

TGP 300 and TGP NEUP
Thermal Impacts to Exceptional Value Waterbodies
in Pennsylvania Cut by Gas Pipeline Projects



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Introduction

Delaware Riverkeeper Network (DRN) deployed automatic temperature loggers in two freshwater streams and wetland complexes located in Pike County, PA that were crossed by two separate and segmented Tennessee Gas Pipeline (TGP) (Kinder Morgan Energy Partners, L.P.) natural gas transmission Right of Way projects (ROW), the TGP 300 Line Upgrade and the TGP Northeast Upgrade Project (NEUP). The TGP 300 project was constructed in 2011 and transporting gas by November, 2011. Savantine Creek Wetland complex (W038) was cut across using an open cut during the TGP 300 project. The TGP NEUP was another segmented pipeline project that was constructed in 2013 and running gas by November 1, 2013. Both pipelines were additions to an existing pipeline ROW that was installed by TGP. Pinchot Brook was cut across during the NEUP phase of the pipeline project. The objective of the monitoring was to document potential thermal changes and impacts due to the constructed pipelines and forest clearing that occurs to install these pipelines. Temperature monitoring probes were installed upstream and downstream of these pipeline cuts, and within the pipeline ROW for W038.

Project Maps and Watershed Characteristics in Study Area

Stream and wetland complexes selected for the temperature study were two tributaries to the Sawkill Creek watershed, Pinchot Brook and Savantine Creek sub-watersheds. Both tributaries and their associated wetland complexes flow into Sawkill Creek, an Exceptional Value, Migratory Fishery (EV, MF) waterbody of Pennsylvania. A stream classified as a High Quality Water (HQ) or Exceptional Value Water (EV) affords the stream special protection under PADEP's regulations (PA Code, Title 25, Chapter 93). This protection includes a requirement for a more stringent planning and permitting process before a discharge is permitted to the stream. An EV designation indicates that the stream constitutes an outstanding national, state, regional or local resource. These include: waters of national, state or county parks or forests; waters which are used as a source of unfiltered potable water supply; waters of wildlife refuges or state game lands; waters which have been characterized by the Pennsylvania Fish Commission as "Wilderness Trout Streams"; and other waters of substantial recreational or ecological significance. Anti-degradation Requirements mandate that the water quality for EV waters remain unchanged and that the water quality for HQ waters remain unchanged except under special exceptions following socio-economic justification reviews. The Pennsylvania Natural Diversity Inventory (PANDI) classifies the Sawkill Creek as High Gradient Clearwater Creek communities (NC 517).

The TGP pipeline ROW cuts across other headwater tributaries of the Sawkill Creek watershed including Dimmick Meadow and Craft Creek which means that this EV watershed has sustained multiple cumulative

impacts to its headwater tributaries from pipeline crossings and likely will continue to do so over the life and maintenance of the ROW and subsequent expansions of the pipeline project over time. Temperature monitoring by DRN was conducted along Pinchot Brook and Savantine Creek Wetland (W038). Efforts were made by DRN to request that TGP be required to conduct its own waterbody monitoring along special protection anti-degradation waterway crossings to document potential changes and needed restoration. To DRN's knowledge that was not required nor voluntarily conducted by TGP; agencies instead relied on mitigation measures, implementation of Best Management Practices (BMPs) and limited restoration and photo monitoring plans designed mostly around vegetation cover as an indicator to determine and monitor impacts and changes over time.

The temperature study by Delaware Riverkeeper Network was conducted in the late spring and summer of 2014 to document stream temperatures when higher water temperatures and lower flows can impact aquatic life. Within freshwater systems, water temperature is a controlling factor in ecosystem dynamics affecting dissolved oxygen, fish and macroinvertebrate habitat and diversity, aquatic organism physiology and metabolism, mortality, spawning migrations, amphibian life cycles, and egg hatching (Handeland 2008; Magoulick & Wilzbach 1998; Lessard & Hayes 2003). In many ways thermal characteristics are responsible for establishing aquatic organism community composition, particularly in fisheries. Populations of native brook trout and wild brown trout live in Sawkill Creek and its tributaries. These cold water species require low temperatures that carry with it high dissolved oxygen concentrations in order to thrive. In addition, the streams of the Sawkill watershed maintain outstanding diversity of stream macroinvertebrates that are characteristic of cold, clean streams (see Pike County Conservation District stream surveys). Alteration to the thermal regime of stream caused by multiple pipeline cuts, elimination of riparian vegetation along streams, and point and non- point source pollution inputs can alter stream conditions and temperatures and can have both acute and chronic detrimental impacts to aquatic life and community structure.

Methodology

This study included the installation of five water temperature data loggers to determine if there are potential thermal impact differences to the waterbodies and wetlands being crossed by the Tennessee gas pipeline crossings. Data loggers were installed in the upstream and downstream pipeline ROW cuts along the Tennessee Gas Pipeline in Pike County PA along two locations located in Delaware State Forest to document water temperatures near Tennessee Gas Pipeline Right of Way. Calibrated HOBOS were installed and set to record hourly temperature data from May 23, 2014 to August 28, 2014 for four of the stations. One station, outfall W038 mainbody site at Craft Brook, was added later in the study when a probe became available, and

documented a shorter temperature reading series from July 1, 2014 to August 28, 2014 within the pipeline ROW itself. Probes were visited and maintained regularly by DRN staff and additional field readings were taken during the study. There were some instances where the probes were out of the water due to low flows in the summer of 2014. All data are included in the tables and graphs included in this report since hourly temperature readings likely average out times when the probes were at low flow conditions and reading air temperatures.

Study Area

Both tributaries studied have special protection designations and requirements under the Clean Water Act's anti-degradation standards. Pinchot Brook and Savantine Creek both flow into Sawkill Creek in Pike County, PA which is designated in Chapter 93 as Exceptional Value (EV), Migratory Fishes (MF). Pinchot Brook and Savantine Creek wetland complex are tributaries that are designated EV and make up two of the seven tributaries of the Sawkill Creek watershed (Gum Brook, Dimmick Meadow Brook, Vantine Brook, Craft Brook, and Sloat Brook are other tributaries of Sawkill Creek that were all cut across by the TGP pipeline). The wetlands complexes associated with both of these waterbodies also have Exceptional Value designation. The Sawkill Creek is classified as a High Gradient Clearwater Creek community (NC-517) in the Pennsylvania Natural Diversity Inventory (PANDI).

The glacial aquifer that underlies the Route 6/209 corridor between Milford and Matamoras, PA, is one of the most productive in Pike County (Davis, 1989). Most businesses and residences along this narrow, 7-mile corridor rely on individual wells for water supply and septic systems for wastewater disposal. Much of the roadway and parking lot runoff is routed to swales, basins, and dry wells or areas at the edges of lots where the runoff infiltrates to the groundwater system. Groundwater quality in the glacial aquifer is threatened because of potential contamination by nutrients, bacteria and viruses from septic systems and salt from roadway runoff. In November 1998, the *Pike County Water Supply Plan and Wellhead Protection Study* was completed, and a groundwater pollution vulnerability map was included (Gehringer-Roth Associates). The Catskill, Trimmer Rock and Mahntango/Mardcellus rock-types are major geologic formations in Pike County. Since groundwater is the main source of potable water in Pike County, each of these formations is considered to be a groundwater reservoir.¹

Pinchot Brook originates in Westfall Township from an unnamed pond and flows in a southwesterly direction until it meets with Sawkill Creek. Pinchot Brook encompasses 1.8 sq miles of the Sawkill Creek sub-watershed and accounts for 7% of the watershed area. It flows for 5.4 miles before it meets the Sawkill Creek.

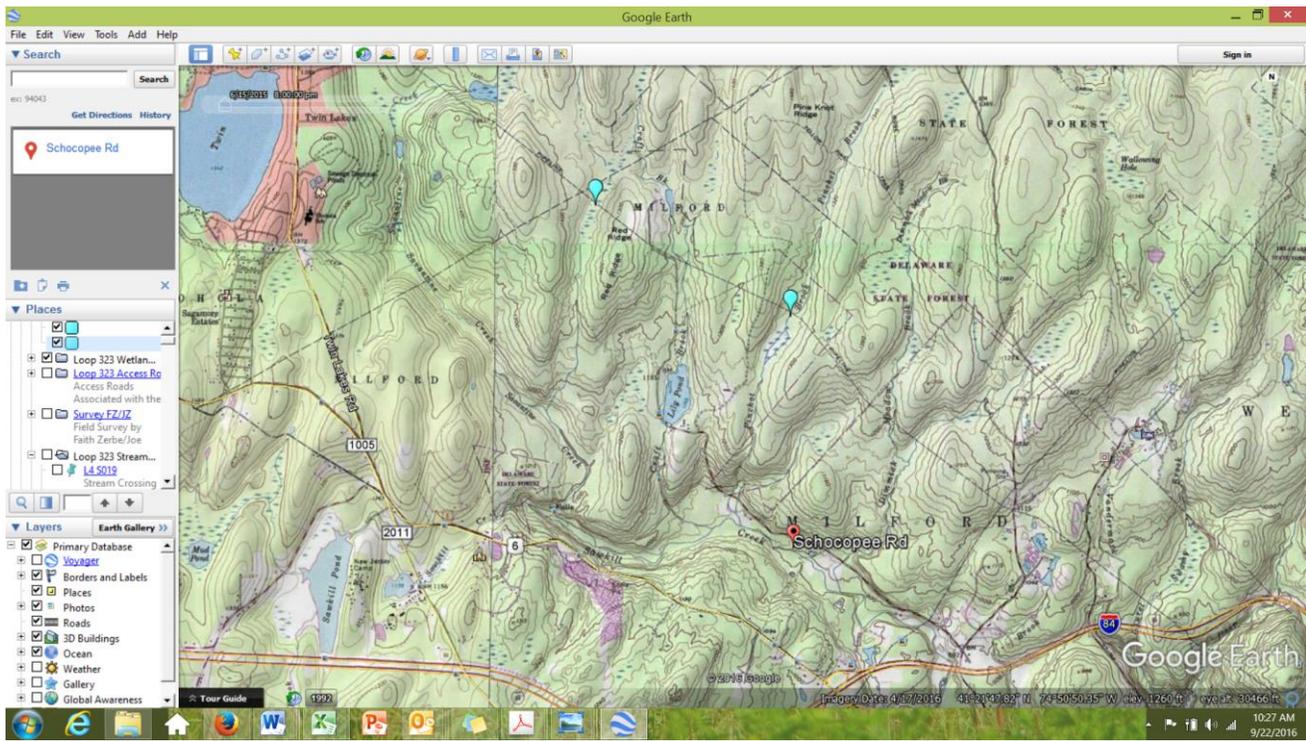
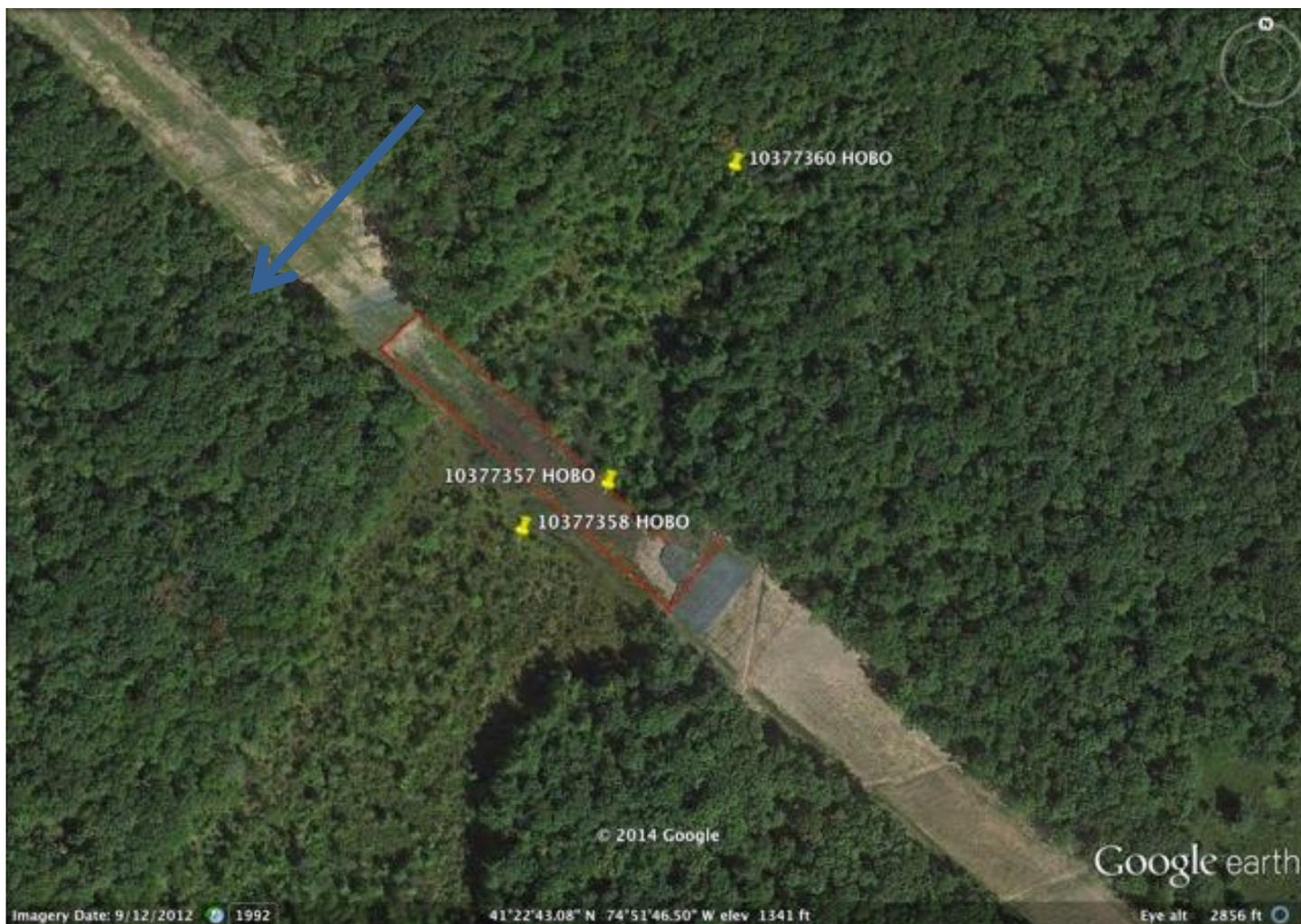
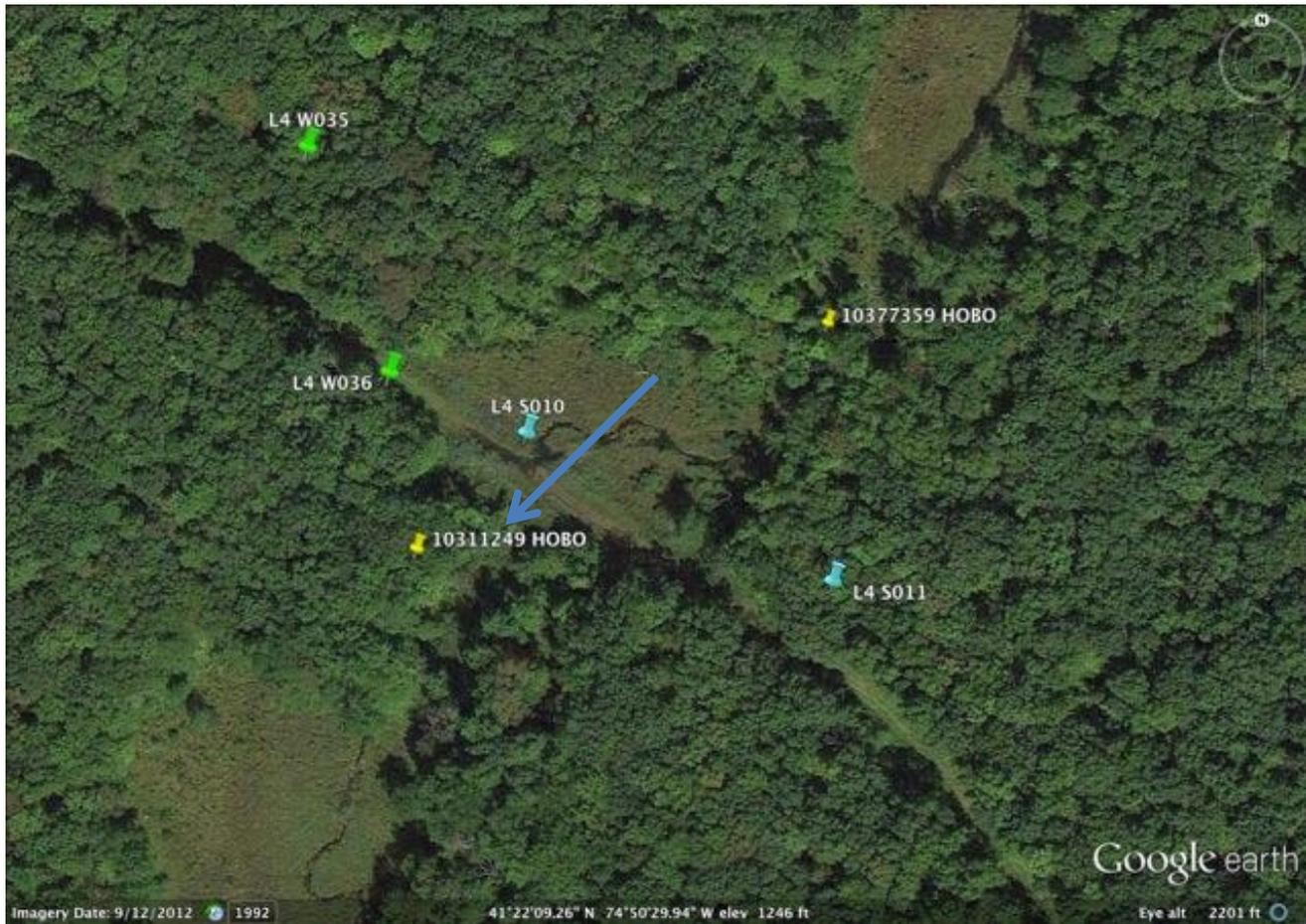


Figure 1. Overview Topo map of the TGP ROW pipeline cuts and study areas. Blue pins denote two tributaries and wetlands of the Sawkill Watershed that were a focus of this temperature study.

HOBO Temperature Monitoring Locations and Summary Data



Savantine Creek Complex – W038 and location of HOBO loggers – blue arrow denotes stream flow direction. 10377357 HOBO was placed within the ROW cut; ROW – 10377358 is downstream pipeline ROW cut and 10377360 is upstream the pipeline ROW cut (blue arrow denotes stream flow) (points were documented from Google Earth not in the field)



Pinchot Brook – location of 2 HOBO loggers upstream (10377359) and downstream (10311249) of pipeline cut.

Pre and Post photos of Pinchot Brook along ROW – NEUP Expansion

Pinchot Brook conditions before TGP NEUP expansion. Existing TGP ROW. Photo taken July 22, 2012



Looking down to Pinchot Brook. conditions before TGP NEUP expansion. Existing TGP ROW. Photo taken before leaf out - April 25, 2012, Standing on West side of Pinchot Brook from top of hill facing down to Pinchot Brook and wetland and East.



Pinchot Brook TGP 1950's Pipeline Cut. Note Phragmites and active ATV impacts. Photo April 25, 2012



April 25, 2012 – closer view of Pinchot Wetland and stream – note ATV damage on opposite side of wetland and phragmites. Standing on West Side Pinchot Brook, facing East.



Hobo Temp Station, Downstream of Pinchot Creek TGP NEUP Pipeline Cut in Forested Area. Photo taken 7/14/13



Close up of Hobo Temp Placement – Downstream Pinchot Pipeline cut. Photo taken 7/14/13

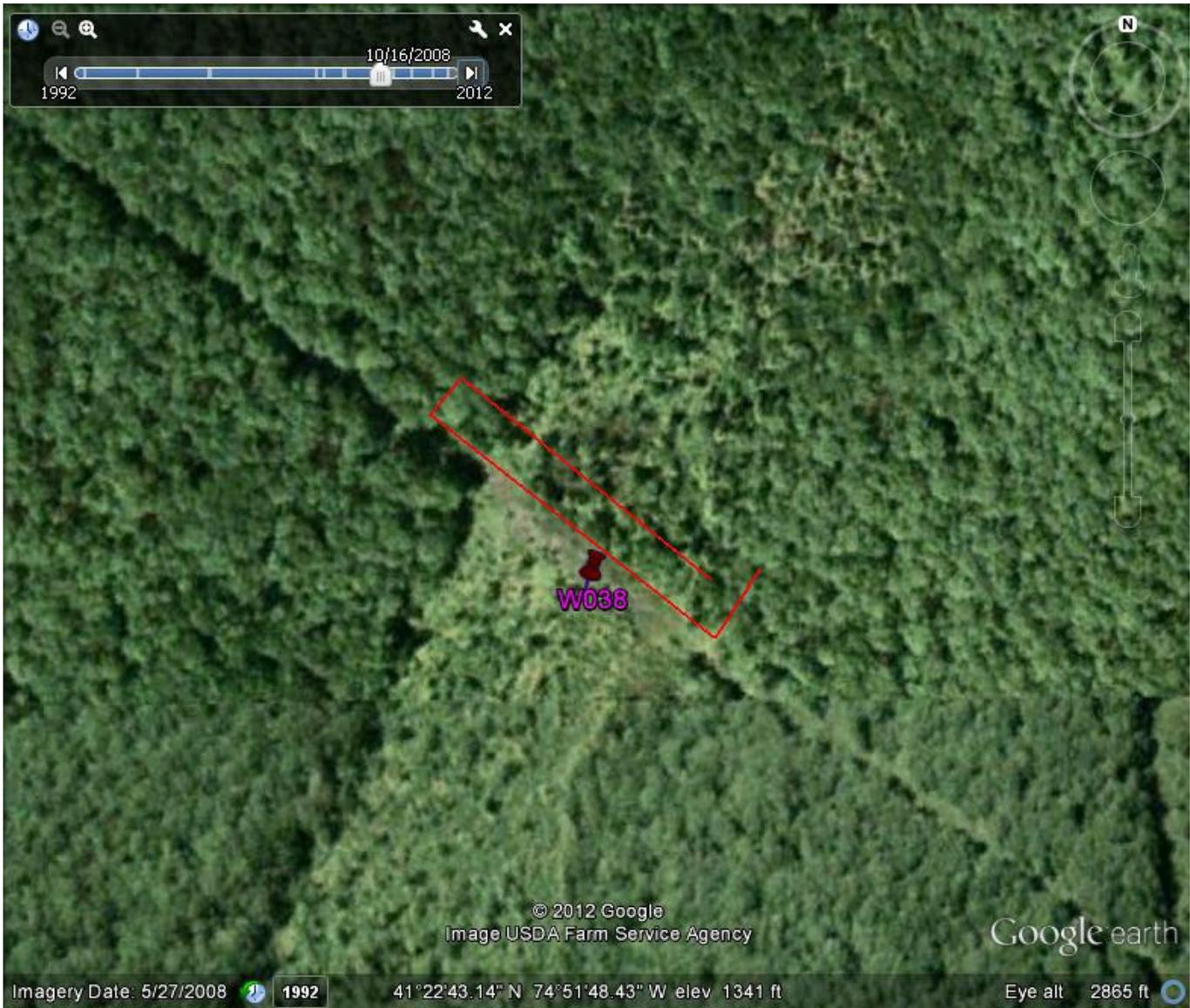


TGP NEUP Active Pipeline Cut Across Pinchot Brook, Photo taken 7/14/13. Standing in TWS on East side of Pinchot Brook crossing.

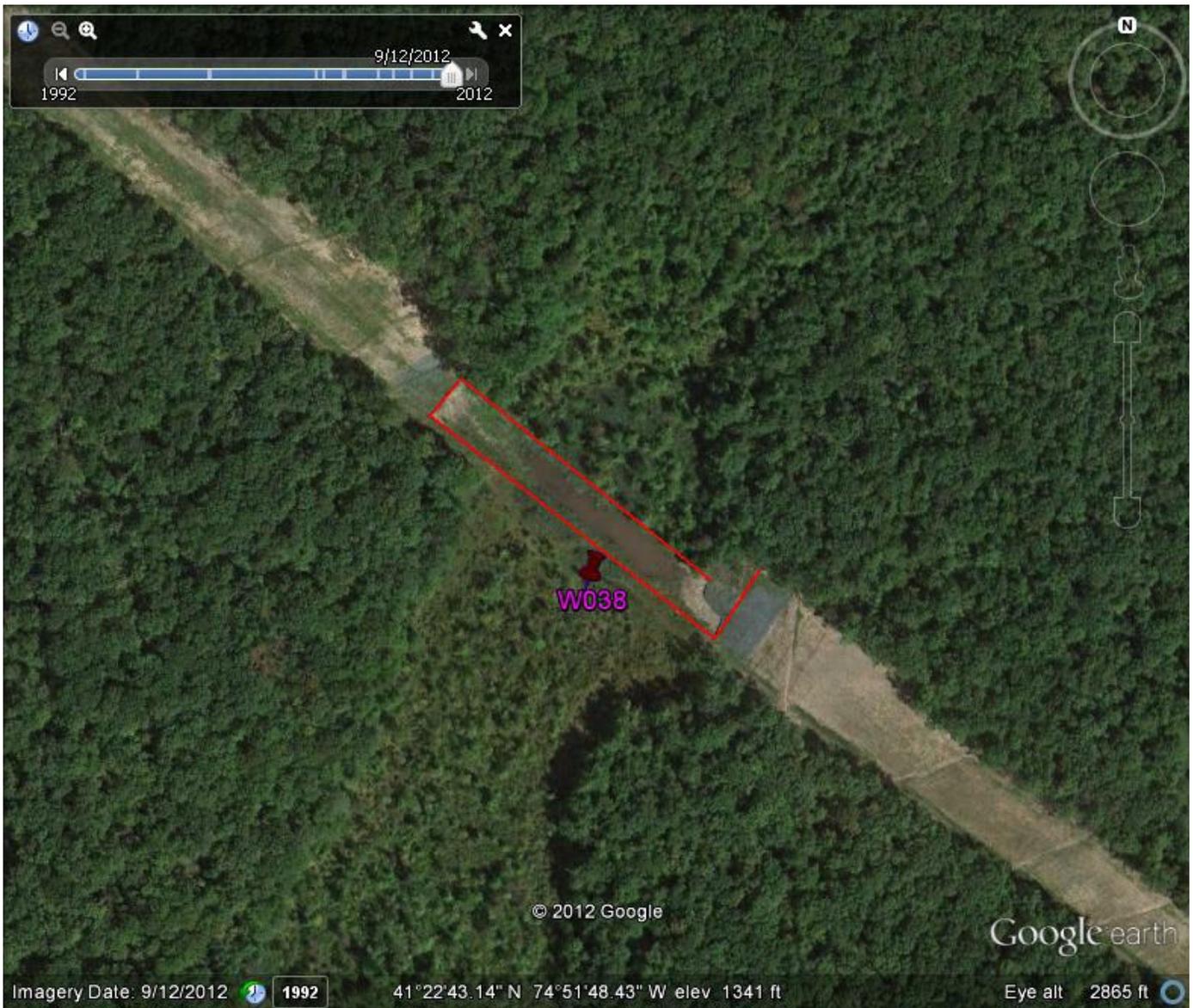


TGP NEUP Active Pipeline Cut Across Pinchot Brook, Standing on east side of Pinchot brook crossing facing west. Photo taken July 14, 2013.

Savantine Creek Wetland Complex --- Pre and Post 300 Line Upgrade Cut



2008 google earth aerial – note the red lines are estimate of the expansion of the ROW – note mature trees present in the wetland.



2012 Google earth imagery after the pipeline cut. W038 – note open water



Savantine wetland complex W038 – Photo taken April 29, 2012. Note open water wetland converted from forested wetland. Note *Phragmites* in old ROW.



W038 was converted from a forested EV wetland to an open waterbody EV wetland. Photo taken 10/11/12. TGP 300 was completed and transporting natural gas by November 2011.



W038 Savantine Wetland Complex with pipeline crossing. Photo taken 10/11/12. TGP 300 upgrade – note open water conditions that were prior forested wetland habitat. Obligate vernal pool species were documented here on multiple field visits. Note *Phragmites australis* in wetland perimeter.



Note that bubbling of the wetlands (W038) was observed on more than 6 field visits by Delaware Riverkeeper Network after new TGP 300 line placement. Bubbling was reported multiple times to agencies and FERC with concern of possible pipeline integrity or leaking issues. Decomposition from churned up soils may also contribute to conditions.

Results

Summary Table for Savantine Creek Wetland Temperatures

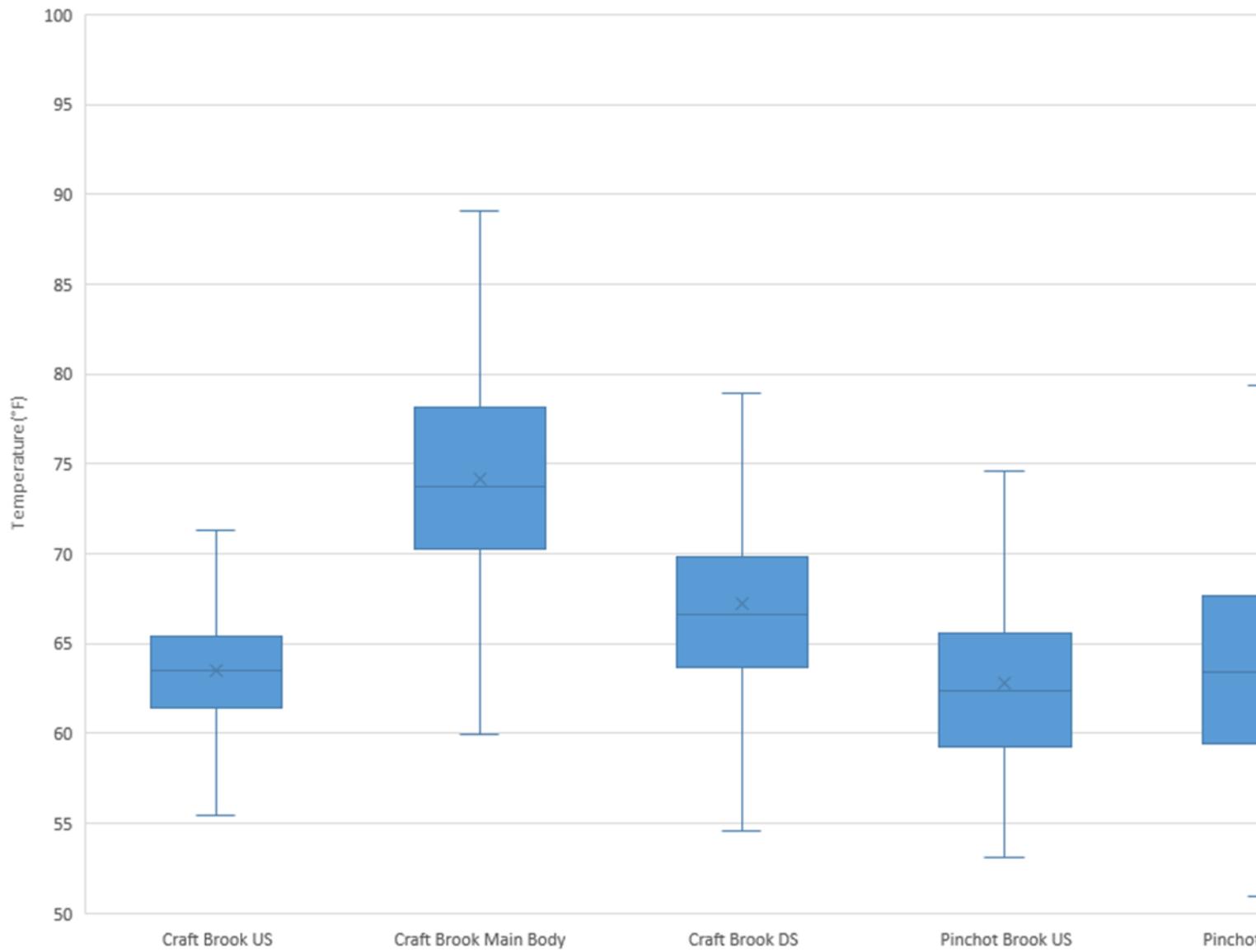
| Savantine Brook/Wetland | # of readings | Avg. (°F) | Max (°F) | Min (°F) | Std. Dev. | Span of samples | Serial # |
|---|---------------|-----------|----------|----------|-----------|-------------------|----------|
| W038 Savantine Brook Wetland Complex (500' US pipeline cut)* | 2335.00 | 63.53 | 78.56 | 52.38 | 3.34 | 5/23/14 – 8/28/14 | 10377360 |
| W038 Savantine Brook Wetland Complex (Within Pipeline ROW Cut)* | 1397.00 | 74.14 | 89.09 | 59.96 | 5.38 | 7/1/14 – 8/28/14 | 10377357 |
| W038S1 Savantine Brook Wetland Complex (DS pipeline ROW cut)* | 2336.00 | 67.26 | 92.48 | 54.39 | 5.40 | 5/23 – 8/28/14 | 10377358 |

*note graphs depict Savantine wetland as complex to Craft Brook

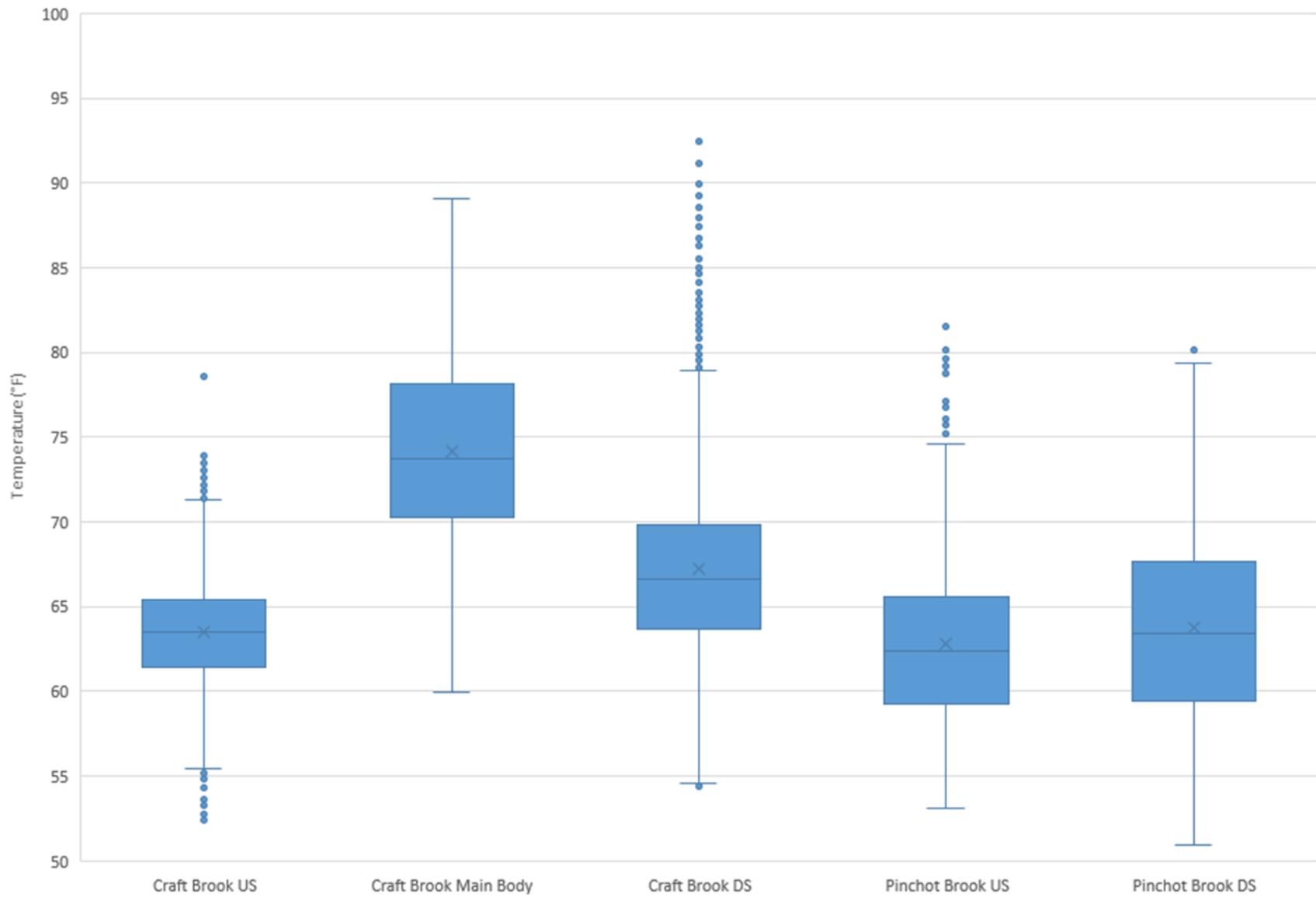
Summary Table for Pinchot Brook Temperatures

| Pinchot Brook | # of readings | Avg. (°F) | Max (°F) | Min (°F) | Std. Dev. | Span of samples | Serial # |
|------------------------------------|---------------|-----------|----------|----------|-----------|-------------------|----------|
| Upstream Pinchot (US pipeline cut) | 2336.00 | 62.77 | 81.64 | 53.12 | 4.65 | 5/23/14 – 8/28/14 | 10377359 |
| Down Pinchot (DS pipeline cut) | 2336.00 | 63.75 | 80.18 | 50.97 | 5.42 | 5/23/14 – 8/28/14 | 10311249 |

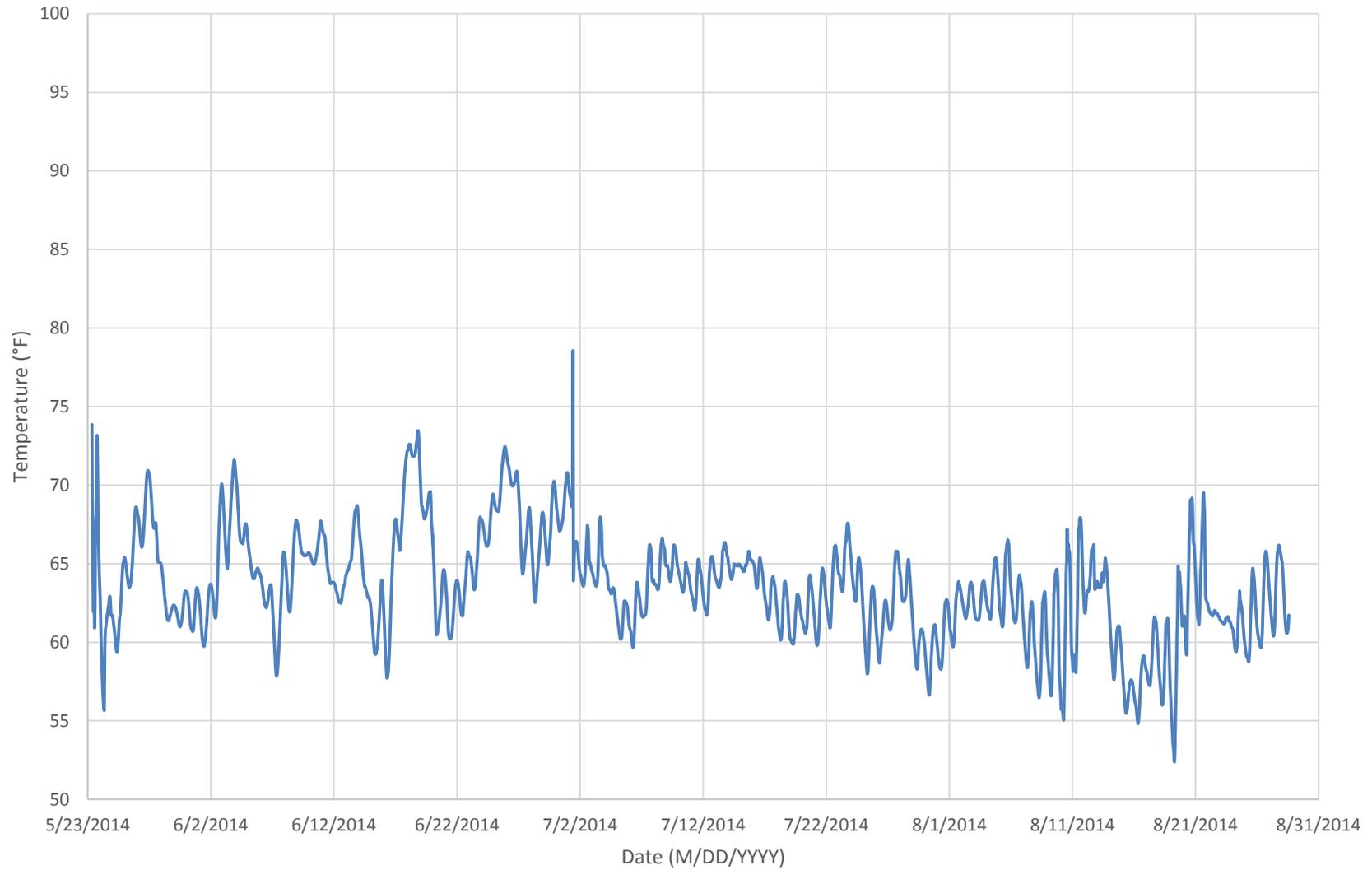
Temperature Ranges for All Stations



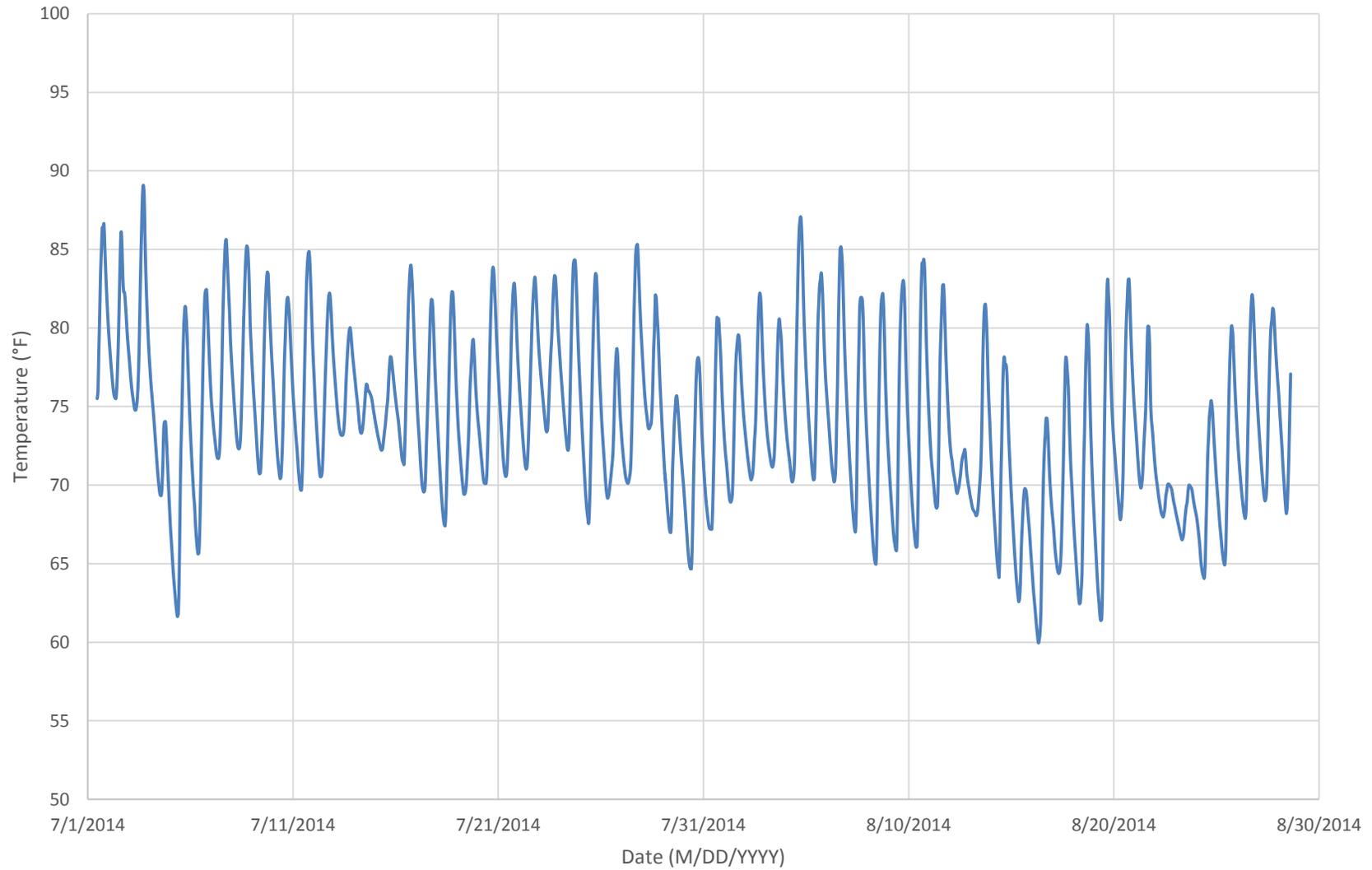
Temperature Ranges for All Stations



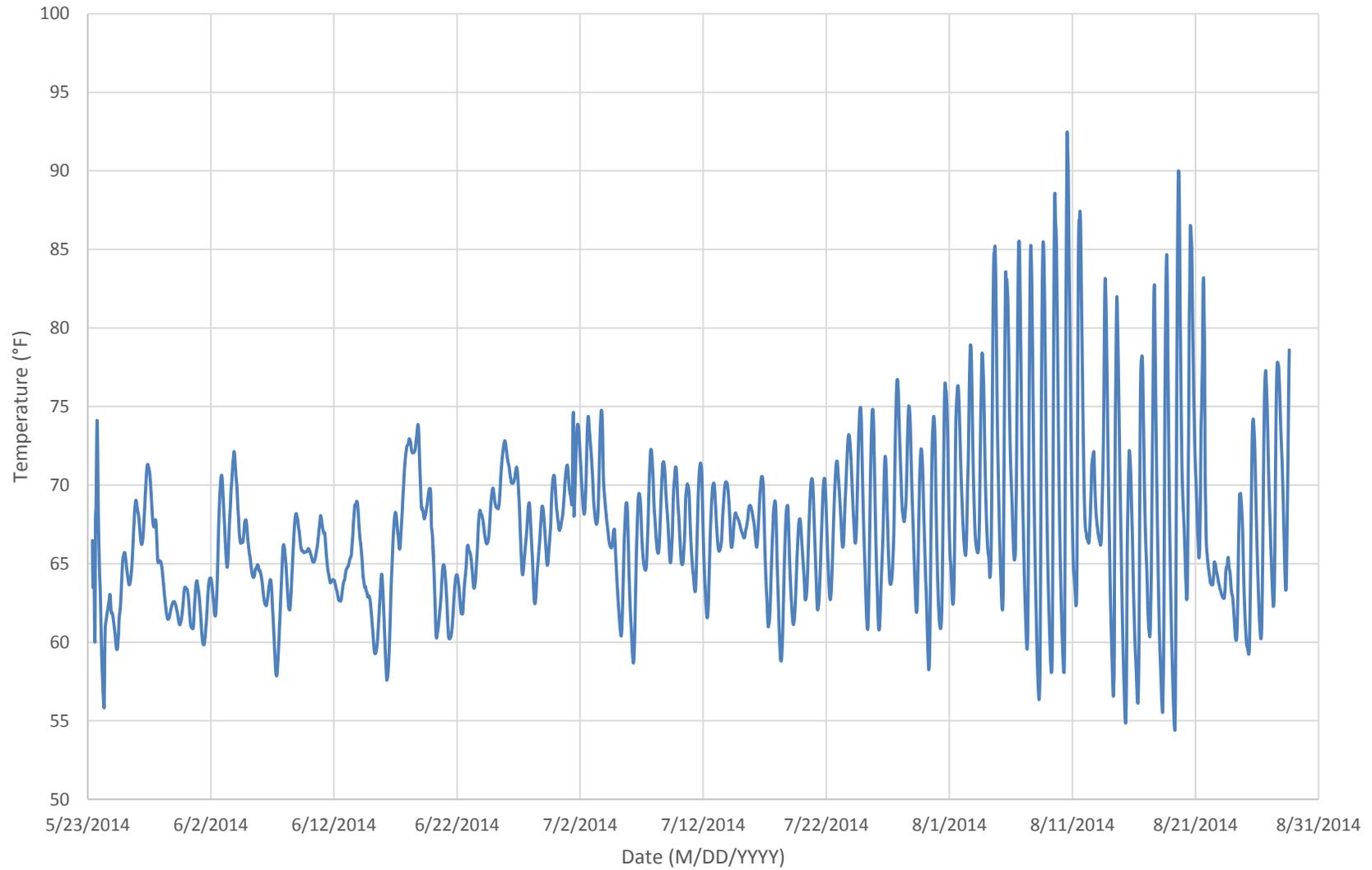
Savantine Brook/Wetland Complex – 500 ft. Upstream Pipeline ROW Cut - 10377360



Sanvantine Brook/Wetland Complex, Within Pipeline ROW Cut - 10377357



Savantine Brook/Wetland , Downstream Pipeline ROW Cut - 10377358



Discussion

Pinchot Brook and Savantine Creek monitoring data indicate long term thermal stream impacts in the Summer of 2014 to the stream and wetland complexes from the TGP 300 and NEUP pipeline cuts – two separate but connected pipeline projects of the Tennessee Gas Pipeline. Savantine Creek was cut across in 2011 with the TGP 300 upgrade project. Pinchot Brook was cut across again in the next stage of the pipeline project, TGP NEUP, in 2013. Both streams show elevated thermal impacts in the Summer of 2014 as a result of the pipeline cuts. Both streams and wetland complexes are designated Exceptional Value (EV).

Temperatures within the pipeline ROW cut of the 300 pipeline upgrade project for Savantine Creek and wetland complex had the highest average temperatures from all the probes indicating direct thermal impacts due to the pipeline cut to this Exceptional Value waterway. Savantine Creek within the pipeline cut had instream average temperatures of 74.14° F and a maximum of 89.09°F with a standard deviation of 5.38 (1,397 temperature readings collected). Downstream of the pipeline cut temperatures were elevated for Savantine Creek with the average stream temperature at 67.26° F (N=2,336) compared to the station located Upstream of the pipeline cut with an average temperature of 63.53° F (N=2,335). These impacts to Savantine Creek were documented in the summer of 2014, three years after the 300 upgrade project was completed – the 300 Upgrade Project was constructed in 2011 and running gas by November 2011. These temperatures indicate sustained thermal impacts to the stream more than 2.5 years after the 300 upgrade was running gas through its pipeline.

Pinchot Brook had two temperature stations installed in the Summer of 2014 after the NEUP project had been completed with 2,336 hourly temperature readings collected. Pinchot Brook was cut across by the TGP NEUP in 2013 – this segment of the upgrade was Constructed and running gas by November 2013. Pinchot Brook had higher temperatures downstream of the pipeline cut, though not as pronounced as that of Savantine Creek complex but elevated temperatures were documented downstream of the 2013 pipeline cut to this Exceptional Value waterbody. Pinchot Brook downstream of the pipeline cut average stream temperature was

63.75° F while the upstream station on Pinchot Brook was 62.77° F. There was no probe available to install directly in the pipeline cut for Pinchot Brook.

Upstream and Downstream locations for both streams were located in forested areas outside of the pipeline ROW. The pipeline cuts for both streams involved clearing of mature forest for the pipeline upgrades which led to increased solar radiation to the stream column. Both streams had increased algae growth documented with photo-monitoring after the pipeline cuts were completed, indicating another sign of stream changes indicative of opening up the canopy for these smaller headwater tributaries. Streams had elevated nutrient levels downstream of the pipeline cuts.ⁱⁱ Invasive plant species colonization and spreading were also documented, another indication of forest fragmentation and changes to the ecosystem due to older and recent pipeline crossings. Both of these water complexes, Pinchot Brook and Savantine Creek wetland complex, have some open herbaceous or scrub shrub wetlands in their headwaters and nearby or adjacent besides having the impact of the pipeline cuts which may contribute to some of the overall temperature findings. Both complexes are also very important to vernal pool species reproduction which may be impacted by the pipeline construction and maintenance activities as evidenced during field visits when obligate vernal pool species were observed using these complexes.

Additional field reports of these wetlands and streams that TGP cut across are included in the Appendices.

References

ⁱ The Sawkill Creek & Vandermark Creek Watershed: A Rivers Conservation, Princeton Hydro, 2005,
https://www.pikepa.org/Planning/Watershed/Final_Draft_SV_RCP%20no_figures.pdf

ⁱⁱ Zenes, Nicole K., Effects of Pipeline Construction Clear-Cutting on Water Quality in Northeastern Headwater Streams, May 2015.