APPENDIX A

Stream Electrofishing Survey Data (2018)

This section of the report includes stream survey data completed by the Bureau of Freshwater Fisheries in 2018. All surveys, unless specifically noted otherwise, are sampled in accordance to the Bureau's established stream sampling protocol which is consistent with EPA's Rapid Bioassement Protocol for Wadeable Streams. The Bureau's wadeable stream survey protocol can be found in Appendix B. The Bureau also assesses in-stream and riparian conditions by performing a Habitat Assessment at the time of each survey. This assessment is consistent with the EPA Rapid Bioassessment sampling habitat assessment protocol with regional modifications (Appendix C). Basic water quality parameters are also measured.

Surveys are listed alphabetically by stream name within identified watershed areas. Each survey is identified by the specific project (or intent) for which the survey was conducted. It is important to note, however, the use of established stream sampling protocols permits data to be used beyond the specific project for which they were collected. Data provided for the purposes of this report is only a summary of the individual stream survey data collected by the DFW's Bureau of Freshwater Fisheries. All stream data collected under the Bureau's standardized sampling protocol is entered into the Division's FishTrack database.

Stream Surveys in the Upper Delaware (North) & Wallkill Region

(Shimers Brook to Paulins Kill and Wallkill River)

Beerskill Creek

Date: 08/29/2018
County: Sussex
Township: Sandyston Twp.
Drainage: Flat Brook
Project: Temperature Study - TP Streams
Location: Cemetery Road

Water Chemistry / Habitat

Water Temperature (°C):	20.7
Dissolved Oxygen (mg/L):	9.32
Specific Conductance (uS/cm):	109.4
pH:	6.99
Alkalinity (mg/L):	25
Sample Length (m):	150
Habitat Assessment Score:	169 Optimal (2015)

Fish Species	Number	Length (mm)
Bass, Largemouth	1	67 - 67
Chubsucker, Creek	3	0 - 0
Dace, Blacknose	22	0 - 0
Darter, Tessellated	7	0 - 0
Eel, American	18	0 - 0
Lamprey, American Brook	2	0 - 0
Minnow, Cutlip	1	0 - 0
Pickerel, Redfin	5	138 - 187
Sculpin, Slimy	65	0 - 0
Trout, Brook (YOY)	2	85 - 87
Trout, Brook	6	144 - 245

Summary: Beerskill Creek is a small stream that flows out of both Highpoint State Park and Stokes State Park and ultimately into the Little Flat Brook. This tributary to the Big Flat Brook was electrofished on 08/29/2018 to assess the wild trout populations structure relative to the stream temperature regime. Surveys were conducted in 2015, 2016, and 2017, and are consistent with what was found this year. A total of 8 wild Brook Trout, including 2 young-of-the-year, were captured during the survey. The wild trout population size is relatively small for this size stream, but has continued to persist.

Recommendation: This survey is part of a stream temperature study that is currently being conducted on 19 *Trout Production* streams. This stream will be monitored in this section for the next 1-2 years to study the relationship of stream temperature on wild trout life cycles in New Jersey and help guide in the management of our *Trout Production* streams. (Collenburg)

Big Flat Brook (trib.)(Lake Ashroe)

Date: 07/19/2018
County: Sussex
Township: Sandyston Twp.
Drainage: Flat Brook
Project: Temperature Study - TP Streams
Location: Brook Road bridge

Fish Species	Number	Length (mm)
Bass, Largemouth	1	52 - 52
Chub, Creek	8	0 - 0
Dace, Blacknose	102	0 - 0
Dace, Longnose	7	0 - 0
Eel, American	8	0 - 0
Lamprey, Sea	2	0 - 0
Sculpin, Slimy	56	0 - 0
Sunfish, Bluegill	5	45 - 64
Trout, Brook (YOY)	42	54 - 86
Trout, Brook	15	100 - 190

Water Chemistry / Habitat

Water Temperature (°C): 16.2
Dissolved Oxygen (mg/L): 9.14
Specific Conductance (uS/cm): 92.2
pH: 8.36
Alkalinity (mg/L): 27.2
Sample Length (m): 150
Habitat Assessment Score: 162 Optimal (2016)

Summary: Big Flat Brook (trib.)(Lake Ashroe) is a small *Trout Production* stream that originates in Stokes State Forest flows into the Big Flat Brook and is one of the most productive native Brook Trout stream in the Flat Brook watershed. In 2018, this stream was surveyed to assess the fish population at a survey location previously surveyed in 2016 and 2005. Fifty-seven native Brook Trout were found of which 42 were young-of-the-year (YOY). The number of native Brook Trout found is consistent with what was found during the 2016 survey (56 total, 40 YOY) but less than the 2005 survey (110 total, 107 YOY). This small difference in total numbers of Brook Trout found is within the natural stochasticity found in wild salmonid populations and is not a concern.

A continuous stream temperature monitor was deployed this year to study the relationship of stream temperature on the native Brook Trout life cycles. Lake Ashroe is located upstream of this survey location and has a negative impact to the trout population by heating up the water found in this tributary. The data shows that warm stream temperatures are strongly correlated with rain events and higher flows in the area. This is commonly seen when a lake or pond is situated upstream of a survey location. The surface water of the lake or pond is heated by the sun and is much warmer than the stream temperature downstream. When a storm hits, the warm surface water of the pond is dumped downstream warming the stream and negatively affecting the trout. The 2018 stream temperature data showed several of these warming events coinciding with storm events and higher flows, but the good news is that the stream temperature did not reach a critical temperature for trout survival (>25°C) and was only above 22°C (stressful temperatures) 3.6% of the summer readings.

A native fish species of special interest to biologists based on its low abundance statewide and a unique habitat requirement (the soon to be listed state Threatened Slimy Sculpin) was also found at this location. A total of 246 individual fish representing 9 different species were found in this survey.

Recommendation: This survey is part of a stream temperature study that is currently being conducted on *Trout Production* streams. This stream will be monitored in this section for the next 1-2 years to study the relationship of stream temperature on wild trout life cycles in New Jersey and help guide in the management of our *Trout Production* streams. In addition to the above timetable, this stream should also be monitored in accordance with the schedule established for *Trout Production* streams (minimum of once every 10 years for streams having wild Brook Trout). (Shramko)

Big Flat Brook (trib.)(W. of Lake Ashroe)

Date: 07/19/2018
County: Sussex
Township: Sandyston Twp.
Drainage: Flat Brook
Project: Temperature Study - TP Streams
Location: Brook Road

Fish Species	Number	Length (mm)
Dace, Blacknose	3	0 - 0
Madtom, Margined	1	0 - 0
Sculpin, Slimy	1	0 - 0
Trout, Brook (YOY)	144	33 - 85
Trout, Brook	8	115 - 180

Water Chemistry / Habitat

Water Temperature (°C): 16.4
Dissolved Oxygen (mg/L): 9.16
Specific Conductance (uS/cm): 78.7
pH: 7.62
Alkalinity (mg/L): 28
Sample Length (m): 150
Habitat Assessment Score: 164 Optimal (2017)

Summary: Big Flat Brook (trib.)(W. of Lake Ashroe) is a small T*rout Production* stream that originates in Stokes State Forest flows into the Big Flat Brook and is one of the most productive native Brook Trout stream in the Flat Brook watershed. In 2018, this stream was surveyed to assess the fish population at a survey location previously surveyed in 2017 and 2006. One hundred fifty-two native Brook Trout were found of which 144 were young-of-the-year (YOY). The number of wild Brook Trout found is higher than what was found during the 2017 survey (62 total, 58 YOY) but less than the 2006 survey (247 total, 218 YOY). This stream is a prime example on how Brook Trout population sizes can change from year to year. It is important to remember that wild trout populations can change considerably from one year to another and although some drop-in numbers maybe a cause for concern, we often do not have enough data to know if the drop is part of an overall trend, or just part of natural stochasticity found in wild trout.

It is also interesting to note that in the two previous surveys a small number of wild Brown Trout were found, but none were found in the 2018 survey. The 2006 survey found 5 YOY Brown Trout where the 2017 survey found 3 YOY Brown Trout. The Brown Trout from the previous surveys were euthanized in an effort keep reproducing Brown Trout out of the Flat Brook watershed as this stream is the only known tributary in the watershed where young-of-the-year Brown Trout have been found. A native fish species of special interest to biologists based on its low abundance statewide and a unique habitat requirement (the soon to be listed state Threatened Slimy Sculpin) was also found at this location. A total of 157 individual fish representing 4 different species were found in this survey.

A continuous stream temperature monitor was deployed this year to study the relationship of stream temperature on the native Brook Trout life cycles. The 2018 stream temperature data showed that the stream temperature did not reach a critical temperature for trout survival (>25°C) or even stressful temperatures (above 22°C) anytime during the summer of 2018. In fact, temperatures were < 18°C for 72% of the summer period. This shows that warm stream temperature is unlikely the leading cause for concern on this Brook Trout population.

Recommendation: This survey is part of a stream temperature study that is currently being conducted on *Trout Production* streams. This stream will be monitored in this section for the next 1-2 years to study the relationship of stream temperature on wild trout life cycles in New Jersey and help guide in the management of our *Trout Production* streams. In addition to the above timetable, this stream should also be monitored in accordance with the schedule established for *Trout Production* streams (minimum of once every 10 years for streams having wild Brook Trout). (Shramko)

Forked Brook

Date: 08/16/2018
County: Sussex
Township: Sandyston Twp.
Drainage: Flat Brook
Project: Temperature Study - TP Streams
Location: Grau Road

Fish Species	Number	Length (mm)
Chub, Creek	1	0 - 0
Dace, Longnose	83	0 - 0
Eel, American	12	0 - 0
Sculpin, Slimy	9	0 - 0
Trout, Brook (YOY)	8	61 - 75
Trout, Brook	1	160 - 160

Water Chemistry / Habitat

Water Temperature (°C): 20.4
Dissolved Oxygen (mg/L): 8.02
Specific Conductance (uS/cm): 71.3
pH: 7.19
Alkalinity (mg/L): 15
Sample Length (m): 150
Habitat Assessment Score: 179 Optimal (2015)

Summary: This tributary to the Big Flat Brook was electrofished on 08/16/2018 to assess the wild trout populations structure relative to the stream temperature regime. Forked Brook is a small stream that flows through the forested habitat of Stokes State Forest and its habitat is comprised of small plunge pools, runs, and an intermixing of many large boulders and cobble. This is the fourth time in four years that this exact location was sampled as part of this study. Very similar numbers of Brook Trout have been captured all four years and may be a product of the small population size. Only 9 wild Brook Trout were captured, including 8 young-of-the-year. The wild trout population size is relatively small for this size stream, but has continued to persist.

Recommendation: This survey is part of a stream temperature study that is currently being conducted on 19 *Trout Production* streams. This stream will be monitored in this section for the next 1-2 years to study the relationship of stream temperature on wild trout life cycles in New Jersey and help guide in the management of our Trout Production streams. (Collenburg)

Little Flat Brook (trib.)(Bevans)

Date: 07/10/2018
County: Sussex
Township: Sandyston Twp.
Drainage: Flat Brook
Project: Brook Trout Assessment
Location: Route 615

Fish Species	Number	Length (mm)
Bass, Largemouth	11	34 - 44
Chub, Creek	18	0 - 0
Dace, Blacknose	37	0 - 0
Dace, Longnose	1	0 - 0
Eel, American	2	0 - 0
Pickerel, Chain	1	94 - 94
Sculpin, Slimy	90	0 - 0
Shiner, Common	1	0 - 0
Sunfish, Pumpkinseed	1	99 - 99
Trout, Brook (YOY)	37	55 - 88
Trout, Brook	23	128 - 248
Trout, Brown	1	170 - 170

Water Chemistry / Habitat

Water Temperature (°C): 17.9
Dissolved Oxygen (mg/L): 8.86
Specific Conductance (uS/cm): 350
pH: 7.63
Alkalinity (mg/L): 148
Sample Length (m): 150
Habitat Assessment Score: 148 Sub-Optimal

Summary: Little Flat Brook (trib.)(Bevans) is a small *Trout Production* stream that originates in the Delaware Water Gap National Park Service property near Peters Valley and flows into the Little Flat Brook. No previous surveys were conducted on this stream, therefore it was surveyed to look for Brook Trout Sixty native Brook Trout were found, of which 37 were young-of-the-year (YOY). This is a good number of Brook Trout, but the most impressive thing about this is the number of older than YOY Brook Trout found. The 23 older than YOY Brook Trout found and the multiple age classes they represent shows that this stream is in good condition and that their population is thriving. In addition, a soon to be listed State Threatened species the Slimy Sculpin was also found. The presence of 90 Slimy Sculpin also indicates high water quality and cold-water conditions. Interestingly, not all the species found indicate good cold-water conditions. Largemouth (11) Bass, Chain Pickerel (1), and Pumpkinseed (1) are species typically found in warm water systems. These species were most likely washed downstream out of a pond found in the headwaters and most likely will not thrive or even survive in this cold stream environment.

The biggest threat to the native cold-water fish assemblage is arguably the presence of the Brown Trout found. A frequently documented pattern throughout the Brook Trout's range (especially in New Jersey) is the gradual replacement of Brook Trout with nonnative Brown Trout. There is some disagreement among biologists if the Brown Trout is displacing or replacing Brook Trout, but what is not argued is that Brook Trout populations are declining while Brown Trout populations are increasing, especially in New Jersey. Whether or not the Brown Trout is directly responsible for decreasing native Brook Trout populations or are just moving in to unoccupied Brook Trout niches due to land use changes or other environmental stressors, the competition between the species is having an overall adverse effect on native Brook Trout populations. The Flat Brook Watershed has very few documented wild Brown Trout. In fact, Division biologists have documented only one tributary where Brown Trout reproduce on their own in the entire Flat Brook watershed. This one Brown Trout found in this survey was older than young-of-the-year and may have migrated from the one known wild reproducing Brown Trout population. It is important to monitor this stream in the future to see if the Brown Trout begin to establish themselves or if the one individual found here was a chance encounter. A total of 222 individual fish representing 11 different species were found in this survey.

Recommendation: This stream should be monitored in accordance with the schedule established for *Trout Production* streams (minimum of once every 10 years for streams having wild Brook Trout), but may be monitored more often to determine if Brown Trout are spreading into this tributary. (Shramko)

Parker Brook

Date: 07/10/2018
County: Sussex
Township: Montague Twp.
Drainage: Flat Brook
Project: Temperature Study - TP Streams
Location: Crigger Road Stokes S.F.

Fish Species	Number	Length (mm)
Chub, Creek	11	0 - 0
Dace, Blacknose	71	0 - 0
Madtom, Margined	1	0 - 0
Minnow, Cutlip	3	0 - 0
Shiner, Common	14	0 - 0
Sucker, White	7	0 - 0
Sunfish, Pumpkinseed	5	65 - 75
Trout, Brook	5	140 - 263

Water Chemistry / Habitat

Water Temperature (°C): 20.1
Dissolved Oxygen (mg/L): 8.01
Specific Conductance (uS/cm): 74.2
pH: 7.97
Alkalinity (mg/L): 11
Sample Length (m): 150
Habitat Assessment Score: 169 Optimal

Summary: Parker Brook is a small *Trout Production* stream that flows into the Big Flat Brook in Sussex County. It was managed as a *Wild Trout Stream* since 1990, but was removed from the *Wild Trout Stream Regulation* due to low numbers of wild trout found. A survey has been conducted on Parker Brook five times prior to this year. The most trout found was in 1968 when 38 Brook Trout were found. Since then the stream was surveyed in 2000, 2004, 2014, 2015 and 2018. The number of Brook Trout found has been between 0 and 5 per survey in these years.

Parker Brook continues to be a concern for Brook Trout. All the Brook Trout found this year were adult trout. The lack of young-of-the-year (YOY) trout shows that something is negatively affecting the reproduction or survival of young Brook Trout. In the Fall of 2017, a continuous stream temperature monitor was deployed. The temperature data collected will help biologists determine if the reason for not finding YOY trout is temperature related or if there are other factors at play here. Initial data from the 2018 summer temperature logger shows that Parker Brook is not suffering from warm summertime stream temperatures. At no time during the summer of 2018 did Parker Brook reach a critical temperature (>25°C) and it was only above sub-optimal temperatures (22°C - 25°C) 5.7% of the summer. More data from future years is necessary to determine if warm temperatures are not the leading cause for low Brook Trout populations in Parker Brook, as 2018 could have been an anomaly. Water temperature will be monitored for several years.

In 1968, five species were found (Brook Trout, Blacknose Dace, Slimy Sculpin, Creek Chub, and White Sucker) and are typically of NJ wild Brook Trout streams. The surveys done since then, including the 2018 survey, all showed higher species diversity with species not typically associated with a wild trout stream, hinting that the stream quality may be degrading. Overall, 117 individual fish were collected representing 8 different species.

Recommendation: This survey is part of a stream temperature study that is currently being conducted on *Trout Production* streams. This stream will be monitored in this section for the next 1-2 years to study the relationship of stream temperature on wild trout life cycles in New Jersey and help guide in the management of our *Trout Production* streams. In addition to the above timetable, this stream should also be monitored in accordance with the schedule established for *Trout Production* streams (minimum of once every 10 years for streams having wild Brook Trout). (Shramko)

Paulina Creek

Date: 07/20/2018
County: Warren
Township: Blairstown Twp.
Drainage: Paulins Kill
Project: Brook Trout Assessment
Location: Route 94

Fish Species	Number	Length (mm)
Chub, Creek	24	0 - 0
Dace, Blacknose	135	0 - 0
Darter, Tessellated	2	0 - 0
Eel, American	2	0 - 0
Madtom, Margined	2	0 - 0
Sunfish, Bluegill	2	98 - 160

Water Chemistry / Habitat

Water Temperature (°C): 16.4
Dissolved Oxygen (mg/L): 9.76
Specific Conductance (uS/cm): 595.5
pH: 8.04
Alkalinity (mg/L): 171
Sample Length (m): 150
Habitat Assessment Score: 141 Sub-Optimal

Summary: The Division of Fish and Wildlife is partnering with Trout Unlimited to assess certain streams to determine if they are candidates for Brook Trout restoration. Trout Unlimited has placed several continuous temperature monitoring devices in candidate streams. In addition, an electrofishing survey is performed to ascertain information on the current fish assemblage, its health, and population structure.

Paulina Creek was surveyed on 07/20/2018. No trout were found. The fish assemblage has a few species such as Margined Madtom and Bluegill, not typically characteristic with a cold-water native Brook Trout stream, but their presence certainly does not rule out the possibility of a Brook Trout restoration project. Blacknose Dace, Tessellated Darter, and Creek Chub are species typically found in cold-water native Brook Trout streams in New Jersey and were also found. The habitat assessment score is in the sub-optimal category which supports the possibility of a Brook Trout restoration project.

The temperature found during the survey was 16.4°C which is optimal for Brook Trout survival. This temperature reading would have been very encouraging, if not for the data from the continuous temperature monitor, which paints a very different picture. Just 4 days after our survey, the in-stream temperature climbed to 24.4 °C. This is just under what is considered a lethal temperature for trout. The stream temperature remained above 20°C for 30 days and did reach above the critical threshold (>25°C) for trout survival 2.5% of the summer period.

Recommendation: Due to the warm stream temperatures found, this stream is not recommended for Brook Trout restoration. (Shramko)

Paulins Kill (trib.)(Yellow Frame)

Date: 08/10/2018
County: Warren
Township: Frelinghuysen Twp.
Drainage: Paulins Kill
Project: Brook Trout Assessment
Location: Lincoln Laurel Road

Fish Species	Number	Length (mm)
Bass, Largemouth	1	68 - 68
Dace, Blacknose	159	0 - 0
Sunfish, Bluegill	2	51 - 68
Sunfish, Pumpkinseed	2	75 - 77

Water Chemistry / Habitat

Water Temperature (°C): 20.1
Dissolved Oxygen (mg/L): 8.93
Specific Conductance (uS/cm): 505.4
pH: 8.04
Alkalinity (mg/L): 176
Sample Length (m): 150
Habitat Assessment Score: 145 Sub-Optimal

Summary: The Division of Fish and Wildlife is partnering with Trout Unlimited to assess certain streams to determine if they are candidates for Brook Trout restoration. Trout Unlimited has placed several continuous temperature monitoring devices in candidate streams. In addition, an electrofishing survey is performed to ascertain information on the current fish assemblage, its health, and population structure.

Yellow Frame Brook was surveyed on 08/10/2018. No trout were found while 1 Largemouth Bass (YOY) and 4 sunfish were collected. The presence of the bass and sunfish are likely from the pond located upstream. Blacknose Dace (159) were also documented. This survey is quite similar to what was found in 2008 when 233 Blacknose Dace and 1 American Eel was found. The fish assemblage is consistent with other Brook Trout streams found in New Jersey. Based on the fish assemblage and habitat assessment score, Yellow Frame Brook is still a potential candidate for Brook Trout restoration.

The temperature found during the survey was 20.1°C which is near the upper limit of Brook Trout survival. The continuous temperature logger also showed stressful conditions for trout as the temperature was above 22°C for over 17% of the summer timeframe. Temperature also surpassed the lethal temperature for trout (25°C) during the summer of 2018.

Recommendation: Due to the warm stream temperatures found, this stream is not recommended for Brook Trout restoration. (Shramko)

Sparta Glen Brook

Date: 08/28/2018
County: Sussex
Township: Sparta Twp.
Drainage: Wallkill River
Project: Habitat Restoration
Location: Route 620 - Sparta Glen Park - Area of massive landslide

Fish Species	Number	Length (mm)
Chub, Creek	26	0 - 0
Dace, Blacknose	163	0 - 0
Dace, Longnose	170	0 - 0
Sunfish, Pumpkinseed	1	85 - 85

Water Chemistry / Habitat

Water Temperature (°C): 20.9
Dissolved Oxygen (mg/L): 8.83
Specific Conductance (uS/cm): 333.2
pH: 7.88
Alkalinity (mg/L): 70
Sample Length (m): 150
Habitat Assessment Score: 169 Optimal

Summary: Sparta Glen Brook Restoration project aims to restore a section of Sparta Glen Brook that was devastated by a massive landslide from a microburst, in August of 2000, that dumped 16 inches of rain in a very short period of time. After a partial rebuild, the site again was severely damaged by Hurricane Irene in 2011. The Fred S. Burroughs North Jersey Chapter of Trout Unlimited has partnered with the Township of Sparta to restore this section of stream back into its natural state. Several electrofishing surveys have been completed before and after the restoration efforts to determine the status of the fish populations and wild Brook Trout population in this stream prior to and after the restoration efforts that occurred in the spring of 2016.

The 2018 survey did not find any native Brook Trout. This is especially significant as surveys done prior have found at least a few Brook Trout. The Brook Trout may have moved out of the survey area or may have been lost from the stream entirely. It is too early to determine the overall success of the restoration efforts, which will not be fully understood for several years, but the survey did not find any natural reproduction again this year. These results by no means defines the success or failure of the restoration project, as this is only the second full year after the restoration efforts have been completed. In-stream habitat changes will take several seasons to find equilibrium and the riparian plantings will take several years before their stream shading / thermal benefits are fully felt. A continuous stream temperature monitor was deployed this season and will monitor stream temperatures for years to come. The temperature data will tell us if the restoration efforts and the growth of the newly planted vegetation will re-create temperatures suitable for Brook Trout survival. Initial results from the summer of 2018 shows that temperatures are slightly warmer than optimal for Brook Trout. Temperatures reached the sub-optimal category (22°C-25°C) 16.3% of the summer and did reach the Critical Threshold (>25 °C) 0.6% of the summer period in 2018. It is thought that stream temperatures are currently limiting the success of the Brook Trout recovery efforts and maybe negatively impacted by an impoundment found upstream.

The 2017, 2016, and 2015 surveys all found two native Brook Trout each year, which also compares similarly with other surveys done in 2001 and 2009 where six and two were found respectively. It will be very interesting to compare this baseline to future surveys as the trout respond to the effects of the restoration efforts. Overall, the 2018 survey found 360 individual fish representing four different species.

Recommendation: Additional surveys should be completed in the restoration area for several years after the restoration efforts were completed to monitor the impacts of the restoration efforts. (Shramko)

Trout Brook (Middleville)

Date: 07/13/2018
County: Sussex
Township: Stillwater Twp.
Drainage: Paulins Kill
Project: Trout Stocking Discontinued
Location: Route 521

Fish Species	Number	Length (mm)
Chub, Creek	17	0 - 0
Dace, Blacknose	97	0 - 0
Dace, Longnose	17	0 - 0
Darter, Tessellated	10	0 - 0
Eel, American	9	0 - 0
Madtom, Margined	3	0 - 0
Sucker, White	15	0 - 0
Trout, Brown (YOY)	22	55 - 78
Trout, Brown	6	138 - 316

Water Chemistry / Habitat

Water Temperature (°C): 18.1
Dissolved Oxygen (mg/L): 9.68
Specific Conductance (uS/cm): 186.8
pH: 8.31
Alkalinity (mg/L): 41
Sample Length (m): 150
Habitat Assessment Score: 154 Sub-Optimal

Summary: The Bureau of Freshwater Fisheries discontinued stocking trout in eight small *Trout Production* streams during the period 2005 – 2010. This management action was taken to protect New Jersey's wild trout resources and to better utilize hatchery trout in waters not having self-sustaining trout populations. As of February 2018, trout stocking was discontinued on several additional waters, or sections thereof, that support wild trout. These streams will continue to be monitored to assess the response of the wild trout population to removing the competition of cultured trout.

As of February 2018, Trout Brook (Middleville) has been removed from the trout stocking program and will now fall under the *General Trout Fishing* regulations. This stream was most recently stocked during the spring of 2017. Two previous surveys have been conducted on this waterbody in the vicinity; both taking place upstream. The original work in the area from 1970 found four Brook Trout (three young-of-the-year (YOY) and a single adult) and five Brown Trout adults. Efforts in 2004 only revealed Brown Trout. It should be noted, however, that the more recent survey was conducted above a series of concrete dam structures that most likely act as impassable barriers to upstream movement. It is unclear as to when the impediments were constructed or if they existed during the 1970s timeframe. This current survey location was selected to be studied as related to changes upon trout stocking alteration because it is believed to still fall under the area of influence by introduced cultured fish, while at the same time also possessing habitat qualities that are known to support wild salmonids. This year's sampling confirmed the continued presence of a wild Brown Trout population, with individuals ranging from 55 to 316 mm (2.2 to 12.4 inches) in total length. It found 22 YOY and six adults/juveniles. With minor exceptions, the complete fish assemblage was similar in make-up compared to the two past surveys. While the habitat assessment scores this location in the high sub-optimal category with a 154 rank, the stream temperature was identified at 18℃/64.4°F. It is interesting to note the cool temperature seen in this survey when compared to many other locations upstream, (substantially so in some spots) as observed from extensive spot-checking efforts also conducted on the same day as this sampling event.

Recommendation: Additional surveys will be conducted at this location in 2019 and subsequent summers to provide comparative data that will be used to assess changes to the fish assemblage after cessation of trout stocking. Otherwise, this stream should be monitored in accordance with the schedule established for *Trout Production* streams (minimum of once every 20 years for streams having wild Brown and/or Rainbow Trout). (Diglio and Shramko)

Trout Brook (Middleville) (trib.)(Five Points)

Date: 09/14/2018
County: Sussex
Township: Stillwater Twp.
Drainage: Paulins Kill
Project: Brook Trout Assessment
Location: Shallow Brook Farm - Fairview Lake Road (617)

Fish Species	Number	Length (mm)
Chub, Creek	52	0 - 0
Dace, Blacknose	41	0 - 0
Darter, Tessellated	5	0 - 0
Madtom, Margined	4	0 - 0
Mudminnow, Eastern	1	0 - 0
Shiner, Golden	2	0 - 0
Sunfish, Bluegill	4	39 - 65
Sunfish, Pumpkinseed	1	40 - 40

Water Chemistry / Habitat

Water Temperature (°C): 15
Dissolved Oxygen (mg/L): 10.95
Specific Conductance (uS/cm): 171.4
pH: 6.55
Alkalinity (mg/L): 24
Sample Length (m): 150
Habitat Assessment Score: 170 Optimal

Summary: The Division of Fish and Wildlife is partnering with Trout Unlimited to assess certain streams to determine if they are candidates for Brook Trout restoration. Trout Unlimited has placed several continuous temperature monitoring devices in candidate streams. In addition, an electrofishing survey is performed to ascertain information on the current fish assemblage, its health, and population structure.

Trout Brook (Middleville)(trib.)(Five Points) was surveyed on 09/14/2018. No trout were found. The fish assemblage has several species such as Margined Madtom, Eastern Mudminnow, Pumpkinseed Sunfish, and Bluegill, not typically characteristic with a cold-water native Brook Trout stream, but their presence certainly does not rule out the possibility of a Brook Trout restoration project. The presence of Brown Trout in the Trout Brook (Middleville) mainstem without a barrier to this location will also factor in the decision on whether or not this stream is a good candidate for Brook Trout restoration. The habitat assessment score is in the optimal category which supports the possibility of a Brook Trout restoration project.

The temperature found during the survey was 15.0°C which is optimal for Brook Trout survival. This temperature reading is encouraging, but the continuous temperature monitor will tell us if temperatures are consistently cold enough to make this stream a good candidate for Brook Trout restoration especially in the peak of the summer months. This survey was done after the warmest summer months and the one-time temperature reading during the survey may not show accurate stream temperature stressors that may have occurred in July and August. The data from the temperature monitor will be downloaded for analysis in the Winter of 2018.

Recommendation: The data from the continuous temperature logger will tell if the stream is too warm to be considered a candidate for Brook Trout restoration. If it is cold enough, the decision on whether to keep this stream as a candidate or not will depend on if there is a barrier to Brown Trout movement and the overall size of the tributary. This stream is quite small and may not be an ideal candidate strictly based on amount of flow. (Shramko)

Trout Brook (Middleville)(trib.)(Trout Brook WMA)

Date: 09/14/2018
County: Sussex
Township: Stillwater Twp.
Drainage: Paulins Kill
Project: Brook Trout Assessment
Location: Shallow Brook Farm - Fairview Lake Road (617)

Fish Species	Number	Length (mm)
Bullhead, Brown	1	84 - 84
Chub, Creek	50	0 - 0
Dace, Blacknose	20	0 - 0
Darter, Tessellated	1	0 - 0
Eel, American	1	0 - 0
Madtom, Margined	9	0 - 0
Sunfish, Pumpkinseed	8	62 - 141
Sunfish, Redbreast	1	63 - 63

Water Chemistry / Habitat

Water Temperature (°C): 16.4
Dissolved Oxygen (mg/L): 8.78
Specific Conductance (uS/cm): 92.2
pH: 6.78
Alkalinity (mg/L): 16
Sample Length (m): 150
Habitat Assessment Score: 164 Optimal

Summary: The Division of Fish and Wildlife is partnering with Trout Unlimited to assess certain streams to determine if they are candidates for Brook Trout restoration. Trout Unlimited has placed several continuous temperature monitoring devices in candidate streams. In addition, an electrofishing survey is performed to ascertain information on the current fish assemblage, its health, and population structure.

Trout Brook (Middleville) (trib.)(Trout Brook WMA) was surveyed on 09/14/2018. No trout were found. The fish assemblage has several species such as Brown Bullhead, Margined Madtom, Pumpkinseed Sunfish, and Redbreast Sunfish not typically characteristic with a cold-water native Brook Trout stream, but their presence certainly does not rule out the possibility of a Brook Trout restoration project. The presence of Brown Trout in the Trout Brook (Middleville) mainstem without a barrier to this location will also factor in the decision on whether this stream is a good candidate for Brook Trout restoration. The habitat assessment score is in the optimal category which supports the possibility of a Brook Trout restoration project.

The temperature found during the survey was 16.4°C which is optimal for Brook Trout survival. This temperature reading is encouraging, but the continuous temperature monitor will tell us if temperatures are consistently cold enough to make this stream a good candidate for Brook Trout restoration especially in the peak of the summer months. This survey was done after the warmest summer months and the one-time temperature reading during the survey may not show accurate stream temperature stressors that may have occurred in July and August. The data from the temperature monitor will be downloaded for analysis in the Winter of 2018.

Recommendation: The data from the continuous temperature logger will tell if the stream is too warm to be considered a candidate for Brook Trout restoration. If it is cold enough, the decision on whether to keep this stream as a candidate or not will depend on if there is a barrier to Brown Trout movement and the overall size of the tributary. This stream is quite small and may not be an ideal candidate strictly based on amount of flow. (Shramko)

Yards Creek

Date: 07/20/2018
County: Warren
Township: Blairstown Twp.
Drainage: Paulins Kill
Project: Trout Production Re-Inventory
Location: Wishing Well Road

Fish Species	Number	Length (mm)
Chub, Creek	6	0 - 0
Dace, Blacknose	133	0 - 0
Dace, Longnose	8	0 - 0
Eel, American	3	0 - 0
Sunfish, Pumpkinseed	1	112 - 112
Trout, Brown (YOY)	16	60 - 78
Trout, Brown	8	190 - 280

Water Chemistry / Habitat

Water Temperature (°C): 20.1
Dissolved Oxygen (mg/L): 8.99
Specific Conductance (uS/cm): 136.7
pH: 7.66
Alkalinity (mg/L): 29
Sample Length (m): 150
Habitat Assessment Score: 181 Optimal

Summary: Yards Creek is small T*rout Production* tributary to the Paulins Kill. It was electrofished to monitor the fish populations and distributions found within the stream on 07/20/2018. A previous survey was done at this location in 2002 and found 8 Brown Trout and 2 Brook Trout. These Brook Trout were likely stocked trout. This survey was done in 2018 to monitor the trout population and to see if there were any remaining Brook Trout or Brook Trout reproduction occurring in the stream. Twenty-four Brown Trout (16 young-of-the-year) were the only trout found. The 24 Brown Trout combined with a one-time stream temperature of 20.1℃ indicates that trout species are likely experiencing stressful conditions that are potentially limiting Brook Trout from occurring in the stream. A full temperature profile done with a continuous stream temperature monitor would have to be performed to confirm this hypothesis and to determine if Yards Creek is a candidate for a Brook Trout restoration effort. The presence of a reproducing population of wild Brown Trout in the stream would complicate any reintroduction efforts of Brook Trout in Yards Creek as Brown Trout are known to have a negative effect on Native Brook Trout populations. Brown Trout removal efforts would likely be considered as part of any Brook Trout restoration efforts, but before any of that can be considered, a full temperature profile should be collected to determine if Yards Creek contains suitable stream temperatures for Brook Trout survival. Overall, 175 individual fish were collected from 6 different species. (Shramko)

Recommendation: This stream should be monitored in accordance with the schedule established for *Trout Production* streams (minimum of once every 20 years for streams having wild Brown Trout). (Shramko)

Stream Surveys in the Upper Delaware (South) Region

(Delawanna Creek to Lockatong Creek)

Beaver Brook (trib.)(E. of Manunka Chunk)

Date: 09/05/2018
County: Warren
Township: White Twp.
Drainage: Pequest River
Project: Brook Trout Assessment
Location: Upper Sarepta Road, upstream of waterfall

Fish Species	Number	Length (mm)
Chub, Creek	present	0 - 0
Dace, Blacknose	present	0 - 0
Eel, American	23	0 - 0
Sunfish, Pumpkinseed	1	72 - 72

Water Chemistry / Habitat

Water Temperature (°C): 20.2
Dissolved Oxygen (mg/L): 8.89
Specific Conductance (uS/cm): 222.7
pH: 7.19
Alkalinity (mg/L): 53
Sample Length (m): 520
Habitat Assessment Score: 140 Sub-Optimal (2016)

Summary: Although other Pequest River tributaries have wild Brook Trout, they have not been found anywhere within the Beaver Brook watershed. An electrofishing survey previously conducted in this Beaver Brook tributary (2006, within the Beaver Brook WMA) documented Creek Chub and Blacknose Dace. Although trout were absent, the presence of these trout associated species and in-stream habitat that appeared favorable for trout was the reason for further assessing this stream for potential Brook Trout restoration. Two reaches, separated by a sizeable waterfall, were sampled on 09/05/2018. Log revetments just upstream of the waterfall suggest that the stream channel was modified a long time ago (to direct water away from the now abandoned railroad right of way and tunnel that was cut into the mountainside), which resulted in the formation of a waterfall. This waterfall likely blocks the upstream movement of all fish except American Eels. At this survey location (upstream of the waterfall, at the same location as in 2006) numerous Creek Chub and Blacknose Dace were present, along with 23 American Eel and 1 Pumpkinseed. Sections of the stream bottom exposed to direct sunlight were covered with algae, suggesting summer water temperatures and/or nutrients from upstream farmed areas may a water quality. Trout Unlimited installed a data logger in this tributary in 2018 to collect summer water temperatures to aid in determining if this tributary would be suitable for Brook Trout restoration.

Recommendation: Analyze the water temperature data collected by Trout Unlimited and determine if summer water temperatures are suitable for Brook Trout. (Hamilton)

*******NON – STANDARDIZED SURVEY*******

Beaver Brook (trib.)(E. of Manunka Chunk)

Date: 09/05/2018
County: Warren
Township: White Twp.
Drainage: Pequest River
Project: Brook Trout Assessment
Location: Upper Sarepta Road, downstream of waterfall

Fish Species	Number	Length (mm)
Bass, Largemouth	3	69 - 100
Eel, American	24	0 - 0
Pickerel, Redfin	4	125 - 202
Sunfish, Bluegill	2	68 - 72
Sunfish, Green	2	65 - 70
Sunfish, Pumpkinseed	25	52 - 113

Water Chemistry / Habitat

Water Temperature (°C): N/A
Dissolved Oxygen (mg/L): N/A
Specific Conductance (uS/cm): N/A
pH: N/A
Alkalinity (mg/L): N/A
Sample Length (m): 325
Habitat Assessment Score: N/A

Summary: Although other Pequest River tributaries have wild Brook Trout, they have not been found anywhere within the Beaver Brook watershed. An electrofishing survey previously conducted in this Beaver Brook tributary (2006, within the Beaver Brook WMA) documented Creek Chub and Blacknose Dace. Although trout were absent, the presence of these trout associated species and in-stream habitat that appeared favorable for trout was the reason for further assessing this stream as a potential candidate for Brook Trout restoration. Two reaches, separated by a substantial waterfall, were sampled on 09/05/2018. This waterfall likely blocks the upstream movement of all fish except American Eels. At this survey location (downstream of the waterfall) the fish assemblage was notably different than the assemblage documented upstream of the waterfall. The prevalence of warmwater fishes (Bluegill, Pumpkinseed, Largemouth Bass, Green Sunfish, Redfin Pickerel) and absence of Blacknose Dace and Creek Chub was striking. This was likely due to the low gradient and substrate that was primarily sand and detritus (very few rocks). In-stream cover was limited to occasional woody debris which increased the water depth and concentrated the fish. The stream channel appeared to have been manipulated/straightened to make way for the railroad, and remnant dam/diversion structures were also observed at the downstream end of the survey reach. Although instantaneous water chemistry was not taken, Trout Unlimited installed a data logger in this tributary in 2018 to collect summer water temperatures to aid in determining if this tributary would be suitable for Brook Trout restoration. The fish assemblage present at this location and poor in-stream habitat observed suggest that this stream reach in its current condition would not be a good candidate for Brook Trout restoration.

Recommendation: Analyze the water temperature data to determine if summer water temperatures might be suitable for Brook Trout. (Hamilton)

*******NON – STANDARDIZED SURVEY*******

Delaware River (trib.)(Holland)

Date: 07/12/2018
County: Hunterdon
Township: Holland Twp.
Drainage: Delaware River (11)
Project: Trout Production Re-Inventory
Location: Route 627

Fish Species	Number	Length (mm)
Chub, Creek	1	0 - 0
Dace, Blacknose	155	0 - 0
Eel, American	39	0 - 0
Trout, Brown (YOY)	59	62 - 96
Trout, Brown	19	142 - 370

Water Chemistry / Habitat

Water Temperature (°C): 17.5
Dissolved Oxygen (mg/L): 10.17
Specific Conductance (uS/cm): 334.7
pH: 7.77
Alkalinity (mg/L): 115
Sample Length (m): 150
Habitat Assessment Score: 163 Optimal

Summary: This *Trout Production* tributary flows through private property and directly into the Delaware River. Past electrofishing surveys have documented a wild Brown Trout population (18 Brown Trout in 1970, 12 were young-of-the-year (YOY), survey length 183 m; 30 Brown Trout in 2002, 18 were YOY, survey length 150 m). The recent survey conducted on 07/12/2018 found far more Brown Trout (78 individuals, 59 were YOY), which may be related to a slightly different location surveyed (entirely upstream of the road bridge vs. above and below the bridge). A deep pool yielded the largest trout, 370 mm (l4.6 in). This stream is entirely located on private property and therefore is not considered a good candidate for a wild trout stream fishing regulation. Wild Brook Trout would likely survive in this stream if the wild Brown Trout could be eradicated (or suppressed).

Recommendation: This tributary should continue to be monitored in accordance with the schedule established for *Trout Production* streams (minimum of once every 20 years for streams not having wild Brook Trout). (Hamilton)

Hances Brook

Date: 08/17/2018
County: Warren
Township: Mansfield Twp.
Drainage: Musconetcong River
Project: Brook Trout Assessment
Location: Route 57 (confluence with Musconetcong River to Watters Road)

Water Chemistry / Habitat

Water Temperature (°C):	21.5
Dissolved Oxygen (mg/L):	10.2
Specific Conductance (uS/cm):	236.6
pH:	7.95
Alkalinity (mg/L):	45
Sample Length (m):	940
Habitat Assessment Score:	N/A

Fish Species	Number	Length (mm)
Chub, Creek	present	0 - 0
Dace, Blacknose	present	0 - 0
Dace, Longnose	present	0 - 0
Eel, American	present	0 - 0
Minnow, Cutlip	present	0 - 0
Shiner, Common	present	0 - 0
Sucker, White	present	0 - 0
Trout, Brook (YOY)	1	102 - 102
Trout, Brook	2	181 - 210
Trout, Rainbow	1	285 - 285

Summary: Wild Brook Trout were first documented in this *Trout Production* stream in 1970 during a survey (183 m long) conducted at Hazen Road (19 individuals, 5 were young-of-the-year (YOY)). One Brown Trout (weighing 2 lbs., likely a stocked fish) was also present. From 1990 through 2017 Hances Brook was regulated as a *Wild Trout Stream*. An electrofishing survey conducted 2004 further upstream (survey length 150 m) similar numbers of Brook Trout were found (19 individuals, 15 were YOY). More recent surveys at various locations documented even lower densities of Brook Trout over 150 m (5 YOY in 2014, and 1 in 2015), which prompted the removal of Hances Brook from the *Wild Trout Stream* regulation in 2018. Hances Brook is located within the *Brook Trout Conservation Zone* (regulation effective in 2018) and anglers are required to immediately release all Brook Trout caught. In 2018, as part of a collaborative effort involving Trout Unlimited, two sections of Hances Brook were surveyed to aid in determining the cause of low Brook Trout abundance in this stream.

In this survey (the lowermost of the two conducted in 2018) a 940 m section (from Watters Road downstream to the Musconetcong River) was surveyed. Only three wild Brook Trout (102 – 210 mm, one was YOY) and one stocked Rainbow Trout were found, along with White Sucker, Tessellated Darters, five minnow species, and American Eel. The upper portion of the stretch surveyed winds through a cow pasture that lacks a vegetated riparian zone. According to the NJDEP GIS map layer, the mainstem of Hances Brook originates in a small impoundment. The water temperature of the mainstem (just before it joins with a tributary near Hazen Road) was 25.3°C. At the Route 57 bridge further downstream, the water temperature was lower (21.5°C) due to the mixing of the water in mainstem with that of the tributary (19.4°C). The tributary has substantially more flow than the designated mainstem. The low number of Brook Trout found in surveys conducted over the past five years, and the elevated water temperature recorded in this reach on the day of the 2018 survey, strongly suggests that a summer thermal issue suppresses the Brook Trout population. A sewage treatment plant, long suspected of impacting water quality, is no longer in-service (building was razed). Trout Unlimited installed a temperature data logger in the brook in 2018 to determine if summer water temperatures negatively impact the wild Brook Trout population.

Recommendation: Analyze the water temperature data collected by Trout Unlimited and if confirmed that summer water temperatures are not favorable for Brook Trout, then efforts to restore wild Brook Trout should focus on solving thermal impacts. (Hamilton)

*******NON – STANDARDIZED SURVEY*******

Hances Brook (trib.)(Rockport)

Date: 08/17/2018
County: Warren
Township: Mansfield Twp.
Drainage: Musconetcong River
Project: Brook Trout Assessment
Location: Hazen Road upstream to Highland Avenue

Water Chemistry / Habitat

Water Temperature (°C):	19.4
Dissolved Oxygen (mg/L):	10.2
Specific Conductance (uS/cm):	231.3
pH:	7.40
Alkalinity (mg/L):	36
Sample Length (m):	320
Habitat Assessment Score:	N/A

Fish Species	Number	Length (mm)
Chub, Creek	present	0 - 0
Dace, Blacknose	present	0 - 0
Dace, Longnose	present	0 - 0
Darter, Tessellated	present	0 - 0
Eel, American	present	0 - 0
Sucker, White	present	0 - 0
Trout, Brook (YOY)	3	87 - 95
Trout, Brook	4	162 - 195

Summary: Wild Brook Trout were first documented in this *Trout Production* stream in 1970 during a survey (183 m long) conducted at Hazen Road (19 individuals, 5 were young-of-the-year (YOY)). One Brown Trout (weighing 2 lb, likely a stocked fish) was also present. From 1990 through 2017 Hances Brook was regulated as a *Wild Trout Stream*. An electrofishing survey conducted 2004 further upstream (survey length 150 m) similar numbers of Brook Trout were found (19 individuals, 15 were YOY). More recent surveys at various locations documented even lower densities of Brook Trout over 150 m (5 YOY in 2014, and 1 in 2015), which prompted the removal of Hances Brook from the *Wild Trout Stream* regulation in 2018. Hances Brook is located within the *Brook Trout Conservation Zone* (regulation effective in 2018) and anglers are required to immediately release all Brook Trout caught. In 2018, as part of a collaborative effort involving Trout Unlimited, two sections of Hances Brook were surveyed to aid in determining the cause of low Brook Trout abundance in this stream.

In this survey (the uppermost of the two conducted in 2018) a 320 m section (from Highland Road downstream to Hazen Road) was surveyed. This reach is upstream of the cow pasture and even though it is designated (in NJDEP's GIS mapping) as a tributary of Hances Brook, it has significantly more flow than the mainstem. Seven wild Brook Trout (three were YOY) and one stocked Rainbow Trout were found, along with Tessellated Darter, White Sucker, American Eel, and three minnow species. The water temperature of this tributary (just before it joins with mainstem a near Hazen Road) was 19.4°C. The reason for the low number of Brook Trout found in this reach could not be readily determined. A sewage treatment plant, long suspected of impacting water quality, is no longer in-service (building was razed). This tributary originates near Fish and Wildlife's Rockport Pheasant Farm (which is being decommissioned) and cropland, but it is not known to what extent these land uses impact the stream. Trout Unlimited installed a temperature data logger in the brook in 2018 to determine if summer water temperatures negatively impact the wild Brook Trout population.

Recommendation: Analyze the water temperature data collected by Trout Unlimited and determine if summer water temperatures are unfavorable for Brook Trout and if so, determine the cause. If water temperature is not an issue, then the watershed should be further explored to determine why Brook Trout abundance is so low in this reach. (Hamilton)

*******NON – STANDARDIZED SURVEY*******

Lommasons Glen Brook

Date: 07/17/2018
County: Warren
Township: White Twp.
Drainage: Delaware River (1)
Project: Trout Production Re-Inventory
Location: Rt. 626 (Lommasons Glen Rd.)

Fish Species	Number	Length (mm)
Eel, American	11	0 - 0
Trout, Brook (YOY)	53	43 - 90
Trout, Brook	58	117 - 243
Trout, Brown	1	213 - 213

Water Chemistry / Habitat

Water Temperature (°C): 16.5
Dissolved Oxygen (mg/L): 9.84
Specific Conductance (uS/cm): 187.9
pH: 7.45
Alkalinity (mg/L): 31.0
Sample Length (m): 150
Habitat Assessment Score: 183 Optimal

Summary: Electrofishing surveys conducted previously on this stream have documented a wild Brook Trout population. In the 1970 survey (183 m surveyed) the only fish species present was Brook Trout (38 fish, 26 of these were young-of-the-year (YOY)). In 2001 a 150 m stream length was electrofished, with Brook Trout more abundant (107 fish, 30 of these were YOY) and American Eel were also found. The electrofishing survey conducted on 07/17/2018 shows that Brook Trout continue to thrive in this stream (111 fish, 53 of these were YOY) along with American Eel, however, one wild Brown Trout (213 mm (8.3 in) was also captured. This stream epitomizes a high quality coldwater stream where wild Brook Trout can thrive – high gradient, fast moving water, excellent habitat (large boulders, plunge pools, shallow riffles, suitable spawning gravels as indicated by a high habitat assessment score of 183) and larger Brook Trout (14 individuals > 7 in). The appearance of Brown Trout, a non-native species, that reproduces in the mainstem of Buckhorn Creek and another tributary, does not bode well for Brook Trout, as Brown Trout (a non-native species) compete directly with, and can displace native Brook Trout. The Brown Trout was not returned to this stream (it was relocated to the mainstem of Buckhorn Creek).

Recommendation: This stream should continue to be monitored in accordance with the schedule established for *Trout Production* streams (minimum of once every 10 years for streams having wild Brook Trout). (Hamilton)

Mill Brook (Broadway)

Date: 08/07/2018
County: Warren
Township: Franklin Twp.
Drainage: Pohatcong Creek
Project: Trout Production Re-Inventory
Location: Millbrook Road

Fish Species	Number	Length (mm)
Dace, Blacknose	7	0 - 0
Eel, American	10	0 - 0
Trout, Brook (YOY)	17	59 - 91
Trout, Brook	21	112 - 230
Trout, Brown (YOY)	28	55 - 83
Trout, Brown	13	135 - 243

Water Chemistry / Habitat

Water Temperature (°C): 19.0
Dissolved Oxygen (mg/L): 9.44
Specific Conductance (uS/cm): 289.1
pH: 7.18
Alkalinity (mg/L): 27
Sample Length (m): 150
Habitat Assessment Score: 188 Optimal

Summary: This stream flows down Scott Mountain into Pohatcong Creek, west of Washington. In 1970 both Brook and Brown Trout were documented (30 and 12 fish, respectively, over 183 m), but in 2005 only Brook Trout (163 individuals, 137 were young-of-the-year (YOY)) were found. The electrofishing survey conducted on 08/07/2018 documented nearly equal numbers of Brook Trout (38, 17 were YOY) and Brown Trout (41, 28 were YOY). The reappearance of Brown Trout, particularly in such high numbers, is cause for concern as this non-native species can displace Brook Trout, a native species that is declining in New Jersey. The increased presence of Brown Trout does not bode well for the future of native Brook Trout in this stream. Brown Trout may become the dominate salmonid species in this stream – eradicating them will be difficult, as they are well established in the mainstem and tributaries of Pohatcong Creek.

Recommendation: This stream should be monitored in accordance with the schedule established for *Trout Production* streams (minimum of once every 10 years for streams having wild Brook Trout). (Hamilton)

Musconetcong River (trib.)(Anderson)

Date: 08/08/2018
County: Warren
Township: Mansfield Twp.
Drainage: Musconetcong River
Project: Habitat Restoration
Location: Asbury Anderson Road (lane to NJ Audubon)

Water Chemistry / Habitat

Water Temperature (°C):	19.4
Dissolved Oxygen (mg/L):	9.16
Specific Conductance (uS/cm):	196.2
pH:	7.32
Alkalinity (mg/L):	39
Sample Length (m):	150
Habitat Assessment Score:	165 Optimal

Fish Species	Number	Length (mm)
Chub, Creek	37	0 - 0
Dace, Blacknose	76	0 - 0
Dace, Longnose	1	0 - 0
Darter, Tessellated	2	0 - 0
Eel, American	17	0 - 0
Shiner, Common	1	0 - 0
Sucker, White	3	0 - 0
Trout, Brook (YOY)	3	63 - 80
Trout, Brook	3	149 - 192

Summary: This small *Trout Production* tributary to the Musconetcong River was first surveyed in 1991 for classification purposes at Asbury-Anderson Road. Wild Brook Trout were found (32 individuals, 15 were young-of-the-year (YOY)) over 33 m. A standardized survey (150 m) was conducted at the same location in 2009 and 86 Brook Trout (64 were YOY) were captured. Downstream from this survey location the brook flows through a Wildlife Management Area (WMA) before entering the Musconetcong River. Within the WMA the brook flows through a perched culvert under an abandoned road. This culvert may block the movement of fish upstream and an unnaturally deep, unwadeable pool has formed immediately below the culvert. Trout Unlimited (TU, Central Jersey Chapter) has expressed interested in improving in-stream fish habitat to enhance the wild Brook Trout population. A stream walk taken in the spring did not reveal any obvious in-stream habitat problems aside from the perched culvert, though it appears that the owner of a farm may use a portable pump to withdraw water from the stream. Two electrofishing surveys were conducted on 08/08/2018 further downstream to better assess the status of the wild Brook Trout population, determine if Brown Trout have invaded this stream, and the need to improve in-stream habitat for Brook Trout. Fish and Wildlife was assisted by TU staff and a member of the local TU chapter.

In this uppermost of the two surveys conducted in 2018, only six Brook Trout were found (3 were YOY). The reason for the low abundance of Brook Trout was not apparent. The continued absence of wild Brown Trout (a non-native trout species that competes directly with Brook Trout) is favorable to the conservation of wild Brook Trout in this stream. Trout Unlimited installed a temperature data logger in the brook in 2018 to determine if summer water temperatures are problematic for trout. This sampling event was filmed by a TV station (News 12) and broadcast several days later (see http://www.news12.com/story/38853341/wildlife-crews-on-a-mission-to-protect-states-official-fish).

Recommendation: Analyze the water temperature data to determine if summer water temperatures are a factor limiting Brook Trout. The removal of the culvert, which is deteriorating (and a possible safety hazard), should be explored. A survey should be conducted at the established survey location upstream (at Asbury-Anderson Road) in 2019 to determine if Brook Trout abundance there is also low. Thereafter, this stream should be monitored in accordance with the schedule established for *Trout Production* streams (minimum of once every 10 years for streams having wild Brook Trout). (Hamilton)

Musconetcong River (trib.)(Anderson)

Date: 08/08/2018
County: Warren
Township: Mansfield Twp.
Drainage: Musconetcong River
Project: Habitat Restoration
Location: Confluence with Musconetcong River

Water Chemistry / Habitat

Water Temperature (°C):	17.2
Dissolved Oxygen (mg/L):	9.49
Specific Conductance (uS/cm):	195.4
pH:	7.40
Alkalinity (mg/L):	37
Sample Length (m):	150
Habitat Assessment Score:	178 Optimal

Fish Species	Number	Length (mm)
Chub, Creek	86	0 - 0
Dace, Blacknose	53	0 - 0
Dace, Longnose	2	0 - 0
Darter, Tessellated	8	0 - 0
Eel, American	11	0 - 0
Sucker, White	14	0 - 0
Trout, Brook	1	170 - 170

Summary: This small *Trout Production* tributary to the Musconetcong River was first surveyed in 1991 for classification purposes at Asbury-Anderson Road. Wild Brook Trout were found (32 individuals, 15 were young-of-the-year (YOY)) over 33 m. A standardized survey (150 m) was conducted at the same location in 2009 and 86 Brook Trout (64 were YOY) were captured. Downstream from this survey location the brook flows through a Wildlife Management Area (WMA) before entering the Musconetcong River. Within the WMA the brook flows through a perched culvert under an abandoned road. This culvert may block the movement of fish upstream and an unnaturally deep, unwadeable pool has formed immediately below the culvert. Trout Unlimited (TU, Central Jersey Chapter) has expressed interested in improving in-stream fish habitat to enhance the wild Brook Trout population. A stream walk taken with TU in the spring did not reveal any obvious in-stream habitat problems aside from the perched culvert, though it appears that the owner of a farm may use a portable pump to withdraw water from the stream. Two electrofishing surveys were conducted on 08/08/2018 further downstream to better assess the status of the wild Brook Trout population, determine if Brown Trout have invaded this stream, and the need to improve in-stream habitat for Brook Trout. Fish and Wildlife was assisted by TU staff and a member of the local TU chapter.

In this lowermost of the two surveys conducted in 2018, only one Brook Trout was found. The reason for the low abundance of Brook Trout was not apparent. The continued absence of wild Brown Trout (a non-native trout species that competes directly with Brook Trout) is favorable to the conservation of wild Brook Trout in this stream. Trout Unlimited installed a temperature data logger in the brook in 2018 to determine if summer water temperatures are problematic for trout. This sampling event was filmed by a TV station (News 12) and broadcast several days later (see http://www.news12.com/story/38853341/wildlife-crews-on-a-mission-to-protect-states-official-fish).

Recommendation: Analyze the water temperature data to determine if summer water temperatures are a factor limiting Brook Trout. The removal of the culvert, which is deteriorating (and a possible safety hazard), should be explored. A survey should be conducted at the established survey location upstream (at Asbury-Anderson Road) in 2019 to determine if Brook Trout abundance there is also low. Thereafter, this stream should be monitored in accordance with the schedule established for *Trout Production* streams (minimum of once every 10 years for streams having wild Brook Trout). (Hamilton)

Musconetcong River (trib.)(Lebanon)

Date: 07/13/2018
County: Hunterdon
Township: Lebanon Twp.
Drainage: Musconetcong River
Project: Trout Production Re-Inventory
Location: Hollow Road

Fish Species	Number	Length (mm)
Dace, Blacknose	76	0 - 0
Eel, American	22	0 - 0
Trout, Brook (YOY)	12	64 - 77
Trout, Brook	4	137 - 186
Trout, Brown (YOY)	5	64 - 80
Trout, Brown	1	229 - 229

Water Chemistry / Habitat

Water Temperature (°C): 16.8
Dissolved Oxygen (mg/L): 10.28
Specific Conductance (uS/cm): 204.1
pH: 7.67
Alkalinity (mg/L): 47.5
Sample Length (m): 150
Habitat Assessment Score: 172 Optimal

Summary: When first surveyed in 1982, wild Brook Trout were documented (12 individuals, 7 were young-of-the-year (YOY)); 91 m stretch electrofished). When re-surveyed in 2007 very few Brook Trout were again found (13 individuals, 10 were YOY) in a 150 m stretch, along with one large wild Brown Trout (254 mm (10 in). It was not determined that lone Brown Trout was wild-born or stocked (in the Musconetcong River and moved into this tributary). In the recent survey conducted on 07/13/2018, 16 Brook Trout were present (12 were YOY) and wild Brown Trout were also present (6, of which 5 were YOY). The increased presence of Brown Trout does not bode well for the future of native Brook Trout in this stream. As a conservation measure the Brown Trout captured during the survey were not returned to the stream.

Recommendation: This stream should be monitored in accordance with the schedule established for *Trout Production* streams (minimum of once every 10 years for streams having wild Brook Trout). (Hamilton)

Musconetcong River (trib.)(Port Murray)

Date: 07/13/2018
County: Warren
Township: Mansfield Twp.
Drainage: Musconetcong River
Project: Trout Production Re-Inventory
Location: Washburn Road

Fish Species	Number	Length (mm)
Chub, Creek	10	0 - 0
Dace, Blacknose	133	0 - 0
Eel, American	33	0 - 0
Sunfish, Bluegill	4	40 - 77
Trout, Brook (YOY)	36	65 - 96
Trout, Brook	8	122 - 176

Water Chemistry / Habitat

Water Temperature (°C): 17.6
Dissolved Oxygen (mg/L): 8.55
Specific Conductance (uS/cm): 310
pH: 7.36
Alkalinity (mg/L): 48.5
Sample Length (m): 150
Habitat Assessment Score: 171 Optimal

Summary: When first surveyed on 08/05/1970 the only trout species documented was Brook Trout (17 fish, 16 were young-of-the-year (YOY); 183 m). When next surveyed in 2004 (150 m), in addition to 86 Brook Trout (73 of these were YOY) 2 Brown Trout were also present (1 YOY, and 1 older than YOY). The 2018 survey was conducted slightly further downstream of Washburn Road (rather than immediately above and below the bridge). This survey documented 44 Brook Trout (36 were YOY), and no Brown Trout. Other fish species present include those commonly associated with wild trout, Creek Chub, Blacknose Dace, American Eel, and Bluegill (perhaps these originated from a pond nearby). The absence of Brown Trout in this survey is a positive change as this species competes directly with Brook Trout, New Jersey's only native trout species.

Recommendation: This stream should be monitored in accordance with the schedule established for *Trout Production* streams (minimum of once every 10 years for streams having wild Brook Trout). (Hamilton)

Musconetcong River (trib.)(S. of Point Mtn.)

Date: 08/16/2018
County: Hunterdon
Township: Lebanon Twp.
Drainage: Musconetcong River
Project: Trout Production Re-Inventory
Location: Musconetcong River Road

Fish Species	Number	Length (mm)
Chub, Creek	7	0 - 0
Dace, Blacknose	65	0 - 0
Eel, American	11	0 - 0
Trout, Brook (YOY)	63	44 - 79
Trout, Brook	19	112 - 176

Water Chemistry / Habitat

Water Temperature (°C): 19.3
Dissolved Oxygen (mg/L): 9.82
Specific Conductance (uS/cm): 142.5
pH: 7.73
Alkalinity (mg/L): 28
Sample Length (m): 150
Habitat Assessment Score: 175 Optimal

Summary: When this Musconetcong River tributary was first surveyed in 1993 (over 183 m), two wild trout species were documented – 39 Brook Trout (20 were young-of-the-year (YOY)) and 2 Brown Trout (1 was YOY). In a subsequent survey conducted in 2009, 76 Brook Trout (60 were YOY) were present and Brown Trout were absent. The electrofishing survey conducted on 08/16/2018 found only Brook Trout (82), along with three other fish species (Creek Chub, Blacknose Dace, and American Eel). Though wild Brown Trout may occasional stray and reproduce in this tributary, this species has not established a lasting foothold there and Brook Trout continues to be the dominant trout species in this stream.

Recommendation: This stream should be monitored in accordance with the schedule established for *Trout Production* streams (minimum of once every 10 years for streams having wild Brook Trout). (Hamilton)

Musconetcong R (trib.)(S. of Schooley's Mtn. Brook)

Date: 07/18/2018

County: Morris
Township: Washington Twp.
Drainage: Musconetcong River
Project: Trout Production Re-Inventory
Location: Esna Drive

Fish Species	Number	Length (mm)
Chub, Creek	25	0 - 0
Dace, Blacknose	138	0 - 0
Eel, American	6	0 - 0
Trout, Brook (YOY)	8	63 - 75

Water Chemistry / Habitat

Water Temperature (°C): 21.2
Dissolved Oxygen (mg/L): 8.54
Specific Conductance (uS/cm): 175.4
pH: 7.80
Alkalinity (mg/L): 39
Sample Length (m): 150
Habitat Assessment Score: 159 Sub-Optimal

Summary: In previous surveys (1980 and 2007) wild Brook Trout abundance was low (12 – 17 individuals each time). It was noted that just downstream from the survey the entire stream entered a culvert and flowed underground through the Hackettstown MUA facility before entering the Musconetcong River. The electrofishing survey conducted on 07/18/2018, at the same location as in the past, documented even lower numbers of Brook Trout (just eight young-of-the-year). The elevated water temperature (21.2°C) and scarcity of deep pools (habitat assessment score of 159 – sub-optimal) indicate conditions in this stream are less than ideal for Brook Trout. An electrofishing spot check of a deeper pool just upstream from the survey revealed older/larger Brook Trout (5 individuals, ranging in size from 139 – 160 mm). The culvert was plugged (presumably with woody debris) and the stream was flowing through an open channel to the Musconetcong River. The redirection of flow back into an open stream channel is desirable, but may be temporary as the culvert could always be cleared and the stream would then resume flowing underground. The manufacturer on the opposite stream bank (from the culvert) appears to be environmentally friendly as they discontinued discharging cooling water into this stream (which in the past likely elevated summer water temperatures.

Recommendation: This stream is a good candidate for habitat restoration to conserve wild Brook Trout. A more permanent solution, to ensure the stream continues to flow in an open (and stable) channel should be pursued. In addition, water temperature should be continuously monitored to and the watershed investigated to determine if thermal impacts occur and could be mitigated. This stream should be monitored in accordance with the schedule established for *Trout Production* streams (minimum of once every 10 years for streams having wild Brook Trout). (Hamilton)

Pequest River (trib.)(Buttzville)

Date: 07/05/2018
County: Warren
Township: White Twp.
Drainage: Pequest River
Project: Classification
Location: Creek Road

Fish Species	Number	Length (mm)
Chub, Creek	4	0 - 0
Dace, Blacknose	93	0 - 0
Dace, Longnose	13	0 - 0
Darter, Tessellated	1	66 - 66
Eel, American	3	170 - 400
Lamprey, Sea	1	100 - 100
Pickerel, Redfin	2	92 - 103
Trout, Brown (YOY)	2	77 - 83
Trout, Brown	1	219 - 219

Water Chemistry / Habitat

Water Temperature (°C): 16.2
Dissolved Oxygen (mg/L): 9.61
Specific Conductance (uS/cm): 370.9
pH: 7.79
Alkalinity (mg/L): 114
Sample Length (m): 150
Habitat Assessment Score: 148 Sub-Optimal

Summary: This unnamed tributary to the Pequest River is approximately one mile long and was surveyed on 07/05/2018 to determine if its default surface water classification (FW2-Trout Maintenance) was appropriate. Eight species of fish were documented, including wild Brown Trout (3 fish, 2 were young-of-the-year). The survey was conducted approximately 150 m upstream from the Pequest River, near a cluster of residences that impact the riparian zone. If the survey had been further upstream, where it is less impacted by human encroachment, the habitat assessment might have scored in the optimal range (>159). The property owner at the survey location claimed that wild Brook Trout can be found upstream and given the cold-water temperature recorded (16.2°C) this is a distinct possibility.

Recommendation: The surface water classification of this stream should be proposed for upgrade to FW2-Trout Production (C1). A survey should be conducted further upstream to determine if wild Brook Trout are present. This stream should be monitored in accordance with the schedule established for *Trout Production* streams (minimum of once every 20 years, or every 10 years if wild Brook Trout are present). (Hamilton)

Pohatcong Creek (trib.)(New Village)

Date: 08/07/2018
County: Warren
Township: Franklin Twp.
Drainage: Pohatcong Creek
Project: Trout Production Re-Inventory
Location: Montana Road

Fish Species	Number	Length (mm)
Trout, Brook (YOY)	19	70 - 107
Trout, Brook	8	137 - 205
Trout, Brown (YOY)	58	55 - 100
Trout, Brown	8	149 - 305

Water Chemistry / Habitat

Water Temperature (°C): 17.2
Dissolved Oxygen (mg/L): 10.5
Specific Conductance (uS/cm): 185.8
pH: 6.98
Alkalinity (mg/L): 26
Sample Length (m): 150
Habitat Assessment Score: 182 Optimal

Summary: This stream flows down Scott Mountain into the Pohatcong Creek, west of Washington. In 1984 the stream was surveyed at two locations (Montana Road and Route 57) in response to local concerns about dump truck traffic on Montanan Road for the Merrill Creek Reservoir dam construction. Wild Brook Trout were documented at both locations (91 m surveyed) – at Montana Road 30 individuals were present (10 were YOY), at Route 57 there were 24 individuals (9 YOY). These data were used to upgrade the tributary's surface water classification from *Trout Maintenance* to *Trout Production*. In 1986 another survey conducted at Montana Road (91 m stretch) documented 16 Brook Trout (10 were YOY). The survey conducted 2007 (150 m) marked the first appearance of Brown Trout in this stream (2 YOY) along with 98 Brook Trout (40 were YOY). The largest Brook Trout captured in this survey was 250 mm (9.8 in). When surveyed in 2018 (11 years later) a significant shift in the fish assemblage was detected. Although a nearly identical number of wild trout were present (93), 71% of these were Brown Trout (64, 58 were YOY) and only 27 Brook Trout (19 were YOY). The largest Brook Trout captured in this survey was 205 mm (8.1 in), while the largest Brown Trout was 305 mm (12 in). The shift in dominance to non-native wild Brown Trout does not bode well for the future of native Brook Trout in this stream. Eradicating Brown Trout from this stream, to help conserve wild Brook Trout, will be difficult as Brown Trout are well established in the mainstem and other tributaries of Pohatcong Creek.

Recommendation: This stream should be monitored in accordance with the schedule established for *Trout Production* streams (minimum of once every 10 years for streams having wild Brook Trout). (Hamilton)

Schooley's Mountain Brook

Date: 08/27/2018
County: Morris
Township: Washington Twp.
Drainage: Musconetcong River
Project: Trout Production Re-Inventory
Location: Route 24

Fish Species	Number	Length (mm)
Dace, Blacknose	41	0 - 0
Eel, American	20	0 - 0
Trout, Brook (YOY)	12	53 - 86
Trout, Brook	19	126 - 225

Water Chemistry / Habitat

Water Temperature (°C): 17.6
Dissolved Oxygen (mg/L): 9.51
Specific Conductance (uS/cm): 331.3
pH: 7.94
Alkalinity (mg/L): 42
Sample Length (m): 150
Habitat Assessment Score: 183 Optimal

Summary: A wild Brook Trout population was documented in previous surveys conducted in 1970 and 2005 on this high gradient Musconetcong River tributary. In 1970, 14 wild Brook Trout were captured (8 were young-of-the-year (YOY)) over 183 m; in 2005 50 Brook Trout were captured (15 were young-of-the-year (YOY) over 150 m. The electrofishing survey conducted on 08/27/2018, at the same approximate location, documented 31 wild Brook Trout (12 were YOY); the largest trout measured 225 mm (8.9 in). Other species captured during this survey included Blacknose Dace and American Eel. In past surveys, other species documented included YOY Largemouth Bass (2005), and Creek Chub and White Sucker (1970). This brook continues to be a stronghold for wild Brook Trout. It is located within the Brook Trout Conservation Zone (established in 2018) and all Brook Trout caught, regardless of size, must be immediately released.

Recommendation: This stream should be monitored in accordance with the schedule established for *Trout Production* streams (minimum of once every 10 years for streams having wild Brook Trout). (Hamilton)

Stephensburg Brook

Date: 07/31/2018
County: Morris
Township: Washington Twp.
Drainage: Musconetcong River
Project: Temperature Study - TP Streams
Location: Stephensburg Road

Fish Species	Number	Length (mm)
Chub, Creek	18	0 - 0
Dace, Blacknose	99	0 - 0
Dace, Longnose	1	0 - 0
Darter, Tessellated	8	0 - 0
Eel, American	20	0 - 0
Shiner, Common	1	0 - 0
Sucker, White	1	0 - 0
Trout, Brook (YOY)	14	57 - 75
Trout, Brook	9	136 - 210
Trout, Brown (YOY)	1	68 - 68
Trout, Brown	1	153 - 153

Water Chemistry / Habitat

Water Temperature (°C): 18.6
Dissolved Oxygen (mg/L): 9.51
Specific Conductance (uS/cm): 308.1
pH: 7.70
Alkalinity (mg/L): 34.5
Sample Length (m): 150
Habitat Assessment Score: 154 Sub-Optimal (2015)

Summary: Stephensburg Brook is a tributary of the Musconetcong River and is managed as a *Wild Trout Stream*. It was electrofished on 07/31/2018 to assess the wild trout population structure relative to the stream temperature regime. Habitat here consists of a good mix of riffles, runs, and pools, and of cobble layering and undercut banks. A heavy amount of erosion is visible in spots. Wild Brook Trout were first found here in a survey completed in 1970. In a survey conducted in 2014, wild Brown Trout were first documented in this stream. A total of 23 Brook Trout (14 YOY) and 2 Brown Trout (1 YOY) were captured. Population abundance has varied widely, and this study is designed to understand the causative factors behind these population fluctuations and what implications it has on management decisions.

Recommendation: This survey is part of a stream temperature study that is currently being conducted on 19 *Trout Production* streams. This stream will be monitored in this section for the next 1-2 years to study the relationship of stream temperature on wild trout life cycles in New Jersey and help guide in the management of our *Trout Production* streams. (Collenburg)

Trout Brook (Hackettstown)

Date: 08/27/2018
County: Warren
Township: Independence Twp.
Drainage: Musconetcong River
Project: Brook Trout Assessment
Location: Petersburg Road

Fish Species	Number	Length (mm)
Chub, Creek	present	0 - 0
Dace, Blacknose	present	0 - 0
Eel, American	present	0 - 0
Sucker, White	present	0 - 0

Water Chemistry / Habitat

Water Temperature (°C): 20.2
Dissolved Oxygen (mg/L): 9.08
Specific Conductance (uS/cm): 703
pH: 7.93
Alkalinity (mg/L): N/A
Sample Length (m): 400
Habitat Assessment Score: N/A

Summary: This stream flows along Route 46, through the western edge of Hackettstown, and then passes through the state fish hatchery before entering the Musconetcong River. This brook was stocked annually with trout in the spring until 2016 when stocking was discontinued to better protect the fish hatchery from potential fish pathogens. Due to the stream's relatively high gradient and rocky substrate a survey was conducted on 08/27/2018 to assess its potential for Brook Trout restoration. No trout were found, but 4 fish species that often co-occur with wild trout were documented (Blacknose Dace, Creek Chub, White Sucker, and American Eel). The instantaneous water temperature (20.2°C) suggests that summer water temperatures may not be suitable for Brook Trout. The same fish assemblage (plus one Pumpkinseed) was found during a 2007 survey conducted within the 2018 survey reach. Trout Unlimited installed a temperature data logger in this stream in 2018 to determine if summer water temperatures are problematic for trout.

Recommendation: Analyze the water temperature data collected by Trout Unlimited and determine if summer water temperatures are suitable for Brook Trout. (Hamilton)

*******NON – STANDARDIZED SURVEY*******

Tunnel Brook (Oxford Mtn.)

Date: 07/05/2018
County: Warren
Township: Washington Twp.
Drainage: Pohatcong Creek
Project: Trout Production Re-Inventory
Location: Route 31

Fish Species	Number	Length (mm)
Trout, Brook	5	162 - 184
Trout, Brown	1	185 - 185

Water Chemistry / Habitat

Water Temperature (°C): 13.5
Dissolved Oxygen (mg/L): 10.58
Specific Conductance (uS/cm): 388.4
pH: 7.23
Alkalinity (mg/L): 28
Sample Length (m): 150
Habitat Assessment Score: 153 Sub-Optimal

Summary: This Pohatcong Creek tributary arises from an abandoned railroad tunnel. When first sampled in 2001 a small wild Brook Trout population was documented (34 fish, 27 of which were young-of-the-year (YOY)) and the water temperature was quite cold (13°C). The electrofishing survey conducted on 07/05/2018 at the same location also documented a similar temperature (13.5°C). An unusual feature of this tributary (not previously observed) is that it occasionally flowed underground in the sample reach. Unfortunately, far fewer Brook Trout were present in this survey (five fish, none were YOY) and one Brown Trout, measuring 185 mm (7.3 in) was also found. As a conservation measure, the Brown Trout was not returned to the stream to discourage establishment of this non-native species as it competes directly with Brook Trout for available cover and food. The presence of Brown Trout does not bode well for the future of native Brook Trout in this stream. Brown Trout may become the dominate salmonid species in this stream – eradicating them will be difficult as they are well established in the mainstem and other tributaries to Pohatcong Creek.

Recommendation: This stream should be monitored in accordance with the schedule established for *Trout Production* streams (minimum of once every 10 years for streams having wild Brook Trout. (Hamilton)

Turkey Hill Brook

Date: 09/07/2018
County: Hunterdon
Township: Bethlehem Twp.
Drainage: Musconetcong River
Project: Trout Production Re-Inventory
Location: Turkey Hill Road

Fish Species	Number	Length (mm)
Dace, Blacknose	199	0 - 0
Eel, American	3	0 - 0

Water Chemistry / Habitat

Water Temperature (°C): 18.0
Dissolved Oxygen (mg/L): 8.79
Specific Conductance (uS/cm): 218.5
pH: 8.06
Alkalinity (mg/L): 41
Sample Length (m): 150
Habitat Assessment Score: 142 Sub-Optimal

Summary: Past electrofishing surveys (1987, 1993, and 2009) documented wild Brook and Brown Trout at various locations in the headwaters of this stream, but their abundance was always low (<10 fish/survey). Further downstream the brook flows through a municipal park where Brown Trout are well established (documented there in 2010), before emptying in to the Musconetcong River. In 2018, as part of a collaborative effort involving Trout Unlimited, two sections of Turkey Hill Brook were electrofished to assess the status of the wild trout population. In this survey (the uppermost of the two conducted in 2018) no trout were documented at the Turkey Hill Road bridge (upstream of the I-78 bridge). Only Blacknose Dace (a trout associated species) and American Eel were present. The instantaneous water temperature (18.0°C) suggests that temperatures may be suitable for Brook Trout. Trout Unlimited also installed a temperature data logger in this stream in 2018 to determine if summer water temperatures are problematic for trout.

Recommendation: Analyze the water temperature data collected by Trout Unlimited and determine if summer water temperatures are suitable for Brook Trout. This stream should be monitored in accordance with the schedule established for *Trout Production* streams (minimum of once every 10 years for streams having wild Brook Trout). (Hamilton)

Turkey Hill Brook

Date: 09/07/2018
County: Hunterdon
Township: Bethlehem Twp.
Drainage: Musconetcong River
Project: Brook Trout Assessment
Location: Route 173, upstream of railroad culvert

Fish Species	Number	Length (mm)
Chub, Creek	56	0 - 0
Dace, Blacknose	427	0 - 0
Eel, American	10	0 - 0

Water Chemistry / Habitat

Water Temperature (°C): 20.1
Dissolved Oxygen (mg/L): 8.31
Specific Conductance (uS/cm): 344.9
pH: 7.70
Alkalinity (mg/L): 56
Sample Length (m): 150
Habitat Assessment Score: 145 Sub-Optimal

Summary: Past electrofishing surveys (1987, 1993, and 2009) documented wild Brook and Brown Trout at various locations in the headwaters of this stream, but their abundance was always low (<10 fish/survey). Further downstream the brook flows through a municipal park where Brown Trout are well established (documented there in 2010), before emptying in to the Musconetcong River. In 2018, as part of a collaborative effort involving Trout Unlimited, two sections of Turkey Hill Brook were electrofished to assess the status of the wild trout population. In this survey (the lowermost of the two conducted in 2018) no trout were documented between the railroad culvert and the I-78 bridge. Blacknose Dace and Creek Chub (trout associated species) were present along with American Eel. The instantaneous water temperature (20.1°C) suggests that summer water temperatures may not be suitable for Brook Trout. Trout Unlimited installed a temperature data logger in this stream in 2018 to determine if summer water temperatures are problematic for trout. Trout Unlimited also installed a temperature data logger in this stream in 2018 to determine if summer water temperatures are problematic for trout.

Recommendation: Analyze the water temperature data collected by Trout Unlimited and determine if summer water temperatures are suitable for Brook Trout. This stream should be monitored in accordance with the schedule established for *Trout Production* streams (minimum of once every 10 years for streams having wild Brook Trout). (Hamilton)

Warford Creek

Date: 07/12/2018
County: Hunterdon
Township: Kingwood Twp.
Drainage: Delaware River (11)
Project: Trout Production Re-Inventory
Location: Route 29

Fish Species	Number	Length (mm)
Chub, Creek	91	0 - 0
Dace, Blacknose	325	0 - 0
Eel, American	1	0 - 0

Water Chemistry / Habitat

Water Temperature (°C): 20.7
Dissolved Oxygen (mg/L): 7.21
Specific Conductance (uS/cm): 213.8
pH: 7.34
Alkalinity (mg/L): 57
Sample Length (m): 150
Habitat Assessment Score: 124 Sub-Optimal

Summary: This stream flows directly into the Delaware River in Hunterdon County, near a rock formation known as Devil's Tea Table. When previously sampled in 1998 a few wild Brown Trout were captured (1 young-of-the-year and 8 older fish, 160 – 177 mm (6 – 7 in)). This data was used to upgrade the tributary's surface water classification from *Non-Trout* to *Trout Production*. In the survey conducted on 07/12/2018, no trout were found. The stream has very little water (noted in both surveys) and flows primarily over bedrock, with little suitable spawning substrate for trout (habitat assessment score was sub-optimal). The instantaneous water temperature (20.7°C, taken in the morning) suggests that warm temperatures may be problematic for the long-term survival of trout.

Recommendation: This creek should be surveyed further upstream to determine if it no longer supports a wild trout population. (Hamilton)

West Portal Creek

Date: 09/27/2018
County: Hunterdon
Township: Bethlehem Twp.
Drainage: Musconetcong River
Project: Brook Trout Restoration - Bio Manipulation
Location: I-78 culvert, upstream

Fish Species	Number	Length (mm)
Chub, Creek	present	0 - 0
Dace, Blacknose	present	0 - 0
Eel, American	present	0 - 0
Trout, Brown (YOY)	1	85 - 85
Trout, Brown	3	160 - 295
Trout, Tiger	2	194 - 195

Water Chemistry / Habitat

Water Temperature (°C): 16.9
Dissolved Oxygen (mg/L): 9.88
Specific Conductance (uS/cm): 182.8
pH: 7.41
Alkalinity (mg/L): 40
Sample Length (m): 900
Habitat Assessment Score: N/A

Summary: In May 2016 a major fish kill occurred in this Trout Production stream when detergent leaked from a truck and entered the creek on the downstream side of the I-78 culvert. Electrofishing surveys conducted in the creek since then have sought to remove the non-native wild Brown Trout to give the few remaining Brook Trout (a native species) a chance to recolonize. Unfortunately, not enough effort was expended, and the wild Brown Trout not only quickly recolonized but interbred with Brook Trout in 2017 to produce sterile offspring (Tiger Trout). It was hoped that the perched culvert under I-78 would be a barrier to upstream fish migration, therefore, efforts to restore Brook Trout shifted assessing the stream reach upstream of the culvert. During the electrofishing survey conducted on this reach on 09/27/2018 a total of four Brown Trout (including one young-of-the-year) and two Tiger Trout (yearling fish) were captured and removed. The presence of Tiger Trout (one in 2017 and two in 2018) and Brown Trout (none in 2017 and four in 2018) here indicate that the I-78 culvert is not a complete barrier to trout movement upstream. It may be possible to reposition the existing boulders below the lip of the culvert to prevent trout from swimming upstream into the culvert. Trout Unlimited installed a temperature data logger in this stream in 2018 to determine if summer water temperatures are suitable for Brook Trout.

Recommendation: Analyze the water temperature data collected by Trout Unlimited and determine if summer water temperatures are suitable for Brook Trout. This data will be used to guide future fisheries management decisions and the frequency of surveys to monitor the fish population in this stream. (Hamilton)

*******NON – STANDARDIZED SURVEY*******

Stream Surveys in the Upper Passaic Region

(Pompton, Pequannock, Wanaque, Ramapo, Upper Passaic, Whippany, & Rockaway)

Bear Swamp Brook

Date: 08/02/2018
County: Bergen
Township: Mahwah Twp.
Drainage: Ramapo River
Project: Temperature Study - TP Streams
Location: Bear Swamp Road

Fish Species	Number	Length (mm)
Dace, Blacknose	24	0 - 0
Sunfish, Pumpkinseed	2	86 - 102
Trout, Brook (YOY)	7	56 - 60
Trout, Brook	33	110 - 225

Water Chemistry / Habitat

Water Temperature (°C): 20.7
Dissolved Oxygen (mg/L): 8.61
Specific Conductance (uS/cm): 37
pH: 6.85
Alkalinity (mg/L): 9.1
Sample Length (m): 150
Habitat Assessment Score: 171 Optimal

Summary: Bear Swamp Brook is a coldwater tributary to the Ramapo River running through the Ramapo Valley Reservation in Mahwah Township. Quickly changing gradients from low to high creates a complexity of habitat from plunge pools to flat runs and the presence of native Brook Trout has been documented during the first electrofishing survey conducted here in 1968. This survey was conducted on 08/02/2018 to assess the wild trout population structure relative to stream temperature regime. It is currently classified as a *Trout Production* stream and regulated as a *Native Brook Trout Stream*. This survey will serve as a baseline and to help ensure a more representative sample of NJ trout streams is included in the temperature study. A total of 40 wild Brook Trout were captured ranging from 56-225 mm, 7 of which were YOY. This is similar to numbers of Brook Trout captured in surveys in the same location in 2014 and 2015.

Recommendation: This survey is part of a stream temperature study that is currently being conducted on 19 *Trout Production* streams. This stream will be monitored in this section for the next 1-2 years to study the relationship of stream temperature on wild trout life cycles in New Jersey and help guide in the management of our *Trout Production* streams. (Collenburg)

Bear Swamp Brook (trib.)(Spruce Swamp)

Date: 08/02/2018
County: Bergen
Township: Mahwah Twp.
Drainage: Ramapo River
Project: Brook Trout Assessment
Location: Bear Swamp Road

Fish Species	Number	Length (mm)
NO FISH FOUND	0	0 - 0

Water Chemistry / Habitat

Water Temperature (°C):	18.8
Dissolved Oxygen (mg/L):	7.65
Specific Conductance (uS/cm):	30.9
pH:	5.66
Alkalinity (mg/L):	11.2
Sample Length (m):	150
Habitat Assessment Score:	180 Optimal

Summary: This stream is a tributary to Bear Swamp Brook and has never been surveyed before. It is located in Mahwah Township, inside the Ramapo Valley Reservation, flows into Bear Swamp Lake and eventually into the Ramapo River. The intention of this electrofishing survey was to investigate the absence/presence of Brook Trout above Bear Swamp Lake. It is known that a healthy population of Brook Trout exists in Bear Swamp Brook below Bear Swamp Lake. Upon a sight visit in the spring to install continuous temperature monitors on this stream, it appeared to have adequate flow and great habitat to harbor Brook Trout. On 08/02/2018 an electrofishing survey was conducted, but no fish were found. The fact that no fish were found leads one to speculate that in dry years or in drought conditions, this stream may run dry. Perhaps there are other limiting factors such as the low pH (5.66), which was lower than most Brook Trout streams in NJ and may explain their absence. The habitat suitability index for Brook Trout states "the optimal pH range for brook trout appears to be 6.5-8.0, with a tolerance range of 4.0-9.5." Brook Trout have inhabited streams with a pH of less than 4.75. It was originally hoped to find Brook Trout or that this stream would be a potential candidate for translocation of Brook Trout. Given that no fish were found, this stream would not be a good candidate unless evidence that this stream can support fish is supplied.

Recommendation: Although it is felt to be certain that the absence of fish is a systemic problem, further investigation can entail studying flows during periods of drought to determine this for sure. (Collenburg)

Beech Brook

Date: 08/10/2018
County: Passaic
Township: West Milford Twp.
Drainage: Wanaque River
Project: Trout Production Re-Inventory
Location: Beech Road

Fish Species	Number	Length (mm)
Chub, Creek	27	0 - 0
Dace, Blacknose	72	0 - 0
Sculpin, Slimy	2	0 - 0
Sunfish, Green	61	44 - 113
Trout, Brook (YOY)	9	58 - 73

Water Chemistry / Habitat

Water Temperature (°C): 18.7
Dissolved Oxygen (mg/L): 11.55
Specific Conductance (uS/cm): 55.1
pH: 7.31
Alkalinity (mg/L): 21
Sample Length (m): 150
Habitat Assessment Score: 167 Optimal

Summary: Beech Brook is a tributary to Monksville Reservoir which eventually flows into Wanaque River. A survey was conducted here to potentially add it as a candidate to a stream temperature study as well as part of the Trout Production Re-Inventory. A survey in 2003 had discovered an abundant wild Brook Trout population, a total of 61 wild Brook Trout, including 8 young-of-the-year (YOY), were captured. The survey conducted on 08/10/2018 found 9 wild Brook Trout (all YOY) and 61 Green Sunfish. Green Sunfish are invasive and can outcompete other waterbody inhabitants through direct and indirect competition. It is possible that the small abundance of Brook Trout found was a result of this newly found invasive. All Green Sunfish were destroyed and further removal may be necessary if Brook Trout are being displaced. Another consideration is the current temperature regime, compared to other classified *Trout Production* streams in the Passaic River drainage, is composed of more "warmwater" temperatures in general. This indicates another factor that may be acting to depress the Brook Trout population. About 14% of all summer time stream temperature readings were sub-optimal (22-25℃), which is tolerable for only short durations until it can lead to lethal conditions for Brook Trout.

This survey was the first documentation of Slimy Sculpin in Beech Brook. Slimy Sculpin are soon to be listed as a threatened species in NJ and documenting additional locations where they are found is encouraging.

Recommendation: It is likely that Green Sunfish have established in Beech Brook through its connection with Monksville Reservoir. It may be warranted to conduct additional electrofishing within this system to understand the extent of the problem, investigate the likelihood of removal success, and if Brook Trout are being displaced by Green Sunfish. (Collenburg)

Clinton Brook (trib.)(Cedar Pond E. Branch)

Date: 08/28/2018
County: Passaic
Township: West Milford Twp.
Drainage: Pequannock River
Project: Classification
Location: Clinton Road

Fish Species	Number	Length (mm)
Chub, Creek	41	0 - 0
Dace, Blacknose	30	0 - 0
Mudminnow, Eastern	4	0 - 0
Sunfish, Bluespotted	3	0 - 0

Water Chemistry / Habitat

Water Temperature (°C): 21.4
Dissolved Oxygen (mg/L): 7.47
Specific Conductance (uS/cm): 36.1
pH: 7.43
Alkalinity (mg/L): 14
Sample Length (m): 150
Habitat Assessment Score: 163 Optimal

Summary: This tributary to the Clinton Reservoir was electrofished on 07/03/2018 for classification purposes and by request from the Division of Water Monitoring and Standards. The stream has never been sampled before and had a default classification of *Trout Production* because Clinton Brook is *Trout Production* below the reservoir. This stream runs through the Newark Watershed property in West Milford into the Cedar Pond West Branch, just before entering Clinton Reservoir. The stream has slow flows, a good mix of large woody debris, boulder and cobble layering, and in certain areas it becomes braided and interconnected with wetland or swamp habitat. Species associated with slower flows and warmer temperatures were encountered during this survey. Incidence of Occurrence for this stream was 16.9 and is categorized as *Non-Trout* with a score of < 20 (not supporting trout and/or trout associated species).

Recommendation: No further sampling is necessary at this time. It is recommended for this stream to be classified as *Non-Trout.* (Collenburg)

Clinton Bk (trib.)(Cedar Pond W. Branch)

Date: 07/03/2018
County: Passaic
Township: West Milford Twp.
Drainage: Pequannock River
Project: Classification
Location: Clinton Road

Fish Species	Number	Length (mm)
Chub, Creek	26	0 - 0
Dace, Blacknose	22	0 - 0
Mudminnow, Eastern	16	0 - 0
Shiner, Golden	5	0 - 0
Sunfish, Pumpkinseed	2	84 - 90

Water Chemistry / Habitat

Water Temperature (°C): 20.4
Dissolved Oxygen (mg/L): 6.78
Specific Conductance (uS/cm): 31.9
pH: 7.22
Alkalinity (mg/L): 2
Sample Length (m): 150
Habitat Assessment Score: 138 Sub-Optimal

Summary: This tributary to the Clinton Reservoir was electrofished on 07/03/2018 for classification purposes and by request from the Division of Water Monitoring and Standards. The stream has never been sampled before and had a default classification of *Trout Production* because Clinton Brook is *Trout Production* below the reservoir. It flows from Cedar Lake, is low gradient, and swampy in sections. Species associated with slower flows and warmer temperatures were encountered during this survey. Electrofishing this stream was difficult in sections because of the number of larger boulders, low flows, and instream vegetation. However, enough data has been collected to decide on its classification. Incidence of Occurrence for this stream was 17.1 and is categorized as *Non-Trout* with a score of < 20 (not supporting trout and/or trout associated species).

Recommendation: No further sampling is necessary. It is recommended for this stream to be classified as *Non-Trout.* (Collenburg)

Green Brook (West Milford)

Date: 08/30/2018
County: Passaic
Township: West Milford Twp.
Drainage: Wanaque River
Project: Temperature Study - TP Streams
Location: Warwick Turnpike

Fish Species	Number	Length (mm)
Bullhead, Brown	1	83 - 83
Bullhead, Yellow	3	135 - 163
Pickerel, Chain	1	85 - 85
Trout, Brook (YOY)	31	67 - 109
Trout, Brook	14	142 - 263

Water Chemistry / Habitat

Water Temperature (°C): 20.8
Dissolved Oxygen (mg/L): 7.85
Specific Conductance (uS/cm): 269.8
pH: 7.32
Alkalinity (mg/L): 29
Sample Length (m): 150
Habitat Assessment Score: 176 Optimal

Summary: This tributary to the Wanaque River was electrofished on 08/30/2018 to assess the wild trout populations structure relative to the stream temperature regime. Green Brook is a large tributary to the Wanaque and is a known wild Brook Trout water. The two surveys conducted in the past were downstream and close to Union Valley Road, where the stream flattens out and moves slower. Habitat upstream has higher gradients, full of plunge pools, and includes a better complexity of trout habitat. The area upstream from Union Valley Road was selected for this survey. A total of 45 wild Brook Trout were captured during this survey, including 31 young-of-the-year. The number of impressive sized Brook Trout surprised the crew. Eight of the Brook Trout were larger than 8 inches and the largest reached 10.3 inches, atypical for a NJ Brook Trout stream. This stream would be a good candidate to be regulated as a *Native Brook Trout Stream,* as a good portion of it runs through Abram S. Hewitt State Forest, multiple pull-offs along Warwick Turnpike provide access, and some of the largest catchable sized Brook Trout in NJ can be caught.

Recommendation: This survey is part of a stream temperature study that is currently being conducted on 19 *Trout Production* streams. This stream will be monitored in this section for the next 1-2 years to study the relationship of stream temperature on wild trout life cycles in New Jersey and help guide in the management of our *Trout Production* streams. This stream will be a good candidate to be regulated as a *Native Brook Trout Stream.* (Collenburg)

Harmony Brook

Date: 07/31/2018
County: Morris
Township: Mendham Twp.
Drainage: Whippany River
Project: Brook Trout Assessment
Location: Cold Hill Road

Fish Species	Number	Length (mm)
Bass, Largemouth	2	45 - 50
Dace, Blacknose	68	0 - 0

Water Chemistry / Habitat

Water Temperature (°C): 15.9
Dissolved Oxygen (mg/L): 9.71
Specific Conductance (uS/cm): 47.1
pH: 6.97
Alkalinity (mg/L): 11
Sample Length (m): 150
Habitat Assessment Score: 144 Sub-Optimal

Summary: This headwater section of water exists to the northwest of an on-stream impediment known as the Clyde Potts dam and eventually flows into the Whippany River. Trout exist below Clyde Potts Reservoir and in the mainstem above Clyde Potts Reservoir, but no survey has been conducted on the smaller tributaries that enter into Clyde Potts Reservoir on the western side. It is thought that trout may exist in these tributaries because of their presence in the main stem. The purpose of this survey was to document Brook Trout presence/absence and the fish assemblage that exists on the northwest side of Clyde Potts. An electrofishing survey was conducted on 07/31/2018 and found no trout. This section is degraded, with sediment deposition and channel alteration noticeable and species richness consisting of only Blacknose Dace and Largemouth Bass. The low overall richness can be an indicator of stressful conditions such as low flows during certain times of year. Also, poor water quality, potentially dry conditions, and the size of this system (~1/2 mile) make it a less than ideal candidate for potential re-introduction of Brook Trout.

Recommendation: No further investigation is necessary. (Diglio and Collenburg)

Harmony Brook (trib.)(SW of Clyde Potts Reservoir)

Date: 07/31/2018
County: Morris
Township: Mendham Twp.
Drainage: Whippany River
Project: Brook Trout Assessment
Location: Cold Hill Road

Fish Species	Number	Length (mm)
Bass, Largemouth	4	42 - 51
Dace, Blacknose	149	0 - 0

Water Chemistry / Habitat

Water Temperature (°C): 16.5
Dissolved Oxygen (mg/L): 9.02
Specific Conductance (uS/cm): 51
pH: 6.61
Alkalinity (mg/L): 11
Sample Length (m): 150
Habitat Assessment Score: 142 Sub-Optimal

Summary: This headwater section of water exists to the southwest of an on-stream impediment known as the Clyde Potts dam and eventually flows into the Whippany River. Trout exist below Clyde Potts Reservoir and in the mainstem above Clyde Potts Reservoir, but no survey has been conducted on the smaller tributaries that enter into Clyde Potts Reservoir on the western side. It is thought that trout may exist in these tributaries because of their presence in the main stem. The purpose of this survey was to document Brook Trout potential presence and the fish assemblage that exists in the tributary on the southwest side of Clyde Potts. An electrofishing survey was conducted on 07/31/2018 and found no trout. The only fish species present were Largemouth Bass and Blacknose Dace. The low overall richness can be an indicator of stressful conditions such as low flows during certain times of year. Despite the cold-water temperatures found during sampling, the potentially dry conditions, poor habitat (i.e. poor epifaunal substrate), and the size of this system (~1 mile) make it a less than ideal candidate for potential re-introduction of Brook Trout.

Recommendation: No further investigation is necessary. (Diglio and Collenburg)

Wanaque Reservoir (trib.)(N. of Posts Brook)

Date: 08/06/2018
County: Passaic
Township: Bloomingdale Boro
Drainage: Wanaque River
Project: Brook Trout Assessment
Location: Red Mine Road

Fish Species	Number	Length (mm)
Trout, Brook (YOY)	11	46 - 71
Trout, Brook	15	100 - 175

Water Chemistry / Habitat

Water Temperature (°C): 20
Dissolved Oxygen (mg/L): 8.45
Specific Conductance (uS/cm): 38
pH: 6.41
Alkalinity (mg/L): 9
Sample Length (m): 150
Habitat Assessment Score: 185 Optimal

Summary: This tributary of the Wanaque Reservoir is north of Posts Brook. No survey has ever been conducted at this location and it is thought that because of its close proximity to Blue Mine Brook, a native Brook Trout stream, that an isolated population may be present in this tributary as well. During the electrofishing survey on 08/06/2018 a population of wild Brook Trout was discovered, a total of 26 (11 YOY) were captured. As Brook Trout populations have been in decline across their range, it is positive news to find additional locations they inhabit. There exists more opportunity within the Wanaque River drainage to investigate reservoir tributaries that have never been sampled. Survey results that document fragmented native Brook Trout populations are a catalyst to continue this work.

Recommendation: This stream, currently classified as *Non-Trout*, is recommended for classification of *Trout Production* and should be monitored in accordance with the schedule established for *Trout Production* stream (minimum of once every 10 years for streams having wild Brook Trout). (Collenburg)

Wanaque Reservoir (trib.)(S. of Blue Mine Brook)

Date: 08/06/2018
County: Passaic
Township: Bloomingdale Boro
Drainage: Wanaque River
Project: Brook Trout Assessment
Location: Red Mine Road

Fish Species	Number	Length (mm)
NO FISH FOUND	0	0 - 0

Water Chemistry / Habitat

Water Temperature (°C): 20.4
Dissolved Oxygen (mg/L): 7.95
Specific Conductance (uS/cm): 44.1
pH: 6.60
Alkalinity (mg/L): 12.1
Sample Length (m): 150
Habitat Assessment Score: 147 Sub-Optimal

Summary: This tributary of the Wanaque Reservoir is located directly south of Blue Mine Brook, which holds a population of wild Brook Trout. This stream has never been surveyed in the past and it was thought that because of its proximity to another native Brook Trout population, this stream may contain an isolated population as well. The stream is located on Newark Watershed property, running through heavily forested habitat with good gradient and flow. The entire headwater section of this stream has been left protected and unimpacted due to the ownership by Newark Watershed. However, during the electrofishing survey on 08/06/2018, no fish were found. The absence of fish could be tied to low and possibly intermittent flows. During the survey, stream flows appeared adequate to support fish, but during periods of low flow or drought conditions, this stream may become partially or completely dry.

Recommendation: The default classification of *Trout Maintenance* for this stream should be downgraded to *Non-Trout* as no fish were found. (Collenburg)

West Brook

Date: 08/30/2018
County: Passaic
Township: West Milford Twp.
Drainage: Wanaque River
Project: Brook Trout Assessment
Location: West Brook Road

Fish Species	Number	Length (mm)
Chub, Creek	199	0 - 0
Crappie, Black	4	0 - 59
Pickerel, Redfin	1	137 - 137
Sunfish, Bluegill	4	37 - 44
Sunfish, Bluespotted	3	0 - 0
Sunfish, Pumpkinseed	3	37 - 45
Trout, Rainbow	1	314 - 314

Water Chemistry / Habitat

Water Temperature (°C): 18.1
Dissolved Oxygen (mg/L): 7.33
Specific Conductance (uS/cm): 468.5
pH: 7.32
Alkalinity (mg/L): N/A
Sample Length (m): 150
Habitat Assessment Score: N/A

Summary: West Brook is a popular *Trout Production* stream flowing into the Wanaque River that is regulated as a *Wild Trout Stream*. Along the majority of its extent a wild Rainbow Trout population flourishes, but in the headwater sections of this stream, impacts from historically poor land use are obvious and the tailwaters are disturbed. The Natural Lands Trust has acquired property in the headwater section of West Brook and plan to restore areas that have been degraded and channelized for irrigation. The electrofishing survey on 08/30/2018 was to document the fish assemblage, because multiple impoundments separate the headwaters from areas downstream that have been surveyed in the past. The survey results reflected a disturbed system. Fishes tolerant to poor habitat conditions were found. However, one Rainbow Trout over 12 inches was captured during the survey. It appeared to be stocked with obvious signs of eroded fins, but it is encouraging to see a trout able to survive in this section so late into the summer. Another electrofishing effort to document native Brook Trout in the West Brook headwaters took place on 10/16/2018 further upstream based on a report from a local resident spotting multiple Brook Trout. However, no Brook Trout were found, and it seems unlikely that they would be present given the condition of the habitat, multiple areas of fragmentation, heavily embedded gravel/interstitial space, and the obvious disturbances that occurred in the past. The restoration should benefit the system and improve water quality in West Brook.

Recommendation: Discussion about this as a potential candidate for translocation of a native fish assemblage should take place after the restoration project is completed. Stream temperature loggers have been placed this past summer and should provide additional information to aide this process. (Collenburg)

*****NON-STANDARDIZED SURVEY*****

Whippany River

Date: 07/27/2018
County: Morris
Township: Mendham Twp.
Drainage: Whippany River
Project: Brook Trout Assessment
Location: Bockden Road

Fish Species	Number	Length (mm)
Dace, Blacknose	10	0 - 0
Sunfish, Bluegill	9	0 - 0
Trout, Rainbow (YOY)	9	62 - 84

Water Chemistry / Habitat

Water Temperature (°C): 18.5
Dissolved Oxygen (mg/L): 9.5
Specific Conductance (uS/cm): 375.3
pH: 7.12
Alkalinity (mg/L): 75.5
Sample Length (m): 150
Habitat Assessment Score: 152 Sub-Optimal

Summary: This headwater section of the river originates in Mendham Twp., Morris County and has never been surveyed before. The location of this survey is upstream of Mendham Township Pond and is thought that a fragmented population of trout may be present because Brown Trout and Rainbow Trout are known to exist downstream of this impediment. It also falls within the section of the Whippany River that is managed as a *Wild Trout Stream*. Previous surveys, beginning in 1969 and again in 2001, 2010, and 2014 have found a Brown and Rainbow Trout population downstream. The survey was conducted upstream of Mendham Township Pond on 07/27/2018 and found a fish assemblage that was not very rich, as only 3 species were found, but young-of-the-year (YOY) Rainbow Trout ranging from 62-84 mm (2.5-3.3 in) were captured.

Perhaps the dam is not a complete block to upstream fish movement, but the previously noted dam structure may be playing a role in excluding Brown Trout from making their way to the upper most section of this portion of the Whippany River. Rainbow Trout can naturally reproduce here, as evidenced with the capture of the YOY age class, despite our inability to locate any adult or juvenile individuals. This headwater section may also be acting as a source population for Rainbow Trout in downstream portions of this system. Further investigations would be warranted, but if this portion of the stream is indeed a nursery area for Rainbow Trout, perhaps it could also serve in the same capacity for Brook Trout if native fish were relocated here from nearby catchments where they currently exist. If these waters contain characteristics to support wild non-native Rainbow Trout, presumably native Brook Trout could thrive here if removal efforts were initiated and successful.

Recommendation: Until decisions regarding Brook Trout translocation have taken place, this stream should be monitored in accordance with the schedule established for *Trout Production* streams (minimum of once every 20 years for streams having wild Brown and/or Rainbow Trout). Furthermore, since it is currently identified as Brown Trout in the immediate area, in-house GIS layers should be updated to indicate that this catchment is only composed of an allopatric Rainbow Trout population. Explore the potential success of complete removal of Rainbow Trout and subsequent translocations of Brook Trout. (Diglio and Collenburg)

Whippany River (trib.)(Brookside)

Date: 07/27/2018
County: Morris
Township: Randolph Twp.
Drainage: Whippany River
Project: Brook Trout Assessment
Location: Knight's Bridge Drive

Fish Species	Number	Length (mm)
Chub, Creek	39	0 - 0
Dace, Blacknose	231	0 - 0

Water Chemistry / Habitat

Water Temperature (°C): 19.1
Dissolved Oxygen (mg/L): 8.92
Specific Conductance (uS/cm): 643.1
pH: 7.28
Alkalinity (mg/L): 55
Sample Length (m): 150
Habitat Assessment Score: 150 Sub-Optimal

Summary: This headwater section of the Brookside tributary of the Whippany River begins in Randolph Township and has only been surveyed downstream of Posner Pond. Surveys downstream of Posner Pond have documented wild Rainbow and Brown Trout populations and has recently been added, and now regulated, as a *Wild Trout Stream* in 2018. It is thought that a fragmented population of Brook Trout may be present upstream of Posner Pond since there are wild trout below. The survey conducted on 07/27/2018 captured no trout, only Creek Chubs and Blacknose Dace were encountered during the survey. While the species richness was low, fish abundance was rather high, with 270 individuals being recorded in this stream section. It is unclear as to why this headwater section contains no salmonids, but further long-term investigations should take place to understand potential impacts and projects.

Recommendation: No further sampling is necessary at this time, but installation of a continuous stream temperature monitor will be helpful in understanding the most important limiting factor to trout presence/absence. (Diglio and Collenburg)

Stream Surveys in the Lower Passaic & Upper Atlantic Region

(Lower Passaic, Saddle, Hackensack, Pascack, & Elizabeth to Toms)

Bear Brook (Park Ridge)

Date: 08/03/2018
County: Bergen
Township: Park Ridge Boro
Drainage: Hackensack River
Project: Classification
Location: Pine Drive

Fish Species	Number	Length (mm)
Chub, Creek	93	0 - 0
Dace, Blacknose	17	0 - 0
Dace, Longnose	38	0 - 0
Killifish, Banded	4	0 - 0

Water Chemistry / Habitat

Water Temperature (°C): 23.2
Dissolved Oxygen (mg/L): 8.77
Specific Conductance (uS/cm): 670
pH: 7.80
Alkalinity (mg/L): N/A
Sample Length (m): 150
Habitat Assessment Score: 123 Sub-Optimal

Summary: In 2015, an angler called to report that, he had caught trout in Bear Brook in the 1960's. This stream is a tributary to Woodcliff Lake, which ultimately flows into Pascack Brook. In 2016, three surveys were conducted and one of those surveys, at Arkins Glen Park, captured one stocked Brown Trout. In 2017, a survey upstream captured a wild Brown Trout. Water quality and habitat must be adequate to allow wild trout presence and in 2017, this section's classification was recommended for an upgrade from *Non-Trout* to *Trout-Maintenance.* An additional survey was conducted on 08/03/2018 to document the presence of young-of-the-year trout. No trout were collected. However, the Incidence of Occurrence is 25.1 and supports the *Trout-Maintenance* classification, as a > 20 score indicates support of trout and trout associated species.

Recommendation: No further sampling is required. The current sampling effort supports the classification change in 2017. (Collenburg and Boriek)

Preakness Brook

Date: 08/02/2018
County: Passaic
Township: Wayne Twp.
Drainage: Passaic River - Lower
Project: Classification
Location: Hinchman Road

Fish Species	Number	Length (mm)
Bass, Largemouth	1	139 - 139
Chub, Creek	115	0 - 0
Dace, Blacknose	119	0 - 0
Dace, Longnose	36	0 - 0
Fallfish	4	0 - 0
Hybrid, Sunfish	1	111 - 111
Shiner, Golden	1	0 - 0
Sucker, White	20	0 - 0
Sunfish, Bluegill	4	36 - 72
Sunfish, Pumpkinseed	3	39 - 58

Water Chemistry / Habitat

Water Temperature (°C): 23.7
Dissolved Oxygen (mg/L): 8.35
Specific Conductance (uS/cm): 812
pH: 7.54
Alkalinity (mg/L): 79.5
Sample Length (m): 150
Habitat Assessment Score: 75 Poor

Summary: On 08/02/2018 a backpack electrofishing survey was conducted on a *Non-Trout* classified stretch of Preakness Brook, a tributary to the Passaic River. An angler had reported young-of-the-year trout in this section and the surveys intention was to investigate this. The site is below Barbours Pond and previous surveys in the area (near Hinchman Avenue and Ratzer Road) never documented the presence of trout. Brook Trout were known to previously exist upstream of Barbours Pond, but a survey in 2009 found no trout and impacts from a new development had degraded the stream section. This degradation was suggested as a factor to the populations absence and possibly extirpation from the stream. It is thought to be unlikely, even given this report, that Brook Trout would be found below Barbours Pond. Survey results found no trout and high stream temperatures due to the influence of the dam. Incidence of Occurrence for this stream was 17.0 and supports its current classification, *Non-Trout,* categorized as a score of < 20 (not supporting trout and/or trout associated species).

Recommendation: No further sampling is required and current classification of *Non-Trout* is sufficient. (Collenburg and Boriek)

Stream Surveys in the Raritan Region

(Mainstem Raritan River and all tributaries)

Beaver Brook (Hunterdon)

Date: 07/09/2018
County: Hunterdon
Township: Clinton Twp.
Drainage: Raritan River - South Branch
Project: Trout Stocking Discontinued
Location: Allerton Road

Water Chemistry / Habitat

Water Temperature (°C):	16.1
Dissolved Oxygen (mg/L):	9.54
Specific Conductance (uS/cm):	587.4
pH:	7.87
Alkalinity (mg/L):	100
Sample Length (m):	150
Habitat Assessment Score:	121 Sub-Optimal

Fish Species	Number	Length (mm)
Bass, Largemouth	3	55 - 59
Chub, Creek	14	0 - 0
Dace, Blacknose	134	0 - 0
Dace, Longnose	49	0 - 0
Darter, Tessellated	61	0 - 0
Eel, American	14	0 - 0
Fallfish	1	0 - 0
Lamprey, Sea	1	0 - 0
Sunfish, Bluegill	5	51 - 81
Sunfish, Green	1	131 - 131
Sunfish, Pumpkinseed	1	111 - 111
Trout, Brown (YOY)	6	49 - 80
Trout, Brown	5	140 - 301

Summary: As of February 2018, Beaver Brook (Clinton) is no longer stocked and is managed as a *Wild Trout Stream*, under the new *Wild Brown Trout Enhancement* regulation. Two electrofishing surveys were conducted in 2017 to obtain baseline data prior to cessation of trout stocking. This survey was located upstream of Old Allerton Road in Clinton. Wild Brown Trout persist in this location, despite the proximity of a suite of human impacts within the watershed; specifically consisting of housing developments, a golf course, many roads and impervious surfaces, to name a few examples. Eleven Brown Trout, including 6 young-of-the-year (YOY) were collected on 07/09/2018. The range of this species was from 49 – 301 mm (almost 12 in long). No previously stocked Rainbow Trout were encountered. A small on-stream dam that no longer serves its intended purpose is located along this stream, just downstream of Route 22. Property owners are considering removal of this structure, which would facilitate resident fish passage and restore the stream to a more natural flow regime at this location. Water temperature at the time of this survey was 17.6℃ (63.8℉). Eleven other species of fish were also collected, including the invasive Green Sunfish, which were removed from the stream, as required by the regulations governing the possession or release of potentially dangerous fish. This site was also surveyed in 2001, in which 40 Brown Trout YOY and 7 older Brown Trout were collected, however none were over 9 inches. The 2017 surveys revealed 17 Brown Trout, including 14 YOY, and one stocked Rainbow Trout. The largest Brown Trout measured 355 mm (14.0 in). The fish assemblage during all three surveys was similar. Habitat assessments have also decreased from 154 to 124, and most recently to 121, all within the sub-optimal ranking. This decline may correlate with the decline Brown Trout YOY found during this time frame.

Recommendation: Additional surveys will be conducted at this location in 2019 and subsequent summers to provide comparative data that will be used to assess changes to the fish assemblage after cessation of trout stocking and this stream should be monitored in accordance with the schedule established for *Trout Production* streams (minimum of once every 5 years for streams designated *Wild Trout Streams*). Discussions between DEP staff and the owner of the dam are expected to continue. (Diglio)

Beaver Brook (Hunterdon)

Date: 07/09/2018
County: Hunterdon
Township: Clinton Town
Drainage: Raritan River - South Branch
Project: Trout Stocking Discontinued
Location: Old Highway 22

Water Chemistry / Habitat

Water Temperature (°C):	17.3
Dissolved Oxygen (mg/L):	10.14
Specific Conductance (uS/cm):	725
pH:	7.77
Alkalinity (mg/L):	122
Sample Length (m):	150
Habitat Assessment Score:	112 Sub-Optimal

Fish Species	Number	Length (mm)
Bass, Largemouth	2	55 - 64
Chub, Creek	27	0 - 0
Dace, Blacknose	92	0 - 0
Dace, Longnose	16	0 - 0
Darter, Tessellated	47	0 - 0
Eel, American	14	0 - 0
Sucker, White	22	0 - 0
Trout, Brown (YOY)	2	72 - 74
Trout, Brown	6	216 - 318

Summary: As of February 2018, Beaver Brook (Clinton) is no longer trout stocked and is managed as a *Wild Trout Stream*, under the new *Wild Brown Trout Enhancement* regulation. Two electrofishing surveys were conducted in 2017 along this stream to obtain baseline data prior to cessation of trout stocking. This survey was located upstream of the Leigh Street bridge in Clinton. Despite proximity to a suite of human impacts within the watershed, consisting of housing developments, a golf course, many roads and impervious surfaces, Beaver Brook supports a reproducing Brown Trout population. When this site was originally sampled in 1996 no trout were found. However wild Brown and stocked Rainbow Trout were collected in later surveys. Twenty-five wild Brown Trout and four stocked Rainbow Trout were captured within the 150-m section during a 2015 survey. Water temperature was measured at 17°C/62.6°F. Five of the Brown Trout were over 229 mm (9 in), which can indicate a desirable fishery, however concern was warranted for the sustainability of Brown Trout in Beaver Brook as only four young-of-the-year (YOY) were found. This concern was heightened in 2017, when only six Brown Trout were captured, none of which were YOY and water temperature was elevated at the time of survey (20.7°C / 69.3°F). Three Rainbow Trout were also captured that year and others were observed. Flows in this stream are typically very low during summer months and drought conditions experienced from fall of 2015 through the winter of 2016-17 likely put additional stress on this population. When surveyed on 07/09/2018, data indicated a marginal improvement, as 2 YOY Brown Trout and 6 adults were found up to 318 mm (12.5 in). This coincided with cooler water temperatures (17.3°C/63.1°F). No stocked Rainbow Trout were found.

Recommendation: Additional surveys will be conducted at this location in 2019 and subsequent summers to provide comparative data that will be used to assess changes to the fish assemblage after cessation of trout stocking. (Diglio)

Black Brook (Hunterdon)

Date: 07/12/2018
County: Hunterdon
Township: Union Twp.-Hunterdon Co.
Drainage: Raritan River - South Branch
Project: Temperature Study - TP Streams
Location: Van Syckles Road

Fish Species	Number	Length (mm)
Bass, Largemouth	1	61 - 61
Chub, Creek	41	0 - 0
Dace, Blacknose	93	0 - 0
Dace, Longnose	13	0 - 0
Darter, Tessellated	16	0 - 0
Pike, Northern	1	221 - 221
Shiner, Spottail	13	0 - 0
Sunfish, Bluegill	15	46 - 66
Sunfish, Pumpkinseed	16	53 - 76
Trout, Brown	2	190 - 198

Water Chemistry / Habitat

Water Temperature (°C): 17.5
Dissolved Oxygen (mg/L): 9.38
Specific Conductance (uS/cm): 186.5
pH: 7.39
Alkalinity (mg/L): 25.5
Sample Length (m): 150
Habitat Assessment Score: 145 Sub-Optimal (2015)

Summary: Black Brook is a small stream that flows into the Spruce Run Reservoir in Hunterdon County and is currently classified as a *Trout Production* stream. It was formerly regulated as a *Wild Trout Stream*, but due to low numbers, it was dropped. A backpack electrofishing survey was conducted here on 07/12/2018 to collect more data for the purpose of assessing the wild trout population structure relative to the stream temperature regime. Since construction of the Spruce Run Reservoir (in 1964) and the management practices implemented since it's construction (trout stocking in the reservoir), wild trout populations have been in flux. Brook Trout and Rainbow Trout were originally found here in surveys conducted in 1969 and 1976. Brown Trout were first documented in 2003, but it was also the last survey that Rainbow Trout and Brook Trout were documented. Surveys conducted in 2014, 2015, 2016, and 2017 found a small population of wild Brown Trout (captured 11, 13, 11, and 5 wild Brown Trout in each respective survey) still inhabit this small tributary. No more than 32 trout (in 1969) have been captured in any survey. A total of 2 wild Brown Trout ranging from 190 - 198 mm were encountered during the survey. The wild Brown Trout population continues to persist, but the small population size and extirpation of Brook Trout are indicators of a stressed salmonid environment.

Recommendation: This survey is part of a stream temperature study that is currently being conducted on 19 *Trout Production* streams. This stream will be monitored in this section for the next 1-2 years to study the relationship of stream temperature on wild trout life cycles in New Jersey and help guide in the management of our *Trout Production* streams. (Collenburg)

Burnett Brook

Date: 07/19/2018
County: Morris
Township: Chester Boro
Drainage: Raritan River - North Branch
Project: Brook Trout Assessment
Location: Ironia Road (Ironia-Mendham)

Fish Species	Number	Length (mm)
Chub, Creek	7	0 - 0
Dace, Blacknose	141	0 - 0
Trout, Brown (YOY)	1	63 - 63
Trout, Brown	6	157 - 240

Water Chemistry / Habitat

Water Temperature (°C): 13.9
Dissolved Oxygen (mg/L): 9.91
Specific Conductance (uS/cm): 582.4
pH: 7.15
Alkalinity (mg/L): 42.4
Sample Length (m): 150
Habitat Assessment Score: 165 Optimal

Summary: The mainstem of Burnett Brook has been sampled near the Route 24 bridge three times in the past (1969, 2002, and 2014). It is managed as a *Wild Trout Stream: Wild Brown Trout Enhancement*. Each time Brown Trout young-of-the-year (YOY) and adult/juvenile individuals were found. From this collection of surveys, all upstream waters and related tributaries are classified as *Trout Production* by default under the NJ Surface Water Quality Standards. However, through the use of Arc GIS mapping software, an onstream barrier and related lentic waterbody known as the 4 Bridges Dam and Lake have been identified to the northeast of the previous surveys. The catchment above the noted impoundment has never been sampled and due to the barrier's potential ability to exclude Brown Trout from moving into the specific area, it was thought that habitat above the dam might contain a vestigial Brook Trout population. Scouting efforts failed to identify an accessible location directly above this dam, but GIS revealed an additional structure and ponded water upstream known as the Burnett Brook Dam and Pond. Stream access was identified and an official water temperature reading of an extremely cold reading of 14.8℃/58.6°F was observed. While low in total abundance, a single young-of-the-year (YOY) and six adult/juvenile Brown Trout were taken in this survey. Trout ranged from 63-240 mm (2.5-9.5 in) in total length. Blacknose Dace were found during this and all previous surveys, however Creek Chubs were found only during the original work and now during this survey. The habitat assessment scored a rating in the optimal range with a 165 ranking, with very favorable epifaunal substrate, overall embeddedness, velocity depth regime, and total bends and associated undercut banks.

Recommendation: The catchment above the second dam should be recognized as having a wild Brown Trout population. While an additional survey between the upper and lower on-stream impoundments is warranted to be certain of the existence of Brown Trout in this section of stream, one could assume that these fish already inhabit that part of the stream since they were observed above the top most barrier. If so, then the GIS layer might also be updated to show Brown Trout existence there, or at least the map predicted status for this species of salmonid. Otherwise, this stream should be monitored in accordance with the schedule established for *Trout Production* streams (minimum of once every 20 years for streams having wild Brown Trout). (Diglio)

Cold Brook (trib.)(Laurel Farms)

Date: 07/19/2018
County: Hunterdon
Township: Tewksbury Twp.
Drainage: Raritan River - North Branch
Project: Brook Trout Assessment
Location: Route 517 (Old Turnpike)

Fish Species	Number	Length (mm)
Dace, Blacknose	84	0 - 0

Water Chemistry / Habitat

Water Temperature (°C): 15.9
Dissolved Oxygen (mg/L): 9.66
Specific Conductance (uS/cm): 285.2
pH: 7.47
Alkalinity (mg/L): 31.3
Sample Length (m): 150
Habitat Assessment Score: 152 Sub-Optimal

Summary: The mainstem of Cold Brook has been sampled in the vicinity of the Vliettown Road bridge four times in the past (1970, 1996, 2002, and 2014). Each time, Brown Trout young-of-the-year (YOY) and adult/juvenile individuals were collected. Because of these surveys, all the upstream waters and related tributaries by default are considered *Trout Production* classification by NJ Surface Water Quality Standards. However, through the use of Arc GIS mapping software, an onstream barrier known as the J. Seward Johnson Dam and a related pond have been identified on a tributary northwest of the previous surveys. The catchment above the impoundment has never been sampled and due to the barrier's potential ability to exclude Brown Trout from moving into the specific area, it was thought that water above the dam might contain a vestigial Brook Trout population. Scouting efforts identified water temperatures throughout the catchment in the range of what is considered suitable for salmonid survival and an official reading of 15.9°C/60.6°F was taken in this unnamed tributary of Cold Brook. Despite this finding, no trout species were observed. The only fish species gathered were Blacknose Dace (84 in total). Along with many other species, Blacknose Dace were also taken each time in the previously mentioned past surveys. The habitat assessment scored a rating in the sub-optimal range with a rank of 152, as indicated by low water levels, as well as degraded findings in the epifaunal substrate, velocity/depth regime, and levels of vegetated cover categories.

Recommendation: Since it is currently an unnamed tributary and part of it originates from a location named as such on the GIS mapping software, it is suggested that this water be identified as Cold Brook (trib.) (Laurel Farms). Additionally, due to the observed water temperature, trout would be able to survive in this area, but the poorer habitat may be the actual limiting factor as to why no salmonids were seen. Because this location scored an Incidence of Occurrence rating of 32, as well as the large amount of *Trout Production* waters known elsewhere nearby, future surveys may be warranted in this vicinity, but with the noted downstream barrier, it may be too difficult for trout to naturally recolonize this reach of stream. (Diglio)

Dawson's Brook

Date: 07/20/2018
County: Morris
Township: Randolph Twp.
Drainage: Raritan River - North Branch
Project: Brook Trout Assessment
Location: Calais Road

Fish Species	Number	Length (mm)
No Fish Found		

Water Chemistry / Habitat

Water Temperature (°C): 13.9
Dissolved Oxygen (mg/L): 10.42
Specific Conductance (uS/cm): 534.1
pH: 6.79
Alkalinity (mg/L): 34.0
Sample Length (m): 150
Habitat Assessment Score: 181 Optimal

Summary: Dawson's Brook is a tributary that flows into Burnett Brook at the 4 Bridges Dam and subsequent impounded lake and has been sampled using electrofishing two times shortly above this noted confluence and Ironia-Mendham Road bridge. First surveyed in 1969, Brook Trout young-of-the-year (YOY) were found (along with Pumpkinseed Sunfish, Creek Chub, and Blacknose Dace), but efforts in 2005 documented a change. During that later survey, a larger overall richness was noted. Furthermore, and maybe most importantly, is the fact that Brown Trout, ranging from 68 mm (2.7 in) YOY to 156 mm (6.1 in) adult/juvenile replaced Brook Trout as the resident salmonid. Because of the most recent survey, all the upstream waters and connected tributaries until a barrier/related impoundment fragment the system, are considered *Trout Production,* classification for Brown Trout. Through the use of Arc GIS mapping software, an onstream barrier known as the Cifrese Dam and related pond break up the stream and the catchment above the noted impoundment has never been sampled. Due to the barrier's ability to potentially exclude Brown Trout from moving upstream, it was thought the area might have the possibility to contain a vestigial Brook Trout population. A rather cold temperature reading of 13.9°C/57.0°F was taken on a section above the impediment, but when electrofished on 07/20/2018, no trout species were observed. In fact, no fish of any species were sampled or even observed. The habitat assessment scored a rating in the optimal range with a 181 ranking. Among other characteristics, high ranks in the epifaunal substrate, embeddedness, channel flow status, bank stability, and frequency of bends categories all contributed to the area's high environment quality. From the on-stream work, it is difficult to suggest a reason for the lack of fish life. It should be noted that a good number of crayfish and northern red salamander individuals were continuously seen being influenced by the electrofishing unit during the survey. Perhaps the nearby road and related run-off negatively alter the water quality when salt is applied for seasonal road-treatment. Alternatively, maybe the stream has dried up in the recent past and fish have not been able to make their way back to the area since the mentioned impoundment may act to block their path. Since there are a high number of catchments in the area that hold naturally reproducing Brook, Brown, and Rainbow Trout, it is difficult to understand why no fish exist in this section of Dawson's Brook. With such a high habitat assessment score and a low temperature reading there seems to be a great potential for trout to survive here, despite the finding that none are there now.

Recommendation: Water quality should be monitored during winter during salt application, to identify if salinity levels reach thresholds known to be lethal to fish life. Perhaps a chemical logger (similar to a HOBO temperature monitor) be placed in the brook to gather data all season to try an understand more about the noted impacts that have taken or continue to take place. If findings do not indicate an ion problem, to assist with expanding native populations, the potential exists to possibly reintroduce Brook Trout into this headwater section of stream, especially since there are several naturally reproducing populations in nearby catchments. (Diglio)

Hacklebarney Brook

Date: 08/06/2018
County: Morris
Township: Chester Twp.
Drainage: Raritan River - North Branch
Project: Trout Production Re-Inventory
Location: near confluence with Black River

Fish Species	Number	Length (mm)
Chub, Creek	25	0 - 0
Dace, Blacknose	66	0 - 0
Dace, Longnose	17	0 - 0
Eel, American	10	0 - 0
Sunfish, Bluegill	3	58 - 94
Trout, Brook (YOY)	3	76 - 77
Trout, Brook	2	166 - 175

Water Chemistry / Habitat

Water Temperature (°C): 18.6
Dissolved Oxygen (mg/L): 9.64
Specific Conductance (uS/cm): 432.7
pH: 7.43
Alkalinity (mg/L): 35
Sample Length (m): 150
Habitat Assessment Score: 170 Optimal

Summary: This tributary to the Black (Lamington) River was first surveyed in 1970, resulting in its *Trout Production* classification. During that survey, six young-of-the-year (YOY) and one older than YOY Brook Trout were encountered. Later surveyed in 2005, Brook Trout were much more abundant (47 YOY and 29 older than YOY). Following the monitoring schedule outlined in the Coldwater Fisheries Management Plan, the same location along Hacklebarney Brook was surveyed on 08/06/2018. Once again, the only species of trout found were Brook Trout, but in low abundance (3 YOY and 2 older than YOY). It should be noted that water quality comparisons from 2005 to 2018 appear to be significantly different. Specific Conductance (uS/cm) and pH were higher as of late, with the going from 242.0 to 432.7 and 6.39 to 7.43 respectively. It was projected that Brown Trout may have established in this tributary, as they are well-established in the lower 300 meters of Trout Brook (below a large waterfall), which is approximately 1.7 miles downstream along the Black River, where they are moderately abundant. Brown Trout were also abundant prior to the Brook Trout Restoration Project on Rinehart Brook, which is just downstream from Trout Brook. Brown Trout removed from Rinehart Brook in 2017 were marked by removing the adipose fin. Those fish were relocated within three locations in the Black River and in the lowermost end of Rinehart Brook, however none of these were found in Hacklebarney Brook, as might have been expected. Additional effort was made to search for Brown Trout within Hacklebarney Brook via a non-standardized survey, conducted from the confluence with the Black River, upstream 120 m to the standardized survey location. Only Brook Trout (7 YOY and 3 older than YOY) were found in this section.

Recommendation: No additional surveys are necessary at this time. This stream should be monitored in accordance with the schedule established for *Trout Production* streams (minimum of once every 10 years for streams having wild Brook Trout). (Crouse)

Hickory Run

Date: 07/12/2018
County: Hunterdon
Township: Lebanon Twp.
Drainage: Raritan River - South Branch
Project: Temperature Study - TP Streams
Location: Hickory Run Road

Fish Species	Number	Length (mm)
Chub, Creek	8	0 - 0
Dace, Blacknose	9	0 - 0
Trout, Brook (YOY)	67	46 - 76
Trout, Brook	73	100 - 181

Water Chemistry / Habitat

Water Temperature (°C): 15.7
Dissolved Oxygen (mg/L): 9.85
Specific Conductance (uS/cm): 199
pH: 7.18
Alkalinity (mg/L): 30.5
Sample Length (m): 150
Habitat Assessment Score: 183 Optimal (2015)

Summary: This tributary to the South Branch of the Raritan River was electrofished on 07/12/2018 to assess the wild trout population structure relative to the stream temperature regime. A survey conducted in 1969, upstream of Hickory Farm Dairy, found a wild Rainbow Trout population but the last survey to document wild Rainbow Trout in this location was in 2002. Furthermore, wild Brook Trout were not documented here until 2002. Rainbow Trout were historically stocked in an on-stream farm pond but this has been discontinued. It could be the stocking of Rainbow Trout was supplementing the naturally reproducing population but then declined and has been replaced by Brook Trout that were able to more successfully occupy this stream. This survey was conducted upstream of the Hickory Farm dam. Species encountered in this survey included 140 wild Brook Trout. The number of Brook Trout here has fluctuated each of the last five years from 254 (221 YOY) to 198 (125 YOY) to 92 (36 YOY) to 124 (102 YOY) to 140 (67 YOY). Another interesting aspect of this study is to help understand the causative factors of these changes in fluctuating trout populations and if this is a healthy or normal dynamic.

Recommendation: This survey is part of a stream temperature study that is currently being conducted on 19 *Trout Production* streams. This stream will be monitored in this section for the next 1-2 years to study the relationship of stream temperature on wild trout life cycles in New Jersey and help guide in the management of our *Trout Production* streams. (Collenburg)

India Brook

Date: 07/26/2018
County: Morris
Township: Randolph Twp.
Drainage: Raritan River - North Branch
Project: Brook Trout Assessment
Location: Sussex Turnpike

Fish Species	Number	Length (mm)
Chub, Creek	55	0 - 0
Dace, Longnose	43	0 - 0
Sucker, White	2	0 - 0

Water Chemistry / Habitat

Water Temperature (°C): 20.4
Dissolved Oxygen (mg/L): 8.32
Specific Conductance (uS/cm): 275.7
pH: 6.94
Alkalinity (mg/L): 23
Sample Length (m): 150
Habitat Assessment Score: 175 Optimal

Summary: This headwater section of the mainstem of India Brook flows east of Lake Cherokee and west the Mount Freedom section of Randolph Township. India Brook is managed as a *Wild Trout Stream* from its source downstream to Mountainside Road. Previous sampling surveys have taken place in the mainstem of India Brook downstream of this current site. Initial mainstem work in 1969 gathered 33 Brown Trout, with adults and young-of-the-year (YOY) found. In 2005, 15 Brown Trout adult and YOY were again captured, but these were well outnumbered by 94 adult and YOY Brook Trout that were also sampled. More recently during a 2014 survey, 54 adult and YOY Brown Trout and 12 adult and YOY Brook Trout were found. Everything upstream is classified by default as *Trout Production* for sympatric Brown and Brook Trout populations. Using Arc GIS mapping software, an onstream barrier known as the Winarsky Dam has been identified on the mainstem of India Brook. With the assumption that the impediment has the potential to prevent upstream movement of Brown Trout, the water above maintains the possibility to hold a vestigial Brook Trout population. When surveyed on 07/26/2018, the fish assemblage above the noted dam was only composed of three species, Creek Chub, Blacknose Dace, and White Sucker, all of which were also sampled in the mentioned downstream surveys. No salmonids were sampled in the official survey reach, but a Brown Trout of approximately 127 mm (5 in) was gathered prior to the sampling while settings on the electro-fishing equipment were being tested. Water temperature of 20.4°C/68.7°F and dissolved oxygen levels of 8.32 mg/l were observed. Both abiotic factors are considered on the fringe for what is generally thought to be required necessary to support trout individuals or populations. The habitat assessment for this location was scored in the optimal category, as the overall ranking was found to be at 175. Despite the absence of trout in the official survey location, the single Brown Trout noted just outside of the sample reach indicates that salmonids inhabit the water above the previously noted dam.

Recommendation: This section of stream should continue to be monitored in accordance with the schedule established for *Trout Production* streams (minimum of once every 20 years for streams having wild Brown Trout) and other sampling surveys should take place in the very near future to confirm the existence of trout here. (Diglio)

India Brook (trib.)(E. of Lake Cherokee)

Date: 07/26/2018
County: Morris
Township: Randolph Twp.
Drainage: Raritan River - North Branch
Project: Brook Trout Assessment
Location: Sussex Turnpike

Fish Species	Number	Length (mm)
Bullhead, Brown	1	83 - 83
Chub, Creek	132	0 - 0
Dace, Blacknose	98	0 - 0
Sunfish, Pumpkinseed	1	56 - 56
Trout, Brook	1	151 - 151
Trout, Brown (YOY)	3	50 - 60
Trout, Brown	3	145 - 155

Water Chemistry / Habitat

Water Temperature (°C): 19.9
Dissolved Oxygen (mg/L): 8.5
Specific Conductance (uS/cm): 393.1
pH: 7.19
Alkalinity (mg/L): 33
Sample Length (m): 150
Habitat Assessment Score: 155 Sub-Optimal

Summary: This headwater section of stream flows between Lake Cherokee to the west and the Mount Freedom section of Randolph Township to the east. Previous surveys have taken place in the mainstem of India Brook, downstream of this current site. Initial mainstem work in 1969 gathered 33 Brown Trout, with adults and young-of-the-year (YOY) taken. In 2005, 15 Brown Trout adult and YOY were again found, but these were well outnumbered by 94 adult and YOY Brook Trout. Most recently, 54 adult and YOY Brown Trout and 12 adult and YOY Brook Trout were found in a 2014 survey. From the most recent sampling effort, everything upstream of this location have been classified by default as *Trout Production* for sympatric Brown and Brook Trout populations. Using Arc GIS mapping software, an onstream barrier known as the Klodes Hotel Dam has been identified on the mainstem of India Brook just downstream of the tributary of this survey. With the assumption that the impediment has the potential to prevent upstream movement of Brown Trout, the water above maintains the possibility to hold a vestigial Brook Trout population. With a few exceptions, the fish assemblage found on 07/26/2018 was similar to the most recent downstream survey, and both Brown and Brook Trout were found. Only seven total salmonids were sampled here, with three adult and three YOY Brown Trout, along with a single adult Brook Trout. Water temperature was 19.9°C/67.8°F, on the warmer side for what is generally thought to be required necessary to support trout. The habitat assessment for this location was scored in the sub-optimal category, as the overall ranking was found to be at 155. Sediment deposition, bank stability, and observations related to vegetation protection and vegetation width all lowered the assessment score for the site. Additionally, levels of stream dissolved oxygen were also on the lower end of what is considered optimal to support healthy salmonid populations, as 8.5 mg/l was measured.

Recommendation: Since this tributary to India Brook is currently unnamed, it is suggested to henceforth be call India Brook (trib.)(East of Lake Cherokee). This section of stream should continue to be monitored in accordance with the schedule established for *Trout Production* streams (minimum of once every 10 years for streams having wild Brook Trout). (Diglio)

India Brook (trib.)(Lake Cherokee)

Date: 07/20/2018
County: Morris
Township: Randolph Twp.
Drainage: Raritan River - North Branch
Project: Brook Trout Assessment
Location: Sussex Turnpike

Water Chemistry / Habitat

Water Temperature (°C): 14.8
Dissolved Oxygen (mg/L): 9.51
Specific Conductance (uS/cm): 420.1
pH: 6.74
Alkalinity (mg/L): 40
Sample Length (m): 150
Habitat Assessment Score: 160 Optimal

Fish Species	Number	Length (mm)
Chub, Creek	2	0 - 0
Dace, Blacknose	248	0 - 0
Lamprey, American Brook	4	0 - 0
Sunfish, Pumpkinseed	1	60 - 60
Trout, Brook (YOY)	26	50 - 77
Trout, Brook	11	138 - 247

Summary: India Brook is a tributary to the Raritan River N/Br. that has been sampled in three different locations over the years. The uppermost cluster of surveys occurred above a barrier known as the Mendham Reservoir Dam and subsequent impoundment of water. Each of the three uppermost sample events (1969, 2005, and 2014) identified Brown and Brook Trout in the system. Brown Trout dominated in abundance in the most recent work after the previous two efforts showed Brook Trout making up most of the total of collected salmonids. Except for a lone catchment of an unnamed tributary to the western side of the mainstem of India Brook, all the upstream waters and related tributaries above the noted reservoir by default are considered *Trout Production* classification in the NJ Surface Water Quality Standards. The use of Arc GIS mapping software identified the upper section of this tributary to exist above another barrier and collection of impounded water that fragments this particular section of the lotic system. The second onstream barrier is known as the Cherokee Lake Dam and acts to creates Cherokee Lake; with the above catchment having never been sampled. With the assumption that this barrier has the potential to prevent upstream movement of Brown Trout, the area above maintains the possibility to hold a vestigial Brook Trout population. A temperature reading of 14.8°C/58.6°F was taken during the survey and the habitat assessment scored a rating in the optimal range with a 160 ranking. Among other things, epifaunal substrate, channel alteration, and frequency of bends all contributed to the high environment quality of this location. In this survey, the noted barrier, cold water, and high habitat characteristics correlate to a previously unknown Brook Trout fishery. A total of 37 native salmonids were taken, with 26 young-of-the-year (YOY) (ranging from 50 to 77 mm (2-3 in)) and 11 older fish (ranging from 138-247 mm (5.4-9.7 in)). American Brook Lamprey (4 in total), Blacknose Dace, Creek Chub and a single Pumpkinseed Sunfish were also collected.

Recommendation: Since this tributary to India Brook is currently unnamed, it is suggested to name it India Brook (trib.) (Lake Cherokee). Furthermore, this catchment was not previously sampled, therefore the allopatric Brook Trout population should be acknowledged. Furthermore, upon further review and discussion, this group of Brook Trout may potentially serve as a source population for movement of Brook Trout to restore other areas. This stream should be monitored in accordance with the schedule established for *Trout Production* streams (minimum of once every 10 years for streams having wild Brook Trout). (Diglio)

Lamington (Black) River (trib.)(Fairmount)

Date: 08/21/2018
County: Morris
Township: Washington Twp.-Morris Co.
Drainage: Raritan River - North Branch
Project: Brook Trout Assessment
Location: Pickle Road

Fish Species	Number	Length (mm)
Chub, Creek	12	0 - 0
Dace, Blacknose	59	0 - 0
Trout, Brook (YOY)	20	63 - 112
Trout, Brook	2	166 - 194

Water Chemistry / Habitat

Water Temperature (°C): 17.6
Dissolved Oxygen (mg/L): 8.4
Specific Conductance (uS/cm): 194.4
pH: 7.13
Alkalinity (mg/L): 54
Sample Length (m): 150
Habitat Assessment Score: 155 Sub-Optimal

Summary: This unnamed tributary enters the Lamington (Black) River from the western side, just outside of Hacklebarney State Park. Because it has not been previously sampled, no information existed for this catchment. It is currently classified by default as *Trout Maintenance*. Surrounding watersheds support allopatric Brook or Brown Trout populations, as well as sympatry between both species. This location had a temperature of 17.6°C/63.7°F and dissolved oxygen of 8.4 mg/l. Available habitat was assessed at a sub-optimal score of 155, with velocity/depth regime, sediment deposition, and bank stability lowering the overall ranking. Total species richness was found to be a 3, as Creek Chub, Longnose Dace, and Brook Trout, with 93 individuals collectively. Of these fish, 22 were Brook Trout, ranging from 63-194 mm (2.5-7.7 in) in length. All but two individuals were young-of-the-year (YOY).

Recommendation: It is suggested that this tributary be renamed as Lamington (Black) River (trib.) Fairmount. Additionally, the in-house electronic GIS layer needs to be altered to reflect the existence of an allopatric wild Brook Trout population now in the catchment. Additional surveys should be conducted to solidify a recommendation for upgrade to *Trout Production* status. (Diglio)

Lamington (Black) River (trib.)(N. of Hacklebarney Brook)

Date: 08/07/2018
County: Morris
Township: Chester Twp.
Drainage: Raritan River - North Branch
Project: Brook Trout Assessment
Location: State Park Road, upstream of confluence with Black River

Fish Species	Number	Length (mm)
Chub, Creek	16	0 - 0
Dace, Blacknose	38	0 - 0
Eel, American	5	0 - 0
Trout, Brook (YOY)	34	48 - 77
Trout, Brook	13	102 - 138

Water Chemistry / Habitat

Water Temperature (°C): 19.3
Dissolved Oxygen (mg/L): 9.67
Specific Conductance (uS/cm): 234.1
pH: 7.32
Alkalinity (mg/L): 58
Sample Length (m): 150
Habitat Assessment Score: 144 Sub-Optimal

Summary: This unnamed tributary to the Lamington (Black) River flows through the eastern side Morris County's Black River Park and joins the mainstem of the river just a few feet north of Hacklebarney Brook, a stream currently classified as *Trout Production* because it holds a reproducing population of Brook Trout. Despite the proximity to wild trout, this unnamed stream is classified *Trout Maintenance* by default as it was not previously surveyed and because of its connection to the larger river that is classified as the same. Water quality was near the warmer end of what is known to support salmonids (19.3°C/66.7°F), with a dissolved oxygen of 9.67 mg/l, a level considered of high quality. Habitat was assessed at a sub-optimal 144, with lower quality ratings for velocity/depth regime, sediment deposition, channel flow status, and vegetative protection. Despite some abiotic factors that may be considered less apt to hold salmonid populations, a robust set of Brook Trout were collected during this survey on 08/07/2018. In total, 47 were taken, with 33 young-of-the-year (YOY) (ranging from 50-77 mm / 2.0-3.0 in) and 14 adult/juveniles (ranging from 102-138 mm / 4.0-5.4 in). Creek Chub, Blacknose Dace, and American Eel were also found.

Recommendation: This stream has never been sampled, therefore it is currently unnamed. It be renamed as Lamington (Black) River (trib.)(N. of Hacklebarney Brook) and additional surveys should be conducted to solidify a recommendation for upgrade to *Trout Production* status. (Diglio)

Lamington (Black) River (trib.)(N. of Pottersville)

Date: 08/20/2018
County: Morris
Township: Chester Twp.
Drainage: Raritan River - North Branch
Project: Brook Trout Assessment
Location: Pottersville Road

Fish Species	Number	Length (mm)
Chub, Creek	8	0 - 0
Dace, Longnose	3	0 - 0
Trout, Brook (YOY)	28	53 - 83
Trout, Brook	15	115 - 185
Trout, Brown (YOY)	2	67 - 83
Trout, Brown	4	145 - 175

Water Chemistry / Habitat

Water Temperature (°C): 15.9
Dissolved Oxygen (mg/L): 9.69
Specific Conductance (uS/cm): 235.9
pH: 7.22
Alkalinity (mg/L): 36
Sample Length (m): 150
Habitat Assessment Score: 166 Optimal

Summary: This unnamed tributary enters the Lamington (Black) River from the eastern side of Hacklebarney State Park, just above an onstream barrier of the mainstem known as the Weis Dam. No information exists surrounding this catchment, as it has not been previously surveyed, however it is classified by default as *Trout Production*. Surrounding watersheds support allopatric Brook or Brown Trout populations, as well as sympatry between both species. When surveyed on 08/20/2018, water quality at this location measured a temperature of 15.9°C/60.6°F and dissolved oxygen of 9.69 mg/l, both considered very good as they relate to supporting salmonids. Available habitat was assessed at an optimal score of 166, with channel alteration, frequency of riffles (or bends), bank stability, and traits related to vegetation all scoring very high. Overall species richness was a 4, as Creek Chub, Longnose Dace, and Brown and Brook Trout collectively numbered 60 individuals. Of these fish, 6 were Brown Trout (ranging from 67-175 mm/2.6-6.9 in), with 2 young-of-the year (YOY), and 43 were Brook Trout, measuring 53-185 mm / 2.1-7.3 in, with 28 YOY.

Recommendation: It is suggested that this tributary be renamed as Lamington (Black) River (trib.) N. of Pottersville. Additionally, the in-house GIS layer should be adjusted to reflect that the catchment here holds reproducing Brook and Brown Trout groups. (Diglio)

Millstone River

Date: 06/27/2018
County: Somerset
Township: Franklin Twp.-Somerset Co.
Drainage: Millstone River
Project: Millstone River Restoration
Location: Griggstown Causeway

Water Chemistry / Habitat

Water Temperature (°C):	21.7
Dissolved Oxygen (mg/L):	4.17
Specific Conductance (uS/cm):	420.8
pH:	7.04
Alkalinity (mg/L):	45.5
Sample Length (m):	150
Habitat Assessment Score:	N/A

Fish Species	Number	Length (mm)
Bullhead, Yellow	1	156 - 156
Chub, Creek	2	0 - 0
Crappie, Black	1	140 - 140
Dace, Blacknose	1	0 - 0
Dace, Longnose	6	0 - 0
Darter, Shield	1	0 - 0
Darter, Tessellated	153	0 - 0
Eel, American	146	0 - 0
Killifish, Banded	1	0 - 0
Madtom, Margined	3	0 - 0
Madtom, Tadpole	4	0 - 0
Pickerel, Redfin	1	80 - 80
Shiner, Common	2	0 - 0
Shiner, Satinfin	8	0 - 0
Shiner, Spottail	9	0 - 0
Shiner, Swallowtail	6	0 - 0
Sucker, White	18	0 - 0
Sunfish, Bluegill	22	64 - 125
Sunfish, Green	11	58 - 125
Sunfish, Pumpkinseed	5	68 - 117
Sunfish, Redbreast	20	50 - 165

Summary: An electrofishing survey was conducted on the Millstone River with a Smith Root electrofishing barge approximately nine miles upstream at the Griggstown Causeway. This site was selected to obtain pre and post dam removal fish data above and below the Weston Mill Dam, which was removed during the summer of 2017. In addition, baseline fish assemblage data were also acquired above the Blackwells Mills Dam which is also being considered for removal and will be replicated for the next 2 years. Spring flows were consistently elevated; therefore this survey was delayed until flows subsided to a suitable level. The survey was conducted on 06/27/2018 at flows of 140 CFS. Unfortunately, the timing likely was too late to encounter anadromous species such as American Shad and Blueback Herring, however it was still conducted, as this is an assemblage-based assessment. The fish assemblage was diverse at this location, with at least 21 species documented, 18 of which are native to NJ. The most abundant fishes at this location are Tessellated Darter (n=153) and American Eel (n=146), most of which were collected in the rip-rap under the bridge. No anadromous species were encountered. One species soon to be designated state Special Concern was found, the Shield Darter. It should be noted that both of our state's madtom species were found here as well, this is significant because there are very few sites in NJ in which Margined Madtoms are found this far south and Tadpole Madtoms found this far north. Of the 421 individual fish that were encountered, very few are non-native Centrarchids (Black Crappie (1), Green Sunfish (11), and Bluegills (22)). Eleven invasive Green Sunfish were also found and removed. (Crouse)

Recommendation: Additional electrofishing surveys will be conducted at this location during each spring and fall season from now until the spring of 2020. (Crouse)

Millstone River

Date: 09/24/2018
County: Somerset
Township: Franklin Twp.-Somerset Co.
Drainage: Millstone River
Project: Millstone River Restoration
Location: Griggstown Causeway

Water Chemistry / Habitat

Water Temperature (°C):	20.1
Dissolved Oxygen (mg/L):	5.56
Specific Conductance (uS/cm):	309.1
pH:	7.25
Alkalinity (mg/L):	45
Sample Length (m):	150
Habitat Assessment Score:	N/A

Fish Species	Number	Length (mm)
Bullhead, Yellow	1	74 - 74
Chubsucker, Creek	2	0 - 0
Dace, Blacknose	2	0 - 0
Dace, Longnose	13	0 - 0
Darter, Shield	2	0 - 0
Darter, Tessellated	115	0 - 0
Eel, American	100	199 - 201
Fallfish	2	0 - 0
Killifish, Banded	6	0 - 0
Madtom, Margined	2	0 - 0
Madtom, Tadpole	4	0 - 0
Shiner, Common	2	0 - 0
Shiner, Golden	1	0 - 0
Shiner, Satinfin	7	0 - 0
Shiner, Spottail	17	0 - 0
Shiner, Swallowtail	1	0 - 0
Sucker, White	4	0 - 0
Sunfish, Bluegill	10	30 - 108
Sunfish, Green	2	74 - 104
Sunfish, Pumpkinseed	1	44 - 44
Sunfish, Redbreast	17	27 - 128

Summary: An electrofishing survey was conducted along the Millstone River on 09/24/2018 at the Griggstown Causeway with a Smith Root electrofishing barge. This survey was nine miles upstream of the former Weston Mill Dam which was removed during August 2017. This site was selected to obtain baseline fish assemblage information, as the Blackwells Mills Dam is also being considered for removal. This site was sampled every spring and fall since fall of 2016 and will be replicated for the next 1.5 years. The fish assemblage was diverse at this location, with 26 species documented, 21 of which are native to NJ. The most abundant fish at this location was the Tessellated Darter, composing 115 of the 311 fishes found. No anadromous species were encountered; however, the second most abundant species was the catadromous American Eel (100). Very few non-native piscivores are typically found at this location, with only 2 Green Sunfish (invasive) found. The Shield Darter (2), a species soon to be designated state Special Concern, was also collected. It should be noted that both of our state's madtom species were found here as well, this is significant because there are very few sites in NJ in which Margined Madtoms are found this far south and Tadpole Madtoms found this far north.

Recommendation: Additional electrofishing surveys will be conducted at this location during each spring and fall season from now until the spring of 2020. (Crouse)

Millstone River

Date: 06/27/2018
County: Somerset
Township: Franklin Twp.-Somerset Co.
Drainage: Millstone River
Project: Millstone River Restoration
Location: Blackwells Mills Road Bridge

Water Chemistry / Habitat

Water Temperature (°C):	21.1
Dissolved Oxygen (mg/L):	5.08
Specific Conductance (uS/cm):	413
pH:	7.10
Alkalinity (mg/L):	44.5
Sample Length (m):	150
Habitat Assessment Score:	N/A

Fish Species	Number	Length (mm)
Bass, Largemouth	1	46 - 46
Bass, Rock	3	222 - 235
Bullhead, Brown	4	165 - 191
Bullhead, Yellow	2	160 - 184
Catfish, Channel	4	211 - 572
Crappie, Black	1	143 - 143
Darter, Shield	2	0 - 0
Darter, Tessellated	96	0 - 0
Eel, American	109	0 - 0
Killifish, Banded	5	0 - 0
Madtom, Margined	3	0 - 0
Madtom, Tadpole	1	0 - 0
Pickerel, Redfin	1	95 - 95
Shiner, Satinfin	7	0 - 0
Shiner, Spottail	6	0 - 0
Sucker, White	5	0 - 0
Sunfish, Bluegill	56	41 - 165
Sunfish, Bluespotted	5	73 - 85
Sunfish, Green	29	50 - 125
Sunfish, Pumpkinseed	20	42 - 115
Sunfish, Redbreast	50	44 - 176

Summary: An electrofishing survey was conducted with a Smith Root electrofishing barge approximately five miles upstream of the Weston Mill Dam on the Millstone River at the base of the Blackwells Mills Dam. This site was also sampled last fall and will be replicated for the next 2 years, following the removal of the Weston Causeway Dam (summer of 2017). Spring flows were consistently elevated; therefore, this survey was delayed until flows subsided to a suitable level. The survey was conducted on 06/27/2018 at flows of 140 CFS. Unfortunately, the timing likely is too late to encounter anadromous species such as American Shad and Blueback Herring, however it was still conducted, as this is an assemblage-based assessment. The fish assemblage was very diverse at this location, with at least 21 species documented. One species soon to be designated state Special Concern (Shield Darter) was found during this survey. It should be noted that both of our state's madtom species were found here as well, this is significant because there are very few sites in NJ in which Margined Madtoms are found this far south and Tadpole Madtoms found this far north. Of the 411 individual fish that were encountered, very few are non-native piscivorous Centrarchids (Largemouth Bass (1), Black Crappie (1), Rock Bass (3), Green Sunfish (29), and Bluegills (56)). The only invasive fish regulated as a potentially dangerous species was encountered upstream of the dam was the Green Sunfish. Oriental Weatherfish were previously found in the Millstone Watershed in recent years, however none were captured during this survey.

Recommendation: Additional electrofishing surveys will be conducted at this location during each spring and fall season from now until the spring of 2020. (Crouse)

Millstone River

Date: 09/24/2018
County: Somerset
Township: Franklin Twp.-Somerset Co.
Drainage: Millstone River
Project: Millstone River Restoration
Location: Blackwells Mills Road Bridge

Water Chemistry / Habitat

Water Temperature (°C):	19.7
Dissolved Oxygen (mg/L):	6.58
Specific Conductance (uS/cm):	295.6
pH:	7.33
Alkalinity (mg/L):	43
Sample Length (m):	150
Habitat Assessment Score:	N/A

Fish Species	Number	Length (mm)
Bullhead, Yellow	2	70 - 205
Catfish, Channel	1	165 - 165
Catfish, White	2	48 - 235
Dace, Longnose	3	0 - 0
Darter, Shield	6	0 - 0
Darter, Tessellated	97	0 - 0
Eel, American	103	199 - 201
Fallfish	5	0 - 0
Hybrid, Sunfish	1	0 - 0
Madtom, Margined	4	0 - 0
Shad, American	5	103 - 118
Shiner, Comely	1	0 - 0
Shiner, Common	6	0 - 0
Shiner, Golden	1	0 - 0
Shiner, Satinfin	3	0 - 0
Shiner, Spottail	33	0 - 0
Shiner, Swallowtail	3	0 - 0
Sunfish, Bluegill	19	35 - 129
Sunfish, Bluespotted	1	63 - 63
Sunfish, Green	21	60 - 111
Sunfish, Pumpkinseed	13	49 - 125
Sunfish, Redbreast	42	21 - 146

Summary: An electrofishing survey was conducted on 09/24/2018 with a Smith Root electrofishing barge approximately five miles upstream of the recently removed Weston Mill Dam on the Millstone River at the base of the Blackwells Mills Dam. This site has been sampled every spring and fall since the fall of 2016. A very significant finding of this survey was the presence of juvenile American Shad. Five individuals ranging from 4.1 to 4.6 in were found the first unimpeded migratory season after the dam was removed in the summer of 2017, serving as confirmation of American Shad spawning in the Millstone River. No American Shad were found upstream of this location during the corresponding survey at the Griggstown Causeway on the same date. The fish assemblage was very diverse at this location, with 21 species documented. Two species soon to be designated state Special Concern (Comely Shiner and Shield Darter) were found during this survey. Of the 372 individual fish that were encountered, very few are non-native piscivores (only 21 Green Sunfish and 1 Channel Catfish) and 19 Bluegills. The only invasive fish regulated as a potentially dangerous species encountered upstream of the Weston Mill Dam dam was the Green Sunfish, which were removed. During the fall of 2016 Oriental Weatherfish were found in the Millstone Watershed for the first time, however none were captured since.

Recommendation: Additional electrofishing surveys will be conducted at this location during each spring and fall season from now until the spring of 2020. (Crouse)

Mine Brook (trib)(S. of Somersetin)

Date: 08/03/2018
County: Somerset
Township: Bernardsville Boro
Drainage: Raritan River - North Branch
Project: Brook Trout Assessment
Location: Post Kunhardt Road

Fish Species	Number	Length (mm)
Dace, Longnose	145	0 - 0

Water Chemistry / Habitat

Water Temperature (°C): 17.8
Dissolved Oxygen (mg/L): 11.16
Specific Conductance (uS/cm): 352.1
pH: 6.95
Alkalinity (mg/L): 34
Sample Length (m): 150
Habitat Assessment Score: 156 Sub-Optimal

Summary: This headwater section of the larger Mine Brook system enters the mainstem above an impoundment known as Mill Pond that is created from the existence of Memorial Park Pond Dam. While the lotic waters above the barrier are classified as *Non-Trout*, all the other catchments that surround this location contain salmonids. Brook Trout have been sampled in the tributaries to the west of this location and Rainbow or Rainbow and Brown Trout have been surveys in areas to the east. Water temperature of the current stream was measured at 17.8°C/64°F and a dissolved oxygen reading of 11.16 mg/l. Both findings are well within the range of what is required to support trout populations. Along with these factors, stream habitat was assessed and a score of 156 (sub-optimal) was assigned to the location. It should be noted that it only missed being ranked in the more pristine optimal category by 4 points. This overall habitat score was lowered here by observations of a lesser quality for characteristics related to embeddedness, velocity/depth regime, sediment deposition, and channel flow status. Like surveys conducted in 1995 and 2017 that occurred in the vicinity just to the west, the current work found an abundance of Blacknose Dace. Despite this similarity, the other samplings also located sunfish species, Creek Chub and the previously noted Brook Trout (1995- 36 trout ranging from 53 – 112 mm / 2.1 – 4.4 in) with most being of the young-of-the-year (YOY) age class, and 2017- 5 trout ranging from 147 – 197 mm / 5.8 – 7.8 in, with no YOY found). No salmonids or other species were encountered during the 08/03/2018 survey.

Recommendation: It is suggested that the stream be renamed Mine Brook (trib.) (S. of Somersetin). This stream must be surveyed by the regional fisheries biologist prior to recommending it for an upgrade to T*rout Maintenance* status. With measured water temperature and dissolved oxygen in the salmonid supporting range, habitat assessed on the high end of sub-optimal, and nearby catchments supporting reproducing Brook Trout populations, this catchment warrants further investigation. A potential exists for this area to be considered a candidate for restoration / reintroduction. Further bolstered by the fact that the Raritan River Headwaters Watershed Association oversees a large portion of land surrounding this portion of stream, a temperature logger might be placed on site to understand the thermal range of the locale. (Diglio)

Peapack Brook

Date: 08/07/2018
County: Morris
Township: Chester Twp.
Drainage: Raritan River - North Branch
Project: Brook Trout Assessment
Location: Cooper Lane, Tiger Brook Park

Water Chemistry / Habitat

Water Temperature (°C):	16.3
Dissolved Oxygen (mg/L):	10.78
Specific Conductance (uS/cm):	589.7
pH:	7.07
Alkalinity (mg/L):	33
Sample Length (m):	150
Habitat Assessment Score:	178 Optimal

Fish Species	Number	Length (mm)
Dace, Blacknose	1	0 - 0
Eel, American	8	0 - 0
Sunfish, Green	4	80 - 125
Trout, Brook (YOY)	32	63 - 84
Trout, Brook	16	126 - 186
Trout, Brown (YOY)	32	49 - 76
Trout, Brown	19	112 - 232
Trout, Tiger	1	277 - 277

Summary: This portion of the mainstem of Peapack Brook flows within Chester Township's Tiger Brook Park and is locally known as Tiger Brook. This survey took place in the uppermost headwater location of the system and exists above an impediment known as the Peapack-Gladstone Reservoir Dam which impounds water. While the stream seems to have the ability to flow around the noted lentic water at times, there is an additional unnamed concrete barrier blocking the lotic section that was measured at less than one meter tall. Everything upstream of the 1969 survey is classified as *Trout Production,* because a downstream survey in 1969 gathered 19 Brown Trout (18 young-of-the-year (YOY)) and one even further downstream site in 2002 that found 51 Brown Trout, approximately ¼ of which were YOY. Furthermore, several catchments to the west of this particular survey hold populations of solely native Brook Trout or sympatric groups of Brook and Brown Trout. With the assumption that the mentioned impediments in the immediate have the potential to prevent upstream fish movement, the water above the barriers may maintain the possibility to hold a vestigial Brook Trout population. This survey measured water temperature at 16.3℃/61.3°F and related dissolved oxygen at 10.78 mg/l; both considered excellent to support salmonid species. Habitat was also excellent, as it was assessed with an optimal score of 178. In particular, epifaunal substrate, embeddedness, and frequency of riffles (or bends) scored very high. Richness at the site included 6 species and made up of a single Blacknose Dace, 8 American Eel, 4 Green Sunfish, and 100 trout. Along with one rather large (277 mm / 10.9 in) Tiger Trout (a hybrid between Brown and Brook Trout), 51 Brown Trout and 48 Brook Trout were found. The Brown Trout ranged from 49-232 mm / 1.9-9.1 in and 32 were YOY. Brook Trout ranged from 63-186 mm / 2.48-7.3 in and consisted of 32 YOY. Among the majority of the individuals in this survey, the Brook Trout were larger for each age class compared to the Brown Trout. The invasive Green Sunfish were removed from the stream, as required by the regulations governing the possession or release of "potentially dangerous fish."

Recommendation: While this stream section should now be monitored in accordance with the schedule established for *Trout Production* streams containing native trout, (minimum of once every 10 years for streams containing wild Brook Trout), perhaps it should be looked at more often. Returning to the location possibly every 3 or 5 years would afford the opportunity to follow this interesting age class trend between the two species and see how this trend continues or otherwise progresses. Upon first glance, the observed association may be atypical for what more often takes place in sympatric populations of these species and worth further investigation. Especially with the large amount of concern surrounding competition between resident salmonid species and the expansion of Brown Trout into once allopatric Brook Trout territory, a more in depth examination here may help understand population dynamics or related shifts throughout the region. Further research on the topic from citable published literature, as well as looking at previously gathered in-house data might also take place to help gain a deeper understanding of the noteworthy observation. Finally, the in-house GIS needs to be updated to reflect the presence of Brook Trout in this catchment. (Diglio)

Peapack Brook (trib.)(W. of Mt. Paul)

Date: 08/03/2018
County: Morris
Township: Chester Twp.
Drainage: Raritan River - North Branch
Project: Brook Trout Assessment
Location: Fox Chase Road

Fish Species	Number	Length (mm)
Dace, Blacknose	263	0 - 0
Sunfish, Pumpkinseed	1	114 - 114

Water Chemistry / Habitat

Water Temperature (°C): 16.3
Dissolved Oxygen (mg/L): 10.3
Specific Conductance (uS/cm): 368.7
pH: 6.79
Alkalinity (mg/L): 38
Sample Length (m): 150
Habitat Assessment Score: 140 Sub-Optimal

Summary: This headwater portion of Peapack Brook flows into the mainstem from the east and is situated above an impediment called the Chester Pond Dam and the water it impounds known by the same name. A 1969 survey found 19 Brown Trout (18 young-of-the-year (YOY)) and resulted in the classification of this *Trout Production* stream. A downstream survey was conducted in 2002 that found 51 Brown Trout. About a quarter of the fish from the more recent work were YOY. Several catchments just to the west of this particular area hold populations of solely native Brook Trout or sympatric groups of Brook and Brown Trout. With the assumption that the mentioned impediment has the potential to prevent upstream fish movement, the water above the barrier maintains the possibility to hold a vestigial Brook Trout population due to the impediment's exclusion ability. In this current survey conducted on 08/03/2018, (upstream of the 1969 survey) water temperature was measured at 16.3°C/61.3°F and dissolved oxygen was found to be 10.30 mg/l, both characteristics considered excellent to support salmonid species. Habitat quality was assessed in the sub-optimal category, as a score of 140 was noted, due to lower quality findings in the areas of epifaunal substrate, bank stability, vegetative protection, and riparian vegetative zone width. Despite some favorable abiotic factors, no salmonids were observed in this sampling. A large amount of Blacknose Dace (263) and a single Pumpkinseed were found.

Recommendation: Since this tributary has never been surveyed, it currently has no name and therefore is suggested to be renamed as Peapack Brook (trib.) (W. of Mount Paul). Furthermore, due to the very cold water and high dissolved oxygen levels, this location may be considered as a candidate for Brook Trout restoration efforts. If it is decided to look at this area further, perhaps a long-term temperature logger can be placed in the stream to better comprehend the thermal characteristics of the system. If abiotic water quality monitoring does not point to the restoration potential, no further surveys in this section of stream are necessary. (Diglio)

Raritan River, N/Br (trib.)(N 2nd Watchung Mtn. N/Br)

Date: 07/11/2018
County: Somerset
Township: Far Hills Boro
Drainage: Raritan River - North Branch
Project: Classification
Location: Belcher Road

Fish Species	Number	Length (mm)
Bass, Largemouth	12	20 - 100
Chub, Creek	3	0 - 0
Dace, Blacknose	137	0 - 0
Darter, Tessellated	4	0 - 0
Eel, American	2	0 - 0
Sunfish, Pumpkinseed	7	57 - 101

Water Chemistry / Habitat

Water Temperature (°C): 21.6
Dissolved Oxygen (mg/L): 8.12
Specific Conductance (uS/cm): 1150
pH: 7.93
Alkalinity (mg/L): 114.5
Sample Length (m): 150
Habitat Assessment Score: 140 Sub-Optimal

Summary: This unnamed tributary is classified (by default) as *Non-Trout*, as it has not been previously surveyed and it flows into the *Non-Trout* section of the North Branch of the Raritan River. The location was selected for a survey for several reasons that suggested it may be supportive of reproducing trout populations, such as its proximity to a recently discovered *Trout Production* stream, a steep gradient, and a wooded landscape. A large waterfall within the basalt formations typical in the geology of the Watchung Mountains was observed (at least 30 ft. tall), resulting in a barrier to upstream fish migration. The standardized survey was conducted downstream of this waterfall. The survey resulted in the capture of six species and 165 individual fishes, dominated by 137 Blacknose Dace. The presence of 12 young-of-the-year (YOY) and yearling Largemouth Bass and 7 yearling Pumpkinseeds reflects the presence of several on-stream impoundments along this stream. Water temperature was not optimal for trout at 21.6°C (70.9°F). The Incidence of Occurrence value was calculated at 19.2, supporting the existing *Non-Trout* classification. Several pools were also sampled above the waterfall to search for trout and none were found.

Recommendation: No additional surveys are necessary at this time. (Crouse)

Raritan River, S/Br

Date: 07/10/2018
County: Morris
Township: Mount Olive Twp.
Drainage: Raritan River - South Branch
Project: Trout Stocking Discontinued
Location: Stephens Mill Road

Water Chemistry / Habitat

Water Temperature (°C):	16.2
Dissolved Oxygen (mg/L):	10.33
Specific Conductance (uS/cm):	501.7
pH:	7.56
Alkalinity (mg/L):	37
Sample Length (m):	150
Habitat Assessment Score:	171 Optimal

Fish Species	Number	Length (mm)
Bullhead, Brown	3	159 - 196
Bullhead, Yellow	1	145 - 145
Chub, Creek	28	0 - 0
Dace, Blacknose	139	0 - 0
Dace, Longnose	33	0 - 0
Darter, Tessellated	17	0 - 0
Eel, American	4	0 - 0
Madtom, Margined	1	0 - 0
Mudminnow, Eastern	2	0 - 0
Perch, White	1	154 - 154
Sculpin, Slimy	4	0 - 0
Sucker, White	14	0 - 0
Sunfish, Bluegill	13	77 - 155
Sunfish, Pumpkinseed	12	76 - 182
Trout, Brown (YOY)	5	55 - 80
Trout, Brown	14	149 - 336

Summary: The section of the South Branch of the Raritan River from an old mill dam just upstream of Schooley's Mountain Road in Long Valley to the dam upstream of Flanders-Drakestown Road in Mount Olive is now regulated as a *Wild Trout Stream (multiple wild trout species present).* As a result, trout stocking has been discontinued. Four electrofishing surveys were conducted upstream of Stephen's Mill Road from 2011 through 2015 during the Raritan River, S/Br Headwaters Study. An additional survey was conducted on 07/10/2018 to begin to assess fish assemblage changes following the cessation of trout stocking. The four previous surveys provide a baseline. This standardized 150-m survey starts at the base of a small broken remnant dam and ends at a large natural rock outcropping formation. With minor deviations, the complete fish assemblage for this location has remained similar despite observed temperature swings (ranging from 22.8℃/73℉) to 16.2℃/61.2℉). Wild Brown Trout adults and YOY have consistently been documented at this location. Stocked Rainbow Trout were encountered in 2011 (n=2) and 2012 (n=1), but none were found in the survey since then (although it should be noted that one was observed this year outside the sample area in 2018). The total number of Brown Trout collected at this site were 14, 41, 34, 34, and 19, but with one exception, YOY levels have remained low (3, 32, 10, 5, and 5). When completed, habitat assessment scores have always placed the survey in the optimal category and water temperatures have remained on the cooler end of the scale after consistently dropping since the original work was completed.

Recommendation: Additional surveys will be conducted at this location in 2019 and subsequent summers to provide comparative data that will be used to assess changes to the fish assemblage after cessation of trout stocking. (Diglio)

Raritan River, S/Br

Date: 07/10/2018
County: Morris
Township: Washington Twp.-Morris Co.
Drainage: Raritan River - South Branch
Project: Trout Stocking Discontinued
Location: Bartley WMA (Bartley Rd.)

Water Chemistry / Habitat

Water Temperature (°C):	19.4
Dissolved Oxygen (mg/L):	9.9
Specific Conductance (uS/cm):	420.1
pH:	7.39
Alkalinity (mg/L):	32
Sample Length (m):	150
Habitat Assessment Score:	158 Sub-Optimal

Fish Species	Number	Length (mm)
Bass, Largemouth	1	46 - 46
Chub, Creek	7	0 - 0
Dace, Blacknose	204	0 - 0
Dace, Longnose	41	0 - 0
Darter, Tessellated	121	0 - 0
Eel, American	5	0 - 0
Fallfish	45	0 - 0
Mudminnow, Eastern	9	0 - 0
Pickerel, Chain	1	76 - 76
Sucker, White	18	0 - 0
Sunfish, Bluegill	2	112 - 120
Sunfish, Redbreast	3	85 - 93
Trout, Brook	1	175 - 175
Trout, Brown (YOY)	23	52 - 80
Trout, Brown	5	252 - 305

Summary: The section of the South Branch of the Raritan River from an old mill dam just upstream of Schooley's Mountain Road in Long Valley to the dam upstream of Flanders-Drakestown Road in Mount Olive is now regulated as a *Wild Trout Stream (multiple wild trout species present*). As a result, trout stocking has been discontinued. There are an abundance of wild trout (Brook, Brown, and the occasional Rainbow) found in this section of the river, which is known as one of the most productive locales for natural reproducing salmonids in NJ. Two electrofishing surveys were conducted in previous years to obtain general fisheries data and can serve as a baseline of conditions prior to cessation of trout stocking. This section was surveyed on 07/10/2018 to understand if and how the system may change due to the discontinuation of stocking. This survey was located within the Bartley WMA off Bartley Road in the vicinity of the central angler parking lot. Trout were captured when surveyed in 2014, with 3 YOY Brook Trout and 35 total Brown Trout, 11 of which were YOY. Temperatures during the 2014 survey were well within optimum (15.7℃/60.3℉). It is interesting to note that the 2015 survey took place under extremely warm conditions (23.5℃/74.3℉), yet 16 Brook Trout (the most sensitive of our trout species), 12 of which were YOY, along with 33 Brown Trout, 15 of which were YOY, were found, along with 9 stocked Rainbow Trout. A total of 29 trout, consisting of Brown Trout (23 YOY and 5 adults), one adult Brook Trout (175 mm), and no stocked trout were captured in 2018. Water temperature at the time of survey was adequate to support trout species (19.4℃/66.9℉). Habitat assessment scores have essentially remained unchanged, all just below the optimal ranking in the surveys (157, 157, 158). While this stream section may not always hold large amounts of native trout, there is cause for concern as Brook Trout densities are very low. This is a similar trend seen in the Claremont Stretch, located downstream of this location. Perhaps the negative thermal influence, as witnessed during the summer of 2015 stressed the Brook Trout. The cessation of trout stocking in this area may lessen stress on these vulnerable species.

Recommendation: Additional surveys will be conducted at this location in 2019 and subsequent summers to provide comparative data that will be used to assess changes to the fish assemblage after cessation of trout stocking. (Diglio)

Raritan River, S/Br (trib.)(Drakestown)

Date: 07/27/2018
County: Morris
Township: Mount Olive Twp.
Drainage: Raritan River - South Branch
Project: Temperature Study - TP Streams
Location: Joy Drive

Water Chemistry / Habitat

Water Temperature (°C):	17.3
Dissolved Oxygen (mg/L):	9.03
Specific Conductance (uS/cm):	292.5
pH:	7.47
Alkalinity (mg/L):	32.5
Sample Length (m):	150
Habitat Assessment Score:	176 Optimal (2011)

Fish Species	Number	Length (mm)
Chub, Creek	9	0 - 0
Dace, Blacknose	87	0 - 0
Dace, Longnose	7	0 - 0
Darter, Tessellated	1	0 - 0
Mudminnow, Eastern	4	0 - 0
Sucker, White	1	0 - 0
Trout, Brook	2	147 - 177
Trout, Brook (YOY)	62	51 - 87

Summary: This tributary to the South Branch of the Raritan River was electrofished on 7/27/2018 to assess the wild trout population structure relative to the stream temperature regime. Approximately ten electrofishing surveys have been conducted since 2009 at this location, primarily driven by Division hourly employee Luke Diglio, who at the time, was conducting a study on this subwatershed. Data were gathered and a mark and recapture study was conducted as part of his doctoral dissertation titled, "An Assessment of New Jersey *Trout Production* Systems: A Movement Towards Sustainability." Surveys conducted here found an abundance of wild Brook Trout. Species encountered during this survey included 60 Brook Trout ranging from 51 – 177 mm, including 2 YOY. This is the sixth survey since 2011 that has been conducted in the same location and data is indicating that the total number of Brook Trout has the tendency to fluctuate. In 2011, 2012, 2015, 2016, 2017, and 2018 the total number of Brook Trout captured are 84 (64 YOY), 163 (107 YOY), 110 (38 YOY), 75 (37 YOY), 60 (46 YOY), and 64 (2 YOY) respectively. One of the objectives of this study is to understand these types of population fluctuations, the causative factors that are influencing them, and what implications it has on the standard operating procedures of stream electrofishing surveys.

Recommendation: This survey is part of a stream temperature study that is currently being conducted on 19 *Trout Production* streams. This stream will be monitored in this section for the next 1-2 years to study the relationship of stream temperature on wild trout life cycles in New Jersey and help guide in the management of our *Trout Production* streams. (Collenburg)

Raritan River, S/Br (trib.)(Long Valley)

Date: 07/11/2018
County: Morris
Township: Washington Twp.-Morris Co.
Drainage: Raritan River - South Branch
Project: Trout Production Re-Inventory
Location: Maple Avenue

Fish Species	Number	Length (mm)
Dace, Blacknose	57	0 - 0
Dace, Longnose	3	0 - 0
Trout, Brook	29	60 - 89
Trout, Brown (YOY)	6	61 - 75
Trout, Brown	9	151 - 265

Water Chemistry / Habitat

Water Temperature (°C): 18.7
Dissolved Oxygen (mg/L): 8.98
Specific Conductance (uS/cm): 592
pH: 7.66
Alkalinity (mg/L): 42
Sample Length (m): 150
Habitat Assessment Score: 137 Sub-Optimal

Summary: Last surveyed during the summer of 1996, this tributary to the South Branch of the Raritan River was sampled on 07/11/2018, as recommended in the NJ Coldwater Fisheries Management Plan (2006) to monitor fish assemblages in *Trout Production* streams every 20 years. Data from the 1996 was the basis for its current *Trout Production* status, in which 20 young-of-the-year (YOY) Brook Trout were (and 35 Blacknose Dace) collected. The 2018 survey confirmed the existing *Trout Production* classification, as 29 young-of-the-year (YOY) Brook Trout were found. Although no Brown Trout were encountered during the 1996 survey, unfortunately 15 Brown Trout were found in 2018, consisting of 6 YOY and 9 older than YOY. Similar to the previous survey, 57 Blacknose Dace were found, however 3 Longnose Dace were found as well.

Recommendation: No additional surveys are necessary at this time. This stream should be monitored in accordance with the schedule established for *Trout Production* streams (minimum of once every 10 years for streams having wild Brook Trout). It will be interesting to note whether Brown Trout replace Brook Trout over time. (Crouse)

Raritan River, S/Br (trib.)(SW of Budd Lake)

Date: 07/27/2018
County: Morris
Township: Mount Olive Twp.
Drainage: Raritan River - South Branch
Project: Temperature Study - TP Streams
Location: Route 46

Fish Species	Number	Length (mm)
Chub, Creek	13	0 - 0
Dace, Blacknose	156	0 - 0
Trout, Brook (YOY)	18	59 - 86

Water Chemistry / Habitat

Water Temperature (°C): 17.7
Dissolved Oxygen (mg/L): 9.08
Specific Conductance (uS/cm): 452.3
pH: 7.27
Alkalinity (mg/L): 42
Sample Length (m): 150
Habitat Assessment Score: 147 Sub-Optimal (2011)

Summary: This tributary of the South Branch of the Raritan River was electrofished on 07/27/2018 to assess the wild trout population structure relative to the stream temperature regime. This is the fourth consecutive year a survey has been conducted at this location. A total of 18 Brook Trout (18 YOY) were captured during this survey. The population abundance is low in this section and shows tendencies to fluctuate (i.e. last year only two adult Brook Trout were captured). One of the objectives of this study is to understand these types of population fluctuations, the causative factors that are influencing them, and what implications it has on management.

Recommendation: This survey is part of a stream temperature study that is currently being conducted on 19 *Trout Production* streams. This stream will be monitored in this section for the next 1-2 years to study the relationship of stream temperature on wild trout life cycles in New Jersey and help guide in the management of our *Trout Production* streams. (Collenburg)

Rockaway Creek, S/Br.

Date: 07/02/2018
County: Hunterdon
Township: Lebanon Boro
Drainage: Raritan River - North Branch
Project: Trout Stocking Discontinued
Location: Kullman Industries Campus Drive

Fish Species	Number	Length (mm)
Bass, Largemouth	1	36 - 36
Chub, Creek	19	0 - 0
Dace, Blacknose	138	0 - 0
Dace, Longnose	43	0 - 0
Darter, Tessellated	23	0 - 0
Eel, American	2	0 - 0
Sucker, White	3	0 - 0
Sunfish, Bluegill	1	86 - 86
Trout, Brown (YOY)	15	72 - 96
Trout, Brown	4	202 - 272

Water Chemistry / Habitat

Water Temperature (°C): 18.7
Dissolved Oxygen (mg/L): 9.62
Specific Conductance (uS/cm): 581
pH: 7.61
Alkalinity (mg/L): 128
Sample Length (m): 150
Habitat Assessment Score: 158 Sub-Optimal

Summary: The South Branch of Rockaway Creek was last stocked in the spring of 2017 due to low angler usage and the presence of a viable wild Brown Trout population. Two electrofishing surveys were conducted in 2017 to obtain baseline data prior to cessation of trout stocking. This survey was located near Kullman Industries Campus Drive in Lebanon Boro and was previously surveyed in 2002, 2008, and 2017. Previous surveys resulted in the capture of 25 Brown Trout (12 young-of-the-year (YOY), 7 Brown Trout (2 YOY), and 20 Brown Trout (16 YOY) respectively. This recent survey conducted on 07/02/2018 resulted in 19 Brown Trout (15 of which were YOY). This stream consistently produces wild Brown Trout, some of which are large. The largest captured during each of the last four surveys at this location has ranged from 375 – 450 mm (14.8 – 17.7 in). No stocked Rainbow Trout were encountered during the last three surveys. The remainder of the assemblage has remained consistent.

Recommendation: Due to the presence of a desirable wild Brown Trout fishery, this may be considered for the *Wild Trout Stream - Wild Brown Trout Enhancement Stream* regulations. Additional surveys will be conducted at this location in 2019 and subsequent summers to provide comparative data that will be used to assess changes to the fish assemblage after cessation of trout stocking. (Diglio)

Rockaway Creek, S/Br. (trib.)(Lebanon Boro)

Date: 07/02/2018
County: Hunterdon
Township: Lebanon Boro
Drainage: Raritan River - North Branch
Project: Trout Stocking Discontinued
Location: Main Street

Fish Species	Number	Length (mm)
Chub, Creek	12	0 - 0
Dace, Blacknose	220	0 - 0
Dace, Longnose	56	0 - 0
Darter, Tessellated	15	0 - 0
Sucker, White	7	0 - 0
Sunfish, Bluegill	1	83 - 83
Trout, Brown (YOY)	19	71 - 86
Trout, Brown	5	202 - 329

Water Chemistry / Habitat

Water Temperature (°C): 17.6
Dissolved Oxygen (mg/L): 9.44
Specific Conductance (uS/cm): 579
pH: 7.61
Alkalinity (mg/L): 115
Sample Length (m): 150
Habitat Assessment Score: 150 Sub-Optimal

Summary: The South Branch of Rockaway Creek was last stocked in the spring of 2017 due to low angler usage and the presence of a viable wild Brown Trout population. Two electrofishing surveys were conducted in 2017 to obtain baseline data prior to cessation of trout stocking. It was previously surveyed in 2002 and 2017. Previous surveys resulted in the capture of 5 Brown Trout (2 of which were young-of-the-year (YOY) and 16 Brown Trout (12 of which were YOY), as well as 2 Rainbow Trout (one additional one observed) respectively. This survey was located at Main Street in Lebanon Boro on 07/02/2018. Most recent survey results identified 24 Brown Trout (19 which were YOY) and no Rainbow Trout. This stream consistently produces wild Brown Trout, some of which are large. The largest captured during each of the last three surveys at this location measured 329 and 359 mm (12.9 and 14.1 in). With minor exceptions, the total fish assemblage remains similar, as does consistently cool water temperatures (17.3°C/63.1°F, 15.4°C/59.7°F, 17.6°C/63.9°F) which is necessary to support salmonids.

Recommendation: Due to the presence of a desirable wild Brown Trout fishery, this may be considered for the *Wild Trout Stream - Wild Brown Trout Enhancement Stream* regulations. Additional surveys will be conducted at this location in 2019 and subsequent summers to provide comparative data that will be used to assess changes to the fish assemblage after cessation of trout stocking. (Diglio)

Rocky Run

Date: 07/13/2018
County: Hunterdon
Township: Lebanon Twp.
Drainage: Raritan River - South Branch
Project: Temperature Study - TP Streams
Location: Rocky Run Road

Fish Species	Number	Length (mm)
Dace, Blacknose	160	0 - 0
Trout, Brook (YOY)	47	46 - 92
Trout, Brook	31	117 - 188

Water Chemistry / Habitat

Water Temperature (°C): 20.3
Dissolved Oxygen (mg/L): 8.17
Specific Conductance (uS/cm): 207.4
pH: 7.67
Alkalinity (mg/L): 33
Sample Length (m): 150
Habitat Assessment Score: 162 Optimal (2015)

Summary: This tributary to the South Branch of the Raritan River was electrofished on 07/13/2018 to assess the wild trout population structure relative to the stream temperature regime. The survey was conducted just upstream of an on-stream impoundment that blocks migration up into this section. Brown Trout and Brook Trout are known to exist below this impoundment. Species encountered during this survey included 78 wild Brook Trout ranging from 47 – 188 mm. Surveys were conducted here in 2009, 2014, 2015, 2016, 2017, and 2018 and captured a total of 22 (9 YOY), 69 (61 YOY), 81 (32 YOY), 51 (23 YOY), 50 , and 78 (47 YOY) respectively, indicating that the population of trout here fluctuates.

Recommendation: This survey is part of a stream temperature study that is currently being conducted on 19 *Trout Production* streams. This stream will be monitored in this section for the next 1-2 years to study the relationship of stream temperature on wild trout life cycles in New Jersey and help guide in the management of our *Trout Production* streams. (Collenburg)

Spruce Run Creek

Date: 07/03/2018
County: Morris
Township: Washington Twp.-Morris Co.
Drainage: Raritan River - South Branch
Project: Brook Trout Assessment
Location: Crystal Springs Preserve off Califon Road

Fish Species	Number	Length (mm)
Chub, Creek	6	0 - 0
Dace, Blacknose	68	0 - 0
Darter, Tessellated	12	0 - 0
Perch, Yellow	1	55 - 55
Sunfish, Bluegill	1	56 - 56

Water Chemistry / Habitat

Water Temperature (°C): 21.5
Dissolved Oxygen (mg/L): 8.53
Specific Conductance (uS/cm): 232.2
pH: 6.89
Alkalinity (mg/L): 23
Sample Length (m): 150
Habitat Assessment Score: 161 Optimal

Summary: A backpack electrofishing survey was conducted along upper reaches of Spruce Run Creek to assess the status of Brook Trout, which exist in low numbers within this stream. Wild Brown Trout are routinely captured throughout much of this stream and it is annually stocked with Rainbow Trout (several miles downstream). A survey was conducted on 07/03/2018 within Hunterdon County's 232-acre Crystal Springs Preserve. The northern section of this park extends into Morris County (where this survey was conducted) and is maintained by Washington Twp. Land Trust. The headwaters of Spruce Run originate on property, which also contains a series of at least seven ponds both earthen and beaver dams that are intertwined with the stream channel. This survey was conducted in the only observed section that has a well-defined stream channel. Five species were encountered, including Creek Chub, Blacknose Dace, Tessellated Darter, Bluegill, and Yellow Perch. No trout were encountered. Water temperature was 21.5℃ (70.7℉), which may indicate it is too warm at times for Salmonids. Much of the instream habitat appears suitable for trout, with a Habitat Assessment for high gradient streams was at the low end of optimal, 161.

Recommendation: No additional surveys are necessary at this time. This stream should be monitored in accordance with the schedule established for *Trout Production* streams (minimum of once every 20 years for streams having reproducing trout). (Crouse)

Spruce Run Creek

Date: 07/03/2018
County: Hunterdon
Township: Lebanon Twp.
Drainage: Raritan River - South Branch
Project: Brook Trout Assessment
Location: Miquin Woods off Newport Road

Water Chemistry / Habitat

Water Temperature (°C): 20.3
Dissolved Oxygen (mg/L): 8.8
Specific Conductance (uS/cm): 191
pH: 7.47
Alkalinity (mg/L): 44
Sample Length (m): 150
Habitat Assessment Score: 155 Sub-Optimal

Fish Species	Number	Length (mm)
Bullhead, Yellow	2	147 - 166
Chub, Creek	14	0 - 0
Dace, Blacknose	130	0 - 0
Dace, Longnose	37	0 - 0
Darter, Tessellated	63	0 - 0
Eel, American	6	0 - 0
Shiner, Common	32	0 - 0
Sucker, White	28	0 - 0
Sunfish, Bluegill	8	37 - 47
Sunfish, Pumpkinseed	7	35 - 59
Trout, Brown (YOY)	17	58 - 71
Trout, Brown	4	190 - 218

Summary: A backpack electrofishing survey was conducted along upper reaches of Spruce Run to assess the status of Brook Trout, which exist in low numbers within this stream. Wild Brown Trout are routinely captured throughout much of this stream and it is annually stocked with Rainbow Trout (approximately 1.5 miles downstream). A survey was conducted on 07/03/2018 within Hunterdon County's 302-acre Miquin Woods Preserve. A 1.2-acre off channel pond is supplied by an intake structure, diverting water from Spruce Run. Water temperature in Spruce Run above the pond was 21.4℃ (70.5℉). Water flowing out of the pond was 24.4℃ (75.9℉) and re-enters Spruce Run a short distance downstream. A location downstream of the pond's effluent within Spruce Run was 23.4℃ (74.1℉), indicating a significant thermal impact to Spruce Run and presumably the fish population. Spruce Run was surveyed via electrofishing, upstream of the pond, as it seemed more likely to encounter trout. The survey yielded a relatively diverse fishery consisting of eight species, including 21 Brown Trout (17 young-of-the-year (YOY) and 4 older than YOY from 190–218 mm (7.5 – 8.6 in). No Brook Trout were encountered. In-stream habitat adjacent to the pond (some of which was sampled in the lower end of the 150 meter reach) is significantly altered by substantial beaver activity, as several beaver dams back up water into very stagnant, silted in lentic habitat is present. Excessive sunlight also penetrates the streambed were an abundance of beaver chewed tree stumps remain. Both the riparian buffer and instream habitat were much more suitable for trout upstream of this area (which contributed to the majority of the survey). Like many streams, the headwaters of Spruce Run are negatively impacted by an abundance of man-made impoundments that significantly fragment and thermally impact trout habitat.

Recommendation: No additional surveys are necessary at this time. This stream should be monitored in accordance with the schedule established for *Trout Production* streams (minimum of once every 20 years for streams having reproducing Trout). (Crouse)

Spruce Run Creek

Date: 08/09/2018
County: Hunterdon
Township: Glen Gardner Boro
Drainage: Raritan River - South Branch
Project: Fish Kill
Location: Main Street

Water Chemistry / Habitat

Water Temperature (°C):	19.8
Dissolved Oxygen (mg/L):	12.27
Specific Conductance (uS/cm):	261.2
pH:	7.46
Alkalinity (mg/L):	49
Sample Length (m):	150
Habitat Assessment Score:	166 Optimal

Fish Species	Number	Length (mm)
Bass, Largemouth	2	66 - 76
Bass, Smallmouth	13	68 - 152
Bullhead, Brown	1	145 - 145
Dace, Blacknose	26	0 - 0
Dace, Longnose	25	0 - 0
Darter, Tessellated	9	0 - 0
Eel, American	2	0 - 0
Perch, Yellow	1	149 - 149
Sucker, White	9	0 - 0
Sunfish, Bluegill	2	93 - 98
Sunfish, Green	1	100 - 100
Sunfish, Pumpkinseed	6	57 - 96
Trout, Brown (YOY)	3	80 - 88
Trout, Brown	35	170 - 593
Trout, Rainbow	8	256 - 320

Summary: Spruce Run Creek was re-sampled at two locations on 08/09/2018, as a follow-up to the 2018 quarry spill and subsequent 4-month stream clean-up. In-stream habitat looked wonderful, with no visible trace of quarry sludge. Species abundance and composition remained nearly identical to surveys conducted 2 days after the discharge, however a significant decline in the number of young-of-the-year (YOY) Brown Trout was noted. When surveyed on 8/1/17, a total of 68 Brown Trout (48 YOY and 20 older) were captured at this location, with only 38 Brown Trout (3 YOY and 35 older) captured one year later. The presence of YOY trout indicates that a spawn took place last fall (a major goal of the clean-up), however the limited number indicates the spawn was impacted. One very large wild Brown Trout was captured, measuring 593 mm (23.3 in). During this survey, staff provided a one hour and 15-minute Bureau of Freshwater Fisheries presentation and electrofishing demonstration to representatives from Compliance and Enforcement, Water Allocation, and NJWSA, as part of a comprehensive field training exercise based on Spruce Run as a case study.

Recommendation: The fishery appears to be recovering, however the stream should be monitored prior to the established schedule for *Trout Production* streams (minimum of once every 10 years for streams having wild Brook Trout). (Crouse)

Spruce Run Creek

Date: 08/09/2018
County: Hunterdon
Township: Lebanon Twp.
Drainage: Raritan River - South Branch
Project: Fish Kill
Location: Route 31, across from Rock Run Road

Water Chemistry / Habitat

Water Temperature (°C): 19
Dissolved Oxygen (mg/L): 12.21
Specific Conductance (uS/cm): 270.9
pH: 7.58
Alkalinity (mg/L): 53
Sample Length (m): 150
Habitat Assessment Score: 158 Sub-Optimal

Fish Species	Number	Length (mm)
Bass, Largemouth	17	57 - 76
Bass, Smallmouth	13	69 - 212
Bullhead, Brown	2	135 - 176
Dace, Blacknose	27	0 - 0
Dace, Longnose	25	0 - 0
Darter, Tessellated	41	0 - 0
Eel, American	10	0 - 0
Perch, Yellow	1	159 - 159
Sucker, White	25	0 - 0
Sunfish, Bluegill	14	45 - 136
Sunfish, Green	3	83 - 93
Sunfish, Pumpkinseed	13	53 - 85
Trout, Brook (YOY)	1	92 - 92
Trout, Brook	1	191 - 191
Trout, Brown (YOY)	13	69 - 99
Trout, Brown	13	161 - 425
Trout, Rainbow	5	271 - 342

Summary: Spruce Run Creek was re-sampled at two locations on 08/09/2018, as a follow-up to the 2018 quarry spill and subsequent 4-month stream clean-up. In-stream habitat looked wonderful, with no visible trace of quarry sludge. Species abundance and composition remained nearly identical to surveys conducted 2 days after the discharge, however a significant decline in the number of young-of-the-year (YOY) Brown Trout was noted. When surveyed on 8/1/17, a total of 52 Brown Trout (42 YOY and 10 older) were captured at this location, with only 26 Brown Trout (13 YOY and 13 older) captured one year later. The presence of YOY trout indicates that a spawn took place last fall (a major goal of the clean-up), however the limited number indicates the spawn was impacted. During this survey, staff provided a one hour and 15-minute Bureau of Freshwater Fisheries presentation and electrofishing demonstration to representatives from Compliance and Enforcement, Water Allocation, and NJWSA, as part of a comprehensive field training exercise based on Spruce Run as a case study.

Recommendation: The fishery appears to be recovering, however the stream should be monitored prior to the established schedule for *Trout Production* streams (minimum of once every 10 years for streams having wild Brook Trout). (Crouse)

Stony Brook (Washington)

Date: 07/31/2018
County: Morris
Township: Washington Twp.-Morris Co.
Drainage: Raritan River - South Branch
Project: Temperature Study - TP Streams
Location: Columbia Trail Walking Bridge

Water Chemistry / Habitat

Water Temperature (°C):	18.5
Dissolved Oxygen (mg/L):	9.95
Specific Conductance (uS/cm):	267.5
pH:	7.65
Alkalinity (mg/L):	40
Sample Length (m):	150
Habitat Assessment Score:	168 Optimal (2015)

Fish Species	Number	Length (mm)
Chub, Creek	56	0 - 0
Dace, Blacknose	101	0 - 0
Dace, Longnose	26	0 - 0
Darter, Tessellated	40	0 - 0
Lamprey, American Brook	9	0 - 0
Mudminnow, Eastern	6	0 - 0
Sculpin, Slimy	148	0 - 0
Sucker, White	28	0 - 0
Sunfish, Bluegill	3	61 - 70
Sunfish, Green	4	63 - 82
Trout, Brook (YOY)	5	65 - 78
Trout, Brook	10	130 - 221
Trout, Brown (YOY)	36	55 - 85
Trout, Brown	19	142 - 325

Summary: Stony Brook is a tributary of the South Branch of the Raritan River and was electrofished on 07/31/2018 to assess the wild trout populations structure relative to the stream temperature regime. The first survey conducted here in 1969 discovered a wild Brown Trout and Brook Trout population with Slimy Sculpin present (an excellent indicator of water quality). Many years have passed since the next survey was conducted on this stream, but the species composition has not changed much except for the dominant trout species (now Brown Trout). The 55 wild Brown Trout captured this year was the lowest amount captured from when this study began in 2015. Brook Trout were also captured but continue to be found in low abundance. This stream section has a lot of silt and sand deposited throughout and can potentially be limiting better habitat. Otherwise, undercut banks and large pools (some at depths of 3.5-4 feet deep) are abundant which provide ample cover in times of low flows. The Brook Trout population is struggling throughout the stream reach.

Recommendation: This survey is part of a stream temperature study that is currently being conducted on 19 *Trout Production* streams. This stream will be monitored in this section for the next 1-2 years to study the relationship of stream temperature on wild trout life cycles in New Jersey and help guide in the management of our *Trout Production* streams. (Collenburg)

Teetertown Brook

Date: 08/23/2018
County: Hunterdon
Township: Lebanon Twp.
Drainage: Raritan River - South Branch
Project: Brook Trout Assessment
Location: Hollow Brook Road

Fish Species	Number	Length (mm)
Chub, Creek	93	0 - 0
Dace, Blacknose	107	0 - 0
Trout, Brook (YOY)	7	66 - 93
Trout, Brook	1	185 - 185

Water Chemistry / Habitat

Water Temperature (°C): 17.6
Dissolved Oxygen (mg/L): 8.91
Specific Conductance (uS/cm): 151.8
pH: 7.04
Alkalinity (mg/L): 26
Sample Length (m): 150
Habitat Assessment Score: 175 Optimal

Summary: An electrofishing survey was conducted along Teetertown Brook on 08/23/2018 to assess Brook Trout. It is managed as a *Wild Trout Stream*. A previous survey was conducted in 2017 about 600m (2,000 ft) downstream of this current location, which confirmed the existence of an allopatric Brook Trout population above an onstream unnamed concrete impediment and near Trimmer Road in Lebanon Township. Below the barrier, Brook and Brown Trout have been found several times (1981, 2007, 2014) and the findings have always been evenly split between the two species (3/2, 25/28, 49/44). The survey above the dam last year, revealed 4 Brook Trout, ranging in size from 66-96 mm / 2.6-3.8 in. No adult/juveniles were found. The sampling in the current location was chosen further upstream than previous work to ascertain the existence of Brook Trout above as series of notable rock outcrops/waterfalls (with the largest potential barrier being measured at about 1.5 m tall). Eight total Brook Trout were encountered this year, with a single fish being categorized as an adult/juvenile (185 mm / 7.3 in) and the remaining found as young-of-the-year (YOY), ranging from 66-93mm (2.6-3.7 in). Water temperature was 17.6°C/63.9°F and dissolved oxygen was 8.91 mg/l. Habitat was excellent, as it was assessed to be in the optimal ranking with an overall score of 175. The epifaunal substrate, embeddedness, velocity/depth regime and frequency of riffles or bends categories earned the highest scores for the survey. This work confirmed the existence of a reproducing population of Brook Trout above the set of waterfalls and potential natural barriers.

Recommendation: As undoubtedly noted in last year's work, this stream should continue to be monitored in accordance with the schedule established for *Trout Production* streams containing native trout, (minimum of once every 10 years for streams holding wild Brook Trout). No further work in the near future needs to occur here. (Diglio)

Trout Brook (Hacklebarney)

Date: 07/20/2018
County: Morris
Township: Chester Twp.
Drainage: Raritan River - North Branch
Project: Temperature Study - TP Streams
Location: Hacklebarney State Park

Fish Species	Number	Length (mm)
Dace, Blacknose	137	0 - 0
Dace, Longnose	4	0 - 0
Eel, American	4	0 - 0
Sunfish, Bluegill	3	58 - 62
Trout, Brook (YOY)	86	46 - 90
Trout, Brook	48	120 - 224

Water Chemistry / Habitat

Water Temperature (°C): 17.8
Dissolved Oxygen (mg/L): 8.68
Specific Conductance (uS/cm): 278.2
pH: 7.30
Alkalinity (mg/L): 59
Sample Length (m): 150
Habitat Assessment Score: 179 Optimal (2014)

Summary: Trout Brook is a small stream that flows through Hacklebarney State Park and ultimately into the Black River. It is currently classified a *Trout Production (TP)* stream and one of the two streams inside Hacklebarney State Park that is regulated as a *Wild Trout Stream*. This tributary of the South Branch of the Raritan River was electrofished on 07/20/2018 to assess the wild trout populations structure relative to the stream temperature regime. Past surveys have found an abundant and persistent population of wild Brook Trout here, and a natural barrier ~100 m downstream of the survey's start point has kept Brown Trout in the downstream section of this brook. Species encountered during this survey included 134 wild Brook Trout (86 YOY). One objective of this study is to determine the causative factors of the trout populations fluctuations.

Recommendation: This survey is part of a stream temperature study that is currently being conducted on 19 *Trout Production* streams. This stream will be monitored in this section for the next 1-2 years to study the relationship of stream temperature on wild trout life cycles in New Jersey and help guide in the management of our *Trout Production* streams. (Collenburg)

Turkey Brook

Date: 07/20/2018
County: Morris
Township: Mount Olive Twp.
Drainage: Raritan River - South Branch
Project: Temperature Study - TP Streams
Location: Stephens Mill Road

Water Chemistry / Habitat

Water Temperature (°C):	18.1
Dissolved Oxygen (mg/L):	9.2
Specific Conductance (uS/cm):	155.4
pH:	7.36
Alkalinity (mg/L):	29
Sample Length (m):	150
Habitat Assessment Score:	165 Optimal (2010)

Fish Species	Number	Length (mm)
Bass, Largemouth	2	55 - 62
Chub, Creek	6	0 - 0
Dace, Blacknose	57	0 - 0
Dace, Longnose	9	0 - 0
Mudminnow, Eastern	1	0 - 0
Sculpin, Slimy	96	0 - 0
Sucker, White	3	0 - 0
Sunfish, Bluegill	1	139 - 139
Sunfish, Pumpkinseed	2	90 - 118
Trout, Brook (YOY)	21	62 - 85
Trout, Brook	1	217 - 217
Trout, Brown (YOY)	11	64 - 81
Trout, Brown	5	120 - 213
Trout, Tiger (YOY)	3	72 - 77

Summary: Turkey Brook is a tributary of the South Branch of the Raritan River and was electrofished on 07/20/2018 to assess the wild trout populations structure relative to the stream temperature regime. A survey conducted in 1969 discovered a wild Brook Trout population here. It is managed as a *Wild Trout Stream*. Since then, Brown Trout have been either directly or indirectly introduced into the system. Approximately nine electrofishing surveys have been conducted since 2009 at this location. Multiple surveys have shown Brown Trout populations dominate the species composition closer to the confluence of the South Branch of the Raritan River. Headwater sections are still dominated by Brook Trout, helped by a few on stream impoundments. Species encountered in this survey included 22 wild Brook Trout (21 YOY) and 16 wild Brown Trout (11 YOY). The balance of these two populations seem to fluctuate from year to year, but Brown Trout are typically more abundant at the location of the survey. Three wild Tiger Trout (hybrid of Brook and Brown Trout) was also documented for the first time in this stream.

Recommendation: This survey is part of a stream temperature study that is currently being conducted on 19 *Trout Production* streams. This stream will be monitored in this section for the next 1-2 years to study the relationship of stream temperature on wild trout life cycles in New Jersey and help guide in the management of our *Trout Production* streams. (Collenburg)

Willhoughby Brook

Date: 07/13/2018
County: Hunterdon
Township: Lebanon Boro
Drainage: Raritan River - South Branch
Project: Temperature Study - TP Streams
Location: Route 31

Water Chemistry / Habitat

Water Temperature (°C):	19.2
Dissolved Oxygen (mg/L):	9.26
Specific Conductance (uS/cm):	221.7
pH:	7.85
Alkalinity (mg/L):	49.5
Sample Length (m):	150
Habitat Assessment Score:	149 Sub-Optimal (2015)

Fish Species	Number	Length (mm)
Bass, Largemouth	11	99 - 99
Bass, Smallmouth	1	104 - 104
Bullhead, Brown	20	129 - 129
Bullhead, Yellow	4	129 - 129
Dace, Blacknose	17	0 - 0
Dace, Longnose	11	0 - 0
Darter, Tessellated	23	0 - 0
Eel, American	2	0 - 0
Shiner, Golden	1	0 - 0
Sucker, White	4	0 - 0
Sunfish, Green	17	63 - 105
Sunfish, Pumpkinseed	1	86 - 86
Trout, Brook (YOY)	7	72 - 81
Trout, Brown (YOY)	6	60 - 75
Trout, Brown	17	159 - 295

Summary: This tributary to the Spruce Run Reservoir was electrofished on 07/13/2018 to assess the wild trout population structure relative to the stream temperature regime. It is currently classified as a *Trout Production* stream and regulated as a *Wild Trout Stream*. A survey conducted over a mile upstream from this location in 2014 indicated abundant populations of wild Brook Trout and wild Brown Trout. The survey conducted in this location in 2015 and 2016 found that this section was dominated by larger trout of both species. There was a concern last year that the population of Brook Trout is low and may be struggling compared to the Brown Trout. Again, for a fourth year in a row, Brown Trout outnumbered the Brook Trout by a great deal. Encountered during this survey was a total of 7 wild Brook Trout ranging from 72-81 mm, all of which were YOY, and 24 Brown Trout ranging from 60 – 295 mm, including six YOY. A potential factor limiting Brook Trout success in Willoughby Brook may be the stream's sensitivity to climatic factors and their innate intolerance to thermal degradation (in preliminary analysis of stream temperature data in 2017, it was the most sensitive to air temperature changes in a subset of 5 of the 14 streams currently in the study).

Recommendation: This survey is part of a stream temperature study that is currently being conducted on 19 *Trout Production* streams. This stream will be monitored in this section for the next 1-2 years to study the relationship of stream temperature on wild trout life cycles in New Jersey and help guide in the management of our *Trout Production* streams. (Collenburg)

Stream Surveys in the Lower Delaware Region

(Assunpink Creek to Maurice River)

Rancocas Creek, N/Br. (trib.)(W. of Timbuctoo)

Date: 07/30/2018
County: Burlington
Township: Westampton Twp.
Drainage: Rancocas Creek
Project: Native Species Inventory
Location: Rancocas Road, downstream of trail culvert in Rancocas State Park.

Water Chemistry / Habitat

Water Temperature (°C):	20.6
Dissolved Oxygen (mg/L):	6.42
Specific Conductance (uS/cm):	318.2
pH:	7.44
Alkalinity (mg/L):	NA
Sample Length (m):	150
Habitat Assessment Score:	139 Sub-Optimal

Fish Species	Number	Length (mm)
Crappie, Black	1	0 - 0
Eel, American	16	0 - 0
Mudminnow, Eastern	12	0 - 0
Pickerel, Chain	2	0 - 0
Sunfish, Bluegill	26	0 - 0
Sunfish, Green	1	0 - 0
Sunfish, Pumpkinseed	37	0 - 0
Sunfish, Redbreast	3	0 - 0
Unknown Gambusia spp.	1	0 - 0

Summary: A single backpack electrofishing survey was conducted on 7/30/2018. A 150-meter stretch downstream of Rancocas Road located within Rancocas State Park was sampled. The primary goal of the survey was the collection and documentation of Ironcolor Shiners, a species soon to be designated state Endangered. This survey was intended to provide qualitive fish data (i.e. fish species present) and may not reflect the overall number of fish present in the sections survived. Bluegill, Pumpkinseed, Redbreast Sunfish, Green Sunfish, American Eel, Eastern Mudminnow, Black Crappie, Chain Pickerel, and unknown *Gambusia* sp. were encountered during the survey. Unfortunately, no Ironcolor Shiners were collected during this survey. Invasive Green Sunfish encountered during the survey were removed. Run time was 26 minutes.

Recommendation: This survey is part of an ongoing native fish study that is being conducted throughout the state. Additional sampling should be conducted over the next several years to determine the extent of Ironcolor Shiner distribution within the state. (Boehm)

APPENDIX B

Field Sampling Protocols
Lake Profiles and Wadeable Streams

Lakes – Dissolved Oxygen / Temperature Profiles

Most New Jersey lakes deeper than 3 m (10 ft) thermally stratify during the summer. The epilimnion (surface waters) becomes too warm to support coldwater fishes (trout), and the metalimnion and hypolimnion (middle and bottom waters), while often cold enough for trout, often have dissolved oxygen levels too low to support trout (and other fish species). Only deep lakes (generally at least 15 m (50 ft) deep), that are not overly eutrophic, maintain sufficient levels of dissolved oxygen in some portion of the strata below the epilimnion during the summer and early fall. New Jersey lakes are characteristically shallow and therefore most are too warm to support trout through the critical summer months. They are however quite suitable for a multitude of other cool and warmwater species. The criteria used to determine a lake's trout-supporting capabilities is water temperature $\leq$ 21ºC (69.8ºF) and dissolved oxygen $\geq$ 4 mg/L (Hamilton and Barno 2006).

Dissolved oxygen and temperature profiles are performed during mid–August at the deepest point of the impoundment using a YSI oxygen meter with cable marked in one-foot increments. Measurements are generally taken at 5 to 10-foot intervals, but more frequently (1-ft increments) when marked changes are observed (typically in the metalimnion). A secchi disk (also marked in one-foot increments) is used to measure water transparency.

For QA/QC purposes oxygen meters are re-verified on a monthly basis against a Winkler Titration of deionized water samples. The re-verification procedure is also repeated after any atypical field readings to verify the meter is functioning properly. Meters are field calibrated prior to each use according to the manufacturer specifications.

Wadeable Streams - Electrofishing

As with lakes the summer months are a critical time period for trout survival due to elevated temperatures, lower dissolved oxygen concentrations, and reduced flows. Streams are sampled from June through mid-September of each year using electrofishing gear. Electrofishing provides for the safe, effective sampling of resident fishes with limited associated mortality. Prior to 1980, A.C. electrofishing equipment was used to sample stream fish populations. This sampling gear consisted of two or three paddle-type electrodes powered by a gas generator and operated by a four to six-person crew (two or three electrode-bearers, one or two netters, and one generator operator). With technological advances in electrofishing gear, D.C. electrofishing equipment, powered by battery or generator, has been used almost exclusively since 1980. A battery-powered D.C. backpack unit, having one paddle-type electrode and used by an operator and one or two netters, has been in used since 1980 to sample small streams. On larger streams a gas generator is used in conjunction with a conversion box (to convert A.C. to D.C.), two or three electrodes, and a five to seven-person field crew.

The standard sampling distance, which has been used during and since the original stream surveys, is 182.9 meters (600 feet). This length was occasionally shortened when trout reproduction was found or when conditions such as an abundance of warmwater species or physical stream conditions indicated that trout would not be found. Occasionally a prospective stream or site would not be sampled based upon a visual, water temperature, or pH check that indicated conditions unsuitable for trout. Lack of water, excessive turbidity, temperatures in excess of 24°C, and extremely low pH values (4.0 or less) would result in sampling site rejection. Since 2001, in an effort to standardize data collection efforts across various research and field inventories a distance of 150 meters was established and is used on streams when young-of-the-year trout are encountered. Since the development of the Incidence of Occurrence was based on a sampling distance of 182 meters (600 feet) this distance is still used for classifying streams when young of the year trout are not encountered.

Sampling methods follow those outlined by Kurtenbach (Kurtenbach, 1994) and as defined in the EPA manual "Rapid Bioassessment Protocols for Use in Wadeable Streams and Rivers" (Barbour 1999) and are consistent, for comparative purposes, with data collection efforts for other Activities. All sites are sampled under typical stream flows during the months of June through September. Electrofishing gear is used to provide pulsed direct current to collect fishes. Settings on each of the stream units vary depending on the conductivity and flow conditions at each site, output usually ranges from 3 to 4 amperes. A typical backpack field crew consists of three persons, one to wear the backpack and netters. Stream widths exceeding the capabilities of one backpack unit are either sampled with two backpack teams traveling in tandem or with a two-paddle streamside generator. The type of unit selected is based upon stream width, depth, and contour of the stream environment. One up-stream pass is made through the sample stretch. The sample stretch length is 150 meters for streams having naturally reproducing

trout populations and 182 meters (600 feet) for *Trout Maintenance* or *Non-Trout* waters. Sampling time averages approximately 2.5 hours per site.

All fish encountered are collected without bias to species or size. Fishes with lengths greater than 20 mm are identified to the species level, counted, and examined for disease or anomalies. Anomalies such as visible lesions, tumors, skeletal anomalies, and fin damage may be an indication of impaired conditions. Any obvious injuries due to electrofishing are noted, but not considered anomalies. Total length measurements are taken on all trout and other game species. Retained specimens are preserved in 10% formalin solution in the field. Specimens are then transferred to a 70% ethanol solution for long-term preservation 2-3 weeks after initial collection.

In addition to fish collection, basic physical and chemical parameters of the stream environment are also measured and recorded on the Bureau's Stream Survey Data Sheet. All physical and chemical data are collected one-time-only, thus no long-term data is collected. Physical parameters included stream depth, stream width, substrate type, and shade index. YSI Model 85 and YSI Model 60 meters are used to determine chemical parameters such as dissolved oxygen, temperature, salinity, conductivity, and pH. For QA/QC purposes oxygen meters are re-verified on a monthly basis against a Winkler Titration of deionized water samples. The re-verification procedure is also repeated after any atypical field readings to verify the meter is functioning properly. Meters are field calibrated prior to each use according to the manufacturer specifications. Alkalinity and specific conductance data have been collected since 2002. In-house laboratory staff determine alkalinity via titration. The reference temperature and temperature coefficient for specific conductance are 25°C and 1.91% respectively.

A stream habitat assessment is also conducted at each site, in accordance with criteria established by the EPA (EPA 1999). The habitat assessment is intended to evaluate various aspects of the aquatic habitat, surrounding terrestrial environment, and potential anthropogenic factors that may impact the aquatic biota of the stream. Habitat Assessments have been designed for two stream types - high gradient (riffle/run prevalent) and low gradient (glide/pool prevalent) streams. High Gradient Habitat Assessments are conducted on most streams north of the Fall line, in the Piedmont, Highlands, and Appalachian Valley and Ridge physiographic provinces. Natural high-gradient streams have substrates composed primarily of coarse sediment particles (i.e. gravel or larger) or frequent coarse particulate aggregations along stream reaches. Low gradient habitat assessments are conducted on streams in the Coastal Plain and in other moderate to low gradient landscapes. Natural low gradient streams have substrates of fine sediment or infrequent aggregations of more coarse (gravel of larger) sediment particles along stream reaches. Data are recorded on the Bureau's High Gradient Habitat Assessment Data Sheet and Low Gradient Habitat Assessment Data Sheet (Appendix B).

For the habitat assessment, ten specific physical parameters are assessed. For a low gradient stream the parameters are: epifaunal substrate, pool substrate, pool variability, sediment deposition, channel flow status, channel alteration, channel sinuosity, bank stability, vegetative protection, and riparian vegetative zone width. The assessment for a high gradient stream substitutes pool substrate, pool variability, and channel sinuosity with embeddedness, velocity/depth regime, and frequency of riffles or bends. The first five parameters of each assessment are assessed within the stretch of the stream electrofished. Assessments of the five remaining variables are based upon a larger stream reach that extends 150 meters upstream and downstream of the electrofished stretch. Each assessment variable is divided into four condition categories: optimal, sub-optimal, marginal, and poor, each with established criteria. Twenty points are allotted for each of the ten variables resulting in a maximum score of 200. The left and right banks of a stream, determined by facing downstream, are assessed separately for bank stability, vegetative protection, and riparian vegetative zone width. Biologists from the Bureau of Freshwater Fisheries have received habitat assessment training from EPA staff.

APPENDIX C

Habitat Assessment Data Sheets

NJ Division of Fish and Wildlife
Bureau of Freshwater Fisheries

Habitat Assessment - Datasheet
High Gradient Streams

Stream Name	Date
Location	
WMA	Drainage
Assessment Completed By:	Weather

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

Above parameters are to be evaluated for the length of the sample reach only.

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

Above parameters are to be evaluated 1 sampling length broader upstream and 1 sampling length broader downstream

TOTAL SCORE ☐

NJ Division of Fish and Wildlife

Bureau of Freshwater Fisheries

Habitat Assessment - Datasheet

Low Gradient Streams

Fish and Wildlife

Stream Name		Date
Location		
WMA	Drainage	
Assessment Completed By:	Weather	

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
1.Epifaunal Substrate **Available Cover**	Greater than 50% of substrate favorable for epifaunal colonization and fish cover; mix of snags,submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e. logs/snags that are not new fall and not transient)	30-50% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale)	10-30% mix of stable habitat;habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 10% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
2. Pool Substrate	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud or clay; mud may be dominant; some root mats and submerged vegetation present	All mud or clay or sand bottom; little or no root mat;no submerged vegetation	Hard-pan clay or bedrock;no root mat or vegetation
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
3. Pool Variability	Even mix of large-shallow (> half the stream cross section and < 1 m deep), large-deep(> half the stream cross section and > 1 m deep), small shallow (< half the stream cross section and < 1 m depth), small-deep (< half the stream cross section and > 1m depth) pools present.	Majority of pools large deep; very few shallow pools present (< 1 m in depth)	Shallowpools (< 1 m depth) much more prevalent than deep pools (> 1 m depth)	Majority of pools small and shallow (< half the stream cross section and < 1m in depth) or pools absent.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 20 % of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 20-50% of the bottom affected; slight deposition in pools	Moderate depostion of new gravel, sand or fine sediment on old and new bars; 50-80% of the bottom affected;sediment deposits at obstructions, constrictons and bends;moderate deposition of pools	Heavy deposits of fine material, increased bar development;more than 80% of the bottom changing frequently;pools almost absent due to substantial sediment deposition.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills > 75% of the available channel; or < 25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present in standing pools
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1

Above parameters are to be evaluated for the length of the sample reach only.

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
6.Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern	Some channelization present;usually in areas of bridge abutments;evidence of past channelization, ie. dredging (greater than past 20 yr) may be present but recent channelization is not	Extensive channelization and/or embankments or shoring structures present on both banks; and 40-80% of the stream reach is channelized and disrupted.	Banks shored with gabion or cement;over 80% of the stream reach channelized and disupted. Instream habitat greatly altered or removed entirely.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
7. Channel Sinuosity	The bends in the stream increase the stream length 3 to 4 times longer than if it was a straight line. (Note-channel braiding is considered normal in coastal plains and other low lying areas. This parameter is not easily rated in these	The bends in the stream increase the stream length 1 to 2 times longer if it was in a straight line.	The bends in the stream increase the stream length 1 to 2 times longer if it was in a straight line.	Channel straight; waterway has been channelized for a long distance.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
8. Bank Stability Left and right bank determined by facing downstream	Banks stable:evidence of erosion or bank failure absent or minimal;little or potential for future problems. < 5% of the bank affected	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion;high erosion potential during floods.	Unstable;many eroded areas:"raw" areas frequent along straight sections and bends;obvious bank sloughing;60-100% of bank has erosional scars.
SCORE **Left Bank**	10 9	8 7 6	5 4 3	2 1 0
SCORE **Right Bank**	10 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protection	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or non woody macrophytes;vegetative disruption through grazing or mowing minimal or not evident;almost all plants allowed to grow naturally	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well represented;disruption evident but not affecting full growth potential to any great extent;more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation;disruption obvious;patches of bare soil or closely cropped vegetation common;less than one-half of the potential plant stubble height remaining.	Less than 50 % of the streambank surfaces covered by vegetation;disruption of streambank is very high;vegetation has been removed to 5 cm or less in average stubble height.
SCORE **Left Bank**	10 9	8 7 6	5 4 3	2 1 0
Right Bank	10 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width	Width of riparian zone > 18 meters;human activities (i.e. parking lots, roadbeds, clear cuts, lawns or crops) have not impacted zone.	Width of riparian zone 12-18 meterts;human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters;human activities have impacted zone agreat deal.	Width of riparian zone < 6 meters; little or no riparian vegetation due to human activities.
SCORE **Left Bank**	10 9	8 7 6	5 4 3	2 1 0
Right Bank	10 9	8 7 6	5 4 3	2 1 0

Above parameters are to be evaluated 1 sampling length broader upstream and 1 sampling length broader downstream

TOTAL SCORE ☐

APPENDIX D
List of New Jersey Freshwater Fishes

(Revised 2016)

Scientific Name	Common Name	Trophic Guild	Tolerance	Historical Presence	Status Pending
Petromyzontidae:					
Lampetra appendix	American Brook Lamprey	NF	IS	N	SC
Petromyzon marinus	Sea Lamprey	PF	MT	N	S
Acipenseridae:					
Acipenser brevirostrum	Shortnose Sturgeon	BI	IS	N	E
Acipenser oxyrhynchus	Atlantic Sturgeon	BI	IS	N	E (FED)
Lepisosteidae:					
Lepisosteus osseus	Longnose Gar	P	M	EX	NA
Amiidae:					
Amia calva	Bowfin	P	TS	NN	NA
Anguillidae:					
Anguilla rostrata	American Eel	P	TS	N	S
Monopterus albus	Asian Swamp Eel	G	TS	E	I
Clupeidae:					
Alosa aestivalis	Blueback Herring	PL	MT	N	NE
Alosa mediocris	Hickory Shad	I/P	US	N	NE
Alosa pseudoharengus	Alewife	PL	MT	N	NE
Alosa sapidissima	American Shad	PL	MT	N	NE
Drosoma cepedianum	Gizzard Shad	G	TS	N	NE
Salmonidae:					
Oncorhynchus mykiss	Rainbow Trout	I/P	IS	NN	NA
Salmo salar	Atlantic (Landlocked)	P	IS	NN	NA
Salmo trutta	Brown Trout	I/P	IS	E	NA
Salvelinus fontinalis	Brook Trout	I/P	IS	N	SC
Salvelinus namaycush	Lake Trout	P	IS	NN	NA
Osmeridae:					
Osmerus mordax	Rainbow Smelt	I	IS	N	NE
Umbridae:					
Umbra pygmaea	Eastern Mudminnow	I	TS	N	S
Channidae					
Channa Argus	Northern Snakehead	P	TS	E	I

Scientific Name	Common Name	Trophic Guild	Tolerance	Historical Presence	Status Pending
Esocidae:					
Esox americanus	Redfin Pickerel	P	MT	N	S
Esox lucius	Northern Pike	P	IS	NN	NA
Esox masquinongy	Muskellunge	P	IS	NN	NA
Esox niger	Chain Pickerel	P	MT	N	S
Cyprinidae:					
Carassius auratus	Goldfish	G	TS	E	NA
Carpiodes cyprinus	Quillback	BI	TS	N	S
Cyprinus carpio	Common Carp	G	TS	E	NA
Exoglossum maxillingua	Cutlip Minnow	BI	IS	N	S
Hybognathus regius	Eastern Silvery Minnow	H	MT	N	S
Notemigonus crysoleucas	Golden Shiner	G	TS	N	S
Notropis amoenus	Comely Shiner	I	TS	N	SC
Cyprinella analostana	Satinfin Shiner	I	TS	N	S
Cyprinella spiloptera	Spotfin Shiner	I	TS	N	S
Margariscus margarita	Pearl Dace	G	MT	NN	NA
Notropis bifrenatus	Bridle Shiner	I	IS	N	E
Notropis chalybaeus	Ironcolor Shiner	I	IS	N	E
Luxilis cornutus	Common Shiner	I	MT	N	S
Notropis husdonius	Spottail Shiner	I	MT	N	S
Notropis procne	Swallowtail Shiner	I	MT	N	S
Pimephales notatus	Bluntnose Minnow	G	TS	NN	NA
Pimephales promelas	Fathead Minnow	G	TS	NN	NA
Rhinichthys atratulus	Blacknose Dace	BI	TS	N	S
Rhinichthys cataractae	Longnose Dace	BI	MT	N	S
Semotilus atromaculatus	Creek Chub	I	TS	N	S
Semotilus corporalis	Fallfish	I	MT	N	S
Ctenopharyngodon idella	Grass Carp	H	MT	E	I
Catostomidae:					
Catostomus commersoni	White Sucker	BI	TS	N	S
Erimyzon oblongus	Creek Chubsucker	BI	MT	N	S
Hypentelium nigricans	Northern Hog Sucker	BI	IS	N	SC
Ictaluridae:					
Ameiurus catus	White Catfish	I/P	MT	N	S
Ameiurus melas	Black Bullhead	BI	MT	NN	NA
Ameiurus natalis	Yellow Bullhead	BI	MT	N	S
Ameiurus nebulosus	Brown Bullhead	BI	TS	N	S
Ictalurus punctatus	Channel Catfish	I/P	MT	NN	NA
Noturus gyrinus	Tadpole Madtom	BI	MT	N	S
Noturus insignis	Margined Madtom	BI	IS	N	S
Pylodictis olivaris	Flathead Catfish	P	TS	NN	I
Aphredoderidae:					
Aphredoderus sayanus	Pirate Perch	I	MT	N	S

Scientific Name	Common Name	Trophic Guild	Tolerance	Historical Presence	Status Pending
Cyprinodontidae:					
Fundulus diaphanus	Banded Killifish	I	TS	N	S
Fundulus heteroclitus	Mummichog	I	TS	N	S
Poeciliidae:					
Gambusia affinis	Mosquitofish	I	TS	NN	NA
Gambusia holbrooki	Eastern Mosquitofish	I	TS	N	U
Gasterosteidae:					
Apletes quadracus	Fourspine Stickleback	I	MT	N	NE
Gasterosteus aculeatus	Threespoine Stickleback	I	MT	N	NE
Pungitius pungitius	Ninespine Stickleback	I	MT	N	NE
Moronidae:					
Morone americana	White Perch	I/P	MT	N	S
Morone saxatilis	Striped Bass	P	MT	N	U
Centrarchidae:					
Acantharchus pomotis	Mud Sunfish	I	MT	N	SC
Ambloplites rupestris	Rock Bass	I/P	MT	NN	NA
Enneacanthus chaetodon	Blackbanded Sunfish	I	IS	N	SC
Enneacanthus gloriosus	Bluespotted Sunfish	I	IS	N	S
Enneacanthus obesus	Banded Sunfish	I	IS	N	S
Lepomis auritus	Redbreast Sunfish	I	MT	N	S
Lepomis cyanellus	Green Sunfish	I/P	TS	NN	I
Lepomis gibbosus	Pumpkinseed	I	MT	N	S
Lepomis gulosus	Warmouth	I/P	TS	NN	NA
Lepomis macrochirus	Bluegill	I	TS	NN	NA
Micropterus dolomieu	Smallmouth Bass	I/P	MT	NN	NA
Micropterus salmoides	Largemouth Bass	P	MT	NN	NA
Pomoxis annularis	White Crappie	I/P	TS	NN	NA
Pomoxis nigromaculatus	Black Crappie	I/P	MT	NN	NA
Percidae:					
Etheostoma fusiforme	Swamp Darter	BI	IS	N	S
Etheostoma olmstedi	Tessellated Darter	BI	MT	N	S
Perca flavescens	Yellow Perch	I/P	MT	N	S
Percina peltata	Shield Darter	BI	IS	N	SC
Sander vitreus	Walleye	P	IS	NN	NA
Cottidae:					
Cottus cognatus	Slimy Sculpin	BI	IS	N	T
Cobitidae:					
Misgurnus anguillicaudatus	Oriental Weatherfish	G	TS	E	I
Soleidae:					
Trinectes maculatus	Hogchoker	G	IS	N	NE

Key:

Abbrev.	Term	Definition
Trophic Guild		
BI	Benthic	Specialist feeder that primarily consumes insects taken from the bottom substrate.
H	Herbivore	A species that consumes plant and algae materials.
I	Insectivore	A species that consumes primarily insects.
NF	Nonparasitic	A species that feeds by filtering algae and other microorganisms found in detritus.
G	Generalist	A species that consumes a wide variety of food types from a wide variety of habitats.
P	Piscivore	A species that primarily consumes fish.
PF	Parasitic	A species that feeds by attaching to and rasping a hole in the side of a large fish.
PL	Planktivore	A species that consumes small organisms (algae and animals) that float in the water column.
Historical Presence		
E	Exotic	A non-native species introduced from a foreign country.
EX	Extirpated	A native species no longer present, either as a result of natural causes or because of eradication by humans.
N	Native	In the U.S., a species historically occurring in a geographic range previous to the arrival of the first European settlers.
NN	Non-Native	A species found outside of their historical range. The occurrence of a non-native species may be a result of intentional stocking (sportfish or biological control), unintentional stocking (escape), or a response to habitat/climatic changes.
Tolerance		
IS	Intolerant Species	A species most sensitive to environmental degradation. These species have historical distributions significantly greater than presently occurring populations.
MT	Moderately Tolerant Sp.	A species moderately sensitive to environmental degradation. These species can withstand slight environmental conditions, but can not tolerate significant impact.
TS	Tolerant Species	A species least sensitive to environmental degradation. These species can withstand stressful environmental conditions and often become a dominant member in the fish assemblage.
Status (Formal status review completed and approved by ENSAC in 2016, but not yet implemented into formal regulation.)		
E	Endangered	A species whose prospects for survival within the state are in immediate danger due to one or several factors and likely requires immediate action to avoid extinction within NJ.
T	Threatened	A species that may become Endangered if conditions surrounding it begin to or continue to deteriorate, thus is one that is already vulnerable.
SC	Special Concern	A species that warrants special attention because of inherent vulnerability to environmental deterioration or habitat modification that would result in their becoming Threatened if conditions surrounding the species begin or continue to deteriorate.
S	Secure/ Stable	A species that appear to be secure in NJ and not in any immediate foreseeable danger of becoming Endangered, Threatened, or Special Concern.
NA	Not Applicable	This species does not occur in NJ with regularity or predictability. (ie. Extirpated or Non-native).
NE	Not Evaluated	A species not evaluated as part of the recent species evaluation, due to significant life-history component in brackish/marine habitats.
I	Invasive	A non-native species that has the potential to cause ecologic or economic harm, identified as a Potentially Dangerous Fish Species in N.J.A.C. 7:25-6.2. (2010)
Miscellaneous		
U	Undetermined / Unknown	A species in which not enough information exists on which to base a judgement.

Big Flat Brook / Flat Brook Stocked Trout Radio Telemetry Movement Study (2018)

Investigations and Management of New Jersey's Freshwater Fisheries Resources (APPENDIX E)

By
Ross Shramko, Senior Fisheries Biologist

December, 2018

New Jersey Department of Environmental Protection

Division of Fish and Wildlife

Bureau of Freshwater Fisheries

Sportfish Restoration Grant F-48-R

This grant was paid for by fishing license sales and matching Dingell-Johnson/Wallop-Breaux funds available through the Federal Sportfish Restoration Act.

Stocked Trout Movement Study in the Big Flat / Flat Brook Catch and Release Area

Beginning in 2017, the NJ Division of Fish and Wildlife (NJDFW) initiated a Stocked Trout Movement Study using radio telemetry, where a total of 80 Rainbow Trout were tagged and stocked in the *Catch and Release Area* of the Big Flat Brook / Flat Brook system to determine if the stocked trout were leaving the *Catch and Release Area* and/or possibly leaving the Flatbrook system entirely. Forty tagged trout were stocked beginning in April of 2017 and an additional forty tagged trout were stocked beginning in April of 2018. NJDFW partnered with Montclair State and their School of Conservation for the 2018 portion of this study. The following bullets are highlights from this two-year study.

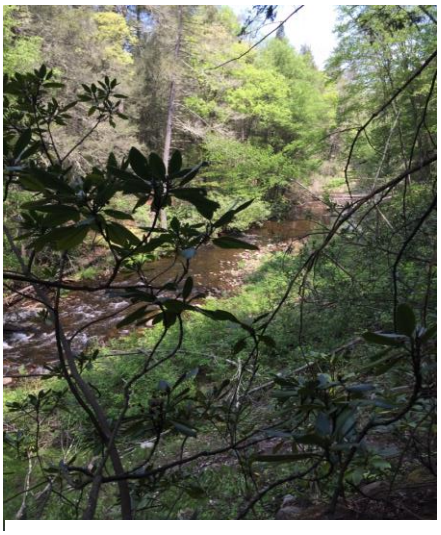
- 70 of the 80 transmitters returned reliable data and were included for analysis.
- 2017 and 2018 data were very similar, with little statistical variation between the years despite the differing variable stream temperatures and flows between the years.
- 68 of 70 trout included for analysis remained within the boundaries of the *Catch and Release Area*. No trout left the Flat Brook system entirely.
- The furthest distance a tagged trout moved from its stocking location ranged from 0 miles to 1.85 miles with an average of 0.295 miles (0.28 miles in 2017 and 0.31 miles in 2018).
- The total distance an individual trout moved ranged from 0 to 1.91 miles with an average distance moved of 0.395 miles (0.45 miles in 2017 and 0.34 miles in 2018).
- Six total fish moved a mile or more from their original stocking location (3 in 2017 and 3 in 2018).
- All 70 transmitters included for analysis were found outside of a trout or were taken away from the stream before the predicted battery life of the transmitters expired (<230 days). Loss was attributed to predation from Great Blue Herons, Common Mergansers, Mink, Otters, and/or other forms of natural predation.
- Overall, it was determined that 32 transmitters were lost due to avian predation and 38 transmitters were most likely lost to mammal predation, but other predation types were possible.
- The number of confirmed days alive (release to termination) ranged from 3 days to 122 days in 2017 and from 1 day to 121 days in 2018.
- The average number of days a trout remained alive after it was stocked was 48.5 days (52 in 2017 and 45 in 2018).

Introduction

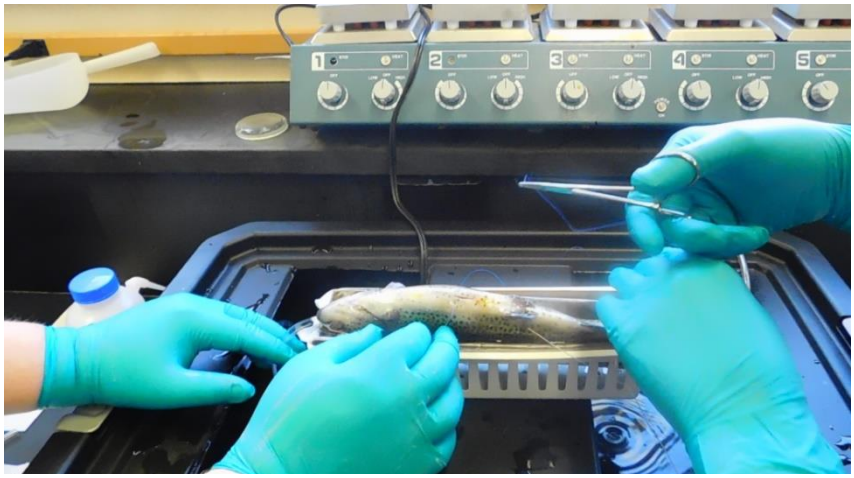
The Big Flat Brook / Flat Brook is located in the northwestern portion of New Jersey in Sussex County. Its headwaters originate out of Saw Mill Pond in Montague Township Sussex County and terminate at its confluence with the Delaware River in Walpack Township Sussex County. Along the way, the Big Flat Brook joins with the Little Flat Brook and the two streams from this point forward are known as the Flat Brook. The portion of stream where this stocked trout telemetry study took place is both upstream and downstream of the confluence with the Little Flat Brook in both the Big Flat Brook and the Flat Brook sections.

The Flat Brook watershed is one of New Jersey's most intact watersheds. Although impacted by logging throughout its history, the Flat Brook watershed has not been subjected to the same impacts from urbanization that many other watersheds in the state have succumbed to. The majority of the

stream flows through multiple state parks and federally protected lands that have kept urban development restricted. While walking along the stream, one can feel the remoteness of this area and many anglers will fish and spend time on the Flat Brook just for the scenery and remoteness the Flat Brook elicits. The watershed is 93% forested and 2.5% agriculture with a very small amount of the remaining 4.5% as urban. Many of the tributaries that flow into the Flat Brook system are classified as *Trout Production* and have reproducing Brook Trout found within. This classification is obtained by the simple fact that biologists have documented reproducing trout in them. The *Trout Production* classification gives the highest protection to the stream from development and other impacts by keeping the riparian buffers intact. The mainstem Big Flat Brook originates at Sawmill Pond and is classified as *Non-Trout* as the water is too warm to support trout year-round and therefore no reproduction has been found to occur. This *Non-Trout* classification continues for about 6.5 miles downstream to a point located in Stokes State Forest where electrofishing sampling has documented trout reproduction in the mainstem Big Flat Brook. From this point to an area known as Three Bridges, the Big Flat Brook is classified as *Trout Production*. From the Three Bridges location to the confluence with the Delaware River the Big Flat Brook / Flat Brook is classified as *Trout Maintenance*, which means that the waterbody has temperatures suitable to hold trout over throughout the summer months, but trout reproduction has not been documented.



Picturesque view of Big Flat Brook in Sussex County



Anesthetized Rainbow Trout from the Pequest Trout Hatchery being surgically implanted with radio transmitter.

The Big Flat Brook / Flat Brook is part of the NJDFW's Spring and Fall Trout Stocking Programs. It is considered one of the state's most popular stocked trout waters and falls under a special regulation created due to the popularity of the streams found in this category, where the water is closed to fishing until 5:00pm on the day that it is stocked. The Big Flat Brook / Flat Brook is allocated 34,000 trout in the spring, which is the 3rd most trout allocated waterbody in New Jersey behind the Musconetcong River and the South Branch of the Raritan River. The Big Flat Brook / Flat Brook and the South Branch of the Raritan River have the only *Catch and Release Areas* in the state. These *Catch and Release Areas* were created in 2014 to give anglers a place where stocked trout cannot be harvested and in theory, these areas will have more fish available to anglers for recreation year-round. Although the Big Flat Brook / Flat Brook has wild trout reproduction, is allocated the third most stocked trout in the state's trout stocking program and has a *Catch and Release Area*, angler success has not always been very good. Many anglers annually call NJDFW and complain about the lack of fish found throughout the Flat Brook. NJDFW biologists have

also been surprised by the low numbers of trout found in many electrofishing surveys conducted throughout the Flat Brook watershed over time.

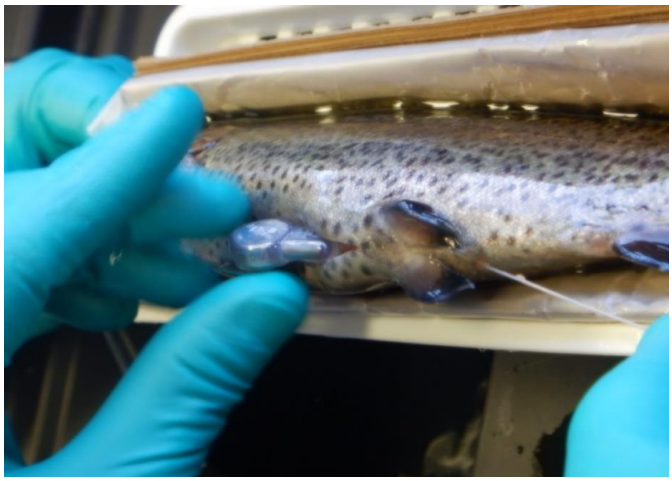
Beginning in 2012, NJDFW began collecting data to establish a baseline in what would ultimately become the *Catch and Release Area*. The *Catch and Release Area* begins at Route 206 and continues downstream to the Roy Bridge found in the Flat Brook / Roy Wildlife Management Area. Four 150-meter backpack electrofishing surveys were done annually to aid NJDFW biologists with baseline data to evaluate the effects of this regulation change beginning in 2012 and continuing until 2017. These surveys were conducted in the summer months as with standard operating procedure of electrofishing sampling. As with previous surveys done throughout the Flat Brook, biologists found less trout than expected in a waterbody that should be able to hold trout throughout the year. It was hypothesized that after the *Catch and Release Area* regulation went into effect, during the spring of 2014, that the four annual electrofishing surveys would show an increase in the number of stocked trout found throughout the survey locations. This unfortunately did not occur. After five years of study, it became clear that stocked trout were not holding throughout the *Catch and Release Area* in good numbers. Some trout may be utilizing deep, non-wadable, very difficult to sample pools in the stream, while other trout may be migrating out of the *Catch and Release Area* outright or are subject to high predation rates.

To help biologists understand if and when trout might be migrating out of the *Catch and Release Area*, six additional surveys were conducted in 2016 and one in 2017. These seven additional surveys were very different than the typical standardized 150m surveys conducted previously. In an attempt to sample a larger area, these surveys covered a total of 1,200 nearly contiguous meters, with only few pools throughout the 1,200m that were too deep to sample with backpack electrofishing units. In these deeper pools, visual observations of the trout were counted. These surveys occurred in May and June, much closer to the spring trout stocking, in hopes to find an increased number of stocked trout. Although biologists found an increase in overall stocked trout per 100m during the 1,200m surveys in comparison with the summer time 150m surveys, the total number of trout per 100m was still far below what would be expected in a *Catch and Release Area* after receiving a spring stocking seasons worth of trout. Biologists also found far less trout than the comparable *Catch and Release Area* on the South Branch of the Raritan River, where biologists are seeing an increase in stocked trout per 100m since the regulation went into effect.

So, what is happening to the stocked trout in the Big Flat Brook / Flat Brook system? It is a possibility that the trout are swimming long distances and leaving the *Catch and Release Area* outright and possibly even leaving the Flat Brook system entirely. It is also possible that the trout are remaining in the *Catch and Release Area* in deep pools where electrofishing equipment cannot collect these fish. It is also possible that these trout are not migrating out from where they were stocked, but being lost to some sort of predation. To help answer these questions, NJDFW staff implemented a two-year trout telemetry study in the *Catch and Release Area* on the Big Flatbrook / Flat Brook that began in the spring of 2017. NJDFW partnered with Montclair State and the School of Conservation for the 2018 portion of this study. A graduate student, who will also be using this study for a portion of his graduate thesis, performed all the data collection in 2018.

Methods and Materials

A total of 40 radio telemetry transmitters per year were surgically implanted into 40 Rainbow Trout from the Pequest Trout Hatchery for a total of 80 tagged trout. Twenty radio tagged trout were released on April 12, 2017, one week after opening day of the 2017 trout fishing season. By waiting until after opening day of the trout season, the radio tagged trout were not influenced by the increased number of anglers and fishing pressure that occurs on the opening day, the busiest day of the entire trout season. Twenty more radio tagged trout were released about a month later on May 17, 2017. This format was again followed in 2018. The difference in stocking periods will allow for analyzing the potential effects of flow and temperature between the two stocking periods. By duplicating the study a second year, we can be more confident with the results due to the larger sample size. It also allows for analysis of data under possibly much different stream conditions as streams are very dynamic and can differ greatly from year to year. There was an attempt to find each tagged fish daily for the first two weeks after each stocking period and every other day after the first two-week period for the remainder of the study. In addition to actively searching for tagged fish, an un-manned station was deployed near the confluence with the Delaware River to record any tagged fish that were about to leave the Flat Brook system entirely. This un-manned station was moved to just downstream of the *Catch and Release Area* partway through 2017 and was placed at this same location throughout the 2018 portion of this study. This un-manned station surveyed the immediate area of the station for any transmitter 24 hours a day, 7 days a week.



Radio transmitter surgically implanted into Rainbow

The Advanced Telemetry Systems F-1580 implant transmitters were surgically implanted in each trout one day prior to each stocking event. The tagged trout were held at the Pequest Hatchery in a portioned off section of raceway overnight. This overnight period allowed for the possible drops of transmitters from possible suture failure and to make sure that each fish came out of the surgery healthy and ready for release. Each transmitter weighed 3.6 grams, about 2% of the overall weight of the trout. This is below the accepted weight determined by other radio telemetry studies that would not substantially impact the movement or behavior of the tagged trout. The study was scheduled to conclude about 230 days after stocking, when the batteries of the transmitters were projected to fail.

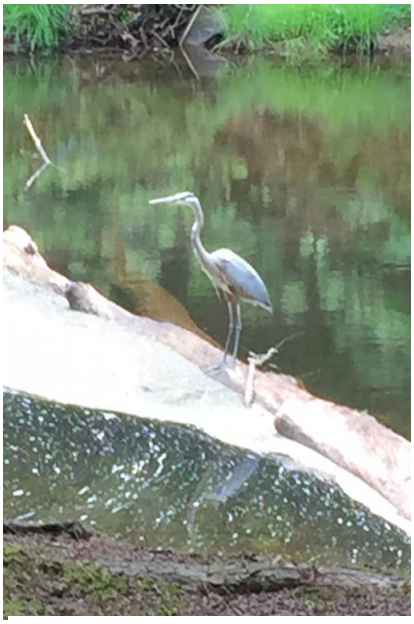
Radio tagged trout being stocked into Catch and Release Area of Big Flat Brook

Individual trout were selected from the production line of the Pequest Trout Hatchery. The average length of trout

implanted was 10.5 inches and weighed on average 0.5 lbs. each. Each fish was anesthetized using MS-222 (Tricaine-S, tricaine methanesulfonate). After the fish was completely anesthetized, the fish was turned upside down and placed on a surgical board to hold the fish in place. A tube with flowing water was inserted in the mouth to allow the fish to "breath," and the abdomen was sterilized with iodine. A ½ inch incision was made in the abdomen and a curved needle was placed in the incision and poked through the side of the trout. The tag end of the antenna was threaded into the needle and then the needle, with the tag end of the antenna, was pulled through the side of the trout. The body of the tag was then placed into the abdominal cavity. Next the incision was closed with two non-absorbable sutures. After surgery was complete, the trout were allowed to recover overnight in a separated area of the hatchery to see how they woke up from the anesthesia and to make sure the transmitters did not fall out of the sutured area. The following morning the trout were loaded onto a truck with a transport tank and stocked in the study area at three different locations.

After each fish was stocked, an attempt to locate each fish was made daily for the first two weeks and about every other day after the first two weeks from each stocking event. To locate each fish, staff walked to the last known location of each fish, scanning for a signal. Once a signal was found, staff determined, to the highest accuracy possible, where exactly the signal was coming from. Locations could usually be determined down to the habitat level. Locations such as head of pool, a riffle below a pool, a root ball, or some other micro habitat level were used to describe exact locations of the fish. If at all possible, visually determining if the signal was still coming from a live fish and not a dropped transmitter was performed and recorded. The latitude / longitude reading of each location was recorded using handheld Garmin GPS unit. If a fish had not moved from a known location for several days and it could not be determined to still be a live fish visually, an attempt to move the fish around in a pool by wading into the pool was done to determine if the signal was emulating from a live fish or a dropped tag. This proved to be very difficult depending on the depth of the pool and in many cases a determination could not be made.

If a transmitter could not be found near the last known location, staff then searched the entire length of the Flat Brook system upstream and downstreamof the last known location by scanning for the signal. An attempt to search the entire river system from Sawmill Pond to the confluence with the Delaware River was performed each time a transmitter signal was lost, but there were a few locations where staff could not get close enough to the river to pick up a signal if the fish was located there. The un-manned station was also checked each day to see if the fish passed by. Staff used kayaks and floated remote areas when the river could not be accessed by vehicle or by foot. If there still was no sign of the lost transmitter, staff would drive around the roads throughout the Flat Brook watershed scanning for lost signals, focusing on known Great Blue Heron rookeries. Earlier lost transmitters were scanned each time that was spent driving the roads looking for a newly lost transmitter. Upon finding a lost transmitter signal, the signal was tracked to the location it is transmitting from and a determination of how the transmitter ended up where it was found was made. Was it moved there and dropped by a bird? Was there evidence that the transmitter was chewed on by a mammal?



A Great Blue Heron hunting for a meal on the Big Flat Brook

Results

In 2017 the study lasted a total of 149 days. All 40 transmitters were either lost or found outside of a fish by 9/11/17. Several days were spent looking for lost transmitters after the last known fish was found dead. In 2018, the study lasted a total of 129 days. All 40 transmitters were either lost or found outside of a fish by 8/24/18. In both years of the study, it was far shorter than the 230 possible days of battery life. It was determined that a lost / missing signal was not due to battery life ending, but due to some sort of predator removing the fish and transmitter from the stream area, due to the calculation that only a little over half of the predicted battery life or less had passed when each signal went missing.

Twenty-nine total transmitters were lost and assumed taken away from the stream beyond the distance of the receiving equipment and could not be located (2017 = 16, 2018 = 13). Other telemetry studies have shown reliability in the transmitters with a less than 1% failure rate. Therefore, all lost transmitters were believed to have been taken away from the stream by predation and not to transmitter failure. These fish were most likely eaten by birds and flown away from the stream.

A dropped radio transmitter found among fish scales and bones. An obvious sign of mammal predation

Forty-six transmitters were found and recovered (24 in 2017 and 22 in 2018). Some of these were found on land by the remains of trout, in scat piles, or found in a mammal runs or den like areas. Three transmitters were tracked to, but not recovered at a Great Blue Heron rookery. These transmitters were likely eaten by Great Blue Herons and regurgitated or excreted at these locations. Nine transmitters were found after some time at the exact location as to where they were stocked (5 in 2017 and 4 in 2018). High flows and deep water made it difficult to determine when these tags were dropped and how that came to be. Due to not being able to determine if these tags were just simply dropped by the trout or if predation was the reason or when the predation event or dropping occurred, these nine transmitters were not used in any analysis for this study. In addition to these nine, one fish did not look right after stocking and was found dead the next day. This fish was also dropped from the analysis leaving a total of 70 radio tagged fish for analysis. Overall, it was determined that 32 transmitters were lost due to avian predation and 38 transmitters were lost due to most likely mammal predation, but other predation types were possible. Individual tagged trout confirmed days alive since their stocking event ranged from 3 days to 122 days in 2017 and from 1 day to 121 days in 2018. The average number of days a trout remained alive after it was stocked was 48.5 days (52 in 2017 and 45 in 2018).

Initial movement from each of the three stocking points was recorded. 41 tagged trout's initial movements were downstream (19 in 2017 and 22 in 2018), 13 were upstream (10 in 2017 and 3 in 2018), and 16 trout did not move from their stocking location but were determined to still be alive at least a week after stocking (6 in 2017 and 10 in 2018). The number of days each trout spent at their stocking location before moving ranged from 0 days to 121 days with an average of 15.5 days before moving (12 in 2017 and 19 in 2018). The furthest distance a tagged trout moved from its stocking location ranged from 0 miles to 1.85 miles with an average of 0.295 miles (0.28 miles in 2017 and 0.31

miles in 2018). The total distance an individual trout moved ranged from 0 to 1.91 miles with an average distance moved of 0.395 miles (0.45 miles in 2017 and 0.34 miles in 2018). Six total fish moved a mile or more from their original stocking location (3 in 2017 and 3 in 2018).

Discussion

Radio tagged trout from the Big Flat Brook Telemetry Study. Notice the silver antenna trailing behind the trout.

This movement study was initiated to explain why biologists and anglers are not finding the expected numbers of stocked trout in the Big Flat Brook / Flat Brook *Catch and Release Area* especially compared to New Jersey's only other *Catch and Release Area*, the Ken Lockwood Gorge, South Branch of the Raritan River where anglers and biologists are finding expected numbers of stocked trout. There were a few main questions this study set out to answer. The first was, "Are fish stocked in the *Catch and Release Area* leaving the Flat Brook system entirely and entering the Delaware River?" The data collected through this study confirmed that the trout are **not** leaving the Flat Brook watershed by swimming into the Delaware River. The un-manned recording station was positioned near the confluence with the Delaware River and it did not record a single radio tagged trout in its vicinity. To make sure equipment was working correctly, the un-manned station was tested by manually moving a transmitter into the area of the un-manned station. The test transmitter was properly recorded and stored in the un-manned station's log, confirming that it was working properly. The un-manned station was moved to just outside of the *Catch and Release Area* for 2018 and still did not record much movement (1 trout moved beyond the location of the un-manned station by a few 100 yards). The fact that trout are not leaving the Big Flat Brook and heading into the Delaware River is good news for anglers and the NJDFW's trout stocking program, because it means that trout are not making large scale movements and leaving the Flatbrook system, on their own accord. This means that trout are potentially remaining available to anglers at intended locations.

Trout carcass found on the bank of the Big Flat Brook. This fish once was likely implanted with a radio transmitter. Notice hole in skin where an antenna

A second question this movement study was designed to answer was, "Are the stocked trout leaving the *Catch and Release Area*, but still remaining in the Big Flat Brook / Flat Brook System?" Ultimately the answer to this question is "no" as well, the trout are not leaving the *Catch and Release* regulated area. Sixty-eight of the seventy radio tagged trout remained inside the *Catch and Release Area*. One radio tagged trout that left the *Catch and Release Area* swam upstream and through the upstream most

boundary by crossing under the Route 206 bridge. This fish continued further upstream and was found 0.4 miles from the boundary. This fish was stocked at the upper most stocking location which is found only 0.35 miles from Route 206. It's total distance from the stocking point was only 0.75 miles. The second fish was stocked at the lower-most stocking point and traveled 1.63 miles downstream crossing the lower boundary of the *Catch and Release Area.* What makes answering this question interesting though is that several fish did swim distances that could have taken them out of the *Catch and Release Area* if they had moved in the opposite direction or if they were stocked at a different location. For example, 7 out of the 17 fish stocked at the upper most stocking location moved in one direction far enough to travel outside of the *Catch and Release Area*, but only 1 of those 7 trout swam in that upstream direction. The other 6 traveled downstream, further into the *Catch and Release Area*. If all of these fish would have traveled upstream, then the overall results of how many fish left the *Catch and Release Area* would be different. Also, the lower-most stocking location was located 0.75 miles from the lower boundary of the *Catch and Release Area*. Nine radio tagged fish traveled an overall distance greater than 0.75 miles from their stocking point and 8 of the 9 went downstream. Hypothetically, if these fish were stocked at the lower most stocking point and if their behavior and movement distance and direction remained the same, they would have moved out of the *Catch and Release Area*. This is strictly hypothetical though, as there could be reasons (temperature / habitat) below the lower most stocking location that keeps fish from traveling that distance. This may have been what occurred, because only one fish that was stocked at the lower most stocking location moved far enough downstream to exit the *Catch and Release Area*. In fact, the furthest distance any fish moved downstream from the lower most stocking location, besides the one mentioned above, was 0.39 miles, which is just over half way to the downstream boundary.

The third question this radio telemetry study was designed to answer was, "Are the fish remaining in the *Catch and Release Area*, but moving minor distances into areas that electrofishing equipment cannot sample effectively due to depth or flow?" Results from the study showed that some trout are moving into these deeper pools and high flow areas. This was expected, because a lot of the deeper pools and higher flow areas are very good trout habitat. What the study also showed is that not all of the radio tagged trout moved into these deeper pools. Many trout spread out and moved throughout the *Catch and Release Area* and utilized habitat that electrofishing equipment can sample effectively. Therefore, it has been determined that the reason that the electrofishing surveys have been collecting less trout than expected is not due to a large number of trout moving into the deeper pools where the electrofishing equipment cannot sample.

A re-captured radio tagged Rainbow Trout with antenna exiting side of trout.

So now we know that the trout are staying relatively close to where they were stocked and that many remained in locations suitable for electrofishing collection. This still does not answer why trout are not collected during these electrofishing surveys and why anglers report less than expected catch rates. The answer to this might be the fact that all 80 radio tagged trout were lost before the end of the summer. Seventy of the 80 radio tagged trout were confidently thought to have been lost due to some sort of predation, while the other 10 may have been lost due to predation or simply just dropped by the fish, possibly due to suture failures. Either way, this study showed that trout are not holding over through the

summer months as predicted and predation is the leading a factor as to why. Direct predation on non-radio tagged trout was also documented by staff several times during the study and staff also anecdotally noted observing several predators such as Great Blue Herons and Mergansers. Staff also saw signs of mammalian predators along the river banks in the forms of tracks, scat piles, runs, and dens. Remote cameras were deployed in 2018 by Montclair State to capture some of the predation efforts in the areas where the study fish were stocked. Review of the data from these cameras is ongoing and will be completed in 2019.

Water temperatures have been monitored annually in the *Catch and Release Area* since before the regulations went into effect and continued while this study occurred. The data from the continuous temperature monitors show that water temperatures in the Big Flat Brook / Flat Brook *Catch and Release Area* are suitable to hold fish year-round, but they do approach and sometimes exceed a temperature above what is considered optimal for trout. The temperature data also shows that at no time does the temperature reach a point above the critical threshold for trout survival. We analyzed the data to see if predation rates increased during or closely following the time periods in which temperatures reach above optimal thermal conditions. It is thought that at these times, the fish could become so thermally stressed that it changes their behavior and ability to evade predators. Although predation rates increased as water temperatures increased, it could not be statistically shown that increased temperature was the reason for the increase in mortality. This was mainly due to the fact that the data showed an increase in mortality rates several weeks prior to temperatures increased above the thermal threshold where stressful conditions would occur.

A mammal's den location found on Big Flat Brook. A dropped radio tag was found just outside this den.

A plausible explanation for the increase in predation rates found on the tagged trout could simply be due to the time of year where more predators are spending more time hunting for trout because of their reproductive life cycles. At these times, predators are not just hunting to feed themselves, but are hunting to feed their offspring and therefore an increase in predator activity occurs. The increase in predation rate on the radio tagged trout correlates nicely with the predicted increase in predator activity due to timing of their reproductive cycles, but more information in this area would be necessary to make any strong conclusions. More information about predation rates in other areas of the state would also be necessary to determine if these found predation rates in the Big Flat Brook / Flat Brook *Catch and Release Area* are atypical compared to predation rates on stocked trout in other areas of the state. More information about predation rates in other areas of the state would also be necessary to determine what if anything could or should be done to counteract these predation rates to keep trout available year-round for angler recreation in areas where thermal conditions allow. (Federal Grant F-48-R, Shramko)

Opening Day Trout Angler Survey Data (2018)

Investigations and Management of New Jersey's Freshwater Fisheries Resources (APPENDIX F)

By
Ross Shramko, Senior Fisheries Biologist

April, 2018

New Jersey Department of Environmental Protection

Division of Fish and Wildlife

Bureau of Freshwater Fisheries

Sportfish Restoration Grant F-48-R

This grant was paid for by fishing license sales and matching Dingell-Johnson/Wallop-Breaux funds available through the Federal Sportfish Restoration Act.

2018 New Jersey Division of Fish and Wildlife Opening Day Angler Survey Report

by Ross Shramko, Senior Fisheries Biologist

What are Angler Surveys?
Angler (or sometimes referred to as "creel") surveys are one device utilized by Fisheries Managers to help protect and enhance freshwater fishing opportunities. An angler survey is a widely applied and broad term that simply refers to methods of sampling used to collect recreational fishing information. Many anglers who fish on Opening Day of trout season may already be familiar with the Bureau of Freshwater Fisheries use of angler surveys given that this tool has been utilized since 2004 on about 120 trout stocked locations throughout the Garden State. So, if you fish on Opening Day, you may have a good chance of having your voice heard and taking part in the management of New Jersey's freshwater fisheries.

The Bureau of Freshwater Fisheries (BFF) relies on anglers to gather information about angler success, fishing preferences, interests, and attitudes, not only about trout stocking, but also about the Division's Freshwater Fisheries program. The type of angler survey that is used on Opening Day is referred to as an "On-Site Creel Survey" because surveys or interviews are conducted at the time the angler is fishing. The intent of this type of data is to provide the Division with information to better understand anglers, provide better service, and ultimately improve fishing throughout New Jersey.

Echo Lake Monmouth County, 4/7/2018
Photo credit: Patricia Walker, WCC

The Opening Day Angler Survey has two main objectives: (1) to record angler presence or turnout on specific waterbodies and (2) to determine angler success. This data is gleaned from casual interviews with anglers. Data about specific species catch, waterbody conditions, cormorant activity, and other pertinent information is also collected to enable the Bureau of Freshwater Fisheries to better manage the waterbodies that are being stocked with trout. The emphasis of the opening day survey is usually on lakes and ponds because of the difficulty in obtaining and assessing accurate angler turnout and success on streams.

How are the opening day surveys conducted?
Wildlife Conservation Corps (WCC) volunteers assist Fish and Wildlife staff in conducting surveys on various waterbodies on Opening Day of trout season. Each volunteer, or angler survey clerk, is assigned a waterbody and given written instructions to be reviewed before Opening Day so questions or concerns about the survey can be addressed.

All individuals fishing are counted by survey clerks to help determine angler turnout. Counts are conducted hourly from 8 a.m. until noon. From the five counts made, the highest number of anglers is used as the indicator of angler turnout. One limitation in hourly counts is that turnover is not taken into account. For example, if 10 anglers leave the waterbody, and 10 new anglers arrive, the count would still be 10. This is done because the survey clerks would have a difficult time keeping track of all anglers coming and going, especially on large waterbodies, as they drove between different locations interacting with anglers.

Speedwell Lake, 4/7/2018 Photo credit: Tony Rego, WCC

In-between hourly counts, survey clerks record angler catches, what successful anglers are using to catch trout, observations about the fishing action in general, and any other pertinent information supplied by the anglers or observed by the survey clerk.

Data is recorded on supplemental data forms and submitted to Bureau of Freshwater Fisheries staff to be compiled and analyzed. Lakes and streams are analyzed separately because of the difficulty in counting total anglers fishing on a given stream stretch at one particular point in time.

Results of the 2018 Opening Day Angler Survey

The Opening Day of the 2018 trout season was Saturday, April 7th. The weather was cold with mostly cloudy skies and somewhat windy conditions with highs in the upper 30's to low 40's throughout the state. There was even a bit of snow showers in Warren, Hunterdon and Morris Counties. Anglers faced difficult fishing conditions as high flows and off colored water on the streams and rivers along with the usual colder water temperatures making fish lethargic. Anglers fishing lakes and ponds were also facing difficult conditions as temperatures leading up to opening day have kept the water colder than average for this time of year. Of the 38 surveys conducted, 32 were on lakes and ponds. 768 anglers were observed fishing (an average of ~24 anglers per waterbody) on the lakes and ponds. This number is down from last year's opening day when 1,810 anglers were observed on 30 lakes and ponds surveyed (an average of ~60 anglers per waterbody). It is important to note, that the number of anglers fishing is much lower than last year partially due to the popularity of Spring Lake in Monmouth County which was not surveyed this year. Spring Lake has a very popular kids fishing derby on opening day annually. Last year about 666 anglers, many of them children, were fishing Spring Lake. If we remove the Spring

Lake anglers from the calculation, survey clerks recorded 1,144 anglers on 29 waterbodies statewide (an average of ~39 anglers per waterbody) last year. Even with removing Spring Lake, this year's total anglers fishing the lakes and ponds is still down from last year. This is likely due to the very poor weather conditions leading up to opening day along with the cold forecast for opening day itself.

With that being said, those anglers who did turn out many of them did very well for themselves. 2018 had the best fish per angler ratio ever recorded by the Division (11 years of data). 0.91 fish per angler were caught in 2018 easily besting the 2008 number of 0.73 fish per angler. This shows that in many places fishing was great and those who braved the winter like conditions were rewarded with some excellent fishing.

Trout-stocked Lakes and Ponds Results

In some locations trout fishing was fantastic. Several anglers expressed what a wonderful day of fishing they had and thanked the Division of Fish and Wildlife for their efforts in making the 2018 opening day a huge success. Warinanco Park Pond (Union), Oak Pond (Camden), Roosevelt Park Pond (Middlesex) and Birch Grove Park Ponds (Atlantic), to name a few, were by far the places to be on opening day as anglers had the highest catch rates per angler at 3.15 fish per angler, 1.84, 1.83 and 1.82 fish per angler respectively.

Angler Craig Rothman proudly holds this 22 ¼ inch Rainbow Trout that he caught from Hook's Creek Lake.

Unfortunately, trout were not as cooperative in all the lakes and ponds across the state. The higher than usual, murky and cold-water temperatures (mid-30's to mid-40's) appeared to keep the fish from biting, frustrating anglers and sending them home early in multiple locations. Many clerks reported the number of anglers at a waterbody was highest at 8 a.m. or sometimes 9 a.m. but dropped heavily by 10 a.m. and throughout the rest of the day.

Richard Pharo with a monster Rainbow Trout he caught at Echo Lake Monmouth Co. on opening day.
Photo Credit: Pat Walker, 4/07/2018

19 different lakes and ponds produced less than 5 total fish during the 4-hour survey time period. Of those 19 waterbodies, 12 of them had more than 10 anglers fishing while 7 were less popular and had less than 10 anglers fishing. We would have liked to see higher turnouts and possibly with the higher angler turnouts, higher success rates on these waterbodies.

Angler success rate data has been collected and calculated per waterbody starting in 2008. Since then, the division has had the ability to compare one year's opening day's success to another year's opening day

success. 2018 results showed the best ever anglers success rate compared with previous opening days. 2018 had a success rate per angler of 0.91 fish per angler or just less than 1 fish for every angler. This fantastic success rate comes just one year after experiencing the worst opening day success rate ever recorded in 2017. See table below for more detail.

Table 1: Yearly comparison of angler success rate

		2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	AVERAGE
Total	**Anglers**	853	1095	1462	1675	1918	1830	2100	664	1810	828	**1424**
	# Trout	485	551	669	1107	1354	996	960	380	402	757	**766**
	Trout/Angler	0.57	0.50	0.46	0.66	0.71	0.54	0.46	0.57	0.22	0.91	**0.54**

Some waterbodies have been producing consistently bad opening day success rates. The following waterbodies in Table 2 will continue to be monitored, but if their success doesn't change, they could in the future be dropped from the trout stocking program.

A complete list of the 2018 Opening Day angler success on the lakes and ponds can be found in the appendix of this report along with information on angler success.

Table 2: Waterbodies with consistent poor angler success.

County	Waterbody	Acres		2010	2011	2012	2013	2014	2015	2016	2017	2018	AVERAGE
Mercer	Colonial Lake	10	**Anglers**	58			50	22	28	50	26	13	**35**
			# Trout	4			8	0	2	0	0	0	**2**
			Trout/Angler	0.07			0.16	0	0.07	0	0	0	**0.06**
Atlantic	Heritage Park Pond	6	**Anglers**					14	25	7	21	11	**16**
			# Trout					1	3	0	2	3	**2**
			Trout/Angler					0.07	0.12	0	0.1	0.27	**0.12**

Trout-stocked Streams and Rivers

Typically, The Opening Day Trout Angler Survey may only have a few streams or rivers as part of the survey because angler counts and success on streams and rivers is difficult to assess. The distance that must be covered and the movement in and out of fishing spots by anglers makes it difficult to get accurate quantitative data from the survey.

Angler surveys and counts were conducted on 6 streams or small sections of streams in 2018. A total of 60 anglers were surveyed. The rivers had high flows and the water was off colored making it somewhat difficult for anglers to target and catch trout. Despite the difficult conditions, a few anglers found some success at the Lopatcong Creek, the Pohatcong Creek and the Musconetcong River (just below the Trout Conservation Area) with catch rates of 3.66 fish per angler, 8.10 fish per angler and 2.50 fish per angler respectively. In

A father helping his sons fish at Warinanco Park Pond on opening day of the 2018 trout season.
Photo Credit: Bryan Delance, 04/07/2018

fact, the rivers and streams seemed to outperform the lakes and ponds as 66% of the waterbodies surveyed showed angler success above the 2018 record of 0.91 fish per angler compared to only 23% of the lakes and ponds surveyed.

In summary, opening day on the streams and rivers was quite successful and anglers who chose to fish them were rewarded with lots of action.

A complete list of Opening Day angler counts on streams and rivers can be found in appendix of this report along with information on angler success.

In Summary

Opening Day success in 2018 was varied. On the positive side, anglers who were interviewed for this survey have never been more successful in the 11 years we have been monitoring trout caught per angler. The 0.91 trout caught per angler smashed the previous record set in 2008 of 0.73 trout per angler. The streams and rivers seemed to fish better than the lakes and ponds overall as 66% of the streams and rivers surveyed had angler success rates above 1.0 fish per angler while only 9 of the 32 total lakes or ponds (28%) surveyed had similar success. On the other hand, the cold water and air temperatures in areas definitely had a negative effect on the number of anglers and the success rate at many waterbodies.

Angler Glen Humbert proudly holds his first trout of the season, caught at Echo Lake Monmouth Co.
Photo Credit: Pat Walker, 04/07/2018

The overall number of opening day anglers counted in this year's survey was 828 anglers. This number is quite a bit lower than the average number of anglers since 2008. The cold temperatures and frequent snow storms in the weeks leading up to opening day made it feel more like February than April and with the forecast for opening day of temperatures in the upper 30's with snow showers, many anglers may have elected to stay home for the opener.

Oak Pond had the largest showing of anglers with 96 individuals fishing. But the place to be was the Pohatcong Creek in Warren County as 81 trout were caught by 10 anglers (8.10 fish per angler). Not bad for the first 4 hours of the season.

Despite the overall average to slow start to the spring trout fishing season on several other waterbodies, anglers will be more successful as the season progresses, when warmer waters, lower flows and milder days prevail.

Reports and detailed results noted by volunteer survey clerks for each waterbody surveyed can be found in the appendix of this report.

Acknowledgements
New Jersey Division of Fish and Wildlife's Bureau of Freshwater Fisheries staff would like to thank the following Volunteers and DEP staff who make this project possible every year. Together with NJDFW staff angler counts were conducted on 38 waterbodies across the state. A special note of thanks is also extended to Fisheries Technician Chuck Sedor for coordinating the volunteer efforts.

Survey Clerks			
Name	**Affiliation**	**Name**	**Affiliation**
Bill Reinert	WCC	John Miraglia	WCC
Paige Smith	WCC	Martin Panariello	WCC
Justin Fuller	WCC	Pat Walker	WCC
Elizabeth Phelps	WCC	Hung Le	WCC
Walter Parker	WCC	Gerardo Rago	WCC
Jim Winters	WCC	Tony Rego	WCC
Michelle R	WCC	Bruce Beveridge	WCC
Jerry Benfer	WCC	Jim Destephano	WCC
Lauren Wasserman	WCC	Erin Colfax	WCC
Dominic L	WCC	Bryan Delance	WCC
Fred Klein	WCC	Matthew Miners	WCC
Juanita Hummel	WCC	Jim Velcheck	WCC
Greg Gocke	WCC	Dan Calligaro	WCC
Cody McLaughin	WCC	Ed Sinning	WCC
Barbara Wingel	WCC	Caitlyn Takacs	WCC

Appendix:

County	Waterbody	Lake/ River Conditions	# of Cormorants Present	Time	# of Shoreline anglers		# of Boat anglers		Total # of anglers	Brook Trout caught				Brown Trout caught				Rainbow Trout caught				Total trout caught	Fish Per Angler	Comments
										<14 in		>14 in		<14 in		>14 in		<14 in		>14 in				
					adult	child	adult	child		kept	rel	kept	rel	kept	rel	kept	rel	kept	rel	kept	rel			
Camden	Oak Pond	Clear	0	8:00	20	16	15	3	54	0	0	0	0	0	0	0	0	162	3	12	0	177	1.844	Very good fishing. People hitting limit in boat and sandy beach area. Many left because of limit.
				9:00	20	16	30	6	72															
				10:00	20	16	30	6	72															
				11:00	48	14	28	6	96															
				12:00	25	6	13	2	48															
Warren	White Lake	Clear	0	8:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000	One angler arrived 9:38, left 9:45, asked to not shore fish by county.
				9:00	1	0	0	0	1															
				10:00	0	0	0	0	0															
				11:00	0	0	0	0	0															
				12:00	0	0	0	0	0															
Hudson	W Hudson Co. Park Pond	Turbid	1	8:00	52	6	0	0	58	0	0	0	0	0	0	0	0	53	18	5	1	77	1.242	Anglers catching trout right away, but slowly/sporadically. One Cormorant. One angler caught limit, put in car and came back and continued fishing. He caught a broodstock and was told to release. He refused and gave it to his friend. Advised it was illegal to keep. All anglers checked for licenses, many didn't display licenses. Couple anglers asked about stocking in season.
				9:00	57	5	0	0	62															
				10:00	53	3	0	0	56															
				11:00	39	2	0	0	41															
				12:00	41	0	0	0	41															
Union	Seeley's Pond	Clear	0	8:00	55	2	0	0	57	0	0	0	0	0	0	0	0	3	0	8	0	11	0.193	Some anglers moved downstream to Green Brook. One angler caught and released 16, one angler caught and released 10, kept 3.
				9:00	40	2	0	0	42															
				10:00	35	2	0	0	37															
				11:00	15	0	0	0	15															
				12:00	8	0	0	0	8															
Passaic	Oldham Park Pond	Clear	40	8:00	-	-	-	-	-	0	0	0	0	0	0	0	0	1	1	0	0	2	0.286	Fishing was obviously slow but anglers spoke highly of this location, action usually beetter and crowds typically larger.
				9:00	7	0	-	-	7															
				10:00	6	1	-	-	7															
				11:00	-	-	-	-	-															
				12:00	4	1			5															
Warren	Blair Lake	Clear	4	8:00	3	0	-	-	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000	Two anglers fished 10 minutes. They said they fish here a lot and it is usually busy on Opening Day. Four people fishing creek below lake. All said usually busy Opening Day. Annual Derby gets about 100 people. 1 fish caught by kid fishing the creek.
				9:00	2	1	-	-	3															
				10:00	1	0	-	-	1															
				11:00	2	0	-	-	2															
				12:00	-	-	-	-	-															
Atlantic	Tuckahoe Lake	Clear	0	8:00	6	1	8	0	15	0	0	0	0	0	0	0	0	5	0	0	0	5	0.333	
				9:00	5	0	8	0	13															
				10:00	4	0	6	0	10															
				11:00	5	0	2	0	7															
				12:00	2	0	1	0	3															
Burlington	Laurel Acres Pond	Clear	12	8:00	22	0	-	-	22	0	0	0	0	0	0	0	0	6	0	1	0	7	0.292	
				9:00	22	2	-	-	24															
				10:00	-	-	-	-	-															
				11:00	-	-	-	-	-															
				12:00	-	-	-	-	-															
Bergen	White's Pond	Clear, Choppy	0	8:00	9	4	0	0	15	0	0	0	0	0	0	0	0	15	4	1	0	20	1.333	A lot of water to cover but not great shore line access. Boating is allowed, but only to Walkwick residents by permit. Garclic salmon eggs - yellow
				9:00	9	0	0	0	9															
				10:00	11	1	0	0	12															
				11:00	10	0	0	0	10															
				12:00	3	1	0	0	4															
Atlantic	Heritage Park Pond	Muddy	5	8:00	7	1	-	-	8	0	0	0	0	0	0	0	0	3	0	0	0	3	0.273	Excess Cormorants. No fish being caught.
				9:00	9	2	-	-	11															
				10:00	8	3	-	-	11															
				11:00	6	3	-	-	9															
				12:00	5	0	-	-																
Essex	Branch Brook Park	Choppy, Clear	0	8:00	8	0	0	0	8	0	0	0	0	0	0	0	0	1	0	0	0	1	0.111	Anglers were not fishing for trout. Bait used: Powerbait, worms, artificial loose, swim gig, shrimp, gulp.
				9:00	7	0	0	0	7															
				10:00	7	0	0	0	7															
				11:00	9	0	0	0	9															
				12:00	9	0	0	0	9															
Burlington	Crystal Lake	Choppy, Low Water	0	8:00	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000	Too shallow, too windy. The 2 people who were there just walked around to find future fishing spots. Neither stayed in one location long an dboth were only actively fishing around 9am.
				9:00	2	0	0	0	2															
				10:00	0	0	0	0	0															
				11:00	0	0	0	0	0															
				12:00	0	0	0	0	0															
Middlesex	Hook's Creek Lake	Clear	2	8:00	12	0	0	0	12	0	0	0	0	0	0	0	0	30	15	4	0	49	2.042	
				9:00	21	0	0	0	21															
				10:00	20	2	0	0	22															
				11:00	23	1	0	0	24															
				12:00	20	0	0	0	20															

Opening Day Trout Angler Survey

County	Waterbody	Lake/ River Conditions	# of Cormorants Present	Time	# of Shoreline anglers		# of Boat anglers		Total # of anglers	Brook Trout caught				Brown Trout caught				Rainbow Trout caught				Total trout caught	Fish Per Angler	Comments
										<14 in		>14 in		<14 in		>14 in		<14 in		>14 in				
					adult	child	adult	child		kept	rel	kept	rel	kept	rel	kept	rel	kept	rel	kept	rel			
Ocean	Pohatcong Lake	Clear	30	8:00	7	0	0	0	7															Anglers were disappointed but cheerful. I spoke with 90% of anglers and explained the stocking of the lake. No boats were on the lake. 20-30 Cormorants, 8-12 Osprey, 2 with fish. 7 anglers at 8am, 2 from shore, 5 from dam. All left between 9-9:30. No strikes or nibbles. Used spinners, Powerbait, live worms and salmon eggs. Termp. mid-40's.
				9:00	6	0	0	0	6															
				10:00	2	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000	
				11:00	4	1	0	0	5															
				12:00	5	0	0	0	5															
Mercer	Rosedale Lake	Muddy, Low	10	8:00	14	1	0	0	15															Saw at least 4 cormorants with identifiable trout in their mouths. Not a lot of action, but everyone having a good time. All 3 fish caught came off the small dockat the north west end of the lake, casting into deep water from the bottom. Everyone used Powerbait - yellow or orange. One person used Powerbait garlic flavored with no luck.
				9:00	12	1	0	0	13															
				10:00	12	0	0	0	12	0	0	0	0	0	0	0	0	3	0	0	0	3	0.200	
				11:00	7	1	0	0	8															
				12:00	5	0	0	0	5															
Cape May	Ponderlodge Pond	Clear	0	8:00	37	17	4	0	58															People in boats catching "lots"…. 10 or 11, one of them big. "Did you put any fish in?" "Are there any Browns?" "Most people I've ever seen here." "Did you guys forget to stock it?" "Where are the 16" Rainbows?" "More fish" "Where is the Game Warden?"
				9:00	-	-	-	-	-															
				10:00	30	12	4	0	48	0	0	0	0	0	0	0	0	24	4	3	0	31	0.534	
				11:00	-	-	-	-	-															
				12:00	-	-	-	-	-															
Passaic	Green Turtle Pond	Clear	4	8:00	4	-	10	2	16															Most anglers were frustrated by the cold weather. Five anglers came to this site because the Ramapo was running too fast. 5 kayaks, 2 boats, 1 canoe, 4 buffleheads, 1 blue heron, 2 swans, 1 osprey w/trout x 2. Bait: spinners, phobes, powerbait, nighcrawlers, spoons.
				9:00	7	-	10	2	16															
				10:00	8	2	8	2	20	0	0	0	0	0	0	0	0	1	0	2	0	3	0.150	
				11:00	-	-	-	-	-															
				12:00	-	-	-	-	-															
Warren	Furnace Lake	Choppy, Muddy	0	8:00	1	1	6	0	8															Canada Geese and Common Merganers on lake. Windy and cold, a few snow flurries at 8:00. Father and sons fishing on docks, some car drive ups to check lake conditions. One boat angler caught a large muskie, 2 boats using large lures likely going for bass/musky. One kayak angler had a strike but that was all. Other kayak angler primarily going for bass.
				9:00	5	2	6	0	13															
				10:00	5	1	6	0	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000	
				11:00	3	0	5	0	8															
				12:00	1	0	4	0	5															
Passaic	Clinton Reservoir	Choppy		8:00	1	-	2	-	3															
				9:00	1	-	-	-	1															
				10:00	-	-	-	-	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000	
				11:00	-	-	-	-	-															
				12:00	-	-	-	-	-															
Middlesex	Roosevelt Park Pond	Muddy, Choppy	18	8:00	17	1	0	0	18															Cormorants aggressively feeding, circling anglers and boats. Complaints from anglers. 3 sets of anglers commented "should stock fewer fish, larger in size and later into season". They believe this would mitigate Cormorant intrusion. Predominant bait was Powerbait. One tagged 10" Rainbow caught. One angler using barbless hooks caught 2 Rainbow and lost 2.
				9:00	23	1	0	0	24															
				10:00	18	1	0	0	19	0	0	0	0	0	0	0	0	39	3	2	0	44	1.833	
				11:00	16	2	0		18															
				12:00	14	1	0	0	15															
Union	Warinanco Park Pond	Clear	1	8:00	6	1	-	-	7															
				9:00	8	4	-	-	12															
				10:00	6	1	-	-	7	0	0	0	0	0	0	0	0	25	38	0		63	3.150	
				11:00	13	4	-	-	17															
				12:00	14	6	-	-	20															
Cumberland	Giampietro Park Pond	Clear	15	8:00	17	1	8	0	26															Very cold and windy. Most caught by one boat at pond center. Three breeders fromo one boat. None caught along beach shore (shallow). One breeder along road side (Lincoln Avenue). Osprey very active feeding. Cormorants did not return afte 8:00 am.
				9:00	17	1	5	0	23															
				10:00	12	1	5	0	18	0	0	0	0	0	0	0	0	8	0	6	0	14	0.538	
				11:00	6	1	5	0	12															
				12:00	5	0	0	0	5															
Gloucester	Greenwich Lake	Clear, Choppy, High Water	6	8:00	22	4	0	0	26															"Lake has never been that great for trout fishing, better for bass" "too many Cormorants" "Just out for the day." Most using Powerbait. Better fishing from boat. 2 County Park Rangers observed fishing activity from truck. "First time since his family sold the property to the county"
				9:00	29	4	0	0	33															
				10:00	20	1	0	0	21	0	1	0	0	0	0	0	0	7	1	1	0	10	0.303	
				11:00	12	1	0	0	13															
				12:00	9	2	1	0	12															
Mercer	Colonial Lake	Clear, Choppy	25	8:00	9	0	0	0	9															40 degrees, north wind
				9:00	9	0	0	0	9															
				10:00	7	0	0	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000	
				11:00	4	0	0	0	4															
				12:00	4	2	0	0	6															
Morris	Lake Musconetcong	Clear, High	2	8:00	10	1	1	0	12															Cold - 34 degrees - overcast day with little wind, water clear and calm, low angler pressure. All anglers clustered by dam off Rt. 183. One kayak used briefly. One small jon boat w/battery operated motor. Trout catch negligible, only 3 by 10AM. Up to 40 crappies caught by water control house on dam. All anglers using lures.
				9:00	9	1	0	0	10															
				10:00	7	1	2	0	10	0	0	0	0	0	0	0	0	3	0	0	0	3	0.250	
				11:00	3	2	2	0	7															
				12:00	4	2	0	0	6															

Opening Day Trout Angler Survey

County	Waterbody	Lake/ River Conditions	# of Cormorants Present	Time	# of Shoreline anglers		# of Boat anglers		Total # of anglers	Brook Trout caught				Brown Trout caught				Rainbow Trout caught				Total trout caught	Fish Per Angler	Comments
										<14 in		>14 in		<14 in		>14 in		<14 in		>14 in				
					adult	child	adult	child		kept	rel	kept	rel	kept	rel	kept	rel	kept	rel	kept	rel			
Monmouth	Echo Lake	Muddy	2	8:00	48	10	0	0	58	0	0	0	0	0	0	1	0	4	8	2	1	16	0.271	"Cormarants have more fish than people" "It's too cold" "Birds are eating all the fish" "Fish aren't biting" "Would be nice if bathrooms were open" One person was very upset with the birds "why doesn't the Federal Government do something with the birds?"
				9:00	52	7	0	0	59															
				10:00	38	11	0	0	59															
				11:00	24	5	0	0	29															
				12:00	12	13	0	0	25															
Hunterdon	Amwell Lake	Clear	0	8:00	28	4	2	0	34	0	0	0	0	0	0	0	0	1	0	2	0	3	0.088	Very cold 8-10am … fish not biting. Other fish caught included 4 sunfish, 2 catfish, 1 bass, all released. Fishermen thought it was too cold. Boat did not come to shore before I left, may have caught a breeder but I could not confirm. Both boat anglers were in the same boat. Used power bait.
				9:00	11	3	2	0	16															
				10:00	10	0	2	0	12															
				11:00	9	2	2	0	13															
				12:00	11	3	2	0	16															
Atlantic	Birch Grove Park Pond	Clear	2	8:00	15	3	-	-	18	0	0	0	0	0	0	0	0	30	6	4	0	40	1.818	Much smaller than normal turnout because "Hooked on Fishing" normally coincides with Opening Day. Tournament scheduled for next week. "Please stock more fish" Lower sections of rail for wheelchair fishing access. Powerbait mostly used, small jig, worm.
				9:00	13	2	-	-	15															
				10:00	9	3	-	-	12															
				11:00	13	3	-	-	16															
				12:00	15	7	-	-	22															
Camden	Gloucester City	Muddy, High	0	8:00	5	1	-	-	6	0	0	0	0	0	0	0	0	2	0	0	0	2	0.133	Fishing slow, water very muddy. Two Osprey between 7:45 and 9:00 am. I witnessed Osprey take 3 trout from pond. Only fish caught were 2 small bass on roostertails and 2 Rainbow Trout. One trout caught on pink Powerbait and one on nightcrawler.
				9:00	5	1	-	-	6															
				10:00	5	7	-	-	12															
				11:00	8	7	-	-	15															
				12:00	4	4	-	-	8															
Morris	Speedwell Lake	Fast, Clear	2	8:00	19	0	0	0	19	0	0	0	0	0	0	0	0	4	3	1	2	10	0.526	Lake area produced more catches than area below spillway. Powerbait most productive; worms not working. Water from lake moving swiftly over spillway and fast moving to Whippany River.
				9:00	10	1	0	0	11															
				10:00	7	1	0	0	8															
				11:00	8	1	0	0	9															
				12:00	7	0	0	0	7															
Morris	Mount Hope Pond	Clear	5	8:00	8	3	-	-	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000	Temperature 36 degrees, disappointments with 0 catches.
				9:00	4	1	-	-	5															
				10:00	3	0	-	-	3															
				11:00	5	4	-	-	9															
				12:00	10	8	-	-	18															
Gloucester	Swedesboro Lake	Muddy, Choppy	10	8:00	11	1	2	0	14	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000	28 Cormorants, eating a lot of fish, looks like mostly gizzard shad.
				9:00	11	1	4	1	17															
				10:00	11	1	4	1	17															
				11:00	13	1	4	1	19															
				12:00	9	0	0	0	9															
Cumberland	Mary Elmer Lake	Clear	5	8:00	10	2	1	0	13	0	0	0	0	0	0	0	0	1	0	0	0	1	0.077	
				9:00	0	0	0	0	0															
				10:00	10	1	0	0	11															
				11:00	0	0	0	0	0															
				12:00	0	0	0	0	0															

Opening Day Trout Angler Survey

Stream Temperature Monitoring (2018)

Investigations and Management of New Jersey's Freshwater Fisheries Resources (APPENDIX G)

By
Scott Collenburg, Senior Fisheries Biologist

December, 2018

New Jersey Department of Environmental Protection

Division of Fish and Wildlife

Bureau of Freshwater Fisheries

Sportfish Restoration Grant F-48-R

This grant was paid for by fishing license sales and matching Dingell-Johnson/Wallop-Breaux funds available through the Federal Sportfish Restoration Act.

Stream Temperature Monitoring

In 2013 the Bureau established an ambient stream temperature monitoring network on 11 streams having trout fisheries that are recreationally important or of conservation interest. For this project (Trout Stocked Waters Stream Temperature Assessment) water temperature data is continuously collected using data loggers and used to assess current temperature conditions, evaluate long term trends, determine if ambient water quality is consistent with NJDEP's Surface Water Quality Standards, and aid in the management of coldwater fisheries in these streams.

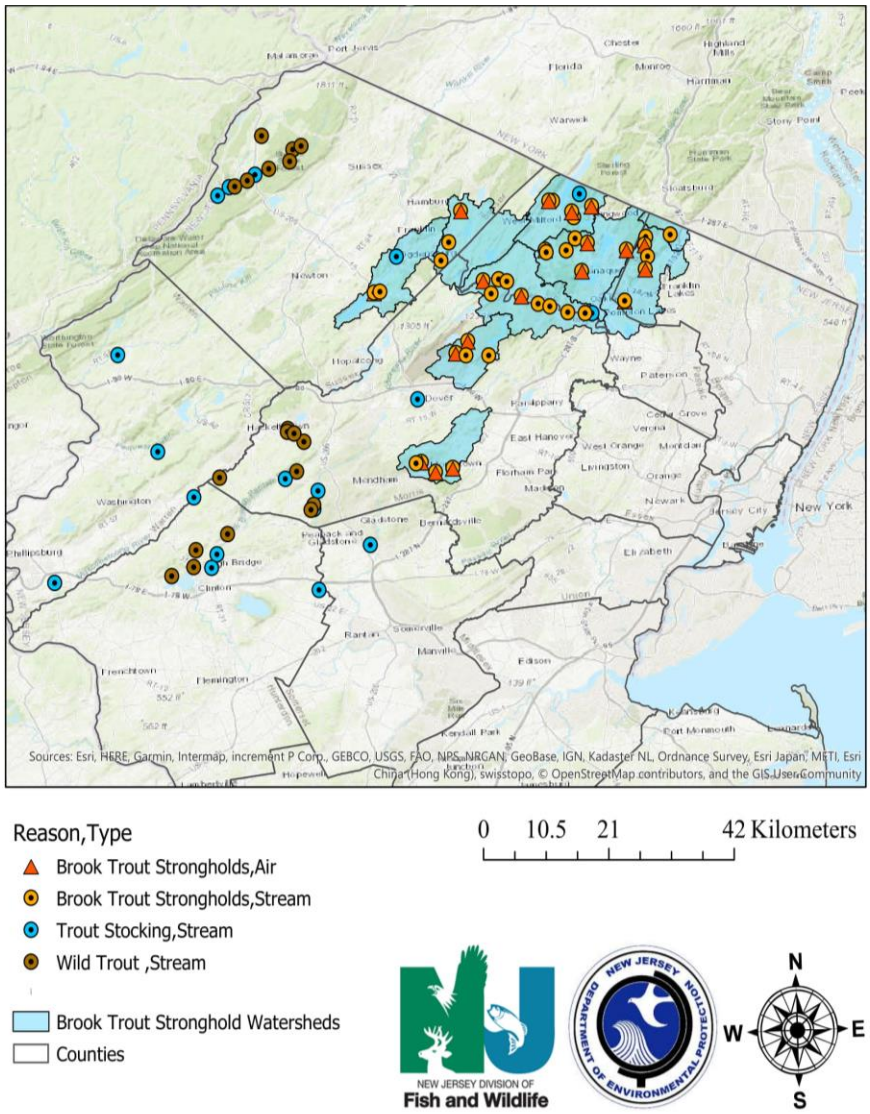
In 2015 the scope of work expanded to include a separate five-year study (Trout Production Stream Temperature Study) to gain insight on the link between seasonal stream and air temperatures, flows, and naturally reproducing Brook Trout populations. In 2018, another study (Brook Trout Strongholds Temperature Study) was developed and implemented to collect stream and air temperature data from streams to identify strongholds for wild Brook Trout. This study focuses on streams inhabited by wild Brook Trout, or streams that could be candidates for potential restoration projects for cold water fish. Understanding the relationship between temperature and Brook Trout in stronghold areas helps fisheries managers understand and define this species resiliency to future climate change and identify streams that may be good candidates for Brook Trout restoration. (Federal Grant F-48-R, Collenburg)

In 2018, temperature was continuously monitored at 72 stream sites and is summarized below:

- Trout Stocked Waters Stream Temperature Assessment – 11 streams (17 sites, water only).
    - Not all data loggers were collected due to persistent high stream flow throughout the fall (data analysis delayed until all loggers collected).
- Trout Production Stream Temperature Study – 17 streams (paired air/water and electrofishing survey).
    - In 2018, the study expanded to include 5 more streams in 2 drainages (Passaic River (2) and Flat Brook (3)) and Rinehart Brook was dropped (due to Brook Trout restoration in progress).
    - Preliminary analysis of data collected from all survey sites over a three-year period found Brook Trout biomass was negatively correlated to increased stream temperatures (>21°C).
- Brook Trout Strongholds Temperature Study - 41 sites (20 were paired air/ water temperature) in the Passaic River drainage.
    - Preliminary analysis indicated variation in groundwater influence was greater within individual watersheds than between watersheds.

The sites monitored in 2018 are displayed in the map below, followed by additional details on each study.

Map of all NJDFW temperature monitoring sites in New Jersey.



Trout Stocked Waters Stream Temperature Assessment

Seventeen of the stream temperature monitoring sites were located on 11 recreationally important, major trout-stocked streams. However, analysis and collection of a portion of the data was not performed because of high flows that have persisted through the fall. Analysis will be conducted when the data is collected. Continuation of this project in 2019 will be contingent upon requests from Regional Biologist that are interested in thermal regimes of important trout stocked areas in their managed waterways.

Trout Production Stream Temperature Study

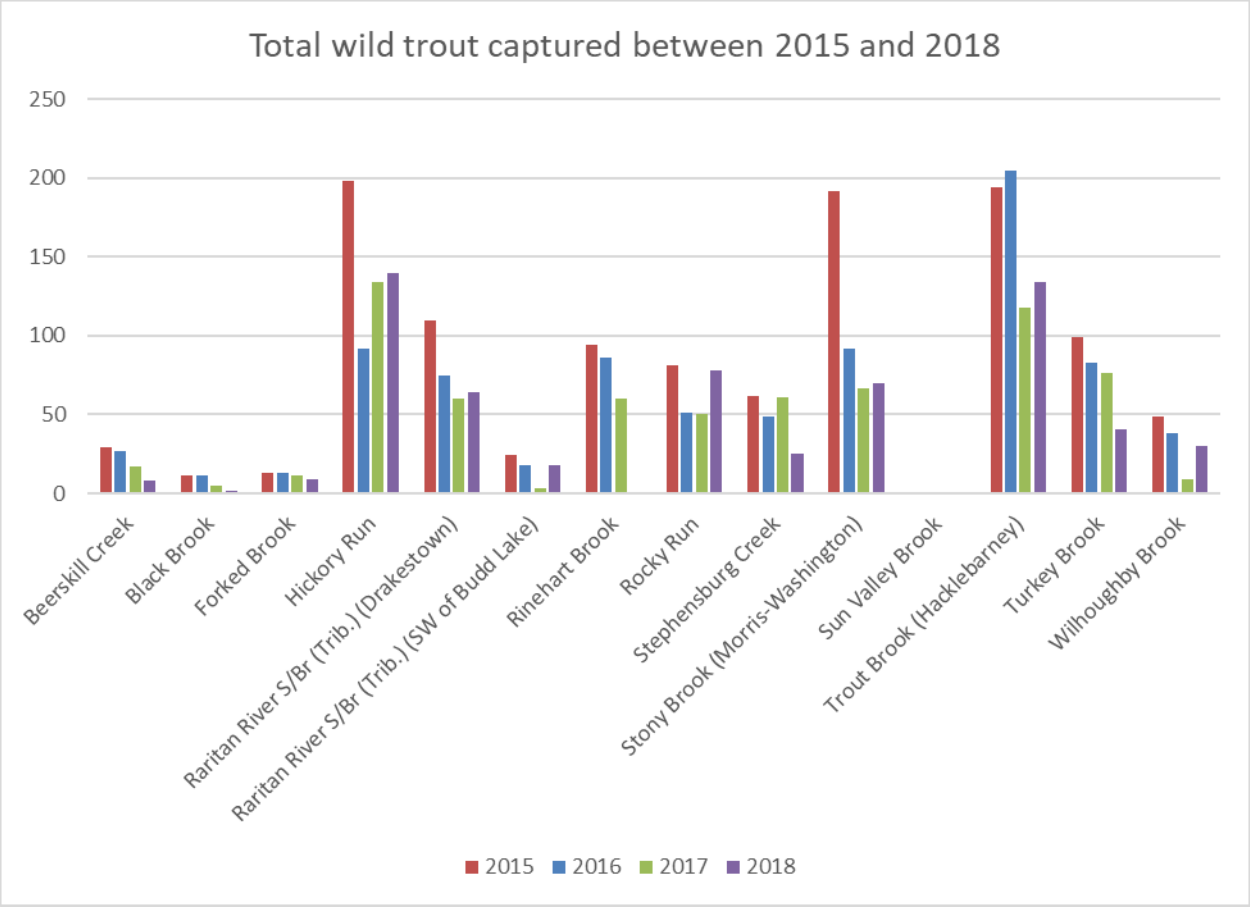
Highlights from 2018:

- In 7 out of 12 streams that were surveyed in 2017 and 2018, age 1+ wild trout increased from the previous year.
- In 6 out of 12 streams that were surveyed in 2017 and 2018, young-of-the-year (YOY) wild trout increased from the previous year. One stream remained unchanged (no YOY captured).
- A significant ($p = 0.016$), negative correlation ($r = -0.3807$), of Brook Trout Biomass to stream temperatures (percent of all summer time stream temperatures exceeding 21°C) was observed when looking at all survey sites for the three-year period.
- It was observed, based on data collected from 2015 to 2018 and using mixed effects models, mean winter stream temperature affected age 1+ trout/area ($\chi^2 = 12.419$, $p=0.000425$), increasing age 1+ trout/area by about 2.65 ± 0.65 adults/100m^2 every 1°C increase.
- It was observed, based on data collected from 2015 to 2018 and using mixed effects models, mean spring stream temperature affected age 1+ trout/area ($\chi^2 = 4.4961$, $p=0.03397$), increasing age 1+ trout/area by about 1.096 ± 0.499 adults/100m^2 every 1°C increase.

Natural variation that is seen in wild trout populations, by stream and by year, can confound analysis, hindering or decelerating management action and objectives. Understanding factors that drive these fluctuations in NJ streams will help managers make decisions pertaining to monitoring, habitat improvements, regulations, and focus of conservation efforts. 2015 marked the beginning of a study to collect year-round continuous stream temperature data on *Trout Production* streams and assess their naturally reproducing trout populations using stream temperature and a host of other variables as potential predictors.

Fourteen *Trout Production* streams were selected in 2015, based on location (i.e. watershed, logistical considerations) and on population structure (struggling or well-established trout populations) to investigate. Year-round stream temperature monitoring and electrofishing surveys were conducted over a three-year period and landscape-based variables were determined. In 2018, the study expanded to be more inclusive of streams in the Passaic and Flat Brook watersheds to expand sample size and avoid selection bias. These streams included Bear Swamp Brook, Big Flat Brook (trib.)(Lake Ashroe), Big Flat Brook (trib.)(W. of Lake Ashroe), Green Brook, and Parker Brook. No more data is being collected for Rinehart Brook, as another project based on removal of Brown Trout is taking place. Under this project, a total of 17 streams were surveyed in 2018 (see figure below).

Data collected from multiple wild trout streams between 2015 and 2018 to study natural variation and the factors that drive these changes.



The impetus for this project's development was that stream temperature background data (established in 2013) were compared to fisheries survey data and resulted in the following observations:

- Streams experiencing the coldest temperatures during trout egg incubation have low wild trout recruitment.
- Trout Production streams with higher Growing Degree Days (GDD) had better recruitment (streams with slightly warmer winter and spring temperatures).

These observations identify potential limiting factors of recruitment of trout in New Jersey and indicate metrics that could be developed for use in the monitoring of stream temperatures and in management of *Trout Production* streams.

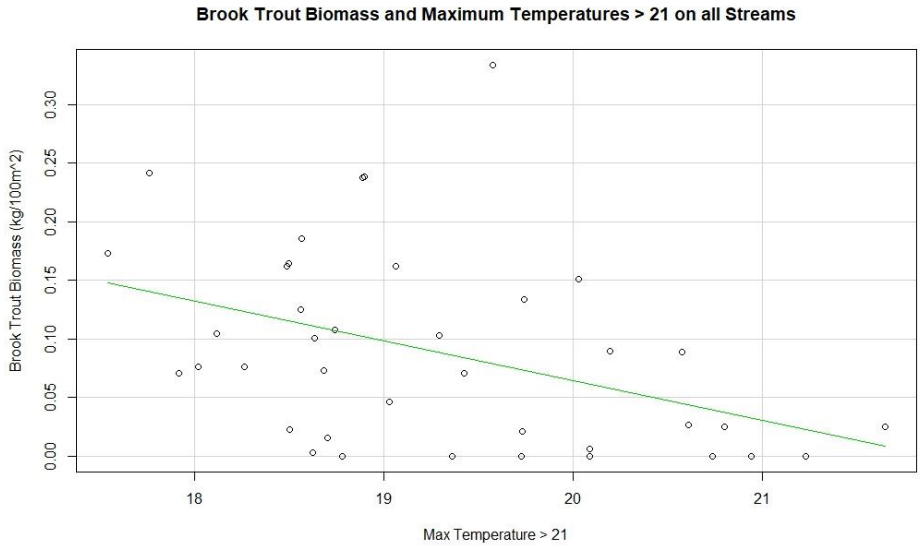
The current analysis has focused on using mixed effect models and Pearson correlations to study a list of factors contributing to these fluctuations. Again, results are preliminary and cursory, but may provide some window into result outcomes. Some interesting results are described below:

- Pearson correlation coefficients were determined between Brook Trout Biomass and independent variables. Significant correlations were found:
    - A negative correlation of Brook Trout Biomass to increased stream temperatures (percent of all summer time stream temperatures exceeding 21°C) was determined when looking at all

survey sites for the three-year period (r = -0.3807, p = 0.016; see figure below). Although this correlation is not surprising, it may help in planning restoration efforts and affect other management implications.

- *Note: Brook Trout Biomass is estimated from fish length data.*

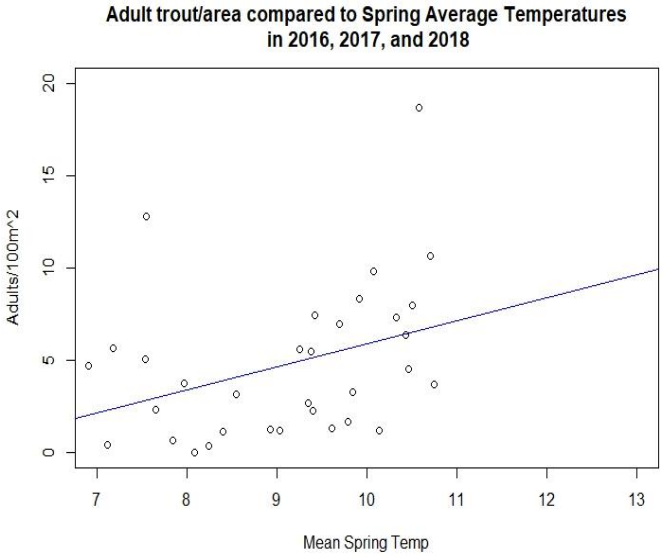
Scatterplot of total Brook Trout Biomass and percent of all summer time stream temperatures exceeding 21°C. A significant (p=0.016), negative correlation (r=-0.3807) between the two variables was found.

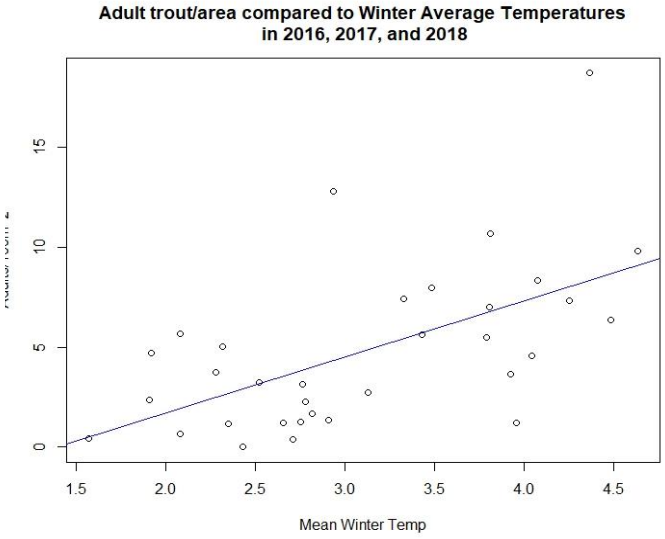


- Mixed effect models, using stream sites as random effects, found that mean winter stream temperature had a significant (χ^2 = 12.419, p=0.000425), positive correlation (increasing age 1+ trout/area by about 2.65 ± 0.65 adults/100m^2 every 1°C) increase to adult wild trout/area on streams (see figure below).
- Mean spring stream temperature significantly affected age 1+ trout/area (χ^2 = 4.4961, p=0.03397), increasing age 1+ trout/area by about 1.096 ± 0.499 adults/100m^2 every 1°C increase (see figure below).

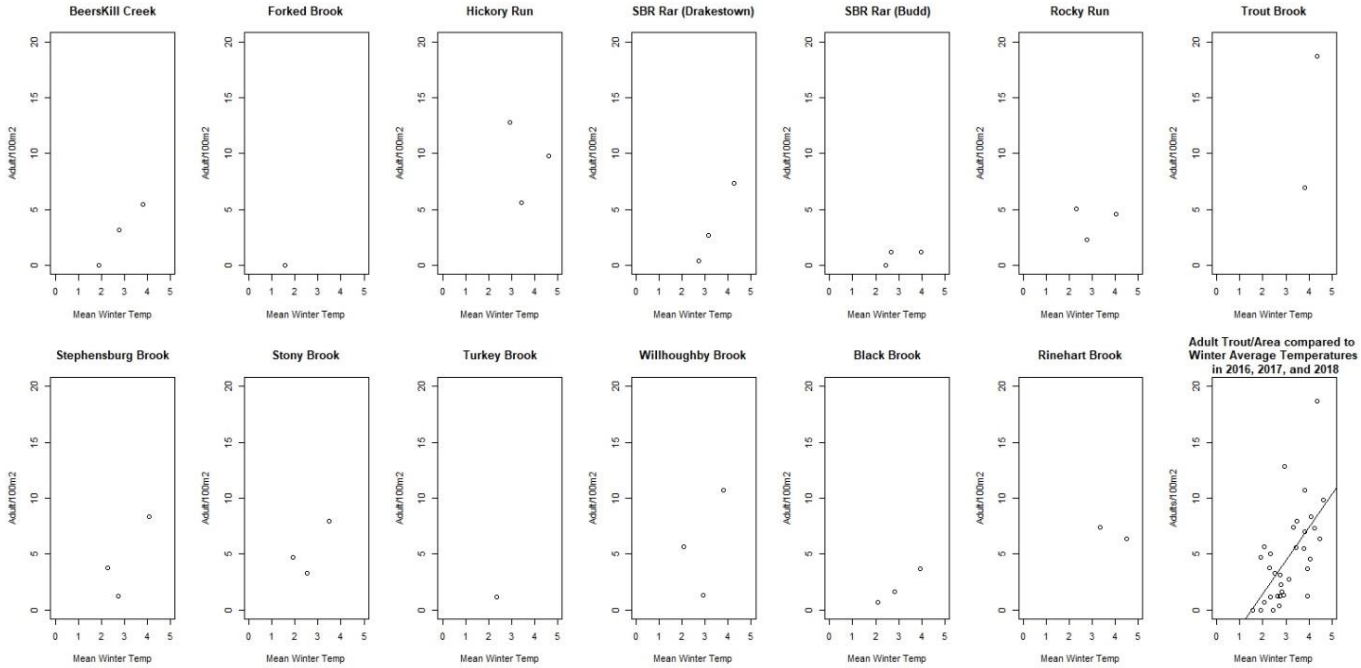
Warmer temperatures in the winter are critical for development of eggs and the life cycle of trout to ensure proper development and emergence times. As stream temperatures decline in the winter time, so does the activity and metabolism of trout. These are harsh conditions and influence the growth and survivability of wild trout populations. Similar results were seen when mixed effect models used spring mean temperatures as a fixed effect and stream sites as random effects. These data support the necessity to collect year-round stream temperature data to properly guide Brook Trout sampling and management activities.

Results from preliminary analysis of winter and spring average stream temperatures and other factors that are driving fluctuations in wild trout populations in New Jersey.





Mean winter stream temperatures and adult trout per $100m^2$ on each individual stream.



Opening Day Trout Angler Survey

Brook Trout Strongholds Temperature Study

Highlights from 2018:

- Data from this past year have been utilized to develop estimates of Ground Water (GW) influence at each site.
- Spatial variation in GW influence was greater within individual watersheds (mean SD within watershed = 0.118) than between them (SD among watershed means = 0.095). This supports previous findings that broad scale assumptions about the future of Brook Trout will be difficult/nearly impossible to make (Johnson et al. 2017). More fine scale analyses need to be made.
- Multiple linear regression models were developed to predict the daily mean water temperature (DMWT) using daily mean air temperature (DMAT) and a GW influence term (i.e. AirX) for each stream site from 2018 (n=53).
- It was observed that models that incorporated a GW influence term were better fit, higher adjusted R^2, than those that used just DMAT and will provide a great platform for making assumptions about future strongholds.

Brook trout resilience in the face of climate change is more strongly linked spatially than temporally. As air temperatures increase, not all streams have responded uniformly across space (Trumbo et al. 2014). This variation in space and sensitivity of stream temperature to increasing air temperature is largely due to the influence of local groundwater. Snyder et al. (2015) documented this interaction in the Catoctin Mountain Park when studying potential predictor variables of Brook Trout responses to climate change. This is good news in the world of coldwater fish in locations with sufficient groundwater. Suitable habitat may still be available despite large changes in air temperature and previous models predicting a high degree of habitat lose in New Jersey (these models were based on a large-scale watershed approach). The nature of currently highly fragmented and patchy catchments of Brook Trout populations in New Jersey lends itself to identifying which catchments will persist or will fail to persist from direct measurements of local air and water temperatures on a fine spatial scale (i.e. catchments). This approach has grown in popularity because of the relatively low cost of temperature loggers and has been implemented in other states (i.e. Virginia, Pennsylvania). NJ Division of Fish and Wildlife installed temperature loggers at 41 sites in the Passaic River drainage, 20 of which were accompanied by air temperature loggers. The following project goals were established:

- The use of Snyder et al. (2015) and Johnson et al. (2017) groundwater and sensitivity models to determine resiliency of streams to future climate change scenarios.
- Continue shifting monitoring network to directly measure stream and air temperature in wild trout waters in 2019 and 2020.
- This project will include existing Brown Trout sympatric and allopatric streams. Various mechanisms have played a role in the displacement of Brook Trout when in the presence of introduced Brown Trout.
- Use patch/catchment resiliency measurements to prioritize and guide potential management actions.

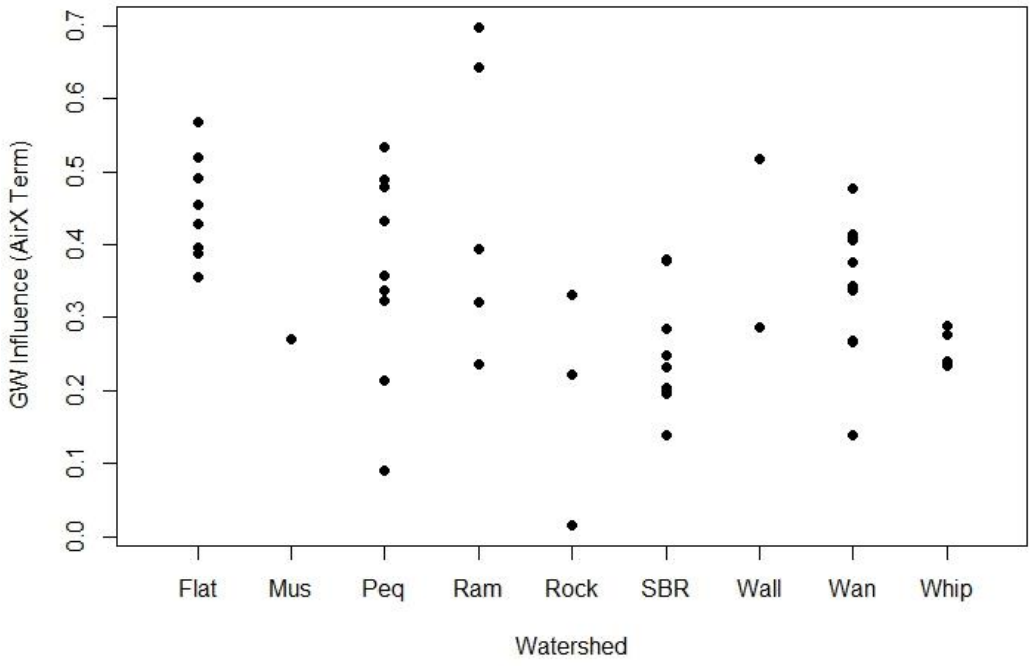
Predicting future habitat in headwater streams will rely heavily on understanding the dynamics of groundwater inputs and stream temperature. Previously developed models using air-stream temperature

regression can lend insight into the sensitivity of stream temperature to air temperature, but they may not be useful in predicting current or future water temperatures.

Assumptions have been previously made based on coefficients from air-stream temperature regressions that state a streams temperature is at a “low” or “high” sensitivity to air temperature (Trumbo et al. 2014) and low sensitivity sites will persist longer or be more resilient to changes in air temperature. A major assumption is coupled with the prior statement, groundwater temperature will remain static. This may remain relatively true for streams with groundwater influence that is stored in deep aquifers, but for streams influenced by shallow groundwater, this may not be true. The temperature of shallow groundwater has been shown to be sensitive to air temperature change and could play a major role in whether a stream will be resilient to warming air temperature in the future (Kurylyk et al. 2015).

The major goal of this study is to develop accurate predictions about future coldwater stream habitat that accounts for changes in one of the major buffers to air temperature change, groundwater.

Groundwater influence for the nine watersheds in 2018.



Preliminary model development reflected more accurate models when accounting for groundwater inputs. Although not direct measures of GW, two metrics developed by Johnson et al. (2017) and Snyder et al. (2015), AirX and Accumulated Degree Days (ADD), respectively, have been utilized to estimate GW influence from air-water regression models. Both metrics work in similar fashion, GW buffers daily air temperature effects and therefore can be inferred by the degree of damped air

temperature estimates over time. For example, stream temperatures with deep GW are estimated using long-term annual mean air temperature (groundwater temperatures are typically close to annual average air temperature).

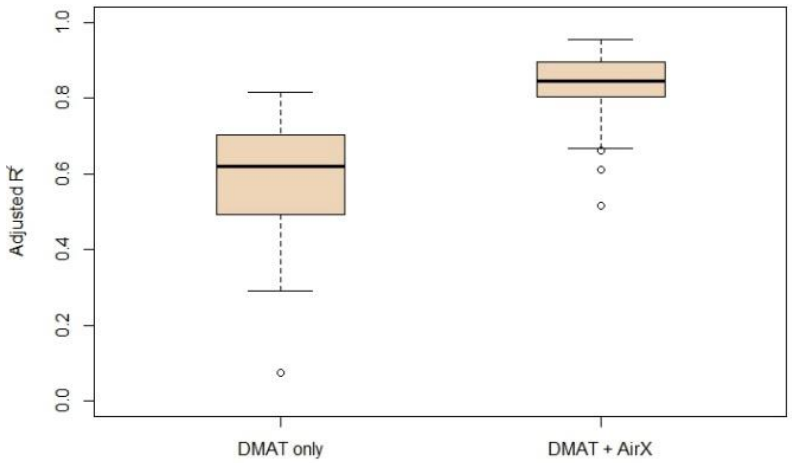
Following methodology from Johnson et al. (2017), multiple linear regression models were developed to predict the daily mean water temperature (DMWT) using daily mean air temperature (DMAT) and a GW influence term (i.e. AirX) were developed for each stream site from 2018. The AirX term is developed by testing 30 to 200 day rolling means, in 10-day increments, of modeled air temperature into the following model:

$$DMWT = b_0 + (b_1 * DMAT) + (b_2 * AirX) + e$$

Each duration (30 to 200 days) was evaluated and chosen based on lowest prediction error rate (i.e. RMSE). It is hypothesized that sites with larger rolling mean durations (i.e. 150 – 200 days) are influenced by deeper sources than sites with smaller rolling mean durations (Johnson et al. 2017), and if this hypothesis is true, most rolling means in the dataset indicated shallow groundwater sources (i.e. 30 - 40-day durations).

It was observed that models that incorporated a GW influence term were better fit, with higher adjusted R^2, than those that used just DMAT (see figure below). These models can be used to incorporate more realistic assumptions regarding the long-term effects of increasing climate on stream temperature.

Comparison of adjusted R^2 values between DMAT models and models that also incorporated an AirX term.



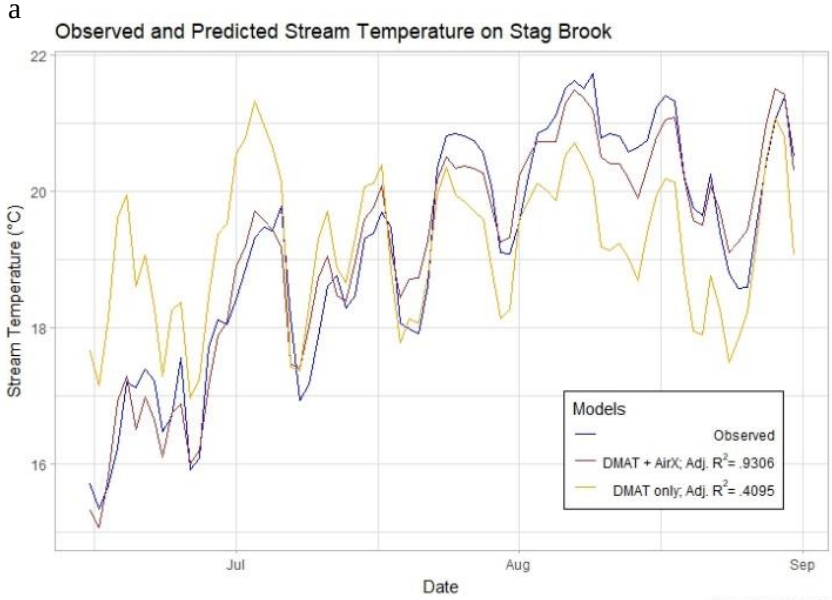
Continuing to follow Johnson et al. (2017) methods, data was utilized to develop estimates of GW influence at each site by deriving dimensionless relative importance metrics from DMAT and AirX terms in the above regression model. The result specifically, is a measure of the amount of variation in DMWT, explained by either DMAT or AirX. The result of the relative importance of AirX is interpreted as the influence of the GW signal in determining stream temperature. From this point on, the relative importance of AirX is referred to as GW influence.

Spatial variation in GW influence was greater within individual watersheds (mean SD within watershed = 0.118) than between them (SD among watershed means = 0.095). These results reflected what was

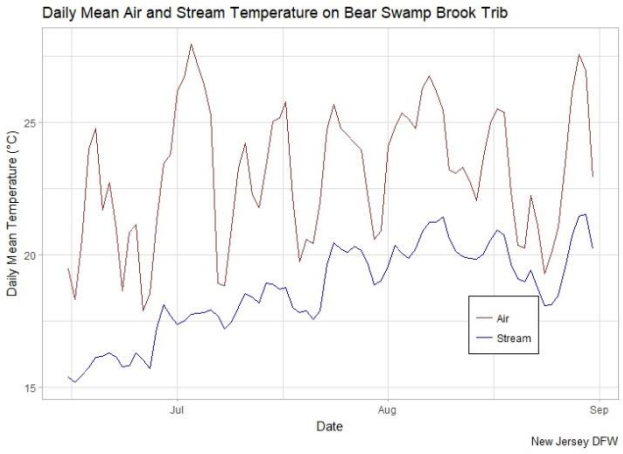
found by Johnson et al. (2017) and again, suggest that important drivers of stream temperature and GW influence may be organized at the sub-watershed scale and variation within watersheds may limit the use of predictions that have been made in the past at broader spatial scales.

Inclusion of the AirX term improved model estimates on all 53 stream reaches included in the analysis. Improvements were most pronounced at sites that were less sensitive to air temperature (see Figure b below, as a stream with more groundwater influence compared to Figure c below, a stream with less groundwater influence). One example, Stag Brook, located in the Ramapo River drainage, had the second highest GW influence from the study group and model accuracy increased substantially from an adjusted R^2 of 0.4095 without an AirX term, to an adjusted R^2 of 0.9306 with an AirX term. In the figure below (Figure a), that difference in model fit can be observed in comparison to the actual stream temperature. Model development will continue to compare the use of another groundwater metric and make predictions about future coldwater habitat in New Jersey based on climate change scenarios.

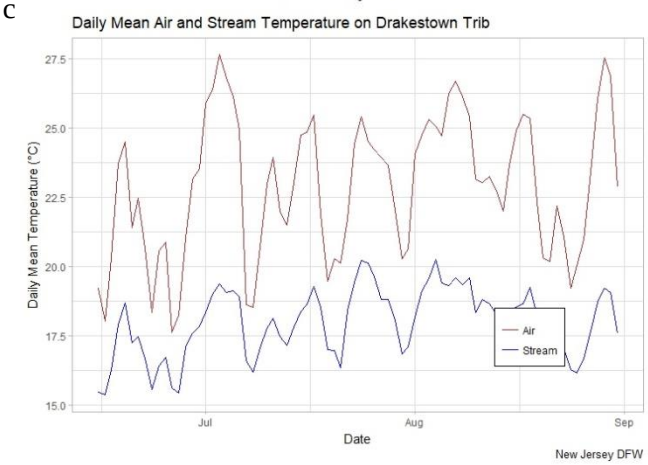
a



b



c



LITERATURE CITED

Johnson, C.Z., C.D. Snyder, and N.P. Hitt. 2017. Landform features and seasonal precipitation predict shallow groundwater influence on temperature in headwater streams. Water Resour. Res., 53: 5788-5812.

Kurylyk, B. L., K. T. B. MacQuarrie, D. Caissie, and J. M. McKenzie. 2015. Shallow groundwater thermal sensitivity to climate change and land cover disturbances: Derivation of analytical expressions and implications for stream temperature modeling, Hydrol. Earth Syst. Sci. 19(5): 2469–2489.

Snyder, C.D., N.P. Hitt, and J.A. Young. 2015. Accounting for groundwater in stream fish thermal habitat responses to climate change. Ecological Applications, 25(5): 1397-1419.

Trumbo, B.A., K.H. Nislow, J. Stallings, M. Hudy, E.P. Smith, K. Dong-Yun, B. Wiggins, and C.A. Dolloff. 2014. Ranking site vulnerability to increasing temperatures in southern Appalachian brook trout streams in Virginia: An exposure-sensitivity approach. Transactions of the American Fisheries Society 143:173-187.