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Upper Esopus Creek
Fisheries Management Plan

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Upper Esopus Creek

Preface

The Esopus Creek upstream of Ashokan Reservoir sustains one of the most renowned wild trout fisheries in southeastern New York. Wild populations of brook trout, brown trout and rainbow trout are found within the watershed, with the fishery for the latter species as one the best in the Catskills (Capossela 1989, Van Put 2007). Until recently, annual stocking of up to 30,000 yearling and older brown trout has supplemented the fishery, providing many quality-sized, catchable fish throughout much of the early trout season. However, the re-evaluation of this stocking policy under the New York State Inland Trout Stream Management Plan (NYSDEC 2020) led to a change in management category from 'Stocked-Extended' to 'Wild-Quality.' The reach is now managed as a wild trout fishery without stocking. The intent of this plan is to establish a routine monitoring protocol to (1) ensure the minimum requirements for a 'Wild-Quality' stream are being met (2) ensure the variety of opportunity to anglers is maintained and (3) to evaluate the factors that limit this section of river from a 'Wild-Premier' designation.

Scope

This adaptive plan provides a brief history of the Upper Esopus Trout Fishery, establishes management targets to support the current management regime, and highlights data needed to ensure the fishery will remain resilient into the future. The plan is a living document and will be updated with new data stemming from routine sampling efforts and recommended research studies.

The primary focus of this management plan is the recently designated 'Wild-Quality' section of Esopus Creek that stretches from the Ashokan Reservoir upstream to Lost Clove Road in Big Indian, NY. Nearly all the public fishing access in the Esopus Watershed is found within this reach, and most fisheries independent and dependent data on the Esopus trout fishery has been collected along this stretch. The portion of creek above Lost Clove Road is not included due to limited public access, while the creek below the reservoir is managed as a warm-water fishery. Roughly 10 tributaries feed into the 'Wild-Quality' section of the Upper Esopus, each having the potential to provide essential cold water, spawning, and nursery habitats to support the mainstem trout fishery. As such, research determining of the importance of each tributary to the trout population is necessary and not outside the scope of this plan. Tributary evaluations will likely be collaborative, building upon the extensive work done by USGS (Siemion et al. 2016; Davis et al. 2009; George and Baldigo 2016; George et al. 2018; George 2020) and the Ashokan Stream Watershed Management Program (ASWMP 2019).

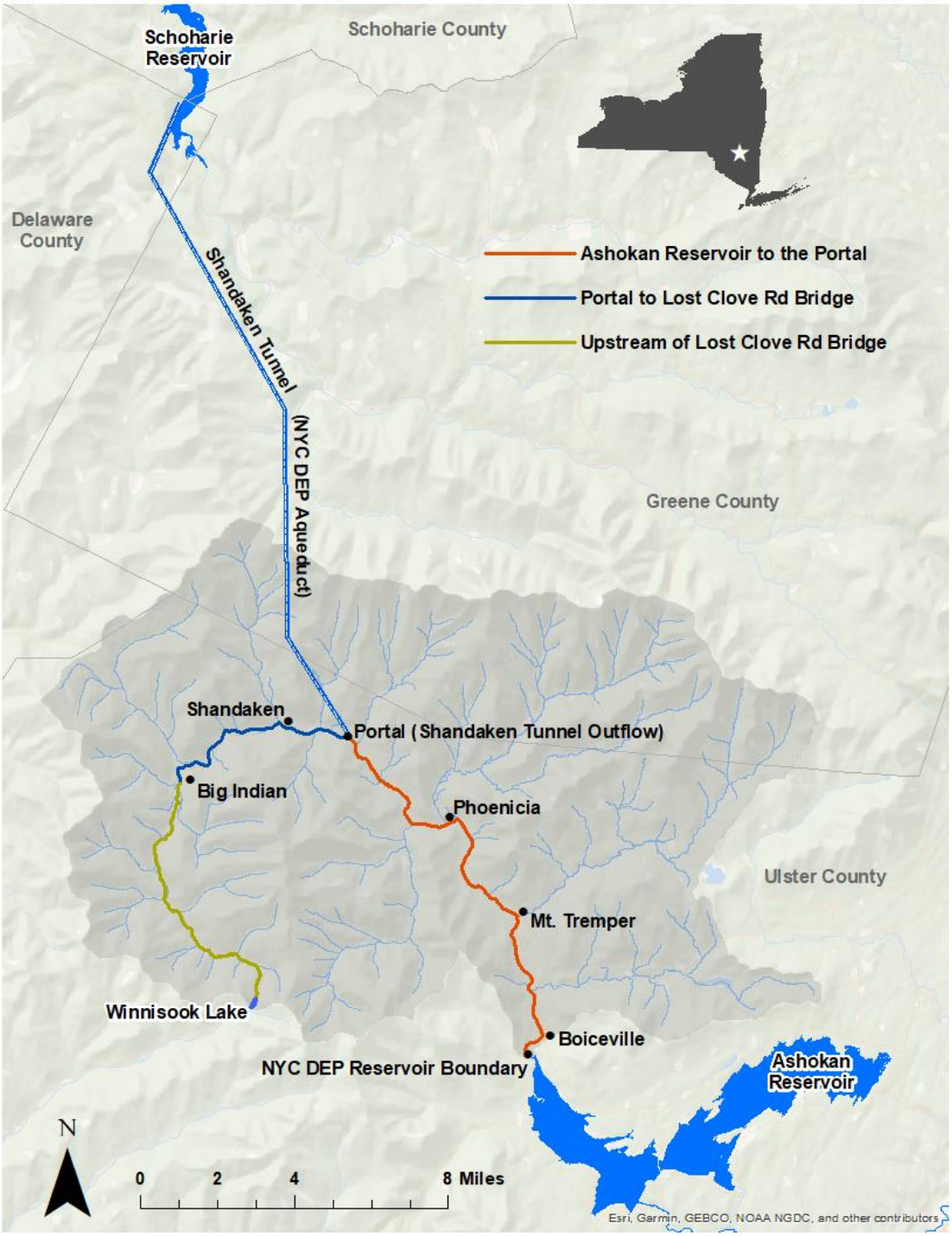
Waterbody characteristics

Esopus Creek (Ulster County) flows 65 miles from the Catskill Mountains to the Hudson River in Saugerties. The Ashokan Reservoir, a NYC drinking water reservoir, splits the creek at its midpoint. The creek upstream of Ashokan Reservoir, referred hereafter as "Upper Esopus", is cold throughout the year and has a robust wild trout population.

The first eight miles of the Upper Esopus supports a wild brook trout population, however because public access is limited, this reach is not currently included in this management plan. The remaining 18 miles of creek from Lost Clove Brook downstream to the Ashokan Reservoir has ample angler access and a long history as a popular trout fishery. This section is split into two vastly different reaches, with the Shandaken Tunnel Outlet (better known as the Portal) serving as the break point (see Figure 1). The creek above the Portal has mean widths of 30-40 feet with significant over-hanging vegetation, medium-sized pools, undercut banks, riffles, and shallow runs. Flows and temperatures along this stretch are mainly influenced by the reach above Big Indian as well as the five larger tributaries that flow into this section (Capossela 1989). In most years, these inputs as well as the ample shading from overhanging vegetation, promote the

thermal refugia required to support wild trout populations during the warmest days of summer. The stretch of creek below the Portal is quite different. Mean widths range from 70-90 feet, with much of the surface water exposed to sunlight. Medium sized runs, deep pools, and swift-moving riffles dominate this stretch. Stream conditions below the Portal are heavily influenced by flows from the Shandaken Tunnel, especially during the dry season. This 18.2-mile aqueduct (completed in 1926) delivers up to 600 million gallons a day (MGD) of water from the Schoharie Reservoir near Gilboa, NY to the Esopus Creek just downstream of the Town of Shandaken.

Figure 1. Map of the Upper Esopus Creek Watershed



Cold-water releases through the Portal create a tail-water type environment that has the potential to support wild trout populations during the summer (Caposella 1989). However, it is important to

note that Portal releases also have a documented history of water quality impacts in this part of the creek, in the form of increased turbidity events, elevated temperatures in mid- to late-summer, as well as dramatic fluctuations in water levels and flow (Baldigo et al. 2015, Van Put 2007). The six major tributaries below the Portal provide the remainder of the flows into the creek prior to its confluence with the Ashokan Reservoir.

History of the fishery

Streams the Esopus watershed, especially Stony Clove Creek, were well-regarded as brook trout streams by the early-1800's (Van Put 2007). Unfortunately, by the mid-1800's water quality throughout much of the watershed was compromised by the many sawmills, tanneries, charcoal kilns that lined the shorelines, as well as the clearing of forests to support settlement and industry (Van Put 2007, Davis et al. 2009). The once robust brook trout population was restricted to the small, cold, headwaters of Esopus Creek, as well as the tributaries that saw minimal human disturbance. Despite substantial improvements to land-use and water quality in the watershed, these headwater areas remain the primary holdouts where brook trout are found to present day (Van Put 2007).

Figure 2. Anglers fishing alongside the Ulster & Delaware Railroad Line which connected Kingston to Phoenicia in 1866 and extended to Pine Hill by 1875. This line allowed unprecedented access to the Esopus trout fishery to anglers from all walks of life. Photo and description credited to the Jerry Bartlett Angling Collection at the Phoenicia Library.

Rainbow trout were stocked in several tributaries of the Esopus in 1883 and subsequently throughout the entire mainstem in 1884. Four years later, the first batch of stocked brown trout were introduced to the system (Van Put 2007). Both species responded well to their new environment, quickly spreading throughout the watershed, especially in the marginal, warmer waters of Esopus Creek where native brook trout populations were either doing poorly or absent altogether. Successful natural reproduction of both species was realized early on, seeding the wild populations of rainbows and browns now established throughout much of the watershed. The stocking of both rainbows and browns continued through 1951, after which New York State stocking policies shifted solely to brown trout at the recommendation of the Grim (1952), who found there to be sufficient reproduction of rainbow trout in the Upper Esopus to maintain the fishery (Grim 1952, Pierce 1996). Brown trout stocking policies since 1952 are found in Table 1.

Table 1. Esopus Creek Stocking Policies

Year(s)	Reservoir to Portal (11.9 miles) BTY	Reservoir to Portal (11.9 miles) 2YBT	Portal to Big Indian (4.1/5/6* miles) BTY	Total (16-17.9 miles)
1952-61	*59500*		*8200*	*67700*
1962-63	*47600*		*4760*	*52360*
1964	*47000*		*4750*	*51750*
1965	*25000*		*3000*	*28000*
1966-79	*28000*		*7000*	*35000*
1980-94	*23700*		*5900*	*29600*
1995-98	*23500*		*5900*	*29400*
1999	*23500*	*1000*	*5900*	*30400*
2000-2020	*15600*	*1950*	*4900*	*22450*

** mileage adjustment up to 5.0 miles in 1995*
** mileage adjustment up to 6.0 miles in 2000*

Several historical studies on the Upper Esopus have evaluated the survival of hatchery trout in the system (Grim 1952, Kelly 1978, Pierce 1996, Angyal 2017). The consensus is that the hatchery yearlings provide an immediate benefit to anglers post-stocking, but survival of these hatchery fish into the fall is minimal and survival into the second year is nearly non-existent. In a 1952 Report, Grim estimated that trout stocked by the Conservation Department and local sportsman organizations accounted for 5% or less of the total trout caught in their two-year survey of the Esopus Creek and its tributaries. A report by Kelly (1978) documented moderate survival of yearling hatchery brown trout into the fall, especially in a section of creek with a 12-inch minimum special harvest regulation; however, zero two-year-old or older hatchery brown trout were observed in the three years surveyed. In a report summarizing a 1988 fall survey of the Upper Esopus, Pierce (1996) reported zero catches of two-year-old or older brown trout and noted that hatchery yearlings comprised only 5% of all yearling and older brown trout captured. The most extensive examination of hatchery holdovers in the Upper Esopus was done by Angyal (2017) as part of a 'Fate of Stocked Trout' statewide study. For consistency in sampling, the primary focus was the reach upstream of the Portal, which was electrofished in both June and August in 2012 and 2013. As expected from previous electrofishing surveys, the percent of hatchery brown trout out of the total yearling and older brown trout caught went from nearly 20% in June to only 4% by August. Interestingly, data from the same report show high catch proportions (~42%) of hatchery brown trout in fall electrofishing samples collected at locations downstream of the Portal in 2010 and 2011; however, as in other historical studies of the Upper Esopus, very few two-year-old or older hatchery brown trout were caught in electrofishing surveys from 2010 through 2013. The Upper Esopus does not appear to be conducive to the over-winter survival of stocked trout.

The construction of the Ashokan Reservoir dramatically changed the population dynamics of trout in Esopus Creek, leading to a relatively unique opportunity for anglers in the region. Prior to its construction, trout were confined to a riverine environment, with both population and individual growth rates constrained by forage availability, competition, stream flow and thermal variability, as well as habitat disturbance. After the completion of the Ashokan Reservoir in 1914, rainbow and brown trout moved into the reservoir becoming top predators in the system. With a richer and more abundant forage base, as well as a more forgiving thermal environment, reservoir trout grew to much larger sizes than those fish that remained in the creek. In late fall and early spring, these wild and stocked 'transients' return to the Esopus and its tributaries to spawn, with the reservoir run rainbows remaining in the lower Esopus until early May in some years (Kelly and Gann 1978, Van Put 2007). These reservoir fish provide an added opportunity for anglers and are highly

sought after in early and late seasons (Caposella 1989; Van Put 2007). In 1977, New York State began stocking the Ashokan Reservoir with brown trout. Those fish that survive to maturity in the reservoir, may add to the spawning brown trout population found in the Esopus in late Fall.

Greeley (1936) published the first major trout population survey after the completion of Ashokan Reservoir. Subsequent population-level surveys of the Esopus and tributaries have been published every 15-20 years, with an increase in recent years (Grim 1952, Kelly and Gann 1978, Pierce 1996, George et al. 2015, George and Baldigo 2016, and Angyal 2017). In addition to the published datasets, the state collected population survey data from reaches in the mainstem Esopus for years 1992-1996, 1998, and 2002.

Though electrofishing catch rates and population estimates are variable among the different survey years, several overarching commonalities exist:

(1) catch rates of yearling and older wild trout are generally high

(2) rainbow trout fingerlings make up a significant part of the catch

(3) catch rates of 12" or larger trout are low

(4) very few hatchery holdovers are observed

(5) sampling the wide, fast reach below the Portal is difficult

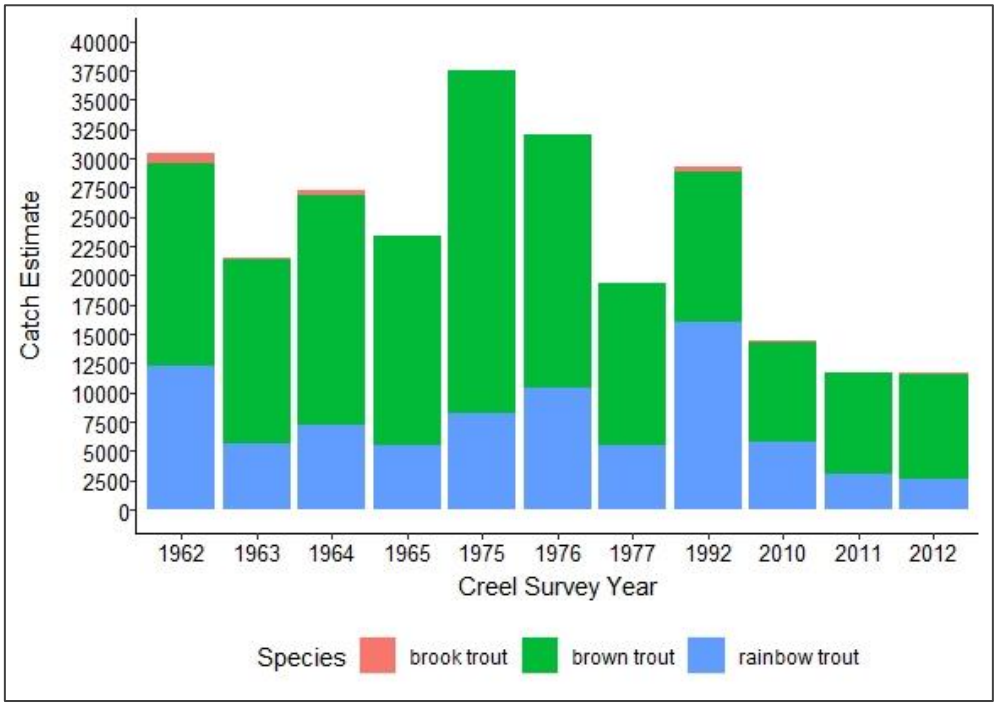
Table 2. Angling pressure and catch rate estimates from historical creel surveys

*Year^*	*Reach*	*Pressure (hr/ac)*	*Catch rate (fish/hr)**
1962	*Ashokan to Lost Clove*	*337*	*0.50*
1963	*Ashokan to Lost Clove*	*270*	*0.44*
1964	*Ashokan to Lost Clove*	*289*	*0.53*
1965	*Ashokan to Lost Clove*	*300*	*0.44*
1975	*Ashokan to Big Indian*	*456*	*0.48*
1976	*Ashokan to Big Indian*	*373*	*0.51*
1977	*Ashokan to Big Indian*	*348*	*0.35*
1992	*Ashokan to Lost Clove*	*369*	*0.51*
2010	*Ashokan to Lost Clove*	*94*	*0.93*
2011	*Ashokan to Lost Clove*	*69*	*0.99*
2012	*Ashokan to Lost Clove*	*66*	*1.05*

^Estimates from 1992-2012 are adjusted for an April -September season

**Catch rates from 1962-1977 likely only represent harvested fish*

Figure 3. Catch estimates for all trout species from historical creel surveys



The best available angling regulations history for Esopus Creek is found in Table 3. The most notable changes are the extension of the season to November 30 after 1979; the regulation split at the Portal from 2012-2020; and the special regulation in the lowest 0.8 miles of river above the reservoir from 1976-1978. This last regulation allowed managers to assess whether sizes of fish would improve with a stricter size regulation. Results showed no difference in sizes of fish caught in the special regulation reach versus those caught in upstream reaches (Kelly and Gann 1978). In 2021, regulations in the upper Esopus were changed to comply with the new designation of 'Wild Quality' per the revised Inland Trout Stream Management Plan (NYSDEC 2020). As a result, the regulations are once again the same above and below the Portal. The harvest season is April 1st and runs through October 15th. During that time, three fish may be kept with only one over 12 inches in total length. From October 16th through March 31st, there is a catch and release season using artificial lures only.

Table 3. Historical regulations for Upper Esopus Creek

Years	Reach	Season	Min Length	Daily Limit
1946-1951	*Upstream of Reservoir*	*2nd Sat in Apr – 1st Sun after Labor Day*	*7"*	*10 trout*
1952-1958	*Upstream of Reservoir*	*Apr 1 - Sep 10*	*7"*	*10 trout*
1975-1976	*Upstream of Reservoir*	*Apr 1 - Sep 30*	*any size*	*10 trout*
1977-1979	*Reservoir - Five Arches Br.*	*Apr 1 - Sep 30*	*12"*	*3 trout*
	Upstream of Five Arches Br.	*Apr 1 - Nov 30*	*any size*	*10 trout*
1980-1996	*Upstream of Reservoir*	*Apr 1 - Nov 30*	*any size*	*10 trout*
1996-2012	*Upstream of Reservoir*	*Apr 1 - Nov 30*	*any size*	*5 trout*
2012-2020	*Reservoir - Portal*	*Apr 1 - Nov 30*	*any size*	*5 trout, with 2 longer than 12"*
	Upstream of Portal			*5 trout*
2021-	*Upstream of Reservoir to Lost Clove Rd Br.*	*Apr 1 - Oct 15*	*any size*	*3 trout, with 1 longer than 12"*
		Oct 16 – Mar 31		*catch & release (artificial only)*

Current state of the fishery

Through a combination of unique trout fishing opportunities, convenient access, rich local history, and beautiful scenery, the Upper Esopus between Lost Clove Road and the Ashokan Reservoir has become a destination trout fishery. The most recent statewide angler survey estimated over 7,200 anglers fished the upper Esopus in 2017 (Responsive Management 2019), placing the creek in the top 20 of trout streams in New York State and top ten for non-Great Lakes tributaries.

Historically, most angling pressure on this stretch occurs in the spring and fall months; however, a smaller, but popular fishery for resident trout, especially smaller wild rainbows, takes place during the summer (Angyal 2017). Prior to the cessation of stocking in 2021, much of the early season effort coincided with annual brown trout stockings, but many savvy anglers make their annual springtime trek to the Upper Esopus for the potential to catch the larger rainbow trout that migrate upstream from the Ashokan Reservoir to spawn. Similarly, many anglers come to the Upper Esopus in the fall for the chance of hooking into a spawning-run, Ashokan brown trout while targeting the plentiful resident trout population (Capossela 1989, Van Put 2007, Angyal 2017).

Fishing access is plentiful in the Upper Esopus, with nearly 14 miles of stream available to anglers via New York State lands, NYCDEP Recreation lands, Ulster County and Municipal lands, and private lands with Public Fishing Right Easements. Most of these locations are easily accessible from local roads that run parallel to the creek. For anglers outside the Catskill Region, travel to the Esopus is easy due to its proximity to the New York State Thruway, and for novice or anglers new to the creek, there are local guide services, tackle/fly shops, resorts, and other local amenities that cater to the trout fishing community. More than half of the over 6,000 angler trips estimated in the 2012 creel survey of the Upper Esopus were made by anglers from outside the surrounding counties (Angyal 2017).

In 2021, the Upper Esopus was designated a ‘Wild-Quality’ stream. This marks a dramatic shift in management approach from annually stocking 20,000-30,0000 brown trout to encouraging wild production. The short-term goal of this management plan is to evaluate the new management approach. Specifically, to evaluate whether wild trout populations are meeting the minimum abundance for a ‘Wild-Quality’ designation and to evaluate angler response to the new management regime. Wholesale changes in angler attitudes and satisfaction in a popular fishery like the Upper Esopus can have major impacts on the local economy.

Challenges/risks facing the fishery

Water quality and stream disturbance

The high gradient of the tributaries and surficial geology of the watershed promote large, natural fluctuations in turbidity and flow throughout the Upper Esopus and its tributaries, especially during storm events (Davis et al. 2009; USGS 2014). For anglers, these flood events create unsafe wading conditions and poor fishing opportunities. Angyal (2017) reported a significant reduction in angling pressure during the prolonged period of high flows and turbidities after Tropical Storms Irene and Lee than expected from previous creel surveys. For the trout population, the timing of these storms appears to be the most important factor, with early and late-season storms causing the most damage to spawning habitats as well as eggs and larvae. Grim (1952) and George et al. (2015) discuss sampling the Upper Esopus stream community before and after major storm/flood events that reshaped the creek and its tributaries. Grim (1952) sampled the Upper Esopus and selected tributaries the summer before and after a late November storm in 1950 and large spring storm in 1951. He estimated the trout population in the watershed was reduced by at least 30%, with significant losses to the fingerling age-group. George et al (2015) evaluated the fish community several years before and after the intense flooding that occurred after Tropical Storms Irene and Lee in late August 2011. Unlike Grim (1952) their results indicated the fish community was minimally impacted by this summer storm, with no major evidence that the 2011 year class of trout experienced high mortalities. They hypothesize the young-of-year were likely large enough by the time of the storms to withstand high velocities and resist displacement. Surprisingly, brown

trout showed excellent recruitment the year immediately after the storms, indicating the spawning habitats were also resilient to the summertime flooding.
The impacts of these natural disturbance events on the stream channel and stream community are often exacerbated by anthropogenic impacts along this reach. Roadways and rail lines bracket the creek, indicative of the rapid settlement and development that has continued in this area over the last century and a half (Van Put 2007; Davis et al. 2009). Increased runoff over

Figure 4. Photographs taken of the Esopus near Phoenicia, NY immediately after Tropical Storm Irene (August 28, 2011). Left image shows water over-topping the Main Street Bridge. Right image shows floodwaters flowing through downtown Phoenicia. Both images credited to the Ashokan Watershed Stream Management Program

impervious surfaces can rapidly change flows, water temperatures, and turbidity levels. In addition, human development in the floodplain has led to shoreline hardening as well as undersized road crossings. These 'improvements' have significantly altered natural flow regimes, often intensifying the erosion of clay deposits commonly found throughout the watershed. A significant amount of research and investment has gone into restoring the natural floodplain in the mainstem and its tributaries (Davis et al. 2009; Siemion et al. 2016; ASWMP 2019); however, much is left to be done, especially when factoring in the predictions of increased storm frequency, intensity, and duration in current climate model projections for New York State (NYSDEC 2021).

Releases from the Shandaken Aqueduct at the Portal provide an added layer of complexity to this already impacted reach. As with the Esopus watershed, the Schoharie watershed is prone to high turbidity events, especially during large storm events. Thus, flows through the Shandaken Tunnel from Schoharie Reservoir have the potential to be excessively turbid. In addition, the historic water intake for the Shandaken Tunnel was at an elevation in the reservoir where turbid waters were accessible and where cold water below the thermocline could be quickly removed if flow rates are at maximum levels during late spring and early summer months. What remained was a supply of warmer and potentially turbid, surface water for releases in the late summer. Prior to the 1970's, releases through the Portal were primarily dictated by the needs of the NYCDEP to manage the water levels at Ashokan Reservoir and to meet demands of other downstream NYC reservoirs (Van Put 2007). As a result, highly variable flows and temperatures, as well as long-term turbidity events could occur at inopportune times such as the trout spawning season or in late summer when the trout population in this lower reach is most stressed. Long-term turbidity events and large-scale fish kills during rapid ramp-downs led to much public scrutiny, a legislative fight to get a NY state reservoir release law (Article 15, Title 8), and eventually a lawsuit (Catskill TU vs. NYC 2001). The ruling in the lawsuit determined Portal releases could be regulated through a New York State Pollutant Discharge Elimination System (SPDES) Permit. The terms of the initial permit provided by the NYSDEC to DEP, especially in relation to flow, temperature, and turbidity were disputed by the DEP, as well as other resource users, resulting in a 2005

adjudicatory hearing (Goldberger 2005). The final SPDES permit was issued in 2006 (Sheehan 2006) and set thresholds for flow and turbidity for non-emergency releases. In addition to these permit requirements, the DEP provides to NYSDEC a cold-water storage plan for Schoharie Reservoir to maximize cold water releases through the Portal to the Esopus Creek during warm summer months. In 2018, the DEP began much-needed maintenance on the intake chamber gates for the Shandaken Tunnel, with project completion date set for the end of 2021. A variable-elevation intake is included in this remodel to best utilize the cold-water bank through the spring and summer. During this extensive maintenance project, the DEP has remained vigilant and proactive to ensure sufficient flows and temperatures have been maintained to support the aquatic community below the Portal. Upon completion, it is anticipated that releases from the Portal will be best managed to promote a wild trout fishery throughout the year, while also continuing to meet the needs of NYC water supply.

Spawning and Recruitment

NYSDEC and USGS survey suggest a significant portion of spawning likely occurs in the headwaters of the Upper Esopus upstream of Lost Clove Road as well as in the many cold-water tributaries found throughout the 'Wild-Quality' reach. Documenting the presence/absence of fingerlings of all three trout species throughout the watershed is ongoing, but an important first step toward defining the geographic extent of tributary spawning. In the short-term, ensuring proper work windows for any permitted actions in these tributaries must be followed and staff should continue to support and promote any restoration projects that benefit natural flows, habitats, and improved water quality in these important areas. In the long term, maintaining the integrity of these tributaries will become increasingly important as the predicted storm intensities, changes in snowpack, and warming trends attributed to climate change will put increased pressure on these tributaries as cold-water refugia and spawning/nursery areas.

It is speculated that trout recruited to the Esopus are from a combination of resident spawners as well as spawners migrating upstream from the Ashokan Reservoir. A better understanding of the spawn-recruit relationship in the Esopus, and for reservoir fish in particular is important for this system and will become a necessity if routine sampling indicates a continued decline in recruitment.

Angling pressure/harvest rates

The upper Esopus Creek gets significant fishing pressure throughout the year, with effort peaking in the spring and fall. Summertime angling can be successful, but is generally dependent on water temperatures, especially in the section below Allaben that relies on the cold-water releases from the Portal to remain viable for trout. In addition to normal Portal releases, large storm events in the Upper Esopus and Schoharie Watersheds can create prolonged periods of poor stream conditions below the Portal, limiting fishing pressure and reducing observed catch rates in this section of creek (Angyal 2017). During these events, the Upper Esopus above the Portal and the major tributaries may see an abnormal increase in angling pressure.

Anecdotally, the Upper Esopus has seen increases in fishing pressure over the last decade, with local anglers reporting major increases over the last five years. Unfortunately, the infrequent periodicity of full-scale creel surveys (Table 2) has not captured this current trend, and recent statewide angler surveys (Connelly and Brown 2009; Responsive Management 2019) are too coarse to truly compare angler pressure rates with those captured in historic creel surveys. A combination of routine angler and trout population surveys provide managers with real-time information on the potential for the fishery to impact wild trout populations. However, comprehensive creel surveys require significant time, money, and analysis, and are thus not usually feasible to accomplish in short enough intervals to capture annual trends in fishing pressure or catch rates. Therefore, more cost-effective and innovative methods must complement traditional surveys.

Efficient sampling methodology
Seasonally high flows, deep pools, and large stream widths make the upper Esopus difficult to efficiently sample with electrofishing equipment. In the portion of creek above the Portal, the most effective sampling occurs during periods of low flow and moderate/low temperatures in the fall, prior to the onset of any significant leaf fall that could overwhelm blocking seines. Electrofishing gear to sample this stretch consists of a barge-mounted generator/control box unit with three to four separate hand-held anodes and respective scappers. This requires a field crew of at least 10-12 people for adequate reach coverage. If crew size allows, one to two additional back-pack electrofishing units can be deployed to better sample stream margins. This survey strategy has been repeatable over time and will routinely be used into the future as long as sufficient volunteers can be recruited to fill staffing requirements.

Below the Portal, the stream gets wider and deeper, with the potential for much higher water levels and flows, depending on tunnel releases. Sampling conditions are likely best when the survey coincides with a Portal shutdown event, requiring coordination with the DEP. Historically the same electrofishing methodology used above the Portal has been used in this lower reach; however, the amount of sampling effort (electrofishing units and staff) must be doubled to roughly 24 people get reasonable sample coverage. This requires the recruitment and coordination of a large volunteer base, with the potential for a wide range of electrofishing experience and comfort levels with wading in difficult conditions. In addition, the effective blocking of 80-100 foot stream widths can be a challenge. Though this sampling strategy will continue in the future, more repeatable, less staff-intensive sampling methodologies must be explored. One alternative currently under evaluation is sampling with boat electrofishing gear in three accessible pools. Mark-recapture for population estimation, depletion methodology for population estimation, and simple catch rates (number of fish captured per mile) will all be explored as sampling strategies using this gear type. The recent purchase of a lighter weight, more portable catamaran-style boat electrofisher with minimal freeboard height will allow for the testing of these methodologies at several notable pools in this section.

Desired state of the fishery

The short-term goal (next 10 years) is for the Upper Esopus to remain a 'Wild Quality' trout stream, where anglers can expect:

- A sustainable fishery for wild rainbow trout and wild brown trout
- An opportunity to catch large trout, especially during the spawning season
- Ample and well-maintained fishing access
- An adaptive management strategy that will incorporate the most up-to-date information

To evaluate whether the current fishery is meeting these expectations, staff will conduct routine trout population and creel surveys. Results from these surveys will be compiled into annual reports and incorporated into a revised management plan.

The long-term goal (next 50 years) is for the Upper Esopus to be a resilient ecosystem that supports a robust wild trout population, that is capable of withstanding both local anthropological stressors and basin-wide threats due to climate change. In addition to the routine population level surveys, any steps toward resiliency must consider the following:

- A best management practice for seasonal Portal releases via the recently renovated Shandaken Tunnel Intake Chamber and High-Level Intake
- The role the Ashokan Reservoir plays in the life-cycles of rainbow and brown trout
- The role major tributaries play in recruitment and any barriers that may restrict access to spawning areas in these tributaries
- Thermal regimes in the mainstem and tributaries and any barriers to seasonal movement of wild trout to and from cold water refugia
- Impacts of local infrastructure (e.g., bridges, culverts, roads, stream bank stabilizations) on stream flow regimes and water quality, especially during periods of high precipitation

A thorough investigation into these topics will require extensive consideration and planning. Fortunately, existing research by local NYSDEC partners has already addressed some of these complicated questions. Therefore, to meet the long-term resiliency goal it would be prudent for Bureau of Fisheries staff to build upon this research and more specifically, to seek collaborative research projects with the NYCDEP, Ashokan Watershed Stream Management Program, USGS, Ulster County, local municipalities, local colleges and universities, as well as other stakeholders that have a vested interest in a healthy, resilient stream community.

Goals for the fishery

Upper Esopus continues to be managed as a 'Wild-Quality' trout fishery			
Indicator	***Metric***	***Short-term actions (2023-2033)***	***Long-term actions (>2033)***
Biomass	*At least 300 yearling or older wild trout per mile or 40 pounds of wild trout per acre*	*Every three years: Depletion-style electrofishing surveys at a minimum of three locations above the Portal and three locations below the Portal*	*Continue tri-annual surveys* *Establish and monitor biomass thresholds for adaptive management*
Recruitment	*Fingerling (age 0) and yearling (age 1) catch rates from depletion surveys*	*Compare current catch rates with historical rates using regression statistics*	*Establish and monitor catch rate thresholds for adaptive management*
Public Access	*Stream miles of public access (State, NYCDEP, county, municipal, PFR) and number of angler parking areas*	*Two maintenance checks per season* *Actively seek new access via the PFR program and through cooperative agreements, especially on parcels adjacent to current access points*	*Continue maintenance checks and pursuit of new acquisitions* *Rectify any shoreline access that has become isolated due to posting*
Angler satisfaction	*Quality of fishing, fishing access, and overall satisfaction all rated 7/10 or greater on creel surveys*	*Annually: digital questionnaire* *Every three years: pressure survey* *Every six years: traditional creel survey*	*Continue suite of angler surveys* *Evaluate consistent deficiencies in ratings* *Establish methodology for long-term evaluation of angler use and changing attitudes*
Outreach	*Presentations and reports*	*Annually: presentations to local stakeholders and a report card of goals* *Every three years: population survey report* *Every six years: creel survey report*	*Continue report cards and survey reports* *Publish important findings in peer-reviewed journals* *Establish an interactive Upper Esopus Creek website*

The Upper Esopus remains resilient in the face of local stressors and climate change

Resiliency focus	Research needs	Potential partners
Portal releases are optimized to support the trout population year-round	*Updated release protocol and Schoharie Reservoir cold-water storage plan to account for renovations to the Schoharie Intake Chamber and new High-level Intake* *Updated seasonal minimum flow thresholds*	*NYSDEC Division of Water* *NYCDEP Source Water Operations Team*
Tributary recruitment is stable and robust	*List of tributaries that currently support spawning* *Amount of spawning habitat available per tributary* *Prioritized list of potential barriers to tributary spawning*	*USGS – New York Water Science Center* *Ashokan Watershed Stream Management Program* *Ulster County and local municipalities* *SUNY Cobleskill, SUNY ESF, SUNY Oneonta, Cornell*
Ashokan Reservoir remains a productive source of healthy, spawning trout	*Migratory patterns of reservoir vs riverine populations* *Contribution of reservoir trout to the spawning population* *Evaluation of the impacts that brown trout stocking in the reservoir may have on the Upper Esopus trout population*	*USGS – New York Water Science Center* *SUNY Cobleskill, SUNY ESF, SUNY Oneonta, Cornell*
Thermal refugia are prevalent and available throughout the mainstem	*Identification and prioritization of ground water inputs in the mainstem river and tributaries* *Prioritized list of potential barriers to thermal refugia* *Investigation into summertime migratory patterns in the mainstem and tributaries*	*USGS – New York Water Science Center* *Ashokan Watershed Stream Management Program* *Ulster County and local municipalities* *SUNY Cobleskill, SUNY ESF, SUNY Oneonta, Cornell*

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