APPENDIX D

STUDY REPORTS

Lake Lynn Hydroelectric Project (FERC No. 2459)

Desktop Fish Entrainment Assessment

Prepared For

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December 2020

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1 Introduction

Lake Lynn Hydro, LLC (Lake Lynn or Licensee) is in the process of relicensing the 51.2-megawatt (MW) Lake Lynn Hydroelectric Project (Project) (FERC No. 2459) with the Federal Energy Regulatory Commission (FERC or Commission). The Project is located on the Cheat River in Monongalia County, West Virginia and Fayette County, Pennsylvania. The current license for the Project expires November 30, 2024.

In an August 29, 2019 filing, the licensee submitted their Pre-Application Document (PAD), and their Notice of Intent (NOI) to seek a new license for the Project. In the same filing, the licensee also requested to use FERC's Traditional Licensing Process (TLP). The Licensee distributed the PAD and NOI simultaneously to Federal and state resource agencies, local governments, Native American tribes, members of the public, and others thought to be interested in the relicensing proceeding. In October 2019, FERC approved the use of the TLP. Following approval, Lake Lynn held a Joint Agency Meeting and site visit in December 2019. Following the Joint Meeting and Site Visit, resource agencies and other stakeholders were afforded the opportunity to comment on the PAD and to request resource studies that they deemed were needed to evaluate Project impacts on natural, cultural and recreational resources.

In response to the NOI/PAD filing and the Joint Meeting and Site Visit, Lake Lynn received written comments and study requests from the U.S. Fish and Wildlife Service (USFWS), West Virginia Division of Natural Resources (WVDNR), Cheat Lake Environment and Recreation Association (CLEAR), Friends of the Cheat (FOC), Monongahela River Trails Conservancy (MRTC), and individual residents in the local community.

Based on the comments received, Lake Lynn developed and distributed a draft Study Plan to the resource agencies and stakeholders on April 15, 2020 for review. Lake Lynn held a conference call/meeting on April 24, 2020 to review and discuss the draft Study Plan. The draft Study Plan has been revised based on the discussions and a Revised Study Plan (RSP) was issued in May 2020. As Lake Lynn is utilizing the TLP, there is no requirement to prepare a formal study plan document as is required in the Integrated Licensing Protocol (ILP), and therefore, there is no subsequent study plan determination by FERC. Nonetheless, Lake Lynn prepared the RSP distributed in May 2020 to document and share with resource agencies and stakeholders its plans for conducting resource studies and ongoing monitoring efforts in 2020 to inform the relicensing process.

This report was prepared on behalf of Lake Lynn to address the Desktop Fish Entrainment Assessment detailed in Section 3.1 of the RSP. The Desktop Fish Entrainment Assessment was requested by the USFWS and WVDNR to estimate the number of fish that are either entrained or impinged by Project operation and the associated rate of injury and mortality for fish that pass through the turbines during Project operation.

2 Study Goals and Scope

2.1 Goals

The goals of this study were to:

1) Conduct a desktop assessment of the potential for impingement/entrainment of selected target fish species at Lake Lynn, and
2) Prepare a quantitative desktop estimate of the numbers of fish entrained at the Project.

2.2 Scope

This Desktop Fish Entrainment Assessment provides the following:

- A description of the Project reservoir, intake structure, turbine units, and seasonal operational regime;
- A summary of available fisheries information historically collected in the Cheat River upstream of the Project;
- An overview of the life history and habitat requirements for target fish species;
- An assessment of impingement and entrainment potential as a function of (1) the existing rack spacing, (2) calculated approach velocities, (3) the physical dimensions of target fish species, and (4) the swim capabilities (i.e., burst speed) of target fish species;
- A review of information contained in the 1997 Electric Power Research Institute (EPRI) database to provide a summary of (1) the size class composition of target fish species, (2) entrainment densities of target fish species, and (3) calculated survival rates of target species for the subset of hydroelectric projects comparable to the Project;
- The calculation of site-specific turbine passage survival rates for target fish species using the USFWS Turbine Blade Strike Analysis Tool (TBSA); and
- The use of seasonal species/size class-specific entrainment densities from comparable projects and project-specific discharge volumes to generate estimates of numbers of fish entrained at the Project.

3 Methods

This study addresses the qualitative classification of impingement, entrainment, and the probability of turbine passage survival at the Project using a review of relevant biological criteria and physical Project characteristics for seven fish species of interest. Factors that can influence the potential for impingement or entrainment at a hydropower project include structural characteristics such as the size and depth of the intake structure, the velocity of water as it enters the intake structure, the location of the intake structure relative to fish habitat, and the biological and behavioral characteristics (e.g., size, movement or migration

patterns, and habitat preferences) of the specific life stages of fish species of interest. The likelihood of impingement is also highly dependent on the physical features and water velocities found at or near the trash racks along with species-specific physiological capabilities (i.e., swim speed). Turbine survival rates are primarily affected by engineering factors such as the amount of head differential of a turbine, its number of blades, rotational speed, hydraulic capacity, and the length of an entrained fish.

In addition to the previously described qualitative entrainment assessment for the Project, a quantitative estimate of entrainment during generation at the Project was performed. The resulting entrainment estimates were then be combined with modeled and empirical based survival rates for fish passing through the Project turbine units. In the absence of site-specific entrainment data during generation at the Lake Lynn Project, the quantitative estimate developed as part of this desktop assessment relied on a combination of site-specific operations data and fish entrainment rates available from similar hydropower dams. Quantitative estimates of entrainment at the Project were calculated for all target fish species for which density data could be obtained from, the EPRI entrainment database. As a result, quantitative estimates of the entrainment totals for six of the target species and one surrogate species at the Lake Lynn Project are presented in this report.

3.1 Project Impoundment, Intake, and Turbine Description

The first step in the evaluation of the potential for fish impingement and entrainment was to describe the physical features of the impoundment, intake structure, and turbine units that will affect entrainment, impingement and turbine passage survival. Where possible, Project features and dimensions were obtained from available engineering drawings and written descriptions of the Project.

3.2 Life History and Habitat Requirements of Target Fish Species

A description of the life history, habitat requirements, and behavior of fish species was compiled to determine the likelihood of presence near the Project intakes and to evaluate entrainment potential. The “Traits Based Assessment” of Čada and Schweizer (2012) was used to qualitatively assess the potential entrainment risk for fish species, which considers each species’ primary location within the Project, preferred habitat, local movements and reproductive strategy. Species-specific behavioral requirements determine if and when a given life stage interacts with intake operation. The potential for each species to be susceptible to entrainment can be determined based on their life history characteristics in relation to the location of the Project’s intake structure.

Categories of entrainment potential based on the likelihood that a fish species/life stage will be located near the intake structures are described as:

- None - species/life stage (e.g., adult, spawning, or juvenile) are not known to prefer the habitat near the intake structures
- Minimal - species may only occasionally be found occupying the habitat near the intake structures

- Moderate - species routinely or seasonally found occupying the habitat near the intake structures
- High - species likely to be found occupying the habitat near the intake structures

3.3 Entrainment Potential of Target Fish Species

The distance between bars on a trash rack (i.e., clear spacing) can affect the likelihood of an individual fish being excluded from moving through the trash rack and entering the turbine intakes. Fish species and life stages with a body width greater than the clear spacing are physically excluded from passing through a trash rack and becoming entrained. Proportional estimates of body width to total length (scaling factor) were compiled by Smith (1985) for the identified target species. This scaling factor was then used to determine the minimum length of each species excluded from the intake by the trash racks at each of the Project intakes (Table 3-1). The clear spacing values were divided by the scaling factors to calculate the minimum length for each target species that would be excluded at the Project.

3.4 Electric Power Research Institute (EPRI) Database Review

The Electric Power Research Institute (EPRI) 1997 entrainment database provides results from entrainment field studies conducted at 43 hydroelectric facilities east of the Mississippi River using full-flow tailrace netting. The database contains site characteristics of each of these facilities, as well as the total number of individuals of each species collected at each of the sites. The species counts are separated into variable size classes ranging from 2 to 30 inches.

A comparison of the EPRI entrainment database was made to provide a literature based assessment to compare with potential entrainment at the Project. To do so, the EPRI database was filtered for characteristics that match or are within a comparable range to those found at the Project which included the following:

- Trash rack clear spacing between 1.75 and 5.5 inches;
- Total powerhouse hydraulic capacities between 1300 and 6600 cfs;
- Plants operated in run-of-river mode or peaking facilities; and
- Target or surrogate fish species.

Collection totals from the set of comparable projects were summarized by the size classes provided in the database for the target species (or a closely related surrogate). In addition, the size class composition of the total number collected was summarized for each target species.

3.5 Impingement Potential of Target Fish Species

The ability for an individual fish to avoid being impinged or entrained at a powerhouse intake often depends on its swimming performance (Castro-Santos and Haro 2005). The swimming performance is directly related to the size of an individual fish; however, the swimming capability also varies among species based on morphological differences. Although there is no standard method that defines how swimming performance is measured, three commonly used definitions or types of swim speed are described in the scientific body of literature for fish

(Katopodis and Gervais 2016). The three swim speed types, cruising, prolonged, and burst, are described as the following:

- Cruising or sustained swim speeds can be maintained indefinitely (Bain and Stevenson 1999);
- Prolonged swim speeds can be maintained between 5 and 8 minutes (Bain and Stevenson 1999); and
- Burst (also called startle, darting or sprint) swim speeds can be maintained for less than 20 seconds (Beamish 1978).

Burst swim speeds were used to assess if a fish can adequately escape involuntary impingement or entrainment. If a fish has a greater burst swim speed than the turbine intake approach velocity, it is capable of moving away from the intake flow field to avoid interaction. To assess swimming capabilities for the target fish species of interest, burst swim speeds were compiled from the available scientific literature.

To ascertain whether or not a certain size fish of a particular species is likely to be impinged or entrained, the burst swim speeds were compared to the calculated approach velocity of the intake trash racks at the maximum hydraulic capacity of the Project. The approach velocity at the Project intake was calculated using the velocity equation:

$$Q = V * A$$

Where:

$\mathrm{Q} = \text{flow rate (cfs)}$

$\mathrm{V} = \text{approach velocity (fps); and}$

$\mathrm{A} = \text{area (square feet)}$

Fish species and sizes whose burst swim speeds are less than the approach velocity at the Project intake are likely to be impinged at the trash racks if their body widths are greater than the trash rack spacing. If the body width of a fish is less than the trash rack spacing and its burst swim speed is less than the approach velocity, it is likely to be entrained.

3.6 Turbine Survival Evaluation

To estimate survival of fish that entrain and pass through turbines at the Project, theoretical predictions were used to estimate a survival rate using a blade-strike model developed by the Department of Energy (Franke et al. 1997) that uses various turbine, fish and operations characteristics of a hydroelectric project to calculate a turbine blade strike and survival probability. This model was further modified by the United States Fish and Wildlife Service which produced the Turbine Blade Strike Analysis (TBSA) model that determines the fraction of a population of fish that are killed by blade strike passing through a hydroelectric project (Towler and Pica 2018). TBSA creates a normally distributed population of fish described by its

number, mean length, and standard deviation of length that are routed through hazards at a hydroelectric project, e. g., a turbine. Monte Carlo simulations are performed to determine the percentage of individuals subjected to turbine blade strike. The blade strike probabilities are based on the Project turbine specifications and calculated using methods outlined in Franke et al. (1997). The probability of blade strike in the model is based on several factors, including the number of runner blades, fish length, runner blade speed, turbine type, runner diameter, turbine efficiency, and total discharge. These factors are inputs into the model which predicts survival for a fish of any species at a designated length. Table 3-2 lists the turbine specifications used as input into the TBSA model which was used to predict turbine passage survival estimates up to the maximum lengths (rounded to whole inch) of each target fish species that could entrain through the existing trash rack spacing at the Project. Lastly, the TBSA model simulations were run using a correlation factor of 0.2 which is the recommended conservative value (Towler and Pica 2018).

3.7 Electric Power Research Institute (EPRI) Turbine Survival Database Review

Similar to the comparison of the EPRI entrainment database review, the EPRI 1997 turbine survival database was reviewed to provide an equitable literature-based comparison of the turbine survival estimates calculated for the Project. To do so, the EPRI database was filtered for characteristics that match or are similar to those found at Lake Lynn. The following are the characteristics selected from the database for comparison to the Project:

- Francis turbines;
- Head rating similar to 81.5 ft;
- Hydraulic capacity rating equal to or less than 10,143 cfs; and
- Target or surrogate fish species.

The immediate, 24-hour, and 48-hour, and control survival estimates were selected, if available, as they provided the greatest range of time difference post-turbine passage for each species.

3.8 Qualitative Assessment of Entrainment and Turbine Survival Potential

Data collected during the literature review and site-specific evaluation process (i.e., habitat and life history, swim speeds, and turbine survival model estimates) were used to compile a qualitative assessment of the potential entrainment of target fishes. The qualitative assessment used a multi-step rank of:

- High (H)
- Moderate (M)
- Low (L)

Desktop impingement and entrainment assessments assigned an overall entrainment potential rank to each member of the suite of target species considered based on consideration of habitat and life history, swim speed relative to intake velocity, and minimum exclusion lengths relative to trash rack spacing. In general, fish with life history attributes that include obligatory downstream migration are given a rating of ‘High’, while those with juvenile life history stages

placing them in the vicinity of the intakes or as adults with swim speeds not necessarily greater than the approach velocity are labeled as 'Moderate' risk. Species with life history attributes that generally keep them away from the intakes or fish that had a burst swim speed greater than the intake velocity are listed as a 'Low' risk for entrainment. In relation to swim speed, regardless of life stage, fish are considered 'High' risk if the maximum burst speed does not exceed the intake velocity, 'Moderate' risk if the intake velocity falls within the range of burst swim speed, and 'Low' risk if the burst swim speed completely exceeded the intake velocity.

The entrainment potential classification for trash rack spacing depended on the minimum body length exclusion results. If the minimum exclusion length for the existing trash rack spacing was longer than the standard length for a juvenile or adult (i.e., many individuals of that species and life stage are likely to be shorter than the minimum exclusion length) it received a "High" entrainment risk potential. A "Moderate" entrainment risk potential was applied when the minimum exclusion length overlapped with a portion of the individuals that would be expected to achieve that length by the life stage indicated. A "Low" entrainment risk potential was applied when the minimum exclusion length of a trash rack was less than the standard length of the life stage being considered.

The risk categories for the turbine survival potential were based on the TBSA model estimates. TBSA results were converted to a qualitative ranking system similar to Winchell et al. (2000) for standard lengths of the juvenile and adult life stages. "High" survival potential was applied to estimates greater than 85%, "Moderate" for estimates between 70-85%, and "Low" for estimates less than 70%.

3.9 Quantitative Assessment of Entrainment and Turbine Survival Potential

In addition to the previously described qualitative entrainment assessment for the Project, a quantitative estimate of entrainment during generation at the Project was calculated. The resulting entrainment estimate could then be combined with modeled and empirical based survival rates for fish passing through the Project turbine units.

In the absence of site-specific entrainment data during generation at the Project, the quantitative estimate presented relied on a combination of site-specific discharge data and surrogate fish entrainment rates available from a comparable projects found in the EPRI database. Quantitative estimates of entrainment at the Project were calculated for all target and surrogate fish species selected for this study. As a result, quantitative estimates of the entrainment totals are presented for six the target species and one surrogate species.

Table 3-1: Lake Lynn Project impoundment and intake characteristics

Site Characteristic	Lake Lynn Project			
Normal Full Pond Elevation (ft)	870			
Operating Mode	dispatchable peaking hydroelectric facility with storage capability			
Surface Area at Normal Full Pond (acres)	1729			
Total Storage Volume (acre-feet)	72,000			
Impoundment Length (miles)	13			
Total Hydraulic Capacity (cfs)	10,143			
	Unit 1	**Unit 2**	**Unit 3**	**Unit 4**
Upper Rack Elevation (ft)	874	874	874	874
Bottom Rack Elevation (ft)	828	828	828	828
Trash Rack Spacing (in)	4	4	4	4
Trash Rack Height (ft)	42	42	42	42
Trash Rack Width (ft)	25.7	25.7	25.7	25.7
Trash Rack Surface Area (sq. ft)	1,078	1,078	1,078	1,078
Maximum Turbine Discharge (cfs)	2425	2868	2425	2425
Intake velocity (fps)	2.3	2.7	2.3	2.3

Table 3-2: Lake Lynn Project turbine characteristics

Project	Lake Lynn			
Turbine ID	1	2	3	4
Turbine Type	Francis	Francis	Francis	Francis
Number of Blades	16	17	16	16
Runner Diameter (ft)	10.8	10.8	10.8	10.8
Runner Diameter at Inlet (ft)	7.1	7.3	7.1	7.1
Runner Diameter at Discharge (ft)	10.1	10.2	10.1	10.1
Runner Height (ft)	3.8	3.9	3.8	3.8
Head (ft)	81.5	81.5	81.5	81.5
Rotational Speed (rpm)	133.3	133.3	133.3	133.3
Max Discharge (cfs)	2425	2868	2425	2425
Peak Efficiency (%)	94.0%	94.0%	94.0%	94.0%

4 Results

4.1 Description of Project's Fish Protection Features

4.1.1 Project Reservoir and Features

The Lake Lynn Project is located on the Cheat River in Monongalia County, West Virginia and Fayette County, Pennsylvania, approximately 10 miles northeast of Morgantown, West Virginia. The Project has a drainage area of 1,411 square miles and is located about 3.7 miles upstream of the confluence with the Monongahela River. The surface area of the Project impoundment is 1,729 acres with a gross storage of 72,000 acre-ft (Table 3-1). The impoundment stretches approximately 13 miles upstream and has a normal full pond elevation of 870 ft NGVD. The Project reservoir can be used for storage as the Project is operated as a dispatchable peaking hydroelectric facility with storage capability.

4.1.2 Powerhouse, Intake Structure, and Trash Racks

The Lake Lynn Project powerhouse was built in 1926 and houses four horizontal Francis turbines, each connected to a generator. The unit intakes are screened by four separate racks that span a horizontal distance of 103 feet and a vertical distance of 42 feet resulting in an intake area of 4,311 ft^2. The intake rack structure is comprised of eight separate racks, two for each unit. Intake racks at Lake Lynn are 4-inch clear spacing.

4.1.3 Downstream Bypass

There is currently no downstream bypass facility at the Lake Lynn Project.

4.1.4 Turbines

The Lake Lynn Project includes four horizontal Francis turbines with a combined generating capacity of 51.2 MW. Units 1, 3, and 4 have a maximum hydraulic capacity of 2,425 cfs, whereas Unit 2 has a hydraulic capacity of 2,868 cfs. At the time of initial construction all four units were identical. During 2018 PE Hydro completed a turbine replacement and upgrade on Unit 2. As a result, the specific physical characteristics for Unit 2 differ slightly from those for Units 1, 3, and 4 and result in an increased hydraulic capacity (see Table 3-2 for unit specifics).

4.1.5 Project Operations

The Project is operated as a dispatchable peaking hydroelectric facility with storage capability. The facility's ponding capability varies by season and allows for peaking. The Project produces a long-term average generation of 140,352 MWh of clean electricity annually, which is enough to power 13,495 homes (Cube Hydro Partners, 2019). The current FERC License requires that the Licensee operate the Project to maintain Cheat Lake between 868 and 870 ft NGVD from May 1 through October 31, between 857 and 870 ft from November 1 through March 31, and between 863 ft and 870 ft from April 1 through April 30, each year. The current FERC License requires the Licensee release a minimum flow of 212 cfs from the dam with an absolute minimum flow of 100 cfs regardless of inflow.

Although the above mentioned operational parameters do allow for some peaking and storage, during the six month period between May 1 and October 31, the Project operates most like a run-of-river station with a maximum fluctuation in headpond level of 2 feet (between 868 and 870 ft NGVD). For the rest of the year, more fluctuation is permitted. Due to the seasonal shifts in operations, we have incorporated dams in our comparisons that include facilities operated as either run-of-river or peaking.

4.2 Life History and Habitat Requirements of Target Fish Species

The fish assemblage of the Cheat River is generally indicative of a moderately sized, low-gradient, mid-Atlantic river. Target species for this analysis were selected in a manner which captured a variety in life history strategies exhibited by fishes in the area. Target species were included because they are either native or naturally occurring fish species within the Project areas, actively managed, or valued as a game species.

The target species selected for inclusion in the Desktop Fish Entrainment Assessment were:

- Bluegill;
- Channel catfish;
- Smallmouth bass;
- Walleye;
- Golden redhorse;
- Emerald shiner; and
- Gizzard shad.

A brief description of the life history characteristics for each target fish species is provided below. A summary of their habitat preferences and behaviors that influence the likelihood of entrainment is provided in Table 4-1.

4.2.1 Cheat Lake Community Sampling

Biological monitoring was conducted in Cheat Lake and Cheat Lake Embayment from 2005 to 2009 in accordance with the current FERC license for the Project. Surveys conducted include night boat electrofishing and gill netting during May and October, when water levels were low. From 2011 to 2015, fish were also sampled from eight sites in Cheat Lake, consistent with previous surveys. A total of 8,338 fishes from 35 species were collected from 2011 to 2015. Species richness was found to have substantially increase in the riverine zone, increasing from 8 species in 1990 to an average of 23 species captured from 2011 to 2015. An increase in sportfish and non-game fish species was also found when compared to previous studies. Specifically, sportfish in highest abundance included bluegill, smallmouth bass, largemouth bass, yellow perch, and channel catfish. Non-game species included emerald shiner, mimic shiner, logperch, brook silverside, and gizzard shad (Smith and Welsh 2015). Table 4-2 presents a summary of the temporal trends in fish species CPUE from 1990 to 2014.

4.2.2 Bluegill (Lepomis macrochirus)

Bluegill are relatively sedentary and are commonly found in the littoral zone of lakes, ponds, and reservoirs, as well as quiet, slow flowing waters of streams and rivers. Adults and juveniles seek cover in the form of submerged structure like woody debris intermixed with submerged aquatic vegetation (Stuber et al. 1982a; Stuber et al. 1982b; Aho et al. 1986; Werner 2004). Sunfish species spawn in shallow littoral areas in the spring and summer when water temperatures are above 18°C. They are known to be prolific breeders. Their nests are constructed in sand and gravel near woody debris and aquatic vegetation in water depths less than five feet. They reach sexual maturity at one year of age, with an average length is 4 to 6 inches (Smith 1985). Generally, juvenile bluegill remain in shallow, protected habitats such as coves and flooded tributary mouths following cessation of parental care. Flooding, which can result in a rapid drop in water temperature and excessive siltation, and excessive lowering of the water level during spawning are the two most common habitat-related reasons for reproductive failure (Becker 1983). Strong orientation to cover and preference for shallower, off-channel habitats generally limits this family of fishes to exposure to impingement and entrainment through hydroelectric projects.

4.2.3 *Channel catfish (Ictalurus punctatus)*

Channel catfish inhabit large, warm lakes, rivers, ponds and reservoirs, as well as both clear, rapidly flowing channels to turbid, mud-bottomed ones. They occupy a variety of substrate types and can be found in moving or still water (Jenkins and Burkhead 1993). Adults are usually found in pools, or under log jams during the day and riffles at night. They are also known to be tolerant of water with low oxygen and light levels. Channel catfish reach maturity between ages 4-6, with relatively slow growth. They reach an average length of 12-24 inches (Jenkins and Burkhead 1994). Spawning begins in late May and continues through early July when water temperatures range from 21-30°C. Males will build a nest and guard eggs until hatched. Fry

begin to school in compact balls, which are guarded by adults until young reach about one inch long and disperse (Becker 1983). Juveniles feed primarily on plankton and insect larvae, but feed on any available invertebrate, fishes, and some plants as they mature (Jenkins and Burkhead 1994).

4.2.4 Smallmouth bass (Micropterus dolomieu)

Smallmouth bass inhabit a range of aquatic habitats, but adults prefer flowing reaches downstream of riffles or bedrock outcrops. These areas provide cover and flows that convey food items. Habitat depth preferences tend to vary seasonally with fish inhabiting shallow littoral zones in the spring and early summer, moving deeper as waters become warmer. Smallmouth bass generally move into deep water and become inactive during winter. Smallmouth bass typically reach maturity at 3-4 years of age, and reach an average length between 12-16 inches (Jenkins and Burkhead 1994). Spawning occurs in early May when water temperatures range from 16-22°C, with males constructing gravel and rock lined nests that are 2-ft to 3-ft in diameter (Jenkins and Burkhead 1994). Nests are often located downstream of large objects such as boulders, ledges, or fallen trees. The coarse substrate and ledge of the main stem provides spawning habitat for smallmouth. Rooted aquatic vegetation provides rearing and cover habitat for young of year (YOY) and juveniles in shallow, slower moving reaches. The diet of the smallmouth bass ranges from a variety of aquatic invertebrates for younger bass to fish, frogs and small mammals as larger adults (Smith 1985). They are known as ambush predators, using vegetation or structure (i.e., rocks, stumps) as cover to prey on smaller fish and invertebrates.

4.2.5 Walleye (Sander vitreus)

Walleye inhabit medium to large, clear lakes, rivers, and impoundments with loose, shifting sediment such as detritus, sand, gravel rubble, and boulders (Jenkins and Burkhead 1994). They are generally found in deeper waters during the day and tend to move into shallower areas during heavy cloud cover and at night for feeding. Walleye are also known to have excellent visual acuity in low light levels. On average, walleye reach a length between 12-14 inches, with some individuals reaching over 30 inches of length. Male walleye reach maturity at 2 to 4 years, whereas females mature at 3 to 6 years. They spawn in the early spring following ice out when water temperatures reach 2.2°C to 15.6 °C. Walleye congregate before spawning and spawn over gravel or rocky substrates in water generally 2 to 4 feet deep (Smith 1985; Jenkins and Burkhead 1993). Females can deposit more than 100,000 eggs, which hatch in two weeks. The eggs are slightly adhesive and settle between rocks, and hatch after 15-30 days. After their small yolk has been fully absorbed into their digestive system, juvenile walleye will feed on zooplankton and fly larvae. As they approach adulthood, their diet consists primarily of fish, crayfish and leeches (Smith 1985), feeding opportunistically.

4.2.6 Golden Redhorse (Moxostoma erythrurum)

The golden redhorse occupies a broad spectrum of warm water habitats, including large creeks and rivers, natural lakes and impoundments (Jenkins and Burkhead 1993), but are known to prefer moderate to large streams with some current. It can tolerate a moderate amount of silting, but is most abundant in clear, unpolluted streams with large pools and well-defined

riffles. Juveniles tend to inhabit shallow areas. They reach an average length of around 12-18 inches, and reach sexual maturity at 3-5 years of age. Spawning occurs in mid to late spring, with ideal temperatures ranging from 10-22.5 °C. Spawning is known to take place in late spring in moderate sized streams over gravel riffles, but may also occur in small tributaries. The golden redhorse forages on the bottom of pools for food, preying on aquatic insects, invertebrates, and detritus (Jenkins and Burkhead 1993).

The golden redhorse was not identified in any of the seven comparable hydroelectric projects within the EPRI entrainment database. As such, the shorthead redhorse (*Moxostoma macrolepidotum*) was chosen as a surrogate. This species share a genus with the golden redhorse, and are documented to have closely related life histories, as well as similar morphologies (Smith 1985).

4.2.7 Emerald Shiner (Notropis atherinoides)

The emerald shiner inhabits large, open rivers, lakes and reservoirs, as well as runs of rivers with low or moderate gradient. They prefer clear water over sand or gravel, and often aggregate in large schools in mid-water or near surface (Page and Burr 1991). They form large schools that move into deeper water for overwintering. This species spawns in the late spring or early summer. Spawning may occur over various substrates, but primarily over gravel (Smith 1983). Females lay up to 2,000 to 3,000 eggs, which hatch 24-36 hours after fertilization. After hatching, fry remain on the substrate for 2-4 days before forming schools. The emerald shiner feeds primarily zooplankton, as well as green algae and diatoms, while juveniles feed almost solely on protozoans (Smith 1983). They reach an average size of 2.5-3.5 inches long (Jenkins and Burkhead 1993).

4.2.8 Gizzard Shad (Dorosoma cepedianum)

The gizzard shad is a pelagic, schooling fish with a variety of habitats. It prefers pools and runs in medium streams, or rivers with low to moderate gradient. This species is also found in reservoirs, lakes, swamps, floodwater pools, estuaries, brackish bays and marine waters. While many populations are diadromous (residing in coastal waters and returning to freshwater environments to spawn), the Cheat River population is known to be landlocked and does not participate in annual migration. They reach maturity by age 2 or 3, and typically spawn between April and June in temperate latitudes (Jenkins and Burkhead 1993). Spawning takes place in freshwater sloughs, ponds, and lakes at near-surface depths, occasionally over vegetation and debris. Eggs are demersal and attach to algae or rocks. This species is known to have a very high spawning potential, with fecundity ranging from 22,400- 543,910 eggs per female (Jenkins and Burkhead 1993). Gizzard shad are filter feeders, feeding almost solely on plankton from the water column (Jenkins and Burkhead 1993). Gizzard shad are also known to be extremely sensitive to changes in temperature and dissolved oxygen, becoming moribund as water temperatures decrease below 56°F and die at about 38°F (Williamson and Nelson 1985). Die-offs are frequent in fall and late summer when water temperature drops. Juvenile gizzard shad typically pass downstream out of reservoirs during fall and early winter, and their tendency to become moribund as their lower temperature threshold is approached may make this species

susceptible to entrainment. This species reaches an average length of 9-14 inches (Jenkins and Burkhead 1993).

4.3 Entrainment Potential of Target Fish Species

The calculated minimum exclusion lengths for each of the seven target fish species relative to the existing 4-inch clear spacing at Lake Lynn intake structure are presented in (Table 4-3). As described in Section 3.3, a scaling factor derived from the proportional estimates of body width to total length were used to determine the minimum length of each target species that would be excluded from entraining through the existing intake rack spacing at the Project (i.e., minimum exclusion size = rack clear spacing/scaling ratio).

The majority of the calculated estimates yielded lengths for target species that are unlikely to be present in the Project (i.e., a length outside of the range expected for the species in the vicinity of the Lake Lynn Project). For example, the minimum size of gizzard shad predicted to be excluded by a 4-inch intake rack is 38.1 inches—a length not attained by this species. In cases where the maximum size of the species did not exceed the minimum exclusion size, a designation of 'none' was applied (Table 4-3). Only channel catfish and walleye had a calculated minimum exclusion length (25.5 and 31.0 inches, respectively) lower than the upper end of the expected range of body lengths for those species in the Project area. The existing four inch intake rack spacing alone is not expected to eliminate the potential for entrainment of bluegill, smallmouth bass, shorthead redhorse, emerald shiner or gizzard shad at Lake Lynn.

4.4 Electric Power Research Institute (EPRI) Entrainment Database Review

A total of ten hydroelectric projects in the EPRI 1997 database met the selection criteria for similarity to Lake Lynn (Table 4-4) and six of the seven target species were represented in the collective subset of data from the ten identified facilities. Due to limited information on entrainment of the golden redhorse, the shorthead redhorse was utilized as a surrogate for this database review. As mentioned in section 4.2.6, the golden redhorse and shorthead redhorse share similar life histories, as well as occupy similar habitats (moderately sized streams with some current and well-defined riffles) (Jenkins and Burkhead 1993).

The length frequency distribution for the entrainment of target fish species at the ten representative hydroelectric projects from the EPRI data base are presented in Figures 4-1 (by species) and 4-2 (cumulative). The majority of individuals representing target fish species entrainment at the ten representative projects were less than or equal to four inches in length (85% of reported individuals). Individuals greater than 10 inches were limited to a minor percentage of four target species (channel catfish, shorthead redhorse, smallmouth bass and walleye, representing 4%, 13%, 11%, and 9% of all individuals entrained, respectively).

4.5 Impingement Potential of Target Fish Species

A summary of burst swim speeds determined for each of the seven target fish species is presented in Table 4-5. These data were obtained using the Swim Speed & Swim Time Tool[1] (Katopodis and Gervais 2016; Di Rocco and Gervais 2020). The expected size range for each of the seven target fish species was evaluated relative to the data available in the Swim Speed & Swim Time Tool and five representative lengths were chosen for burst speed estimation from the database. For each target fish species, the five representative lengths included the upper and lower bounds of the anticipated size range for the Project area as well as the 25th, 50th, and 75th percentile lengths within that range. Each unique species-length combination was input into the Swim Speed & Swim Time Tool and produced a relationship for swim speed and swim time for a particular body length. For each body length selected to be assessed for each species, the following estimates were recorded:

1. Speed (ft/s) achieved by 97.5% of individuals of species X at body length Y for 3 seconds;
2. Speed (ft/s) achieved by 87.5% of individuals of species X at body length Y for 3 seconds;
3. Speed (ft/s) achieved by 50% of individuals of species X at body length Y for 3 seconds;
4. Speed (ft/s) achieved by 12.5% of individuals of species X at body length Y for 3 seconds; and
5. Speed (ft/s) achieved by 2.5% of individuals of species X at body length Y for 3 seconds.

It is understood that burst swim speeds may vary greatly among different fish species as well as among sizes of the same species. However, variation exists within individuals of the same species and size class. Katopodis and Gervais (2016) demonstrate ascending physical capabilities as a smaller portion of the test fish are represented by each speed rating. For example, 97.5% of bluegill in the 6 inch size class are expected to be capable of achieving a speed of 2.98 fps for a period of 3 seconds, while only 2.5% of bluegill of the same size are expected to be able to achieve a speed of 6.96 fps for 3 seconds. For the purposes of this desktop evaluation values representing the 50th percentile of swim speed over a three second period were selected as representative of a fishes burst swim capability. The 50th percentile speed rating for the minimum, median, and maximum size of each of the seven target fish species is provided in Table 4-5. The full range of swim speed estimates for target fish species generated using the Swim Speed & Swim Time Tool are provided in Appendix A.

Figure 4-3 provides a visual representation of the reported burst speeds for the target species and size classes relative to the calculated intake velocities at the Project turbine units. The species and sizes of target fish likely to become impinged are those whose burst swim speeds are less than the approach velocity at the Project intake. The calculated intake velocity for the

[1] Available online at: http://www.fishprotectiontools.ca/speedtime.html

three original Francis turbines (i.e., Units 1, 3, and 4) is 2.3 fps whereas the calculated intake velocity for the recently upgraded Unit 2 is 2.7 fps.

Four species-length class combinations have burst speeds less than the calculated intake velocities under maximum discharge conditions at Lake Lynn (Table 4-5). These species-length classes are the minimum sizes considered for bluegill (1.6 fps), channel catfish (2.4 fps), smallmouth bass (2.4 fps), and emerald shiner (2.3 fps). All other species-length class combinations were deemed capable of achieving a burst speed in excess of the project intake velocity—thus reducing the likelihood of impingement or entrainment at the Lake Lynn Project. It should be noted that of the four species-size class combinations with burst speeds lower than the calculated approach velocities, all would have a higher probability of being entrained than impinged as they will fit through the existing rack spacing at the Project.

Although the full range of body lengths assessed for gizzard shad as part of this evaluation are capable of a burst speed in excess of the calculated Project intake velocities, they will be a primary focus within the quantitative entrainment assessment due to the propensity for this species to experience extreme lethargy in cold temperatures (see Section 4.2.8). During periods of low water temperature gizzard shad tend to be less capable of escaping entrainment due to their tendency to become moribund.

4.6 Turbine Survival Evaluation

Tables 4-6 and 4-7 provide a summary of the calculated TBSA turbine survival estimates for fish entrained at Francis Units 1, 3, and 4 and Francis Unit 2, respectively. Survival values were estimated for the range of body lengths anticipated to be prone to entrainment based upon the minimum exclusion sizes presented in Table 4-3. As would be expected, estimates of turbine passage were inversely related to body length with highest survival estimated for fish at 2 inches of length (~95%) and the lowest for fish at 30 inches of length (21-24%).

4.7 Electric Power Research Institute (EPRI) Turbine Survival Database Review

Upon review of the EPRI (1997) survival database, two hydroelectric facilities had comparable characteristics for a direct comparison with Lake Lynn (Table 4-8). However, previously quantified survival rates were available in the EPRI survival database for only two of the target species evaluated as part of this assessment (bluegill and walleye; Table 4-9). When examined across comparable site locations, estimates of 48-hour latent survival based on recovered 4-inch bluegill ranged from 66% to 100%. Latent 48-hour survival based on recovered walleye was 77% for individuals ranging between 6-25 inches.

In general, survival through turbines is related to fish size, with the smaller fish entrained typically having higher survival rates than larger fish. Winchell et al. (2000) provides a review of the EPRI (1997) database and a generalized summary of survival based on turbine type, runner speed, and fish size (Table 4-10). Winchell et al. (2000) reports mean survival rates (all fish species combined) for low speed Francis units to range from 93.9% for fish ≤ 4 inches to 73.2% for fish ≥ 12 inches.

4.8 Qualitative Assessment of Entrainment and Turbine Survival Potential

Evaluating entrainment potential of the seven target fish species at the Project required combining and synthesizing the species-specific behavioral traits, life stages, and swimming capabilities and comparing them to the Project's unique intake, water conveyance and infrastructure characteristics. The blending of these factors yielded a qualitative assessment of whether or not an individual of the target fish species will potentially entrain through the Project's intakes or not. If a fish becomes entrained, a secondary evaluation of the potential of that individual surviving passage through the Project's turbines depended primarily on its length and the physical dimensions as well as operating conditions of the turbines at the time of passage. The final qualitative assessment of the potential for surviving downstream passage at the Project took into consideration and summarized all of the factors that influenced entrainment and turbine passage. The results of this qualitative assessment are presented in Table 4-11.

Entrainment potential as a function of behavior, habitat use and life history was ranked as 'low' for nearly all of the target fish species considered in this evaluation with the exception of gizzard shad. The lack of high quality aquatic habitat in the immediate vicinity of the intake structure coupled with the fact that none of those fish species are considered an obligatory migrant contributed to the low entrainment potential. With regards to gizzard shad, their susceptibility to colder water temperatures and downstream movement of juvenile individuals during the fall season resulted in a qualitative entrainment rank of 'high' for the species. When considered on its own, the existing 4-inch intake rack spacing at the Project resulted in an entrainment potential rank of 'high" for nearly all species and life stages. Only adult channel catfish and walleye are expected to achieve a minimum exclusion length suitable to physically avoid entrainment at the Project with the existing 4-inch intake rack spacing. Conversely, the calculated approach velocities for the turbine units at Lake Lynn under maximum generation conditions resulted in an entrainment potential rank of 'low' for adults of nearly all seven of the target fish species. The juvenile life stage for several of the target fish species (bluegill, channel catfish, smallmouth bass, and emerald shiner) received an entrainment potential rank of moderate to high due to their reported burst swim capabilities relative to approach velocities at the Project intake. Gizzard shad are capable of reaching a burst swim speed in excess of calculated approach velocities at Lake Lynn. However to account for their reaction to lowered thermal conditions they were assigned a more conservative rank of 'moderate' relative to swim capabilities at the intake.

When the four factors summarized in Table 4-11 are considered it is likely that gizzard shad will have the highest susceptibility to entrainment at the Project. Their seasonal behavior and response to cold temperatures may make them more vulnerable than the other species considered in this evaluation. The other six target fish species are not anticipated to be present in the immediate vicinity of the intake under most conditions. In the event that they are it is expected that the adult life stage for those six target species have the ability to exceed approach velocities at the intake area or in the case of two species may be effectively screened by the intake rack. If present in the immediate intake area the juvenile life stages of those six species will have a higher likelihood of entrainment due to their slower burst speeds and small

body size. However, as noted in Tables 4-6 and 4-7 fish under six inches in length are expected to have a high rate of survival following downstream passage via the Lake Lynn turbine units. These size classes are representative of juvenile fish species (Table 4-11).

Table 4-1: General habitat use and behavior of target fish species

Common Name	Life Stage	Habitat Requirement	Behavioral Movements	Likelihood of Proximity to Intakes
Bluegill	Adult Spawning	Shallow water over fine gravel	None	Low
	Adult	Shallow water with vegetation and structure, or high in water column over deep water	Local migration to deeper water in winter and summer for thermal refuge	
	Juvenile	Shallow water with vegetation and structure	None	
Channel catfish	Adult Spawning	Warm, slow or stagnant water over soft sediments in open water or areas with vegetation	Will form aggregations and build nests in areas of soft sediments	Low
	Adult		None	
	Juvenile			
Smallmouth bass	Adult Spawning	Gravel with shallow water	May travel to smaller streams to spawn	Low
	Adult	Clear water with boulders, rocky shoals, riffles, or structural cover	Occasionally moves to deep water during the day, forms aggregation in deep water in winter	Low
	Juvenile		None	Low
Walleye	Adult Spawning	Shallow shoreline areas, shoals, riffles	Moves to near-shore areas or tributaries to spawn	Low
	Adult	Pools moderate turbidity and substantial areas of rocky substrate	Moves to near-shore areas at night to feed	Low
	Juvenile			
Shorthead redhorse	Adult Spawning	Gravelly runs and riffles	May migrate out of large rivers to smaller streams to spawn	Low
	Adult	Rocky pools, runs, and riffles in moderate to large streams	None	Low
	Juvenile			Low
Emerald shiner	Adult Spawning	Near surface in open water over gravel shoals	None	Low
	Adult	Large, open areas of variable turbidity	Local migration to deeper water in winter	Low
	Juvenile		None	Low
Gizzard shad	Adult Spawning	Surface water in low-gradient areas	Migrate in large schools in surface waters	Low
	Adult	Non-migratory; found near substrate for filter feeding	May be susceptible to seasonal low water temperatures	High
	Juvenile	Shallow, near-shore water	May move downstream out of reservoirs in cooler months; susceptible to “cold shock”	High

Table 4-2: Temporal trends in fish CPUE from boat electrofishing in Cheat Lake

Species	1990	1997	1998	2001	2005	2008	2011	2014	Grand Total
Banded Darter	0.00	0.00	0.00	0.00	0.00	0.50	0.00	0.50	0.11
Black Crappie	0.22	0.00	0.11	0.00	0.00	0.50	2.50	3.75	0.81
Bluegill	8.44	15.08	11.56	30.11	12.5	186	10.5	27.25	36.59
Bluntnose Minnow	0.22	0.00	0.00	9.11	10.5	14.25	7.75	0.75	5.38
Brook Silverside	4.00	5.00	4.89	11.33	6.00	37.25	11.25	5.75	10.58
Brown Bullhead	5.11	0.00	0.56	0.00	0.00	0.00	0.50	0.00	0.59
Common Carp	0.89	2.67	2.56	2.33	3.50	1.25	0.25	0.75	1.88
Emerald Shiner	7.11	21.67	20.56	25.67	5.00	7.25	125.50	22.25	29.30
Chain Pickerel	0.00	0.00	0.00	0.00	0.00	0.00	0.25	3.00	0.37
Channel Catfish	0.22	0.42	0.22	1.00	0.75	3.00	1.00	2.00	1.05
Channel Darter	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.06
Gizzard Shad	0.00	0.00	0.22	2.44	1.00	0.75	5.75	0.00	1.31
Golden Redhorse	0.00	0.92	1.67	1.33	4.25	4.25	19.50	40.00	8.39
Golden Shiner	0.00	0.00	0.11	0.11	0.00	0.50	0.00	0.00	0.10
Greenside Darter	0.00	0.00	0.00	0.33	0.00	0.00	0.00	1.25	0.20
Green Sunfish	0.22	0.00	0.33	2.11	1.75	19.50	1.25	10.50	4.21
Flathead Catfish	0.00	0.25	0.33	0.00	0.25	0.00	0.00	0.25	0.14
Freshwater Drum	0.44	0.58	0.56	0.78	0.75	1.00	0.50	3.00	0.93
Hybrid Striped Bass	0.00	0.00	0.00	0.00	0.00	0.00	0.25	0.00	0.03
Hybrid Sunfish	1.56	0.00	0.00	0.00	0.00	0.00	0.25	0.25	0.19
Johnny Darter	0.00	0.00	0.11	0.44	0.00	3.25	0.00	1.75	0.67
Largemouth Bass	2.44	2.75	3.89	3.67	8.50	4.50	9.50	17.50	6.39
Logperch	0.00	1.42	3.33	3.11	10.75	1.50	2.25	14.00	4.52
Longnose Gar	0.00	0.00	0.00	0.22	0.00	0.50	0.25	1.25	0.27
Mimic Shiner	0.89	0.00	0.00	33.78	5.50	54.50	12.75	29.50	17.55
Northern Hogsucker	0.00	0.00	0.33	0.00	0.50	0.25	0.00	0.25	0.17
Northern Pike	0.22	0.08	0.22	0.11	0.75	0.00	0.00	0.00	0.17
Popeye Shiner	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.25	0.03
Pumpkinseed	4.67	1.75	2.33	1.22	0.50	3.75	0.50	0.50	1.81
Quillback	0.00	0.33	0.00	0.00	0.00	0.00	0.75	0.25	0.15
Rainbow Darter	0.00	0.00	0.22	0.00	0.00	0.00	0.00	2.50	0.32
River Carpsucker	0.00	0.00	0.22	0.00	0.00	0.00	0.00	0.00	0.04
Rock Bass	0.67	0.42	3.33	2.11	0.25	6.50	2.00	11.25	3.32
Rosyface Shiner	0.00	0.00	0.00	0.00	30.25	3.50	0.00	0.00	3.86
Sauger	0.00	0.67	2.44	1.78	1.50	1.50	4.25	4.50	2.17
Smallmouth Redhorse	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.00	0.06
Silver Redhorse	1.56	0.25	0.78	0.00	0.00	0.25	0.00	11.25	1.61
Silver Shiner	0.00	0.00	0.00	0.00	0.00	5.00	0.00	6.25	1.29
Smallmouth Bass	0.44	6.42	5.78	4.78	5.00	18.50	27.00	35.50	12.41

Species	1990	1997	1998	2001	2005	2008	2011	2014	Grand Total
Spottail Shiner	0.22	1.67	1.00	0.00	0.00	0.00	0.00	0.25	0.41
Spotted Bass	0.22	0.75	0.00	1.00	2.25	4.75	3.25	8.75	2.45
Spotfin Shiner	0.22	0.00	0.00	0.67	7.25	9.00	0.50	0.25	2.08
Walleye	0.00	0.00	0.00	1.00	0.00	0.50	6.25	2.00	1.17
Warmouth	0.22	0.00	0.00	0.00	0.00	0.25	0.00	0.00	0.05
White Bass	0.00	0.00	0.00	0.00	0.00	0.00	3.50	0.00	0.40
White Sucker	0.00	0.00	0.00	0.00	0.25	0.00	0.00	0.00	0.03
White Crappie	0.00	0.33	0.00	0.67	0.00	0.00	0.00	0.00	0.15
Yellow Bullhead	0.44	0.08	0.11	0.33	0.00	0.00	0.00	0.50	0.18
Yellow Perch	9.56	7.92	24.22	14.00	1.75	0.25	1.25	22.75	11.25

*Reproduced from the Lake Lynn PAD (Table 5.11).

Table 4-3: Minimum length for target fish to be excluded from entrainment based on existing trash rack spacing

Common Name	Scaling Factor for Body Width[1]	Typical Length (inches) for target species juveniles and adults potentially encountered at the Lake Lynn Project		Calculated Minimum Exclusion Length (inches)*
Bluegill	0.133	Juvenile	1.0-3.0[1]	None
		Adult	4.0-6.0[1]	
Channel catfish	0.157	Juvenile	2.0-10.0[1]	25.5
		Adult	10.5-50.0[2]	
Smallmouth bass	0.128	Juvenile	2.0-7.0[2]	None
		Adult	8.0-27.0[2]	
Walleye	0.129	Juvenile	2.0-11.0[1]	31.0
		Adult	12.0-36.0[1&3]	
Shorthead redhorse	0.13	Juvenile	2.0-10.0[2]	None
		Adult	14-18[1]	
Emerald shiner	0.108	Juvenile	1.0-4[1]	None
		Adult	5 [1]	
Gizzard shad	0.105	Juvenile	2.0-7.0[4]	None
		Adult	10.0-14.0[1]	

* "None" indicates that the calculated exclusion length exceeds the maximum length expected for the species at Lake Lynn.

1 Smith, C. L. 1985. The Inland Fishes of New York State. Albany, NY. New York Department of Environmental Conservation.

2 Rohde F. C., Arndt R. G., Foltz, J. W., Quattro, J. M. 2009. Freshwater Fishes of South Carolina. University of South Carolina. University of South Carolina Press.

3 Pennsylvania Fish and Boat Commission. 2020. Gallery of Pennsylvania Fishes. Perches and Darters. Site accessed 12/8/20. https://www.fishandboat.com/Fish/PennsylvaniaFishes/GalleryPennsylvaniaFishes/Pages/PerchesandDarters.aspx

4 Pennsylvania Fish and Boat Commission. 2020. Gallery of Pennsylvania Fishes. Herrings. Site accessed 12/8/20. https://www.fishandboat.com/Fish/PennsylvaniaFishes/GalleryPennsylvaniaFishes/Pages/Herrings.aspx

Table 4-4: Hydroelectric facility characteristics from the EPRI entrainment database comparable to Lake Lynn

Facility Name	Total Plant Capacity (cfs)	Operating Mode	Trash Rack Spacing (in)
Centralia	3,640	ROR	3.5
Crowley	2,400	ROR	2.375
Sandstone Rapids	1,300	PK	1.75
Schaghticoke	1,640	ROR	2.125
Twin Branch	3,200	ROR	3
Sherman Island	6,600	PK	3.125
Herrings	3,610	ROR	4.125
Townsend Dam	4,400	ROR	5.5
E.J. West	5,400	NA	4.5
Caldron Falls	1,300	PK	2
Lake Lynn	10,143	PK/ROR	4

ROR = Run-of-river, PK= Peaking

Table 4-5: Burst swim speed information compiled from scientific literature for target fish species

Common Name	Size potentially encountered in WV/PA (in)	Size included in burst speed estimate based on data availability	Burst Speed (fps) at minimum size[5]	Burst Speed (fps) at median size[5]	Burst Speed (fps) at maximum size[5]
Bluegill	1.0-6.0[1]	1.0-6.0	1.6*	3.4	4.6
Channel catfish	2.0-50.0[1&2]	2.0-21.0	2.4*	6.8	9.7
Smallmouth bass	2.0-27.0[2]	2.0-15.0	2.4*	5.6	8.0
Walleye	2.0-36.0[1&3]	2.0-20.0	3.6	10.6	15.4
Shorthead redhorse	2.0-10.0[1&2]	2.0-10	3.6	7.2	10.0
Emerald shiner	1.0-5[1]	1.0-3.0	2.3*	3.6	4.7
Gizzard shad	2.0-7.0[4]	2.0-7	5.2	9.3	12.7
	10.0-14.0[1]	10.0-14	16.2	18.4	20.4

*Highlighted cells denote swim speeds that are slower than the intake velocity of one or more units at the Project

1 Smith, C. L. 1985. The Inland Fishes of New York State. Albany, NY. New York Department of Environmental Conservation.

2 Rohde F. C., Arndt R. G., Foltz, J. W., Quattro, J. M. 2009. Freshwater Fishes of South Carolina. University of South Carolina. University of South Carolina Press.

3 Pennsylvania Fish and Boat Commission. 2020. Gallery of Pennsylvania Fishes. Perches and Darters. Site accessed 12/8/20. https://www.fishandboat.com/Fish/PennsylvaniaFishes/GalleryPennsylvaniaFishes/Pages/PerchesandDarters.aspx

4 Pennsylvania Fish and Boat Commission. 2020. Gallery of Pennsylvania Fishes. Herrings. Site accessed 12/8/20. https://www.fishandboat.com/Fish/PennsylvaniaFishes/GalleryPennsylvaniaFishes/Pages/Herrings.aspx

5 Katopodis, C, and R Gervais. 2016. Fish Swimming Performance Database and Analyses. DFO Can. Sci. Advis. Sec. Res. Doc. 2016/002., 550.

Table 4-6: TBSA predicted survival estimates for passage through Units 1, 3 or 4 at Lake Lynn for body lengths with a probability of entrainment based on rack spacing and minimum exclusion length

Unit	Units 1, 3, and 4									
Fish Body Length	2 in	4 in	6 in	8 in	10 in	12 in	14	19	24	30
Survival rate	95.0%	89.9%	84.3%	79.6%	78.4%	69.3%	64.8%	52.4%	38.1%	24.5%

Values calculated for Units 1, 3, 4 at maximum rated capacity (2,425 cfs per unit), 80% efficiency, and correlation coefficient = 0.2

Table 4-7: TBSA predicted survival estimates for passage through Unit 2 at Lake Lynn for body lengths with a probability of entrainment based on rack spacing and minimum exclusion length

Unit	Unit 2									
Fish Body Length	2 in	4 in	6 in	8 in	10 in	12 in	14	19	24	30
Survival rate	94.7%	89.6%	84.3%	79.1%	74.0%	68.5%	63.5%	50.6%	37.3%	21.0%

Values calculated for Unit 2 at maximum rated capacity (2,868 cfs), 80% efficiency, and correlation coefficient = 0.2

Table 4-8: Hydroelectric facility characteristics from the EPRI turbine survival database comparable to the Lake Lynn Project

Facility Name	Turbine Type	Rated Head (ft)	Rated Flow (cfs) Per unit	Speed (rpm)	Runner Diameter (ft)	Runner Blades
E.J. West	Francis (vertical)	63	2,450	112.5	10.9	15
Hardy	Francis (vertical)	100	1,500	163.6	7	16
Lake Lynn unit 1,3 & 4	Francis	81.5	2425	133.3	10.8	16
Lake Lynn unit 2	Francis	81.5	2868	133.3	10.8	17

Table 4-9: Turbine survival estimates of target species from the EPRI turbine survival database

Project Name	Species	Length (in)		Based on Number Released			Based on number recovered			Control		
		Min	Max	Immediate Survival (%)	24-hr. Survival (%)	48-hr. Survival (%)	Immediate Survival (%)	24-hr. Survival (%)	48-hr. Survival (%)	Immediate Survival (%)	24-hr. Survival (%)	48-hr. Survival (%)
E.J. West	Bluegill	-	4	1.26	-	1.71	1.11	-	1.51	0.79	-	0.36
	Bluegill	-	4	0.44	-	0.41	0.7	-	0.66	0.93	-	0.58
	Bluegill	-	4	0.21	-	0.24	0.59	-	0.67	0.99	-	0.62
Hardy	Bluegill	4.7	7.3	0.98	0.91	0.93	0.96	0.9	0.92	1	1	0.98
	Bluegill	3.1	5.9	0.77	0.67	0.71	0.97	0.85	0.9	1	0.98	0.93
	Walleye	5.8	25	0.83	0.83	0.81	0.8	0.8	0.77	0.97	0.94	0.94

Table 4-10: Fish survival rates for generating units comparable to Project based on EPRI (1997) database and summarized by Winchell (2000)

Turbine Type	Runner Speed (rpm)	Hydraulic Capacity (cfs)	Fish Size (mm)	Average immediate survival (all species combined)		
				Minimum	Maximum	Mean
Lake Lynn Units 1, 3, 4 (Francis)	133.3	2,425 each	N/A			
Lake Lynn Unit 2 (Francis)	133.3	2,868 each	N/A			
Radial Flow (Francis) Winchell (2000)	<250	440-1,600	<100	85.9%	100%	93.9%
		370-1,600	100-199	74.8%	100%	91.6%
		370, 2,450	200-299	59.0%	100%	86.9%
		440-1,600	300+	36.1%	100%	73.2%

Table 4-11: Qualitative project passage survival potential for target fish species relative to factors influencing entrainment and turbine survival at the Project

Species and Life Stage		Entrainment Potential				Turbine Survival Potential
		Behavior, Habitat and Life History	Trash Rack Clear Spacing	Swim Speed compared to Unit 1,3,4 Approach Velocity	Swim Speed compared to Unit 2 Approach Velocity	
			4 inch	(2.3 fps)	(2.7 fps)	
Bluegill	Adult	L	H	L	L	H-M
	Juvenile			H	H	H
Channel Catfish	Adult	L	M	L	L	M-L
	Juvenile		H	M	H	H
Smallmouth Bass	Adult	L	H	L	L	M-L
	Juvenile			M	H	H
Walleye	Adult	L	M	L	L	M-L
	Juvenile	L	H	L	L	H
Shorthead Redhorse	Adult	L	H	L	L	M-L
	Juvenile			L	L	H
Emerald Shiner	Adult	L	H	L	L	H
	Juvenile			M	H	H
Gizzard Shad	Adult	L	H	M*	M*	M-L
	Juvenile			M*	M*	H

*Likelihood relative to burst speed is low, however, this species is susceptible is to lethargic behavior during the winter months, leading to less responsive burst movements

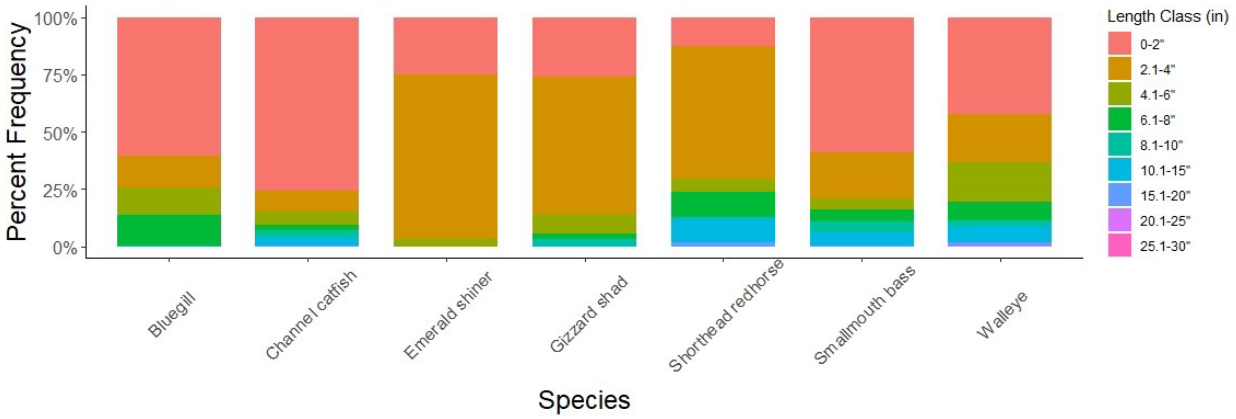

Figure 4–1. Length class composition by target fish species from the subset of comparable hydroelectric projects within the EPRI 1997 database.

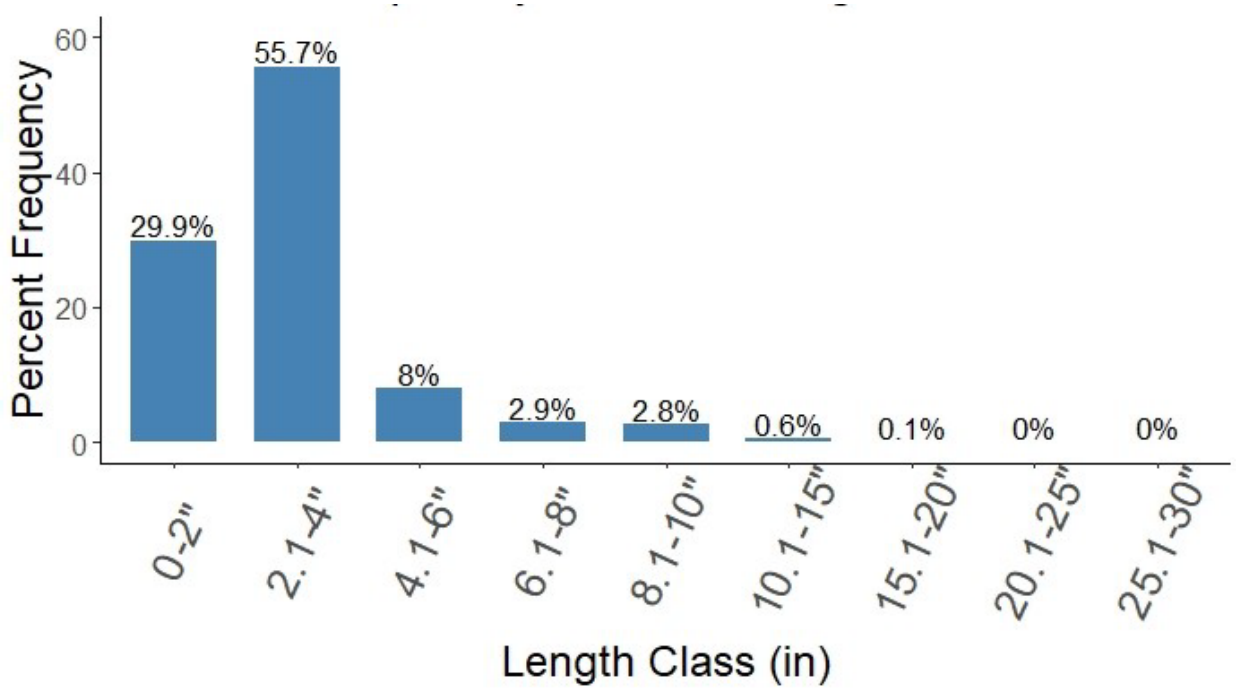

Figure 4–2. Length class composition for target fish species combined from the subset of comparable hydroelectric projects within the EPRI 1997 database.

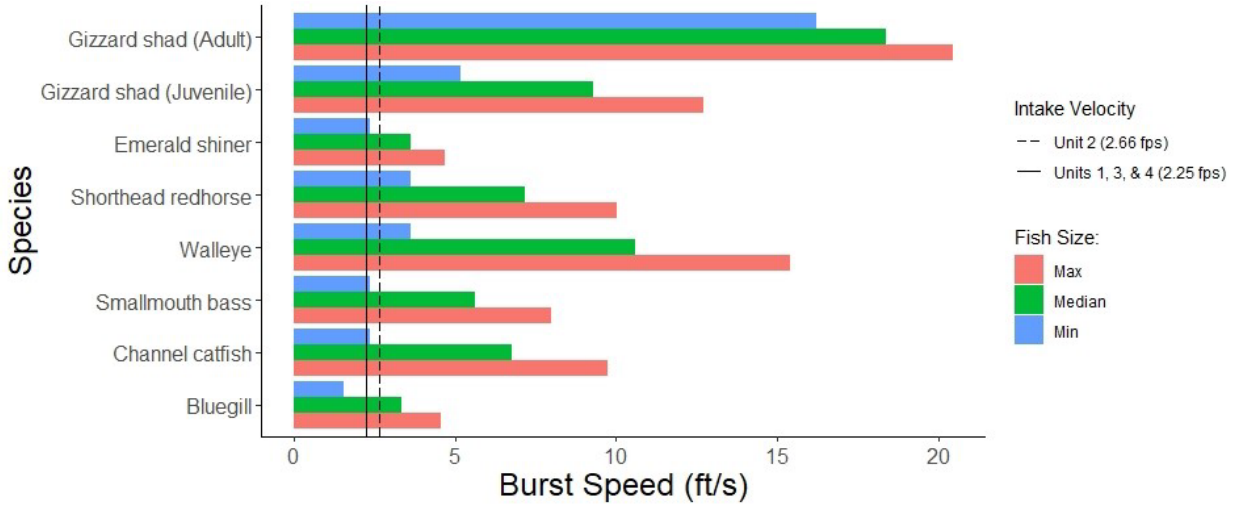

Figure 4–3. Burst swim speed of target fish species compared to calculated approach velocities at the Lake Lynn intakes.

5 Quantitative Assessment of Entrainment and Turbine Survival Potential

Information contained in the EPRI (1997) data compilation and other sources were used to compile a qualitative assessment of the potential entrainment of target fishes at Lake Lynn (see Section 4.8 of this report). Likewise, a desktop approach, relying on modeled and empirical data, was conducted to provide estimates of fish survival during turbine entrainment (see Section 4.6 of this report). In addition to the previously described qualitative entrainment assessment for the Lake Lynn Project, a quantitative estimate of entrainment during generation at the Project was calculated. The resulting entrainment estimate was then combined with modeled survival rates for fish passing through the Project turbine units.

In the absence of site-specific entrainment data at the Lake Lynn Project, the quantitative estimates presented here relied on a combination of site-specific operations data and surrogate fish entrainment rates available from similar hydroelectric projects. Quantitative estimates of entrainment at Lake Lynn were calculated for each of the target fish species. As noted in Section 4.8, the susceptibility to colder water temperatures and downstream movement of juvenile individuals during the fall season described in the literature for gizzard shad can result in seasonal increases in entrainment for that species.

5.1 Site-specific Operations Data

Flow duration curves for the Project were obtained from Appendix E of the PAD and used to develop estimated values of turbine unit discharge for use in the quantitative entrainment analysis. Values for the 10^{th}, 25^{th}, 50^{th}, 75^{th}, and 90^{th} exceedance conditions were extracted from the flow duration curves for each calendar month. For each month-exceedance condition combination, values were adjusted for station capacity. For instances where the river flow was in excess of station capacity it was assumed the Project was operating at its capacity of 10,143 cfs and for instances where the river flow was less than station capacity it was assumed the Project was operating at the available inflow less the required 212 cfs minimum flow. The resulting discharge rate (i.e., cubic feet per second) was applied to the full month (i.e., cfs * 86,400 seconds per day * no. days per month) to generate an estimate of the total volume (ft^3) of water passing through the Project turbines. The resulting monthly volume estimates for the five exceedance conditions are presented in Table 5-1.

5.2 Summary of Fisheries Entrainment Data

Of the 43 projects contained in the EPRI (1997) database, a total of ten (Table 4-4) were identified for comparison to Lake Lynn for evaluation of entrained species and sizes (see Section 4.4) and two projects were identified for evaluation of survival (see Section 4.7). Of the ten comparable projects used for evaluation of entrainment, only one, Townsend Dam, included volume based entrainment density information for all seven of the target fish species included in this evaluation. Townsend Dam is located in New Brighton, PA, so is also a reasonable comparison due to its relative proximity to the Lake Lynn Project. Fisheries entrainment rate data collected during netting studies conducted during the early 1990's at Townsend Dam were

selected as the best available surrogate of entrainment rate data for the full set of target species considered at the Lake Lynn Project.

Within any comparison among hydroelectric projects, site-specific differences in facilities and equipment as well as the manner in which they are operated will exist. Townsend Dam has a smaller hydraulic capacity (4400 cfs) in comparison to that at Lake Lynn (10,143 cfs), two turbines versus four, and is operated in a true run-of-river mode. The section of the Beaver River (a tributary within the Ohio River basin) upstream of Townsend Dam is more riverine in nature (0.9 mile impoundment) than the larger Cheat Lake located upstream of Lake Lynn Project (13 mile impoundment). Lastly, the intake rack clear spacing at Townsend dam is 5.5 inches, while the Lake Lynn spacing is 4 inches.

In addition to differences between the stations and their source water bodies, variability in the relative proportions and densities of individual fish species within the community needs to be considered and may be influenced by a variety of factors including water quality, habitat availability, flow, and overall productivity. For example, relative abundance data for gizzard shad collected during eight sampling seasons by boat electrofishing in Cheat Lake suggests the species is the twentieth most frequently sampled species. However, gizzard shad comprised the vast majority of entrainment samples collected at Townsend Dam (88%). As a result, available gizzard shad density data from Minetto Dam in Fulton, NY and the Richard B. Russell pump storage station on the Savannah River, GA/SC were also used to provide a range of estimates of entrainment for the species at Lake Lynn. Based on the identified available entrainment density information, the following estimates were generated for the target species considered in this evaluation:

- Bluegill – based on available monthly entrainment rates from Townsend Dam;
- Channel catfish – based on available monthly entrainment rates from Townsend Dam;
- Smallmouth bass – based on available monthly entrainment rates from Townsend Dam;
- Walleye – based on available monthly entrainment rates from Townsend Dam;
- Emerald shiner – based on available monthly entrainment rates from Townsend Dam;
- Shorthead redhorse – based on available monthly entrainment rates from Townsend Dam; and
- Gizzard shad – based on available monthly entrainment rates from Townsend Dam, Minetto Dam, and Richard B. Russell pump storage.

Entrainment monitoring at Townsend and Minetto Dams was conducted during all months of the year and at the Richard B. Russell Project was conducted during the months of April-November. The quantitative estimates of entrainment at the Lake Lynn Project presented in this report reflect all available data, with some months being blank because individuals of a

particular species were not entrained at the comparison projects. The EPRI (1997) data compilation provides the total number of collected fish by species and adjusted for net collection efficiency as well as the total volume of water sampled through the collection nets. Theoretical estimates of entrainment densities for target and surrogate species were calculated on a monthly basis using the equation:

$$D_i = \frac{C_x}{G_x}$$

where:

D_i = density of fish species A per cubic foot of sampling flow;

C_x = count of the number of fish species A during month *x*, and

G_x = sampling volume in cubic feet for month *x*.

Monthly entrainment rates used to calculate estimated entrainment for target fish species at Lake Lynn are provided in Appendix B. Tables in Appendix B provide the reported monthly values for raw number of individuals collected, volume of water sampled (ft^3), and the resulting species-specific density (#/ft^3) for each target species at the comparison projects.

5.3 Quantitative Estimates of Entrained individuals by Species

Monthly operating volumes for the 50% exceedance condition (Table 5-1) and target species densities obtained from comparative projects were used to calculate estimates of entrainment during generation at Lake Lynn (Table 5-2)[2]. Based on the assumption that entrainment rates observed at Townsend Dam and reported by EPRI (1997) are an accurate representation of entrainment rates for the target fish species at Lake Lynn, an estimated 7,164 channel catfish, 6,110 bluegill, 2,099 walleye, 889 smallmouth bass, 124 emerald shiner, and 115 redhorse are entrained on an annual basis at the Project. Estimates of annual entrainment count for gizzard shad at Lake Lynn vary widely dependent on the comparative project selected. Based on the assumption that the reported entrainment rates for gizzard shad at the Townsend, Minetto, and Richard B. Russell Projects are representative of those for gizzard shad at Lake Lynn, annual entrainment for the species ranges from 265 individuals up to 14 million individuals (Table 5-2). The extreme variation in the predicted entrainment estimates for gizzard shad at Lake Lynn calculated using densities from the three comparative projects suggests that the species can be susceptible to entrainment, particularly during the colder months of the year. However, the assumption that site-specific entrainment rates for this species are readily transferable between sites may not be appropriate.

[2] A full listing of entrainment estimates for target species under the range of exceedance conditions in Table 5-1 can be found in Appendix C.

5.4 Predicted Entrainment Survival

The predicted number of entrained individuals for each target fish species (Table 5-2) was combined with the estimated survival rates for turbine units at Lake Lynn obtained using the TBSA to calculate the estimated number of individuals lost during turbine passage. Prior to calculation, the total entrainment estimates for each target species were categorized into length classes based on proportions observed for catch at the project from which the data were reported by EPRI (1997). Estimated numbers of entrained individuals within each length class were then used in combination with modelled survival rates for passage through the Lake Lynn turbines to obtain an estimate of mortality for each species at the Lake Lynn Project. A species specific mortality rate was then calculated as the proportion of the total entrainment estimate for each species represented by individuals predicted to be lost during turbine passage.

Table 5-3 provides a summary of the estimated monthly number of each target fish species entrained at Lake Lynn broken out by length class proportions associated with the site-specific entrainment rates reported for other hydroelectric projects by EPRI (1997). Based on the assumption that entrainment rates observed at Townsend Dam and reported by EPRI (1997) are an accurate representation of entrainment rates for the target fish species at Lake Lynn and incorporation of the size-specific turbine survival rates obtained during the TBSA exercise, an estimated 1,403 channel catfish, 688 bluegill, 557 walleye, 148 smallmouth bass, 16 emerald shiner, and 40 redhorse are lost during turbine passage on an annual basis at the Project. When viewed as a singular percentage of the total number estimated to be entrained on an annual basis at Lake Lynn under a median flow condition, these numbers represented between 11 and 35% of the total number estimated to be entrained.

Similar to the estimates of abundance for entrained gizzard shad (see Section 5.3), the estimated rate of mortality for the species varied widely depending on which of the projects in the EPRI 1997 database was used as a source for “representative” density data. Estimated percent mortality for entrained gizzard shad ranged from a low of 8% using Townsend Dam density data, to a high of 34% using Richard B. Russell density data. This wide range of these estimates further highlights the idea that site-specific entrainment data for gizzard shad may not be transferable between sites.

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Table 5-1: Monthly generation volume (ft^3) at Lake Lynn as estimated from site-specific flow curves provided in Appendix E of PAD

% Exceeded	JAN	FEB	MAR	APR	MAY	JUN
10	27,167,011,200	24,537,945,600	27,167,011,200	26,290,656,000	27,167,011,200	26,290,656,000
25	21,785,182,149	24,537,945,600	18,298,090,538	23,971,506,859	27,167,011,200	9,205,392,890
50	11,028,256,632	24,537,945,600	10,046,221,174	11,892,949,444	14,553,928,174	4,400,326,621
75	4,700,119,918	7,228,251,369	5,673,822,781	5,580,539,795	6,773,167,404	3,108,858,973
90	2,484,667,393	3,444,202,756	2,507,259,905	4,082,485,951	3,878,315,710	1,732,546,030
% Exceeded	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**
10	20,660,624,886	7,048,884,520	26,290,656,000	27,167,011,200	24,704,352,000	27,167,011,200
25	8,259,271,412	4,700,119,918	5,315,231,421	10,283,644,281	17,707,829,553	21,950,624,391
50	4,011,413,812	3,412,745,945	1,463,674,242	3,129,776,879	8,056,068,145	10,124,779,340
75	2,288,659,697	1,896,973,911	927,481,247	1,590,595,910	3,163,212,976	4,979,184,202
90	1,688,238,171	1,393,291,498	772,821,202	1,175,037,405	1,601,815,716	2,694,124,861

Table 5-2: Estimated entrainment for target fish species at Lake Lynn under a 50% exceedance condition and calculated using entrainment density data reported by EPRI (1997) at the Townsend, Minetto Richard B. Russell Projects. Unless otherwise indicated estimates are based on density data collected at the Townsend Project.

Species	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Gizzard shad (Townsend Dam)	143,547	12,058	144,870	2,009	1,230	58	76,477	10,083	100,225	1,907,612	795,825	11,142,179
Gizzard shad (Minetto)	7,802	3,220	3,065	507	10	-	10	94,618	84	173,556	384,933	390
Gizzard shad (Richard B. Russell)	-	-	-	73	-	12	80	29	-	16	55	-
Smallmouth bass	-	-	35	57	434	202	118	25	18	-	-	-
Bluegill	199	482	526	344	1,013	260	177	89	36	629	1,828	527
Walleye	119	289	35	172	217	-	89	25	18	22	103	1,010
Emerald shiner	80	-	-	-	-	-	44	-	-	-	-	-
Channel catfish	-	289	245	287	4,558	665	429	433	171	43	-	44
Shorthead redhorse	-	-	-	115	-	-	-	-	-	-	-	-

Table 5-3: Estimated entrainment of target fish species at at Lake Lynn under a 50% exceedance condition adjusted for survival using predicted size-specific rates generated for Units 1, 3, and 4 using the TBSA model

Species		Size Class (Inches)										Estimated Total for Lake Lynn	Percent Total Mortality
		0-2	2-4	4-6	6-8	8-10	10-15	15-20	20-25	25-30	30+		
Gizzard shad (Townsend Dam)	Proportion of fish entrained	47.21%	46.85%	3.93%	0.87%	1.07%	0.08%	0.00%	0.00%	0.00%	0.00%	14,336,172	8%
	Calculated Mortality	338409	678364	88420	25436	32993	3822	18	0	0	0	1,167,462	
Gizzard shad (Minetto)	Proportion of fish entrained	0.02%	26.33%	59.38%	13.71%	0.57%	0.00%	0.00%	0.00%	0.00%	0.00%	668,195	15%
	Calculated Mortality	6	17766	62291	18687	819	11	0	0	0	0	99,580	
Gizzard shad (Richard B. Russell)	Proportion of fish entrained	0.00%	6.69%	0.00%	0.00%	0.00%	93.31%	0.00%	0.00%	0.00%	0.00%	265	34%
	Calculated Mortality	0	2	0	0	0	87	0	0	0	0	89	
Smallmouth bass	Proportion of fish entrained	7.41%	14.81%	40.74%	7.41%	25.93%	3.70%	0.00%	0.00%	0.00%	0.00%	891	17%
	Calculated Mortality	3	13	57	13	50	12	0	0	0	0	148	
Bluegill	Proportion of fish entrained	19.30%	50.88%	19.88%	9.36%	0.58%	0.00%	0.00%	0.00%	0.00%	0.00%	6,111	11%
	Calculated Mortality	59	314	191	117	8	0	0	0	0	0	688	

Species		Size Class (Inches)										Estimated Total for Lake Lynn	Percent Total Mortality
		0-2	2-4	4-6	6-8	8-10	10-15	15-20	20-25	25-30	30+		
Walleye	Proportion of fish entrained	0.00%	2.00%	2.00%	35.18%	22.72%	34.09%	4.00%	0.00%	0.00%	0.00%	2,100	27%
	Calculated Mortality	0	4	7	151	103	252	40	0	0	0	557	
Emerald shiner	Proportion of fish entrained	0%	60%	40%	0%	0%	0%	0%	0%	0%	0%	124	13%
	Calculated Mortality	0	8	8	0	0	0	0	0	0	0	16	
Channel catfish	Proportion of fish entrained	1.08%	13.98%	40.32%	18.28%	13.98%	7.53%	4.30%	0.54%	0.00%	0.00%	7,165	20%
	Calculated Mortality	4	101	454	267	216	190	147	24	0	0	1,403	
Shorthead redhorse	Proportion of fish entrained	0%	0%	0%	0%	0%	100%	0%	0%	0%	0%	115	35%
	Calculated Mortality	0	0	0	0	0	40	0	0	0	0	40	

6 Summary

The Cheat River supports both warm water and cool water fish species including popular game species such as largemouth bass, smallmouth bass, trout, crappie, walleye, and channel catfish. Community data for biological sampling conducted upstream of Lake Lynn in Cheat Lake documented 35 fish species between 2011 and 2015. Seven species were identified as representative of that community and were included in this desktop assessment of fish entrainment at the Project (bluegill, channel catfish, smallmouth bass, walleye, emerald shiner, golden redhorse, and gizzard shad). Life history information for the target fish species was reviewed and based on the available habitat requirements and behavioral responses to environmental conditions it was determined that gizzard shad are the target species most susceptible to entrainment at the Project. Gizzard shad are abundant in reservoirs where they are found and tend to school together in the pelagic zone. These fish may be present in the vicinity of the Project intakes and could be entrained. Though they are capable of swimming against intake velocities, they may follow the flow or become entrained while attempting to escape predators. These fishes will succumb or become moribund at prolonged cold water temperatures below about 38°F. Young gizzard shad may move downstream out of reservoirs during fall and early winter and their tendency to become moribund as their lower temperature threshold is approached furthers their susceptibility to entrainment. As a result, entrainment of shad tends to peak in the fall and winter in reservoirs where they are abundant. The entrainment potential for the remaining target fish species is expected to be low given the lack of high quality aquatic habitat in the immediate vicinity of the intake structure coupled with the fact that none of the additional fish species are considered obligatory migrants.

Nearly all of the target fish species are unlikely to attain a minimum body size that would be excluded based solely on the existing 4-inch clear spacing at the Project intakes. Only two species, channel catfish and walleye, are likely to achieve a size too large to fit through the existing intake racks. Intake velocities, a factor impacting involuntary entrainment and impingement, were calculated in the range of 2.3 to 2.7 fps. When these intake velocities are considered, only the smallest size classes (i.e., less than 2 inch) of bluegill, channel catfish, smallmouth bass and emerald shiner are at risk of entrainment due to burst swim capabilities less than the calculated approach velocities. Reported burst swim capabilities for the larger size classes of those species as well as all size classes for the remaining three target species are in excess of the expected intake velocities. This is further supported by a review of the EPRI (1997) database which resulted in ten hydroelectric projects with similar characteristics to Lake Lynn at which entrainment studies were conducted. Six of the target species and one surrogate species were identified in the entrainment data from the ten comparable projects and the majority of fish entrained were less than 4 inches in length.

In general, entrainment for most of the target fish species considered during this evaluation is not anticipated to be high at Lake Lynn. As demonstrated at comparable hydroelectric projects (EPRI 1997), the majority of individuals representing the target fish species were less than four inches in length (i.e., likely representative of primarily juvenile fish). Relative to Lake Lynn, the entrainment of juvenile life stages of target species during generation at the Project is probably incidental as they are likely more abundant in shoreline littoral habitat than the pelagic or

deep-water benthic habitat in front of the Lake Lynn intake rack structure. Gizzard shad are the target species most likely to be seasonally entrained during periods of low water temperatures. However, due to their high burst speed swimming capability at all sizes, they are expected to have relatively low entrainment susceptibility during the warmer months of the year.

In the event individuals are entrained, TBSA assessments were conducted for fish lengths representative of the size range of target species with potential to fit through the existing rack spacing at Lake Lynn. The TBSA analysis produced a range of survival estimates for turbine survival through the four Francis units at the Project and were slightly higher for Units 1, 3, and 4 than for the recently modified Unit 2. Within the range of size classes evaluated, survival increased with decreasing body size, a trend also identified in a review of the EPRI (1997) database and consistent with the findings in Winchell et al. (2000). Survival rates calculated for size classes representative of juvenile life stages (i.e., those less than or equal to six inches) ranged from 84-95%.

In addition to the qualitative evaluation for the seven target fish species, quantitative estimates of entrainment and entrainment survival were calculated. Density data available from the EPRI (1997) database was combined with estimated monthly generation volumes to calculate estimates of monthly entrainment for the seven target species. It is important to note that the monthly entrainment estimates are based on the assumption that entrainment rates observed at projects reported by EPRI (1997) are an accurate representation of entrainment rates for the target fish species at Lake Lynn. Assuming this is accurate, annual entrainment estimates for species other than gizzard shad ranged from a low of 115 individuals (redhorse) to a high of 7,165 individuals (channel catfish). Three different sets of monthly entrainment density data were pulled from the EPRI (1997) database to calculate estimates for gizzard shad entrainment at the Project and produced a wide range of estimates with the highest estimate over 14 million individuals entrained annually and a lowest estimate of 265 individuals entrained annually. The wide range of estimated annual entrainment numbers suggest that entrainment rates for gizzard shad may not be readily transferable between sites.

Entrainment estimates for each target species were adjusted to reflect the predicted survival rates generated during the TBSA analysis for the Lake Lynn turbine units. The percentage of the annual entrainment expected to experience mortality was generally low, ranging from 11% of entrained individuals for bluegill to 35% of entrained individuals for redhorse. Similar to the observations for overall abundance, the estimates for the rate of entrainment mortality for gizzard shad varied from a low of 8% of entrained individuals when based on density information available from Townsend Dam to 34% of entrained individuals when based on density information available from Richard B. Russell.

In summary, entrainment potential for most of the target species is anticipated to be low due to a low likelihood of encountering the Project intakes and the lack of obligatory migrants within the system. Of the seven target fish species, gizzard shad are the most likely to be exposed to entrainment at Lake Lynn given their lowered activity and ability to respond during periods of low water temperatures.

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8 Appendices

Appendix A. Supporting tables for burst speed analysis

Bluegill					
% indicates portion of test fish able to achieve speed listed (fps) for 3 seconds					
Size (in)	97.50%	87.50%	50%	12.50%	2.50%
1	1.01	1.21	**1.55**	1.99	2.37
2.25	1.63	1.94	2.49	3.19	3.81
3.5	2.19	2.61	**3.35**	4.30	5.12
4.75	2.60	3.10	3.97	5.09	6.07
6	2.98	3.54	**4.56**	5.84	6.96

Channel catfish					
% indicates portion of test fish able to achieve speed listed (fps) for 3 seconds					
Size (in)	97.50%	87.50%	50%	12.50%	2.50%
2	1.54	1.83	**2.35**	3.02	3.58
6.75	3.21	3.81	4.89	6.30	7.48
11.5	4.43	5.28	**6.76**	8.66	10.34
16.25	5.48	6.53	8.40	10.76	12.83
21	6.37	7.58	**9.74**	12.50	14.90

Smallmouth bass					
% indicates portion of test fish able to achieve speed listed (fps) for 3 seconds					
Size (in)	97.50%	87.50%	50%	12.50%	2.50%
2	1.54	1.83	**2.35**	3.02	3.58
5.25	2.79	3.31	4.27	5.48	6.53
8.5	3.71	4.40	**5.64**	7.25	8.63
11.75	4.53	5.38	6.89	8.86	10.53
15	5.22	6.20	**7.97**	10.20	12.17

Walleye					
% indicates portion of test fish able to achieve speed listed (fps) for 3 seconds					
Size (in)	97.50%	87.50%	50%	12.50%	2.50%
2	1.87	2.45	**3.61**	5.32	6.99
6.5	3.94	5.18	7.61	11.22	14.73
11	5.48	7.22	**10.60**	15.62	20.51
15.5	6.79	8.92	13.16	19.36	25.43
20	7.97	10.47	**15.39**	22.67	29.76

Shorthead redhorse					
% indicates portion of test fish able to achieve speed listed (fps) for 3 seconds					
Size (in)	97.50%	87.50%	50%	12.50%	2.50%
2	1.87	2.45	**3.61**	5.32	6.99
4	2.88	3.77	5.58	8.20	10.79
6	3.71	4.89	**7.19**	10.56	13.88
8	4.53	5.94	8.73	12.86	16.90
10	5.18	6.79	**10.01**	14.73	19.36

Emerald shiner					
% indicates portion of test fish able to achieve speed listed (fps) for 3 seconds					
Size (in)	97.50%	87.50%	50%	12.50%	2.50%
1	1.21	1.59	**2.34**	3.45	4.53
1.5	1.62	2.14	3.14	4.63	6.07
2	1.87	2.45	**3.61**	5.32	6.99
2.5	2.20	2.89	4.27	6.27	8.24
3	0.24	3.19	**4.69**	6.92	9.09

Gizzard shad (Juvenile)					
% indicates portion of test fish able to achieve speed listed (fps) for 3 seconds					
Size (in)	97.50%	87.50%	50%	12.50%	2.50%
2	4.17	4.56	**5.18**	5.87	6.43
3.25	6.04	6.59	7.51	8.53	9.35
4.5	7.45	8.17	**9.29**	10.56	11.55
5.75	8.76	9.58	10.93	12.40	13.58
7	10.20	11.16	**12.70**	14.44	15.81

Gizzard shad (Adult)					
% indicates portion of test fish able to achieve speed listed (fps) for 3 seconds					
Size (in)	97.50%	87.50%	50%	12.50%	2.50%
10	13.03	14.24	**16.21**	18.44	20.21
11	13.91	15.22	17.32	19.69	21.56
12	14.76	16.14	**18.37**	20.90	22.90
13	15.58	17.06	19.42	22.08	24.18
14	16.41	17.98	**20.44**	23.26	25.46

Appendix B: EPRI (1997) reported sample volumes and entrainment densities for the set of Lake Lynn target fish species

Month	Gizzard Shad - Townsend Dam		
	Total Catch (#)	Sample Volume (ft^3)	Density (#/ft^3)
January	3775	290,030,000.00	1.30E-05
February	131	266,080,000.00	4.91E-07
March	4323	299,800,000.00	1.44E-05
April	37	216,770,000.00	1.69E-07
May	18	210,410,000.00	8.45E-08
June	2	159,160,000.00	1.31E-08
July	5410	283,770,000.00	1.91E-05
August	827	280,060,000.00	2.95E-06
September	11656	170,220,000.00	6.85E-05
October	91950	150,860,000.00	6.10E-04
November	24142	244,390,000.00	9.88E-05
December	265437	241,200,000.00	1.10E-03

Month	Gizzard Shad - Minetto		
	Total Catch (#)	Sample Volume (ft3)	Density (#/ft^3)
January	661	934,200,000.00	7.07E-07
February	63	479,300,000.00	1.31E-07
March	624	2,044,600,000.00	3.05E-07
April	43	1,012,600,000.00	4.27E-08
May	2	2,381,400,000.00	6.72E-10
June	-	-	-
July	2	640,000,000.00	2.50E-09
August	8672	312,800,000.00	2.77E-05
September	16	281,800,000.00	5.75E-08
October	62002	1,118,100,000.00	5.55E-05
November	56913	1,191,100,000.00	4.78E-05
December	23	596,700,000.00	3.85E-08

Month	Gizzard Shad - Richard B. Russell		
	Total Catch (#)	Sample Volume (ft3)	Density (#/ft^3)
January	-	-	-
February	-	-	-
March	-	-	-
April	4	648,000,000.00	6.17E-09
May	-	-	-
June	2	760,800,000.00	2.63E-09
July	14	701,900,000.00	1.99E-08
August	4	464,500,000.00	8.61E-09
September	-	-	-
October	3	596,200,000.00	5.03E-09
November	12	1,709,700,000.00	6.77E-09
December	-	-	-

Month	Smallmouth bass - Townsend Dam		
	Total Catch (#)	Sample Volume (ft^3)	Density (#/ft^3)
January	-	-	-
February	-	-	-
March	1	299,800,000.00	3.49E-09
April	1	216,770,000.00	4.83E-09
May	6	210,410,000.00	2.98E-08
June	7	159,160,000.00	4.60E-08
July	8	283,770,000.00	2.95E-08
August	2	280,060,000.00	7.47E-09
September	2	170,220,000.00	1.23E-08
October	-	-	-
November	-	-	-
December	-	-	-

Month	Bluegill - Townsend Dam		
	Total Catch (#)	Sample Volume (ft^3)	Density (#/ft^3)
January	5	290,030,000.00	1.80E-08
February	5	266,080,000.00	1.97E-08
March	16	299,800,000.00	5.23E-08
April	6	216,770,000.00	2.90E-08
May	15	210,410,000.00	6.96E-08
June	9	159,160,000.00	5.91E-08
July	13	283,770,000.00	4.42E-08
August	7	280,060,000.00	2.61E-08
September	4	170,220,000.00	2.46E-08
October	30	150,860,000.00	2.01E-07
November	55	244,390,000.00	2.27E-07
December	13	241,200,000.00	5.20E-08

Month	Walleye - Townsend Dam		
	Total Catch (#)	Sample Volume (ft^3)	Density (#/ft^3)
January	3	290,030,000.00	1.08E-08
February	3	266,080,000.00	1.18E-08
March	1	299,800,000.00	3.49E-09
April	3	216,770,000.00	1.45E-08
May	3	210,410,000.00	1.49E-08
June	-	-	-
July	6	283,770,000.00	2.21E-08
August	2	280,060,000.00	7.47E-09
September	2	170,220,000.00	1.23E-08
October	1	150,860,000.00	6.93E-09
November	3	244,390,000.00	1.28E-08
December	24	241,200,000.00	9.97E-08

Month	Emerald shiner - Townsend Dam		
	Total Catch (#)	Sample Volume (ft^3)	Density (#/ft^3)
January	2	290,030,000.00	7.21E-09
February	-	-	-
March	-	-	-
April	-	-	-
May	-	-	-
June	-	-	-
July	3	283,770,000.00	1.11E-08
August	-	-	-
September	-	-	-
October	-	-	-
November	-	-	-
December	-	-	-

Month	Channel catfish - Townsend Dam		
	Total Catch (#)	Sample Volume (ft^3)	Density (#/ft^3)
January	-	-	-
February	3	266,080,000.00	1.18E-08
March	7	299,800,000.00	2.44E-08
April	5	216,770,000.00	2.41E-08
May	66	210,410,000.00	3.13E-07
June	24	159,160,000.00	1.51E-07
July	30	283,770,000.00	1.07E-07
August	36	280,060,000.00	1.27E-07
September	20	170,220,000.00	1.17E-07
October	2	150,860,000.00	1.39E-08
November	-	-	-
December	1	241,200,000.00	4.34E-09

Month	Shorthead redhorse - Townsend Dam		
	Total Catch (#)	Sample Volume (ft^3)	Density (#/ft^3)
January	-	-	-
February	-	-	-
March	-	-	-
April	2	216,770,000.00	9.65E-09
May	-	-	-
June	-	-	-
July	-	-	-
August	-	-	-
September	-	-	-
October	-	-	-
November	-	-	-
December	-	-	-

Appendix C: Estimated monthly entrainment abundance for Lake Lynn target fish species under five different flow conditions

Calculated estimates of entrained gizzard shad by month under five different flow conditions at the Lake Lynn Project based on density data collected at Townsend Dam

% Exceeded	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
10	353,613	12,058	391,758	4,440	2,296	346	393,892	20,825	1,800,259	16,558,405	2,440,439	29,896,917
25	283,561	12,058	263,865	4,049	2,296	121	157,462	13,886	363,962	6,267,924	1,749,282	24,156,356
50	143,547	12,058	144,870	2,009	1,230	58	76,477	10,083	100,225	1,907,612	795,825	11,142,179
75	61,178	3,552	81,819	943	572	41	43,633	5,604	63,509	969,475	312,481	5,479,523
90	32,341	1,692	36,156	690	328	23	32,186	4,116	52,919	716,190	158,237	2,964,847

Calculated estimates of entrained gizzard shad by month under five different flow conditions at the Lake Lynn Project based on density data collected at Minetto

% Exceeded	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
10	19,219	3,220	8,289	1,122	18	-	52	195,429	1,511	1,506,495	1,180,416	1,047
25	15,412	3,220	5,583	1,023	18	-	21	130,310	306	570,260	846,110	846
50	7,802	3,220	3,065	507	10	-	10	94,618	84	173,556	384,933	390
75	3,325	949	1,731	238	5	-	6	52,593	53	88,203	151,144	192
90	1,758	452	765	174	3	-	4	38,629	44	65,159	76,538	104

Calculated estimates of entrained gizzard shad by month under five different flow conditions at the Lake Lynn Project based on density data collected at Richard B. Russell Pump-Storage

% Exceeded	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
10	-	-	-	162	-	69	412	61	-	137	167	-
25	-	-	-	148	-	24	165	40	-	52	120	-
50	-	-	-	73	-	12	80	29	-	16	55	-
75	-	-	-	34	-	8	46	16	-	8	21	-
90	-	-	-	25	-	5	34	12	-	6	11	-

Calculated estimates of entrained smallmouth bass by month under five different flow conditions at the Lake Lynn Project based on density data collected at Townsend Dam

% Exceeded	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
10	-	-	95	127	810	1,210	609	53	323	-	-	-
25	-	-	64	116	810	423	244	35	65	-	-	-
50	-	-	35	57	434	202	118	25	18	-	-	-
75	-	-	20	27	202	143	67	14	11	-	-	-
90	-	-	9	20	116	80	50	10	9	-	-	-

Calculated estimates of entrained bluegill by month under five different flow conditions at the Lake Lynn Project based on density data collected at Townsend Dam

% Exceeded	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
10	490	482	1,422	761	1,891	1,555	914	184	646	5,463	5,604	1,414
25	393	482	958	694	1,891	544	365	123	131	2,068	4,017	1,142
50	199	482	526	344	1,013	260	177	89	36	629	1,828	527
75	85	142	297	162	471	184	101	50	23	320	718	259
90	45	68	131	118	270	102	75	36	19	236	363	140

Calculated estimates of entrained walleye by month under five different flow conditions at the Lake Lynn Project based on density data collected at Townsend Dam

% Exceeded	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
10	294	289	95	381	405	-	457	53	323	188	317	2,709
25	236	289	64	347	405	-	183	35	65	71	227	2,189
50	119	289	35	172	217	-	89	25	18	22	103	1,010
75	51	85	20	81	101	-	51	14	11	11	41	497
90	27	41	9	59	58	-	37	10	9	8	21	269

Calculated estimates of entrained emerald shiner by month under five different flow conditions at the Lake Lynn Project based on density data collected at Townsend Dam

% Exceeded	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
10	196	-	-	-	-	-	228	-	-	-	-	-
25	157	-	-	-	-	-	91	-	-	-	-	-
50	80	-	-	-	-	-	44	-	-	-	-	-
75	34	-	-	-	-	-	25	-	-	-	-	-
90	18	-	-	-	-	-	19	-	-	-	-	-

Calculated estimates of entrained channel catfish by month under five different flow conditions at the Lake Lynn Project based on density data collected at Townsend Dam

% Exceeded	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
10	-	289	664	634	8,509	3,974	2,209	895	3,070	377	-	118
25	-	289	447	578	8,509	1,391	883	597	621	143	-	95
50	-	289	245	287	4,558	665	429	433	171	43	-	44
75	-	85	139	135	2,121	470	245	241	108	22	-	22
90	-	41	61	99	1,215	262	180	177	90	16	-	12

Calculated estimates of entrained shorthead redhorse (surrogate for Golden redhorse) by month under five different flow conditions at the Lake Lynn Project based on density data collected at Townsend Dam

% Exceeded	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
10	-	-	-	254	-	-	-	-	-	-	-	-
25	-	-	-	231	-	-	-	-	-	-	-	-
50	-	-	-	115	-	-	-	-	-	-	-	-
75	-	-	-	54	-	-	-	-	-	-	-	-
90	-	-	-	39	-	-	-	-	-	-	-	-

Freshwater Mussel Reconnaissance Scoping Survey Report

Cheat River

November 2020

Lake Lynn Hydroelectric Project (FERC No. P-2459)

Prepared For:

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Bethesda, Maryland 20814

Prepared By:

TRC Companies, Inc.
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Cleveland, OH 44113

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ACRONYM LIST

AMD	Acid Mine Drainage
°C	Celsius
EnviroScience	EnviroScience, Inc.
FERC	Federal Energy Regulatory Commission
Lake Lynn	Lake Lynn Generation, LLC
MW	Megawatt
NOI	Notice of Intent
PAD	Pre-Application Document
PFBC	Pennsylvania Fish and Boat Commission
Project	Lake Lynn Hydroelectric Project (FERC No. P-2459)
Protocol	2020 West Virginia Mussel Survey Protocols
Study Plan	*Lake Lynn Hydroelectric Project (FERC No. P-2459) Final Study Plan* dated September 2020
TRC	TRC Companies, Inc.
USFWS	United States Fish and Wildlife Service
WVDNR	West Virginia Division of Natural Resources

Acknowledgements

Lake Lynn Generation, LLC (Lake Lynn) has contracted TRC Companies, Inc. (TRC), to conduct a reconnaissance scoping survey for the Lake Lynn Hydroelectric Project (FERC No. P-2459) (Project) near Morgantown, Monongalia County, West Virginia and Fayette County, Pennsylvania near the borough of Point Marion. TRC contracted EnviroScience, Inc. (EnviroScience) for an approved malacologist for the survey. Ms. Joyce Foster (TRC) was the Project Manager, Ms. Sarah Veselka (EnviroScience) was the Pennsylvania and West Virginia Approved Malacologist and Ms. Lindsey Jakovljevic (TRC) was the field team lead for the duration of the survey. Mr. Thomas Radford (TRC) and Mr. Tony Tredway (TRC) assisted with the field effort. Ms. Jakovljevic, Ms. Veselka, and Mr. Radford co-authored this report.

1.0 Introduction

Lake Lynn Generation LLC (Lake Lynn), owner and operator of the Lake Lynn Hydroelectric Project (FERC No. P-2459) (Project), is relicensing the Project with the Federal Energy Regulatory Commission (FERC). The current FERC license was issued in December 1994 and will expire on November 30, 2024. The Project is located on the Cheat River near Morgantown, Monongalia County, West Virginia and Fayette County, Pennsylvania near the borough of Point Marion (**Figure 1**). Lake Lynn filed a Notice of Intent (NOI) and Pre-Application Document (PAD) with FERC on August 29, 2019 and held a Joint Meeting and Site Visit in December 2019. Following the Joint Meeting and Site Visit, resource agencies and other stakeholders were afforded the opportunity to comment on the PAD and to request natural resource studies that they deemed were needed to evaluate Project impacts on natural, cultural and recreational resources. The United States Fish and Wildlife Service (USFWS) reviewed the NOI and PAD and requested that a mussel reconnaissance scoping survey be conducted downstream of the dam.

2.0 Objectives

The purpose of the reconnaissance scoping survey as outlined in the *Lake Lynn Hydroelectric Project (FERC No. P-2459) Final Study Plan* dated September 2020 (Study Plan) is to identify what freshwater mussel species, if any, may occur within the Cheat River from the Project dam to the confluence with the Monongahela River, approximately 3.5-miles downstream.

3.0 Background and Existing Information

By email dated May 18, 2020, Lake Lynn provided a draft Mussel Survey Plan to the USFWS, Pennsylvania Fish and Boat Commission (PFBC), and West Virginia Division of Natural Resources (WVDNR). Lake Lynn convened a meeting via Microsoft Teams and conference call on May 20, 2020 to discuss the draft Mussel Survey Plan. The draft Mussel Survey Plan proposed following 2020 West Virginia Mussel Survey Protocols (Protocol) guidance for effort required for Group 3 streams (WVDNR, 2020) and defining the survey area as the area inside the Project boundary and a downstream buffer (DSB) limit of 25 meters beyond the Project boundary. The Resource Agencies expressed concerns about limiting the survey area and requested that the survey area extend 1 mile downstream of the Project since they considered this project as a scoping project without a full hydraulic study. As an action item, Lake Lynn agreed to share the 1993 Project Instream Flow Study to provide additional information about the Project's operational influence downstream of the dam and the geographic scope of the survey.

Lake Lynn distributed the 1993 Project Instream Flow Study to the resource agencies on June 2, 2020. The 1993 Project Instream Flow Study reported that water level fluctuations due to Project operation are greatest in the segment of river extending 1.02-miles below the Project dam. The 1993 Project Instream Flow Study also reported that the water depth in the Cheat

River segment from the 1.02-mile point below the Project dam to the confluence with the Monongahela is dependent upon and maintained by Pool 7 water elevations during Project shutdown.

By email dated July 9, 2020, Lake Lynn provided a revised draft Mussel Survey Plan to the USFWS, PFBC, and WVDNR. Comments were received from WVDNR and PFBC. WVDNR requested that the first page of the Mussel Survey Plan clarify the intent of the survey and noted that if the intent is to conduct a reconnaissance scoping survey, then the methodology provided is sufficient. WVDNR also requested that the Mussel Survey Plan address the handling of mussels and include a completed summary protocol form. PFBC agreed with the proposed survey methodology outlined in the Mussel Survey Plan dated July 9, 2020 but disagreed with the limits of the survey area being restricted to 1.02-miles downstream of the Project dam (copies of relevant correspondence are included in Attachment 2 of the Mussel Survey Plan in **Appendix A**).

A revised survey plan was submitted to WVDNR and PFBC by EnviroScience, Inc. (EnviroScience) on Monday September 7, 2020. Comments were received on September 8, 2020 from PFBC stating that the one mile was not sufficient and that a survey would need to be performed to the confluence of the Monongahela River, approximately 3.5 miles downstream, of the Project boundary.

The draft Mussel Survey Plan was revised based on comments received on September 8, 2020 from PFBC. The final Mussel Survey Plan was approved by WVDNR on September 9, 2020 and by PFBC on September 11, 2020 and is provided in **Appendix A**.

The Project is a 51.2 megawatt (MW) single development hydroelectric project operated since 1926. It consists of:

- a 125-foot high by 1,000-foot long concrete gravity-type dam with a 624-foot long spillway controlled by 26 Tainter gates, each 17 feet high by 21 feet long;
- a reservoir with a surface area of 1,729 acres and containing about 72,00 acre-feet of water at full pool elevation of 870 feet National Geodetic Vertical Datum;
- a log boom and track racks at the intake facility;
- eight 12-foot by 18-foot gated penstocks of reinforced concrete;
- a 72-foot by 165-foot by 68-foot high brick powerhouse containing four identical Francis generating units with a total rated capacity of 51.2 MW;
- dual 800-foot long 13 8-kilovolt transmission lines; and
  appurtenant facilities.

4.0 Study Area

The study area within the Cheat River includes the Project boundary, which extends approximately 200 meters downstream of the Project dam, and approximately 3.5 miles downstream of the Project boundary to the confluence of the Monongahela River. The entirety of the Study Area is within the channel of the Cheat River and excludes its tributaries that exist within the reach. TRC Companies, Inc. (TRC) has preliminarily defined the study area as depicted on the attached **Figure 2**.

5.0 Methods

Ms. Lindsey (Moss) Jakovljevic (TRC) was the field team leader for this survey. TRC collaborated with EnviroScience for the duration of the field work and Sarah Veselka (EnviroScience) was the Pennsylvania and West Virginia permitted malacologist (Permit #19-ES0034 and 2020.111) for the survey. The survey was conducted within the study area on September 16 and 17, 2020. Conditions (visibility and flow) at each site were adequate for detecting mussel presence. Visibility was exceptional and clear to the bottom in most cases. The flow conditions were observed to be low and normal. Maximum depth observed was approximately four meters. Weather was clear and air temperatures averaged 21 degrees Celsius (°C) for the duration of the field work. Water temperatures averaged 21.7 °C for the duration of the fieldwork.

5.1 Qualitative Survey Design

Reconnaissance scoping survey efforts were coordinated and led by a West Virginia and Pennsylvania approved malacologist. The qualified malacologist provided survey oversight and guidance on execution of the survey and was the lead taxonomist in the field for the duration of the work. The survey followed modified West Virginia Protocol guidance (WVDNR, 2020) with additional guidance from the *American Fisheries Society Monograph 8* (Strayer and Smith, 2003). The survey area included the Project boundary, that extends approximately 200 meters downstream of the Project dam, and approximately 3.5 miles downstream of the Project boundary to the confluence with the Monongahela River.

TRC and EnviroScience biologists performed a reconnaissance scoping survey to determine areas of suitable mussel habitat and evaluate mussel presence/absence within the survey area downstream of the Project dam. The habitat assessment started at the Project dam and continued approximately 3.5 miles downstream to the confluence of the Monongahela River (**Figure 2**). The habitat assessment started at the dam instead of the mouth of the Cheat River, as stated in the Survey Plan, as it was easier to navigate the river with the flow instead of against it. The banks were searched for shell material and the substrate was evaluated to identify suitable mussel habitat (stable burrowable substrates including sand, gravel, cobble, etc.). Once suitable mussel habitat was located, a qualitative timed search was employed for a minimum of 10 minutes to

search for live mussels and shell material. In the state of West Virginia, there was one qualitative search every 100 meters in the best possible substrate. Qualitative surveys in the Commonwealth of Pennsylvania were only performed where suitable habitat was identified. If live mussels were observed, the area was searched until the limits of the mussel bed were delineated.

This reconnaissance scoping survey consisted of visually and tactilely searching the area for the presence of mussels and to determine the limits of any mussel concentrations. Snorkeling was used to visually and tactilely search for mussels at the substrate surface; moving cobble and woody debris; hand sweeping away silt, sand and/or small detritus; and disturbing/probing the upper 5 centimeters (2 inches) of substrate to ensure recovery of buried mussels. Data was collected separately for each qualitative search.

Photographs were taken of the survey area. Data recorded included:

- substrate composition of each sample (visual percentage based on Wentworth scale;
- water depth (meters);
- mussel shells (classified as fresh dead, weathered dead, or relic shell);
- where applicable; Global Positioning System (GPS) coordinates of the survey area,
- mussel aggregation limits; and
- other notable features such as land use and general observations about the stream.

6.0 Results

In accordance with the approved survey plan, biologists from TRC and EnviroScience completed a reconnaissance scoping survey at 12 discrete sites within the Cheat River, from the Project dam downstream to the confluence with the Monongahela River (approximately 3.5 miles). The survey was conducted on September 16 and 17, 2020. The survey area included the Project boundary, that extends approximately 200 meters downstream of the Project dam, and approximately 3.5 miles downstream of the Project boundary to the confluence with the Monongahela River.

During the survey, no live native mussels were observed. However, eight live native mussels comprised of one species (*Potamilus alatus* [Pink heelsplitter]), were observed from the confluence of the Cheat River and the Monongahela River outside of the downstream limits of the survey area. The live mussels observed were not within one of the recorded sites searched and were assumed to be part of a mussel bed located in the Monongahela River. The mussels were observed while surveyors were heading to the kayak take out location. Live *Corbicula fluminea* (Asian Clam), an invasive freshwater clam, was observed in abundance at Site #11. Additionally, several sub-fossil relic shells of multiple species were collected along the left descending bank of the Cheat River at Site #12. These relic shells appeared to be extremely old and assumed to have been washed up the Cheat River from the Monongahela River during a flood event. Representative photographs of the survey area and mussels ovserved are provided in **Appendix B**.

6.1 Mussel Community

The reconnaissance scoping survey effort was concentrated in areas were suitable mussel habitat was present. Zero live mussels were observed within the survey area of the Cheat River. However, a total of eight live mussels, representing one species (*P. alatus* [Pink heelsplitter]) were observed approximately 3.5-miles downstream of the Project dam at the confluence with the Monongahela River. The live mussels observed were not within one of the recorded sites searched and were assumed to be part of a mussel bed located in the Monongahela River. The mussels were found while surveyors were heading to the kayak take out location. All live mussels observed were located along the left descending bank at the confluence of the Cheat River and Monongahela River in an area of sand, silt, and mud, outside of the survey area. No federal or state listed species were observed during the survey.

6.2 Mussel Habitat

Beginning in the 1970s, whitewater paddlers on the Cheat River observed water quality becoming increasingly degraded by acid mine drainage (AMD) discharging from abandoned mine lands and active coal mine operations. In the spring of 1994, polluted water from an illegally-sealed major underground coal mine blew out the hillside and poured into Muddy Creek. This massive release of mine water entered the main stem of the Cheat River just upstream of the Cheat Canyon, and turned the river orange for miles. A second blowout in 1995 further accentuated the problem and caused American Rivers, Inc., a national river conservation organization, to name the Cheat as one of the nation's ten most endangered rivers (Friends of the Cheat, 2020). AMD inputs heavy metals into bodies of water adjacent to coal mining activities, such as the Cheat River. Freshwater mussels are confined to the river bottom, generally immobile, and are therefore very sensitive to poor water quality. The input of AMD may continue to affect the water quality in this reach of the Cheat River and create an environment that is not conducive to mussel colonization.

Starting at approximately 0.4 miles downstream of the Project dam and continuing to the confluence of the Monongahela River, there was evidence of AMD, a yellow-orange coating on the rocks, sediment, and aquatic plants, from Grassy Run, a tributary of the Cheat River (**Attachment 2**; photos 18-20). There was also evidence of AMD coming from unnamed tributaries of the Cheat River, along the left descending bank at 1.8 miles downstream and along the right descending bank at approximately 1.9 miles downstram (**Attachment 2**; photos 44-46).

Substrate within the Cheat River from the Project dam to approximately 1.2-miles downstream was deemed suitable for freshwater mussel presence. Substrate throughout the survey area was mostly a heterogenous mixture of cobble, gravel, and sand. Cobble and gravel were the predominant substrates throughout the reach. Water depths within this reach ranged between 0.2 meters and 1.5 meters. The Cheat River from the Project dam to approximately 1.2-miles downstream was primarily a riffles/run complex. Despite the presence of suitable substrate throughout this section of the Cheat River, no mussel communities or shell material, were observed.

From 1.2-miles downstream of the Project dam to the confluence with the Monongahela River, the Cheat River was majority pool, with depths ranging between 1.5 meters and 4 meters. The substrate in this reach transitioned from cobble, gravel, and sand to mostly sand and silt. Three sites were surveyed in this reach where suitable habitat was found along the banks. Site #11 was the best possible site that was searched within the survey area that could support live mussels. Live *Corbicula fluminea* (Asian Clam), an invasive freshwater clam, was observed in abundance at Site #11 (**Figure 3**). Despite the presence of suitable mussel habitat throughout this section of the Cheat River, no native freshwater mussel communities, were observed within the study area. However, eight live native mussels were found outside the study area, within the Monongahela river while kayaking to the takeout location. Relic shell material was also observed at Site #12. A summary of substrate characteristics of each site is provided in **Table 1**. Table 1. Summary of Substrate characteristics in the Cheat River, 2020.

Table 1. Summary of Substrate characteristics in the Cheat River, 2020.

Site	State	% Substrate Composition								**Total**
		Br	Bo	Co	Gr	Sd	St	LWD	Vegetation	
1	WV	*10*	*30*	*45*	*10*	*5*	–	–	–	**100**
2	WV	*5*	*25*	*40*	*20*	*10*	–	–	–	**100**
3	PA	–	–	*70*	–	–	–	–	*30*	**100**
4	PA	–	–	*45*	*30*	*25*	–	–	–	**100**
5	PA	–	–	*60*	*30*	–	–	–	*10*	**100**
6	PA	–	*5*	*55*	*25*	–	–	–	*15*	**100**
7	PA	–	–	*60*	*40*	–	–	–	–	**100**
8	PA	–	–	*40*	*35*	–	–	*5*	*20*	**100**
9	PA	–	–	*65*	*15*	–	–	–	*20*	**100**
10	PA	–	–	*75*	*15*	–	–	–	*10*	**100**
11	PA	–	–	*60*	*15*	*25*	–	–	–	**100**
12	PA	–	–	–	–	*55*	*35*	*10*	–	**100**
Br= Bedrock, Bo= Boulder, Cb= Cobble, Gr= Gravel, Sd= Sand, St= Silt, LWD= Large Woody Debris										

7.0 Variances from the Study Plan

The habitat assessment was conducted from the dam to the confluence instead of from the confluence to the dam. This was done as it was more efficient to conduct the survey with the flow of the river.

8.0 Summary

In accordance with the approved survey plan, biologists from TRC and EnviroScience completed a reconnaissance scoping survey at 12 discrete sites within the Cheat River, from the Project dam downstream to the confluence with the Monongahela River (approximately 3.5 miles). The survey was conducted on September 16 and 17, 2020. The survey area included the Project boundary, that extends approximately 200 meters downstream of the Project dam, and approximately 3.5 miles downstream of the Project boundary to the confluence with the Monongahela River.

Suitable mussel habitat exists within the surveyed reach of the Cheat River. From the dam to approximately 1.2 miles downstream, the substrate was a heterogenous mixture of cobble, gravel, and sand and was predominately a riffle/run complex. From 1.2 miles downstream to the confluence of the Monongahela River the substrate was mostly sand and silt with intermittent cobble bars along the shore, at the confluence of tributaries, and island margins. This section of the Cheat River was predominately a pool. No native freshwater mussels were observed within the study area during the survey. Live *Corbicula fluminea* (Asian Clam), an invasive freshwater clam, was observed at Site #11 and several sub-fossil relic shells of multiple species were observed along the left descending bank of the Cheat River at Site #12 (approximately 3.4 miles downstream at the confluence to the Monongahela River). Additionally, there were eight live mussels of one species (*P. alatus*) found outside of the survey area at the confluence of the Monongahela River. The lack of established mussel communities within this reach of the Cheat River is possibly due to water quality influenced by AMD.

9.0 References

Friends of the Cheat. “History.” Friends of the Cheat, 2020, www.cheat.org/about/history/.

Strayer, D.L., and D.R. Smith. 2003. A guide to sampling freshwater mussel populations. American Fisheries Society, Monograph 8, Bethesda, Maryland.

West Virginia Division of Natural Resources (WVDNR). 2020. West Virginia Mussel Survey Protocols. West Virginia Division of Natural Resources. unpublished. 25pp + app.

TRC - GIS

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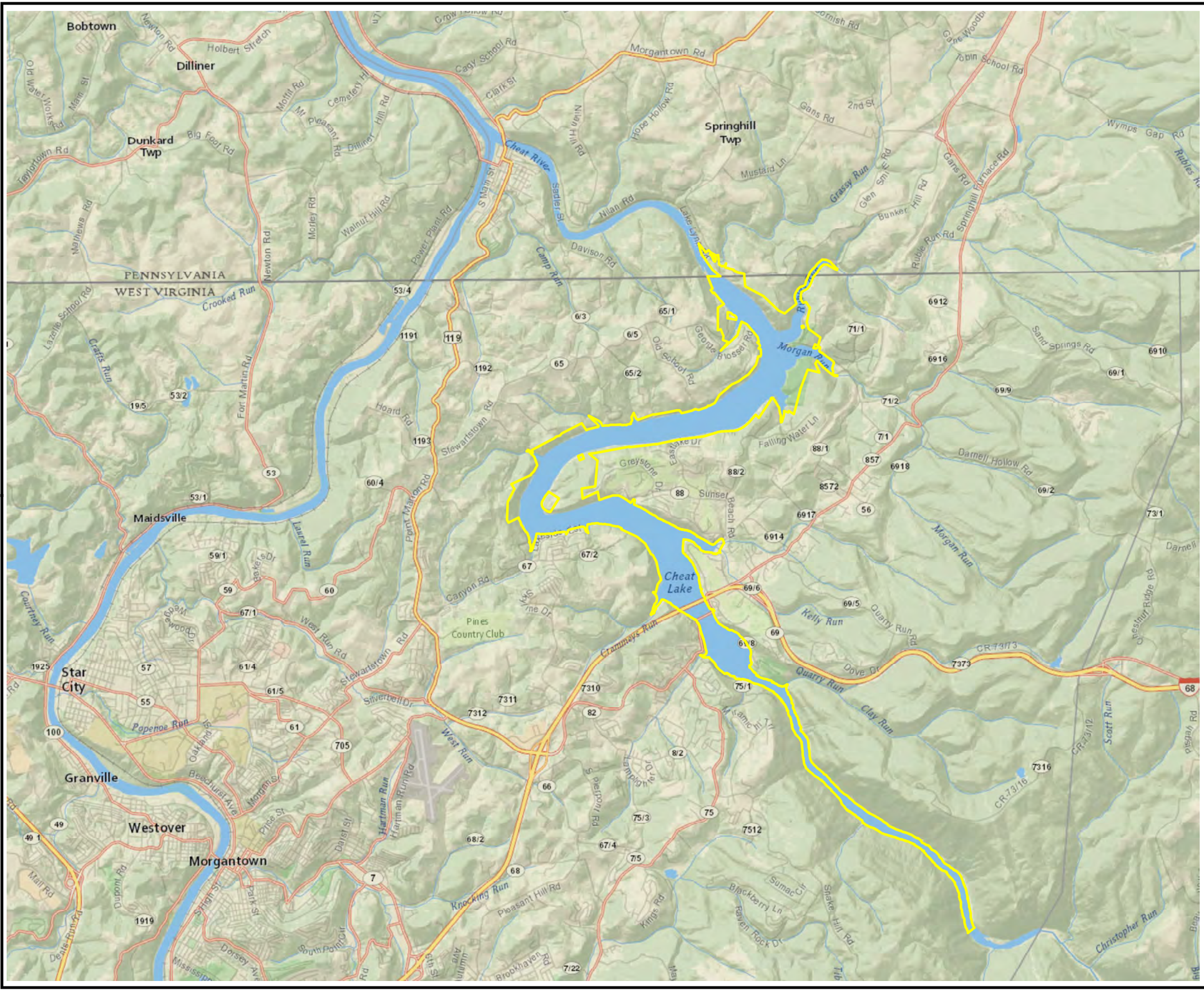
Coordinate System: NAD 1983 UTM Zone 17N (Foot US)
Map Rotation: 0



LEGEND

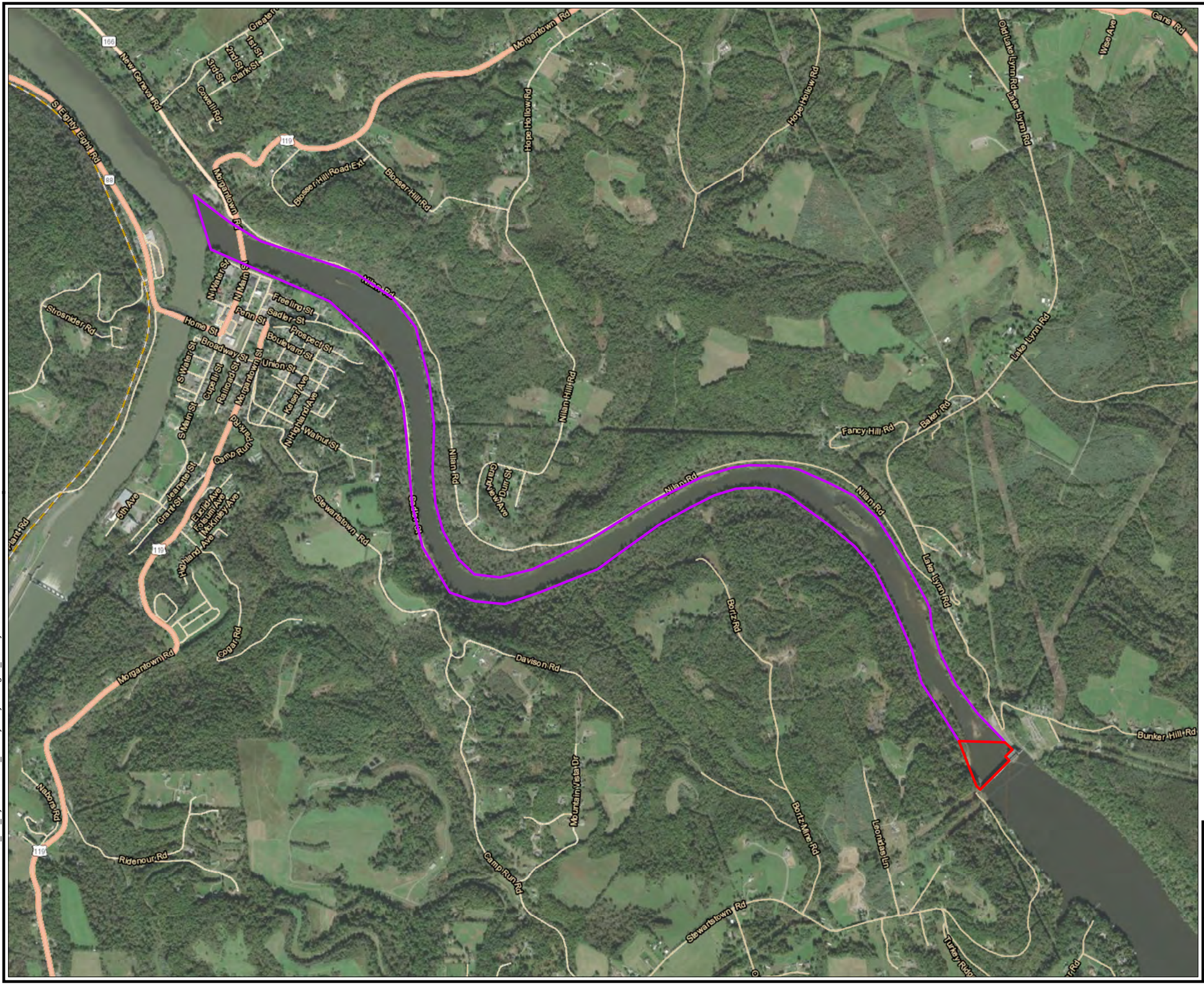
FERC Project Boundary

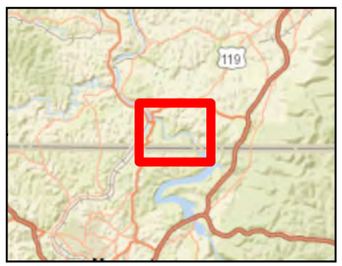
PROJECT:	LAKE LYNN GENERATION, LLC
TITLE:	Project Location Map
DRAWN BY: K. BABCOCK	PROJ. NO.: 232345.0000.0000
CHECKED BY:	FIGURE 1
APPROVED BY:	
DATE: JULY 2019	

TRC
14 Gabriel Drive
Augusta, ME 04330

FILE NO.: Lake_Lynn_Project_Location.mxd

TRC - GIS





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1 " = 1,500 ' 1:18,000

LAKE LYNN HYDROELECTRIC PROJECT
MONONGALIA COUNTY, WEST VIRGINIA

FIGURE 2
SURVEY AREA LIMITS

TRC
1382 West Ninth Street
Suite 400
Cleveland, OH 44113
Phone: 216-344-3072

SEPTEMBER 2020 Fig02_SurveyArea.mxd

Plot Date: 9/9/2020, 11:03:27 AM by MOPEL – LAYOUT: ANSI B(11"X17")
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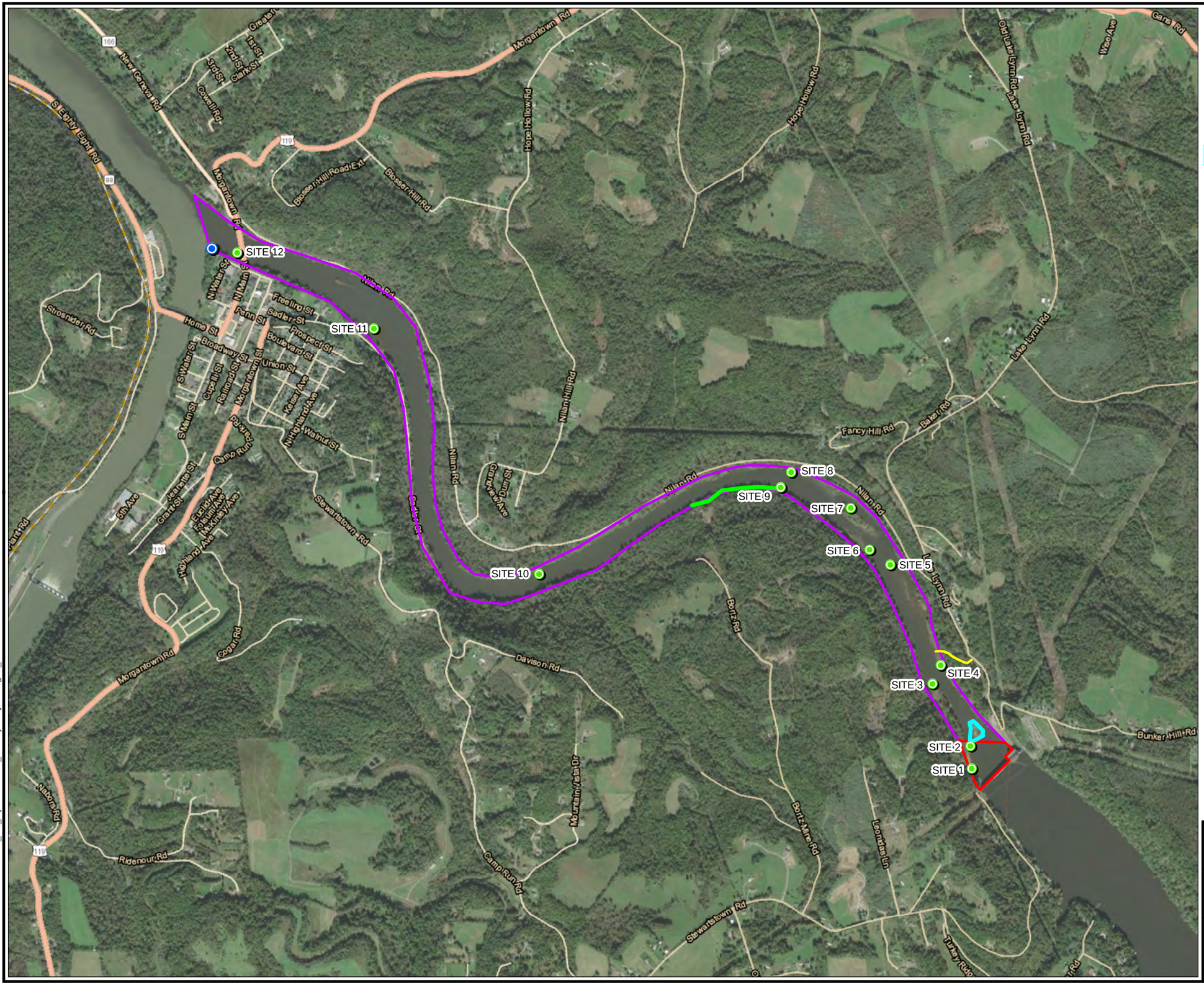
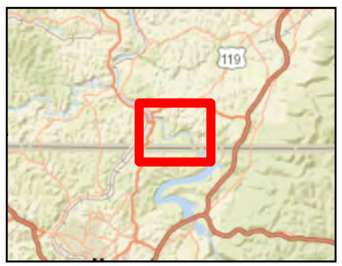
TRC - GIS





Project Boundary
Downstream Survey Buffer
Live Mussel Observation
Suitable Mussel Habitat (Survey Site Location)
Island/Out of Water
Acid Mine Drainage Stream
Suitable Mussel Habitat

0 1,500 3,000 Feet

1 " = 1,500 ' 1:18,000

LAKE LYNN HYDROELECTRIC PROJECT
Monongalia County, West Virginia and Fayette County, Pennsylvania

FIGURE 3
RECONNAISSANCE MUSSEL SURVEY AREA SITE LOCATIONS

TRC
1382 West Ninth Street
Suite 400
Cleveland, OH 44113
Phone: 216-344-3072

OCTOBER 2020 Fig03_ReconSites.mxd

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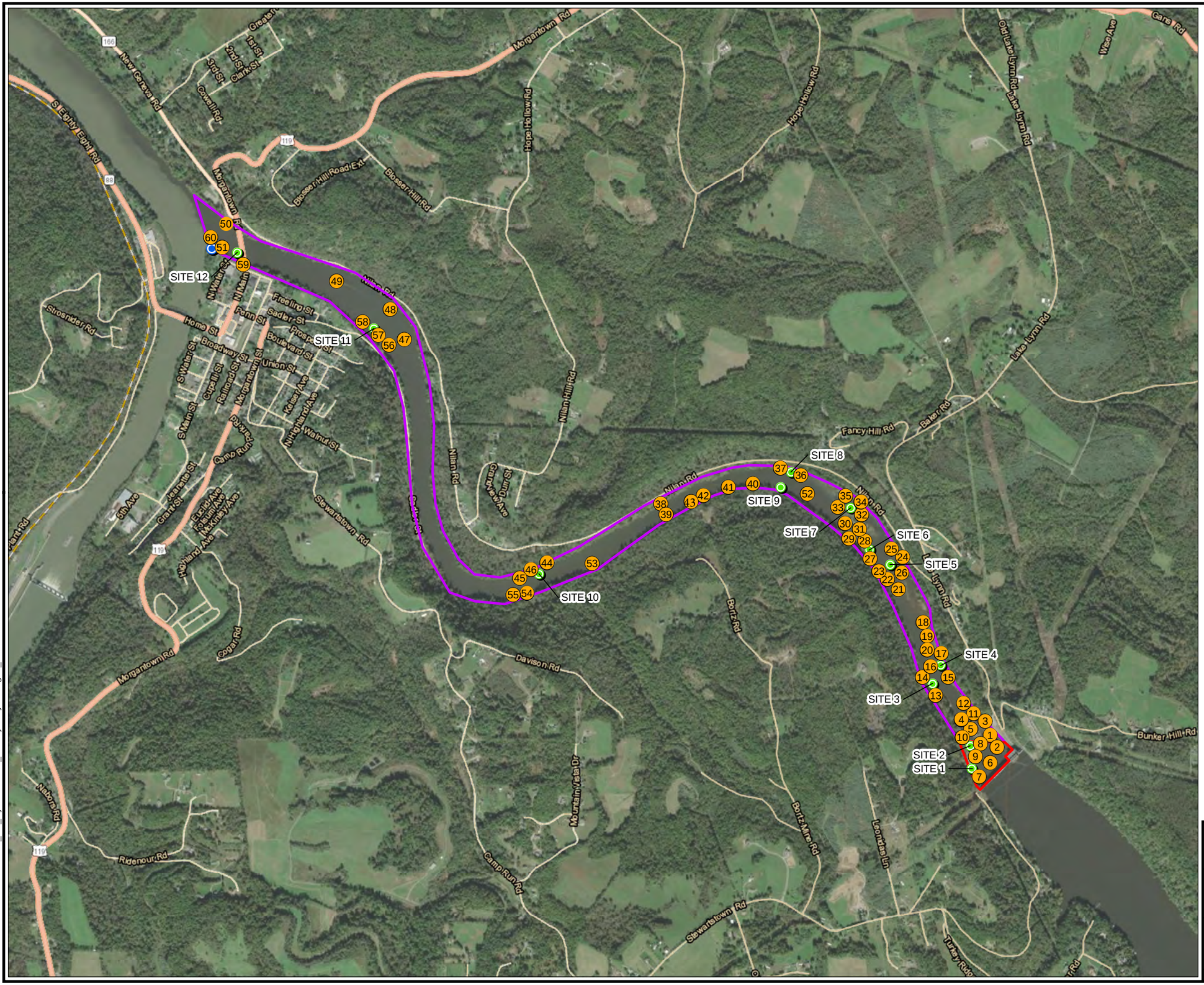
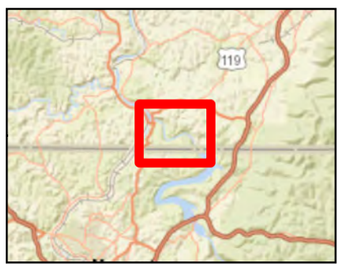
TRC - GIS





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1 " = 1,500 ' 1:18,000

LAKE LYNN HYDROELECTRIC PROJECT
Monongalia County, West Virginia and Fayette County, Pennsylvania

FIGURE 4
PHOTO LOCATION MAP

TRC
1382 West Ninth Street
Suite 400
Cleveland, OH 44113
Phone: 216-344-3072

OCTOBER 2020 Fig04_Photos.mxd

Plot Date: 10/30/2020, 11:19:00 AM by MOPEL -- LAYOUT: ANSI B(11"x17")
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Appendix A
Approved Mussel Survey Plan, Agency Correspondence, Permits

REVISED 2020 MUSSEL SURVEY PLAN (SEPTEMBER 2020)
CHEAT RIVER – LAKE LYNN HYDROELECTRIC PROJECT
MONONGALIA COUNTY, WEST VIRGINIA AND FAYETTE COUNTY, PENNSYLVANIA

Survey Background and Justification

Lake Lynn Generation LLC (Lake Lynn) is relicensing the Lake Lynn Hydroelectric Project (FERC No. P-2459) (Project) with the Federal Energy Regulatory Commission (FERC). The current FERC license was issued in December 1994 and will expire on November 30, 2024. The Project is located on the Cheat River near Morgantown, West Virginia in Monongalia County, West Virginia and Fayette County, Pennsylvania (**Figure 1**). Lake Lynn filed a Notice of Intent (NOI) and Pre-Application Document (PAD) with FERC on August 29, 2019 and held a Joint Meeting and Site Visit in December 2019. Following the Joint Meeting and Site Visit, resource agencies and other stakeholders were afforded the opportunity to comment on the PAD and to request resource studies that they deemed were needed to evaluate Project impacts on natural, cultural and recreational resources. The U.S. Fish and Wildlife Service (USFWS) reviewed the NOI and PAD and requested that a mussel survey be conducted downstream of the dam.

By email dated May 18, 2020, Lake Lynn provided a draft Mussel Survey Plan to the USFWS, Pennsylvania Fish and Boat Commission (PBFC), and West Virginia Division of Natural Resources (WVDNR). Lake Lynn convened a meeting via MS Teams and conference call on May 20, 2020 to discuss the draft Mussel Survey Plan. The draft Mussel Survey Plan proposed following West Virginia Protocol guidance for effort required for Group 3 streams (WVDNR, 2020) and defining the survey area as the area inside the Project boundary and a downstream buffer (DSB) limit of 25 meters beyond the Project boundary. The Resource Agencies expressed concerns about limiting the survey area and requested that the survey area extend 1 mile downstream of the Project since they considered this project as a scoping project without a full hydraulic study. As an action item, Lake Lynn agreed to share the 1993 Project Instream Flow Study to provide additional information about the Project's operational influence downstream of the dam and the geographic scope of the survey.

Lake Lynn distributed the 1993 Project Instream Flow Study to the Resource Agencies on June 2, 2020. The 1993 Project Instream Flow Study reported that water level fluctuations due to Project operation are greatest in the segment of river extending 1.02 mile below the Project dam. The 1993 Project Instream Flow Study also reported that the water depth in the Cheat River segment from the 1.02-mile point below the Project dam to the confluence with the Monongahela is dependent upon and maintained by Pool 7 water elevations during Project shutdown.

By email dated July 9, 2020, Lake Lynn provided a revised draft Mussel Survey Plan to the USFWS, PBFC, and WVDNR. Comments were received from WVDNR and PFBC. WVDNR requested that the first page of the Mussel Survey Plan clarify the intent of the survey and noted that if the intent is to conduct a reconnaissance scoping survey, then the methodology provided is sufficient. WVDNR also requested that the Mussel Survey Plan address the handing of mussels and include a completed summary protocol form. PFBC agreed with the proposed survey methodology outlined in the Mussel Survey Plan dated July 9, 2020 but disagreed with the limits of the survey area being restricted to 1.02 miles downstream of the Project dam (copies of relevant correspondence is included in **Attachment 2**).

A revised Survey Plan was submitted to WVDNR and PFBC by EnviroScience on Monday, September 7, 2020. Comments were received on September 8, 2020 from PFBC stating that the one mile was not sufficient and that a survey would need to be performed to the confluence of the Monongahela River, approximately 3.5 miles downstream, of the Project boundary.

REVISED 2020 MUSSEL SURVEY PLAN (SEPTEMBER 2020)
CHEAT RIVER – LAKE LYNN HYDROELECTRIC PROJECT
MONONGALIA COUNTY, WEST VIRGINIA AND FAYETTE COUNTY, PENNSYLVANIA

The draft Mussel Survey Plan has been revised based on comments received on September 8, 2020 from PFBC and follow-up discussion with PFBC. The objective of this mussel survey is to conduct a reconnaissance scoping survey to identify what mussels, if any, may be within the Cheat River from the Project dam to approximately 3.5 miles downstream to the confluence of the Monongahela River. Mussel habitat (location, depth, and substrate) and the occurrence density, distribution, and relative abundance of any mussel species present will be recorded.

The Project is a 51.2 megawatt (MW) single development project operated since 1926. It consists of:

- a 125-foot high by 1,000-foot long concrete gravity-type dam with a 624-foot long spillway controlled by 26 Tainter gates, each 17 feet high by 21 feet long;
- a reservoir with a surface area of 1,729 acres and containing about 72,00 acre-feet of water at full pool elevation of 870 feet National Geodetic Vertical Datum;
- a log boom and track racks at the intake facility;
- eight 12-foot by 18-foot gated penstocks of reinforced concrete;
- a 72-foot by 165-foot by 68-foot high brick powerhouse containing four identical Francis generating units with a total rated capacity of 51.2 MW;
- dual 800-foot long 13 8-kilovolt transmission lines; and
- appurtenant facilities.

Survey Plan

Reconnaissance scoping survey efforts will be coordinated and led by a West Virginia and Pennsylvania approved malacologist. The qualified malacologist will provide survey oversight and guidance on execution of the survey and will be the lead taxonomist in the field for the duration of the work. The survey will follow modified West Virginia Protocol guidance (WVDNR, 2020) with additional guidance from the American Fisheries Society Monograph 8 (Strayer and Smith, 2003). The survey area includes the Project boundary that extends approximately 200 meters downstream of the Project dam and will continue approximately 3.5 miles downstream to the confluence with the Monongahela River. TRC has preliminarily defined the survey area as depicted on the attached **Figure 2**. A summary protocol form (Mussel Survey Scope of Work Summary Sheet) is attached (**Attachment 1**).

TRC will perform a reconnaissance scoping survey to determine areas of suitable mussel habitat and evaluate for mussel presence/absence within the survey area downstream of the dam. The habitat assessment will start at the mouth of the Cheat River, approximately 3.5 miles downstream of the Project boundary and move upstream to the Project dam (**Figure 2**). The banks will be searched for shell material and the substrate will be evaluated to identify suitable mussel habitat (stable burrowable substrates including sand, gravel, cobble, etc.). Once suitable mussel habitat is located, a qualitative timed search will be employed for a minimum of 10-minutes to search for live mussels and shell material. In the state of West Virginia, there will be at least one qualitative dive every 100 meters in the best possible substrate, if no suitable habitat is located. Qualitative surveys in the Commonwealth of Pennsylvania will only be performed where suitable habitat is identified. If live mussels are collected, the area will be searched until the limits of the mussel bed are delineated.

This survey will consist of visually and tactilely searching the survey area for presence of mussels and to determine limits of any mussel concentrations. Snorkeling and surface supplied air diving will be used to visually and tactilely search for mussels at the substrate surface; moving cobble and woody debris; hand

sweeping away silt, sand and/or small detritus; and disturbing/probing the upper 5cm (2in) of substrate in order to ensure recovery of buried mussels. Data will be collected separately for each qualitative search.

If any federally listed species are observed during survey or efforts, efforts will stop and PBFC, WVDNR, and USFWS will be immediately contacted.

Data Collection

Photographs will be taken of the survey area and a minimum of one representative photo of each mussel species will be taken for verification purposes. Live mussels will be kept in stream water in mesh collection bags and out of water time will be kept to one (1) minute or less during processing. Mussels that are bagged and held for identification will be hand placed back into their respective habitats where they were collected. At a minimum, data to be recorded includes: substrate composition of each sample (visual percentage based on Wentworth scale; water depth (meters); mussel species, individual size (length, height, and width to the nearest millimeter), sex (where applicable), and age (external annuli count); mussel shells (classified as fresh dead, weathered dead, or relic shell); where applicable; Global Positioning System (GPS) coordinates of the survey area, mussel aggregation limits; and other notable features such as land use and general observations about the stream.

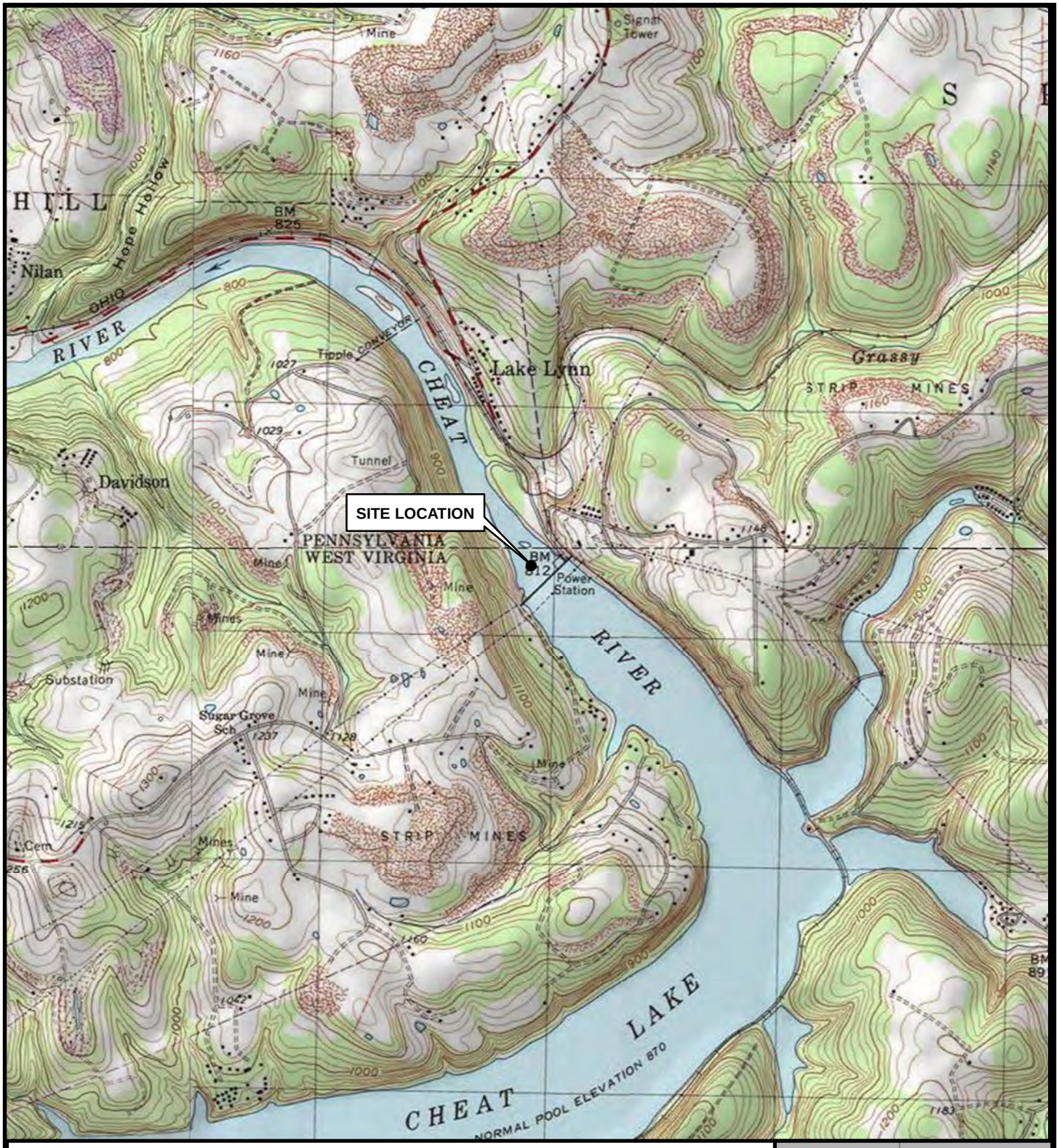
Reporting

A report documenting the results of the habitat assessment survey will be prepared upon completion of field work. Reports will follow technical reporting guidelines and will include an introduction, methods, results, and discussion with associated tables, figures, and appendices. Maps showing the survey area, mussel distribution, and habitat conditions will also be included, along with photo documentation of the survey area and mussel species encountered. Reporting will follow Protocol recommendations.

References

Strayer, D.L., and D.R. Smith. 2003. A guide to sampling freshwater mussel populations. American Fisheries Society, Monograph 8, Bethesda, Maryland.

West Virginia Division of Natural Resources (WVDNR). 2020. West Virginia Mussel Survey Protocols. West Virginia Division of Natural Resources. unpublished. 25pp + app.



BASE MAP FROM USGS TOPOGRAPHIC MAP WEB SERVICE, QUAD: LAKE LYNN

TRC

1382 West Ninth Street
Suite 400
Cleveland, OH 44113
Phone: 216-344-3072

TRC - GIS

PROJECT:

LAKE LYNN HYDROELECTRIC PROJECT
MONONGALIA COUNTY, WEST VIRGINIA

TITLE:

SITE LOCATION MAP

FIGURE 1

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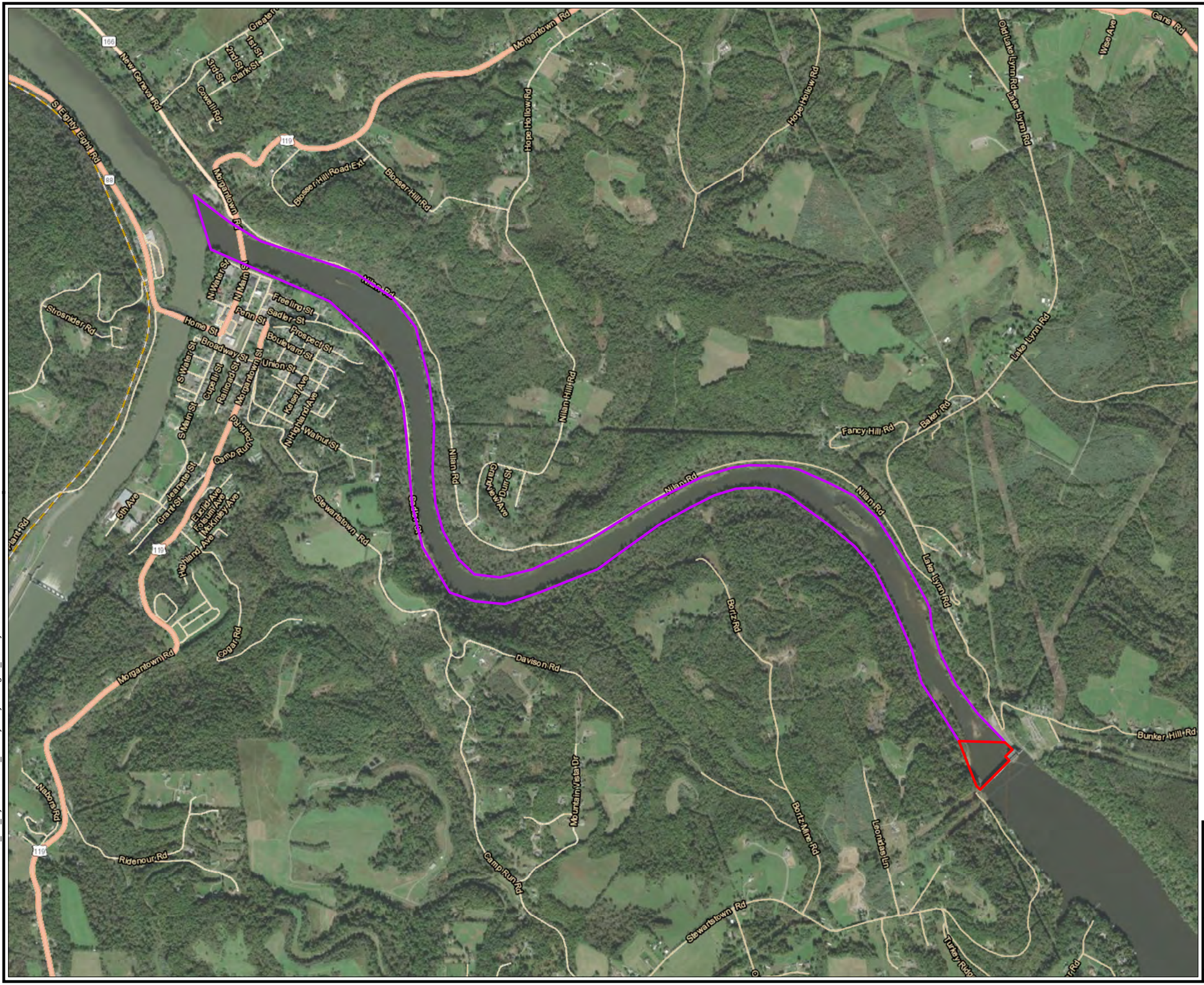

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1 " = 1,500 ' 1:18,000

LAKE LYNN HYDROELECTRIC PROJECT
MONONGALIA COUNTY, WEST VIRGINIA

FIGURE 2
SURVEY AREA LIMITS

TRC
1382 West Ninth Street
Suite 400
Cleveland, OH 44113
Phone: 216-344-3072

SEPTEMBER 2020 Fig02_SurveyArea.mxd

Plot Date: 9/9/2020, 11:03:27 AM by MOPEL – LAYOUT: ANSI B(11"X17")
Path: S:\1-PROJECTS\Cube_PE_Hydro\282346_LakeLynnHydroFig02_SurveyArea.mxd

Mussel Survey Scope of Work Summary Sheet

Form Date **3/16/2020**

Project Title: Reconnaissance Scoping Survey for the Lake Lynn Hydroelectric Relicensing Project (FERC No. P-2459) on the Cheat River, Monongalia County, West Virginia and Fayette County, Pennsylvania

Project Company: Lake Lynn Generation LLC
Mussel Contractor: EnviroScience, Inc.
Lead Malacologist: Sarah Veselka
Project Contractor: TRC Environmental Corporation
Collectors: if applicable: Lindsey Jakovljevic, Tom Radford, Tony Tredway
County: Monongalia, WV and Fayette, PA
Group (Circle One): 1 2 (3) 4
Stream: Cheat River
Location Description: The Project is located on the Cheat River near Morgantown, West Virginia in Monongalia County, West Virginia and Fayette County, Pennsylvania
Navigational Pool if Applicable:
If Group 1 or 2, Receiving Stream:

Date Submitted: 9/7/2020
Date Revised: 9/9/2020

Project Type: Hydropower (corresponds to Table 3, WV Mussel Survey Protocol)

ADI Length:	100 m	ADI Width:	195 m	Salvage area (m^2):	
US Buffer Length:	NA	US Buffer Width:	NA	USS Buffer Length:	
DS Buffer Length:	3.5 Miles	DS Buffer Width:	60 m	DSS Buffer Length:	
Lateral Buffer Length:	NA	Lateral Buffer Width:	BB	Lateral S Buffer Width:	

Phase 1 Survey Method: Transect [ ] Cells [ ] Other [X] qualitative spot dives

# Transects/Length (m):		Cell Size (mxm):	Cell Search Effort (Min/m^2)
	ADI:		10-minute spot dive in suitable habitat or every 100 m (WV ONLY)
	USB:		NA
	DSB:		10-minute spot dive in suitable habitat or every 100 m (WV ONLY)
	Spacing Between Transects (M)		

Coordinates (Decimal Degrees, NAD83)

Upstream End US Buffer:	Long.	NA	Lat.	NA
Upstream End ADI:	Long.	-79.857352	Lat.	39.719387
ADI Center:	Long.	-79.857683	Lat.	39.720052
Downstream End ADI:	Long.	-79.858185	Lat.	39.720662
Downstream End DS Buffer:	Long.	-79.901564	Lat.	39.742802
RELOCATION AREA:	Long.	NA	Lat.	NA

Map: Show ADI, USB, DSB and survey layout with outline of proposed impact.

Did you provide? Justification must be provided in scope of work

Addressed Alternative Methods	[ ] Yes	FERC relicense no alternate methods
Addressed Alternative Sites	[ ] Yes	FERC relicense no alternate sites

Phase 2 requested?: [ ] Yes [X] No

Request for Relocation: [ ] Yes [X] No

Method:
(check one) [ ] Cell Size (mxm):
[ ] Moving Transect:
[ ] Other:_____

Multiple passes are to be made through the area until less than 5 % of the number collected on the first two passes combined are recovered on the

Foster, Joyce

Subject: FW: [EXTERNAL] Lake Lynn Relicensing - Draft Mussel Survey Plan
Location: Microsoft Teams Meeting

Start: Wed 5/20/2020 11:00 AM
End: Wed 5/20/2020 12:00 PM
Show Time As: Tentative

Recurrence: (none)

Meeting Status: Not yet responded

Organizer: Jody Smet

-----Original Appointment-----
From: Jody Smet <Jody.Smet@eaglecreekre.com>
Sent: Monday, May 18, 2020 11:04 PM
To: Jody Smet; Janet_Norman@fws.gov; Jacob Harrell; Heather Smiles; Foster, Joyce
Cc: Robert Flickner; Dale Short
Subject: [EXTERNAL] Lake Lynn Relicensing - Draft Mussel Survey Plan
When: Wednesday, May 20, 2020 11:00 AM-12:00 PM (UTC-05:00) Eastern Time (US & Canada).
Where: Microsoft Teams Meeting

All,

Based on the responses received to the Doodle poll, I would also like to schedule a conference call at 11 a.m. on Wednesday, May 20, to discuss the attached draft survey plan for the proposed Lake Lynn Project mussel survey. We anticipate that this call will last no more than an hour. Please join by phone, or MS Teams link, below. Please forward this invitation to others, as appropriate.

Thank you.

Join Microsoft Teams Meeting

+1 920-393-6252 United States, Green Bay (Toll)

Conference ID: 578 406 16#

Local numbers | Reset PIN | Learn more about Teams | Meeting options

---

From: Jody Smet
To: Smiles, Heather A
Subject: [EXTERNAL] RE: Lake Lynn Relicensing - Draft Mussel Survey Plan
Date: Tuesday, May 19, 2020 8:16:18 AM

Great, thanks Heather.

Jody J. Smet, AICP
Vice President Regulatory Affairs
Eagle Creek Renewable Energy

Please note my new email address – jody.smet@eaglecreekre.com

-----Original Appointment-----
From: Smiles, Heather A <hsmiles@pa.gov>
Sent: Tuesday, May 19, 2020 8:15 AM
To: Jody Smet
Subject: Accepted: Lake Lynn Relicensing - Draft Mussel Survey Plan
When: Wednesday, May 20, 2020 11:00 AM-12:00 PM (UTC-05:00) Eastern Time (US & Canada).
Where: Microsoft Teams Meeting

Jody,

Our Malacologist, Nevin Welte, will join the meeting. For your records, below is his information.

Thanks,

Heather A. Smiles | Chief, Division of Environmental Services
PA Fish and Boat Commission
595 East Rolling Ridge Drive | Bellefonte, PA 16823
Phone: 814.359.5194
Email: hsmiles@pa.gov
www.fishandboat.com

Nevin Welte
Malacologist/Nongame Biologist, Natural Diversity Section
Pennsylvania Fish & Boat Commission
Centre Region Office
595 E. Rolling Ridge Dr.
Bellefonte, PA 16823
c-nwelte@pa.gov

412-586-2334

From:	Jody Smet
To:	Norman, Janet; Harrell, Jacob D; Heather Smiles; c-nwelte@pa.gov
Cc:	Dale Short; Robert Flickner; Michael Scarzello; Matthew Nini; Foster, Joyce
Subject:	[EXTERNAL] Lake Lynn Relicensing – Revised Draft Mussel Survey Plan
Date:	Thursday, July 9, 2020 11:11:10 AM
Attachments:	image001.png Lake Lynn Mussel Survey Plan_REV 1.pdf

All,

As follow-up to our call on May 20 discussing the draft Lake Lynn Mussel Survey Plan and review of the 1993 Lake Lynn Instream Flow Study Report, we have attached a revised draft Lake Lynn Mussel Survey Plan for your review. Please provide your comments on the revised Survey Plan by July 17.

Thank you,

Jody J. Smet, AICP | Vice President Regulatory Affairs
Eagle Creek Renewable Energy
Desk: 804 739 0654
Mobile: 804 382 1764
Email: jody.smet@eaglecreekre.com

From: Jody Smet
To: Foster, Joyce
Subject: FW: [EXTERNAL] Lake Lynn Relicensing – Revised Draft Mussel Survey Plan
Date: Tuesday, July 14, 2020 10:42:38 AM
Attachments: image001.png

Jody J. Smet, AICP
Vice President Regulatory Affairs
Eagle Creek Renewable Energy

Please note my new email address – jody.smet@eaglecreekre.com

---

From: Norman, Janet <janet_norman@fws.gov>
Sent: Tuesday, July 14, 2020 10:37 AM
To: Jody Smet <Jody.Smet@eaglecreekre.com>
Subject: Re: [EXTERNAL] Lake Lynn Relicensing – Revised Draft Mussel Survey Plan

Received, thank you.
Will look over this week.

Janet

Janet Norman
Fish and Wildlife Biologist
USFWS Chesapeake Bay Field Office
177 Admiral Cochrane Dr.
Annapolis, MD 21401
(O) 410-573-4533
(Fax) 410-269-0832
(cell) 410-320-5519

From: Jody Smet <Jody.Smet@eaglecreekre.com>
Sent: Thursday, July 9, 2020 11:10 AM
To: Norman, Janet <janet_norman@fws.gov>; Harrell, Jacob D <Jacob.D.Harrell@wv.gov>; Heather Smiles <hsmiles@pa.gov>; c-nwelte@pa.gov <c-nwelte@pa.gov>
Cc: Dale Short <Dale.Short@eaglecreekre.com>; Robert Flickner <Robert.Flickner@eaglecreekre.com>; Michael Scarzello <Michael.Scarzello@eaglecreekre.com>; Matthew Nini <Matthew.Nini@eaglecreekre.com>; Foster, Joyce <JFoster@trccompanies.com>
Subject: [EXTERNAL] Lake Lynn Relicensing – Revised Draft Mussel Survey Plan

All,

As follow-up to our call on May 20 discussing the draft Lake Lynn Mussel Survey Plan and review of the 1993 Lake Lynn Instream Flow Study Report, we have attached a revised draft Lake Lynn Mussel Survey Plan for your review. Please provide your comments on the revised Survey Plan by July 17.

Thank you,

Jody J. Smet, AICP | Vice President Regulatory Affairs
Eagle Creek Renewable Energy
Desk: 804 739 0654
Mobile: 804 382 1764
Email: jody.smet@eaglecreekre.com

From: Jody Smet
To: Foster, Joyce
Subject: [EXTERNAL] FW: Lake Lynn Mussel Survey Plan Comments
Date: Thursday, July 30, 2020 9:39:25 AM
Attachments: Lake Lynn Mussel Survey Plan Revision Comments.pdf

FYI, I haven't seen any others.

Jody J. Smet, AICP
Vice President Regulatory Affairs
Eagle Creek Renewable Energy

Please note my new email address – jody.smet@eaglecreekre.com

From: Harrell, Jacob D <Jacob.D.Harrell@wv.gov>
Sent: Tuesday, July 21, 2020 2:37 PM
To: Jody Smet <Jody.Smet@eaglecreekre.com>
Subject: Lake Lynn Mussel Survey Plan Comments

Jody,

Please see the attached comments concerning the Lake Lynn Mussel Survey Plan. Comments by our Diversity section are included within.

Thanks,

Jacob Harrell

Coordination Unit
WVDNR – Wildlife Resources Section
1110 Railroad Street
Farmington, WV 26571
(304)704-9328
Jacob.D.Harrell@wv.gov

Sarah Veselka

From: Welte, Nevin <c-nwelte@pa.gov>
Sent: Friday, September 11, 2020 9:30 AM
To: Sarah Veselka
Cc: Jacob.D.Harrell@wv.gov; Smiles, Heather A; Jody.Smet@eaglecreekre.com; Foster, Joyce; Jakovljevic, Lindsey; Urban, Chris; Anderson, Robert M
Subject: RE: [External] FW: Lake Lynn Survey Plan

Hi Sarah,

Thanks for sharing with us a revised study plan. PFBC concurs with the proposed survey methodology and extent of the study area. Please keep us posted on anticipated survey dates and we may join you in the field.

Thanks again and good luck with the survey,

Nevin

Nevin Welte
Malacologist/Nongame Biologist, Natural Diversity Section
Pennsylvania Fish & Boat Commission
Centre Region Office
595 E. Rolling Ridge Dr.
Bellefonte, PA 16823
c-nwelte@pa.gov

From: Sarah Veselka <sveselka@enviroscienceinc.com>
Sent: Thursday, September 10, 2020 5:10 PM
To: Welte, Nevin <c-nwelte@pa.gov>
Cc: Jacob.D.Harrell@wv.gov; Smiles, Heather A <hsmiles@pa.gov>; Jody.Smet@eaglecreekre.com; Foster, Joyce <JFoster@trccompanies.com>; Jakovljevic, Lindsey <LJakovljevic@trccompanies.com>; Urban, Chris <curban@pa.gov>; Anderson, Robert M <Robert_M_Anderson@fws.gov>
Subject: RE: [External] FW: Lake Lynn Survey Plan

Hi Nevin,

Thank you for your comments. Please find the requested revised survey plan attached here for your review.

Thank you,

Sarah

Sarah Veselka
EnviroScienceInc.com
"Excellence in Any Environment"

From: Welte, Nevin <c-nwelte@pa.gov>
Sent: Tuesday, September 8, 2020 8:51 AM

To: Sarah Veselka <sveselka@enviroscienceinc.com>; Sargent, Barbara D <Barbara.D.Sargent@wv.gov>
Cc: Jacob.D.Harrell@wv.gov; Smiles, Heather A <hsmiles@pa.gov>; Jody.Smet@eaglecreekre.com; Foster, Joyce <JFoster@trccompanies.com>; Jakovljevic, Lindsey <LJakovljevic@trccompanies.com>; Urban, Chris <curban@pa.gov>; Anderson, Robert M <Robert_M_Anderson@fws.gov>
Subject: RE: [External] FW: Lake Lynn Survey Plan

Hi Sarah,

Thanks for the email and the attached survey plan. While PFBC agrees with the proposed survey methods (i.e., "how to look for mussels") we continue to disagree with the extent of the study area (1.0 mile downstream of the project). The extent of the study area was not revised based upon recent PFBC comments submitted by Heather Smiles (email dated August 3, 2020) and no biological rationale was given for maintaining a limited study area. Any data collected from this limited study area will be continue to be insufficient data to answer the question of whether or not this dam or its operations have an effect on Pennsylvania's freshwater mussels. We continue to advise that the study scope be revised and extended to include the length of the Cheat River in Pennsylvania using the approach described in Heather's email (in quotes below).

"Although the Cheat River has not been examined recently to detect freshwater mussels it is possible that species have recolonized the Cheat in areas that contain suitable mussel habitat. A survey of the Pennsylvania stretch of the Cheat would entail a scouting trip to determine areas of potentially suitable habitat followed by a qualitative survey of these areas (similar to the Large Scoping Projects in the WV mussel protocol). Such an effort would be necessary to determine whether mussels are present and to determine, to some extent, what the effects of the existing management of Lake Lynn are having on the Cheat River downstream of the dam."

We look forward to reviewing a revised study plan.

Thanks,

Nevin

Nevin Welte
Malacologist/Nongame Biologist, Natural Diversity Section
Pennsylvania Fish & Boat Commission
Centre Region Office
595 E. Rolling Ridge Dr.
Bellefonte, PA 16823
c-nwelte@pa.gov

From: Sarah Veselka <sveselka@enviroscienceinc.com>
Sent: Monday, September 7, 2020 4:19 PM
To: Welte, Nevin <c-nwelte@pa.gov>; Sargent, Barbara D <Barbara.D.Sargent@wv.gov>
Cc: Jacob.D.Harrell@wv.gov; Smiles, Heather A <hsmiles@pa.gov>; Jody.Smet@eaglecreekre.com; Foster, Joyce <JFoster@trccompanies.com>; Jakovljevic, Lindsey <LJakovljevic@trccompanies.com>
Subject: [External] FW: Lake Lynn Survey Plan

Hello Nevin and Barb,

On behalf of Lake Lynn Generation and TRC, please find the attached mussel survey plan for the Lake Lynn Hydroelectric Project for your review and approval. I will be acting as the WV/PA qualified malacologist for the Project.

Thank you,

Sarah

Sarah Veselka
EnviroScienceInc.com
"Excellence in Any Environment"

Sarah Veselka

From: Sargent, Barbara D <Barbara.D.Sargent@wv.gov>
Sent: Wednesday, September 9, 2020 10:20 AM
To: Sarah Veselka
Cc: Harrell, Jacob D
Subject: RE: [External] FW: Lake Lynn Survey Plan
Attachments: carlson_bAdd10.pdf; veselka_sAdd08.pdf; dunford_dAdd04.pdf; schwegman_rAdd04.pdf; mathias_pAdd04.pdf; winterringer_rAdd04.pdf

Hi Sarah—

I have attached your addenda for the Lake Lynn project. The Scope is approved only for the WV portion; we defer to PA for their portion.

b.

From: Sarah Veselka [mailto:sveselka@enviroscienceinc.com]
Sent: Monday, September 07, 2020 4:19 PM
To: Welte, Nevin; Sargent, Barbara D
Cc: Harrell, Jacob D; hsmiles@pa.gov; Jody.Smet@eaglecreekre.com; Foster, Joyce; Jakovljevic, Lindsey
Subject: [External] FW: Lake Lynn Survey Plan

Hello Nevin and Barb,

On behalf of Lake Lynn Generation and TRC, please find the attached mussel survey plan for the Lake Lynn Hydroelectric Project for your review and approval. I will be acting as the WV/PA qualified malacologist for the Project.

Thank you,

Sarah

Sarah Veselka
EnviroScienceInc.com
"Excellence in Any Environment"

From: Jody Smet
To: Norman, Janet; Harrell, Jacob D; Heather Smiles; c-nwelte@pa.gov
Cc: Dale Short; Robert Flickner; Michael Scarzello; Matthew Nini; Foster, Joyce
Subject: [EXTERNAL] RE: Lake Lynn Relicensing – Revised Draft Mussel Survey Plan
Date: Thursday, July 30, 2020 9:41:00 AM
Attachments: image001.png

All,

Comments were due on the revised mussel survey plan on 7/17. We received comments from WVDNR. We are working to finalize this study plan so that we are prepared to be in the field in late August / early September.

Thank you,

Jody J. Smet, AICP
Vice President Regulatory Affairs
Eagle Creek Renewable Energy

Please note my new email address – jody.smet@eaglecreekre.com

---

From: Jody Smet
Sent: Thursday, July 9, 2020 11:10 AM
To: Norman, Janet <janet_norman@fws.gov>; Harrell, Jacob D <Jacob.D.Harrell@wv.gov>; Heather Smiles <hsmiles@pa.gov>; c-nwelte@pa.gov
Cc: Dale Short <Dale.Short@eaglecreekre.com>; Robert Flickner <Robert.Flickner@eaglecreekre.com>; Michael Scarzello <Michael.Scarzello@eaglecreekre.com>; Matthew Nini <Matthew.Nini@eaglecreekre.com>; Foster, Joyce <JFoster@trccompanies.com>
Subject: Lake Lynn Relicensing – Revised Draft Mussel Survey Plan

All,

As follow-up to our call on May 20 discussing the draft Lake Lynn Mussel Survey Plan and review of the 1993 Lake Lynn Instream Flow Study Report, we have attached a revised draft Lake Lynn Mussel Survey Plan for your review. Please provide your comments on the revised Survey Plan by July 17.

Thank you,

Jody J. Smet, AICP | Vice President Regulatory Affairs
Eagle Creek Renewable Energy
Desk: 804 739 0654
Mobile: 804 382 1764
Email: jody.smet@eaglecreekre.com

From: Jody Smet
To: Foster, Joyce
Subject: FW: [External] RE: Lake Lynn Relicensing – Revised Draft Mussel Survey Plan - PFBC Comments
Date: Monday, August 3, 2020 12:29:10 PM
Attachments: image001.png

Jody J. Smet, AICP
Vice President Regulatory Affairs
Eagle Creek Renewable Energy

Please note my new email address – jody.smet@eaglecreekre.com

---

From: Smiles, Heather A <hsmiles@pa.gov>
Sent: Monday, August 3, 2020 11:35 AM
To: Jody Smet <Jody.Smet@eaglecreekre.com>
Subject: RE: [External] RE: Lake Lynn Relicensing – Revised Draft Mussel Survey Plan - PFBC Comments

Dear Jody,

Thanks for the opportunity to review the proposed study plan. While PFBC agrees with the proposed survey methodologies, we disagree with the limits of the study area being restricted to 1.02 miles downstream of the dam.

Per the study plan, the study area was restricted based upon the area of fluctuating water elevations, but wetted width of a river is but one component of regulated rivers that may have an adverse effect on freshwater mussel communities. Discharge water temperature is another critical component to the survival and persistence of a viable mussel community. Discharge temperatures are controlled by where water is being released from within the impoundment, and coldwater releases have a well-documented effect on freshwater mussel communities including limiting gametogenesis, growth, as well as altering the host fish community which affects mussel community composition. The Lake Lynn study limit should, at minimum, consider the entire length of the Cheat that has temperature affected by the discharge of the dam.

In lieu of a temperature study delimits the downstream thermal effects of the dam, a mussel study that focuses on potential mussel habitat from the dam downstream to its confluence with the Monongahela River would be appropriate to ascertain what species if any, occur in the Cheat River.

If such a survey effort results in the detection of no mussels or a limited community in the Cheat River then it would be a worthy biological objective of relicensing to try and mimic, to the extent practicable, the natural flow and/or thermal regime as much as possible to maintain the river's restoration potential.

The proximity of the project to recent/known populations of state listed species (e.g., Snuffbox, Salamander Mussel, and Pistolgrip) approximately ~ 2.4 miles from the confluence of the Cheat and Monongahela River confluence suggests that it is a possibility that these species could occur in the Cheat, could disperse there in the future, and thus may be affected by Lake Lynn dam operations.

As you may know, the Cheat contained a diverse mussel fauna including the state and federal listed Clubshell (*Pleurobema clava*), a species undergoing a federal status assessment (SSA) (Longsolid, *Fusconaia subrotunda*), as well as two species that haven't been seen in Pennsylvania in over 100 years (Pimpleback, *Cyclonaias pustulosa* and Purple Wartyback, *C. tuberculata*). This Cheat River population was likely an extension of the Monongahela River population which was also quite diverse (e.g., Fanshell, *Cyprogenia stegaria*) until the effects of the steel and associated industries became too severe, before 1900. The Monongahela River, like the Ohio River (21 mussel species in PA), is a river in recovery since water quality improvements began in the 1970s.

Despite the effects of that industry, Dunkard Creek – a tributary to the Monongahela River just 2.4 miles downstream of the Cheat – was considered the crown jewel of the Monongahela River system until 2009, when a toxic event wiped that fauna out. Dunkard Creek harbored – as of 2009 – the state and federally endangered Snuffbox (*Epioblasma triquetra*), the state endangered Salamander Mussel (*Simpsonaias ambigua*, also undergoing a federal SSA), and the state endangered Pistolgrip (*Tritogonia verrucosa*). Numerous other species also occurred in Dunkard and PFBC and WVDNR are actively working to restore Dunkard with common mussels and via propagation and augmentation efforts. It's not unreasonable to suspect that glochidia-inoculated host fishes from Dunkard Creek were able to traverse the short distance to the Cheat River.
Although the Cheat River has not been examined recently to detect freshwater mussels it is possible that species have recolonized the Cheat in areas that contain suitable mussel habitat. A survey of the Pennsylvania stretch of the Cheat would entail a scouting trip to determine areas of potentially suitable habitat followed by a qualitative survey of these areas (similar to the Large Scoping Projects in the WV mussel protocol). Such an effort would be necessary to determine whether mussels are present and to determine, to some extent, what the effects of the existing management of Lake Lynn are having on the Cheat River downstream of the dam.

We look forward to reviewing a modified mussel survey plan.

Heather A. Smiles | Chief, Division of Environmental Services
PA Fish and Boat Commission
595 East Rolling Ridge Drive | Bellefonte, PA 16823
Phone: 814.359.5194
Email: hsmiles@pa.gov
www.fishandboat.com

From: Jody Smet <Jody.Smet@eaglecreekre.com>
Sent: Thursday, July 30, 2020 9:41 AM

To: Norman, Janet <janet_norman@fws.gov>; Harrell, Jacob D <Jacob.D.Harrell@wv.gov>; Smiles, Heather A <hsmiles@pa.gov>; Welte, Nevin <c-nwelte@pa.gov>
Cc: Dale Short <Dale.Short@eaglecreekre.com>; Robert Flickner <Robert.Flickner@eaglecreekre.com>; Michael Scarzello <Michael.Scarzello@eaglecreekre.com>; Matthew Nini <Matthew.Nini@eaglecreekre.com>; Foster, Joyce <JFoster@trccompanies.com>
Subject: [External] RE: Lake Lynn Relicensing – Revised Draft Mussel Survey Plan

All,

Comments were due on the revised mussel survey plan on 7/17. We received comments from WVDNR. We are working to finalize this study plan so that we are prepared to be in the field in late August / early September.

Thank you,

Jody J. Smet, AICP
Vice President Regulatory Affairs
Eagle Creek Renewable Energy

Please note my new email address – jody.smet@eaglecreekre.com

---

From: Jody Smet
Sent: Thursday, July 9, 2020 11:10 AM
To: Norman, Janet <janet_norman@fws.gov>; Harrell, Jacob D <Jacob.D.Harrell@wv.gov>; Heather Smiles <hsmiles@pa.gov>; c-nwelte@pa.gov
Cc: Dale Short <Dale.Short@eaglecreekre.com>; Robert Flickner <Robert.Flickner@eaglecreekre.com>; Michael Scarzello <Michael.Scarzello@eaglecreekre.com>; Matthew Nini <Matthew.Nini@eaglecreekre.com>; Foster, Joyce <JFoster@trccompanies.com>
Subject: Lake Lynn Relicensing – Revised Draft Mussel Survey Plan

All,

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Thank you,

Jody J. Smet, AICP | Vice President Regulatory Affairs
Eagle Creek Renewable Energy
Desk: 804 739 0654
Mobile: 804 382 1764
Email: jody.smet@eaglecreekre.com

DIVISION OF NATURAL RESOURCES
Wildlife Resources Section
District I
PO Box 99, 1110 Railroad Street
Farmington, West Virginia 26571-0099
Telephone 304 825-6787
Fax 304 825-6270
TDD 800-354-6087

Stephen S. McDaniel
Director

July 20, 2020

Jody Smet, AICP
Vice President Regulatory Affairs
Eagle Creek Renewable Energy
2 Bethesda Metro Center, Suite 1330
Bethesda, MD 20814

RE: Lake Lynn Hydroelectric Project, FERC no. 2459; Lake Lynn Mussel Survey Plan Revision

Dear Ms. Smet:

Thank you for allowing the West Virginia Division of Natural Resources, Wildlife Resources Section (WRS) the opportunity to review the Mussel Survey Plan as part of the relicensing process for the Lake Lynn Hydroelectric Project, FERC no. 2459. The WRS has reviewed the plan and offers the following comments for your consideration.

As provided, it is unclear if the intent of the surveys is for scoping or to identify potential impacts related to the project. Such intent should be made clear on the first page of the mussel survey plan. If the intent is to conduct a reconnaissance scoping survey to identify what mussels, if any, may be within the project impact area, then the methodology as provided would be sufficient. However, if the intent of the survey is to identify potential impacts that may occur due to project operation, then the methodology provided is insufficient and would fail to meet the standards of the 2020 West Virginia Mussel Survey Protocols which would require additional work (i.e. transect surveys).

Within West Virginia, the Cheat River is a Group 3 stream (large river not expected to have federally threatened and endangered mussel species). Transect surveys on Group 3 streams must include a minimum of 500 linear meters of surveyed area and contain a minimum of 5 transects (up to a maximum of 10 transectes).

With further regard to the methodology, the handling of mussels should be addressed within the survey plan. Mussels that are bagged and held for identification need to be hand placed back into their respective habitat where they were collected.

A summary protocol form, see attached, must also be completed and attached to the mussel survey plan. The mussel survey plan must also be approved by the Diversity Section of the West Virginia Division of Natural Resources and a scientific collection permit would need to be obtained to survey the sections of the survey within West Virginia.

Thank you again for the opportunity to provide comments regarding the mussel survey plan. If you have any questions or comments concerning the mussel survey plan please contact me at (304)989-0208 or by email at jacob.d.harrell@wv.gov.

Sincerely Yours,

Jacob Harrell
Hydropower Coordination Biologist

Mussel Survey Scope of Work Summary Sheet

Form Date: 3/16/2020

Project Title: _____

Project Company: _____ Date Submitted: _____

Mussel Contractor: _____ Date Revised: _____

Lead Malacologist: _____

Project Contractor: _____

Collectors: if applicable _____

County: _____ Group (Circle One): 1 2 3 4

Stream: _____ Location Description: _____

Navigational Pool if Applicable: _____

If Group 1 or 2, Receiving Stream: _____

Project Type: _____ (corresponds to Table 3, WV Mussel Survey Protocol)

ADI Length: _____ ADI Width: _____ Salvage area (m^2): _____

US Buffer Length: _____ US Buffer Width: _____ USS Buffer Length: _____

DS Buffer Length: _____ DS Buffer Width: _____ DSS Buffer Length: _____

Lateral Buffer Length: _____ Lateral Buffer Width: _____ Lateral S Buffer Width: _____

Phase 1 Survey Method: Transect ☐ Cells ☐ Other ☐ _____

# Transects/Length (m):		Cell Size (mxm):	Cell Search Effort (Min/m^2)
_____	ADI:	_____	_____
_____	USB:	_____	_____
_____	DSB:	_____	_____

_____ Spacing Between Transects (M)

Coordinates (Decimal Degrees, NAD83)

Upstream End US Buffer:	Long. _____	Lat. _____
Upstream End ADI:	Long. _____	Lat. _____
ADI Center:	Long. _____	Lat. _____
Downstream End ADI:	Long. _____	Lat. _____
Downstream End DS Buffer:	Long. _____	Lat. _____
RELOCATION AREA:	Long. _____	Lat. _____

Map: Show ADI, USB, DSB and survey layout with outine of proposed impact.

Did you provide? Justification must be provided in scope of work

Addressed Alternative Methods	☐ Yes	Provide Description in Scope
Addressed Alternative Sites	☐ Yes	Provide Description in Scope

Phase 2 requested?: ☐ Yes ☐ No

Request for Relocation: ☐ Yes ☐ No

Method:

(check one)
- ☐ Cell Size (mxm): _____
- ☐ Moving Transect:
- ☐ Other: _____

Multiple passes are to be made through the area until less than 5 % of the number collected on the first two passes combined are recovered on the

COMMONWEALTH OF PENNSYLVANIA

PENNSYLVANIA FISH AND BOAT COMMISSION
Bureau of Fisheries - Environmental Services Division - Natural Diversity Section
595 E. Rolling Ridge Drive
Bellefonte, PA 16823

THIS IS TO CERTIFY THAT ACTING UNDER THE PROVISIONS OF THE FISH AND BOAT CODE, ACT 1980-175 AMENDED:

Name and Town of Permit Owner	Age	Height	Weight	Eyes	Hair	PA Fishing License #
SARAH VESELKA, EnviroScience, Inc.-Malacologist Morgantown, WV	41	5ft. 7In.	1	Hazel	Brown	071-887-806

AND ASSISTANTS LISTED, ARE HEREBY AUTHORIZED TO COLLECT FISH OR OTHER AQUATIC LIFE FOR SCIENTIFIC PURPOSES AND IS LIMITED TO THOSE ACTIVITIES AS DESCRIBED IN RESPONSE TO THE APPLICATION PROJECT DETAILS SECTION. THIS PERMIT IS VALID FOR COLLECTION PROJECTS: (SEE ATTACHED SHEET)

UNLESS OTHERWISE PERMITTED, ALL SPECIES MUST BE RELEASED UNHARMED AT SITE OF CAPTURE. A SCIENTIFIC COLLECTOR'S PERMIT DOES NOT GRANT THE PERSONS THE AUTHORITY TO TRESPASS ON PRIVATE PROPERTY.

THIS PERMIT IS GOOD FOR THE CALENDAR YEAR **2020** OR DATE SPECIFIED IN PERMIT CONDITIONS, WHICHEVER COMES FIRST.

THE OWNER OF THIS PERMIT AND LISTED ASSISTANTS MUST BE THE HOLDERS OF A RESIDENT OR NONRESIDENT FISHING LICENSE WHICH MUST BE CARRIED WITH THEM AT ALL TIMES, ALONG WITH THIS PERMIT, OR A COPY THEREOF. PROPER NOTIFICATION MUST BE GIVEN TO THE REGIONAL LAW ENFORCEMENT OFFICE COVERING THE COUNTY IN WHICH COLLECTIONS ARE BEING CONDUCTED. OFFICES ARE OPEN MONDAY THRU FRIDAY BETWEEN 8:00AM AND 4:00PM

IN WITNESS THEREOF, I HAVE HEREUNTO SET MY HAND AND AFFIXED THE OFFICAL SEAL OF THE COMMISSION THE DAY AND DATE FIRST ABOVE WRITTEN

PENNSYLVANIA FISH & BOAT COMMISSION

Christopher A. Urban

EXECUTIVE DIRECTOR OR DESIGNEE

Pennsylvania Fish & Boat Commission

Natural Diversity Section
595 E. Rolling Ridge Drive
Bellefonte, PA 16823-9620
(814) 359-5237 Fax: (814) 359-5175

May 27, 2020

SARAH E VESELKA
EnviroScience, Inc.
129 Greenbag Road,
Morgantown, WV 26501

RE: Chapter 75.4 Special Permit for Collection of Threatened and Endangered Species
Scientific Collectors' Permits No. 2020-03-0241 Type 3

Dear SARAH E VESELKA:

THIS IS TO CERTIFY THAT, pursuant to PA 58 Code §75.4,

SARAH E VESELKA

and approved Scientific Collectors' Permit (SCP) assistants, are hereby granted written permission to search for, trap, measure, and mark threatened and endangered species under Pennsylvania Fish and Boat Commission jurisdiction in exception of the prohibition of possession. Specifically, this permit grants permission for SARAH E VESELKA to survey for the following species:

Common Name	***Scientific Name***
Northern Riffleshell	*Epioblasma torulosa rangiana*
Snuffbox	*Epioblasma triquetra*
Sheepnose Mussel	*Plethobasus cyphyus*
Clubshell	*Pleurobema clava*
Salamander Mussel	*Simpsonaias ambigua*
Pistolgrip Mussel	*Quadrula verrucosa*
Rayed Bean Mussel	*Villosa fabalis*

Upon capture, these specimens will be measured, marked, photo-documented, and immediately released to the point of capture and reported to the Commission within 48 hours via the Scientific Collectors' Permit online reporting system. This Special Permit **DOES NOT AUTHORIZE** any individual to kill or take from the wild endangered or threatened species. However, this permit authorizes valid Scientific Collector Permit holders (Types I, II and III) and their approved SCP assistants to engage in scientific collecting for endangered or threatened species at the locations approved on their 2020 Scientific Collectors' Permit. **Any endangered or threatened species captured during these permitted activities shall be released as authorized by the conditions outlined in your Scientific Collector's permit.** Deceased specimens, in whole or parts, shall be reported immediately to the Pennsylvania Fish & Boat Commission to determine disposition. This permit, unless sooner revoked, is effective immediately and expires with the 2020 Scientific Collectors' Permit.

FOR THE PENNSYLVANIA FISH AND BOAT COMMISSION

Christopher A. Urban, Chief
Natural Diversity Section

DIVISION OF NATURAL RESOURCES
Wildlife Resources Section
Elkins Operations Center
738 Ward Rd., PO Box 67
Elkins, WV 26241
Telephone 304-637-0245
Fax 304-637-0250

Stephen S. McDaniel
Director

ADDENDUM TO SCIENTIFIC COLLECTING PERMIT NO. 2020.111

Permittee: Sarah Veselka
Address: EnviroScience, Inc.
West Virginia – Appalachia Operations
129 Greenbag Road
Morgantown, WV 26501

Expiration Date: October 1, 2020

THE FOLLOWING PROVISIONS ARE ADDED TO THIS PERMIT: The Scope of Work is approved for the West Virginia portion of the project only. The WVDNR defers to the Pennsylvania Fish and Boat Commission for surveys conducted in their waters.

Mussel surveys are permitted in the Cheat River in Monongalia at the West Virginia – Pennsylvania state line (Lake Lynn Hydroelectric Relicensing)

THIS ADDENDUM MUST BE ATTACHED TO ORIGINAL PERMIT.

Must be signed before valid.

Sarah Veselka
Signature of permittee

Scientific Collecting Permit Coordinator

9/9/2020
Date of Issue

Appendix B
Photolog

PHOTOGRAPHIC RECORD

Mussel Reconnaissance Scoping Survey

Lake Lynn Hydroelectric Project (FERC No. P-2459)

Client Name:	Site Location:	Project No.
Lake Lynn Generation LLC	Cheat River, Monongalia County, West Virginia and Fayette County, Pennsylvania	282346.2020.000

Photo No. 1. **Date:** September 16, 2020 **Description:** View of the Lake Lynn Generation, LLC development looking upstream, facing east.	

Photo No. 2. **Date:** September 16, 2020 **Description:** View of the Lake Lynn Generation, LLC dam development looking upstream, facing southeast.	

PHOTOGRAPHIC RECORD

Mussel Reconnaissance Scoping Survey

Lake Lynn Hydroelectric Project (FERC No. P-2459)

Client Name:	Site Location:	Project No.
Lake Lynn Generation LLC	Cheat River, Monongalia County, West Virginia and Fayette County, Pennsylvania	282346.2020.000

Photo No. 3. **Date:** September 16, 2020 **Description:** View of the right descending bank of the island just downstream of the Project dam, facing south west.	

Photo No. 4. **Date:** September 16, 2020 **Description:** Cross stream view looking towards the left descending bank of the Cheat River, facing west.	

PHOTOGRAPHIC RECORD

Mussel Reconnaissance Scoping Survey

Lake Lynn Hydroelectric Project (FERC No. P-2459)

Client Name:	Site Location:	Project No.
Lake Lynn Generation LLC	Cheat River, Monongalia County, West Virginia and Fayette County, Pennsylvania	282346.2020.000

Photo No. 5. **Date:** September 16, 2020 **Description:** View of the left descending bank of the Cheat River from the island just downstream of the dam, facing southwest.	

Photo No. 6. **Date:** September 16, 2020 **Description:** View of Site 1 from the island directly downstream of the Project dam.	

PHOTOGRAPHIC RECORD

Mussel Reconnaissance Scoping Survey

Lake Lynn Hydroelectric Project (FERC No. P-2459)

Client Name:	Site Location:	Project No.
Lake Lynn Generation LLC	Cheat River, Monongalia County, West Virginia and Fayette County, Pennsylvania	282346.2020.000

Photo No. 7. **Date:** September 16, 2020 **Description:** Substrate within Site 1, directly downstream of the dam.	

Photo No. 8. **Date:** September 16, 2020 **Description:** View of the substrate at the point of Site 2.	

PHOTOGRAPHIC RECORD

Mussel Reconnaissance Scoping Survey

Lake Lynn Hydroelectric Project (FERC No. P-2459)

Client Name:	Site Location:	Project No.
Lake Lynn Generation LLC	Cheat River, Monongalia County, West Virginia and Fayette County, Pennsylvania	282346.2020.000

Photo No. 9. **Date:** September 16, 2020 **Description:** View of the left descending bank from Site 2.	

Photo No. 10. **Date:** September 16, 2020 **Description:** View of Site 2 on the island directly downstream of the Project dam, facing northeast.	

PHOTOGRAPHIC RECORD

Mussel Reconnaissance Scoping Survey

Lake Lynn Hydroelectric Project (FERC No. P-2459)

Client Name:	Site Location:	Project No.
Lake Lynn Generation LLC	Cheat River, Monongalia County, West Virginia and Fayette County, Pennsylvania	282346.2020.000

Photo No. 11. **Date:** September 16, 2020 **Description:** View of the Cheat River looking downstream along the right descending bank downstream of the island, facing northwest.	

Photo No. 12. **Date:** September 16, 2020 **Description:** View of the Cheat River looking across at the left descending bank downstream of the island, facing southwest.	

PHOTOGRAPHIC RECORD

Mussel Reconnaissance Scoping Survey

Lake Lynn Hydroelectric Project (FERC No. P-2459)

Client Name:	Site Location:	Project No.
Lake Lynn Generation LLC	Cheat River, Monongalia County, West Virginia and Fayette County, Pennsylvania	282346.2020.000

Photo No. 13. **Date:** September 17, 2020 **Description:** Representative view of Site 3, facing west.	

Photo No. 14. **Date:** September 17, 2020 **Description:** Representative view of Site 3 looking downstream, facing north.	

PHOTOGRAPHIC RECORD

Mussel Reconnaissance Scoping Survey

Lake Lynn Hydroelectric Project (FERC No. P-2459)

Client Name:	Site Location:	Project No.
Lake Lynn Generation LLC	Cheat River, Monongalia County, West Virginia and Fayette County, Pennsylvania	282346.2020.000

Photo No. 15. **Date:** September 16, 2020 **Description:** Representative view of Site 4, facing northwest.	

Photo No. 16. **Date:** September 16, 2020 **Description:** Representative view of Site 4, facing northwest.	

PHOTOGRAPHIC RECORD

Mussel Reconnaissance Scoping Survey

Lake Lynn Hydroelectric Project (FERC No. P-2459)

Client Name:	Site Location:	Project No.
Lake Lynn Generation LLC	Cheat River, Monongalia County, West Virginia and Fayette County, Pennsylvania	282346.2020.000

Photo No. 17. **Date:** September 16, 2020 **Description:** Substrate within Site 4.	

Photo No. 18. **Date:** September 16, 2020 **Description:** Representative photo of acid mine drainage, downstream of Site 4, facing east.	

PHOTOGRAPHIC RECORD

Mussel Reconnaissance Scoping Survey

Lake Lynn Hydroelectric Project (FERC No. P-2459)

Client Name:	Site Location:	Project No.
Lake Lynn Generation LLC	Cheat River, Monongalia County, West Virginia and Fayette County, Pennsylvania	282346.2020.000

Photo No. 19. **Date:** September 16, 2020 **Description:** Evidence of acid mine drainage, downstream of Site 4.	

Photo No. 20. **Date:** September 16, 2020 **Description:** View of milky colored water with iron covered rocks, downstream of Site 4.	

PHOTOGRAPHIC RECORD

Mussel Reconnaissance Scoping Survey

Lake Lynn Hydroelectric Project (FERC No. P-2459)

Client Name:	Site Location:	Project No.
Lake Lynn Generation LLC	Cheat River, Monongalia County, West Virginia and Fayette County, Pennsylvania	282346.2020.000

Photo No. 21. **Date:** September 16, 2020 **Description:** Representative view of Site 5 looking downstream, facing north.	

Photo No. 22. **Date:** September 16, 2020 **Description:** Representative view of Site 5, looking at the left descending bank, facing southwest.	

PHOTOGRAPHIC RECORD

Mussel Reconnaissance Scoping Survey

Lake Lynn Hydroelectric Project (FERC No. P-2459)

Client Name:	Site Location:	Project No.
Lake Lynn Generation LLC	Cheat River, Monongalia County, West Virginia and Fayette County, Pennsylvania	380830.0000.0000

Photo No. 23. **Date:** September 16, 2020 **Description:** View of substrate within Site 5.	

Photo No. 24. **Date:** September 16, 2020 **Description:** Representative view of Site 5 looking downstream at right descending bank, facing northeast.	

PHOTOGRAPHIC RECORD

Mussel Reconnaissance Scoping Survey

Lake Lynn Hydroelectric Project (FERC No. P-2459)

Client Name:	Site Location:	Project No.
Lake Lynn Generation LLC	Cheat River, Monongalia County, West Virginia and Fayette County, Pennsylvania	380830.0000.0000

Photo No. 25. **Date:** September 16, 2020 **Description:** Representative view of Site 5 looking downstream at left descending bank, facing northwest.	

Photo No. 26. **Date:** September 16, 2020 **Description:** Representative view of a riffle within Site 5 looking upstream, facing southeast.	

PHOTOGRAPHIC RECORD

Mussel Reconnaissance Scoping Survey

Lake Lynn Hydroelectric Project (FERC No. P-2459)

Client Name:	Site Location:	Project No.
Lake Lynn Generation LLC	Cheat River, Monongalia County, West Virginia and Fayette County, Pennsylvania	380830.0000.0000

Photo No. 27. **Date:** September 17, 2020 **Description:** View of the right descending bank at Site 6, facing west.	

Photo No. 28. **Date:** September 17, 2020 **Description:** Representative view of Site 6, facing west.	

PHOTOGRAPHIC RECORD

Mussel Reconnaissance Scoping Survey

Lake Lynn Hydroelectric Project (FERC No. P-2459)

Client Name:	Site Location:	Project No.
Lake Lynn Generation LLC	Cheat River, Monongalia County, West Virginia and Fayette County, Pennsylvania	380830.0000.0000

Photo No. 29. **Date:** September 17, 2020 **Description:** Representative view of Site 6 looking downstream at the left descending bank, facing northwest.	

Photo No. 30. **Date:** September 17, 2020 **Description:** Representative view of Site 6 looking upstream, facing east.	

PHOTOGRAPHIC RECORD

Mussel Reconnaissance Scoping Survey

Lake Lynn Hydroelectric Project (FERC No. P-2459)

Client Name:	Site Location:	Project No.
Lake Lynn Generation LLC	Cheat River, Monongalia County, West Virginia and Fayette County, Pennsylvania	380830.0000.0000

Photo No. 31. **Date:** September 17, 2020 **Description:** View of substrate within Site 6.	

Photo No. 32. **Date:** September 16, 2020 **Description:** Representative view of the island adjacent to Site 7, facing southwest.	

PHOTOGRAPHIC RECORD

Mussel Reconnaissance Scoping Survey

Lake Lynn Hydroelectric Project (FERC No. P-2459)

Client Name:	Site Location:	Project No.
Lake Lynn Generation LLC	Cheat River, Monongalia County, West Virginia and Fayette County, Pennsylvania	380830.0000.0000

Photo No. 33. **Date:** September 16, 2020 **Description:** Representative view of Site 7 looking downstream, facing northwest.	

Photo No. 34. **Date:** September 16, 2020 **Description:** Representative view of Site 7 looking upstream at the right descending bank, facing northeast.	

PHOTOGRAPHIC RECORD

Mussel Reconnaissance Scoping Survey

Lake Lynn Hydroelectric Project (FERC No. P-2459)

Client Name:	Site Location:	Project No.
Lake Lynn Generation LLC	Cheat River, Monongalia County, West Virginia and Fayette County, Pennsylvania	380830.0000.0000

Photo No. 35. **Date:** September 16, 2020 **Description:** View of substrate within Site 7.	

Photo No. 36. **Date:** September 16, 2020 **Description:** View of Site 8 looking upstream at a riffle, facing southeast.	

PHOTOGRAPHIC RECORD

Mussel Reconnaissance Scoping Survey

Lake Lynn Hydroelectric Project (FERC No. P-2459)

Client Name:	Site Location:	Project No.
Lake Lynn Generation LLC	Cheat River, Monongalia County, West Virginia and Fayette County, Pennsylvania	380830.0000.0000

Photo No. 37. **Date:** September 16, 2020 **Description:** View of Site 8 looking across at the right descending bank, facing north.	

Photo No. 38. **Date:** September 16, 2020 **Description:** Representative view of the Cheat River approximately 1.5 miles downstream, looking downstream, facing west.	

PHOTOGRAPHIC RECORD

Mussel Reconnaissance Scoping Survey

Lake Lynn Hydroelectric Project (FERC No. P-2459)

Client Name:	Site Location:	Project No.
Lake Lynn Generation LLC	Cheat River, Monongalia County, West Virginia and Fayette County, Pennsylvania	380830.0000.0000

Photo No. 39. **Date:** September 16, 2020 **Description:** Representative view of the Cheat River approximately 1.5 miles downstream, looking at the left descending bank, facing southwest.	

Photo No. 40. **Date:** September 17, 2020 **Description:** View of Site 9 looking downstream at the left descending bank, facing northwest.	

PHOTOGRAPHIC RECORD

Mussel Reconnaissance Scoping Survey

Lake Lynn Hydroelectric Project (FERC No. P-2459)

Client Name:	Site Location:	Project No.
Lake Lynn Generation LLC	Cheat River, Monongalia County, West Virginia and Fayette County, Pennsylvania	380830.0000.0000

Photo No. 41. **Date:** September 17, 2020 **Description:** Representative view of Site 9 looking upstream, facing east.	

Photo No. 42. **Date:** September 17, 2020 **Description:** View of Site 9 looking upstream along the left descending bank, facing southeast.	

PHOTOGRAPHIC RECORD

Mussel Reconnaissance Scoping Survey

Lake Lynn Hydroelectric Project (FERC No. P-2459)

Client Name:	Site Location:	Project No.
Lake Lynn Generation LLC	Cheat River, Monongalia County, West Virginia and Fayette County, Pennsylvania	380830.0000.0000

Photo No. 43. **Date:** September 17, 2020 **Description:** View from the downstream end of Site 9 looking downstream, facing northwest.	

Photo No. 44. **Date:** September 16, 2020 **Description:** Representative view of Site 10, facing northwest.	

PHOTOGRAPHIC RECORD

Mussel Reconnaissance Scoping Survey

Lake Lynn Hydroelectric Project (FERC No. P-2459)

Client Name:	Site Location:	Project No.
Lake Lynn Generation LLC	Cheat River, Monongalia County, West Virginia and Fayette County, Pennsylvania	380830.0000.0000

Photo No. 45. **Date:** September 16, 2020 **Description:** Representative view of Site 10 looking downstream, facing west.	

Photo No. 46. **Date:** September 16, 2020 **Description:** View of Site 10, facing north.	

PHOTOGRAPHIC RECORD

Mussel Reconnaissance Scoping Survey

Lake Lynn Hydroelectric Project (FERC No. P-2459)

Client Name:	Site Location:	Project No.
Lake Lynn Generation LLC	Cheat River, Monongalia County, West Virginia and Fayette County, Pennsylvania	380830.0000.0000

Photo No. 47. **Date:** September 16, 2020 **Description:** Representative view of the Cheat River approximately 2.9 miles downstream of the Project dam, looking downstream, facing west.	

Photo No. 48. **Date:** September 16, 2020 **Description:** Representative view of the Cheat River approximately 2.9 miles downstream of the Project dam, looking downstream, facing west.	

PHOTOGRAPHIC RECORD

Mussel Reconnaissance Scoping Survey

Lake Lynn Hydroelectric Project (FERC No. P-2459)

Client Name:	Site Location:	Project No.
Lake Lynn Generation LLC	Cheat River, Monongalia County, West Virginia and Fayette County, Pennsylvania	380830.0000.0000

Photo No. 49. **Date:** September 16, 2020 **Description:** Representative view of the Cheat River approximately 3.1 miles downstream of the Project dam, looking downstream, facing west.	

Photo No. 50. **Date:** September 16, 2020 **Description:** Representative view of the Cheat River approximately 3.1 miles downstream of the Project dam, looking upstream, facing east.	

PHOTOGRAPHIC RECORD

Mussel Reconnaissance Scoping Survey

Lake Lynn Hydroelectric Project (FERC No. P-2459)

Client Name:	Site Location:	Project No.
Lake Lynn Generation LLC	Cheat River, Monongalia County, West Virginia and Fayette County, Pennsylvania	380830.0000.0000

Photo No. 51. **Date:** September 16, 2020 **Description:** Representative view of the Cheat River approximately 3.5 miles downstream, at the mouth of the Monongahela River, facing south.	

Photo No. 52. **Date:** September 17, 2020 **Description:** Representative view of the Cheat River approximately 1 mile downstream, facing northwest.	

PHOTOGRAPHIC RECORD

Mussel Reconnaissance Scoping Survey

Lake Lynn Hydroelectric Project (FERC No. P-2459)

Client Name:	Site Location:	Project No.
Lake Lynn Generation LLC	Cheat River, Monongalia County, West Virginia and Fayette County, Pennsylvania	380830.0000.0000

Photo No. 53. **Date:** September 17, 2020 **Description:** Representative view of the Cheat River approximately 1.75 miles downstream, facing west.	

Photo No. 54. **Date:** September 17, 2020 **Description:** View of the left descending bank of the Cheat River approximately 2 miles downstream, facing south.	

PHOTOGRAPHIC RECORD

Mussel Reconnaissance Scoping Survey

Lake Lynn Hydroelectric Project (FERC No. P-2459)

Client Name:	Site Location:	Project No.
Lake Lynn Generation LLC	Cheat River, Monongalia County, West Virginia and Fayette County, Pennsylvania	380830.0000.0000

Photo No. 55. **Date:** September 17, 2020 **Description:** Representative view of Cheat River approximately 2 miles downstream, facing west.	

Photo No. 56. **Date:** September 17, 2020 **Description:** View of the left descending bank at Site 11, facing south.	

PHOTOGRAPHIC RECORD

Mussel Reconnaissance Scoping Survey

Lake Lynn Hydroelectric Project (FERC No. P-2459)

Client Name:	Site Location:	Project No.
Lake Lynn Generation LLC	Cheat River, Monongalia County, West Virginia and Fayette County, Pennsylvania	380830.0000.0000

Photo No. 57. **Date:** September 17, 2020 **Description:** View of Site 11 looking upstream along the left descending bank, facing west.	

Photo No. 58. **Date:** September 17, 2020 **Description:** View of Site 11 looking downstream along the left descending bank, facing southwest.	

PHOTOGRAPHIC RECORD

Mussel Reconnaissance Scoping Survey

Lake Lynn Hydroelectric Project (FERC No. P-2459)

Client Name:	Site Location:	Project No.
Lake Lynn Generation LLC	Cheat River, Monongalia County, West Virginia and Fayette County, Pennsylvania	380830.0000.0000

Photo No. 59. **Date:** September 17, 2020 **Description:** Relic shells found under the SR 119 bridge along the left descending bank approximately 1,000 feet from the mouth of the Monongahela River.	

Photo No. 60. **Date:** September 17, 2020 **Description:** Representative photo of *Potamilus alatus* (Pink heelsplitter) found downstream of Site 12, near the mouth of the Monongahela River.	

Recreation Site Enhancement Feasibility and Assessment

July 2021

Lake Lynn Hydroelectric Project (FERC No. 2459)

Prepared For:

Lake Lynn Generation, LLC
2 Bethesda Metro Center, Suite 1330
Bethesda, Maryland 20814

Prepared By:

TRC

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TABLES

FIGURES

ACRONYM LIST

Commission	Federal Energy Regulatory Commission
FERC	Federal Energy Regulatory Commission
Lake Lynn	Lake Lynn Generation, LLC or Licensee
Licensee	Lake Lynn Generation, LLC or Lake Lynn
Project	Lake Lynn Hydroelectric Project (FERC No. 2459)
Study Plan	*Lake Lynn Hydroelectric Project (FERC No. P-2459) Final Study Plan* dated September 2020
WMA	Snake Hill Wildlife Management Area
WVDCTR	West Virginia Department of Commerce Travel and Recreation

Introduction

A recreation site enhancement feasibility and assessment was conducted in August and September 2020 to support the relicensing of the Lake Lynn Hydroelectric Project, FERC No. 2459 (Project). Lake Lynn Generation, LLC (Licensee) is licensed by the Federal Energy Regulatory Commission (FERC or Commission) to operate the Project. Results of the recreation site enhancement feasibility and assessment are included herein.

Objectives

In accordance with Section 5.1 of the *Lake Lynn Hydroelectric Project (FERC No. P-2459) Final Study Plan* dated September 2020 (Study Plan), the objectives of the Recreation Site Enhancement Feasibility and Assessment were to:

- Evaluate the feasibility of making certain recreation site/facility enhancements at the Project. Specific enhancements to be evaluated included:
    1. Connection from the Cheat Lake Trail to the Sheepskin Trail at the northern end of the Cheat Lake Trail;
    2. Extension of the Cheat Lake Trail toward the south to Sunset Beach Marina;
    3. Extension of the swimming beach area to create a dog beach; and
    4. Public access to the upper reaches of Cheat Lake by improving an existing road in Snake Hill Wildlife Management Area (WMA) along Buzzard Run.
- Conduct both desktop and in-field assessments.

Background and Existing Information

The Project is located on the Cheat River, in Monongalia County, West Virginia near the City of Morgantown, and in Fayette County, Pennsylvania near the Borough of Point Marion, Pennsylvania (Figure 3.0-1). Cheat Lake and the Cheat River are popular destinations for boating, fishing, and other water sport activities. Cheat Lake is quickly becoming one of the best bass fisheries in the state. Cheat Lake is known for largemouth bass, smallmouth bass, crappie, yellow perch, white bass, and channel catfish. Known for excellent fishing of sauger, walleye, and smallmouth bass. The Project tailwater attracts hundreds of anglers each year (West Virginia Department of Commerce Travel and Recreation [WVDCTR], 2017).

Project recreation sites provide fishing, boating, nature viewing, picnicking, and hiking/biking opportunities. Existing Project recreation sites are summarized in Table 3-1 and shown in Figure 3.0-2.

Table 3-1: Commission Approved Recreation Facilities at the Lake Lynn Project

Recreation Site Name	Recreation Facilities
Cheat Lake Park	Hilltop and shoreline picnic areas, parking areas, playground area, car-top/winter boat launch, 3 restroom facilities, security/maintenance station, day-use boat docks, swimming beach, fish cleaning station, fishing platforms, access to the Cheat Lake Trail, 80 vehicle parking spaces (50 paved; 30 gravel), 5 Americans with Disabilities Act (ADA) parking spaces
Cheat Lake Trail	4.5-mile hiking/biking trail (ADA accessible), 15 vehicle parking spaces, additional parking at Cheat Lake Park, interpretive signs
Tailrace Recreation Area	Fishing platform, bank fishing opportunities, 20 vehicle parking spaces (including 2 ADA accessible spaces), portable ADA toilet
Sunset Beach Marina Public Boat Launch	Boat launch, approximately 60 boat trailer parking spaces
Cheat Haven Peninsula Nature Viewing Area	Nature trail, bike rack, picnic table
Cheat Lake Park Nature Viewing Area	Nature viewing area
Nature Viewing Area Across from Cheat Haven	Nature viewing area (Accessible by boat only)
Tower Run Nature Viewing Area	Pull-off parking, nature trail

Study Area

The study area for this assessment includes enhancements of several existing Project recreation sites and a new recreation site. The potential recreation enhancements assessed for this study include:

1. Connection from Cheat Lake Trail (northern trailhead) to proposed route for the Sheepskin Trail);
2. Extension of the Cheat Lake Trail (southern terminus) to Sunset Beach Marina;
3. Extension of the swimming beach area at Cheat Lake Park to create a dog beach; and
4. Public access to the upper reaches of Cheat Lake by improving an existing road in Snake Hill Wildlife Management Area (WMA) along Buzzard Run.

Figure 4.0-1 depicts the locations of the enhancements assessed for this study.

Methods

The desktop phase examined existing tax and property records to determine property ownership and access limitations associated with each site or enhancement. Safety and security concerns and considerations associated with Project operations, were also assessed including a review of any history of past safety or security concerns at the Project.

Subsequent to the initial desktop phase, an in-field assessment of each of the listed enhancements was conducted to assess the requested enhancements.

Figure 3.0-1: Overview Map of the Lake Lynn Project

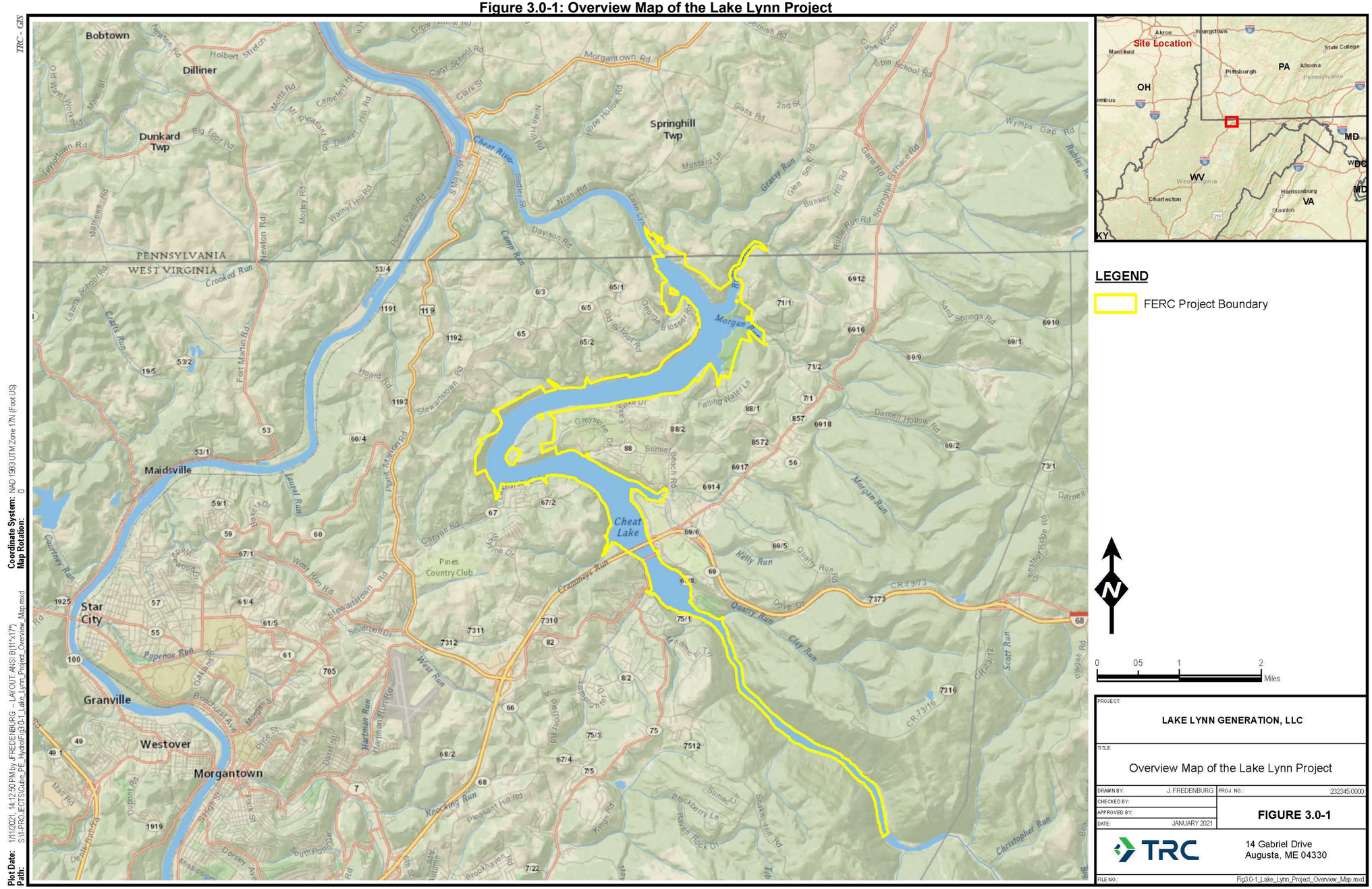


Figure 3.0-2: Lake Lynn Project Recreation Sites

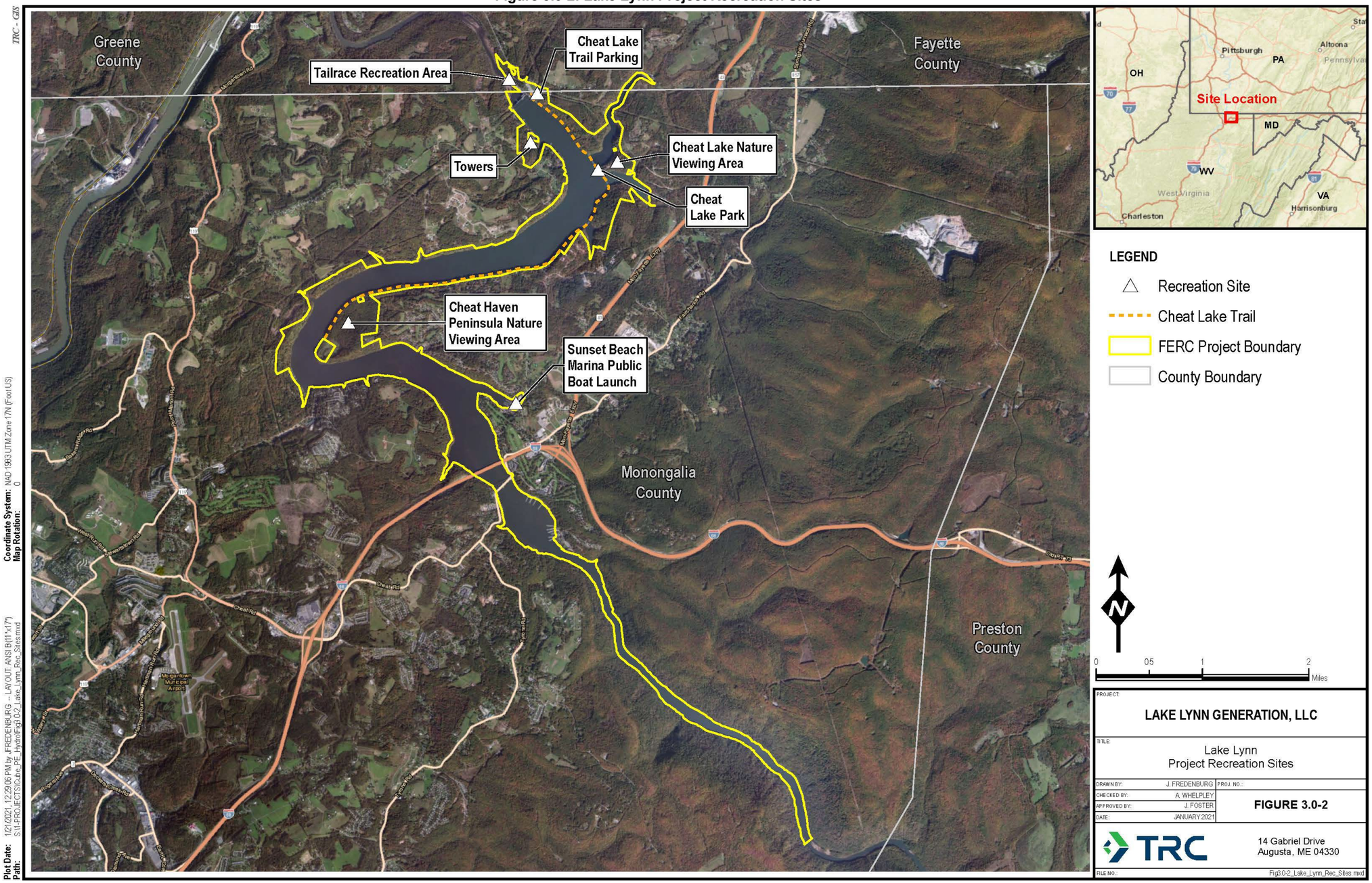
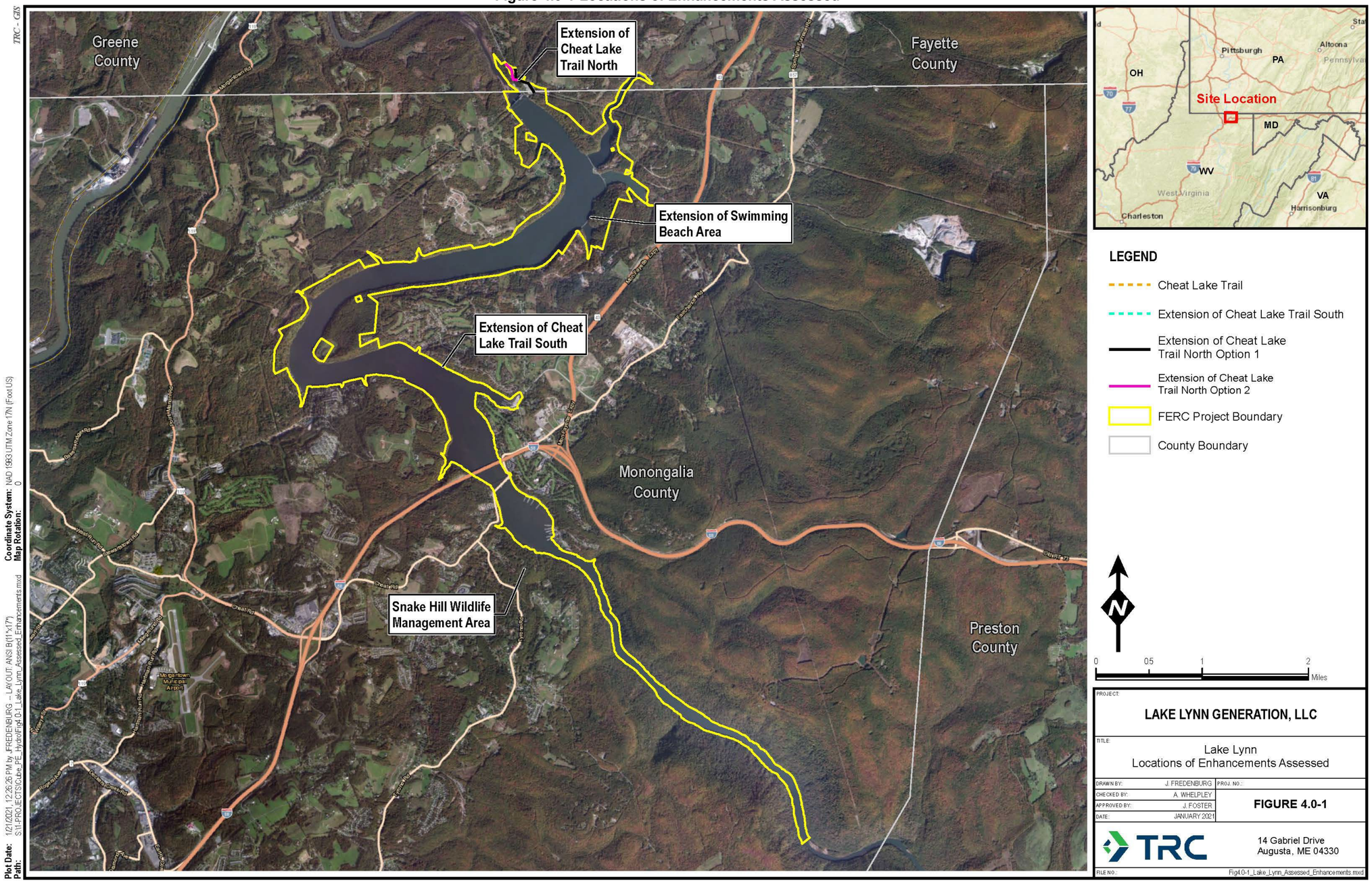


Figure 4.0-1-Locations of Enhancements Assessed



Results

A recreation site enhancement feasibility and assessment was conducted in August and September 2020 for the enhancements identified in Section 4.0 and the Study Plan. Results of the recreation site enhancement feasibility and assessment are summarized below.

1.1 Connection from the Cheat Lake Trail to the Sheepskin Trail (North)

Monongahela River Trails Conservancy (MRTC), Cheat Lake Environmental and Recreation Association (CLEAR), Friends of the Cheat (FOC), and several individuals requested that the Licensee work with stakeholders on planning and building a connection from the Cheat Lake Trail to the Sheepskin Trail, including opening the gate at the northern end of the trail to create a passageway from the northern end of the Cheat Lake Trail through the dam facility. CLEAR also requested a continued commitment for a connection to other regional trails. Options for connecting the Cheat Lake Trail to the Sheepskin Trail were examined. The first option is along an existing maintenance road that runs by the powerhouse. There is currently a locked gate prohibiting public access through this area. The second option is creating a trail from the Substation Parking Area located at the northern terminus of Cheat Lake Trail to connect to the proposed Sheepskin Trail segment.

Continue Trail North Through Gate Beside the Powerhouse

One option is to extend the Cheat Lake Trail approximately 0.24 miles from the current Cheat Lake Trail terminus to Bunker Hill Road along an existing maintenance road that runs by the powerhouse. After crossing the road, the extension would connect to the existing transmission line corridor and run along the transmission line corridor for approximately 0.1 mile to connect to the proposed Sheepskin Trail.

Property Ownership

Most of the property that would be needed for the extension of the Cheat Lake Trail through the existing gate would be on Licensee owned land with the exception or Bunker Hill Road and the WVDOT ROW.

Security

While this is likely the easiest option, this trail extension option would be in close proximity to the powerhouse and at a higher elevation than the existing powerhouse parking area creating a potential security and safety issue. The gate is in place to keep the public away from the powerhouse. This option would require additional security measures at the powerhouse to ensure objects cannot be thrown at the powerhouse or into the powerhouse parking area.

Safety

There are also safety concerns with this trail option. Bunker Hill Road is steep, narrow, and winding in this area which poses a public safety concern for creating a trail extension that crosses the road or runs along the road in this area. The area to access the existing transmission line corridor is steep and heavily vegetated and would require improvements to create safe access (see photo 1).

Photo 1: View of transmission line corridor assessed for trail extension.

Extend Trail from Substation Parking Area

A new Sheepskin Trail segment would be approximately 0.34 miles from the Substation Parking area. The second option for connecting Cheat Lake Trail to the Sheepskin would be to create a bike route from the northern terminus of Cheat Lake Trail that could be used instead of the current steps to the Substation Parking Area. There is a significant slope from the parking area to the Cheat Lake Trail and limited space that would be challenging to create a bike route that could be used by bikers of all skill levels. The trail extension would follow the road into the Substation Parking area, cross Bunker Hill Road, and then follow the existing transmission corridor for about 0.1 mile to the proposed Sheepskin Trail.

Property Ownership

Most of the property that would be needed for the extension of the Cheat Lake Trail from the Substation Parking area would be on Licensee owned land except for the WV ROW and Bunker Hill Road.

Access Limitations

There are access limitations associated with this trail option. The first would be the proximity to the substation. This trail would pass outside of the substation fence that could potentially create a public safety issue. The second access limitation would be the Bunker Hill Road crossing. This road is steep, narrow and winding in the area of the crossing. Finally, the access to the existing transmission line corridor is steep and heavily vegetated.

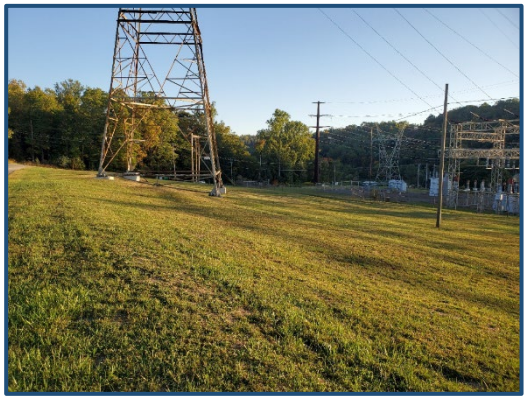


Photo 2: View of assessed trail extension area within the proximity of the substation.

Safety

There are several safety concerns with this trail option. In order for bikers to traverse the steep hill from the Cheat Lake Trail to the Substation Parking area, a bike route with a ramp would need to be installed. Installing a route suitable for bikers of all skill levels would be challenging given the slope and space limitations in this area. This ramp could cause potential hazards for trail users during inclement weather. Bunker Hill Road is steep, narrow, and winding in this area which poses a public safety concern

for creating a trail extension that crosses the road or runs along the road in this area. The area to access the existing transmission line corridor is also steep and heavily vegetated and would require improvements to create safe access (see photo 1).

1.2 Extension of the Cheat Lake Trail (South)

MRTC and FOC requested the Licensee extend the Cheat Lake Trail toward the south that would begin in the Cheat Haven Nature Viewing Area and follow the shoreline of Cheat Lake and end at Sunset Beach Marina. The extension would be approximately 3.1 miles long and end at the Sunset Beach Marina Parking Area.

Property Ownership

Access across approximately 47 properties would be needed for the extension of the Cheat Lake Trail from the Cheat Haven Nature Viewing Area south to Sunset Beach Marina. Of these properties, the Licensee has ownership of only one (1). The remaining 46 properties are privately owned.

Access Limitations

Due to the steep topography along the Cheat Lake shoreline south from Cheat Haven, there is very limited land located within the Project boundary or owned by the Licensee. Given the steep topography along the shoreline, sections of the existing trail that have washed out or been damaged due to runoff from the upland subdivision. This subdivision is also located above a large section of the potential south trail extension that could potentially be washed out as well. The proximity of nearby residential homes is another limitation to extending this trail to the south. The Cheat Haven Nature Viewing Area preserves land to reduce habitat destruction thereby creating a limitation for extending the Cheat Lake Trail to the south. Finally, the Sunset Beach Marina parking area would be the terminus of the extended Cheat Lake Trail to the south. This parking area is frequently crowded in its existing condition and would not be able to accommodate additional parking associated with the requested Cheat Lake Trail extension to the south.

Photo 3: View of steep shoreline in close proximity to local homeowners taken from Sunset Beach Marina.

Security

The local Homeowners Association and homeowners adjacent to the Cheat Lake Trail have historically raised concerns about the Cheat Lake Trail (southern portion) and extending the Cheat Lake Trail. They feel an extension would bring additional people too close to their homes creating safety issues to their properties. The Licensee currently contracts with a security company to patrol/maintain the existing Cheat Lake Trail from Memorial Day through Labor Day. The security company is responsible for locking and unlocking a gate across the southern portion of the Cheat Lake Trail to address the concerns of homeowners adjacent to the trail. Extending

the Cheat Lake Trail to the south with another trailhead would likely create additional security burden to open and close a gate at both entrances to the southern portion of the Cheat Lake Trail.

1.3 Extension of Swimming Beach Area to Create Dog Beach/Swim Area

CLEAR requested the Licensee extend the swimming beach area toward the day-use boat docks to create a dog beach or swimming area.

Property Ownership

All of the property that would be needed for the extension of the swimming beach area toward the day-use boat docks would be on Licensee owned land.

Maintenance

Access to the requested dog beach area would be along the existing Cheat Lake Trail. Parking for the proposed dog beach would be at the existing Cheat Lake Park. Extending the beach would require additional maintenance along with hauling in sand to the area. Due to the nature of this area, sand would need to be replenished periodically as erosion occurs and washes out the beach sand. The area suggested for the expansion has an abundance of wetland vegetation present. This area also collects an abundance of woody debris that needs to be removed frequently.

Photo 4: View of potential dog park area showing woody debris, wetland vegetation and the proximity of the boat docks in the background.

Safety

There are safety concerns related to the requested location of the dog beach/swim area. First, this area is close to the eight day use boat docks that are in place during the recreation season. Since boats may come and go to the docks throughout the day during the recreation season this would pose a safety risk to the dogs in the water as well as the boats as boat operators may have to navigate around a dog in the water. Another safety concern is the water quality at the swimming beach. The Monongalia County Health Department and FOC conduct bacteria monitoring at the beach. Dogs in the water in close proximity to the swimming beach could potentially increase bacteria levels at the swimming beach. Another safety concern is related to unleashed dogs. Cheat Lake Park rules currently require that all dogs be leashed for the safety of all visitors. Creating a swimming area for dogs would encourage the unleashing of dogs that could potentially pose a safety risk to swimmers at the swimming beach or to other recreationists in the area.

1.4 Public Access to Upper Reaches of Cheat Lake through Snake Hill WMA

FOC requested the Licensee create public access to the upper reaches of Cheat Lake by improving an existing gated road in the Snake Hill Wildlife Management Area (WMA) along Buzzard Run to provide a trailhead for hikers, angler access to upper Cheat Lake, and egress for whitewater paddlers running the Lower Cheat Canyon. West Virginia Department of Natural

Resources (WVDNR) commented that it is unequivocally opposed to creating public access to the upper reaches of Cheat Lake by opening a gated road that passes through Snake Hill WMA property because continued maintenance of the access road would be problematic and an undue burden for the State of West Virginia and the Licensee with very little benefit to the WVDNR's prime constituents. This requested enhancement was assessed at a cursory level in this report since the property owner is the and it is managed by WVDNR, which is opposed to the request. The American Whitewater website[1] describes the stretch of the Cheat River that runs along the WMA as . There is an existing put-in at Jenkins burg Bridge which is 7.4 miles upstream of the take-out located at Cheat Lake.

Property Ownership

This property is located outside of the Project boundary and owned by the and managed by WVDNR. WVDNR is opposed to creating a public access to the upper reaches of Cheat Lake by improving an existing gated road in the WMA (see figure 6.4-1 for a map of the WMA). The WMA is managed to provide visitors with undisturbed hunting, fishing, and other outdoor recreation and providing a road for vehicular traffic is inconsistent with the management of the WMA.

Maintenance

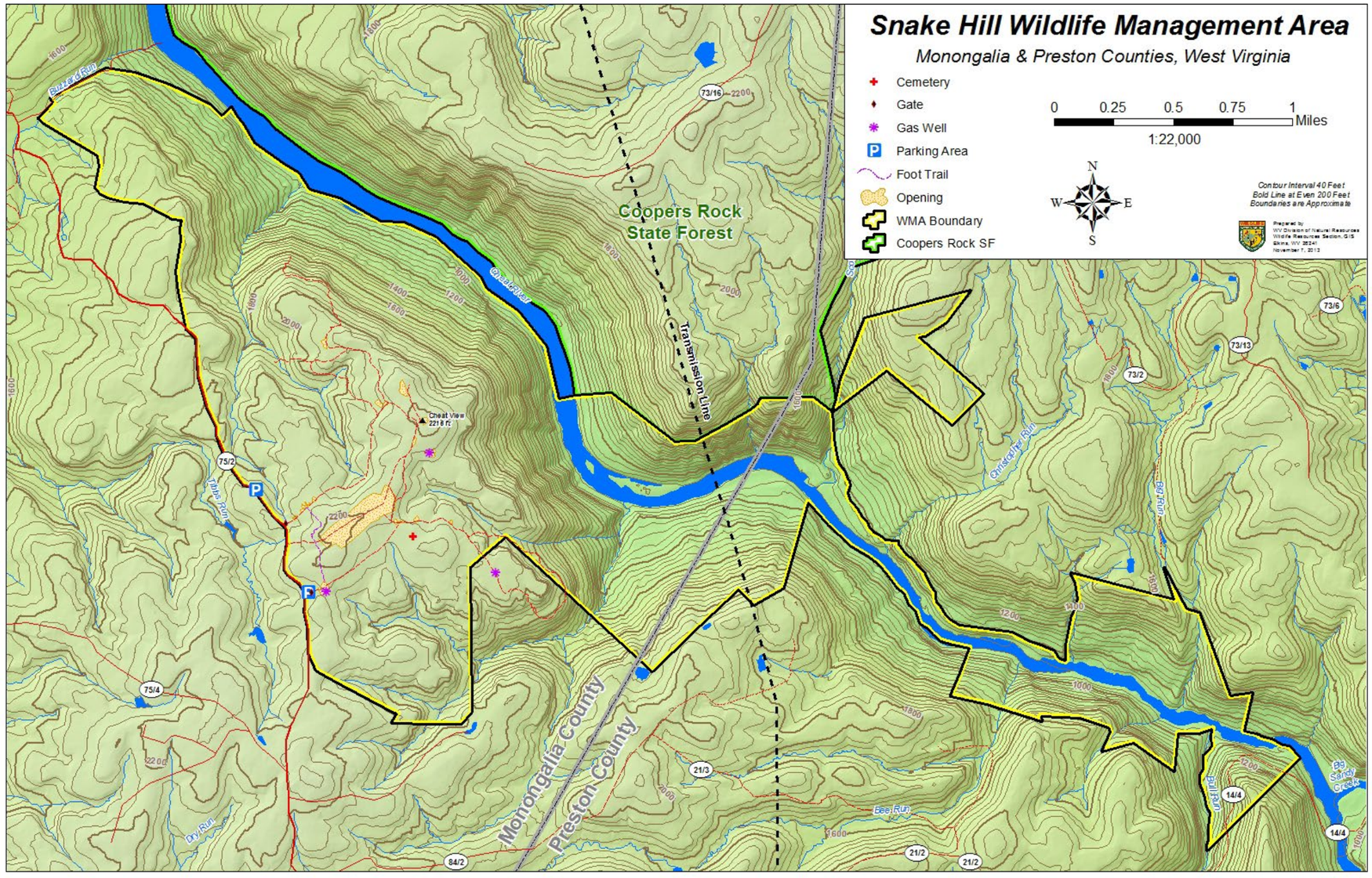
The WMA access road along Buzzard Hill Road is currently gated and unmanned. If the State were to open the gate to provide an access road, significant improvements would be needed that would require continued maintenance. This would create an undue burden on the State and the Licensee. Given the steep topography to the river, road construction would be needed to safely access the river.

Safety

The WMA is managed to provide visitors with undisturbed hunting, fishing, and other outdoor recreation. Due to the large number of hunters in West Virginia, the safety of both hunters and other recreationists is one of the greatest safety concerns at the Snakehill WMA. There are numerous hunting seasons in West Virginia which extend from September 5 through December 31 and then again from April 17 through May 23. Given the wide variety of game in the Snakehill WMA, hunters could be prevalent. If a road were constructed for angler access or egress for whitewater paddlers, this could pose a significant public safety risk.

1

Figure 6.4-1 Snakehill Wildlife Management Area



Source: http://www.wvdnr.gov/wmamapproj/images/SnakeHillFinal11x17.jpg

7.0 Variances from the Study Plan

There were no variances from the Study Plan.

8.0 Summary

The feasibility of certain recreation site/facility enhancements at the Project, as requested by the agencies and stakeholders, was examined. Specific improvements examined include:

1. Connection from Cheat Lake Trail (northern trailhead) to the proposed route for the Sheepskin Trail;
2. Extension of the Cheat Lake Trail (southern terminus) to Sunset Beach Marina;
3. Extension of the swimming beach area at Cheat Lake Park to create a dog beach; and
4. Public access to the upper reaches of Cheat Lake by improving an existing road in Snake Hill WMA along Buzzard Run.

The feasibility of connecting the northern terminus of the Cheat Lake Trail to the proposed route for the Sheepskin Trail was examined. Based on a review of tax maps, aerial photography, and a site visit to Lake Lynn, a trail extension north toward the proposed route for the Sheepskin Trail could feasibly use one of two proposed options. The first option that was assessed would be the easiest option to construct and would entail the Licensee opening a gate near the powerhouse. This option involves security risks for on-site staff and the powerhouse. The second option would be to create a bike route (ramp) from the northern terminus of the Cheat Lake Trail up a steep slope (next to the existing steps) to the Substation Parking area and then create a trail from the parking area to the Sheepskin Trail.. Both options would also include safety risks to the general public including a road crossing and steep terrain on the existing transmission line corridor.

The feasibility of providing an extension of the Cheat Lake Trail toward the Sunset Beach Marina was examined and determined to not be feasible. Based on a review of tax maps, aerial photography, and a site visit to Lake Lynn, a trail extension south toward the Sunset Beach Marina would require many easement agreements with local landowners. Steep topography along the trail would also make constructing this extension costly.

The feasibility of providing an extension of the swimming beach area to create a dog beach was examined. Given the proximity to the existing swimming area and the day use boat docks, there are safety risks associated with the requested enhancement..

Providing public access to the upper reaches of Cheat Lake by improving an existing road in the Snake Hill WMA was determined to not be feasible. The land is owned by the State of West Virginia and WVDNR is opposed to opening a gated road that passes through Snake Hill WMA property because continued maintenance of the access road would be problematic and an undue burden.

Lake Lynn Hydroelectric Project

FERC No. 2459

Exhibit G

Project Maps

PENNSYLVANIA

Sheet 1

GREENE COUNTY
MONONGALIA COUNTY

FAYETTE COUNTY
MONONGALIA COUNTY

FAYETTE COUNTY
PRESTON COUNTY

MONONGALIA COUNTY
PRESTON COUNTY

Monongahela River

Cheat River

Sheet 2

Coopers Rock State Forest

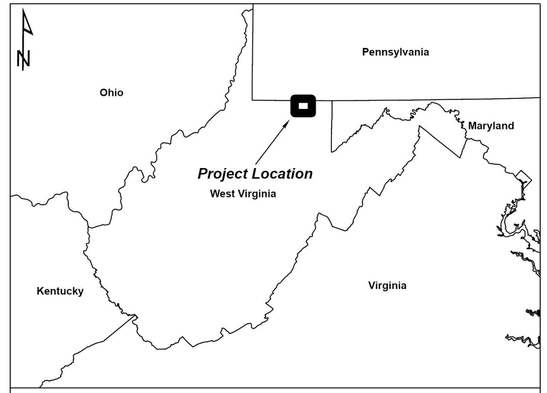
Project Boundary

Coopers Rock State Forest

Sheet 3

WEST VIRGINIA

Snake Hill Wildlife Management Area



9.19°W
4/9/2021

- Project Boundary
- Waterbody
- County
- State
- Protected Land
- Map Index

Map notes:

1. The Lake Lynn Project is located in the States of West Virginia and Pennsylvania in Monongalia and Fayette Counties, respectfully.
2. Reference Point coordinates are shown in NAD 1983 StatePlane West Virginia North FIPS 4701 Ft US.
3. Elevations shown are referenced to NGVD 29, where NAVD 88 = NGVD 29 + 0.378 ft. Conversion factor was determined from The NGS Coordinate Conversion and Transformation Tool (NCAT).
4. Licensee has acquired all flowage rights and title in fee or the right to use in perpetuity all lands necessary or appropriate for the construction, maintenance, and operation of the Project. All property records are kept on file with the licensee.
5. There are no federal lands within the Project boundary.
6. The Project boundary description, as required by 18 CFR 4.41, is represented here by a grid of Northings and Eastings around, and graticules within, the map frame. Any position in Northings and Eastings along the Project boundary can be determined using these references.
7. The Project boundary, in part, was digitized from contour elevations derived from USGS WV Southcentral LiDAR data (USGS 2018).

EAGLE CREEK RENEWABLE ENERGY

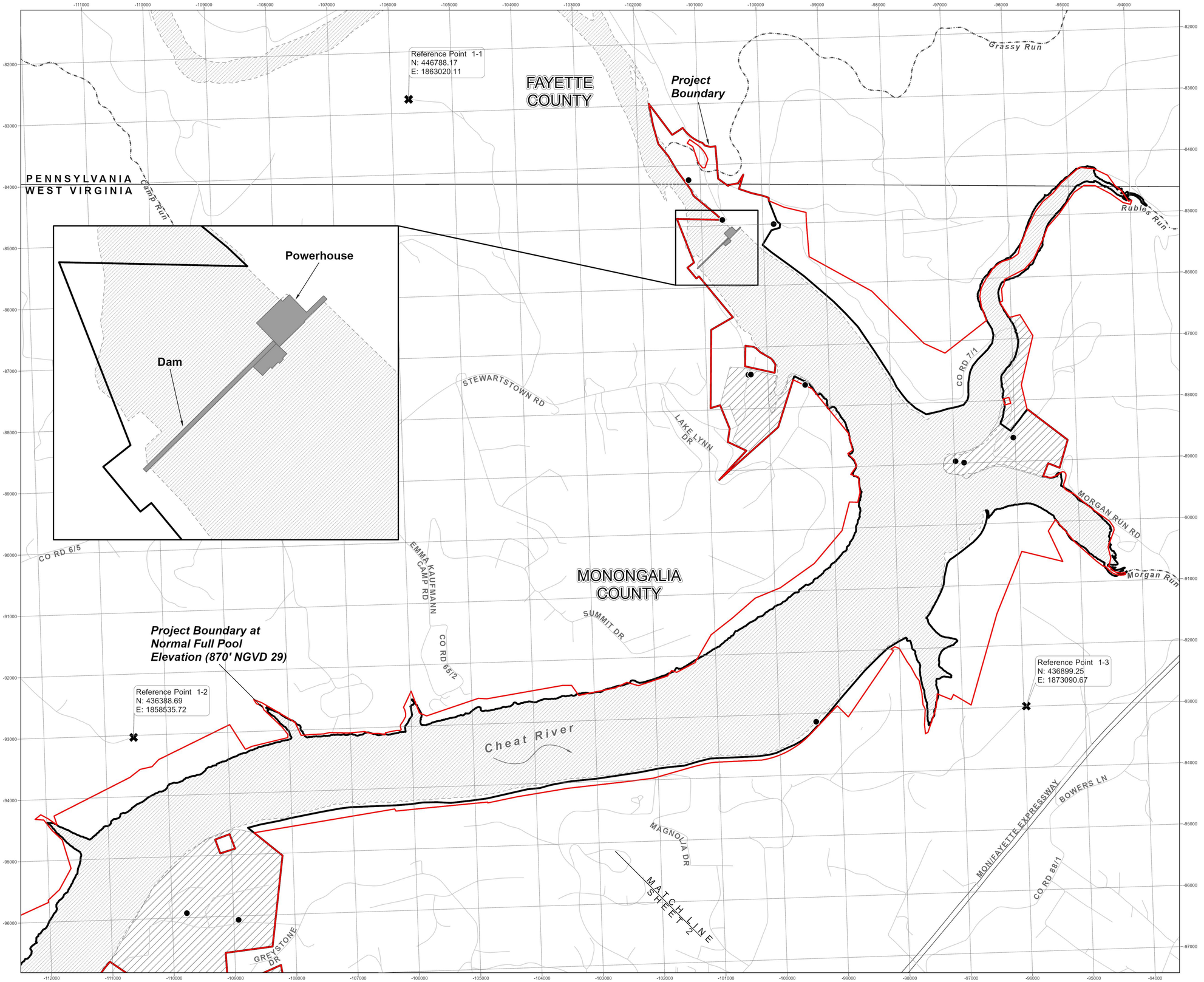
LAKE LYNN HYDROELECTRIC PROJECT
FERC NO. 2459

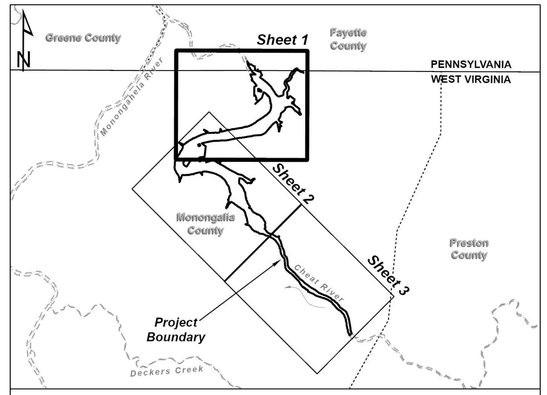
PROJECT BOUNDARY MAP

EXHIBIT G SCALE: 1" = 2,502' SHEET NO. OF 3

0 1,500 3,000 6,000 9,000 12,000 Feet

FERC DWG. NO. 2459-





9.19°W
4/9/2021

- Project Boundary (Proposed)
- Project Boundary (Existing)
- Reference Point
- Recreation
- Nature Viewing Recreation Area
- Features
- Hydrography
- Waterbody
- Interstate
- Road
- Match Line
- Protected Land
- County
- State

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EAGLE CREEK RENEWABLE ENERGY

LAKE LYNN HYDROELECTRIC PROJECT
FERC NO. 2459

PROJECT BOUNDARY MAP

EXHIBIT G | SCALE: 1" = 750' | SHEET NO. 1 OF 3

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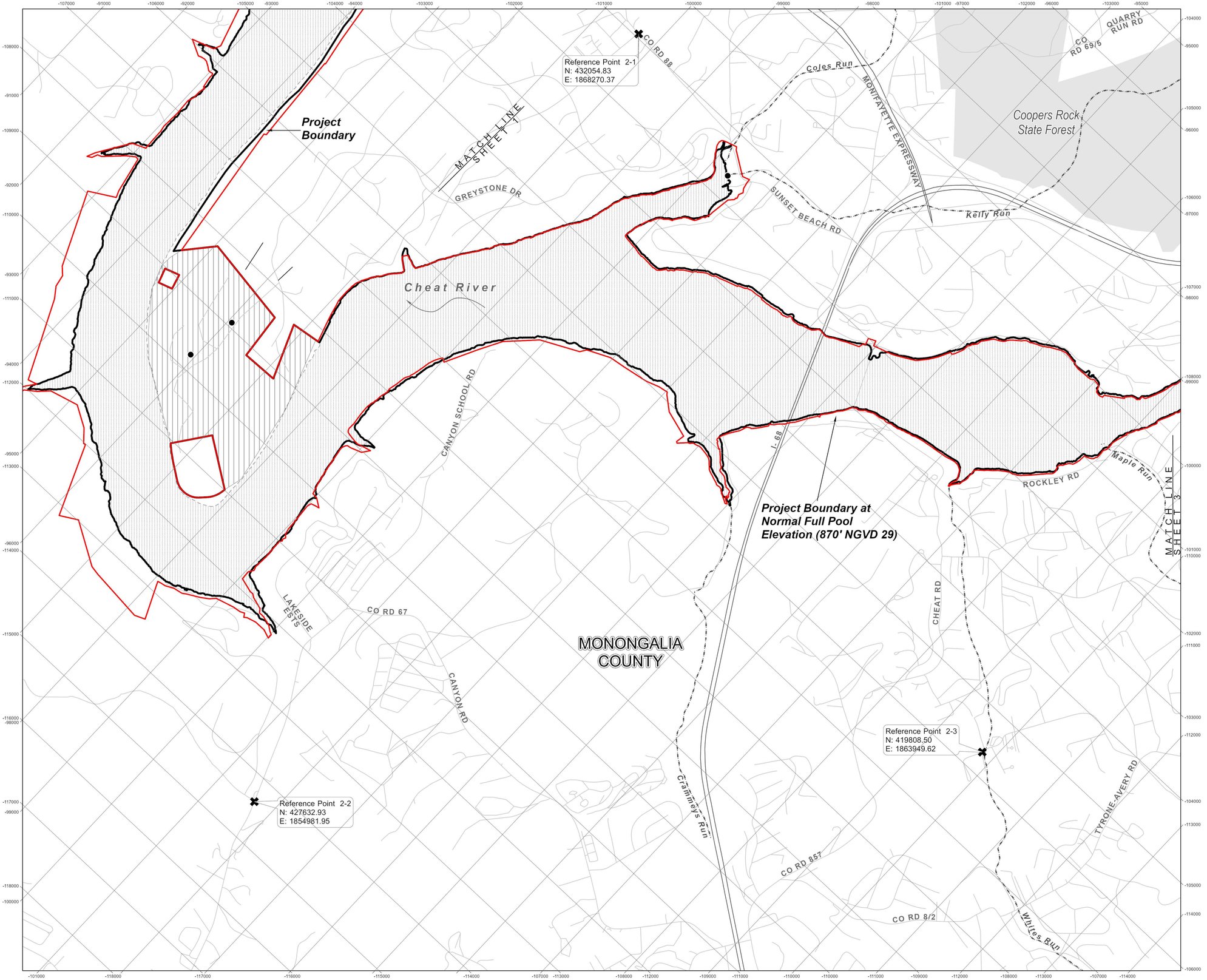
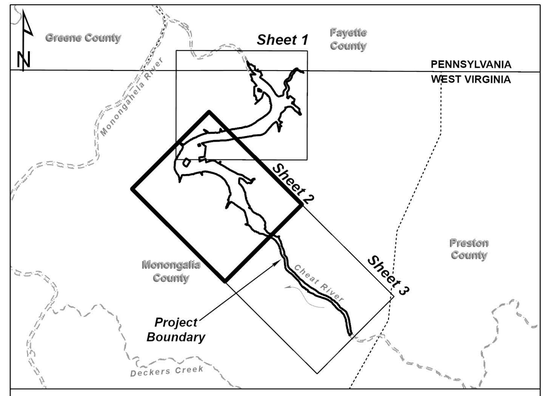
FERC DWG. NO. 2459-





9.19°W
4/9/2021

- Project Boundary (Proposed)
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EAGLE CREEK RENEWABLE ENERGY

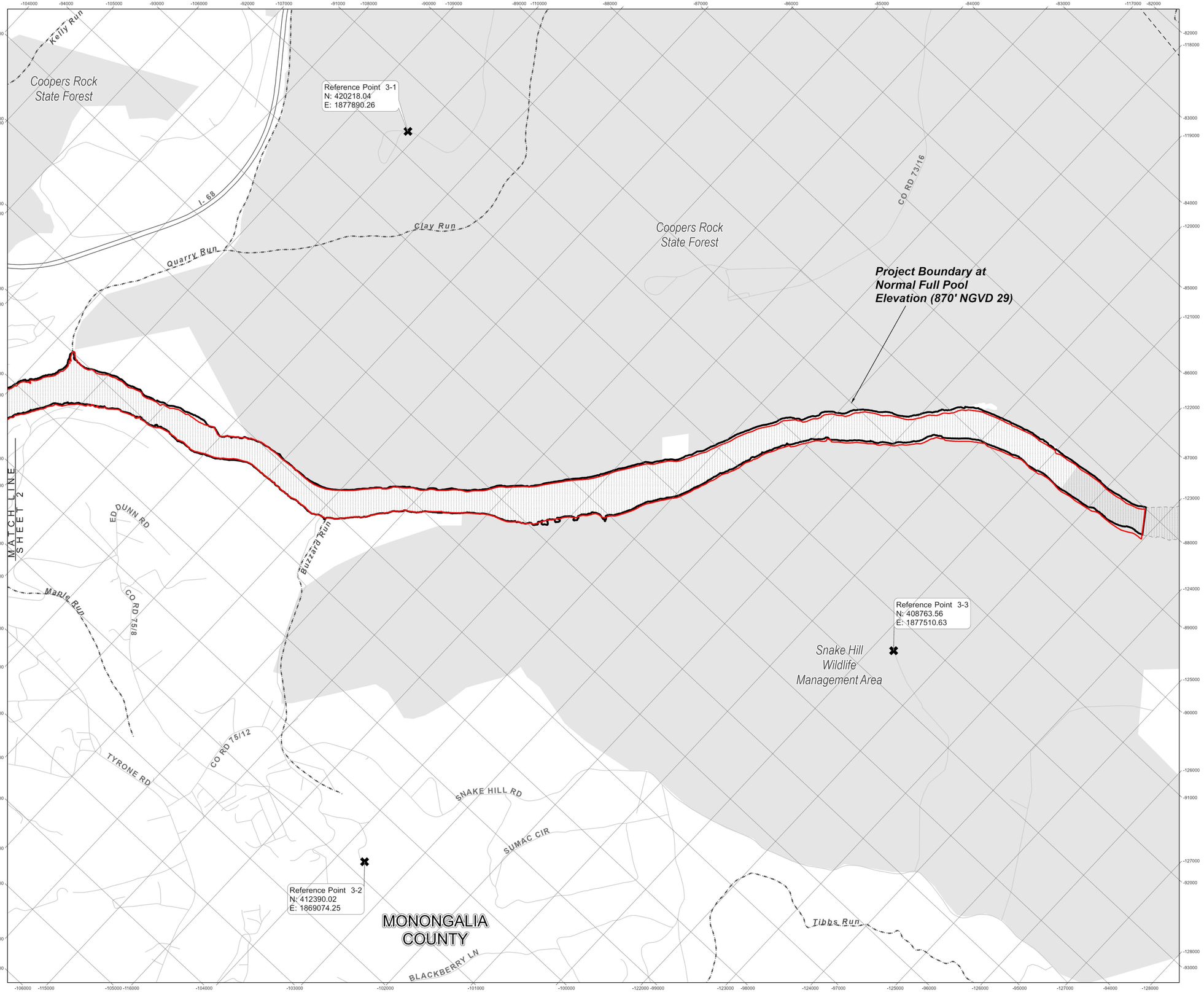
LAKE LYNN HYDROELECTRIC PROJECT
FERC NO. 2459

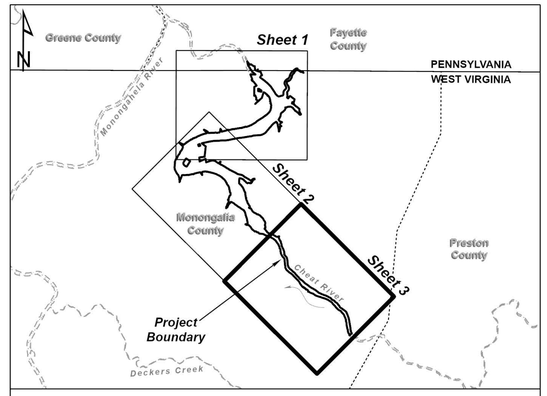
PROJECT BOUNDARY MAP

EXHIBIT G | SCALE: 1" = 750' | SHEET NO. 2 OF 3

0 500 1,000 2,000 3,000 4,000 Feet

FERC DWG. NO. 2459-





9.19°W
4/9/2021

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EAGLE CREEK RENEWABLE ENERGY

LAKE LYNN HYDROELECTRIC PROJECT
FERC NO. 2459

PROJECT BOUNDARY MAP

EXHIBIT G | SCALE: 1" = 750' | SHEET NO. 3 OF 3

0 500 1,000 2,000 3,000 4,000 Feet

FERC DWG. NO. 2459-

Lake Lynn Hydroelectric Project

FERC No. 2459

Exhibit H

Description of Project Management and Need for Project Power

TABLE OF CONTENTS

LIST OF APPENDICES

1.0 INTRODUCTION

Lake Lynn Generation, LLC (Lake Lynn or Licensee), a subsidiary of Eagle Creek Renewable Energy, LLC (Eagle Creek), is the licensee, owner, and operator of the existing 51.2-megawatt (MW) Lake Lynn Hydroelectric Project (Lake Lynn Project). The Lake Lynn Project is located on the Cheat River in Monongalia County, West Virginia, near the city of Morgantown and in Fayette County, Pennsylvania, near the borough of Point Marion. The Federal Energy Regulatory Commission (FERC or Commission) issued the current license for the Lake Lynn Project (FERC No. 2459) on December 27, 1994.

2.0 INFORMATION TO BE SUPPLIED BY ALL APPLICANTS

2.1 Plans and Ability of the Applicant to Operate and Maintain the Project (18 CFR Section 5.18(c)(1)(i)(A))

2.1.1 Plans to Increase Capacity or Generation

The Licensee has no current plans to increase the capacity or generation of the Lake Lynn Project.

2.1.2 Plans to Coordinate the Operation of the Project with Other Water Resource Projects

The Licensee does not own other hydroelectric facilities in the river system. The Lake Lynn Project operates as a dispatchable peaking hydroelectric facility with storage capability, and therefore the Lake Lynn Project is operated independently of other facilities.

2.1.3 Plans to Coordinate the Operation of the Project with Other Electrical Systems

There is no coordination of generation with other electrical systems because the applicant is not a utility. The Licensee is an independent power producer and currently delivers all power generation directly to PJM Interconnection, LLC (PJM), a regional transmission organization (RTO), that coordinates the movement of wholesale electricity. PJM is a voluntary association whose members include not only traditional electric utilities, but independent power producers that are participating in the competitive wholesale electricity marketplace. As an RTO, PJM operates a wholesale electricity market that spans all or part of Delaware, Illinois, Kentucky, Maryland, Michigan, New Jersey, North Carolina,

Ohio, Pennsylvania, Tennessee, Virginia, West Virginia, and the District of Columbia. Acting as a neutral, independent party, PJM operates electricity "spot markets" in which generators sell and utilities or electricity providers buy energy for immediate delivery.

2.2 Need for the Electricity Generated By the Project (18 CFR Section 5.18(c)(1)(i)(B))

2.2.1 The Reasonable Costs and Availability of Alternative Sources of Power

The Lake Lynn Project generates emission-free, renewable power and the electrical output from the Lake Lynn Project is sold to PJM. The replacement of energy and capacity provided by the Lake Lynn Project (165,650 megawatt-hour (MWh) annually; based on a period from 2012-2018) would be met through other sources (see also Exhibit A). Alternative sources of power could be obtained by purchasing power from electricity markets operated in the region. Power could also be supplied through the construction of new power plants. Services to the grid would need to be provided by other existing projects, or in some other means by the system operator, if a new license for the Lake Lynn Project is not granted. This would likely be the equivalent amount of power from PJM with costs based on market pricing. Therefore, it is difficult for Lake Lynn to speculate the cost and availability of such alternative sources of power since the price and source can vary hourly.

2.2.2 Increase in Costs if the Licensee is not Granted a License

If the Licensee is not granted a license, the Lake Lynn Project would cease to provide affordable, clean electricity to PJM. An unquantified increase in costs may occur to the electric customer in the region if a license for continued operation of the Lake Lynn Project were not granted.

2.3 Effects of Alternative Sources of Power

2.3.1 Effects on Licensee's Customers

This section is not applicable to the Licensee since the Licensee sells its electricity to PJM.

2.3.2 Effects on Licensee's Operating and Load Characteristics

The Licensee is an independent power producer and, as such, does not maintain a separate transmission system which could be affected by replacement or alternative power sources.

2.3.3 Effects on Communities Served by the Project

See the discussion above in Section 2.2*, Need for Electricity Generated by the Project*, regarding the loss of generation from the Lake Lynn Project. Because the Licensee cannot predict with any certainty the actual type or location of a potential alternative facility providing replacement power, it cannot specifically discuss potential effects of an alternative source of power on any particular community.

2.4 Need, Reasonable Cost, and Availability of Alternative Sources of Power (18 CFR Section 5.18(c)(1)(i)(C))

The Licensee is an independent power producer and, as such, does not have an obligation or need to prepare load and capability forecasts in reference to any particular group or class of customers. For the region, those obligations and tasks remain within the scope of services provided by PJM. If Lake Lynn is not granted a license, the Lake Lynn Project would cease to provide affordable, clean electricity to the PJM market. The annual cost of replacing the power produced by the Lake Lynn Project is estimated to be $[***to be provided in the final license application***], which is the average annual revenue based on data from [***to be provided in the final license application***].

2.5 Effect of Power on Applicant's Industrial Facility (18 CFR Section 5.18(c)(1)(i)(D))

This section is not applicable as Lake Lynn does not use the power generated for its own industrial operations.

2.6 Need of the Tribe for Electricity Generated by the Project (18 CFR Section 5.18(c)(1)(i)(E))

Lake Lynn is not a Native American Tribe; therefore, this section is not applicable.

2.7 Impacts on the Operations and Planning of the Licensee's Transmission System of Receiving or Not Receiving the License (18 CFR Section 5.18(c)(1)(i)(F))

The Licensee does not own the local transmission system other than the dual 800-foot-long, 138 kV transmission lines which connect to the XXX system; therefore, this section is not applicable. However, power generated by the Lake Lynn Project is currently transmitted to the PJM transmission/distribution system as shown in the Single Line Diagram for the Lake Lynn Project (see Appendix H-1).

2.8 Statement of Need for Modifications to Existing Project Facilities or Operations (18 CFR Section 5.18(c)(1)(i)(G))

Lake Lynn has no plans to construct new facilities or to alter operations of the Lake Lynn Project. Lake Lynn is seeking authorization to continue operating the Lake Lynn Project in its current configuration and as it is currently licensed to operate.

2.9 Consistency with Comprehensive Plans (18 CFR Section 5.18(c)(1)(i)(H))

Section 10(a)(2)(A) of the Federal Power Act (FPA), 16 U.S.C. section 803 (a)(2)(A), requires FERC to consider the extent to which a project is consistent with Federal or state comprehensive plans for improving, developing, or conserving a waterway or waterways affected by a hydropower project. On April 27, 1988, the Commission issued Order No. 481-A, revising Order No. 481, issued October 26, 1987, establishing that the Commission will accord FPA section 10(a)(2)(A) comprehensive plan status to any Federal or state plan that: (1) is a comprehensive study of one or more of the beneficial uses of a waterway or waterways; (2) specifies the standards, the data, and the methodology used; and (3) is filed with the Secretary of the Commission.

FERC currently lists 66 comprehensive plans for the state of West Virginia and the Commonwealth of Pennsylvania combined. Of those the following 8 comprehensive plans are identified as pertaining to waters in the vicinity of the Lake Lynn Project:

- National Park Service. The Nationwide Rivers Inventory. Department of the Interior, Washington, D.C. 1993.
- Pennsylvania Department of Environmental Resources. 1983. Pennsylvania State water plan. Harrisburg, Pennsylvania. January 1983. 20 volumes.
- Pennsylvania Department of Environmental Resources. 1986. Pennsylvania's recreation plan, 1986-1990. Harrisburg, Pennsylvania.
- Pennsylvania Department of Environmental Resources. 1988. Pennsylvania 1988 water quality assessment. Harrisburg, Pennsylvania. April 1988.
- West Virginia Division of Natural Resources. 1982. Monongahela River Basin plan. Charleston, West Virginia.
- West Virginia Division of Natural Resources. 2015 West Virginia State Wildlife Action Plan. Charleston, West Virginia. September 1, 2015

- West Virginia Governor's Office of Community and Industrial Development. West Virginia State Comprehensive Outdoor Recreation Plan: 1988-1992. Charleston, West Virginia.
- U.S. Fish and Wildlife Service. n.d. Fisheries USA: the recreational fisheries policy of the U.S. Fish and Wildlife Service. Washington, D.C.

Based on a review of these plans, Lake Lynn has determined that current and proposed operations of the Lake Lynn Project facilities are consistent with these plans.

2.10 Financial and Personnel Resources (18 CFR Section 5.18(c)(1)(i)(I))

The Licensee has considerable experience operating not only the Lake Lynn Project but other hydroelectric and water storage projects within the region. The Licensee employs 2 full time operators and 4 full time staff cross trained in maintenance and operations dedicated to the Lake Lynn Project. In addition to the operators, staff engineers and managers who are familiar with Lake Lynn Project maintenance and operations are available if needed. Information regarding the Lake Lynn Project's expected annual costs and value will be provided in Exhibit D of the Final License Application.

2.11 Notification of Affected Landowners (18 CFR Section 5.18(c)(1)(i)(J))

Lake Lynn is proposing to modify the Lake Lynn Project boundary by removing lands in order to encompass only lands necessary for Lake Lynn Project maintenance and operations. Notification of adjacent landowners is not applicable.

2.12 Applicant's Electricity Consumption Efficiency Improvement Program (18 CFR Section 5.18(c)(1)(i)(K))

Because the Licensee is an independent power producer, this section is not applicable to the Lake Lynn Project.

2.13 Tribes Affected by the Project (18 CFR Section 5.18(c)(1)(i)(L))

There are no Native American lands, known Native American traditional cultural properties or religious properties, or National Register-eligible or -listed sites associated with Native American Nations within the Lake Lynn Project boundary or which would likely be affected by the relicensing. The following is a listing of Native American tribes that

have been consulted by the Licensee (letters dated May 20, 2019) and by FERC (letters dated June 27, 2019):

Licensee:
Absentee-Shawnee Tribe of Oklahoma
Cayuga Nation
Cherokee Nation
Delaware Nation, Oklahoma
Delaware Tribe of Indians
Eastern Band of Cherokee Indians
Eastern Shawnee Tribe of Oklahoma
Oneida Indian Nation
Oneida Indian Nation of Wisconsin
Onondaga Nation
Osage Nation
Seneca Nation of Indians
Seneca-Cayuga Tribe of Oklahoma
Shawnee Tribe
St. Regis Mohawk Tribe
Stockbridge-Munsee Band of the Mohican Nation of Wisconsin
Tonawanda Band of Seneca
Tuscarora Nation
United Keetoowah Band of Cherokee Indians in Oklahoma

FERC:
Delaware Nation
Delaware Tribe of Indians
Osage Nation

The Cherokee Nation indicated via email dated June 19, 2019 that the Lake Lynn Project was outside of its Area of Interest. The Delaware Nation indicated via letter dated July 10, 2019 that the Lake Lynn Project as proposed does not endanger cultural or religious sites of interest to it. The Stockbridge-Munsee Band of the Mohican Nation indicated by email dated October 24, 2019 that it did not wish to participate in the Lake Lynn Project relicensing since the Lake Lynn Project is located outside its area of cultural interest.

3.0 INFORMATION TO BE PROVIDED BY AN APPLICANT WHO IS AN EXISTING LICENSEE

3.1 Measures Planned to Ensure Safe Management, Operation, and Maintenance of the Project (18 CFR Section 5.18(c)(1)(ii)(B))

The Lake Lynn Project is subject to Emergency Action Plan (EAP) requirements under Part 12-C of the Commission's regulations. The Lake Lynn Project EAP outlines specific monitoring, response, and communication actions by Lake Lynn operations staff and emergency response authorities under various potential emergency levels. The EAP is maintained and tested annually in compliance with the Commissions regulations and EAP guidelines.

3.1.1 Safe Management, Operation, and Maintenance

Lake Lynn implements a FERC-approved Public Safety Plan (PSP). The PSP summarizes public safety measures at the Lake Lynn Project, provides figures showing where public safety measures are located, and provides exhibits containing language for the public safety signs. The PSP contains public safety information only and is not intended to include each safety sign or warning device present for the benefit of Lake Lynn employees.

The Licensee's Station Operations and Maintenance Manager is responsible for the implementation of the PSP. The Licensee's Regional Operations Manager is responsible for implementation oversight, and for ensuring that all relevant personnel are trained in the requirements of the PSP. Lake Lynn's Compliance Director is responsible for periodically conducting reviews of the PSP to confirm its adequacy and reviewing and reporting any public safety incidents.

The Licensee's Station Operations and Maintenance Manager conducts a comprehensive compliance inspection at the beginning of the recreation season to ensure that the PSP is being fully implemented. Inspections are documented, and Inspection Checklist M from the PSP and inspection records are kept on file at the Lake Lynn Project powerhouse. Signs and other public safety mechanisms and measures are repaired or replaced as needed. A summary list of the safe management, operations, and maintenance provided in more detail within the PSP related to the Lake Lynn Project includes:

- Immediate Dam Area Public Safety Measures

- Tailrace Fishing Area Public Safety Measures
- Public Warning System
- Signs
- Public Safety Measures in First Mile of Tailrace
- Public Safety Measures at Substations Parking Area for Cheat Lake Trail
- Cheat Lake Trail Public Safety Measures
- Cheat lake Park and Hilltop Picnic Area Public Safety Measures
- Sunset Beach Marina Public Safety Measures

3.1.2 Description of Operation During Flood Conditions

A description of operations during flood conditions is provided in Exhibit B of this Draft License Application.

3.1.3 Description of Warning Devices Used to Ensure Downstream Public Safety

The Lake Lynn Project has a downstream public warning system that is equipped with set points for warning devices that are used to ensure downstream public safety. The public warning system includes:

1. Monitoring Stream Flow

   At the initial opening of the gate to provide the minimum flow, the total flow changes from 1,100 cubic feet per second (cfs) (1 turbine at minimum discharge) to 212 cfs (maximum requirement for minimum flow). The opposite situation occurs based on initial closing. Twenty-five (25) cfs is the maximum subsequent change per hour in flow.

2. Mitigating Flood Conditions

   To mitigate during flood conditions with turbines already generating at full capacity of 9,700 cfs there are usually 2 gates operated every 10 minutes, but it is possible if necessary to operate a maximum of 8 gates at once in 18-inch increments. Once initiated, the warning will repeat every 10 minutes until stopped once the operator has positive knowledge that no more gates will be opened.

3. Public safety signs:

    - Case 1 Warnings - Notifying people of a change and to stay in the water (yellow lights, low sirens);
    - Case 3, 5, 6, 7 - Advising people to evacuate the area immediately (red lights, high sirens);
    - Case 3 - most critical case due to the frequency of occurrence and volume of water;
    - Case 5 - second most critical case because of largest volume of water with shortest advance warning.

Note: Sirens and lights are activated together to account for those with sight or hearing impairments.

4. Warning Systems

To ensure public safety, prior to activation of equipment:

- Operators will determine the events that cause a decrease in flow as to not create a situation that would jeopardize public safety and the warning system will be activated only for increasing flow events.
- A voice message identifies that the water level will change by many feet within a few minutes indicating to the public to leave the area (based on tests, this is 3 feet in 10 minutes at 200 yards).
- If applicable the warning message will identify the need to evacuate the area immediately.
- A red light in the exclusion zone is activated to account for hearing impaired people.
- A voice message identifies the person violating the exclusion zone, warn that their safety is in jeopardy, and instruct them to leave the area immediately.

3.1.4 Discussion of Any Proposed Changes to the Operation of the Project or Downstream Development Affecting the Emergency Action Plan

Lake Lynn is not proposing any changes to the operation of the Lake Lynn Project that would affect the EAP. Lake Lynn is not aware of any proposed downstream development

that would be affected by the Lake Lynn Project. Lake Lynn submitted the most recent annual update to the EAP for the Lake Lynn Project on January 18, 2022.

3.1.5 Description of Monitoring Devices and Description of Maintenance and Monitoring Programs

Headpond and tailwater elevations are monitored at the Lake Lynn Project with electronic instrumentation and visual staff gages. Additional information regarding dam safety and monitoring is provided in the Lake Lynn Dam Safety Surveillance and Monitoring Plan (DSSMP), filed as Critical Energy Infrastructure Information (CEII) with the Commission. The DSSMP was last filed on March 30, 2022.

3.1.6 Project's Employee Safety and Public Safety Record

The Licensee has an excellent record of operating in a safe-work environment. Since the Licensee acquired the Lake Lynn Project in February 2015, there have been no employee deaths, lost-time accidents, or recordable injuries at the Lake Lynn Project to our knowledge. Since the Licensee acquired the Lake Lynn Project in February 2015, there have been no Lake Lynn Project-related deaths or serious injuries to members of the public within the Lake Lynn Project boundary to our knowledge.

3.2 Current Project Operation (18 CFR Section 5.18(c)(1)(ii)(C))

A description of Lake Lynn Project operations is provided in Exhibit B of this Draft License Application.

3.3 Project History (18 CFR Section 5.18(c)(1)(ii)(D))

A description of Lake Lynn Project construction history is provided in Exhibit C of this Draft License Application.

3.4 Lost Generation Due to Unscheduled Outages (18 CFR Section 5.18(c)(1)(ii)(E))

A summary of any unscheduled outages and lost generation during the previous 5-year period (2017-2021) will be provided in the Final License Application.

3.5 Record of Compliance (18 CFR Section 5.18(c)(1)(ii)(F))

The Lake Lynn Project has a good record of compliance with the terms and conditions of the existing license. A review of the Licensees' records indicates no violations of the terms and conditions of the license. In addition, the Licensee has no records of communication from the Commission indicating possible noncompliance.

3.6 Actions Affecting the Public (18 CFR Section 5.18(c)(1)(ii)(G))

The Licensee provides public access for recreation, including fishing, boating, nature viewing, picnicking, and hiking/biking opportunities. The Licensee provides and maintains a tailrace fishing area; a hiking/biking trail with two parking areas; a park that includes a winter/car-top boat ramp, 8 day-use boat docks, a playground, a swimming beach, shoreline picnic area, shoreline fishing; an upper picnic area; a public boat ramp, and nature viewing areas.

3.7 Ownership and Operating Expenses that would be Reduced if the license were transferred (18 CFR Section 5.18(c)(1)(ii)(H))

This section is not applicable because there is no competing application to take over the Lake Lynn Project and no proposal to transfer the license.

3.8 Annual fees for use of federal or Native American lands (18 CFR Section 5.18(c)(1)(ii)(I))

This section is not applicable because the Lake Lynn Project uses no federal or Native American lands.

APPENDIX H-1

SINGLE LINE DIAGRAMS (FILED AS CEII)