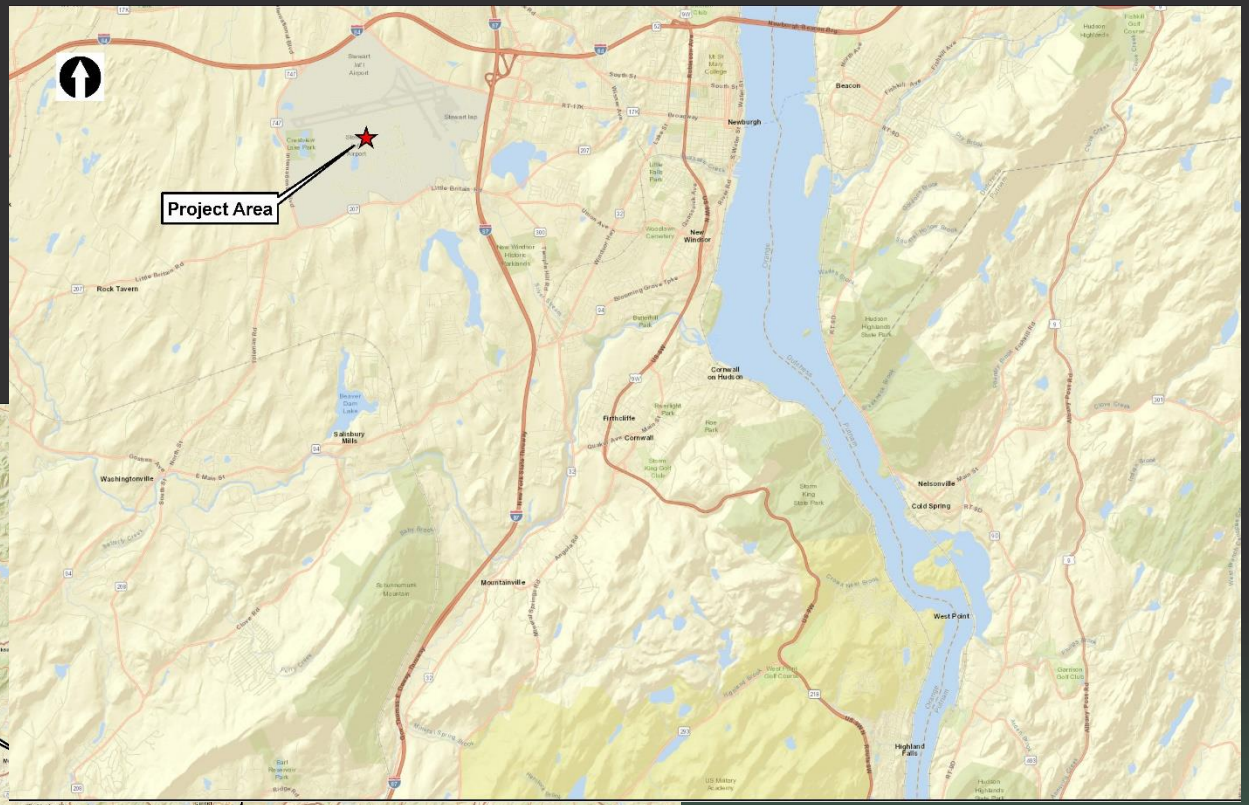
PROJECT OVERVIEW



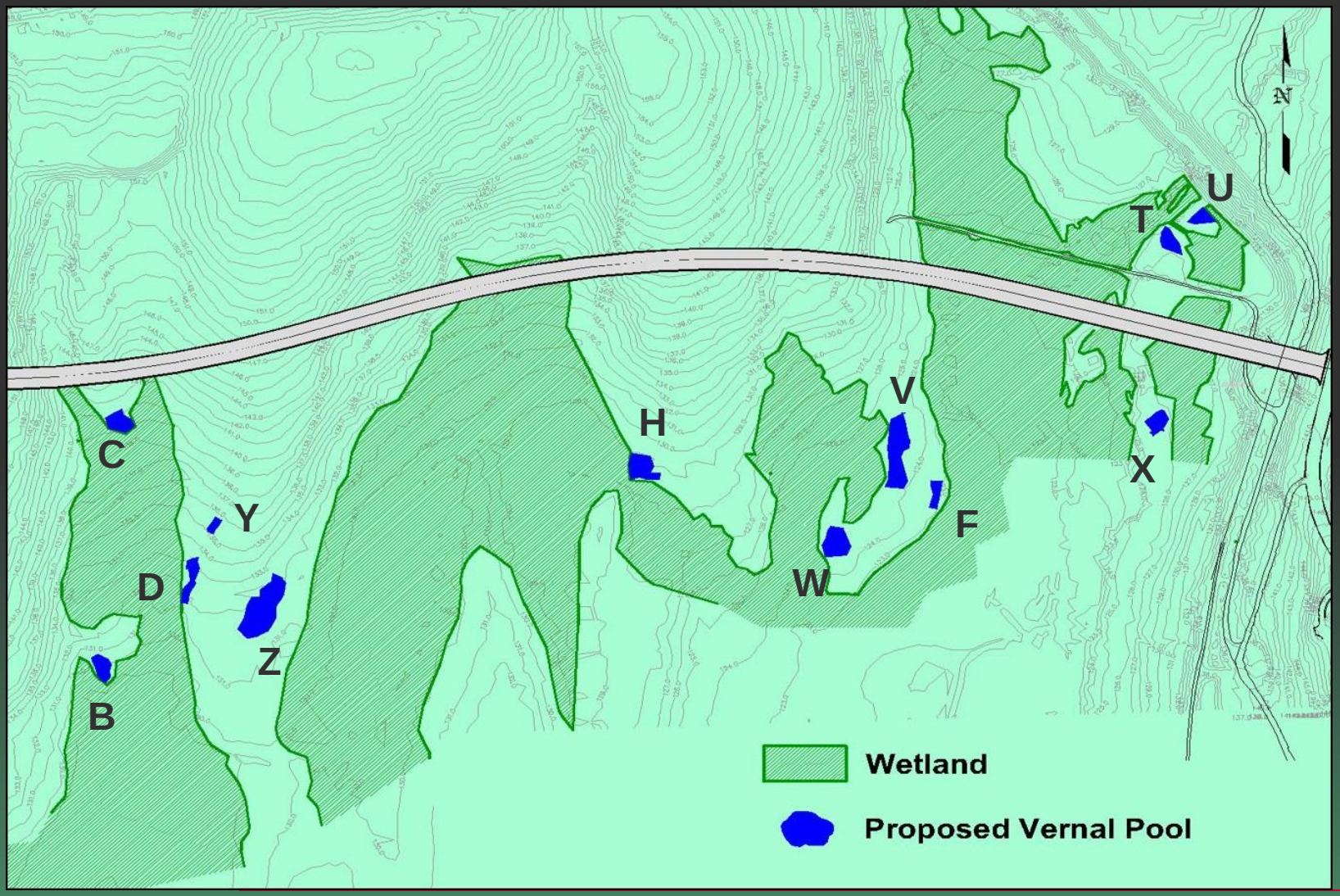


PROJECT OVERVIEW

- 2006 construction of 2-lane interconnector road at Stewart Airport, Orange County, New York
- Mitigate for habitat impacts to 2.44 acres of forested, emergent, and scrub-shrub wetlands
- NYSDEC requested habitat replacement in the form of vernal pools, but did not require a specific percentage of the vernal pools to be successful
- Habitat for New York State Species of Special Concern - Jefferson salamander *(Ambystoma jeffersonianum)* and spotted turtle *(Clemmys guttata);* also intended to benefit mole salamanders *(Ambystoma* spp.*)* and wood frogs *(Rana sylvatica)*
- Wildlife crossings included in roadway design for connectivity

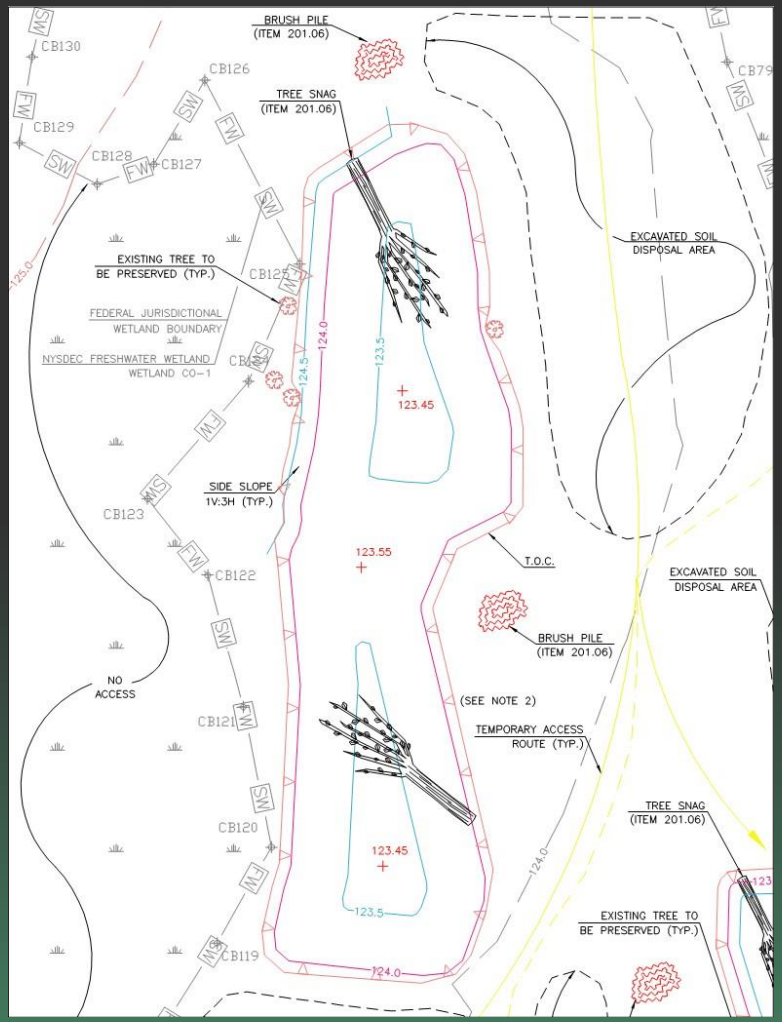
PROJECT OVERVIEW

12 vernal pools constructed in 2006– B,C,D,F,H,T,U,V,W,X,Y,Z totaling 1.37 acres



DESIGN ELEMENTS

- 4 inch bentonite clay liner
- Mineral soil layer
- Leaf litter layer
- Egg anchor sites
- Landscape features
  - brush piles
  - preservation of border trees
  - upland buffers
- Intended inundation hydroperiod ➡ March-July
- NYSDEC directed that vernal pools to be constructed in uplands only; stoney soils and slopes presented constraint in locating suitable sites



Vernal Pool Permit Conditions

Two permits issued 2005-06, expiring 2016:

New York State Department of Environmental Conservation – Article 24 Freshwater Wetlands

- Ensure that purple loosestrife *(Lythrum salicaria*), Eurasian milfoil *(Myriophyllum spicatum*), Japanese stiltgrass *(Microstegium vimineum*), and common reed (*Phragmites australis*) do not cover more than 5% of the mitigation area
- All work shall be carried out in strict accordance with – Vernal Pool Mitigation Feasibility Report & Mitigation Monitoring Plan

U.S. Army Corps of Engineers – Section 404 of Clean Water Act

- Ensure that purple loosestrife or common reed do not cover more than 10 percent of created wetlands
- Hydrology data –demonstrates that the wetland mitigation areas are progressing towards the established long-term goals
- Vernal pools shall be established as described in the Mitigation Monitoring Plan

MONITORING METHODOLOGY

10 Years of Monitoring

- **Hydrology Monitoring**
  - Water level loggers (1 measurement daily)
  - Monthly photo documentation
- **Vegetation Monitoring**
  - Forest canopy cover
  - Plant species in and around pool
  - Invasive species coverage

MONITORING METHODOLOGY

10 Years of Monitoring

- **Herpetile Surveys**

  Dip net, callback surveys, egg searches

  Weekly – March through April,

  Second week of September through October

  Monthly – May through August with extra surveys in June/July/Aug

  Target species:

  Jefferson salamander *(Ambystoma jeffersonianum)*

  blue-spotted salamander *(Ambystoma laterale)*

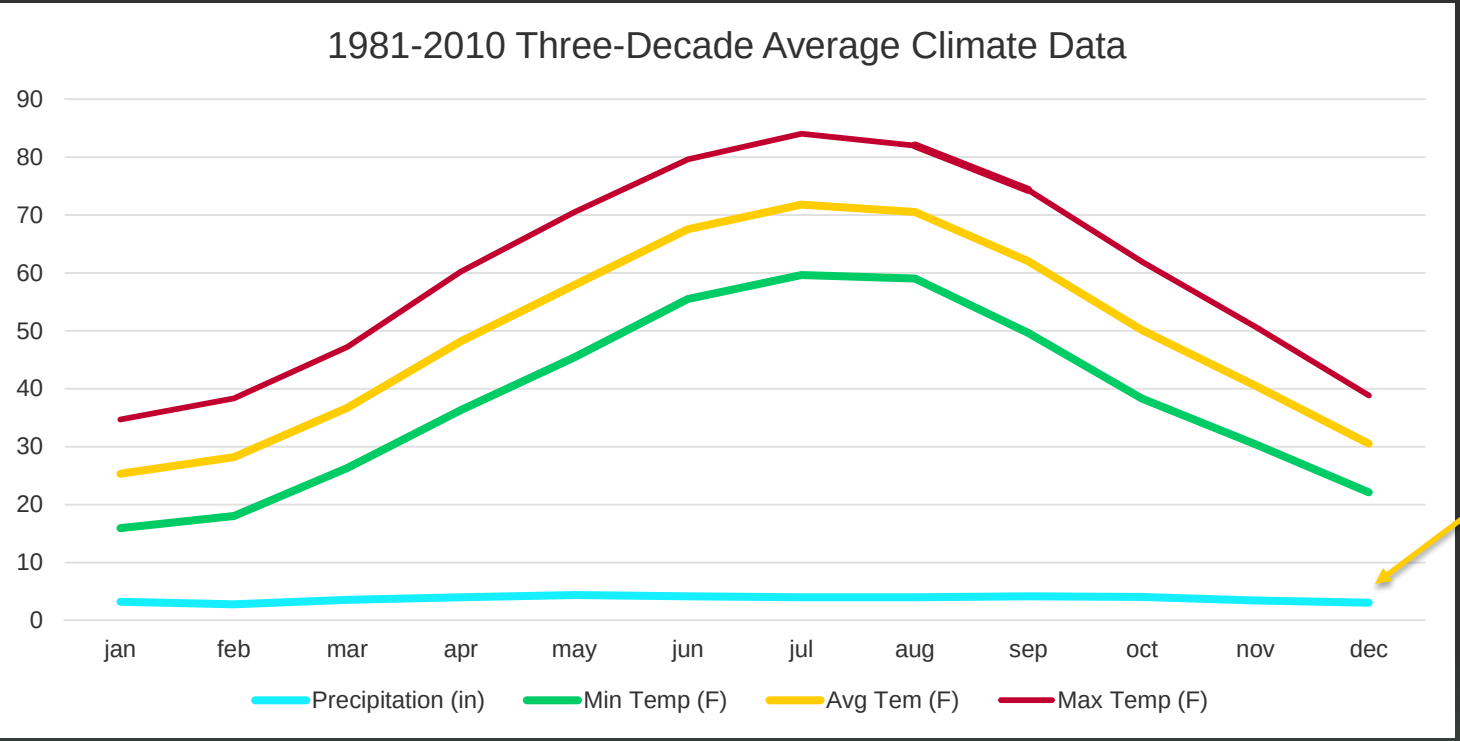
  spotted salamander *(Ambystoma maculatum)*

  marbled salamander (*Ambystoma opacum*)

  wood frog (*Rana sylvatica)*

  spotted turtle (*Clemmys guttata*)

Regional Climate Conditions



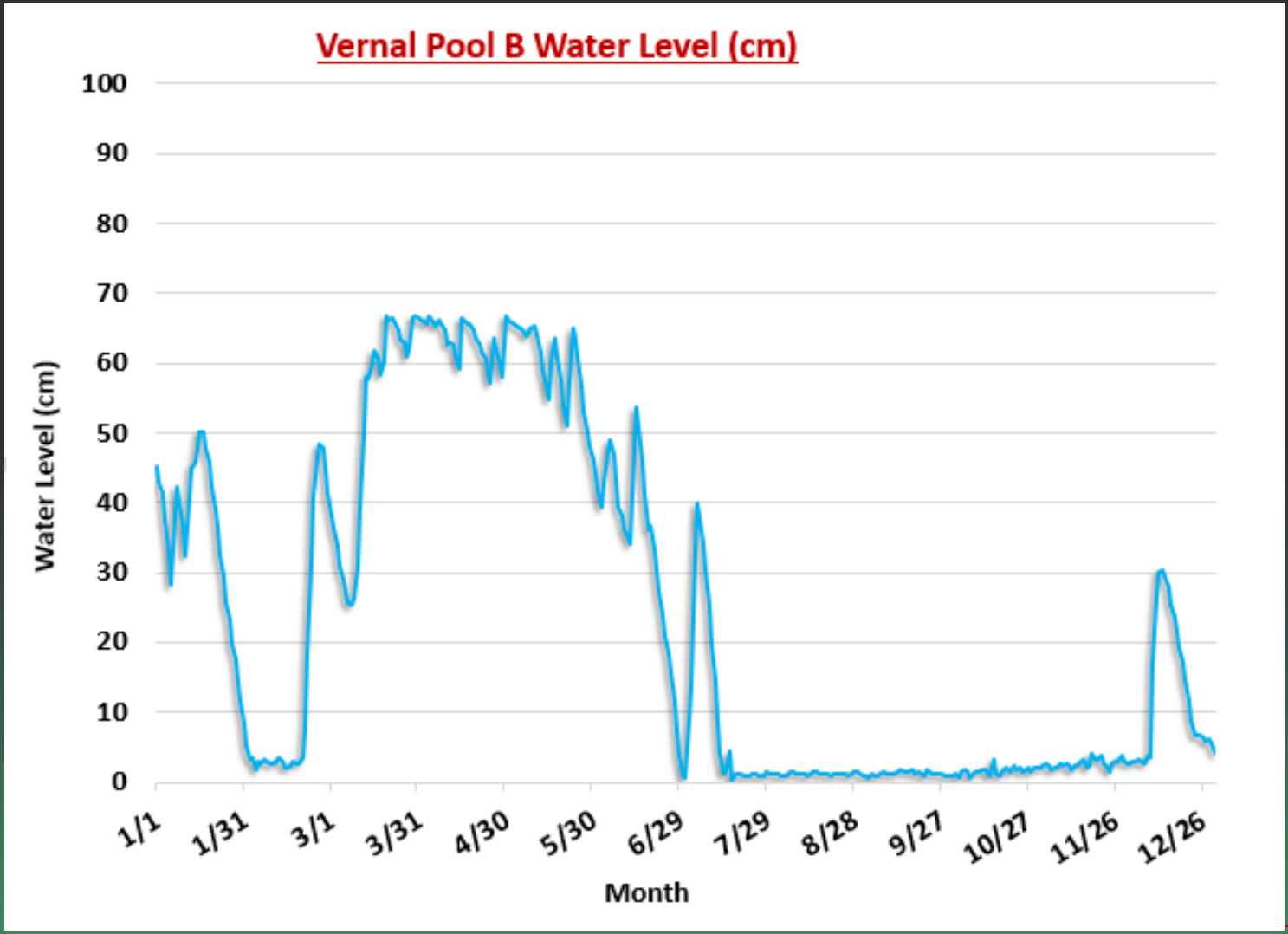
The area averages 3.7 inches of rainfall per month

Seasonal Average	Precip (in)	Min Temp (°F)	Avg Temp (°F)	Max Temp (°F)
Annual	44.59	38.1	49.2	60.3
Winter	9.01	18.7	28.0	37.2
Summer	12.16	58.0	70.0	81.9
Spring	11.84	36.0	47.6	59.3
Autumn	11.58	39.4	50.9	62.3

Source: NOAA National Climatic Data Center www.ncdc.noaa.gov; Montgomery, NY, Orange County Airport

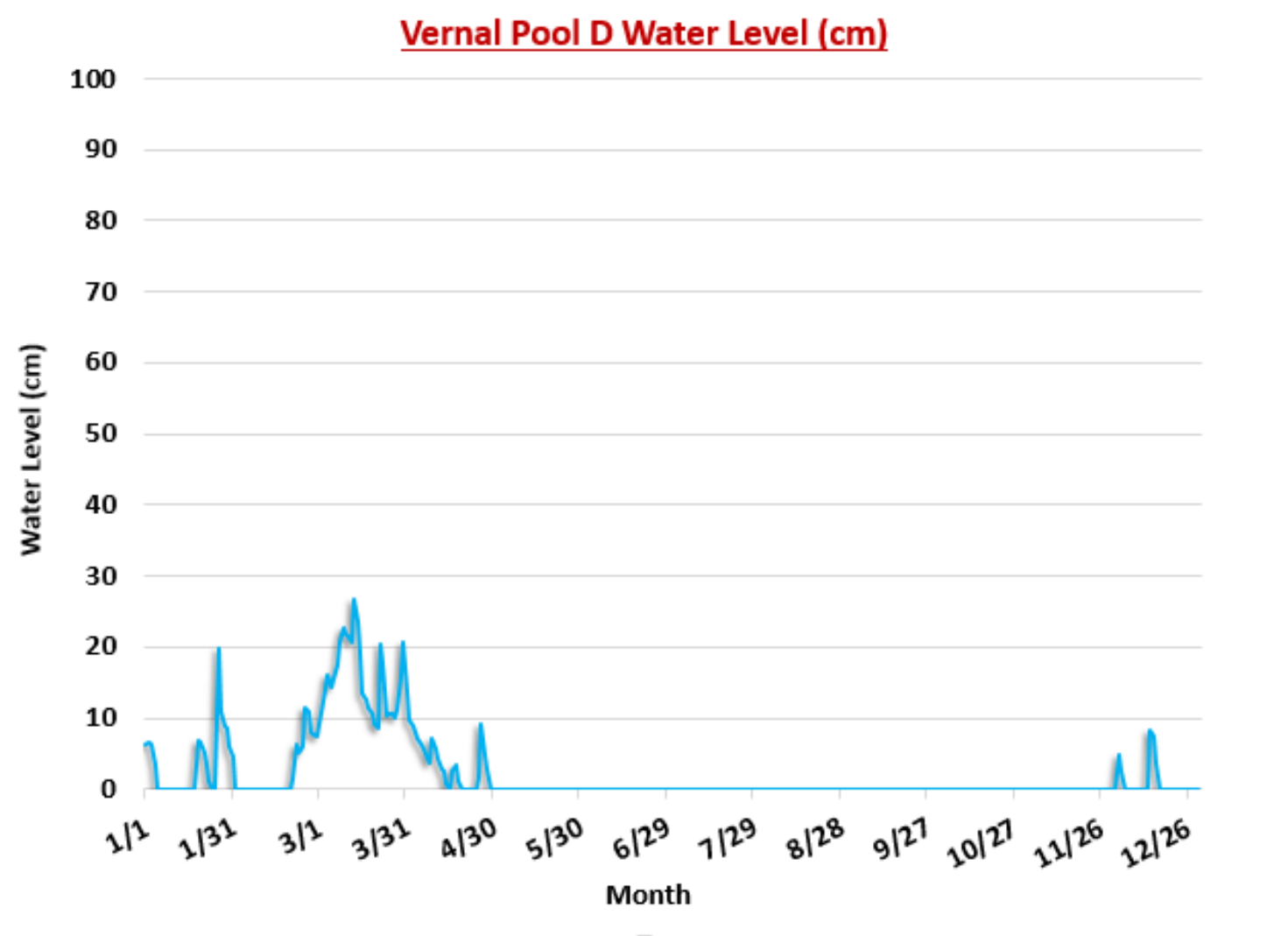
RESULTS

Hydrology Monitoring– Successful vernal pool example



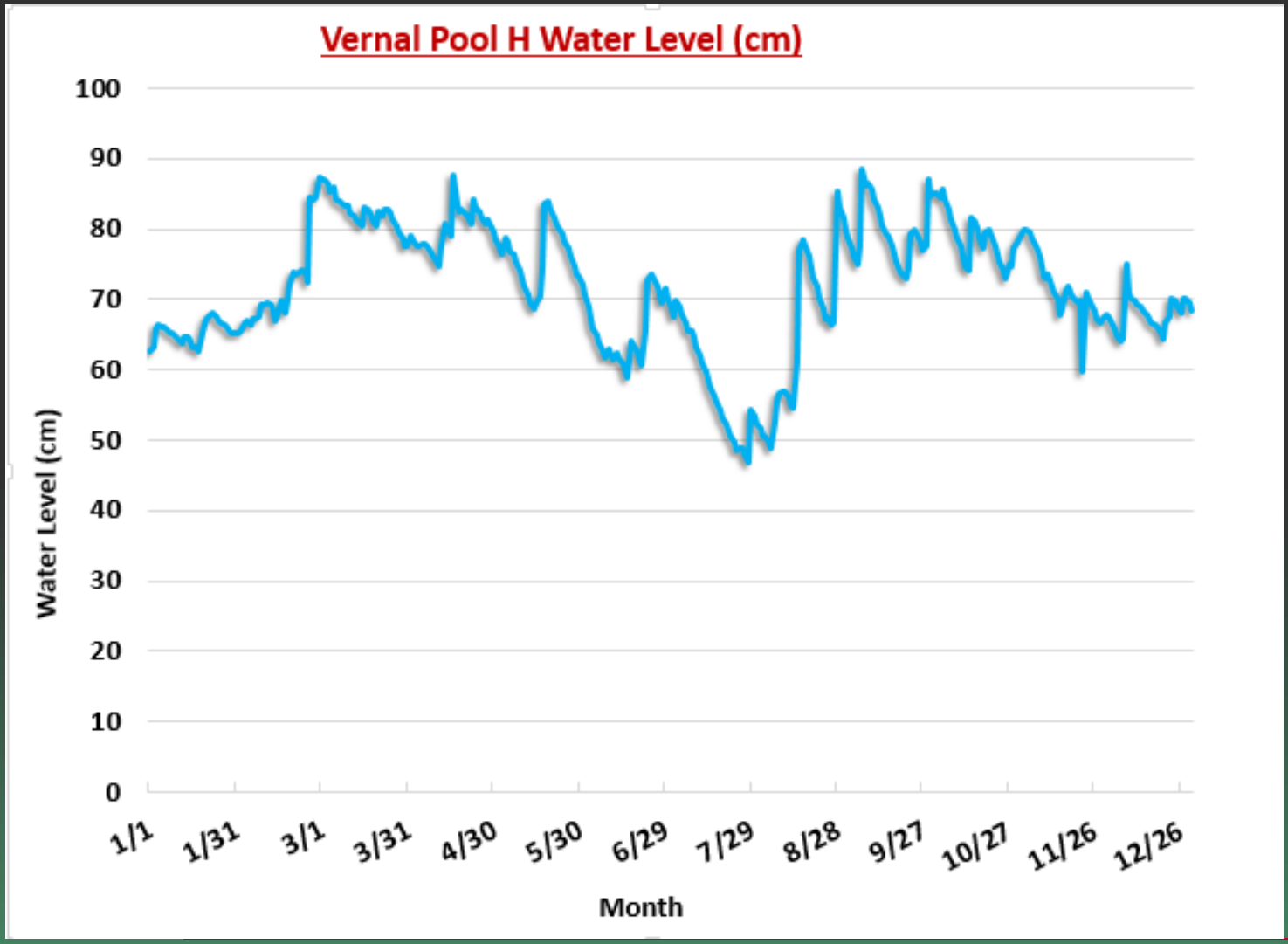
RESULTS

Hydrology Monitoring– Dry pool example



RESULTS

Hydrology Monitoring– Permanently inundated pool example



RESULTS

Hydrology Monitoring

- Of 12 constructed pools, 5 have been observed to sustain water levels during the targeted hydroperiod, during normal precipitation years.
- Of 12 constructed pools, 2 have performed as permanent ponds, with limited drawdown during the summer months. These pools have been inundated since construction.
- Of 12 constructed pools, 5 have been observed to remain dry throughout the year or dry too quickly to sustain amphibian breeding.

Pool B, June

Pool X, August

Pool V, April

RESULTS

Herpetile Surveys

- 15 species of amphibians and reptiles observed
- 6 species confirmed breeders

Scientific Name	Common Name	Breeding Observed
Ambystoma maculatum	spotted salamander	X
Bufo americanus	American toad	X
Chelydra serpentina serpentina	common snapping turtle	
Chrysemys picta picta	painted turtle	
Clemmys guttata	spotted turtle	
Glyptemys insculpta	wood turtle	
Hemidactylium scutatum	four-toed salamander	
Hyla versicolor	northern gray treefrog	X
Notopthalamus viridescens viridescens	red-spotted newt	
Pseudacris crucifer crucifer	northern spring peeper	X
Rana catesbeiana	American bullfrog	
Rana clamitans melanota	green frog	X
Rana palustris	pickerel frog	
Rana sylvatica	wood frog	X
Storeria dekayi dekayi	northern brown snake	
Thamnophis sirtalis sirtalis	common garter snake	

RESULTS

RESULTS

Herpetile Surveys

RESULTS

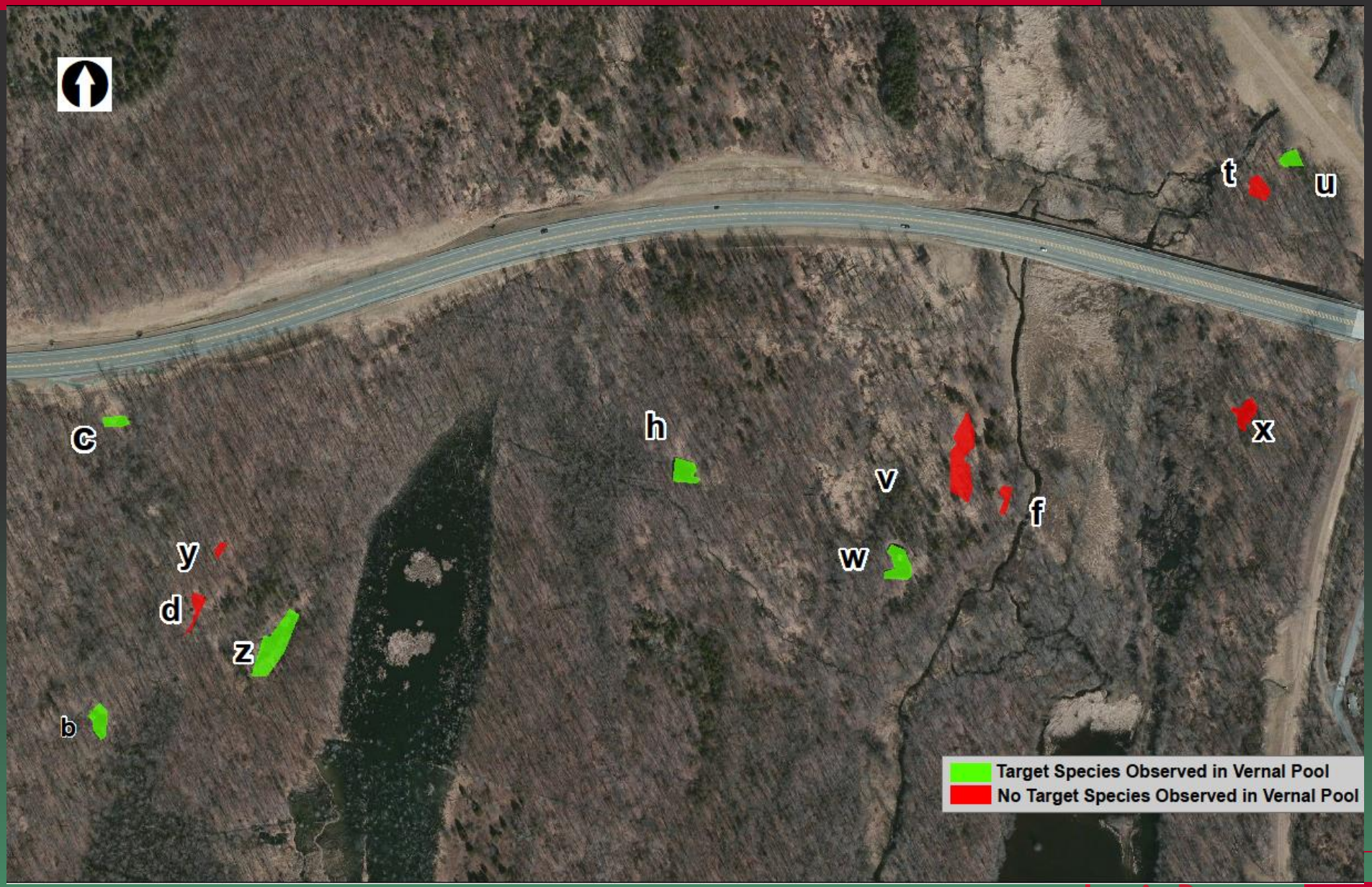
Herpetile Surveys

- Of 12 constructed pools, 6 have been observed to attract target species for 2+ consecutive years, over the 10-year monitoring period.

- This includes pool H, which has remained permanently inundated since construction.
  - Attracts wood frogs, spotted salamanders, and spotted turtles.
  - Completion of the breeding cycle (emergence) within the pool has not been confirmed.
  - The presence of green frogs, and the occasional bullfrog, may limit success in pool H.

- 6 constructed pools have not attracted target species, or allowed for complete larval development, over the 10-year monitoring period. Inappropriate hydroperiods are the sole reason for their inability to provide habitat.

RESULTS


t
u
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b
Target Species Observed in Vernal Pool
No Target Species Observed in Vernal Pool

RESULTS

Vegetation Surveys

- Percent canopy cover at the vernal pool sites ranges from 5 to 90 percent with eight pools having 50% or less canopy coverage in mid-summer.

- Common native species growing in pools include *Carex* species, *Persicaria* species, broadleaf cattail (*Typha latifolia*), sensitive fern (*Onoclea sensibilis*), and woolgrass (*Scirpus cyperinus*).

- Percent coverage of invasive species:

  Phragmites australis – exceeds 5% coverage in 7 pools (≥25% coverage in 6 pools)

  Microstegium vimineum – exceeds 5% coverage in 8 pools

  Lythrum salicaria – exceeds 5% coverage in 1 pool

RESULTS

Vegetation Surveys

Vernal Pool W

2010

2016

RESULTS

Vegetation Surveys

Vernal Pool U

2008

2015

RESULTS

Vegetation Surveys

Vernal Pool Z

2007

2016

LESSONS LEARNED

Reasons for pool success

Construction:

- Pool elevations properly excavated and meet design specifications.
- The depth of the pools are ideal for their surrounding watershed and meet the target hydroperiod.
- Pools hold water long enough for metamorphosis and dry out to limit predators.
- Invasive species have not encroached and reduced functionality of the pools
- Closed canopy mimics that of natural vernal pools

Pool B, March

Pool B, May

Pool B, July

LESSONS LEARNED

Reasons for pool failure

Construction:

- Improper pool elevations
  too shallow or too deep
- Improper installation of bentonite layer
- Introduction of invasive species from construction vehicles and local sources

Pool Y, March 2010

Pool C, August 2016

LESSONS LEARNED

Reasons for pool failure

Canopy Factors:

- Open canopy likely resulted in higher evaporation rates, and excess vegetation growth.
  - Changed available area and water budget.
- Open canopy has contributed to establishment of invasive vegetation.

Pool U, January 2007

Pool U, August 2016

Pool Z, March 2007

Pool Z, May 2012

Pool Z, May 2016

LESSONS LEARNED

- Plan for long term invasive species management
- Continuous construction oversight at critical stages such as grading and low permeability layer installation
- Better topographic mapping
- Flexibility in site selection
- Reference Site
- Better defined success criteria
- Realistic Goals

ACKNOWLEDGEMENTS

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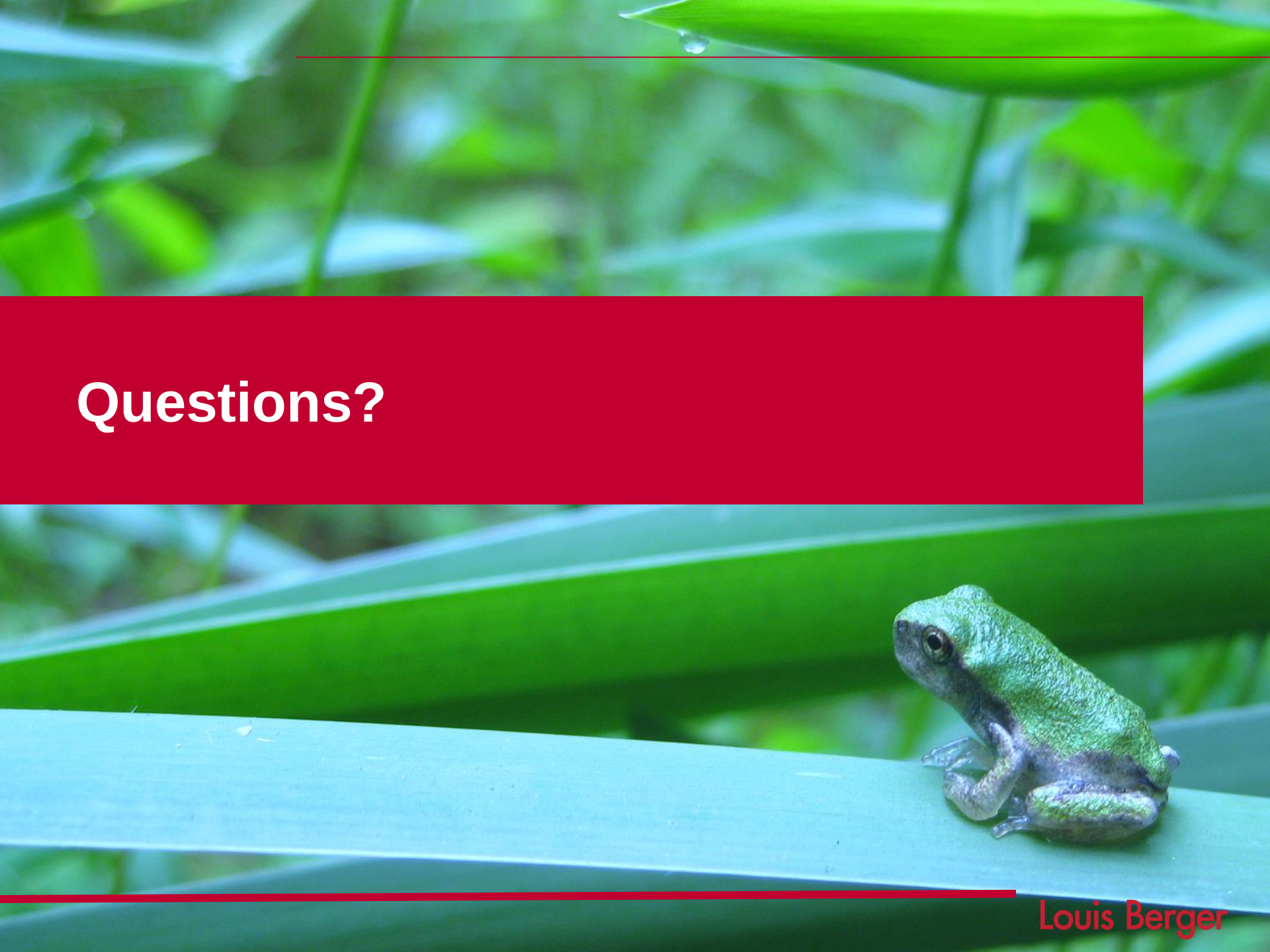
Questions?



Louis Berger