COLDWATER CONSERVATION PLAN

for

Clear Creek; Callen, Pine, and Leeper Runs

Jefferson County, Pennsylvania

Final September 2018

Western Pennsylvania Conservancy

COLDWATER HERITAGE PARTNERSHIP

Western Pennsylvania Conservancy

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Founded in 1932, the Western Pennsylvania Conservancy (WPC) is a non-profit conservation organization that protects and restores exceptional places to provide our region with clean waters and healthy forests, wildlife and natural areas for the benefit of present and future generations. The Conservancy creates green spaces and gardens, contributing to the vitality of our cities and towns, and preserves Fallingwater, a symbol of people living in harmony with nature.

The WPC's Watershed Conservation Program protects and restores rivers, lakes and streams to provide our region with sustainable, clean water supplies that are critical to our quality of life and economy. We provide cost-free, comprehensive assistance to communities and local watershed groups, helping with project selection and prioritization, funding proposals and project management. We also partner with individual landowners and businesses to help them improve water quality and protect the environment on their properties. The Watershed Conservation Program has extensive expertise applying on-the-ground restoration activities since 2001.

Project Funders

This project was funded in part by a grant from the Coldwater Heritage Partnership on behalf of the PA Department of Conservation and Natural Resources, the PA Fish and Boat Commission, the Foundation for Pennsylvania Watersheds and the PA Council of Trout Unlimited.

Table of Contents

Watershed Background

The watersheds of Clear Creek, Callen, Pine and Leeper Runs are important coldwater tributaries to, and a vital part of, the greater Clarion River ecosystem. The Clarion, in turn, flows to the Allegheny River, a tributary of the Ohio River and, ultimately, the Mississippi River system. The great majority of these watersheds lie within Heath Township, Jefferson County. Clear Creek and Callen Run also drain parts of Polk, Eldred, and Barnett townships, with Clear Creek entering the Clarion River in Barnett Township. Clear Creek and Callen Run are High-Quality Coldwater Fisheries, and Pine and Leeper are Coldwater Fisheries, according to their designated uses determined by PA DEP. All four streams support naturally reproducing populations of wild trout. A total of 38.2 miles of streams are mapped in the combined 22.7 square miles of these watersheds. Details on each specific stream are included in **Table 1.**

Table 1. Stream Geography and Forest Coverage.

Stream Name	Drainage Area (sq. miles)	Mapped Stream Miles	% Forested
Clear Creek	12.5	21.8	94
Callen Run	7.3	12.1	99
Pine Run	1.5	2.6	92
Leeper Run	1.4	1.7	96

Clear Creek State Park and Clear Creek State Forest cover 55% of these watersheds, allowing numerous recreational opportunities for the general public. The other 45% is privately owned, with the primary land uses being timber and fossil fuel production, as well as rural residential and agricultural lands. Recreational activities, such as hunting, fishing, hiking, and ecotourism, are common in this area. Small residential lots and camps account for the greatest number of privately held parcels, while Matson Lumber, Seneca Natural Resources, and National Fuel Gas Supply Co. own some of the largest private tracts.

The Pennsylvania Department of Conservation and Natural Resources (DCNR) Bureau of Forestry (BoF) was founded in 1895, with Clear Creek State Forest (CCSF) established on September 1, 1920 (BoF 2017). The earliest components of this forest were purchased in Heath Township, Jefferson County, in 1919. CCSF has grown to include 16,229 acres in Jefferson, Clarion, Venango, Forest, and Mercer counties today (DCNR 2017). Like all Pennsylvania State Forests, the management of CCSF is guided by the *State Forest Resource Management Plan*, as well as the overall mission of the BoF to ". . . ensure the long-term health, viability, and productivity of the Commonwealth's forests and to conserve native wild plants" (BoF 2017). Activities supporting the Management Plan, as well as the Mission on the CCSF, include recreational improvements, timber sales and vegetation management, habitat restoration, road and bridge projects, prescribed fire, invasive species management, and other actions found in the Management Plan (2017).

Clear Creek State Park (CCSP), also managed by DCNR, was created out of land initially included in the Clear Creek State Forest, in 1963(DCNR 2017). It is comprised of 1,901 acres of the Clear Creek valley, from the mouth at the Clarion River to State Route 949. CCSP fulfills the mission of the Pennsylvania State Park system to "... provide opportunities for enjoying healthful outdoor recreation and serve as outdoor classrooms for environmental education." Year-round visitors to the forests, streams, and camping areas of CCSP are a testament to this effort. The park's museum focuses on the area's natural and logging history, some of which can also be seen in the form of relic dams and other historic structures in the Clear Creek valley.

Matson Lumber owns nearly 1,500 acres in the Callen Run and Clear Creek watersheds, and they pride themselves on environmental stewardship. Their management policies include promoting sustainable timber growth, environmental stewardship, and public recreation, in addition to producing high quality timber. Like the Clear Creek State Forest and other conservation-minded forest landowners, their properties and operations are also certified to Forestry Stewardship Council (FSC) standards. This helps ensure that timber management activities positively impact the ecosystems and communities they are practiced in (FSC 2017).

A rich history of anthropogenic—human influenced—activities has transformed the original hills and valleys of these streams to their present state. Before European settlement, Native Americans inhabited this area, and evidence of that era is occasionally uncovered during earth-moving or archaeological activities. In the 1800's, settlers and lumbermen came to this area of the Clarion River valley to exploit its vast timber resources. Trees were harvested and dragged to rivers and streams, which were used to transport them to downstream markets. To facilitate this activity, obstacles were blasted and watercourses straightened while a network of dams was built to control flows and power milling equipment. Evidence of these early lumbering activities is copiously available in the Clear Creek and Callen Run drainages, and less so in Leeper and Pine Runs.

Lumbering activities continue to this day, although in a much more environmentally-friendly manner. Waterways are no longer used to transport harvested timber, and state and federal regulations require erosion and sediment control measures for earth disturbance activities, as well as stream and wetland crossings. More stringent regulations have also been applied to the oil and natural gas production and transmission industries to protect aquatic resources. While these regulations establish a minimum level of protection, private and public landowners have the option of adding further requirements to harvest, production, and transmission activities, such as those provided for in FSC certification.

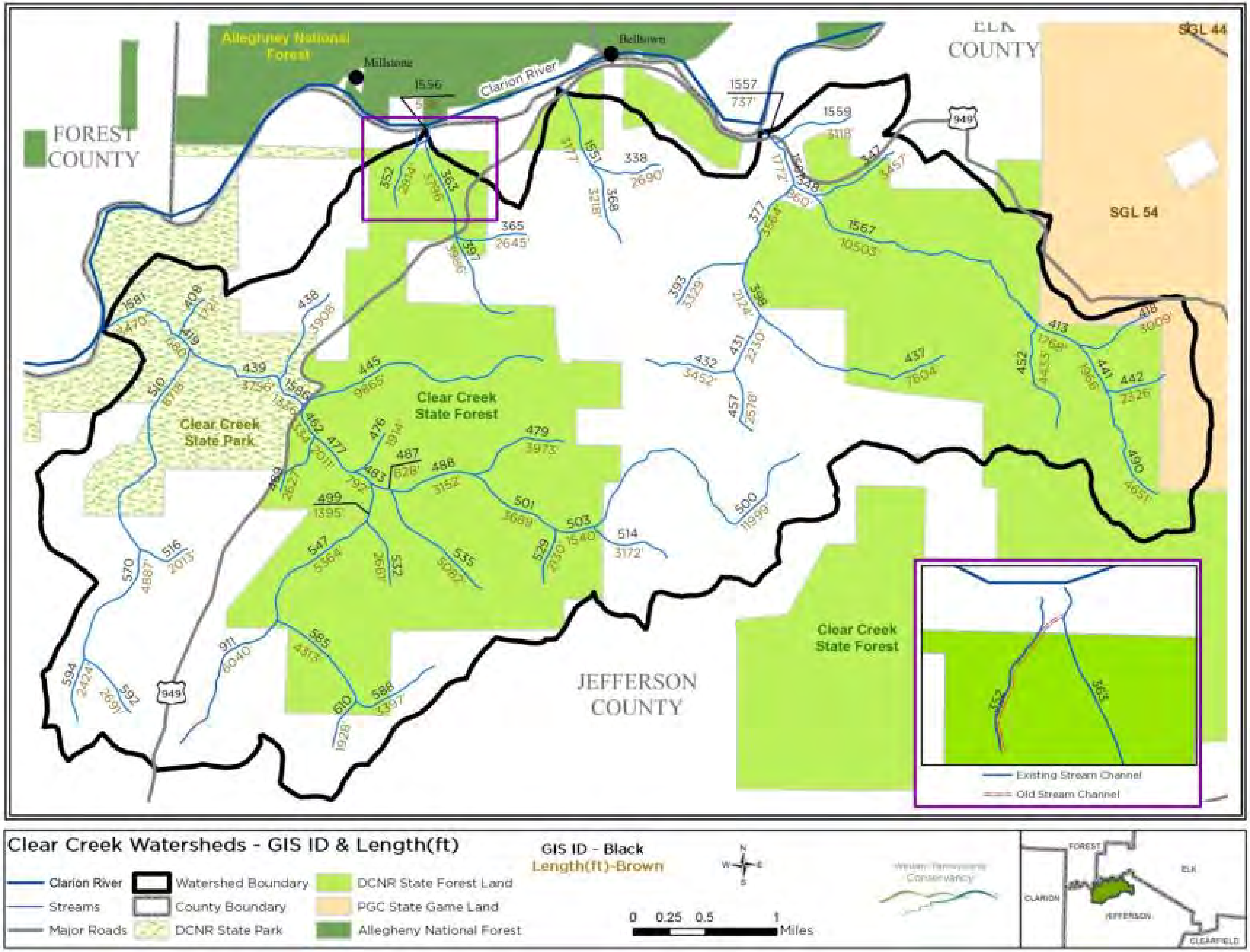
State Impairment Status

Clear Creek, Callen, Pine, and Leeper Runs are all categorized in "List 2: At Least One Use Attained" in Pennsylvania's *2016 Integrated List of All Waters* (CoP 2016).

Permitted Discharges

One permitted National Pollutant Discharge Elimination System (NPDES) discharge currently exists within the Clear Creek Watershed. One additional permitted discharge of Industrial Wastes expired on 3/31/2017, at National Fuel Gas' Heath Station Facility in the Callen Run Watershed. This facility is being removed, and the discharge is no longer necessary. Both permit identification numbers are available in *Appendix 4: Permitted Discharges*; as well a link to the permit on the PA Department of Environmental Protection's website.

Watershed Overview Map

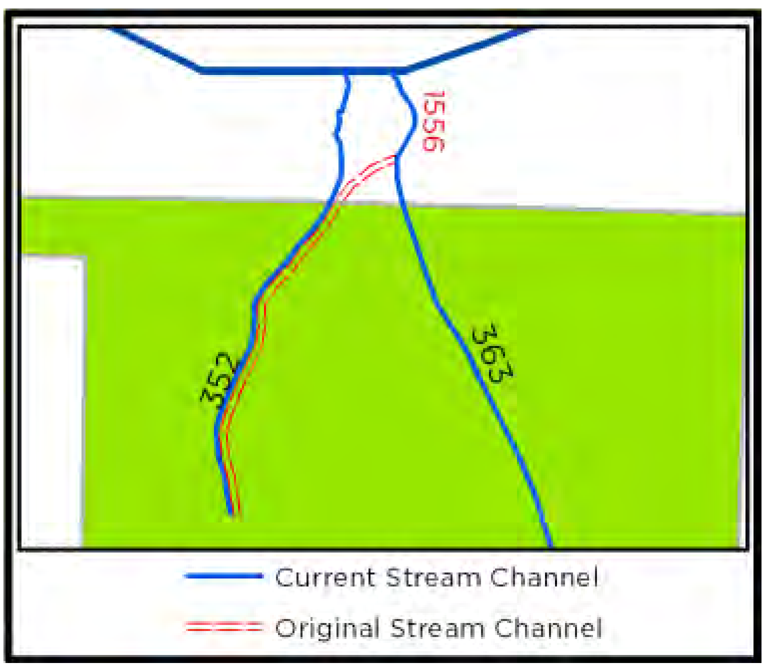


Watershed Data

Sampling Methods

The primary assessment protocol was based on the EPA's "Rapid Bioassessment Protocols (RBP) for Streams and Wadeable Rivers-Habitat Assessment and Physicochemical Parameters," (Barbour et. al. 1999) and was augmented with WPC's current standard Visual Assessment Datasheet to more closely align with the goals and concerns of this Coldwater Conservation Plan. Stream reach, width, depth and velocity, as well as canopy cover, proportion of stream morphology types, channelization and obstructions were recorded. Water quality parameters, including temperature, pH, and conductivity, were measured at the upstream and downstream terminus of each segment.

Staff and volunteers conducted visual assessments in the field to collect the most accurate data on watershed characteristics. Streams were assessed by examining one "segment" at a time, with each segment being the length of stream between two confluences. These confluences could be at two small tributaries, or a tributary joining the mainstem. Each segment is labeled with a GIS_ID number, and it is by those numbers that the segments were referred to during field assessments, as well as in this plan (see Watershed Overview Map on the preceding page).



In the instance of Segment 1556, it no longer exists as a unique segment between two confluences. Pine Run flows directly into the Clarion River, without making a confluence with the unnamed tributary to the west. See the inset to the left for the originally mapped stream channels as well as on the ground observations.

On every assessment outing, each field team consisted of two to three crew members for safety, as well as, objectivity in sampling. A Western Pennsylvania Conservancy (WPC) staff person led each assessment team, following the assessment methodology and standards established during previous surveys.

Respecting private property and the landowner's wishes were a top priority while conducting visual assessments. Stream segments having multiple landowners with varying permission statuses were assessed to the best of the field crew's ability, on rare occasions simply via the roadway. Information gathered on private lands was assimilated into the larger dataset per each stream segment to protect those landowners' privacy.

Ten physical habitat parameters (from the EPA protocol) observed during field assessments were combined to provide the most concise, informed snapshot of watershed health. These parameters were independently scored for each stream segment assessed, and then averaged to provide an overall score for that segment. Each parameter was worth a maximum of 20 points for the most ideal habitat condition, and a minimum of 0 points for the least ideal habitat condition. Point awards of 16–20 scored in the Optimal category, 11–15.9 points scored as Suboptimal, 6–10.9 points for Marginal, and 0–5.9 scored in the Poor category.

In addition to parameters based on the EPA's Habitat Assessment Protocol, special attention was given to the amount of Large Woody Material (LWM) in a segment; the presence of Aquatic Organism Passage (AOP) barriers; the impact of Dirt and Gravel Roads (DGR) on the stream; erosion throughout the segment; presence and length of channelization on the segment; and if native or wild trout were observed.

Large Woody Materials (LWM)

During field assessments, segments were classified as having significant, moderate, minimal, or none (not present) amounts of LWM. Guidelines for these categories were somewhat subjective, yet estimates of approximately 120, 80, 40, and zero pieces (respectively) of LWM per mile were used as loose standards for these categories. Numbers of pieces of LWM per mile used to determine the categories above are lower than those found by Williams and Cook (2010), as well as falling in the lower range of those recommended in the U.S. Forest Service (USFS) *Allegheny National Forest's Management Plan* (2007). At the time of this writing, PA DCNR recommendations for LWM densities were being developed.

Aquatic Organism Passage (AOP)

An Aquatic Organism Passage (AOP) barrier is a structure that impedes the up- or downstream movement of fish and other aquatic and riparian species. For the purposes of this study, focus was held on man-made AOP barriers, but natural AOP barriers were also noted. AOP barriers included culvert and bridge structures at road-stream crossings, active and defunct dams, and any other man-made structures that would impede passage throughout the reach of the stream segment assessed.

While no formal protocol was used, attributes of each crossing and structure were evaluated and compared with those of the stream. Evaluated attributes included elevation, slope, width, blockage, water depth and velocity, presence of a scour pool, substrate presence and composition, floodplain development, and alignment. Notes and latitude/longitude coordinates were also taken for each suspected AOP barrier.

Dirt and Gravel Roads (DGR)

During in-field assessments, dirt and gravel roads were noted when observed within each segment, as well as any obvious issues that may have been associated with them. These issues may have included stream fords, drainage ditches discharging high amounts of sediment to the stream, heavily eroded tire tracks leading to the stream, and changes in streambed substrate composition near the road-stream interaction zone.

Erosion

This assessment categorized the degrees of erosion as None, Minimal, Moderate, or Heavy, based on the amount of erosion observed throughout an entire segment. The EPA habitat parameters of Bank Stability and Vegetative Protection were also used to help make these determinations.

Channelization

The EPA's habitat parameter of Channel Alteration played heavily into the assessment of this specific category. The assessor(s)'s best professional judgment was used to estimate the length of channelization in a segment. This was done at the time the channelization was observed - usually culverts and bridge crossings.

Native or Wild Trout Observed

If fish were observed and a positive identification of species (trout) could be made, it was noted. No fish population samples were collected in correlation with this project utilizing traditional fisheries methods, such as backpack electrofishing, because the focus of this assessment was to document stream health utilizing visual assessment methodologies. However, these watersheds have been surveyed numerous times by Dr. Andrew Turner of Clarion University. Dr. Turner has graciously provided a species list for Clear Creek and Callen Run, which are included in the Results Section.

Water Quality Testing

Measurements of pH, conductivity, and water temperature were taken in the field with an Oakton PCSTestr 35 Multi-Parameter multi-meter at the upstream and downstream terminus of each assessed segment. The multi-meter was inserted into the water until a stable value was reached for each parameter, which was then recorded on the datasheet. All of the mulitmeters were calibrated to the manufactures specifications at the start of each field day to ensure that accurate reading were collected by the various field teams.

Results

Approximately 89.2% of the streams included in this study, totaling 34.1 miles, were evaluated via field assessments. The remaining 10.8% of the stream found in the watershed(s) was either dry (3.5%) or unable to be assessed (7.2%), depending on permission and logistics. The entire assessed watershed averaged an overall habitat quality score of 14.8, which is in the high range of the Sub-optimal category. Stream segments that were classified as dry or unassessed were not included in this analysis (Table 7). The highest average score any singular segment received was 17.5 (the middle of the Optimal category), while the lowest average score any segment scored was 12.1 (low Suboptimal category). These findings are generally consistent with assessment scores for streams designated as High-Quality Coldwater Fisheries. Four of the individually assessed parameters in the habitat assessment scored a 20 (most ideal) on at least one stream segment, with the six other habitat parameters having at least one segment scoring in the Optimal category. Embeddedness had the lowest score of any category on at least one segment, with a score of 5, placing it in the Poor category. Sediment Deposition (Min. score=6) and Riparian Vegetative Zone Width (Min. score=6) exhibited the second lowest scores present in any one category. Table 2 lists all the habitat scores for each segment surveyed, with the map in Appendix 2 giving a visual representation of segment scores by stream reach.

Acidity (pH) is the measure of free hydrogen ions in solution. It is measured on a logarithmic scale from 0–14, with a pH of 7.0 as a neutral midpoint. Solutions become 10 times more acidic with each integral drop in pH value (e.g. pH 5 is ten times more acidic than pH 6). Streambed elevation and groundwater interaction with the stream heavily influence stream pH value. Headwater streams on the Allegheny Plateau tend towards a pH of 4.5–6.0 due to acid precipitation and initial reduced groundwater interaction, while downstream pH values in lower elevations often range from 5.5 to 7.0, with some as high as 8.0. Those considered to be “impacted by acid precipitation” typically exhibit pH values lower than 5.5 (PA DEP 2012). Coldwater fishes on the Allegheny Plateau can survive through a range of acidic solutions, but thrive in the pH 6.0–7.0 range**.** Acidity in the assessed watersheds was not as low as investigators expected, and largely improved as stream elevation dropped. pH readings at the bottom of each stream reach ranged from 4.75 to 8.0, with the majority falling in the range of 6.06–7.35. As can be expected, higher up in the surveyed watersheds pH values exhibited a larger range, from 4.39–7.60. Ten segments fell below the pH 5.5 threshold, and six of those rose above it before their terminus. Details on pH recorded at the bottom of each specific segment can be found on the Watershed-Acidity map in Appendix 2, and overall water quality data can be found in Table 3: Water Quality.

Specific Conductance (or Conductivity) is the ability of water to conduct an electrical current. Pure water is unable to conduct electricity, yet as the amount of dissolved ions in solution increases, water is increasingly able to pass electrons through it. On the Allegheny Plateau, conductivity in streams similar to Clear Creek, Callen, Pine, and Leeper Runs generally range from about 20 to 100 µs/cm, with typical values between 50–70 µs/cm. Like pH, conductivity is also influenced by elevation and groundwater interaction. Since it is a measure of dissolved ions (usually salts, metals, and other conductive materials), conductivity is influenced by human activity within a watershed. Due to these factors, specific conductance was generally predictable.

No “typical” observation (measurement taken at the top or bottom of a stream segment) of specific conductance was greater than 200 µs/cm, with the highest measurement at 169 µs/cm on segment 489. In addition to the typical observations taken on every stream segment, several other specific conductance measurements were taken in areas where discolored springs and seeps entered the main stream. The highest of these were on segments 1559 (450 µs/cm), 499 (297 µs/cm), 1551 (190 µs/cm), and 510 (182.3 µs/cm). In stream measurements below the seep confluences on segments 1559 (122.8 µs/cm), 1551 (105.8 µs/cm), and 499 (45.80 µs/cm), showed that the stream flow had a significant diluting effect on the incoming seep. However, in the case of segment 510 (Truby Run), conductivity remained relatively high (151 µs/cm) for approximately one-quarter of a mile in the stream below the seep, with the stream substrate discolored (orange) and lethargic wild trout observed. Further details on conductivity recorded in each segment can be found in Table 3: Water Quality. Highest conductivities observed, as well as those segments whose conductivities changed the most, can be found in those maps in Appendix 2.

Water temperature is another important factor in the quality of a stream for fish habitat. Though there is some slight variation in temperature thresholds between species; in general, trout can survive in water temperatures near freezing 0°C (32°F) and begin to experience thermal and oxygen-related stress between 18–21°C (65–70°F). Field investigations were conducted from June through September 2017, with stream temperatures ranging from 10.4°C–19.8°C (50.7°F–67.6°F). To standardize measurements across sampling dates, the difference in temperature from the top of a segment to the bottom of a segment were used. Data for each segment are available in Table 3: Water Quality, as well as the Temperature Change map in Appendix 2.

Dr. Andrew Turner of Clarion University has periodically sampled the fish populations of Clear Creek and Callen Run. Three separate reaches have been surveyed on Callen Run, with a sharp drop in species diversity upstream of the lowest dam. See Table 4 for details. For questions or more information, please contact Dr. Turner, via his information in the literature cited section.

Table 4: Species Observed in Clear Creek and Callen Run (Courtesy of Dr. Andrew Turner)

Watershed	**Clear Creek, below swimming dam**	**Clear Creek, above swimming dam**	**Callen Run at mouth, below all dams**	**Callen Run above lower dam**	**Johns Run, Tributary to Callen, above dam near mouth.**
	brown trout	brook trout	brown trout	brook trout	brook trout
	brook trout	blacknose dace	brook trout	blacknose dace	mottled sculpin
	blacknose dace	white sucker	blacknose dace	mottled sculpin	

Species Observed	creek chub	mottled sculpin	creek chub		
	central stoneroller		central stoneroller		
	white sucker		longnose dace		
	northern hogsucker		white sucker		
	greenside darter		northern hogsucker		
	blackside darter		banded darter		
	Johnny darter		Johnny darter		
	variegate darter		fantail darter		
	mottled sculpin		greenside darter		
			mottled sculpin		
Total Species	**12**	**4**	**13**	**3**	**2**

Invasive Species

Invasive species were present to some degree in nearly every portion of the watershed that had regular human interaction, mostly in developed areas or along roads. By far, Japanese stiltgrass (*Microstegium* vimineum) was the most widespread, bordering nearly every road within our study area. Multiflora rose (*Rosa multiflora*), Japanese barberry (*Berberis thunbergii*), Garlic mustard (*Alliaria petiolata)*, and Honeysuckles (*Lonicera spp*.) were some of the other common species encountered. No species of invasive animals were recorded, though their absence from our assessment in no way indicates that they are not present in the area.

Discussion

Importance of Specific Evaluation categories

Large Woody Materials (LWM)

Trees and forests play an integral role in the protection of coldwater resources. Not only do they shade and cool streams, but branches and trunks physically interact with water. Standing trees lessen the impact force of precipitation, reducing soil compaction and erosion, and provide channels along roots for water to seep underground. After they fall, trees on land become natural “water bars” on slopes, slowing and further infiltrating sheet-flow of water into the soil. Trees growing nearer to the water serve an equally vital role. On floodplains fallen trees slow high water en route to downstream communities. Infiltration into floodplain groundwater tables also ensures that summer low-flows have a cool, clean, underground reservoir to draw from. As muddy, debris-filled flood flows are dispersed over the floodplain and their velocity is reduced, their ability to keep particles entrained (mobilized with the flow) is also reduced, forcing them to drop sediment. This nutrient-rich sediment fertilizes the land surface. Seeds from higher in the watershed are also caught by floodplain vegetation and woody debris, providing a freshly fertilized seedbed in the dropped sediment for the next generation of riparian plants to grow. In this manner, vegetation that has evolved to be in and near streams stays in those environments to provide habitat for aquatic and terrestrial species, and the associated ecosystem services they provide.

Woody materials in the channel help provide habitat for numerous aquatic and terrestrial species while interacting with water in much the same fashion as their upland counterparts. Multiple tree species, age classes, and rates of decay provide a diverse substrate for aquatic macroinvertebrates, fungi, and plants that then transfer that energy across the food web. Fish, reptiles, amphibians, birds and mammals all rely on these more "basic" food web pieces, as well as the trees themselves for cover and protection. As the volume of water flowing within a channel increases it interacts more forcefully with all substrates present, including LWM. If the individual pieces of LWM or those that they are entangled with are of sufficient size, mass, and shape to not be transported (a "key piece"), they can force the water to scour additional pools, sort gravels, and aggrade, or build, sediment in their slack waters. In this physical role, they help set the grade of the stream, provide areas for nesting, feeding, breeding, and rearing young, as well as refuge from predators.

Aquatic Organism Passage (AOP)

In the course of field assessments, AOP barriers were encountered in a variety of situations. Some were on major paved roads, while others existed on dirt and gravel roads or ATV trails. A separate subset of AOP barriers were documented where old dams still hinder natural ecological processes. All encountered structures were evaluated on their ability to keep the aquatic ecosystem connected. A crossing structure that in some way hinders or prevents passage effectively serves as a bottleneck in that entire ecosystem, reducing the flow of nutrients and energy in both directions.

Flood flows can also become problematic for road managers at road-stream intersections as bridges and culverts become blocked by debris or sediment, or are undersized for the watershed they are conveying. Issues can include erosion of the crossing structure and road base, up to and including the whole road itself failing; flooding of low-lying roads posing a public safety hazard, and flood debris accumulating in ditches and on the road surface. Crossing structures that are adequately sized to the stream reach and location they are installed on will allow for a floodplain to develop inside, as well as provide passage at multiple flow levels for aquatic and terrestrial species to benefit the entire ecosystem.

Dirt and Gravel Roads (DGR)

Roads and trails surfaced with dirt and/or gravel can provide an economic alternative to impervious surfacing materials like concrete or asphalt. They provide several environmental benefits as well: allowing stormwater to more readily infiltrate into the ground, slowing the flow of runoff, and, where limestone is used, they can help buffer the effects of acid precipitation. However, if improperly constructed or maintained, they can negatively impact the watersheds they traverse. Sediment that washes off DGRs quickly finds its way into streams, filling the interstitial spaces between cobble and gravel that provide habitat for fish and aquatic macroinvertebrates. These interstitial spaces are essential locations for spawning activities for fish, particularly Eastern Brook Trout, and are often used as colonization areas by a number of important macroinvertebrate taxa.

Erosion

While some erosion is natural and necessary in a lotic system, it can also have negative consequences for aquatic ecosystems. Similar to the sediment originating from dirt and gravel roads, erosion of a stream's bed and banks can produce excess amounts of fine sediment. This erosion is most often observed as scalloped, non-vegetated areas on banks, undercutting of the riparian vegetation's roots, and headcutting of the substrate in an upstream direction.

Channelization

Though the EPA parameter of Channel Alteration is used in the determination of habitat scores, we felt it was also necessary to show how much channelization was present in each stream segment. By removing natural bed substrate like boulders, cobbles, gravels, and woody materials from the aquatic ecosystem, the habitat quality as well as energy dissipation abilities of some stream segments have been reduced. Channelization was often observed near road-stream crossings, but in some instances smaller streams were culverted and forced underground to accommodate development. Other instances of channelization were observed as relics of historic industrial practices, such as log driving and milling.

Native or Wild Trout Observed

As a state-listed Wild Trout stream (from headwaters to mouth) as well as a High-Quality Coldwater Fishery, Clear Creek and Callen Run are protected by some of the most stringent water quality protections in Pennsylvania. While Leeper and Pine Runs lack the High Quality designation, they are still Wild Trout streams. As such, wetlands in these watersheds are protected by even more stringent regulations, which apply to Exceptional Value waters (25 PA Code §105.17). Additionally, under the Tributary Linkages rule of the PA Code, all tributaries to a wild trout stream are also considered to be wild trout streams for "their function as habitat for segments of wild trout populations, including nurseries and refuges, and in sustaining water quality necessary for wild trout" (58 PA Code §57.11).

Though the entirety of the watersheds have rigorous water quality protections in place and are considered to contain Wild Trout, WPC staff as well as volunteers while conducting field investigations were encouraged to record any wild trout they observed, as an informal record for the future. Should climate change or other stochastic events extirpate a portion of the trout population present in these watersheds; locations where trout were observed in this assessment can serve as source populations or refuge areas for future restoration efforts.

Water Quality Measurements

Just as air pollution can make terrestrial habitats inhospitable to human and animal life, so too can water pollution make aquatic habitats toxic. This pollution can be: thermal, often resulting from a "top release" pond with a spillway or overflow pipe draining the warmest water in the pond into the stream; chemical, in the form of acid rain falling on soils with low buffering capacity or road runoff elevating the stream's conductivity; or physical, with a substance (usually sediment) taking up the interstitial spaces that provide habitat for fish and aquatic macroinvertebrates. While the thermal and chemical qualities of water in this assessment were measured, sediment in the form of turbidity was not quantitatively measured, but was subjectively estimated and categorized as Clear, Slightly Turbid, Turbid, Opaque, Stained, or Other.

Climate Change

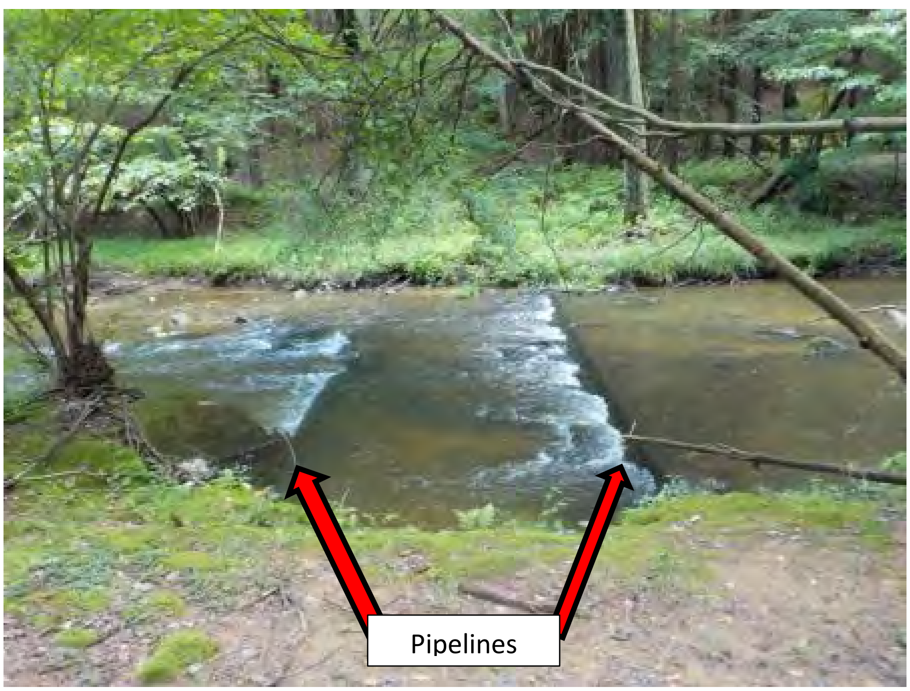
Anthropogenic induced climate change is one of the most diverse and complicated issues facing humanity today. To the non-scientific observer, its effects may seem miniscule and irrelevant, yet numerous and far-reaching climate related impacts have been documented in recent history. These include species' ranges and distributions changing with a warming climate (Chen et. al 2011), as well as, negative impacts on crop yields (IPCC 2014). Effects of climate change specific to coldwater ecosystems, along with mitigation strategies for those effects, can be found in Table 6 in the Recommendations section of this report.

Areas of Concern and Opportunity

Numerous areas of concern were found throughout all four watersheds. Those concerning the level of LWM in the stream, Dirt and Gravel Roads impacting a segment, length of channelization, observance of wild or native trout, and amount of erosion in a segment are illustrated in their respective maps in Appendix 2. Specific examples are included below, but are not totally inclusive of all potential projects present in the basin.

Large Woody Materials

499: *Large, stable wood pieces help sequester smaller pieces, scour pools, and assist the stream in accessing its floodplain during high water events. This section had a moderate amount of LWM.*



477: Stretches lacking an abundance of large, stable pieces allow smaller pieces to move more freely. Mobile pieces of wood in the channel may pose risks to exposed infrastructure, especially as they undercut and become more exposed. Note the absence of larger pieces of wood near these exposed pipelines on the streambed. LWM installations could be used here to control the grade of the streambed.

532: Smaller, mobile pieces of wood accumulating on the upstream side of this footbridge. A "catcher structure" may be a valuable upstream installation.

488: Not all wood in the channel is natural. This footbridge washed downstream in a flood, and is now creating its own debris jam and scour pool.

Dirt and Gravel Roads

588: Dirt and gravel roads throughout this and other drainages contributed sediment during heavy precipitation or runoff events, at times even preventing accurate assessments.


588: Ephemeral tributary near the top of the watershed that captures all of the runoff in the previous photo.

General Habitat Improvement Opportunities

348: This segment is heavily fished. Improving habitat (increasing pools) through structures and LWM additions would prolong the holding time of stocked fish, as well as enhance the resiliency of wild fish.

438: Gabions near the footbridge on Phyllis Run should be removed and replaced with log and stone habitat structures to stabilize the streambank and reduce the risk of scour associated gabion failure. The new structures will also have a more natural appearance that will blend in more with the natural environment.

439: Though it may seem to be an attractive photograph of an idyllic section of stream, when viewed through "fish eyes," or those of an angler, one sees a lack of deep water habitat and cover. This stretch is a prime candidate for large woody materials additions.

445: Gabions are used to stabilized part of the PA-DCNR BoF Maintenance yard and shed on the banks of Little Clear Creek. When possible, these should be replaced with a tree and boulder engineered log jam, for stability as well as habitat enhancement purposes. Additionally, buildings and parking lots should be situated 35 feet or more from the streambank.

477: Long, straight stretches in this segment lack energy dissipating structure.

483: Shallow stretches in this segment would benefit from more deep-water habitat.

1561: In addition to removal of this mild AOP barrier, this heavily fished segment would benefit from additional deep-water habitats and LWM.

1581: This section is heavily used by both recreationists and migratory fishes. Habitat structures would be especially beneficial in the lower portion of the reach, where recreationists often create "hand dams" *and runs that negatively impact the fish and macroinvertebrate communities (bottom). Educational signage may also be advisable. Gabions are present in the upper reaches of this segment near the tail out of a relic log/mill dam (top). It is recommended to remove the gabions, and replace with habitat structures.*

1586: Gabions upstream of the swimming dam should be replaced with log and stone stabilization structures. Habitat structures throughout this reach would benefit recreationists and migrating fishes as well.

Erosion

Clarion River at the confluence with Clear Creek: Though not technically one of the streams assessed in the Coldwater Conservation Plan, the Clarion River immediately downstream of the mouth of Clear Creek has been experiencing significant erosion for several years. Note the constructed riffle or "hand dam" directing flow toward the eroding bank, which is a part of Clear Creek State Park.

Channelization

1559: This segment traverses a portion of the old Heath Pump Station grounds. It was kept straight, mowed and cleaned by National Fuel Gas.

Wild or Native Trout

1561: Native brook trout were observed in many stream segments, and are considered to inhabit the entire watershed. The trout above are not wild, but a mix of brook, brown, rainbow, and golden rainbow trout raised by the Heath Township Sportsmen's Club. They are stocked in Clear Creek and Callen Run in April and May during the height of Pennsylvania's Trout Season.

Water Quality

510: Several measurements of specific conductivity were taken upstream of, downstream of, and throughout this area of seeming ferric deposition on Truby Run.

510: The ferric deposition and a sulphurous odor originate at a seep that bubbles up through the stream gravel.

499: A gas well near the top of this segment on the right descending bank leaks discolored, Sulphur-smelling water that is 9.5°C, pH 7.88, and 297µs/cm. The stream does not appear to be mortally impaired from this source, but the water leak is recommended to be plugged in the event that the outflow changes in volume or chemistry.

AOP Barriers

Segments with AOP barriers can be found on the AOP Barriers Present map in Appendix 2, as well as in Table 5. AOP Barriers and Locations. Photo documentation of most of the AOP barriers is included in the following pages, by stream segment.

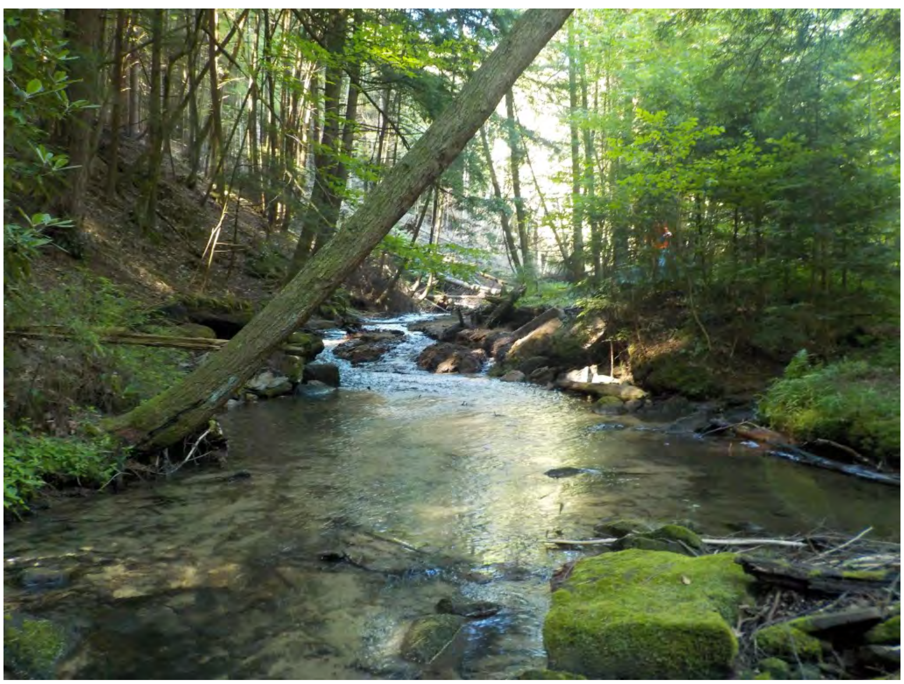
In an ideal world, human transportation and construction activities would have no impact on streams and riparian ecosystems. In reality, issues like budgetary constraints, lack of awareness, and apathy to ecosystem connectivity often end up reducing or completely disconnecting stream ecosystems. These effects can linger for decades, sometimes hundreds of years. Prime examples of these are found throughout all of the four watersheds assessed as part of this plan.

A number of dams are present in the Clear Creek and Callen Run watersheds. They range in size from small hand dams created by recreational stream users, to moderately sized jack and splash dams, to the large impoundments at Heath Pump Station and Clear Creek State Park. Nearly all were created out of a genuine interest to improve the stream, either for commercial uses like log driving and rafting or for recreational uses like swimming and fishing. Nearly all have the same effect of disconnecting populations of fish and other aquatic organisms, as well as raising stream temperatures and disrupting natural sediment transport regimes. Additionally, these dams serve a central role in the communities they serve, with familial ties that often reach back several generations. In any efforts to improve aquatic organism passage through or around dams, it is important to involve all stakeholders, and ensure that all sides have the opportunity to voice concerns. Depending on each individual dam's location and condition, possible options for reconnecting aquatic organism populations are: removal and stream channel reconstruction (including angler friendly fish habitat structures), removal and letting the stream naturally adjust, building a bypass channel, or any combination of these and other cost-effective strategies.

348: The Callen Run Road bridge crossing Callen Run is not a barrier to Aquatic Organism Passage. It is noted here only because it does cause a slight constriction of the floodplain, thus influencing natural stream flows in a small way.

363: A culvert near the mouth of Pine Run is undersized, perched, and has no substrate inside.

377: The relic dam on Johns Run at low flow.



377: This dam was removed on July 9th, 2018, by the Western Pennsylvania Conservancy, Jefferson County Conservation District, Heath Township Sportsmans Club, and other volunteers through a generous grant from the Coldwater Heritage Partnership. Its Removal restored aquatic connectivity to approximately 4.75 miles of upstream habitat for native coldwater fishes.


408: Culvert on Clear Creek Park Road is perched and undersized.


431: A relic dam (partially breached) with an old road grade on the breastworks forms a partial AOP barrier. A large sediment slug exists upstream of the breast in the former impoundment.


437: An exposed gas pipeline (left) as well as an undersized culvert on a timber haul road (right) form 2 AOP barriers on this segment.


438: This undersized culvert where Clear Creek State Park Road crosses Phyllis Run prevents Aquatic organism passage from Clear Creek. The outlet is perched (left), with a large sediment slug upstream of inlet (right).

439: Two barriers to fish passage on Clear Creek main stem include a vehicle ford to a picnic area and a jack dam.

445: Several footbridges for the hiking trail in the Little Clear Creek watershed cross the stream, forming little if any AOP barrier, but still create a minor restriction on natural stream flow (left). The vehicle bridge for Corbett Road (right) is a more substantial barrier to passage for terrestrial and riparian animals, as no floodplains (dry passage) are present within the crossing structure. Crossings like these may increase animal/motorist collisions.

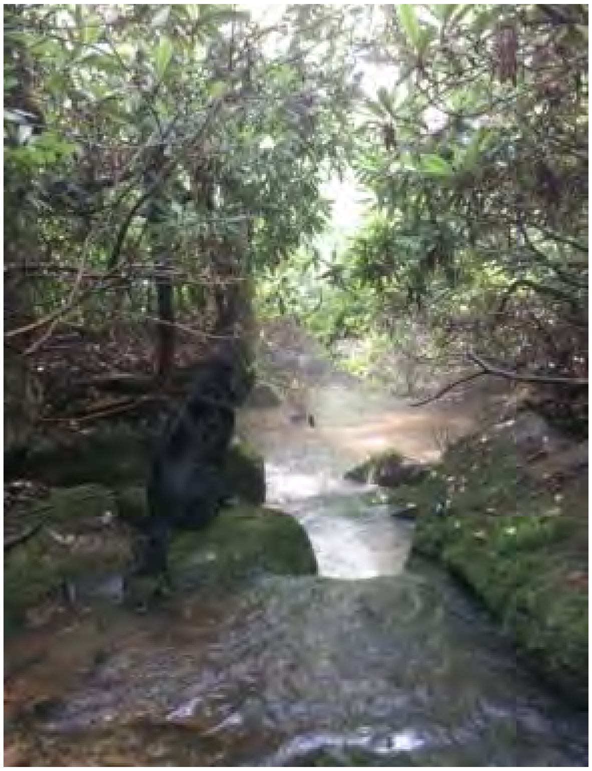
457: An ATV bridge/ford crosses this segment near its confluence. This was a short segment and most of the channel was dry above this crossing.

476: Two undersized culverts form AOP barriers on this stream. One is on Corbett Road (left), and the other is on Little Clear Creek Road (right). Both are perched at the outlet. Copious Japanese stiltgrass is in evidence in both of these photos.


477: Two water jacks form partial to full AOP barriers at varying flow levels. The older jack (left) is falling apart. A side channel is developing to the river right of the newer jack (right), and, if properly constructed and secured, may provide passage around the jack during all flow levels.


479: This crossing on a logging road in the headwaters is undersized, and therefore an AOP barrier. It is also clogged at the inlet (left). Road ditches enter directly into the stream in this area, further reducing the efficacy of the crossing structure, as well as it's passability during flood flows. If the road is to continue to see use, the culvert should be replaced and DGR improvements made to reduce sedimentation to the creek.

483: A small footbridge minimally constricts the natural stream channel near the top of this segment. No photo available.



488: This waterfall, approximately three feet high, may prove a natural barrier to upstream aquatic organism passage at most flows.

490: The culvert on Callen Run Road, where it crosses Callen Run in the headwaters, is undersized. A sediment wedge is forming upstream of the inlet (left), and the outlet is perched (right). Downstream of the outlet's primary scour area, sediment from the dirt and gravel road has begun to accumulate.

500: The culvert at the Pine Run Road crossing (top left), as well as on a private dirt and gravel road (top right) are undersized for this watershed. Several relic logging road corduroys also exist on this segment (bottom photos), and may form partial AOP barriers in lower flows.

535: Culvert on a State Forest road is undersized and poorly aligned. Inlet with sediment wedge (left) and outlet with scour pool (right).

547: While not much of an AOP barrier, this small bridge over Trap Run does constrict the natural stream channel during high flow.

570: Shaffer Road Culvert. Inlet with sediment slug (left), Outlet with scour pool (right).

1551: Leeper Run crossing through State Route 949. Inlet (left) and outlet (right) with scour pool.

1557: The State Route 949 bridge over Callen Run is not an AOP barrier. While it does provide a slight constriction of natural streamflow, natural and semi-natural dry passage is present through both sides of the structure, as well as a semi-natural stream substrate in the channel.

1559: Two culverts reduce connectivity on this segment. The most permanent is that which crosses under State Route 949. Its inlet (top photos) is undersized and clogged. Its outlet (middle photos) exhibits the scour pool typical of undersized crossings. Just downstream of that scour pool is the inlet to a temporary culvert (bottom left) which provides access for trucks and equipment decommissioning the Heath Pump Station. It will be removed, and this area re-contoured, at the completion of that removal and restoration project. Its outlet is perched (bottom right).

1561: Meeting on 08/30/2017 with stakeholders interested in the dam on Callen Run at Heath Pump Station.

1561: Callen Run Dam during a high water event.

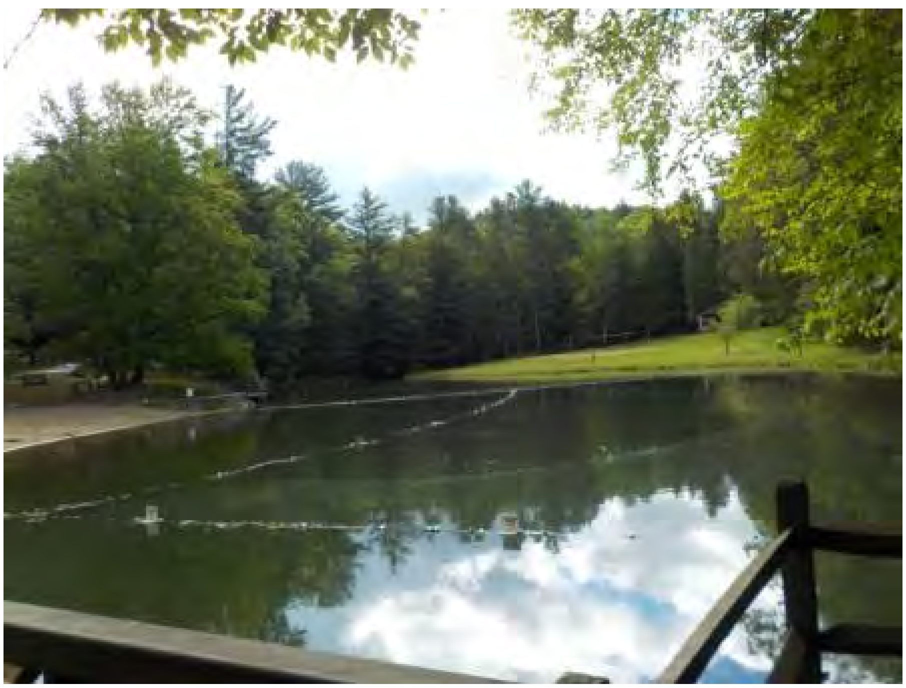
1561: Callen Run Dam during a low water event.

1567: Breastworks (from downstream, a migrating fish’s perspective) of the “upper dam” on Callen Run. It is upstream of the bridge where Callen Run Road crosses this segment.

1567: Impoundment with sediment upstream of the upper dam on Callen.

1567: A breached splash dam (left) downstream of the “upper dam” on Callen Run provides a low water AOP barrier. It is a low priority to remove, as it will likely fail on its own. A set of well casings (right) used as a foot and atv bridge has fallen into the stream, and serves as a low-water AOP barrier.

1581: Clear Creek mainstem has several AOP barriers. One of the most impactful is the set of culverts near the mouth. They are part of a bridge that aggrades sediment upstream (top), and forms a large scour pool downstream (bottom). The bridge is designed to be overtopped during high flood flows, which may create a public safety risk to people on the left bank during those events. Additionally, by impacting the natural sediment regime the structure may be exacerbating the erosion problem at the confluence with the Clarion River.



1586: One of the most noticeable AOP barriers on Clear Creek main stem is the "Swimming Dam" (above). Its high breast is a complete passage barrier to fish.

Recommendations

Targeted efforts to protect and restore Clear Creek, Callen, Pine, and Leeper Runs should focus on the lowest scoring categories from the habitat assessments, as well as increasing aquatic connectivity. Based on those scores, improvements for coldwater organisms can be accomplished through reductions in sedimentation, increasing base flows, and habitat improvements. Water quality concerns, including elevated conductivity levels should also be addressed on Truby Run, as well as at leaking gas wells and brine seeps. Before any restoration project is implemented all appropriate State and Federal permits should be acquired before implementing any recommendations in this plan.

Large Woody Materials

Restoring the LWM component of habitat to these watersheds can best be implemented by referencing the LWM Present Map in Appendix 2, and concentrating on those segments denoted as Minimal with regards to the amount of LWM present in the reach. Begin adding 30 pieces of LWM per every 300 feet of stream, per DCNR BoF recommendations (DCNR personal communication). This method of improving the ecosystem should be used judiciously and be considerate of potential downstream infrastructure risks. Installation should use primarily on-site materials, and structure designs may be based on those in *Guidance for Stream Restoration and Rehabilitation* (Yochum 2016). The level of complexity of these projects is proportional to the amount of drainage area upstream of the project site, and inversely proportional to the distance to downstream infrastructure. In headwater areas with little risk (or great distance to) downstream infrastructure, simple directional felling techniques can be used to improve habitat. Trees with rootwads still attached can also be uprooted by hand/winch and drug into the stream, or installed by heavy equipment. Rootwads and the amount of winching or need for heavy equipment, as well as engineering and design, increase as these streams gain in size and power. It is pertinent to bear in mind that structures installed using these techniques may not be "fishable" for the first year or two after installation, however, studies in Vermont have reported initial increases in wild trout biomasses of 140-150% after LWM restoration (Taylor 2017).

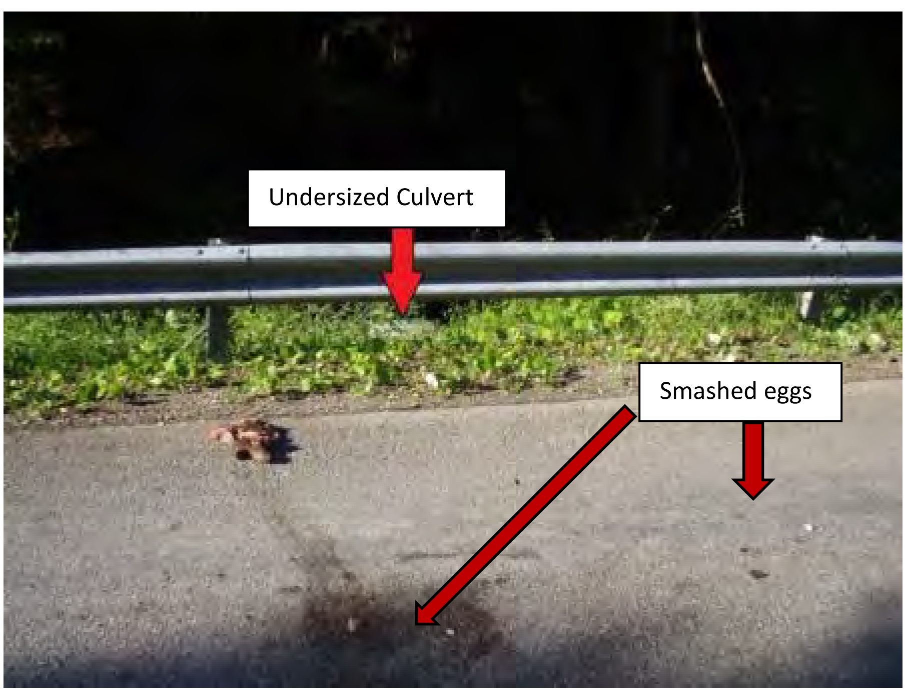
As mentioned in the *Retrofit* method of AOP Recommendations and Abbe et al. (2009), LWM installations can also be used to stabilize and protect infrastructure. This applies widely to the streams in this conservation plan, as exposed pipelines and/or undersized road-stream crossing structures were found on nearly every stream segment. Specific to pipeline infrastructure, segment 477 has several exposed pipeline segments that may benefit from wood and boulder grade controls to protect the infrastructure, the environment, and provide enhanced aquatic habitat. If attempting to protect infrastructure in this manner, it is highly recommended that the project partners have the plans professionally engineered and designed, in order to provide the greatest ecological lift along with protections for industry and the environment.

Aquatic Organism Passage Barriers

Barriers to aquatic organism passage should be remediated to allow for full passage of aquatic and terrestrial/riparian species. This suite of species includes fish, mollusks, amphibians, mammals, reptiles, and birds; or any other organism that would use a waterway as a natural travel corridor. Several options are available to accomplish this goal, including:

Replacement

As in the case of segment 570, the culvert crossing under Shaffer Road is undersized, putting the stream and roadway at risk. This structure should be replaced with a larger one, be it a squashed pipe, bottomless arch, or bridge. Structure type and installation will vary by site based on the stream, landowner, and roadway needs, as well as available funding. The structure should be sized to one hundred and twenty percent (120%) of the stream's current bankfull width that is out of the "zone of influence" of the existing crossing structure. A substrate/bedload mix comparable to that present naturally in the stream channel should be used to simulate it through the crossing. Floodplains should be built inside the crossing structure to facilitate higher flows expected to be associated with climate change trends (thus reducing future maintenance), as well as assist non-fish species in utilizing the waterway for travel. The photo below, taken in the East Branch Tionesta Creek drainage in McKean County, poignantly illustrates the importance of a properly sized crossing structure. Had she been able to traverse the stream and floodplain through the culvert, the smashed, gravid female snapping turtle would not have been hit by a vehicle. She, as well as the eggs she was carrying, represent a rare source of energy traveling *upstream.* Not only has the culvert impacted the turtle population, but the energy cycle of the entire ecosystem.



Retrofit

While retrofitting may not be the ideal solution for crossing structures, it may be necessary until funding is available for proper replacement or removal. The culvert on segment 490 may be a candidate for a retrofit. By strategically installing large rocks and logs as grade controls on the downstream side, water may be retarded in its seaward journey and increase in depth. The pool backing up into the pipe will allow fish and other aquatic organisms to swim up into and through the crossing, keeping the ecosystem connected. For a retrofit of this nature, it may also be prudent to install a stable “catcher” type LWM structure upstream of the crossing structure that will sequester small, mobile pieces of wood that may cause clogs. It may not decrease the terrestrial animal/ vehicle collisions at the structure, but it can work as a “bandage” type of fix in the short term.

Removal

Three dams in the Callen Run watershed form complete barriers to aquatic organism passage. They are listed in the Areas of Concern and Opportunity section of this plan. To fully reconnect the watershed, these dams should be removed. Complicating factors include the lower Callen Run dam providing water to the Heath Township Sportsman Club’s cooperative fish hatchery and the legacy of historic uses of the impoundments. At the time of this writing, a consortium of partners are working toward the goals of dam removal, providing water for the hatchery, increased aquatic organism passage, and improved aquatic habitat. The partners include the Sportsman’s Club, state and local TU Chapters, National Fuel Gas, PA Fish and Boat Commission, PA Department of Environmental Protection, Jefferson County Conservation District, PA Department of Conservation and Natural Resources-Bureau of Forestry, and the Western Pennsylvania Conservancy.

Removing a structure also applies to the numerous relic dams found throughout these watersheds, such as those found on segment 1581. However, this option for relic dams comes with the caveat of historical significance. The heritage of industry and transportation on Pennsylvania’s waterways is rich and broadly appreciated; projects that would impact evidence of that heritage should make strong efforts to involve all stakeholders. To facilitate aquatic organism passage, it may be necessary to remove entire structures, yet remnants of abutments or approaches to the structure may be left to preserve the historical integrity of the site. Interpretive signs and preservation of removed materials (i.e. timbers, cut stone, other archaeological evidence) by historical societies or other qualified organizations may be beneficial to include in AOP barrier removal projects from their inception.

Bypass Channel

Constructing a bypass channel may be a fourth option for increasing aquatic organism passage around historic structures, where space allows. This may be feasible for the swimming dam on segment 1586, in Clear Creek State Park. Enough area exists on the right descending bank to construct a bypass channel from roughly the footbridge at the dam backwaters, around the beach and dam, and reconnecting with the stream downstream. It would serve as the primary water conveyance of the stream, allowing aquatic organisms to pass freely up and down stream at all times of the year. While water would flow through the bypass channel, the current dam's spillway would be dry. If the bypass channel is built to the proper grade, the dam's spillway will re-engage in periods of high flow. Examples of similar projects in the past several years include the bypass channel on the Piscataquis River in Howland, Maine (Bangor Daily News, 2016), as well as on the Naugatuck River in Seymour, Connecticut (New Haven Register, 2014).In addition to aquatic organism passage, construction of the bypass channel would: allow the park staff to "Shut off" flow to the impoundment area for maintenance (dredging, habitat enhancements, or dam breast maintenance); double the linear stream footage in that segment, thus increasing habitable stream miles and providing more area to disperse fishing pressure during peak season; and, illustrate an innovative technique that preserves a historical structure while accomplishing ecological connectivity. In the event that space requirements for park infrastructure in the vicinity of the recommended bypass channel prohibit a complete bankfull width channel being constructed, a partial bankfull width channel may be advisable. Different aquatic species require various flow levels throughout the year to complete their life history requirements. To be effective, a partial width bypass channel would need to replicate the size, shape, slope, and dimensions of a side channel on the main stream, so that it would contain sufficient water year round to pass any aquatic species present in the watershed.

While several options to improve aquatic organism passage have been recommended for these specific sites, each one is different, and may require a different approach after conferring with the landowner, subsurface rights owners, natural resource management agencies, and other stakeholders. It is highly recommended that, before attempting any aquatic organism passage project, project partners consult with the above parties. Segments containing AOP barriers can be found in Appendix 2 on the AOP Barriers Present map. Funding to assist with those projects may be available as well, and stakeholders should reference the *Potential Funding Sources* section starting on page 60.

Dirt and Gravel Roads

Dirt and gravel roads are recommended to be managed to have a minimum impact on aquatic resources and be removed, decommissioned, or at the very least vegetated when they are no longer needed. Proper Best Management Practices (BMPs) should be installed whenever possible, including but not limited to: re-surfacing with Driving Surface Aggregate, grade breaks, and cross drains. Specific segments are not listed here; please see the Dirt and Gravel Road Improvements Recommended map in Appendix 2. While sediment contributions from dirt and gravel roads were noted as minimal throughout the majority of these watersheds, staff noted high amounts of sand and fine material on many of the segments assessed. They were not noted as DGR sediment contributions as this connection could not positively be established. Some of the material noted was natural to the area, yet it was also hypothesized that tributaries and road ditches in ephemeral headwaters were acting as conduits for fine, sandy sediment to the streams. As field staff were under time and budgetary constraints, field investigations often did not extend to these smaller, drier areas. Additionally, not all Dirt and Gravel Roads were available through GIS mapping, and segments on that map may have improvements recommended for "unmapped" private access roads. Stakeholders seeking to reduce road maintenance and sediment contributions to those stream segments should work with the township or borough, landowner(s) and mineral rights owner(s) for solutions that benefit all. If possible, while working on DGR improvements, AOP barriers should also be removed/replaced/decommissioned within the same project. The PA DCNR, USDA Forest Service, Penn State Center for Dirt and Gravel Road Studies, USDA Natural Resources Conservation Service (NRCS), Jefferson County Conservation District, and Western Pennsylvania Conservancy are all excellent resources for these types of projects. Recommendations for improvements to a specific section of road can be arranged by contacting them and scheduling a field visit. Find their contact information in the list of Potential Project Partners starting on page 57.

Erosion

Coupled with contributions from Dirt and Gravel Roads and stormwater runoff, excessive bank erosion is the primary supplier of stream sedimentation and pollution. Erosion issues can be addressed with "hard" stabilization structures (Lutz 2007, Yochum 2016) in the short term, and vegetative stabilization structures in the long term. Where feasible, the LWM approach should be used to stabilize eroding banks as it more closely mimics natural conditions and can be more effective at reducing the erosive force of shear stress on channel walls. In more developed areas, such as yards or next to houses, structures like those in the PA Fish and Boat Commission's *Habitat Improvement for Trout Streams* hand book (Lutz 2007) may be used, as they are less intrusive into the stream and the bank. Both approaches abate erosion and help sequester sediment in slackwaters they create. Those structures' longevity is projected to be 20 years, yet wood that is completely underwater can often persist for 50–100 years or longer. These approaches can be further augmented by installing soil bioengineering (intensive vegetative plantings) practices along with them.

Soil bioengineering (SBE) is the practice of installing live, dormant plant materials into streambanks in pre-designed configurations for stabilization. Native species, such as willows and dogwoods, have the natural capability to grow roots quickly from dormant cuttings, producing viable adult plants. The resulting network of roots creates a self-healing basket of "root rebar" that stabilizes the bank. A diversity of native species may be used, and harvested on site, if possible. This will simultaneously reduce project costs and keep site specific plant genomes (specifically adapted to that location's climate, photoperiod, and hydrologic cycle) within their native range. For a full list of species and their rooting capabilities for soil bioengineering projects, see *NRCS Plant Materials Technical Note No. One* (Burgdorf et. al. 2007). This document also lists several additional reference documents, and a brief overview of some of the installation techniques. The most recent U.S. Army Corps of Engineers *Wetland Plants List for* *the Eastern Mountains and Piedmont* (Lichvar et. al 2016) may be beneficial to review during a soil bioengineering project to assist in determining planting zones.

Soil bioengineering will be necessary to stabilize the eroding bank of the Clarion River, at the confluence with Clear Creek. Since this location is a direct connection to the larger ecosystem, this stabilization project is included in this plan. The Clarion River is federally designated as a Wild and Scenic River in the reach adjacent to Clear Creek State Park, and as such is under a stricter set of regulations for activities that may or may not occur within and along its banks. This includes methods and rational for bank stabilization and instream habitat improvements. Utilizing a soil bioengineering approach coupled with naturally inspired and implemented large wood structures for toe stabilization will protect this popular recreation spot, and enhance the connection of Clear Creek to the larger Clarion River ecosystem.

Clarion River, at the confluence with Clear Creek exhibits eroding banks approximately 6 feet tall in the left side of the photo.

Due to the heavily forested nature of these watersheds, opportunities for soil bioengineering in the majority of smaller streams are somewhat shade limited. However, in areas where "hard" stabilization structures are installed, live cuttings should be incorporated into the structures, especially where AOP barriers are removed and the channel reconstructed. Utilizing this BMP will not only provide root rebar to lace structures together, but jump start riparian vegetation and provide numerous ecological benefits for the biotic community. Additional areas to focus on include those indicated as "Moderate" in the Erosion Presence map in Appendix 2, as well as bank stabilization projects where gabions are removed. Some of these sites may require the use of heavy equipment (as is the case on the Clarion River/Clear Creek confluence site), but bank stabilization at other sites may be accomplished with volunteers on a weekend workday.

One of the simplest methods of preventing bank erosion is to not mow the vegetation on the streambanks. A diverse strip of native plants maintained as a forested riparian buffer approximately 100 feet (30 meters) or more around waterways can be the most cost effective and least maintenance intensive practice for preventing streambank erosion (Sweeney 2014). While the plan watersheds are primarily forested, efforts can be made in the developed portions to enhance and install riparian buffers. By slowing down sheetflow velocity and quantity as it approaches the stream, erosion will be reduced locally as well as cumulatively downstream. This is also a prime opportunity to increase environmental education, as sites with newly established riparian buffers can host educational signage or programming which can greatly influence landowner decisions about potential land management objectives.

Channelization

Wherever possible, it is recommended to reduce the amount of channelization in the watershed. Future rigid channelization efforts should be reduced or eliminated completely to reduce flooding, erosion, and pollution. Streams should be returned to a natural form and function, dependent on stream order, size, and where they occur within the watershed. For example, restoration of segment 445, Little Clear Creek, in the vicinity of the DCNR-BoF maintenance shed, will be completely different than the restoration that would need to occur on the segment 1559, tributary to Callen Run. Restoration plans for any channelized segment to be restored should include access to the floodplain and a stable, naturally inspired bedload mix with habitat pieces, to effectively mimic a natural stream section.

Wild Trout

Wild trout were not visibly detected in every stream segment, though it is likely that they were present in some capacity. In order to determine if native and wild trout are truly present in a given stream reach, backpack electrofishing surveys will need to be completed. Since these four watersheds are already designated as Wild Trout streams by the PA Fish and Boat Commission, this level of detail was not within the scope of the assessment. To improve conditions for native trout in these watersheds, individuals and organizations may follow the recommendations in this plan. Habitat, access to habitat, and competition all are key factors to consider. Additionally, if the PA Fish and Boat Commission should deem it appropriate, the stocking of non-native trout and hatchery raised brook trout may be reduced in these watersheds. As has been demonstrated in Montana (Vincent, 1987) and Colorado (Epifanio and Nickum, 1997), adverse impacts from stocked fish can reduce the ability of wild and native trout to thrive in watersheds. Seasons, sizes, and creel limits may also need to be adjusted to protect the native trout until their populations reach the desired quality of sport fishery. However, not all lands and streams are equal in terms of their inherent productivity, and it may well be that these streams "need" to be stocked with hatchery fish to maintain an adequate sport fishery. A recommendation to totally change the current stocking schedule and management is slightly outside the scope of this plan, and should involve a balance of sound scientific research and stakeholder input. For additional reading on this topic, see "Why Montana Went Wild," Vincent, 1987, and Baird et. al 2006.

Water Quality

Low pH on the Allegheny Plateau is typically attributed to acid precipitation and the low buffering capacity of the soils. At a local level, it may not be feasible to prevent acidic precipitation from falling, yet improvements to dirt and gravel roads with limestone DSA application as well as alkalinity basins would help mitigate it once it fell. Our study did not show pH values that were completely outside the range of existence for coldwater organisms, but they could be improved in some areas. If further study should determine that low pH is affecting the resource, a mitigation strategy can be developed at that time.

Improving conductivity may prove a difficult endeavor in these watersheds. Off colored seeps and springs are visible from cracks in bedrock shelves, hillslopes, and leaking gas and oil wells. Plugging these leaks may result in the high conductivity brine that flows from them simply finding another outlet to the stream. Historic, undocumented pilot holes for oil and gas extraction will become new outlets, as indeed many already are. It is recommended to plug the inactive and abandoned wells whenever possible, and to mitigate new leaks as they arise. Due to the behavior of wild trout observed within the impacted area, the leak on segment 510 (Truby Run) is the highest priority for mitigation. In addition to well plugging, keeping riparian areas forested, restoring historic levels of LWM to streams, and installing DGR BMPs like Corman Clearwater Crossings will help mitigate negative effects from increased conductivity.

Additional General Habitat Improvements

Nearly all segments would benefit from an increase in deep-water habitats, of both fast and slow flow velocities. Nine specific segments were identified in the Areas of Concern section, where adding habitat structures to heavily used areas will benefit both stocked and wild fish, and enhance the fishing experience for anglers. Habitat improvement projects should not be limited to these nine segments, but they do provide a starting point that will have the maximum benefit to the angling public as well as the resource.

490: Wetlands like this one at the top of Callen Run will become increasingly important as hydrologic cycles change in the coming century.

In addition to the riparian buffer activities mentioned in the Erosion section of these Recommendations, individuals engaged in any sort of development, resource extraction, or timber harvest should also heed a minimum buffer of 35 feet on all stream segments. While some tree harvest may be necessary within this riparian buffer zone, it should only be done in efforts to add LWM to the stream and floodplain. If during commercial harvest a tree should fall into the stream, it is recommended that it stays there, except in the event that less than three meander bends are present on the stream between the tree and downstream infrastructure (bridges, culverts, etc.).

Climate Change

While individuals and small organizations at the local scale can't immediately change the pace of anthropogenic climate change globally, we can act locally to improve the resiliency of our coldwater ecosystems. By following recommendations in this plan, as well as those of the PA Fish and Boat Commission, Trout Unlimited, and other conservation organizations, we can act together to improve these watersheds, impacting the rest of Clarion River ecosystem, the Allegheny River, and points downstream. See Table 6 for pertinent mitigation strategies.

Table 6. Climate Change, Coldwater Ecosystems, and Mitigation Strategies

Climate Change Condition	Effect on Coldwater Ecosystems	Mitigation Strategies
Increased drought frequency, intensity, and duration during summer and fall	Habitat fragmentation or loss as streams lose water	-Ensure adequate AOP throughout the watershed, to allow access to water of the proper quality and temperature -Enhance groundwater infiltration from headwaters to mouth, through green stormwater infrastructure, large wood additions, and other BMP's
	Reduced prey abundance as seasonal wetlands dry before larval amphibians metamorphose and migrate	-Provide native riparian tree or shrub plantings to the south of known wetlands to reduce evaporation -Promote beaver usage of the watershed. This can include providing base structures in areas lacking riparian wood, so that upon colonization the beaver structures remain in the system
Warmer average water temperature	Less dissolved oxygen available for aquatic organism respiration	-Safeguard existing forest/shrub riparian areas, as well as plant new areas where needed to shade and cool waters, increasing DO capacity -Diminish or eliminate fishing pressure during hot summer months to reduce physical stress in hypoxic water conditions
	Habitat loss due to increased temperature	-Decrease water temperatures through riparian plantings and increased hyporheic interaction
Increased precipitation event frequency, intensity, and duration during winter and spring, mostly as rain	Road-stream crossing structures become undersized as storm events increase in intensity, creating AOP barriers and further fragmenting habitat	-Ensure adequate AOP throughout the watershed, simultaneously increasing hydraulic capacity of crossing structures -Slow stormwaters upslope and upstream to increase infiltration and reduce quantity of flood flows
	Less snowpack and more precipitation falling as rain means more runoff quicker, resulting in less infiltration to groundwater tables and reduced base flows	-Slow stormwaters upslope and upstream to increase infiltration, install stormwater BMP's -Keep development out of floodplain areas to reduce negative interactions with water table

Table developed from Woodward et. al. 2010 and Moore et. al. 1997.

Species of Concern and Other Species Observed

A number of sensitive species have been observed in this watershed, both during field assessments for this study, and for more broad studies by the Pennsylvania Natural Heritage Program and WPC's Watershed Conservation Program. For more information on what those species might be and protections in place for them, please see http://www.naturalheritage.state.pa.us/. No new species occurrences or range expansions were found during this assessment, but several notable species were observed within the drainage. For their protection we are not able to provide exact locations for their occurrences, but their presence in the watershed is a testament to the fine habitat quality already present there.

Potential Project Partners

The list on the following pages includes partners and potential funding sources for the variety of improvements recommended in this plan. In particular, road and upland managers may be interested in "new" sources of funding to support their management activities. For instance, installing dirt and gravel road best management practices (culverts, DSA, etc.) may make a road improvement project eligible for grant funding from the Coldwater Heritage Partnership, Growing Greener, Commonwealth Financing Authority and others, since it will also have benefits to the aquatic ecosystem. Coordinating with a variety of partners is likely to increase the chances of a particular project getting funded, as the initiating party can rely on a wide field of expertise. The Western Pennsylvania Conservancy is happy to partner with willing parties to assist in grant application and management. Those interested should contact the Allegheny Regional Office.

Allegheny Mountain Chapter #036 of Trout Unlimited
107 Simmons St.
Dubois, PA 15801
https://amctu.org/

Allegheny National Forest
United States Department of Agriculture
Forest Supervisor's Office

4 Farm Colony Drive
Warren, PA 16701
814-728-6100
https://www.fs.usda.gov/allegheny

Allegheny WINs Coalition
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4 Farm Colony Drive
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814-728-6163
nwelker@fs.fed.us

American Rivers
Mid-Atlantic – Pittsburgh Office
150 Lloyd Ave
Pittsburgh, PA 15218
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Barnett Township, Jefferson County
814-752-2763
njreyob@alltel.net

Clear Creek State Forest
158 South Second Avenue
Clarion, PA 16214-1904
814-226-1901
fd08@pa.gov

Clear Creek State Park
38 Clear Creek Park Road
Sigel, PA 15860-6702
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clearcreeksp@pa.gov

Ducks Unlimited
1383 Arcadia Road, Room 8
Lancaster, PA 17601
717-945-5068
www.ducks.org
jfeaga@ducks.org

Eldred Township, Jefferson County
3441 Rt. 36
Brookville, PA 15825
814-849-7683
eldredtwp@windstream.net

Headwaters Resource Conservation and Development Council
109 North Brady Street, 2nd Floor
Dubois, PA 15801
http://headwaterspa.org/

Heath Township, Jefferson County
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Iron Furnace Chapter #288 of Trout Unlimited
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https://www.facebook.com/IronFurnaceChapterTU/

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Jefferson County Conservation District

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jccd@windstream.net

Matson Lumber Company
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814-849-5334
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info@matsonlumber.com

National Fuel Gas Supply Corporation
1100 State Street
Erie, PA 16501
1-800-365-3234
https://www.natfuel.com/

National Wild Turkey Federation
Bob Schmid/Jefferson Co.
1415 Brocious Road
Brookville, PA 15825
814-328-5159
www.nwtf.org
bob.schmid@thermofisher.com
smotts@nwtf.net

North Atlantic Aquatic Connectivity Collaborative
http://streamcontinuity.org/
contact@streamcontinuity.org

Pennsylvania Department of Environmental Protection
Northwest Regional Office
230 Chestnut Street
Meadville, PA 16335-3481

Ruffed Grouse Society
Allegheny Chapter
1016 Long Level Road

Phone: 814-332-6945
Emergencies: 1-800-373-3398
http://www.dep.pa.gov/Business/Water/Pages/default.aspx

Pennsylvania Fish and Boat Commission
North Central Region Office
595 East Rolling Ridge Drive
Bellefonte, PA 16823
814-359-5250

Habitat Management Division
450 Robinson Lane
Pleasant Gap, PA 16823
814-359-5100
http://www.fishandboat.com/Pages/default.aspx

Pennsylvania Department of Transportation
PennDOT Engineering District 1-0
255 Elm Street, P.O. Box 398
Oil City, PA 16301
814-678-7085

PennDOT Engineering District 10
2550 Oakland Avenue
P.O. Box 429
Indiana, PA 15701-0429
724-357-2800
http://www.penndot.gov/RegionalOffices/district-10/Pages/default.aspx

Polk Township, Jefferson County
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Johnsonburg, PA 15845-2402
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wlhab@windstream.net

Western Pennsylvania Conservancy
Allegheny Regional Office
159 Main Street
Ridgway, PA 15853
814-776-1114
alleghenyproject@paconserve.org
www.waterlandlife.org

Potential Funding Sources

Colcom Foundation

http://colcomfdn.org/

Coldwater Heritage Partnership

http://www.coldwaterheritage.org/

Commonwealth Financing Authority

https://dced.pa.gov/programs-funding/commonwealth-financing-authority-cfa/

Community Foundation of Warren County

https://cfowc.org/

Eastern Brook Trout Joint Venture

http://easternbrooktrout.org/

Eastern National Forest Interpretive Association

http://www.enfiamich.org/home.aspx

Foundation for Pennsylvania Watersheds

http://pennsylvaniawatersheds.org/apply-for-a-grant/

National Forest Foundation

https://www.nationalforests.org/grant-programs

North Central Greenways

http://www.ncentralgreenways.com/

Northwest Greenways

http://www.northwestpa.org/greenways-block-grant-program/

Ohio River Basin Fish Habitat Partnership

http://www.fishhabitat.org/the-partnerships/ohio-river-basin-fish-habitat-partnership

PA Department of Conservation and Natural Resources

http://www.dcnr.state.pa.us/brc/grants/

PA Department of Environmental Protection: Growing Greener

http://www.dep.pa.gov/Citizens/GrantsLoansRebates/Growing-Greener/Pages/default.aspx

PA Fish and Boat Commission- Cooperative Habitat Improvement Program

http://www.fishandboat.com/Resource/Habitat/Documents/CHIP-GuidelinesApplication.pdf

Patagonia

http://www.patagonia.com/environmental-grants-and-support.html

Richard King Mellon Foundation

http://fdnweb.org/rkmf/

Seneca Natural Resources Corporation

http://www.natfuel.com/seneca/contact_us.aspx

Shell Foundation

http://www.shellfoundation.org/

Stackpole-Hall Foundation

http://www.stackpolehall.org/

US Department of Agriculture: Natural Resources Conservation Service

https://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/programs/?cid=stelprdb1048817

US Fish and Wildlife Service Fish Passage Program

https://www.fws.gov/fisheries/fish-passage.html

List of Resources for BMPs relating to Watershed Conservation

North Atlantic Aquatic Connectivity Collaborative

https://streamcontinuity.org/

Pennsylvania Center for Dirt and Gravel Roads

http://www.dirtandgravel.psu.edu/

PA Department of Environmental Protection

http://www.dep.pa.gov/Business/Water/Waterways/Pages/default.aspx

PA Fish and Boat Commission

http://www.fishandboat.com/Pages/default.aspx

PA State Conservation Commission

https://www.agriculture.pa.gov/Plants_Land_Water/StateConservationCommission/Pages/default.aspx

Penn State Extension Service

http://extension.psu.edu/natural-resources/water

Stroud Water Research Center

http://www.stroudcenter.org/

US Department of Agriculture: Natural Resource Conservation Service Field Office Technical Guide (FOTG)

https://efotg.sc.egov.usda.gov/

US Forest Service: Guidance for Stream Restoration and Rehabilitation

https://www.fs.fed.us/biology/nsaec/assets/yochumusfs-nsaec-tn102-4guidancestreamrestoration.pdf

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Summary and Conclusion

The watersheds of Clear Creek, Callen, Pine, and Leeper Runs are well deserving of their designations of High Quality and Coldwater Fisheries. Native and Wild trout, though not "jumping out of the banks," are holding on well in these streams. Through field investigations, review of published data, and personal communications with professionals and interested stakeholders, the field staff and plan writers involved in this project hope that the recommendations developed herein are able to assist those wild trout in truly thriving here. That goal will only be possible through the concerted efforts of a diverse coalition of partners including federal, state, and local agencies, private businesses and organizations, and concerned citizens. Prime examples of these partnerships are the removals of AOP barriers in the Callen Run watershed, currently in the planning phase at the writing of this plan (December, 2017). The relationships developed by those successful projects will serve as a model to continue implementing the recommendations of this plan, leading to improved coldwater resources in the Clear Creek, Callen, Pine, and Leeper Run watersheds.

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Appendix 1:

Data Tables

Table 2: Habitat Scores

Stream Name	GIS ID	Epifaunal Substrate	Embedded-ness	Velocity Depth Regimes	Sediment Deposition	Channel Flow Status	Channel Alteration	Frequency of Riffles or bends	Bank Stability Right Bank	Bank Stability Left Bank	Vegetative Protection Right Bank	Vegetative Protection Left Bank	Riparian Zone Width Right Bank	Riparian Zone Width Left Bank	Total Score
Trib 50011 To Leeper Run	338	10	11	10	8	9	15	7	8	8	8	8	10	10	12.2
Trib 50028 To Callen Run	347	14	16	16	18	15	19	19	9	10	10	10	9	10	17.5
Callen Run	348	16	17	16	17	15	15	17	9	9	9	9	8	8	16.5
Trib 50006 To Pine Run	352	15	14	13	13	12	19	13	9	9	8	9	9	10	15.3
Pine Run	363	15	15	16	15	12	12	16	9	9	9	9	9	9	15.5
Leeper Run	368	13	16	16	13	11	19	15	9	9	9	9	10	10	15.9
Johns Run	377	16	16	17	16	13	14	17	9	9	9	9	9	8	16.2
Pine Run	397	11	11	13	7	10	16	11	7	7	8	8	9	10	12.8
Johns Run	398	16	17	18	15	13	15	16	8	8	9	8	8	4	15.5
Trib 49912 To Clear Creek	408	8	5	13	10	17	15	17	10	10	9	9	9	9	14.1
Callen Run	413	16	13	16	15	12	18	17	8	8	9	9	10	10	16.1
Clear Creek	419	10	13	13	17	16	20	17	9	10	9	10	8	10	16.2

Table 2: Habitat Scores

Stream Name	GIS ID	Epifaunal Substrate	Embedded -ness	Velocity Depth Regimes	Sediment Deposition	Channe l Flow Status	Channel Alteration	Frequenc y of Riffles or bends	Bank Stabilit y Right Bank	Bank Stability Left Bank	Vegetative Protection Right Bank	Vegetative Protection Left Bank	Riparian Zone Width Right Bank	Riparian Zone Width Left Bank	Total Scor e
Trib 50026 To Johns Run	431	15	15	17	12	13	15	16	9	10	10	10	9	10	16.1
Trib 50026 To Johns Run	432	15	18	16	13	13	13	16	9	9	9	9	9	9	15.8
Johns Run	437	13	10	17	13	14	18	18	10	10	9	10	8	10	16
Phyllis Run	438	13	14	16	14	12	13	16	9	9	9	9	8	8	15
Clear Creek	439	15	16	16	15	16	11	14	7	8	7	8	3	3	13.9
Callen Run	441	16	11	16	13	13	20	16	8	7	8	8	10	10	15.6
Trib 50031 To Callen Run	442	13	14	13	16	10	20	17	9	8	9	8	10	10	15.7
Little Clear Creek	445	11	11	15	10	8	14	14	8	8	8	8	9	10	13.4
Trib 50027 Of Johns Run	457	13	16	15	15	8	15	12	10	10	10	10	9	9	15.2
Clear Creek	462	14	13	15	14	16	16	17	9	9	9	9	9	8	15.8

Table 2: Habitat Scores

Stream Name	GIS ID	Epifaunal Substrate	Embedded -ness	Velocity Depth Regimes	Sediment Deposition	Channe l Flow Status	Channel Alteration	Frequenc y of Riffles or bends	Bank Stabilit y Right Bank	Bank Stability Left Bank	Vegetative Protection Right Bank	Vegetative Protection Left Bank	Riparian Zone Width Right Bank	Riparian Zone Width Left Bank	Total Scor e
Trib 49919 To Clear Creek	476	8	15	11	14	12	16	16	6	6	7	7	7	7	13.2
Clear Creek	477	15	15	17	13	16	14	17	7	7	8	8	9	7	15.3
Trib 49925 To Clear Creek	479	12	15	17	17	15	15	18	9	9	8	8	8	8	15.9
Clear Creek	483	14	10	16	12	15	16	18	6	6	7	7	7	9	14.3
Clear Creek	487	15	13	16	13	15	14	14	8	9	8	9	7	8	14.9
Clear Creek	488	11	10	18	13	17	18	16	9	9	9	9	9	8	15.6
Trib 49918 To Clear Creek	489	12	12	15	9	16	16	17	9	9	9	9	9	7	14.9
Callen Run	490	14	11	13	10	13	14	17	8	8	8	8	7	7	13.8
Trap Run	499	16	15	18	13	13	15	16	8	8	9	9	8	8	15.6
Clear Creek	500	9	8	16	8	13	11	14	7	7	7	7	8	8	12.3
Clear Creek	501	15	15	17	15	16	20	18	9	9	9	9	9	8	16.9
Clear Creek	503	13	7	16	12	15	20	14	9	9	10	10	10	10	15.5

Table 2: Habitat Scores

Stream Name	GIS ID	Epifaunal Substrate	Embedded-ness	Velocity Depth Regimes	Sediment Deposition	Channel Flow Status	Channel Alteration	Frequency of Riffles or bends	Bank Stability Right Bank	Bank Stability Left Bank	Vegetative Protection Right Bank	Vegetative Protection Left Bank	Riparian Zone Width Right Bank	Riparian Zone Width Left Bank	Total Score
Truby Run	510	11	17	18	16	9	15	17	8	9	9	9	8	8	15.4
Trib 49927 To Clear Creek	514	12	11	16	13	14	18	12	9	9	10	10	10	10	15.4
Trib 49926 To Clear Creek	529	11	11	16	9	7	17	11	9	9	9	9	10	6	13.4
Trib 49921 To Trap Run	532	12	16	16	16	13	18	16	9	9	9	9	9	9	16.1
Dry Run	535	8	12	16	13	14	12	15	9	7	8	8	8	6	13.6
Trap Run	547	16	17	18	16	13	18	18	7	7	9	9	10	9	16.7
Trap Run	585	12	12	13	9	8	18	11	7	7	7	7	10	9	13
Trib 49923 To Trap Run	588	7	7	11	6	8	19	8	9	9	9	9	9	10	12.1
Trap Run	610	12	10	12	9	8	19	10	9	9	10	10	10	10	13.8
Leeper Run	1551	12	12	17	12	12	11	16	7	8	7	8	6	6	13.4
Callen Run	1557	14	11	16	13	15	15	14	6	5	7	7	5	5	13.3
Trib 50023 To Callen Run	1559	12	15	16	16	13	10	16	5	5	6	6	5	5	13
Callen Run	1561	13	10	16	10	16	9	13	8	8	8	7	5	5	12.8

Table 2: Habitat Scores

Stream Name	GIS ID	Epifaunal Substrate	Embedded-ness	Velocity Depth Regimes	Sediment Deposition	Channel Flow Status	Channel Alteration	Frequency of Riffles or bends	Bank Stability Right Bank	Bank Stability Left Bank	Vegetative Protection Right Bank	Vegetative Protection Left Bank	Riparian Zone Width Right Bank	Riparian Zone Width Left Bank	Total Score
Callen Run	1567	13	13	16	13	12	13	15	8	8	9	9	10	9	14.8
Clear Creek	1581	14	14	16	15	15	7	12	7	8	6	7	5	6	13.2
Clear Creek	1586	13	16	18	11	12	11	17	10	9	9	9	6	8	14.9
Minimum		7	5	10	6	7	7	7	5	5	6	6	3	3	12
Maximum		16	18	18	18	17	20	19	10	10	10	10	10	10	18
Median		13	13	16	13	13	15	16	9	9	9	9	9	9	15
Mean		13	13	15	13	13	15	15	8	8	9	9	8	8	15
Range		9	13	8	12	10	13	12	5	5	4	4	7	7	5

Table 3: Water Quality

Stream Name	GIS ID	pH: Top of Segment	pH: Bottom of Segment	Change in pH from Top to Bottom	Water Temperature (°C): Top of Segment	Water Temperature (°C): Bottom of Segment	Change in Water Temperature (°C) from Top to Bottom	Conductivity (µs/cm): Top of Segment	Conductivity (µs/cm): Bottom of Segment	Change in Conductivity (µs/cm) from Top to Bottom
Trib 50011 To Leeper Run	338	4.91	5.05	0.14	13.80	13.80	0.00	30.30	36.10	5.80
Trib 50028 To Callen Run	347	5.87	6.27	0.40	10.60	13.20	2.60	38.40	72.80	34.40
Callen Run	348	6.58	6.82	0.24	13.70	13.60	-0.10	54.70	53.30	-1.40
Trib 50006 To Pine Run	352	5.76	6.92	1.16	14.40	13.20	-1.20	38.00	44.50	6.50
Pine Run	363	6.30	7.14	0.84	12.60	14.20	1.60	33.50	72.20	38.70
Leeper Run	368	6.29	6.22	-0.07	13.60	13.30	-0.30	30.70	30.60	-0.10
Johns Run	377	7.09	7.12	0.03	14.20	14.00	-0.20	44.60	44.20	-0.40
Pine Run	397	6.52	7.07	0.55	13.50	12.00	-1.50	30.90	33.70	2.80
Johns Run	398	6.78	6.72	-0.06	13.20	14.20	1.00	38.10	43.90	5.80
Trib 49912 To Clear Creek	408	6.89	7.23	0.34	10.90	12.10	1.20	28.00	30.80	2.80
Callen Run	413	6.50	6.67	0.17	12.10	12.70	0.60	35.00	40.10	5.10
Clear Creek	419	7.45	7.52	0.07	12.30	12.30	0.00	45.20	46.70	1.50
Trib 50026 To Johns Run	431	6.50	6.58	0.08	13.90	14.10	0.20	29.10	32.70	3.60
Trib 50026 To Johns Run	432	6.56	6.48	-0.08	16.10	15.20	-0.90	59.70	27.80	-31.90
Johns Run	437	6.30	6.40	0.10	11.70	12.90	1.20	31.40	41.90	10.50
Phyllis Run	438	6.81	7.08	0.27	19.40	15.50	-3.90	97.60	142.00	44.40
Clear Creek		7.35	7.33	-0.02	11.60	12.00	0.40	42.20	44.40	2.20
Callen Run	441	5.25	6.24	0.99	14.10	12.10	-2.00	25.40	34.80	9.40
Trib 50031 To Callen Run	442	5.50	5.00	-0.50	13.20	14.10	0.90	24.30	26.10	1.80
Little Clear Creek	445	5.87	7.05	1.18	13.80	14.60	0.80	28.60	53.40	24.80
Trib 50027 Of Johns Run	457	6.30	6.49	0.19	10.40	11.10	0.70	32.30	30.90	-1.40
Clear Creek	462	7.30	7.20	-0.10	17.80	17.70	-0.10	42.30	43.40	1.10
Trib 49919 To Clear Creek	476	6.87	6.96	0.09	16.70	17.10	0.40	40.70	129.30	88.60
Clear Creek	477	7.12	6.91	-0.21	17.30	17.70	0.40	40.70	38.80	-1.90

Table 3: Water Quality

Stream Name	GIS ID	pH: Top of Segment	pH: Bottom of Segment	Change in pH from Top to Bottom	Water Temperature (°C): Top of Segment	Water Temperature (°C): Bottom of Segment	Change in Water Temperature (°C) from Top to Bottom	Conductivity (µs/cm): Top of Segment	Conductivity (µs/cm): Bottom of Segment	Change in Conductivity (µs/cm) from Top to Bottom
Trib 49925 To Clear Creek	479	4.67	6.14	1.47	18.30	13.60	-4.70	27.30	21.40	-5.90
Clear Creek	483	6.88	6.78	-0.10	16.90	17.30	0.40	35.40	36.30	0.90
Clear Creek	487	6.73	6.62	-0.11	15.80	16.20	0.40	27.90	29.60	1.70
Clear Creek	488	5.78	6.40	0.62	15.80	15.60	-0.20	22.00	24.40	2.40
Trib 49918 To Clear Creek	489	7.11	7.46	0.35	19.80	18.70	-1.10	169.00	151.00	-18.00
Callen Run	490	5.30	5.75	0.45	13.50	14.10	0.60	21.50	25.70	4.20
Trap Run	499	6.66	7.00	0.34	18.30	16.00	-2.30	42.30	45.80	3.50
Clear Creek	500	5.30	5.22	-0.08	16.10	17.00	0.90	20.00	21.00	1.00
Clear Creek	501	5.74	5.83	0.09	13.50	14.50	1.00	23.30	24.23	0.93
Clear Creek	503	5.85	5.75	-0.10	12.80	13.60	0.80	23.20	23.50	0.30
Truby Run	510	7.26	8.00	0.74	13.00	11.80	-1.20	74.50	137.20	62.70
Trib 49927 To Clear Creek	514	4.39	6.12	1.73	15.80	10.90	-4.90	36.00	24.90	-11.10
Trib 49926 To Clear Creek	529	4.82	4.75	-0.07	16.10	15.80	-0.30	25.10	26.20	1.10
Trib 49921 To Trap Run	532	4.94	6.00	1.06	16.40	15.00	-1.40	27.60	29.30	1.70
Dry Run	535	5.25	6.67	1.42	15.90	17.80	1.90	23.00	50.30	27.30
Trap Run	547	6.43	6.73	0.30	14.10	13.70	-0.40	44.30	42.50	-1.80
Trap Run	585	6.10	6.15	0.05	13.00	14.10	1.10	50.10	42.70	-7.40
Trib 49923 To Trap Run	588	6.56	6.15	-0.41	16.70	14.80	-1.90	31.60	30.10	-1.50
Trap Run	610	6.34	6.13	-0.21	12.40	12.20	-0.20	67.00	53.30	-13.70
Leeper Run	1551	7.40	7.80	0.40	13.60	13.30	-0.30	36.10	105.80	69.70
Callen Run	1557	7.04	7.05	0.01	15.20	15.30	0.10	52.70	55.90	3.20
Trib 50023 To Callen Run	1559	6.43	6.87	0.44	15.10	14.90	-0.20	50.10	122.80	72.70
Callen Run	1561	7.13	7.08	-0.05	13.50	14.80	1.30	51.50	52.80	1.30
Callen Run	1567	6.77	7.40	0.63	12.90	14.60	1.70	39.30	62.30	23.00
Clear Creek	1581	7.60	7.44	-0.16	12.40	13.30	0.90	46.90	47.10	0.20
Clear Creek	1586	7.26	7.31	0.05	12.50	11.90	-0.60	41.20	41.80	0.60

Table 3: Water Quality

Stream Name	GIS ID	pH: Top of Segment	pH: Bottom of Segment	Change in pH from Top to Bottom	Water Temperature (°C): Top of Segment	Water Temperature (°C): Bottom of Segment	Change in Water Temperature (°C) from Top to Bottom	Conductivity (µs/cm): Top of Segment	Conductivity (µs/cm): Bottom of Segment	Change in Conductivity (µs/cm) from Top to Bottom
Minimum		4.39	4.75	-0.50	10.40	10.90	-4.90	20.00	21.00	-31.90
Maximum		7.6	8	1.73	19.8	18.7	2.6	169	151	88.6
Median		6.5	6.725	0.12	13.8	14.1	0.05	36.05	42.2	1.75
Mean		6.33	6.62	0.29	14.41	14.27	-0.14	41.01	50.45	9.43
Range		3.21	3.25	2.23	9.40	7.8	7.5	149	130	120.5

Table 5: AOP Barriers and Locations

Stream Name	GIS ID	AOP Barrier Description	Latitude	Longitude
Callen Run	348	Callen Run Road Bridge. Not a barrier, but does slightly constrict high water flows	41.344031	-79.009821
Pine Run	363	Culvert on private access road is undersized and perched near the mouth of Pine Run	41.349774	-79.060635
Johns Run	377	Relic Dam	41.343865	-79.013274
Trib 49912 To Clear Creek	408	Culvert on Clear Creek Park Road is perched and undersized	41.329298	-79.093616
Trib 50026 To Johns Run	431	Relic, breached dam is partial AOP barrier at lower flows	41.327954	-79.018509
Johns Run	437	Pipeline acts as "false wood", an unnatural AOP barrier at some flows	41.327888	-79.009917
	437	Culvert on access road is undersized	41.326627	-78.995001
Phyllis Run	438	Undersized, perched culvert on Phyllis Run, at Clear Creek Park Road crossing	41.329254	-79.093583
Clear Creek	439	Concrete vehicle ford to Big Coon Picnic Area	41.326407	-79.088894
	439	Jack dam for fish habitat creates AOP barrier, also is a grade control for the pipeline upstream	41.327245	-79.092011
Little Clear Creek	445	Vehicle bridge over Little Clear Creek lacks dry passage within the structure	41.321746	-79.076782
Trib 50027 Of Johns Run	457	ATV trail ford/culvert combination	41.326101	-79.019418
Trib 49919 To Clear Creek	476	Culvert under Corbett Road is undersized	41.315998	-79.068992
	476	Culvert under Little Clear Creek Road is undersized	41.318308	-79.066921
Clear Creek	477	Newer jack dam, with partial bypass channel	41.317945	-79.073756
	477	Older, failing jack dam	41.319025	-79.075333
Trib 49925 To Clear Creek	479	Culvert on access road is undersized	41.31983	-79.046301
Clear Creek	483	Small foot bridge constricts high flood flows. Minimal AOP barrier, if at all.	41.3145	-79.06815
Clear Creek	488	Natural waterfall. A potential AOP barrier	41.315104	-79.058542
Callen Run	490	Undersized, perched culvert in the headwaters of Callen Run, at the Callen Run Road crossing	41.317424	-78.96665
Clear Creek	500	Concrete culvert under Pine Run Road is less than 1/4 bank full width of the stream	41.310679	-79.019341
Dry Run	535	Culvert is undersized and poorly aligned	41.312871	-79.064746

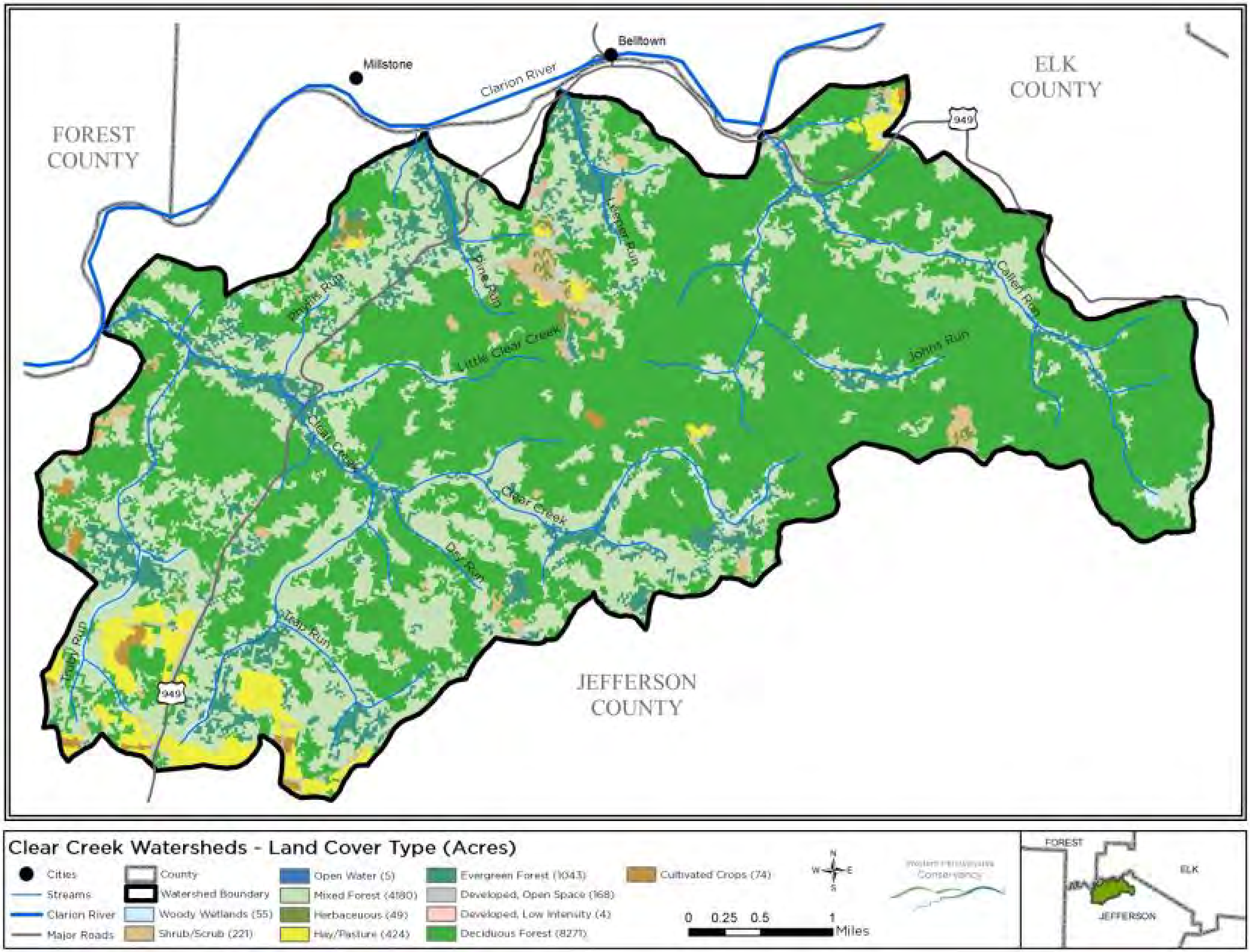
Table 5: AOP Barriers and Locations

Stream Name	GIS ID	AOP Barrier Description	Latitude	Longitude
Trap Run	547	Footbridge for hiking trail constricts some high flood flows. Minimal, if any, AOP barrier	41.301233	-79.08026
Truby Run	570	Culvert under Shaffer Road is undersized	41.299096	-79.105277
Leeper Run	1551	Historic stone arch under SR 949, connecting Leeper Run to the Clarion River. Baffles present inside, but a large scour pool is also present at the outlet	41.354134	-79.042541
Callen Run	1557	SR 949 Crosses Callen Run. Not an AOP Barrier. Dry passage and semi-natural floodplain development through the structure	41.349784	-79.014897
Trib 50023 To Callen Run	1559	Culvert under SR 949 is undersized	41.349736	-79.014101
	1559	Temporary culvert for Heath Pump Station decommissioning is undersized	41.349652	-79.014383
Callen Run	1561	Large dam at Heath Pump Station	41.349153	-79.014496
Callen Run	1567	Upper Dam, upstream of Callen Run Road Crossing	41.342028	-79.007624
	1567	Breached splash dam is low water AOP barrier	41.34318	-79.008085
	1567	Pipes for relic footbridge/atv trail are low-water AOP barrier	41.339225	-79.00242
Clear Creek	1581	Multiple culvert bridge is low-water AOP barrier at the mouth of Clear Creek	41.330018	-79.102807
Clear Creek	1586	Swimming dam for Clear Creek State Park.	41.32317	-79.079789

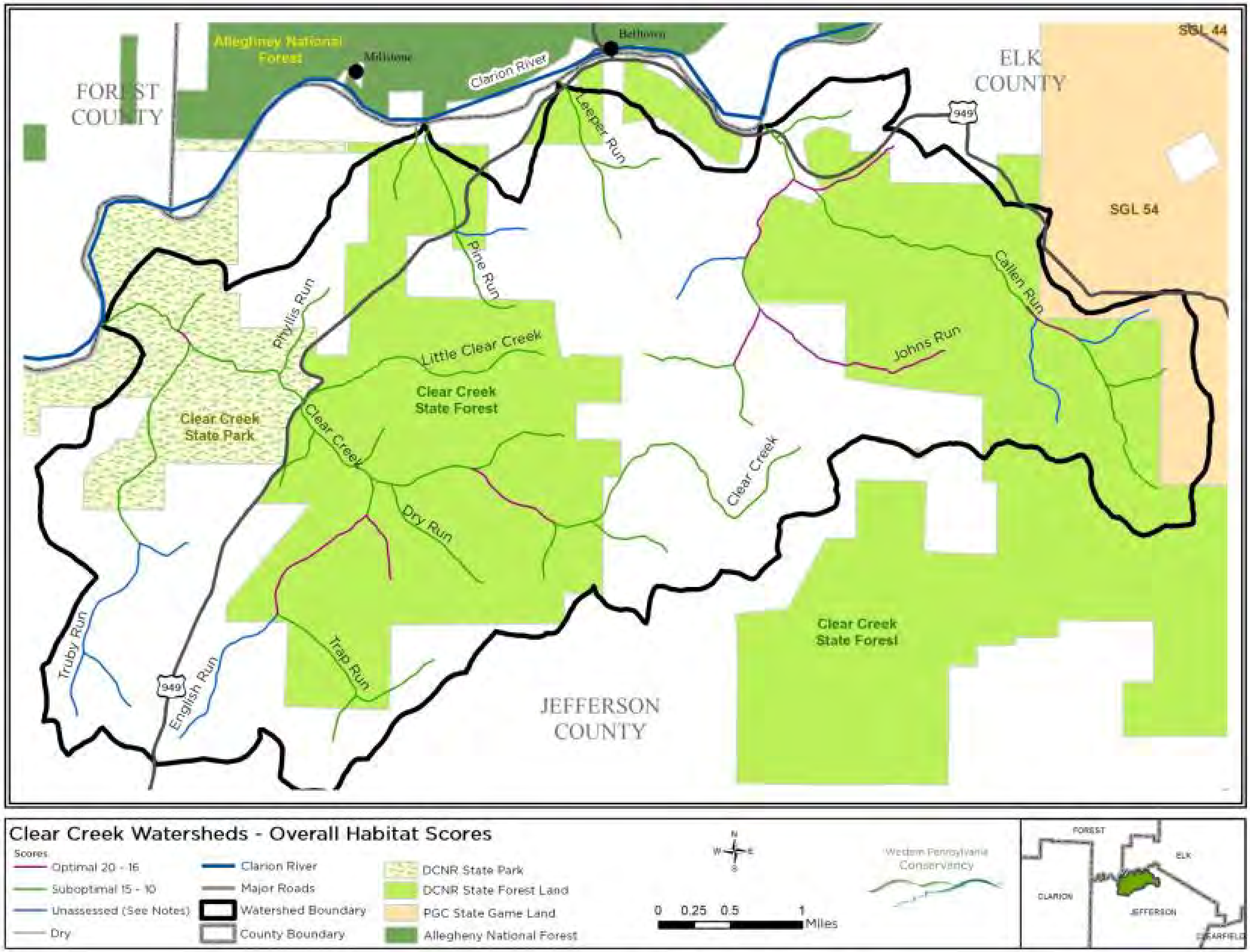
Table 7: Segments Excluded from Analysis

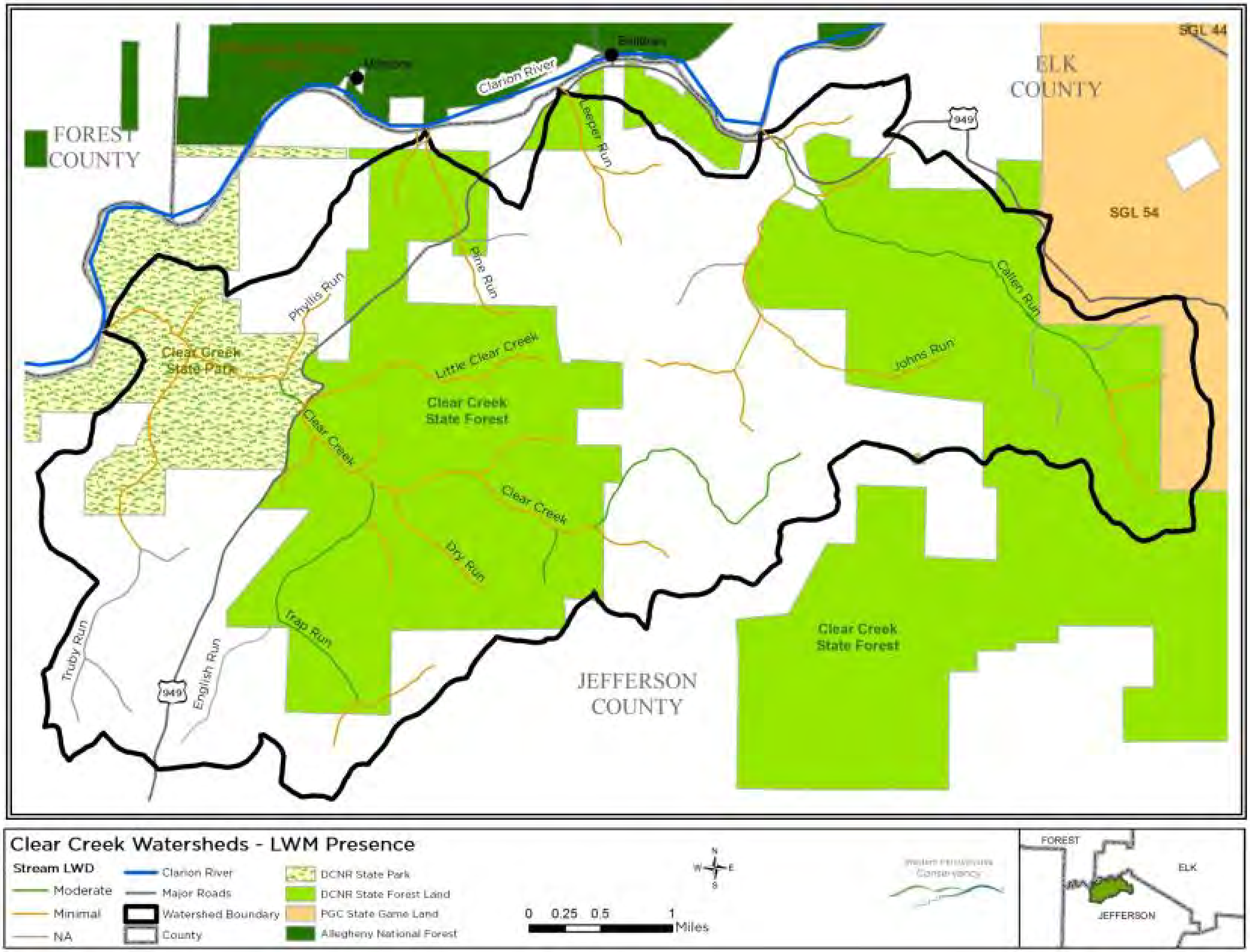
Stream Name	Segment ID	Reason for Exclusion from Analysis
Trib 50007 To Pine Run	365	Dry Segment
Trib 50025 To Johns Run	393	Segment Unassessed due to permission or logistical access issues
Trib 50030 To Callen Run	418	Dry Segment
Trib 50029 To Callen Run	452	Dry Segment
Trib 49914 To Truby Run	516	Dry Segment
Truby Run	570	Segment Unassessed due to permission or logistical access issues. Culvert on Shafer Road assessed from road for AOP barrier potential.
Trib 49915 To Truby Run	592	Dry Segment
Truby Run	594	Dry Segment
English Run	911	Segment Unassessed due to permission or logistical/access issues

Appendix 2:
Watershed Maps



Clear Creek Watersheds - Land Cover Type (Acres)


Allegheny National Forest
Millstone
Belltown
Clarion River
FOREST COUNTY
ELK COUNTY
SGL 44
SGL 54
949
Leeper Run
Pine Run
Phyllis Run
Little Clear Creek
Clear Creek State Forest
Clear Creek State Park
Clear Creek
Dry Run
Trap Run
Truby Run
English Run
Johns Run
Callen Run
JEFFERSON COUNTY
Clear Creek Watersheds - Overall Habitat Scores
Scores
Optimal 20 - 16
Suboptimal 15 - 10
Unassessed (See Notes)
Dry
Clarion River
Major Roads
Watershed Boundary
County Boundary
DCNR State Park
DCNR State Forest Land
PGC State Game Land
Allegheny National Forest
0 0.25 0.5 1 Miles
Western Pennsylvania Conservancy
FOREST
ELK
CLARION
JEFFERSON



Clarion River
Millstone
Belltown
FOREST COUNTY
ELK COUNTY
SGL 44
SGL 54
949
Leeper Run
Pine Run
Phyllis Run
Clear Creek State Park
Little Clear Creek
Clear Creek State Forest
Clear Creek
Dry Run
Trap Run
Callen Run
Johns Run
Truby Run
English Run
JEFFERSON COUNTY
Clear Creek Watersheds - LWM Presence
Stream LWD
Moderate
Minimal
NA
Clarion River
Major Roads
Watershed Boundary
County
DCNR State Park
DCNR State Forest Land
PGC State Game Land
Allegheny National Forest
0 0.25 0.5 1 Miles
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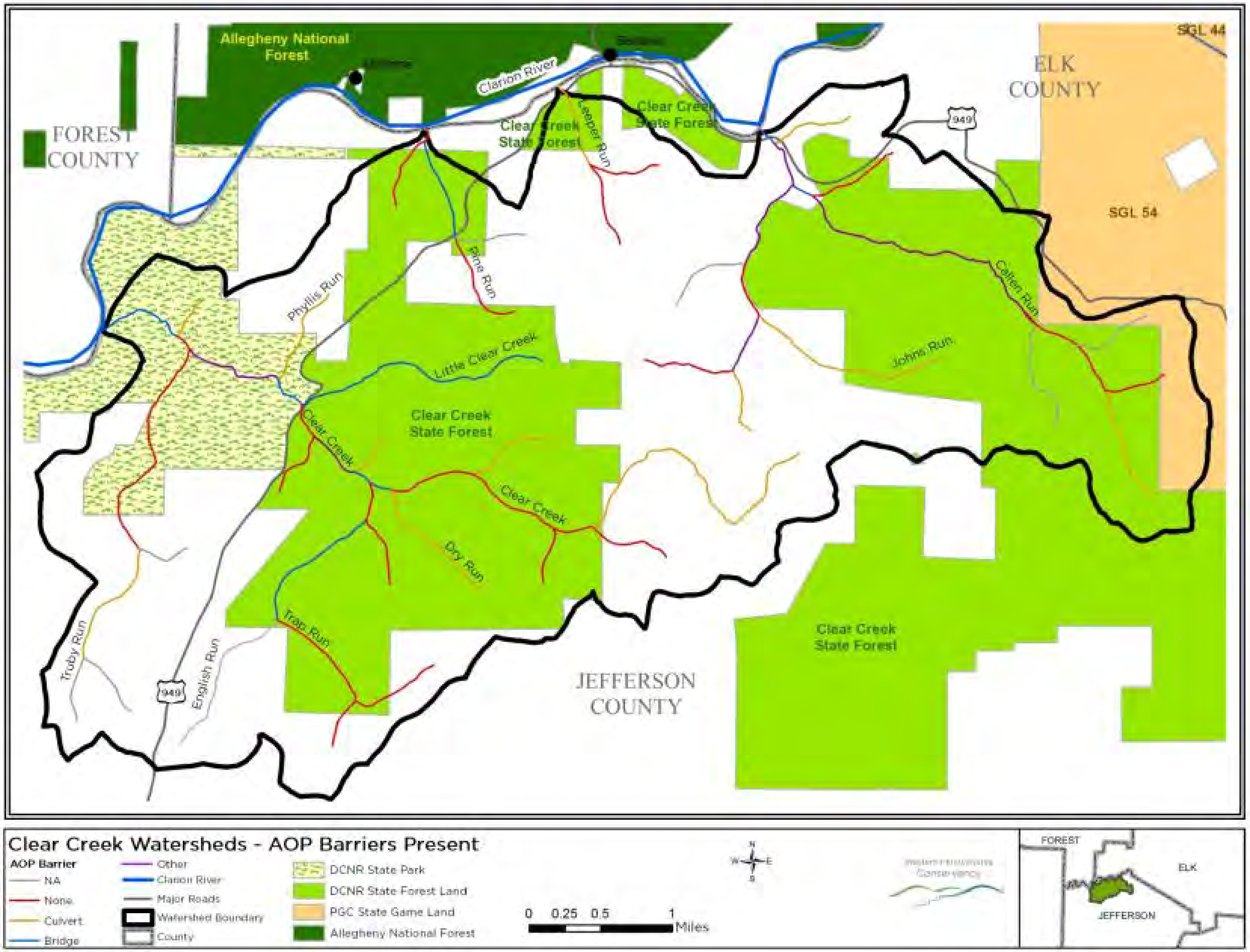
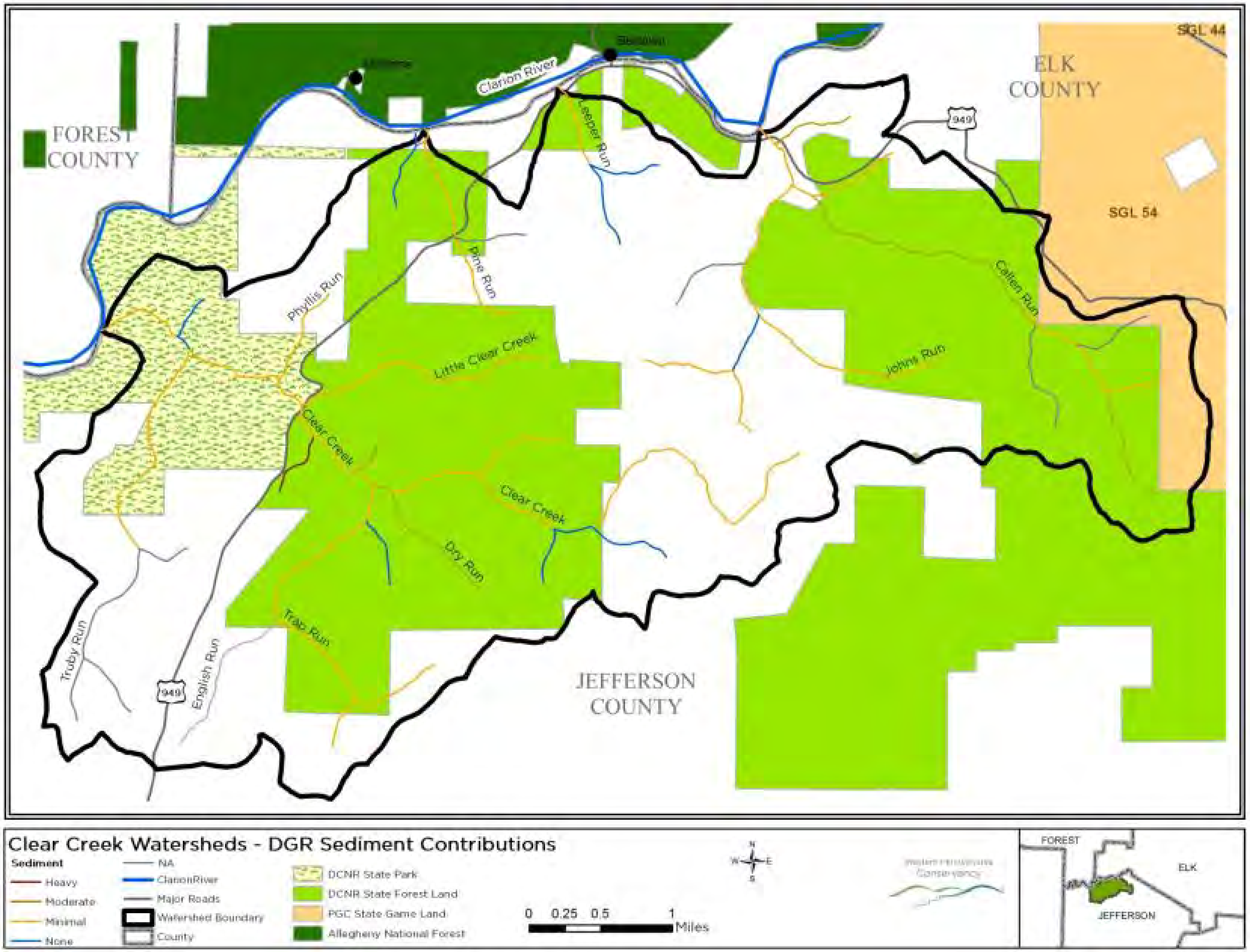
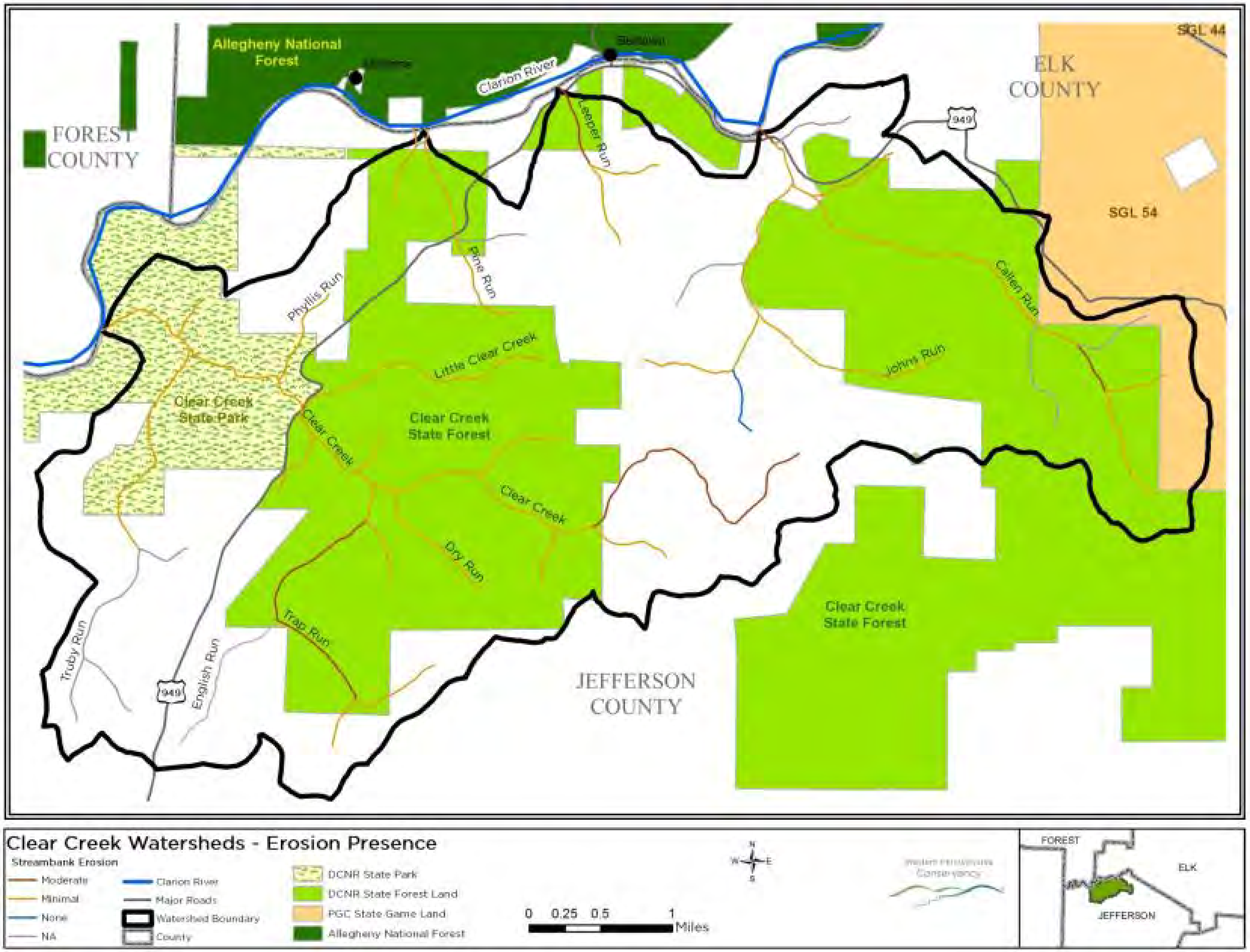
Western Pennsylvania Conservancy
FOREST
ELK
JEFFERSON


Allegheny National Forest
Clarion River
FOREST COUNTY
ELK COUNTY
SGL 44
SGL 54
949
Clear Creek State Forest
Leeper Run
Pine Run
Phyllis Run
Little Clear Creek
Clear Creek
Dry Run
Trap Run
Truby Run
English Run
Callen Run
Johns Run
JEFFERSON COUNTY
Clear Creek Watersheds - AOP Barriers Present
AOP Barrier
NA
None
Culvert
Bridge
Other
Clarion River
Major Roads
Watershed Boundary
County
DCNR State Park
DCNR State Forest Land
PGC State Game Land
Allegheny National Forest
0 0.25 0.5 1 Miles
FOREST
ELK
JEFFERSON


Clear Creek Watersheds - DGR Sediment Contributions
Sediment
Heavy
Moderate
Minimal
None
NA
ClarionRiver
Major Roads
Watershed Boundary
County
DCNR State Park
DCNR State Forest Land
PGC State Game Land
Allegheny National Forest
0 0.25 0.5 1 Miles
FOREST COUNTY
ELK COUNTY
JEFFERSON COUNTY
SGL 44
SGL 54
Clarion River
949
Leeper Run
Pine Run
Phyllis Run
Little Clear Creek
Clear Creek
Dry Run
Trab Run
English Run
Truby Run
Johns Run
Callen Run
FOREST
ELK
JEFFERSON


Allegheny National Forest
Clarion River
FOREST COUNTY
ELK COUNTY
SGL 44
SGL 54
949
Leeper Run
Pine Run
Phyllis Run
Callen Run
Little Clear Creek
Johns Run
Clear Creek State Park
Clear Creek State Forest
Clear Creek
Clear Creek
Dry Run
Trap Run
Truby Run
English Run
949
JEFFERSON COUNTY
Clear Creek State Forest
Clear Creek Watersheds - Erosion Presence
Streambank Erosion
Moderate
Minimal
None
NA
Clarion River
Major Roads
Watershed Boundary
County
DCNR State Park
DCNR State Forest Land
PGC State Game Land
Allegheny National Forest
0 0.25 0.5 1 Miles
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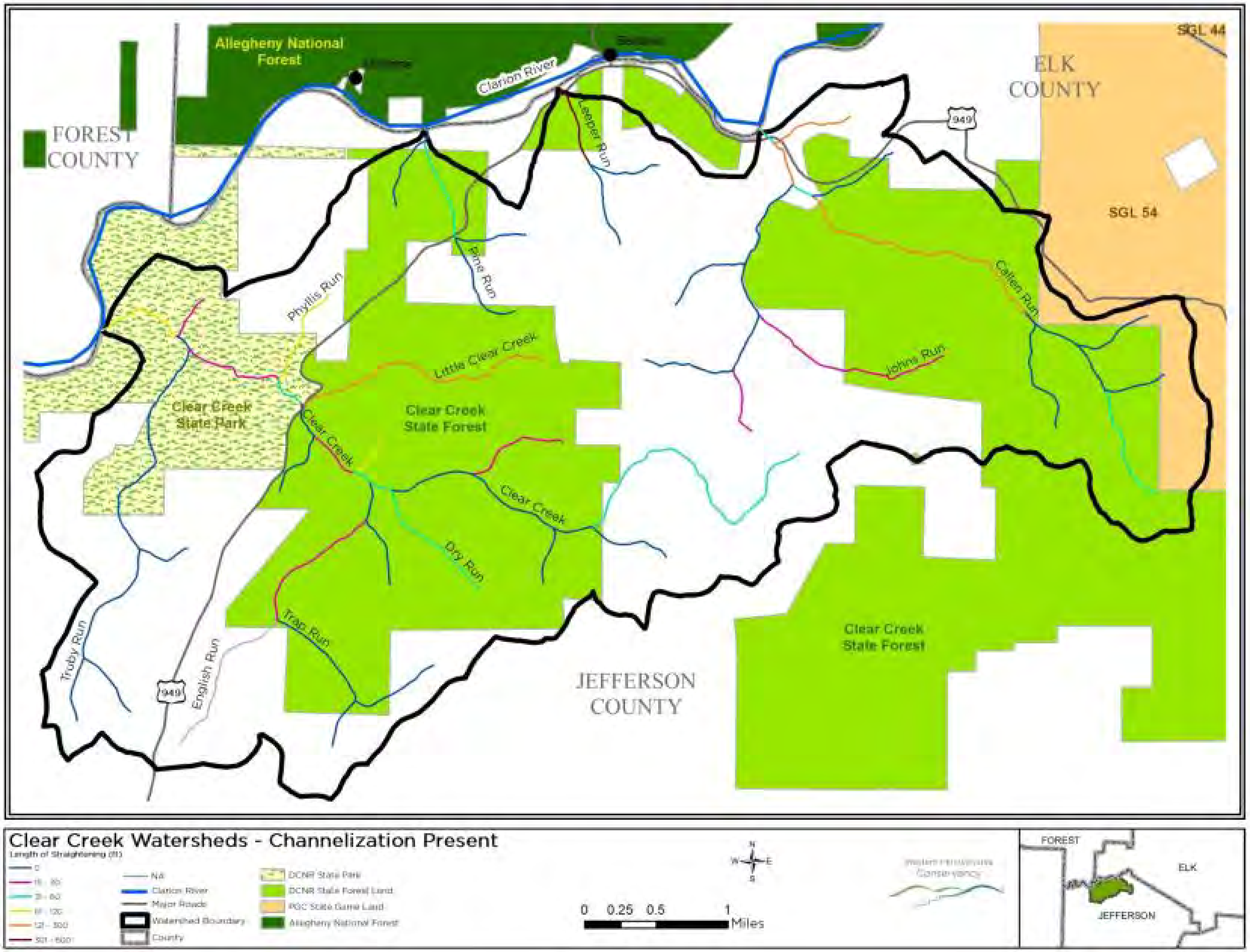
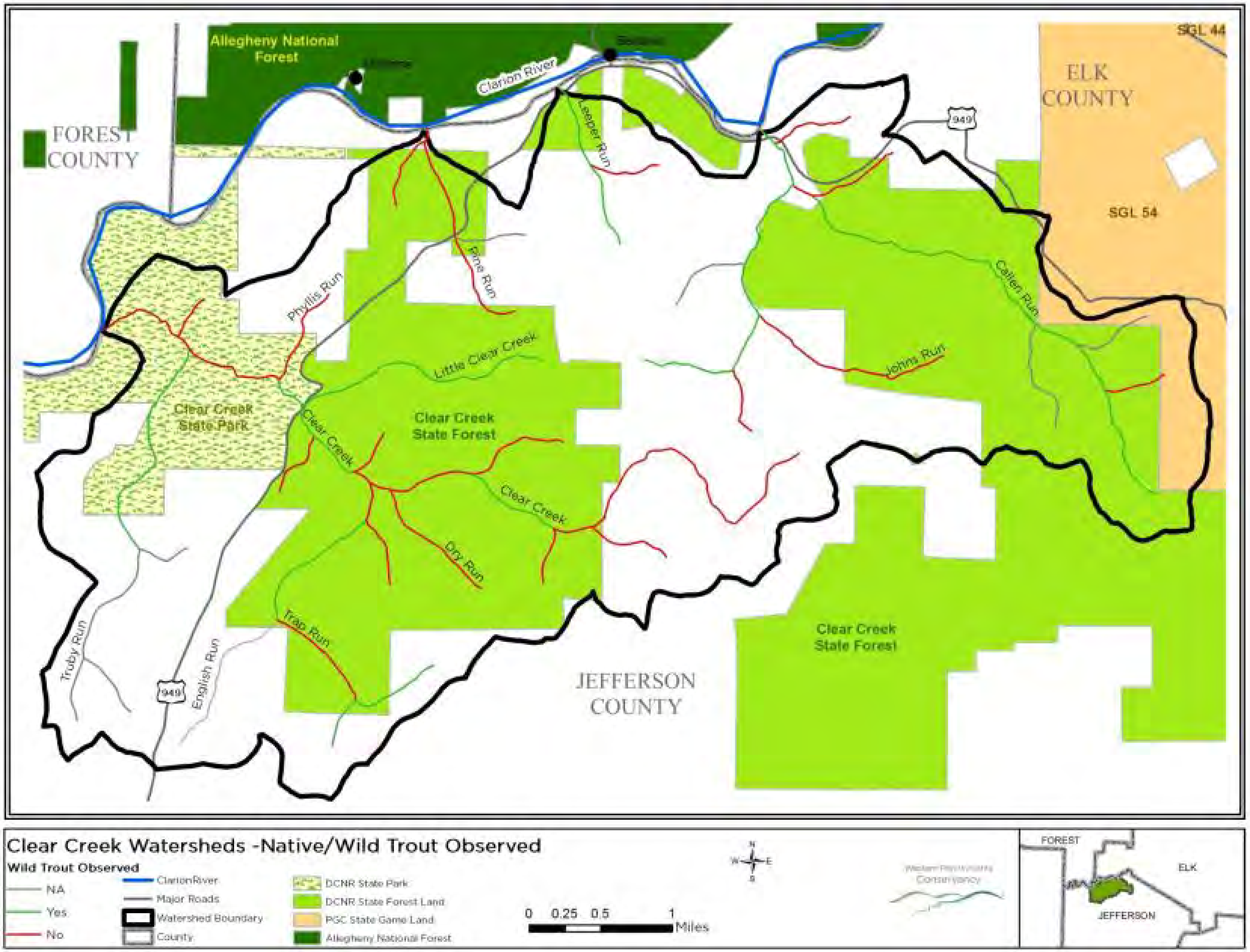
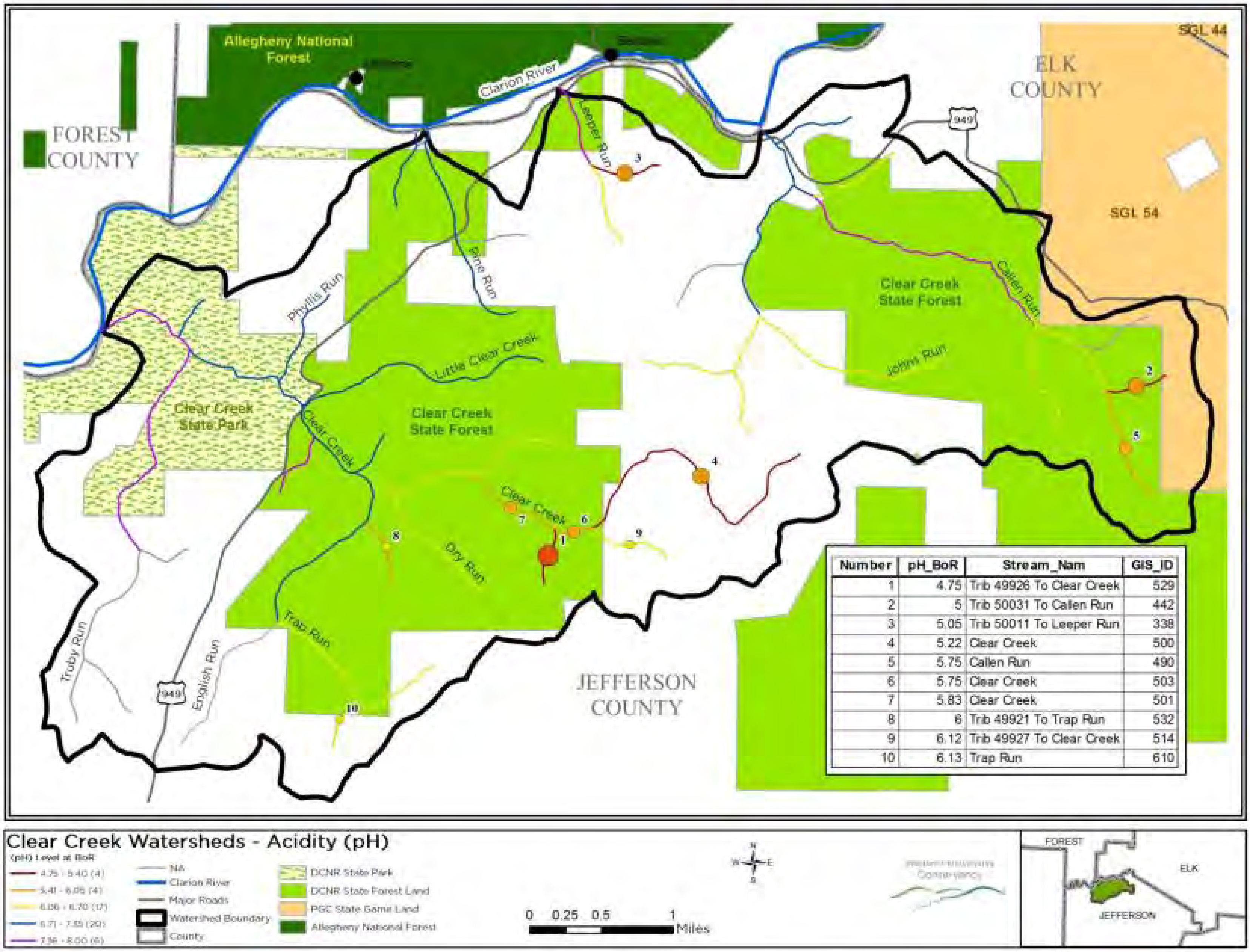
ELK
JEFFERSON

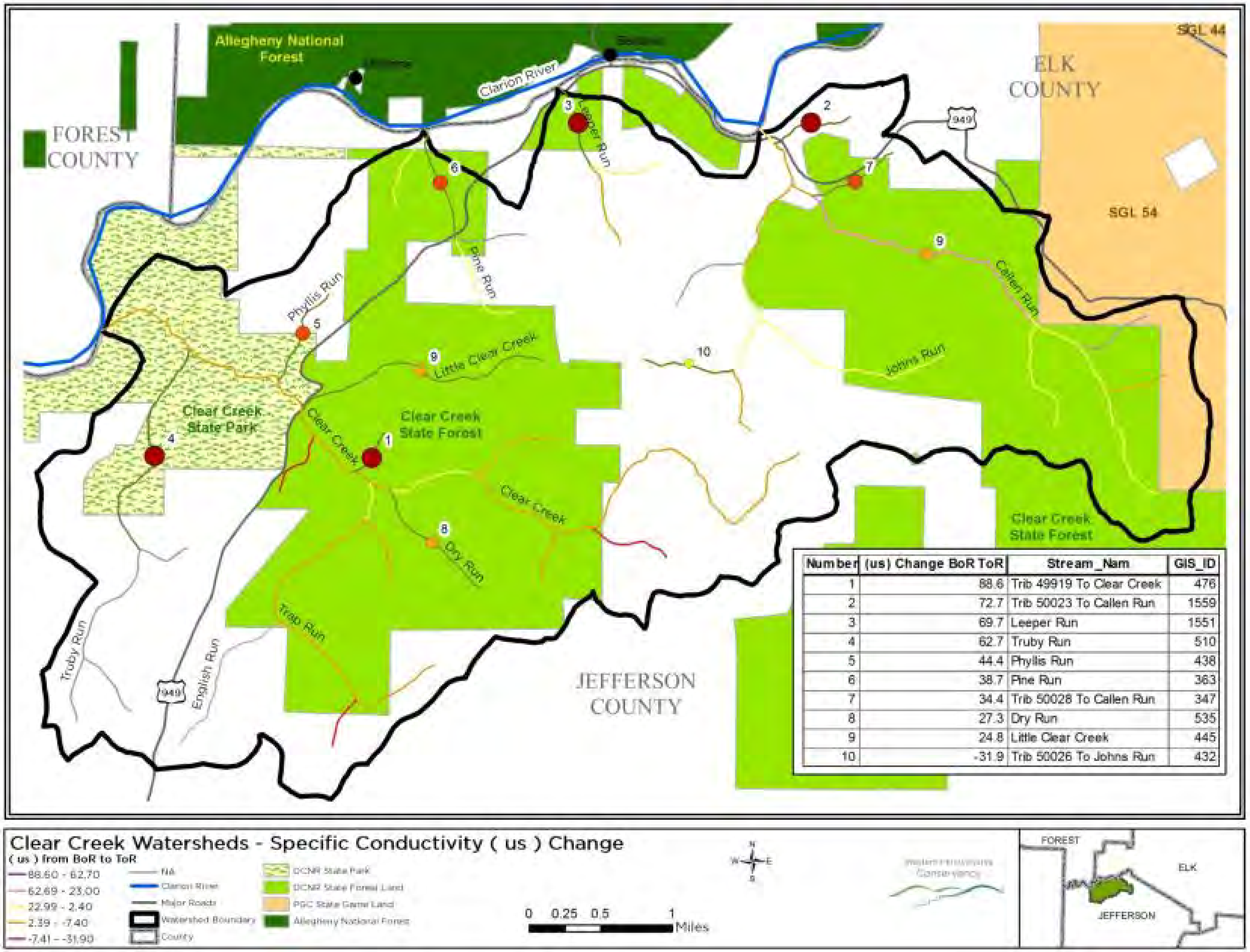


Allegheny National Forest
Clarion River
FOREST COUNTY
ELK COUNTY
SGL 44
SGL 54
949
Leeper Run
Pine Run
Phyllis Run
Little Clear Creek
Clear Creek State Park
Clear Creek State Forest
Clear Creek
Dry Run
Trap Run
English Run
Truby Run
Johns Run
Callen Run
JEFFERSON COUNTY
Clear Creek Watersheds - Channelization Present
Length of Straightening (ft)
NA
Clarion River
Major Roads
Watershed Boundary
County
DCNR State Park
DCNR State Forest Land
PGC State Game Land
Allegheny National Forest
0 0.25 0.5 1 Miles
FOREST
ELK
JEFFERSON

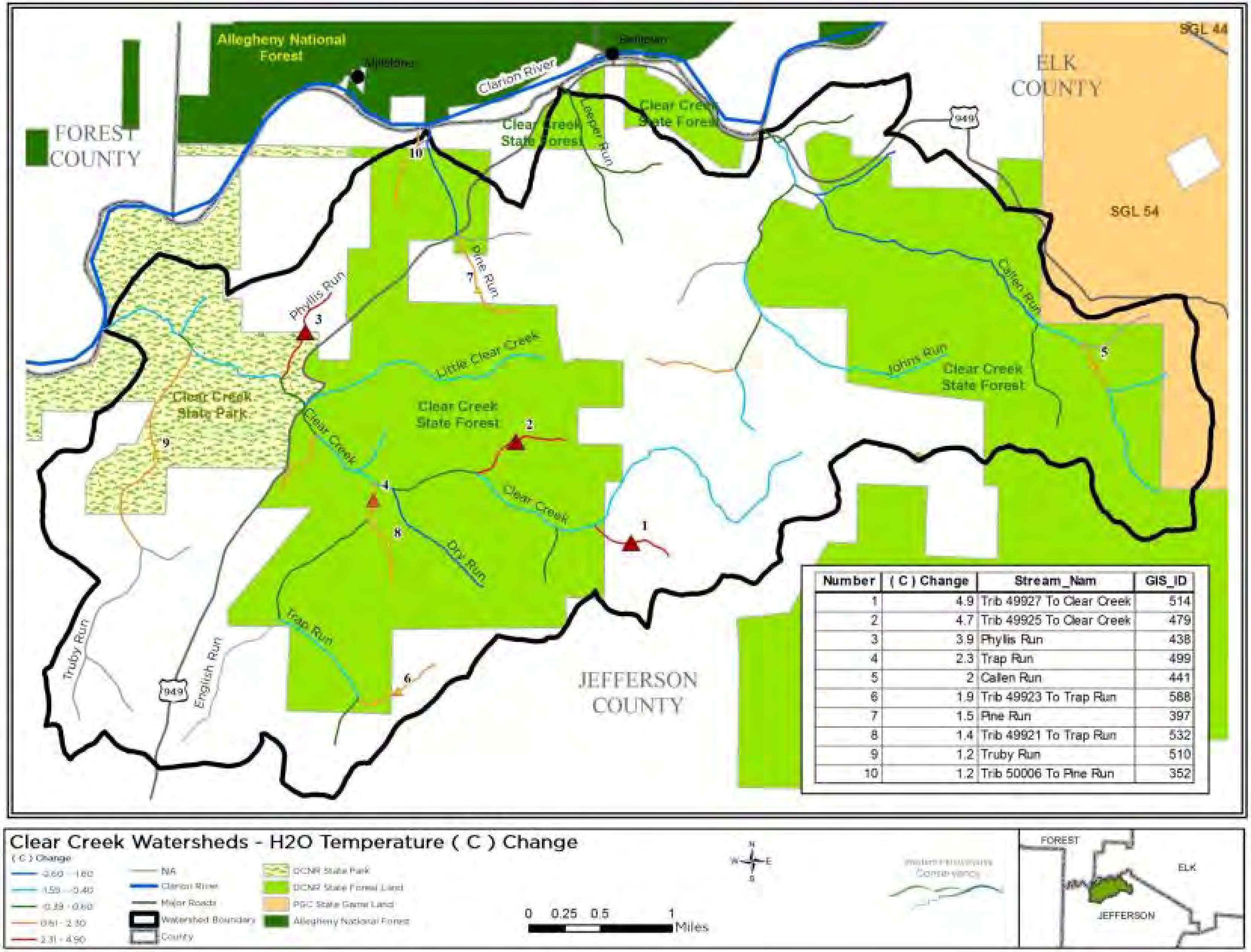

Allegheny National Forest
Clarion River
FOREST COUNTY
ELK COUNTY
SGL 44
SGL 54
949
Leeper Run
Pine Run
Phyllis Run
Little Clear Creek
Clear Creek State Park
Clear Creek State Forest
Clear Creek
Clear Creek
Dry Run
Trap Run
Callen Run
Johns Run
Truby Run
English Run
949
JEFFERSON COUNTY
Clear Creek State Forest
Clear Creek Watersheds -Native/Wild Trout Observed
Wild Trout Observed
NA
Yes
No
ClarionRiver
Major Roads
Watershed Boundary
County
DCNR State Park
DCNR State Forest Land
PGC State Game Land
Allegheny National Forest
N
W
E
S
0 0.25 0.5 1
Miles
Western Pennsylvania Conservancy
FOREST
ELK
JEFFERSON



Number	pH_BoR	Stream_Nam	GIS_ID
1	4.75	Trib 49926 To Clear Creek	529
2	5	Trib 50031 To Callen Run	442
3	5.05	Trib 50011 To Leeper Run	338
4	5.22	Clear Creek	500
5	5.75	Callen Run	490
6	5.75	Clear Creek	503
7	5.83	Clear Creek	501
8	6	Trib 49921 To Trap Run	532
9	6.12	Trib 49927 To Clear Creek	514
10	6.13	Trap Run	610



Number	(us) Change BoR ToR	Stream_Nam	GIS_ID
1	88.6	Trib 49919 To Clear Creek	476
2	72.7	Trib 50023 To Callen Run	1559
3	69.7	Leeper Run	1551
4	62.7	Truby Run	510
5	44.4	Phyllis Run	438
6	38.7	Pine Run	363
7	34.4	Trib 50028 To Callen Run	347
8	27.3	Dry Run	535
9	24.8	Little Clear Creek	445
10	-31.9	Trib 50026 To Johns Run	432



Number	(C) Change	Stream_Nam	GIS_ID
1	4.9	Trib 49927 To Clear Creek	514
2	4.7	Trib 49925 To Clear Creek	479
3	3.9	Phylis Run	438
4	2.3	Trap Run	499
5	2	Callen Run	441
6	1.9	Trib 49923 To Trap Run	588
7	1.5	Pine Run	397
8	1.4	Trib 49921 To Trap Run	532
9	1.2	Truby Run	510
10	1.2	Trib 50006 To Pine Run	352

Appendix 3:
Standard Data Forms

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (FRONT)

STREAM NAME	**SEGMENT ID**
GIS ID # __________	**STREAM CLASS**
LAT ______________ **LONG** ______________	**RIVER BASIN**
STORET # N/A	**AGENCY** Western Pennsylvania Conservancy
INVESTIGATORS	

FORM COMPLETED BY	**DATE** ___________________ **TIME** __________ **AM PM**	**REASON FOR SURVEY**

WEATHER CONDITIONS	**Now** ☐ clear/sunny ☐ storm (heavy rain) ☐ rain (steady rain) ☐ showers (intermittent) ☐ % cloud cover (circle %) 25% - 50 % - 75% - 100%	**Past 24 hours** ☐ clear/sunny ☐ storm (heavy rain) ☐ rain (steady rain) ☐ showers (intermittent) ☐ % cloud cover (circle %) 25% - 50 % - 75% - 100%	**Has there been a heavy rain in the last 7 days?** ☐ Yes ☐ No **Air Temperature** _____ °F **Other**_______________________________

FEATURES of NOTE:

Describe significant features and/or impacts seen in section. Include GPS points when applicable

Latitude (North)	Longitude (West)

☐ Check box if stream is dry and record any significant info about section.

HABITAT IMPROVEMENT OPPORTUNITIES:

☐ Segment has need for improvement project(s)

Describe:

Recommendation(s):

Segment Accessibility:

☐ Excellent ☐ Good ☐ Poor ☐ In-Accessible – Describe:____

STREAM CHARACTERIZATION

Stream Subsystem
☐ Perennial ☐ Intermittent

Stream Type
☐ Main Stem ☐ Named Tributary
☐ Unnamed Tributary ☐
☐ Headwater UNT ☐ Other ________

Stream Type
☐ Coldwater ☐ Warmwater

WATERSHED FEATURES (with in 30 meter buffer)	**Predominant Surrounding Land-Use** (Must = 100%) ☐ Forest ____% ☐ Field/Pasture ____% ☐ Agricultural ____% ☐ Open space (i.e., parks/golf courses) ____% ☐ Commercial/Industrial ____% ☐ Residential ____% ☐ Paved Roads ____% ☐ Dirt and Gravel Roads ____% (TWP, Gas & Logging) ☐ Rail Line ____% ☐ Wetland ____% ☐ Other _______________ ____% **Stormwater Inputs** ☐ None ☐ Tile Drain ☐ Road Ditch ☐ Urban Stormwater Pipe ☐ Field Ditch ☐ Overland Flow **D&GR Sediment Contribution (Runoff)**: ☐ None ☐ Minimal ☐ Moderate ☐ Heavy **Bank revetments:** ☐ None ☐ Rip-rap ☐ Gabion ☐ Concrete ☐ Other ________
VEGETATION INFORMATION **NOTE: Bank side determined when facing DOWN Stream**	**Riparian Zone Width** **Riparian Zone Encroachment** ☐ Yes ☐ No Right Bank: ☐ 0 – 15 feet ☐ 16 – 50 feet ☐ 51 – 150 feet ☐ 150 – 300 feet ☐ Greater than 300 feet Left Bank: ☐ 0 – 15 feet ☐ 16 – 50 feet ☐ 51 – 150 feet ☐ 150 – 300 feet ☐ Greater than 300 feet **Indicate dominant vegetation type within riparian zone (~18 meter buffer),and record dominant species present:** ☐ Trees ☐ Shrubs ☐ Grasses ☐ Herbaceous ☐ Invasive - Dominant species present:____________________________ **Bank Canopy Vegetation:** Left Bank ☐ 100% (Shaded) ☐ 75% ☐ 50% ☐ 25% ☐ 0% (No Cover) Right Bank ☐ 100% (Shaded) ☐ 75% ☐ 50% ☐ 25% ☐ 0% (No Cover) **Channel Canopy:** ☐ Open ☐ Closed **Presence of Large Woody Debris (LWD):** ☐ Significant ☐ Moderate ☐ Minimal ☐ None **Presence of aquatic vegetation:** ☐ None ☐ Normal ☐ Excessive - Describe:___________________________________
INSTREAM FEATURES	**Average Stream Width** _________ ft. **Active Streambank Erosion for Segment** ☐ None ☐ Minimal ☐ Moderate ☐ Heavy **Surface Velocity:** ☐ Slow ☐ Moderate ☐ Fast **Flow Status:** ☐ Low ☐ Moderate ☐ High **Springs/Seeps:** ☐ Abundant ☐ Minimal ☐ None **Adjacent Wetlands:** ☐ Abundant ☐ Minimal ☐ None **Proportion of Stream Morphology Types** ☐ Riffle_______% ☐ Run_______% ☐ Pool_______% **Average Number of Riffles in section** _______________ **Channelization** ☐ No ☐ Yes: Length of Straitening ____ft. **Dam Present (Beaver or Human)** ☐ Yes ☐ No **Constrictions Present :** ☐ None ☐ Culvert ☐ Bridge ☐ Old Abutment ☐ Bedrock Outcrop ☐ Other _________ **Stream Ford or Animal Crossing Present** ☐ Yes ☐ No **Debris Jam Present** ☐ Yes ☐ No **Connectivity to Flood Plain** (Zero percent equals not connected to flood plain) Right Bank: ☐ 100% ☐ 75% ☐ 50% ☐ 25% ☐ 0% Left Bank: ☐ 100% ☐ 75% ☐ 50% ☐ 25% ☐ 0%
WATER QUALITY **(During visual assessment use pH and conductivity meters to take reading.)** **WQ Instrument(s) Used** _______________ _______________	**pH ________ (Top of section) H2O Temp ________(Top)** **pH________(Bottom of section) °F or C ________(Bot.)** **Specific Conductance (Top)________ (Bottom)________** **Turbidity (if not measured)** ☐ Clear ☐ Slightly turbid ☐ Turbid ☐ Opaque ☐ Stained ☐ Other______ **Water Odors** ☐ Normal/None ☐ Sewage ☐ Petroleum ☐ Chemical ☐ Fishy ☐ Other___________ **Water Surface Oils** ☐ Slick ☐ Sheen ☐ Globs ☐ Flecks ☐ None ☐ Other________________________ **Overall Water Quality** ☐ Excellent ☐ Good ☐ Fair ☐ Poor **Primary source(s) of water quality impact** ☐ Agriculture ☐ Active Pasture ☐ AMD ☐ Gas Wells ☐ Development ☐ Sewage ☐ Bank Erosion ☐ Sedimentation

INORGANIC SUBSTRATE COMPONENTS (should add up to 100%)		
Substrate Type	**Diameter**	**% Composition in Sampling Reach**
Bedrock		
Boulder	> 256 mm (10")	
Cobble	64-256 mm (2.5"-10")	
Gravel	2-64 mm (0.1"-2.5")	
Sand	0.06-2mm (gritty)	
Silt	0.004-0.06 mm	
Clay	< 0.004 mm (slick)	

Additional Notes

WT Observed? Y or N **Coord. of Obs.:**

HABITAT ASSESSMENT FIELD DATA SHEET – HIGH GRADIENT STREAMS (FRONT)

STREAM NAME	GIS ID # __________
SEGMENT ID	STREAM CLASS
LAT ______________ LONG ______________	RIVER BASIN
STORET # N/A	AGENCY Western Pennsylvania Conservancy
INVESTIGATORS	
FORM COMPLETED BY	DATE ____________________ TIME __________ AM PM
	REASON FOR SURVEY Visual Assessment

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate & Available Cover	Greater than 70% (50% for low gradient streams) of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% (30-50% for low gradient streams) mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% (10-30% for low gradient streams) mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% (10% for low gradient streams) stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE ___	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
SCORE ___	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Velocity/ Depth Regimes	All 4 velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (slow is <0.3 m/s, deep is >0.5 m).	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
SCORE ___	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% (<20% for low-gradient streams) of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% (20-50% for low-gradient) of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% (50-80% for low-gradient) of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% (80% for low-gradient) of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE ___	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE ___	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

HABITAT ASSESSMENT FIELD DATA SHEET – HIGH GRADIENT STREAMS (BACK)

Habitat Parameter	Condition Category			
	Optimal	**Suboptimal**	**Marginal**	**Poor**
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr.) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE ___	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Frequency of Riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
SCORE ___	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8. Bank Stability (score each bank) **Note: determine left or right side by facing downstream**	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank) **Note: determine left or right side by facing downstream**	More than 90% of the streambank surfaces and immediate riparian zones covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

Total Score ________

HABITAT ASSESSMENT SCORE SHEET
HIGH GRADIENT STREAM

STREAM NAME	SEGMENT ID	
GIS ID # __________	STREAM CLASS	
LAT ______________ LONG ______________	RIVER BASIN	
STORET # N/A	AGENCY Western Pennsylvania Conservancy	
INVESTIGATORS		
FORM COMPLETED BY	DATE ___________________ TIME _________ AM PM	REASON FOR SURVEY Visual Assessment

Habitat Parameter	Score	Explanation of Score Given *(Complete especially for poor rating)*	
1. Epifaunal Substrate /Available Cover			
2. Embeddedness			
3. Velocity/ Depth Regimes			
4. Sediment Deposition			
5. Channel Flow Status			
6. Channel Alteration			
7. Frequency of Riffles (or bends)			
8. Bank Stability **(score each bank)** ***Note: determine left or right side by facing downstream***	Total of LB & RB	**(LB)**	
		(RB)	
9. Vegetative Protection **(score each bank)** ***Note: determine left or right side by facing downstream***	Total of LB & RB	**(LB)**	
		(RB)	
10. Riparian Vegetative Zone Width **(score each bank riparian zone)**	Total of LB & RB	**(LB)**	
		(RB)	
Total Score		**Add all scores and divide by the number of scores given.**	

Appendix 4:
Permitted Discharges

NPDES ID	Permit Name	Effective Date	Expiration Date	Receiving Waters	County Name	Curr. Major Minor Status	Total App. Design Flow (MGD)	Facility Name
PA0104191	NATL FUEL GAS SUPPLY CORP	4/1/2012	3/31/2017	UNT To Callen Run	Jefferson	Minor	0.007	NATL FUEL GAS HEATH STA
PA0240001	PA DCNR Bureau of State Parks	6/1/201	5/51/2023	Clarion River	Jefferson	Minor	<0.05	Clear Creek State Park

National Fuel Gas Permit available to view at:
http://files.dep.state.pa.us/Water/Wastewater%20Management/eDMRPortalFiles/Permits/PA0104191.3.Final.12-20-2011_14517_v1.pdf

Clear Creek State Park Permit available to view at:
http://files.dep.state.pa.us/Water/Wastewater%20Management/EDMRPortalFiles/Permits/PA0240001_NPDES_PERMIT_20180502_Final_V5.pdf