

**Wild Trout Symposium XII  
West Yellowstone, Montana  
September 26-29, 2017**

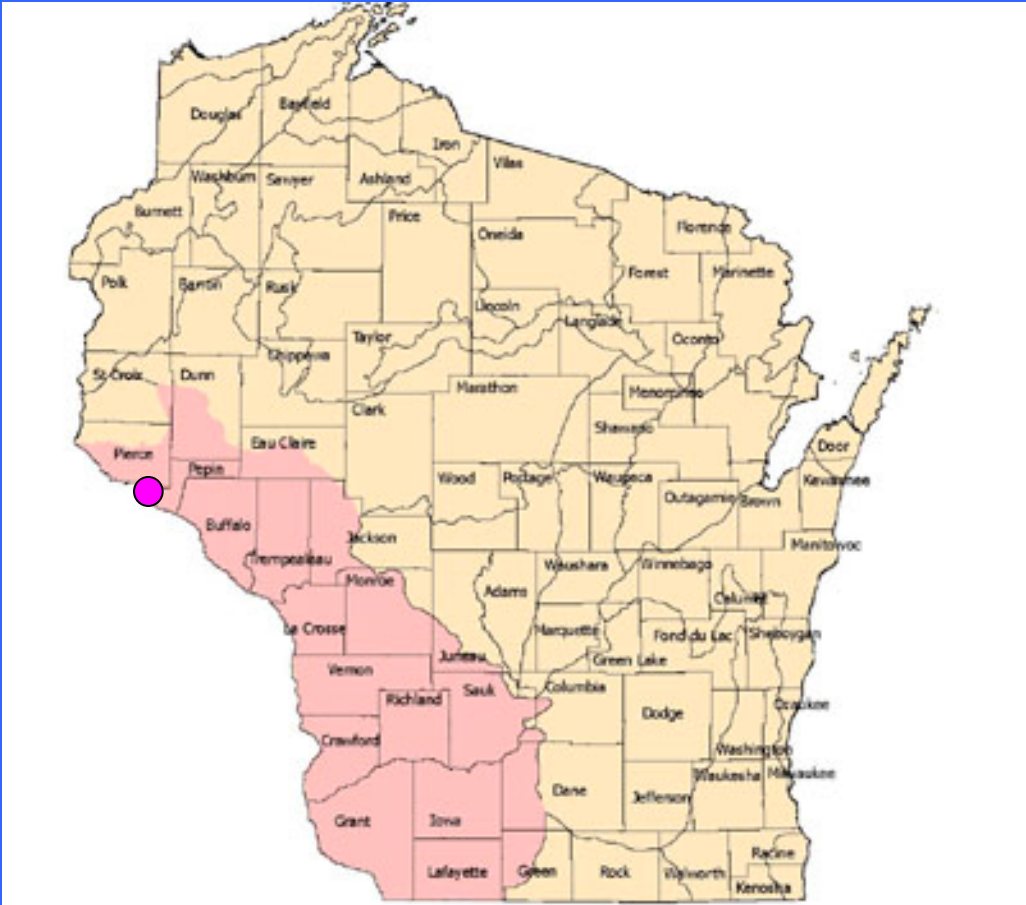
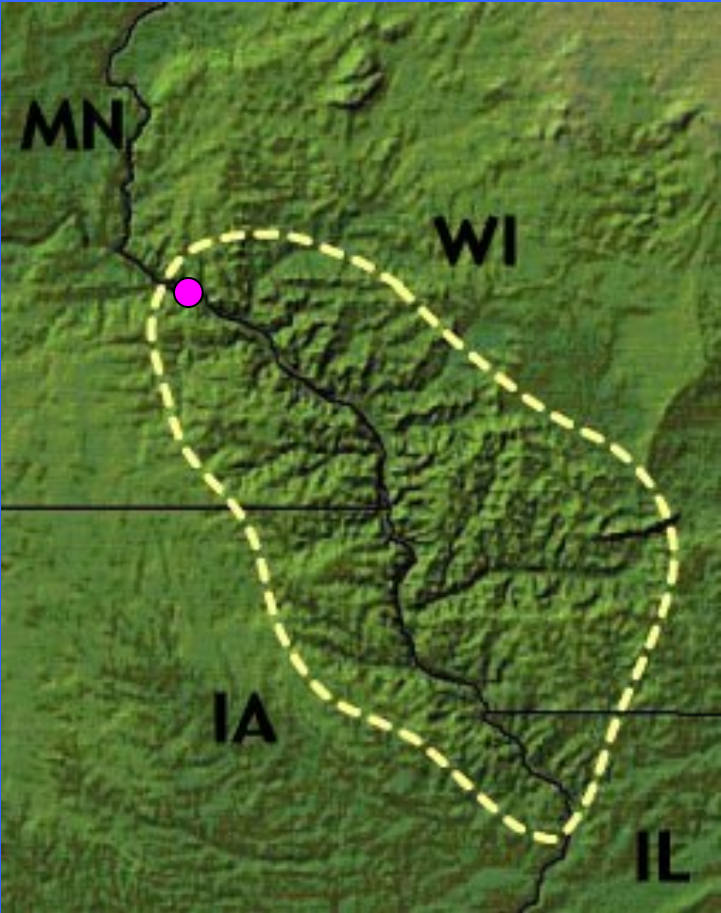
# **Evaluating Trout Stream Restoration Benefits: A Case Study at Pine Creek, Wisconsin**

**Kent Johnson, Kiap-TU-Wish Chapter, Trout Unlimited**



Photo courtesy of Jeanne Kosfeld, Pine Creek Artist in Residence, 2009

# Pine Creek, in the Upper Midwest's Driftless Area



# Pine Creek and Watershed Maiden Rock, WI



# Pine Creek Restoration Project Background

- Pine Creek is spring-fed, with 3 miles of permanent flow
- Creek has long supported a wild population of Brook Trout
- Creek had excellent water quality, but severe stream bank erosion, due to poor agricultural practices and overgrazing
- In 2002 and 2003, the West Wisconsin Land Trust purchased 220 acres that encompass the majority of Pine Creek
- Pine Creek Restoration Project planning began in 2006



# Pine Creek Restoration Project: 2007-2011



Maiden Rock, Wisconsin

# Project Objectives

Measurable project objectives include:

- Improve stream temperature regime and armor for climate change
- Reduce stream bank erosion to 10% of pre-existing conditions
- Reduce fine sediment and increase coarse bottom substrate by 50%
- Increase aquatic macrophyte growth by 25%
- Increase numbers of Brook Trout by 40-50%
- Increase numbers of Brook Trout 10+ inches by 50-100%



# WDNR Stream Restoration Methods

- Grade stream banks at a 3:1 slope, for floodplain access
- Stabilize and re-vegetate stream banks, for erosion reduction
- Narrow and deepen the stream channel
- Increase flow velocity, for groundwater conveyance
- Install LUNKER structures, for trout cover and flood refuge
- Install boulder clusters and root wads, for mid-stream trout cover
- Excavate plunge pools for deep water and over-wintering habitat



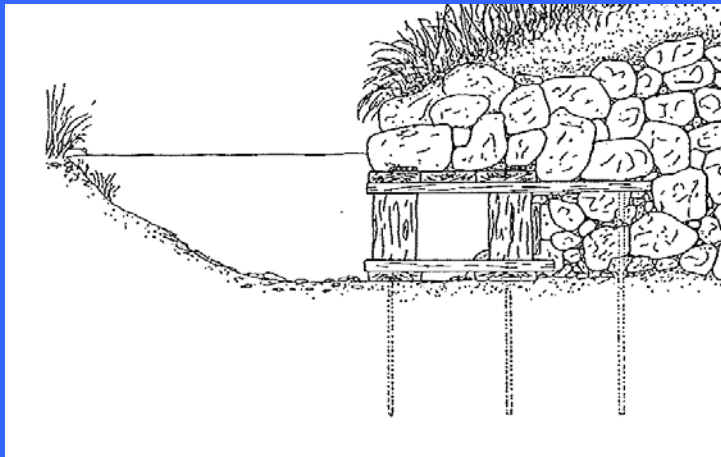
# Lower Pine Creek Restoration Work (2007)

## LUNKER\* Structures



Stream bank  
seeded and  
mulched

Rip-rap  
placed



LUNKER  
Structures

\*Little Underwater Neighborhood Keepers Encompassing Rheotactic Salmonids (Vetrano 1988)



# Pine Creek Restoration Project: 2007-2011 Project Summary

Total Stream Length Restored: 11,167 feet (2.11 miles)

- Upper Pine Creek: 4,365 feet (0.83 mile)
- Lower Pine Creek: 4,378 feet (0.83 mile)
- North Spring Tributary: 914 feet (0.17 mile)
- South Spring Tributary: 1,380 feet (0.26 mile)
- North Branch Tributary: 130 feet (0.02 mile)

Total Restoration Cost: \$270,273 (\$24/foot)





# National Fish Habitat Action Plan

## 2009 Waters to Watch

### 2009 10 “Waters to Watch” List Celebrates Acceleration in Aquatic Conservation

(WASHINGTON, D.C.) - The 10 Waters to Watch list, assembled by the nation's leading authorities on aquatic conservation, is a collection of rivers, streams and shores that will be cleaner and healthier habitats for the many fish and wildlife species and people who call these areas home.

Thanks to the combined actions of concerned community groups, non-profit organizations, local watershed groups, Native American tribes and state and federal agencies, these waters are being improved by planting stream-side vegetation, removing structures blocking fish from habitat and protecting bodies of water from the effects of industrial processes, agriculture and livestock.

They are representative of freshwater to marine waters across the country including lakes and reservoirs that are improving through the conservation efforts of the National Fish Habitat Action Plan — a bold initiative to reverse persistent declines in aquatic habitat.

### 10 Waters to Watch

[Agulowak River, AK](#)

[Jockey's Ridge, NC](#)

[Lake Houston, TX](#)

[Lower Flint River, GA](#)

[Maggie Creek, NV](#)

[Meramec Basin, MO](#)

[Pine Creek, WI](#)

[Little Conemaugh, PA](#)

[Teton Creek, ID](#)

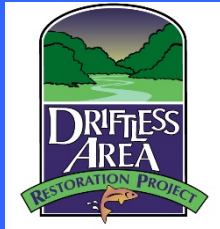
[Whitethorn Creek, WV](#)

# Pine Creek Monitoring Summary

## Pre- and Post-Restoration Monitoring:

- Climate conditions (on-site weather station)
- Spring and stream temperature (6 sites)
- Habitat assessment (18 sites)
- Macrophyte presence (18 sites)
- Macroinvertebrate communities (8 sites)
- Trout surveys (2 sites)





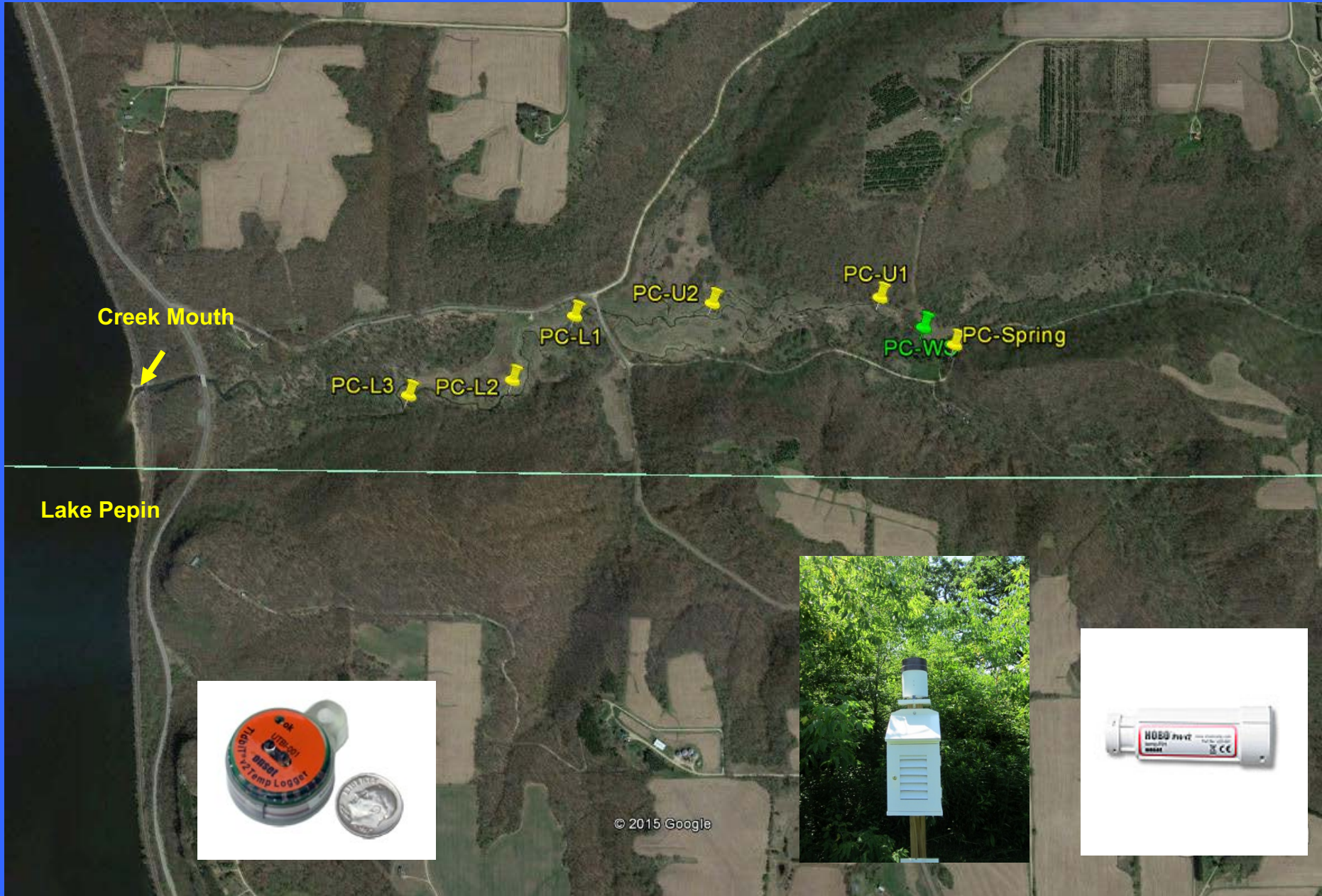
# TUDARE Stream Monitoring Protocols

## September 2011

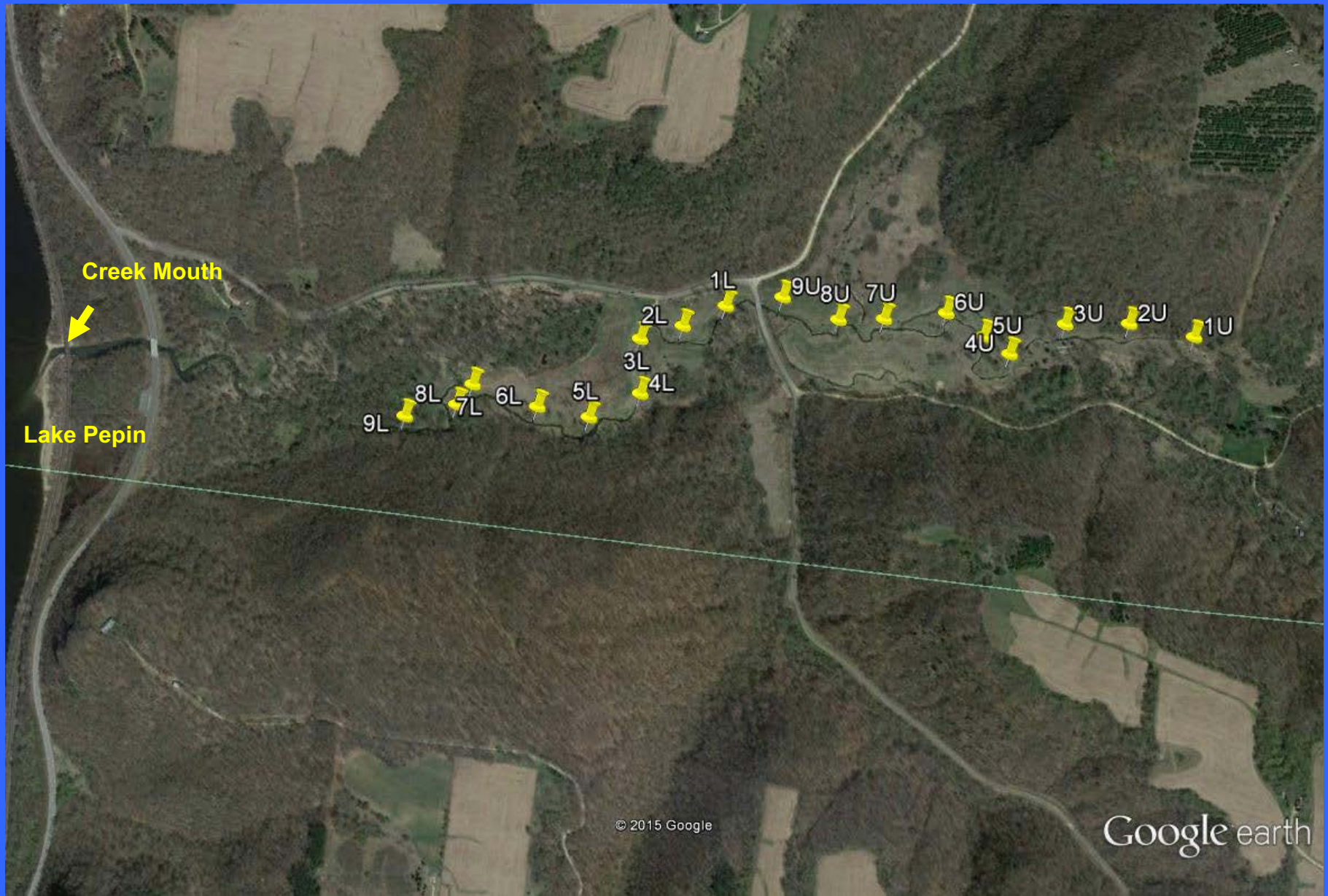
Jeff Hastings, TUDARE Project Manager, Trout Unlimited  
Kent Johnson, Kiap-TU-Wish Chapter, Trout Unlimited  
Matthew Mitro, Coldwater Fisheries Research Scientist, WDNR



# Pine Creek: Stream Temperature Monitoring Sites



# Pine Creek: Habitat Assessment Sites



# Pine Creek: Trout Survey Sites

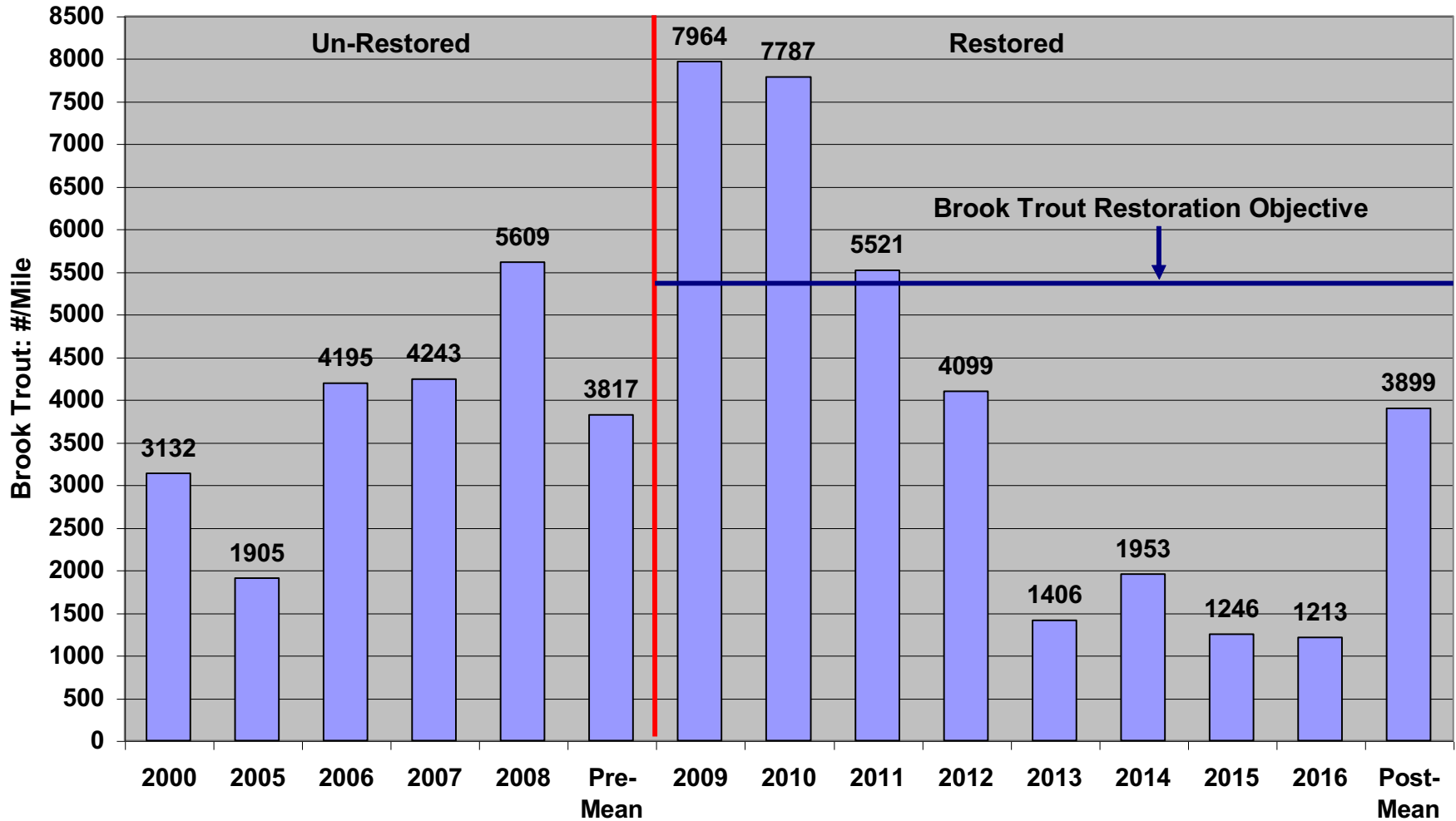
Wisconsin Department of Natural Resources\*



# Project Objective: Increase Numbers of Brook Trout by 40-50%

## Pine Creek (2A) Pre- vs Post-Restoration Brook Trout: Total/Mile

Brook Trout: Total/Mile



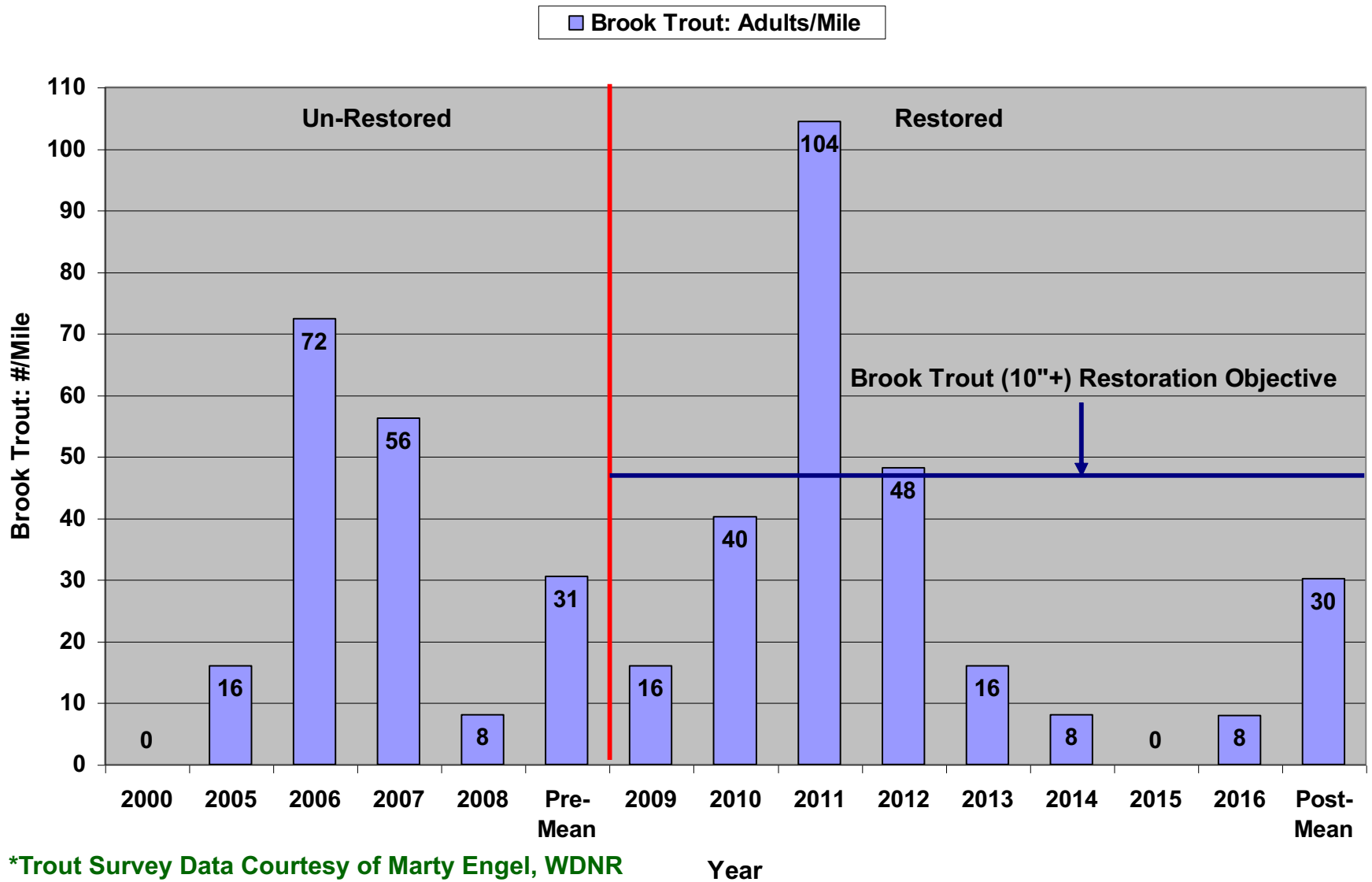
\*Trout Survey Data Courtesy of Marty Engel, WDNR

Year



# Project Objective: Increase Numbers of Brook Trout 10"+ by 50-100%

## Pine Creek (2A) Pre vs Post Restoration Brook Trout: Adults (10"+)/Mile

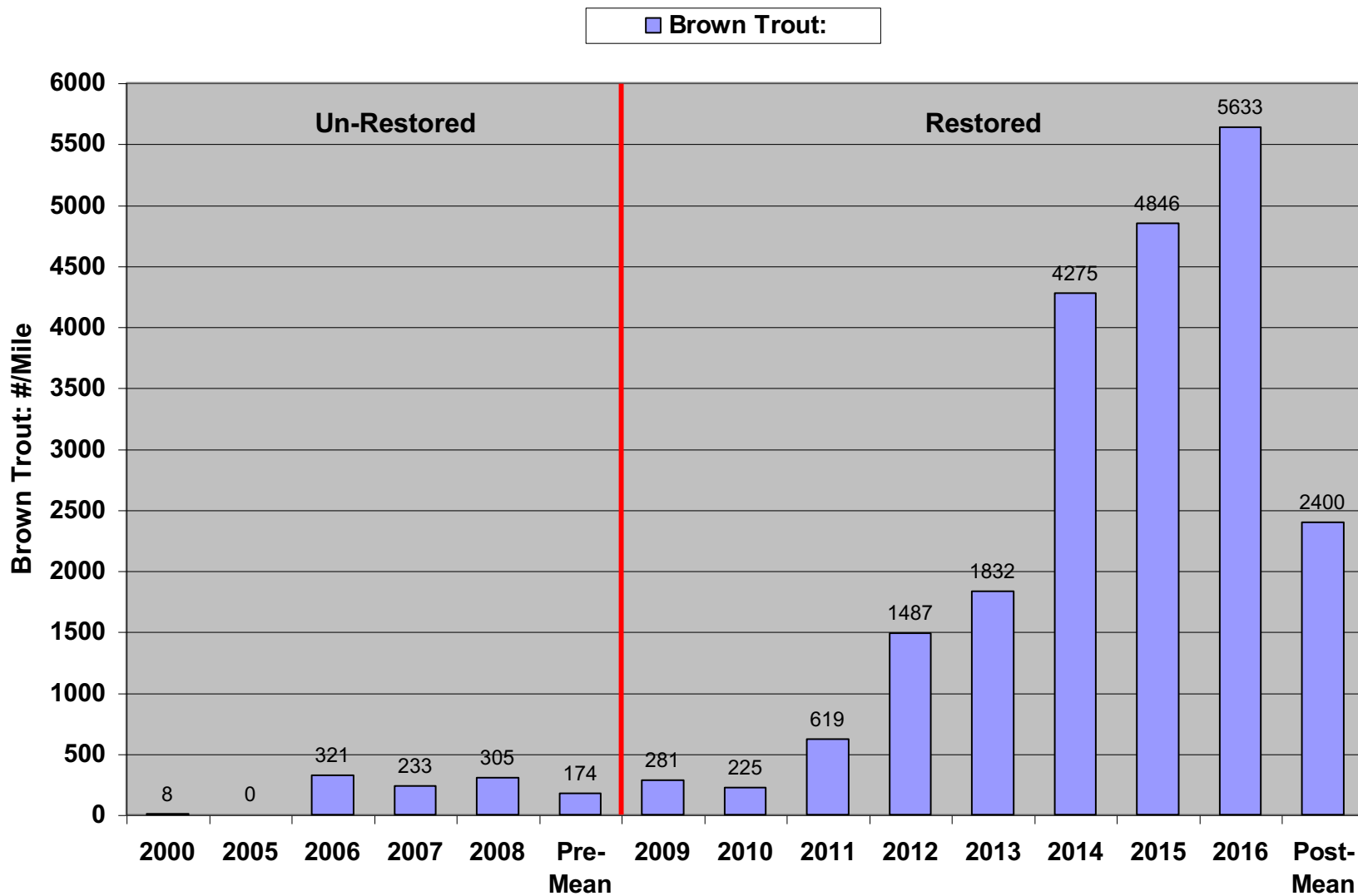


\*Trout Survey Data Courtesy of Marty Engel, WDNR

Year

# Brown Trout Abundance in Pine Creek: 2000-2016

Pine Creek (2A) Pre vs Post Restoration Brown Trout: Total/Mile



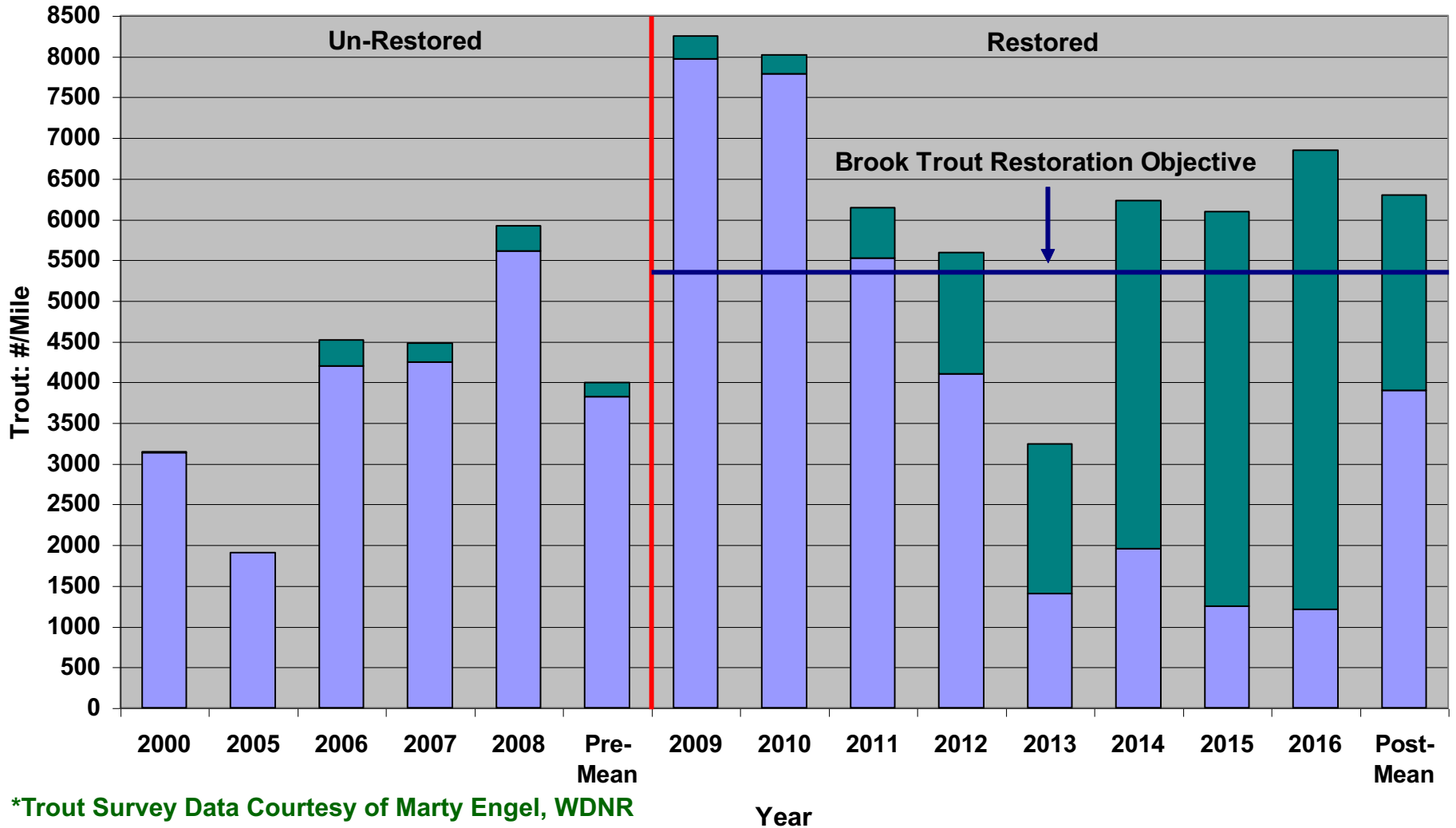
\*Trout Survey Data Courtesy of Marty Engel, WDNR

Year

# Project Objective: Increase Numbers of Brook Trout by 40-50%

Pine Creek (2A) Pre- vs Post-Restoration Trout: Total/Mile

Brook Trout: Total/Mile      Brown Trout: Total/Mile



\*Trout Survey Data Courtesy of Marty Engel, WDNR

# Evaluating Stream Restoration Benefits: A Case Study at Pine Creek, Wisconsin

## Value of Monitoring

- Pre- and post-restoration monitoring of stream temperature, habitat, and biota was an integral part of the Pine Creek Restoration Project
- Monitoring provided a wealth of information on project outcomes (Johnson 2017), including benefits, unintended consequences, and opportunities for improvement
- Monitoring enabled a determination of whether the six key project objectives were met



# Evaluating Stream Restoration Benefits: A Case Study at Pine Creek, Wisconsin

## Project Outcomes: Benefits

- Measurable improvement in the stream temperature regime, providing a buffer against future climate change impacts (Project Objective 1)
- 60% decrease in stream bank height, reducing erosion potential and re-connecting stream to floodplain (Project Objective 2)
- 140% increase in coarse stream bottom substrate (Project Objective 3)
- 133% increase in aquatic macrophyte presence (Project Objective 4)
- 40% decrease in stream channel width
- 75% increase in water depth



# Evaluating Stream Restoration Benefits: A Case Study at Pine Creek, Wisconsin

## Project Outcomes: Unintended Consequences

- 15% decrease in stream velocity
- 20% decrease in canopy cover
- Significant Brown Trout domination of a native Brook Trout stream

~70% decrease in Brook Trout abundance by 2016

Project Objective 5 targeted a 40-50% increase in Brook Trout numbers

~75% decrease in abundance of 10-inch+ Brook Trout by 2016

Project Objective 6 targeted a 50-100% increase in 10-inch+ Brook Trout numbers

>3,000% increase in Brown Trout abundance by 2016

# Evaluating Stream Restoration Benefits: A Case Study at Pine Creek, Wisconsin

## Why Did Brown Trout Become Dominant?

- Brown Trout were already present in low abundance (6%) pre-restoration, but Brook Trout dominated (94%)
- WDNR trout survey crews unsuccessfully attempted Brown Trout removal in 2007-2008, via electrofishing
- An exceptionally cold temperature regime in Pine Creek did not provide a competitive post-restoration advantage for Brook Trout
- Brown Trout have an ability to out-compete Brook Trout for occupation of the best available habitat, which the restoration project created via installation of LUNKER structures, boulder clusters, and root wads
- Post-restoration increase in overhead cover and shade provided by LUNKER structures and root wads may also favor the presence of Brown Trout
- Combined effects of interspecific competition, an increased susceptibility of Brook Trout to angling, differential response to environmental factors, Brown Trout predation on juvenile Brook Trout, and growing problem of gill lice parasitism of Brook Trout may all favor Brown Trout presence

# Evaluating Stream Restoration Benefits: A Case Study at Pine Creek, Wisconsin

## Project Outcomes: Opportunities for Improvement

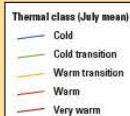
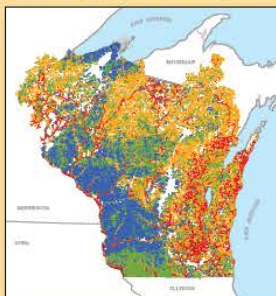
- Resource managers hoping to protect and enhance native Brook Trout streams, especially those vulnerable to Brown Trout cohabitation, should consider an adaptive management approach that creates habitat favorable for Brook Trout
- This consideration will become even more critical as climate change creates stream temperature regimes that are more suitable for Brown Trout, at the expense of Brook Trout
- Given the challenge posed by climate change, improving the stream temperature regime should be a primary restoration objective
- Restoration of riparian areas provides multiple benefits that complement stream channel restoration for trout
- Establish refugia (close to groundwater sources?), to protect native coldwater species such as Brook Trout



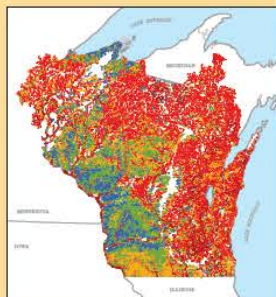
Prepared in cooperation with the Wisconsin Department of Natural Resources

## A Model for Evaluating Stream Temperature Response to Climate Change in Wisconsin

Present-day stream temperatures (estimated)



Late 21st century stream temperatures (projected)

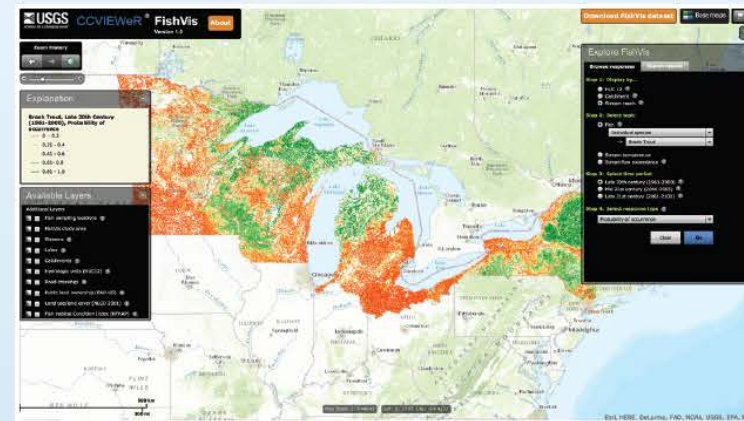


Scientific Investigations Report 2014–5186

U.S. Department of the Interior  
U.S. Geological Survey

Prepared in cooperation with Michigan State University, Michigan Department of Natural Resources Institute of Fisheries Research, and the Wisconsin Department of Natural Resources

## FishVis, A Regional Decision Support Tool for Identifying Vulnerabilities of Riverine Habitat and Fishes to Climate Change in the Great Lakes Region



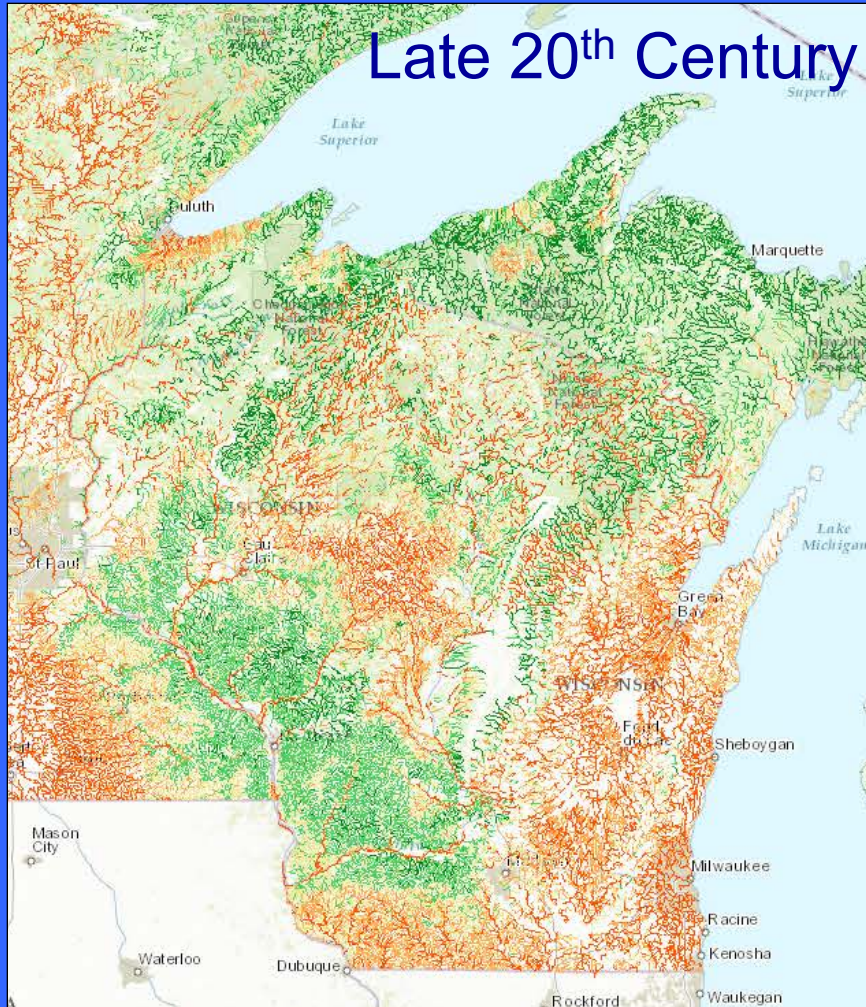
Scientific Investigations Report 2016–5124

U.S. Department of the Interior  
U.S. Geological Survey

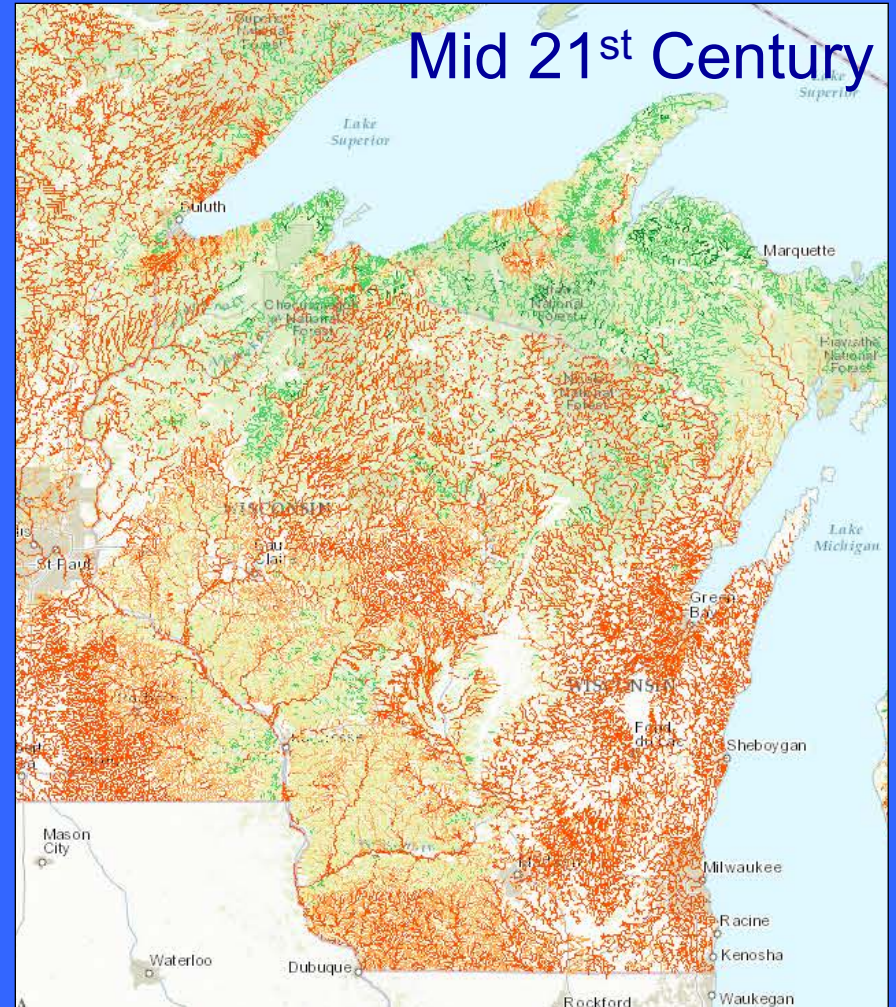
# Brook Trout



Late 20<sup>th</sup> Century



Mid 21<sup>st</sup> Century



Mitro, M. 2017. Effects of changing environmental conditions on Driftless fishes. WDNR, Madison, WI. Presented at 2017 Driftless Area Symposium, La Crosse, WI.

A close-up photograph of a brook trout, a species of fish, resting in a black fishing net. The fish is oriented horizontally, facing left. Its body is covered in numerous small, bright yellow spots and several larger, distinct red spots. The fish's mouth is slightly open, and it appears to be holding a small, light-colored lure or bait. The net is made of a dark, fine-mesh material, and the background is dark and out of focus. The overall lighting is somewhat dim, highlighting the textures of the fish's scales and the net.

Lower Pine Creek  
Post-Restoration Brookie

Questions?