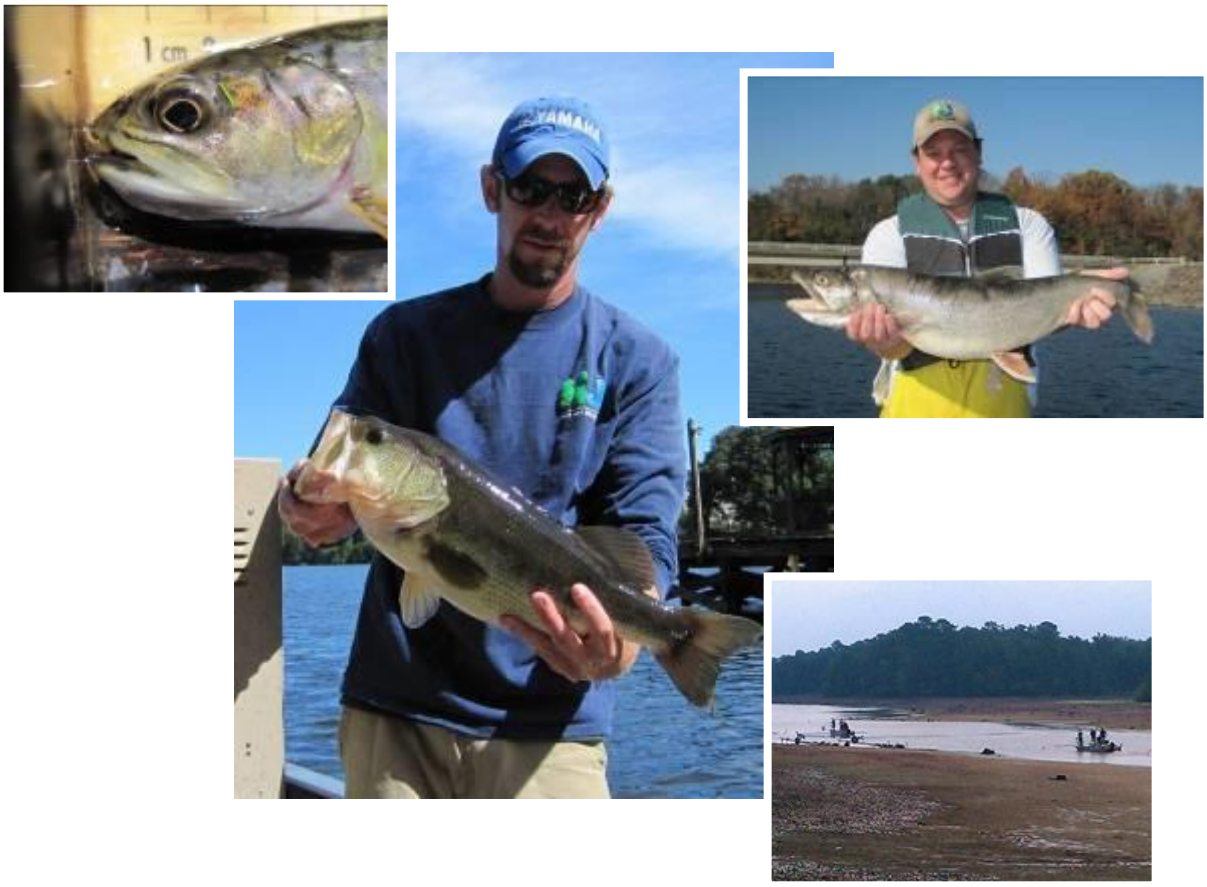
2011

INVESTIGATIONS AND MANAGEMENT OF NEW JERSEY'S FRESHWATER FISHERIES RESOURCES



State of New Jersey
Division of Fish and Wildlife
Bureau of Freshwater Fisheries

NEW JERSEY DIVISION OF
Fish and Wildlife

INVESTIGATIONS AND MANAGEMENT OF NEW JERSEY'S FRESHWATER FISHERIES RESOURCES 2011

Including
Sport Fish Restoration Grant F-48-R

Interim Job Performance Reports Segment 25
(November 1, 2010 – December 31, 2011)

Final Reports

March 2012

New Jersey Department of Environmental Protection
Division of Fish and Wildlife
Bureau of Freshwater Fisheries
Research and Management Unit

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

State of New Jersey

Chris Christie
Governor

Kim Guadagno
Lt. Governor

New Jersey
Department of Environmental Protection

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NEW JERSEY DIVISION OF
Fish and Wildlife

INVESTIGATIONS AND MANAGEMENT OF NEW JERSEY'S FRESHWATER FISHERIES RESOURCES 2011

BUREAU OF FRESHWATER FISHERIES

Report Prepared By:

Lisa Barno **Pat Hamilton**

Shawn Crouse **Christopher Smith** **Mark Boriek**

With the assistance of:

Scott Collenburg, Luke Diglio, Stephanie George, Brian Neilan, Tom Peck, Paul Saunders, Ross Shramko, and Ryan Warren

New Jersey's Freshwater Research and Management activities are funded entirely by New Jersey's licensed anglers. These activities benefit the state's 8 million residents by protecting and assessing New Jersey's vital freshwater resources.

Clean water for fish means clean water for us and generations to come

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INTRODUCTION

In 2011, the Bureau of Freshwater Fisheries Research and Management Unit completed fisheries surveys at 33 different waterbodies throughout the state, covering a variety of project objectives and demonstrating the diversity of the state's aquatic resources. Fifteen lake surveys encompassed species management activities targeting largemouth and smallmouth bass, muskellunge, and lake trout. These and other ongoing efforts are geared towards maintaining and enhancing NJ's trophy warm, cool, and coldwater fisheries found in nearly every corner of the state. The success of these fisheries, coupled with an aggressive three season trout stocking program support New Jersey's fishing slogan – "It's Never Been Better."

Of the 18 stream surveys, 7 were conducted as part of continuing efforts to assess and classify New Jersey's fresh waters. These assessments use important stream health indicators such as brook, brown, and rainbow trout to identify high water quality and critical habitat areas. The state's stream classification system is the cornerstone in protecting our critical watersheds. This data is also useful in documenting changes in the state's trout producing waters and provides information on the current distribution of brook trout, New Jersey's only native trout species. This species demands the best of the best with regards to habitat and water quality and is a true beacon to the current condition of our northern waters. The decline of brook trout due to land use changes has been documented throughout its entire native range.

As the emphasis on invasive species management continues to grow, the Bureau continued efforts to control exotic species such as Asian swamp eels, snakeheads, and even invasive plants such as water chestnut.

Every fisheries survey provides insight to the current distribution of our native fishes. Although most native fishes are not sought after by anglers, they are useful indicators of stream health and contribute greatly to our biodiversity. They are particularly valuable as indicator species in our southern waters, where trout are not naturally found. Of the state's 60 native fishes, several such as bridle, ironcolor, and comely shiners, black banded and banded sunfish are of particular interest as their numbers appear to have dramatically declined over the years. Efforts are underway to resample historically known areas they once inhabited.

Work critical to managing important anadromous species such as American shad, blueback, and alewife herring also continues. The final report for previous years sampling efforts was completed in 2011. With the removal of the Calco Dam on the Raritan River in the summer of 2011 and the removal of the Roberts St. Dam scheduled for August 2012, there is renewed interest in documenting fish passage at the Island Farm Weir fish ladder.

This work could not have been accomplished if it were not for the tremendously dedicated full-time staff within the Bureau, assisted by a talented group of seasonal staff. Together these individuals provide incredible insight and enthusiasm to the field sampling efforts and the countless tasks that must be performed before, during, and after each field visit.

Bureau of Freshwater Fisheries

The mission of the Bureau of Freshwater Fisheries (BFF) is to protect and manage the state's freshwater fish resources to maximize their long-term biological, recreational, and economic value for all New Jerseyans. Our goals are:

1) To maintain New Jersey's rich variety of freshwater fish species at stable healthy levels and enhance the many habitats on which they depend;
2) To educate New Jerseyans on the values and needs of our freshwater fish resources and to foster a positive human/wildlife co-existence;
3) To maximize the recreational and commercial use of New Jersey's freshwater fishes for both present and future generations.

The Bureau of Freshwater Fisheries is responsible for the propagation, protection, and management of the State's freshwater fisheries resources as well as promoting its recreational use. In addition to raising and distributing over 3.5 million fish annually, the Bureau conducts research and management surveys, classifies the state's waterways, provides technical input on a variety of watershed and habitat based issues, facilitates habitat restoration projects, serves as a liaison to a variety of sportsmen groups, and provides information to the general public, in a variety of forums, concerning the status of the State's fishery resources. The Bureau also administers approximately 600 permits annually to provide for the effective management and protection of the State's aquatic resources.

Organizationally, the Bureau is divided into two units; the Fish Culture Unit, responsible for the raising of 19 species of fish and the stocking of over 300 waterbodies each year, and the Research and Management Unit, responsible for the protection and management of the aquatic resources throughout the State.

The Fish Culture Unit is comprised of the Pequest Trout Hatchery and the Charles O. Hayford Hatchery in Hackettstown. The Pequest Trout Hatchery raises and stocks over 725,000 brook, brown, and rainbow trout each year during the spring, fall, and winter trout stocking periods. Pequest also provides brown trout for the Division's successful Sea Run Brown Trout program in the Manasquan River. Newly renovated just in time for its centennial, the Hackettstown Hatchery raises the State's warmwater and coolwater species. The hatchery also coordinates the Division's popular Children's Fishing Derby program and supplies the State's Mosquito Commissions with sunfish, killifish, and Gambusia to assist with the Commission's efforts for effective mosquito control. Both the Pequest and Hackettstown hatcheries are in operation 24 hours a day, 7 days a week.

Research and Management Unit

The Research and Management Unit has personnel in two regionally placed offices; Lebanon Field Office (Hunterdon) and the Southern Regional Office (Camden). This unit oversees the management and protection of the State's over 27,000 miles of streams and over 400 public lakes. The biologists also carry out a number of freshwater research projects each year.

The Research and Management Unit conducts fishery surveys, classifies the state's waterways, provides technical input on a variety of watershed and habitat based issues, facilitates habitat restoration projects, serves as liaisons to a variety of sportsmen groups, and provides information to the general public, in a variety of forums, concerning the status of the State's fishery resources. The Research and Management Unit also administers permits for fish stocking, water lowering, commercial harvests, and scientific collecting to further provide for the effective management and protection of the State's aquatic resources.

For management purposes, the State is divided into six regional watershed management areas (Figure 1). Due to current staffing shortages vacant management regions have been subdivided and reassigned to remaining biologists. In addition to regional responsibilities, each biologist also has a specific area of expertise and oversees related research and management programs.

Upper Delaware, Pochuck and Wallkill Drainages

Patricia Hamilton – Coldwater Research & Management
Federal Aid Coordinator

Passaic and Hackensack and Toms River Drainages

Mark Boriek – Anadromous Fish Management

Lower Delaware and Atlantic Coastal Drainages

Chris Smith – Warmwater Research & Management
Anadromous Fish Management

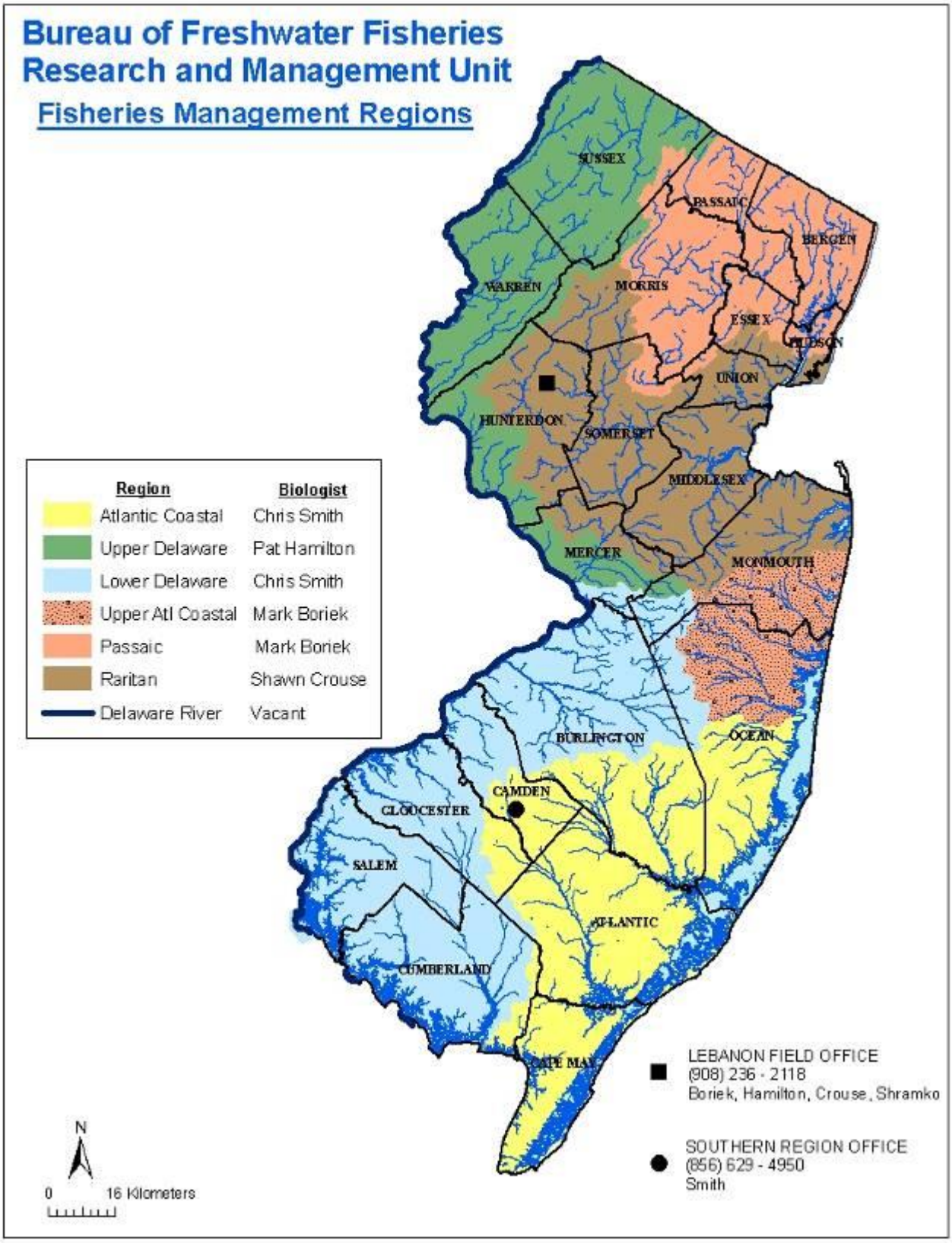
Raritan, Rahway, Navesink and Shrewsbury Drainages

Shawn Crouse – Native Fishes and Index of Biotic Integrity

Delaware River - Mainstem

VACANT

Figure 1.


Bureau of Freshwater Fisheries
Research and Management Unit
Fisheries Management Regions
Region
Biologist
Atlantic Coastal
Chris Smith
Upper Delaware
Pat Hamilton
Lower Delaware
Chris Smith
Upper Atl Coastal
Mark Boriek
Passaic
Mark Boriek
Raritan
Shawn Crouse
Delaware River
Vacant
SUSSEX
PASSAIC
BERGEN
WARREN
MORRIS
ESSEX
HUDSON
UNION
HUNTERDON
SOMERSET
MIDDLESEX
MERCER
MONMOUTH
BURLINGTON
OCEAN
CAMDEN
GLOUCESTER
SALEM
ATLANTIC
CUMBERLAND
CAPE MAY
LEBANON FIELD OFFICE
(908) 236 - 2118
Boriek, Hamilton, Crouse, Shramko
SOUTHERN REGION OFFICE
(856) 629 - 4950
Smith
N
0
16 Kilometers

FUNDING

The Division's Bureau of Freshwater Fisheries is funded entirely by New Jersey sportsmen, through the sale of fishing licenses and permits and through a Federal excise tax on the manufacturing of hunting and fishing related equipment. This includes both the Bureau's fish culture operations and research and management activities. This "user-pays" system has made great strides in financing the management of New Jersey's fish and wildlife resources, not only to the benefit of licensed hunters and anglers but to every one of the state's over 8 million residents. Wildlife associated recreation also generates $2.2 billion dollars into the state's economy each year, with an estimated 300,000 freshwater anglers generating $138 million dollars alone.

Licenses, stamps and permits

The sale of freshwater fishing licenses and trout stamps generates over $5 million dollars to the Division each year. Of this, 2.5 million is allocated to the Bureau of Freshwater Fisheries to operate its two state of the art fish culture facilities, the Pequest Trout Hatchery and the Hackettstown Hatchery, and to support the state's freshwater research and management efforts. The remaining funds are used to fund other activities within the Division such as Information and Education, Lands Management, and Law Enforcement, as well as Administrative staff.

Sport Fish Restoration Program

Federal excise tax money is distributed through the Sport Fish Restoration Fund administered by the United States Fish and Wildlife Service. The Sport Fish Restoration Program, established from an amendment to the Dingell-Johnson Act of 1950, provides funding for the management, conservation and restoration of fishery resources. The Sport Fish Restoration program is funded by revenues collected by the manufacturers of fishing rods, reels, creels, and lures, who pay an excise tax on these items to the U.S. Treasury.

For Federal Fiscal Year 2011, New Jersey was allocated $1,148,183 for Freshwater Fish Restoration. Of this amount, $900,000 is allocated to support fish culture operations for put and take, and delayed take fisheries programs (Grant F-50-D) and $248,183 is available for research and management programs (Grant F-48-R). Unfortunately, due to critical staffing shortages, the Research and Management Unit is unable to use a significant portion of available Federal Aid. As a result, several jobs within the grant have been discontinued and are currently classified as inactive. The list of active and inactive jobs funded through Grant F-48-R is found in Table 1.

The grant cycle for Research and Management runs from November 1 to October 31 of the following year. The program is a cost-reimbursement program, where the state covers the full amount of the approved project then applies for reimbursement for up to 75% of project expenses.

This report includes activities funded by both the dedicated monies of Hunters and Anglers funds and the Sport Fish Restoration Program. This report contains a site list of field surveys conducted in 2011 (Table 2) and a location map (Figure 2).

Table 1.

Active Jobs under Federal Aid Grant F-48-R-25 (November 1, 2010 – October 31, 2011)	
Project I	**Investigations and Management of Anadromous Fisheries**
Job I-1	Delaware River American Shad Population Estimate
Job I-2	Delaware River Juvenile American Shad Outmigration
Job I-5	American Shad Restoration in the Raritan River
Job I-7	Inventory and Status of Anadromous Clupeid Spawning Migrations in New Jersey Freshwaters
Project II	**Investigations and Management of Coldwater Fisheries**
Job II-7	Inventory of Trout Production Streams
Job II-10	Evaluation of Landlocked Salmon Introductions
Job II-11	Assessment and Restoration of Wild Brook Trout
Project III	**Investigations and Management of Warm and Coolwater Fisheries**
Job III-1	Inventory of New Jersey Lakes
Job III-2	Assessment and Management of Aquatic Invasive Fishes and Plants
Project IV	**Assessments of Biological Integrity and Recreational Use of New Jersey's Inland Waters**
Job IV-1	Assessment and Classification of New Jersey's Fresh Waters
Job IV-2	Mapping of the State's Aquatic Resources
Job IV-5	Management of Diseases and Fish Health in Wild Populations

Inactive Jobs under Federal Aid Grant F-48-R-25 (November 1, 2010 – October 31, 2011)	
Project I	**Investigations and Management of Anadromous Fisheries**
Job I-9	Delaware River Creel Survey
Project IV	**Assessments of the Biological Integrity and Recreational Use of New Jersey's Inland Waters**
Job IV-3	Angler Attitude, Preference, and Use Survey
Job IV-4	Index of Biotic Integrity for New Jersey's Piedmont Province

Table 2. 2011 Field Sampling Locations

Bureau of Freshwater Fisheries Research and Management Unit 2011 Field Sampling Activities	Assessment and Classification	Brook Trout Assessment	Inventory of Trout Production Streams	Anadromous	Lake Inventory	Invasive Species	Information and Education	Native Fishes	Raritan River S/Br Headwater Study	Species Management	Temperature and/or DO Monitoring	RBA Stream Sampling Protocol Applied*	Page # Results
Funding Source	**FEDERAL JOB #**						**HUNTERS AND ANGLERS FUND**						
	IV-1	**II-11**	**II-7**	**I**	**III-1**	**III-2**							
Delaware River Basin - Lower													
Alloway Lake (Salem)	▲				●							–	57,D
Cooper River Park Lake (Camden)						●				▲		–	19,D
Davis Millpond										●		–	35
Delaware River						●				▲		–	19,35,D
DOD Lake (Salem)										●		–	35, 36
Elmer Lake										●		–	35
Higbee Beach Lake										●		–	35
Hilliards Creek						●						No	19,35,D
Lake Audrey (Cumberland)										●		–	35
Little Mantua Creek						●				▲		No	19,D
Delaware River Basin – Lower (cont.)													

	Bureau of Freshwater Fisheries Research and Management Unit 2011 Field Sampling Activities	Assessment and Classification	Brook Trout Assessment	Inventory of Trout Production Streams	Anadromous	Lake Inventory	Invasive Species	Information and Education	Native Fishes	Raritan River S/Br Headwater Study	Species Management	Temperature and/or DO Monitoring	RBA Stream Sampling Protocol Applied*	Page # Results
	Funding Source	**FEDERAL JOB #**						**HUNTERS AND ANGLERS FUND**						
		IV-1	**II-11**	**II-7**	**I**	**III-1**	**III-2**							
	Mason Run - Pine Hill G. C. (Trump Nat.)													
	-Upstream golf cart path	▲	▲										Yes	39,16
	-Upstream gabion wall by apartments	▲	▲										Yes	40,16
	-Upstream recreated section culvert section	▲	▲										Yes	41,16
	-Downstream of trout production area	▲	▲										Yes	42,16
	Newton Lake						●				▲		–	19,35,D
	Prospertown Lake										●		–	35
	Silver Lake (Gibbsboro)						●						–	18,D
	Stewart Lake (Gloucester)						●				▲		–	19, 35,D
	Union Lake (Cumberland)										●		–	35
	Woodbury Creek						●				▲		No	19,35,D
Delaware River Basin- Upper														
	Lake Musconetcong										●		–	35
	Pohatcong Creek							●					No	28,43

	Bureau of Freshwater Fisheries Research and Management Unit 2011 Field Sampling Activities	Assessment and Classification	Brook Trout Assessment	Inventory of Trout Production Streams	Anadromous	Lake Inventory	Invasive Species	Information and Education	Native Fishes	Raritan River S/Br Headwater Study	Species Management	Temperature and/or DO Monitoring	RBA Stream Sampling Protocol Applied*	Page # Results
	Funding Source	**FEDERAL JOB #**						**HUNTERS AND ANGLERS FUND**						
		IV-1	**II-11**	**II-7**	**I**	**III-1**	**III-2**							
Passaic-Hackensack River Basin														
	Passaic River							●					No	29,44
Raritan River Basin														
	Electric Brook		▲							●			Yes	45,32
	Manalapan Lake	▲										●	–	22,58,D
	Raritan River, Farm Island Weir				●								–	13, D
	Raritan River, S/Br. (trib) (Diglio Ditch)		▲							●			Yes	46,32
	Raritan River, S/Br. (trib) (Drakestown)	▲	▲							●			Yes	47,32
	Raritan River, S/Br. (trib) (N of Drakestown)		▲							●			Yes	48,32
Raritan River Basin (cont.)														
	Raritan River, S/Br. (trib) (SW of Budd Lake)	▲	▲							●			Yes	49,32
	Raritan River, S/Br. (trib) (Warmwater)	▲	▲							●			Yes	50,32
	Raritan River, S/Br.													

	Bureau of Freshwater Fisheries Research and Management Unit 2011 Field Sampling Activities	Assessment and Classification	Brook Trout Assessment	Inventory of Trout Production Streams	Anadromous	Lake Inventory	Invasive Species	Information and Education	Native Fishes	Raritan River S/Br Headwater Study	Species Management	Temperature and/or DO Monitoring	RBA Stream Sampling Protocol Applied*	Page # Results
	Funding Source	**FEDERAL JOB #**						**HUNTERS AND ANGLERS FUND**						
		IV-1	**II-11**	**II-7**	**I**	**III-1**	**III-2**							
	-Stephens Mill Road	▲	▲							●			Yes	51,32
	-Flanders Drakestown Road	▲	▲							●			Yes	52,32
	-River Road, immediately above YMCA dam	▲	▲							●			Yes	53,32
	-Svea Drive (Vasa Park)	▲	▲							●			Yes	54,32
	Round Valley Reservoir (Hunterdon)										●		–	34
	Sun Valley Brook		▲						●				Yes	55,32

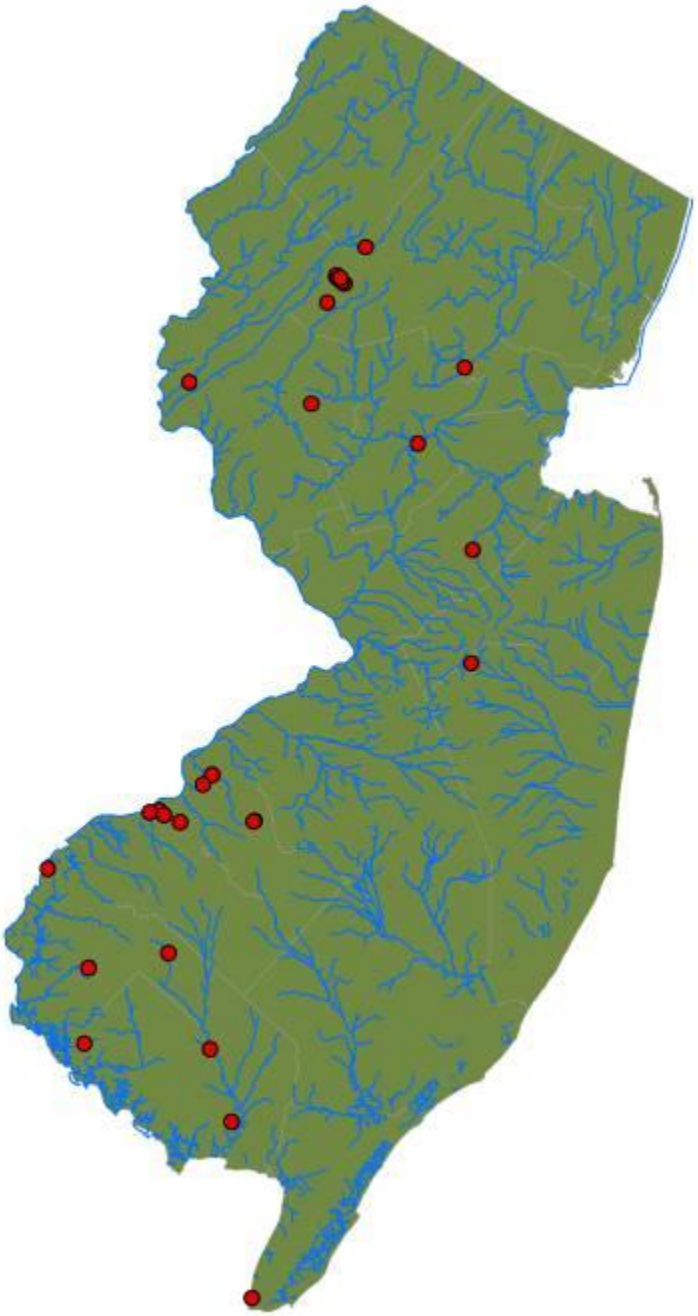
● Funding source or reason of data collection ▲ Additional projects data is applicable

** The Bureau of Freshwater Fisheries strives to use established sampling protocols for all field sampling efforts. However, certain sampling objectives adherence to established sampling protocols would be prohibitive to accomplishing project goals. In these instances non-standardized surveys are performed and are identified in appropriate areas within this document.*

Figure 2.

2011 FIELD SAMPLING SITES
DIVISION OF FISH AND WILDLIFE
BUREAU OF FRESHWATER FISHERIES

NEW JERSEY DIVISION OF
Fish and Wildlife



N = 33

FEDERAL FUNDED PROJECT SUMMARIES

Delaware River American Shad Population Estimate Job I-1

The major NJ recreational American shad fishery takes place within the main stem Delaware River from just north of Trenton to the NJ / NY state line with a very limited commercial fishery occurring in Delaware Bay. The single freshwater commercial fishery is The Lewis Fishery in Lambertville has provided valuable information on this species, but is currently operated primarily as a historical / hobby venture.

The continued decline of the Delaware River American shad population into the early 1970's, prompted the NJ Division of Fish and Wildlife (NJDFW) to expend considerable effort to monitor the spring Delaware River adult American shad *(Alosa sapidissima*) migration in order to estimate the magnitude of its population. Initially (1975 through 1992), a very labor intensive mark-recapture technique was employed. A contractor was contracted to conduct a population estimate using hydroacoustic technology, which was conducted intermittently from 1991 to 2007. The final report, which is summary of these research efforts, was completed in 2011 (Appendix D).

Delaware River Juvenile American Shad Outmigration Job I-2

Beginning in 1979, the NJ Bureau of Freshwater Fisheries seined for Delaware River juvenile American shad as far upstream as Matamoras, PA, and as far downstream as the mouth of Rancocas Creek, Delanco, NJ.

The collected data was used to develop an annual index of juvenile American shad abundance (JAI) for the Delaware River, and these JAI's satisfied a requirement of Atlantic States Marine Fisheries Commission. Ultimately, the JAI's were used by the ASMFC's American shad and River herring Technical Committee to develop management plans for the Atlantic Coast stocks of American shad.

Concurrent with the above mentioned sampling and presently, the NJ Bureau of Marine Fisheries conducts seining for Delaware River juvenile striped bass at representative stations, in the tidal river, from Trenton to Delaware Bay. Abundance of juvenile American shad are also recorded. As the American shad JAI data collected by the Bureau of Marine Fisheries in the lower, tidal river, mirrored the JAI data collected by the Bureau of Freshwater Fisheries in the upper, non-tidal river, it was decided that the Bureau of Marine Fisheries JAI data would satisfy the ASMFC's requirement. Staff reductions at the NJ Bureau of Freshwater Fisheries were also a factor in 2007 being the last year that Job I-2 fieldwork was performed. The final report, which is summary of these research efforts, was completed in 2011 (Appendix D).

American Shad Restoration in the Raritan River (Job I-5)

Adult American Shad, an anadromous species, return from the ocean annually to spawn in the same freshwater rivers and streams where they hatched 3 to 5 years prior. Although the actual numbers of historic shad passage on the Raritan are not well

documented, the run was often referred to as abundant for inhabitants along the river. By the late 1880's the runs were considered extinct due to water pollution in the New Brunswick area and the construction of low head dams preventing shad from reaching spawning areas. By the 1970's effective sewage treatments resulted in considerable improvements in water quality in the lower river and anadromous fish once again attempted to seek native spawning grounds. However, multiple dams still posed significant barriers in their path.

In the early 1980's, adult male and gravid female Delaware River American shad were stocked in an attempt to reestablish a spawning run. Subsequent to that, a dam, the Island Farm Weir, was constructed at the confluence of the Millstone and Raritan rivers by the Elizabethtown Water Company to improve the ability of a major water purveyor to collect water for potable water use. The weir was completed in October, 1995 and the adjacent vertical slot fish ladder, with an underground viewing chamber, opened on April 9, 1996.

Monitoring the passage of fish through the ladder commenced on April 22, 1996 using a high resolution, black & white video camera, time lapse VCR, and infrared lighting system powered by two deep cycle 12-volt batteries. The operation of the camera is labor intensive, requiring visits to the ladder at three-day intervals to replace batteries and tapes. The video tapes would then be viewed at a later date in the office (also labor intensive) and individual fish passage data recorded. Fish passage was routinely monitored in this manner during the spring (mid March – June 15) from 1996 – 2003 and in 2005, and 2011 (Table 1). Not all of the video has been viewed as 7 tapes from 1999 and 26 tapes from 2000 still must be reviewed. All of the tapes from 2002 must be reviewed again, for fish count and identification accuracy.

During Segment 25 the passage of American shad and other fish species through the fish ladder at the Island Farm Weir was monitored with a new digital recorder. Emphasis was placed on viewing the backlog of video tapes and a total of 55 tapes (1 tape = approximately 3 days of monitoring) were viewed. Additionally, all of the recorded (on SD cards) 2011 fish passage was reviewed.

This Job has recently taken on renewed importance because the three lowermost fish passage impediments on the Raritan River (Calco Dam, Nevius Street Dam, and Robert Street Dam) will be removed as part of a settlement through NJDEP's Natural Resource Damages funds. The only dam downstream of the Island Farm Weir, the Calco dam, was removed in the summer of 2011. The Robert St. dam is slate to be removed in July 2012. Under the next five-year grant agreement, which begins November 1, 2011, it will be proposed that this job be continued so fish passage can be monitored in 2012 (post dam removal). A table of fish passage can be found in Appendix D.

Inventory and Status of Anadromous Clupeid Spawning Migrations in New Jersey Freshwaters (Job I-7)

The objective of the Anadromous Clupeid Inventory (ACI) was to revisit all areas sampled during the 1972 to 1976 anadromous fisheries inventory conducted by H.E. Zich, which was originally conducted to establish the ground work for clupeid spawning migration documentation in New Jersey. Additional locations that were not sampled during the 1970's, which were deemed potential clupeid spawning locations, were included to assess the current status of American shad and river herring spawning migrations in New Jersey waters.

The Anadromous Clupeid Inventory sampled 112 locations for the presence of adult spawning clupeids from 2002 to 2007. A total of 27 locations were confirmed for alewife, five locations confirmed for blueback herring and four locations were confirmed for American shad. There were no clupeids collected at 78 of the locations. Of the 112 locations sampled while the job was active; 74 locations were "re-sampled" locations which were identified in the Zich Report. Thirty-eight locations sampled were considered "new" locations and had not previously been sampled by Zich.

A total of 122 of the 237 locations have not been sampled for the presence of anadromous clupeids. A total of 147 individual locations have been confirmed for the presence of adult anadromous clupeids from 60 drainages. 132 blockages consisting of lake dams, low head dams, flood gates, gaging station dams, natural barriers and culverts or pipes have been identified at the 237 locations. A final report for this project is found in Appendix D.

Inventory of Trout Production Streams (Job II-7)

Wild populations of brook, brown, rainbow, and lake trout are found in New Jersey. These self-sustaining populations are important indicators of healthy ecosystems. Trout require superior water quality and pristine habitat. Trout production waters are used by trout for spawning and nursery areas. Despite the protection that regulatory programs afford trout waters, ongoing changes in land use have impacted the state's coldwater fisheries populations. To assess the current status of designated trout production waters a monitoring schedule has been established to re-inventory trout production streams that have historical data (1968-1973). The data will be evaluated to determine if population changes have occurred and to develop management strategies to protect these fragile resources. Population data gathered from these investigations will also be utilized to develop criteria for streams regulated as Wild Trout.

In 2011, no surveys were specifically conducted under Job II-11 due to other Bureau priorities; instead efforts focused on analyzing past data collected (Appendix D).

Assessment and Restoration of Wild Brook Trout (Job II-11)

Anthropogenic landscape changes and past management practices have negatively impacted New Jersey's freshwater resources. In particular, resulting land use changes have taken their toll on brook trout, New Jersey's only native salmonid. Of the four species of trout occurring within New Jersey, brook trout are the least tolerant of habitat degradation. Habitat alteration and fragmentation, diminished water quality, and non-native salmonids have contributed to the decline of wild brook trout in New Jersey. Wild populations of brook trout persist in less than half their original range in New Jersey, and in some watersheds the status of brook trout is unknown. They have been extirpated from 96 sub-watersheds within the state.

NJ Division of Fish and Wildlife (DFW) actively participates in the Eastern Brook Trout Joint Venture, a unique partnership initiated in 2004 to unify range-wide efforts to protect, restore, and enhance aquatic habitat of brook trout in the eastern U.S. Through this partnership, a comprehensive assessment of the current status and resulting conservation plan was developed to help ensure the long-term viability of wild brook trout, not only in New Jersey but also across their entire native range.

In watersheds where the status of wild brook trout is unknown (Eastern Brook Trout Joint Venture's range-wide assessment) or poorly documented, streams are surveyed using established protocols (Appendix A). Physicochemical parameters measured include water temperature, dissolved oxygen, pH, alkalinity, conductivity, specific conductance, stream width, stream and depth, and substrate type. The EPA Rapid Bioassessment sampling habitat assessment protocol is also used to assess in-stream habitat and riparian conditions (Barbour et al. 1999) with regional modifications (Appendix B). The information collected is entered into *FishTrack*, (Fish and Wildlife's freshwater fish computerized database) and provided to the Eastern Brook Trout Joint Venture (EBTJV) partnership for range-wide mapping and planning purposes. NJDFW staff actively participates in EBTJV's planning activities. The information collected is also used to identify and prioritize NJ watersheds and streams for wild brook trout restoration. Appropriate projects will be initiated through partnerships with stakeholder groups (landowners and conservation organizations such as watershed associations and Trout Unlimited).

In 2011, no surveys were specifically conducted to assess or restore wild brook trout under Job II-11 due to other Bureau priorities. However, surveys conducted under a variety of other jobs and/or funding sources provide data that is useful in documenting the distribution and occurrence of wild brook trout (Appendix D). Surveys conducted as part of the S/Br. Raritan River Headwaters Study confirmed the continued presence of wild brook trout (Table 2). Surveys conducted on Mason Run, the only stream in southern New Jersey where wild brook trout occur, suggested that sedimentation is negatively impacting that population (pages 39-42).

Inventory of Lakes, Ponds and Rivers (Job III-1)
Successful management of New Jersey's warm/cool water fisheries resource is based upon specific knowledge of its physical, chemical, biological, and use characteristics. Such knowledge may serve to direct immediate management recommendations or be used as a base upon which to recognize future changes requiring remedial management efforts.

The Inventory of New Jersey Lakes Project collects physical, chemical and biological data upon which to base fisheries management recommendations. These parameters are analyzed for each lake utilizing standard sampling techniques.

Physical parameters include morphometry, bathymetry, access, watershed, and aquatic vegetation characteristics. Chemical parameters include basic water chemistry and sediment nutrient characteristics. Biological parameters include fish species composition, abundance (catch-per-unit-effort), length frequency distribution, and calculated indices of population structure and dynamics such as proportional stock density (PSD), relative weight (W_r), and age and growth.

The results of individual surveys are prepared as fisheries management plans. Reports include current status of the lake, fishery resource and recommendations for improvements. These reports are summarized and published for dissemination to the angling public.

This year Alloway Lake (Salem County) was inventoried and a final report completed. Alloway Lake is an impoundment of Alloway Creek. The lake has a rather diverse fish population with over 19 species documented. The lake has an excellent largemouth bass, black crappie, and white crappie population that will continue to improve as the lake achieves balance. The lake's dam was replaced in 2008 and the lake was refilled. The lake had been left in lowered condition for eight years following a Dam Safety mandated lowering in March 2000. Trophy Bass Regulations were established in 2012 and will help maintain an excellent largemouth bass population. The complete inventory report can be found in Appendix D.

Assessment and Management of Aquatic Invasive Fishes and Plants (Job III-2)
New Jersey is host to over 85 freshwater fish species and of these, nearly 60 are native. Native fishes contribute to the biological integrity of aquatic communities and may also be economically, recreationally, and culturally important. Introductions of invasive, non-native fish and aquatic plants are a growing concern of natural resource managers in New

Jersey and elsewhere because of their potential to dominate and destroy aquatic ecosystems causing irreversible economic and cultural damage.

Early detection and response to emerging threats posed by invasive fishes and macrophyte is critical in preventing their establishment and spread to other waters. A coordinated and proactive approach to invasive species management that includes public awareness, monitoring, control efforts, and regulatory components would help maintain and protect aquatic ecosystems from potentially damaging effects of invasive species.

Several non-native fishes considered invasive by other states have been recently documented in New Jersey, including northern snakehead, Asian swamp eel, flathead catfish, and bighead carp. In 2010, New Jersey's freshwater fishing regulations were amended to include a list of the following potentially dangerous fish species: Asian swamp eel, *Monopterus albus,* bighead carp, *Hypophthalmichthys nobolis,* brook stickleback, *Culaea inconstans,* flathead catfish, *Pylodictis olivaris*, grass carp (diploid), *Ctenopharyngodon idella*, green sunfish, *Lepomis cyanellus,* snakeheads, *Channa spp.*, oriental weatherfish, *Misgurnus anguillicaudatus*, silver carp, *Hypophthalmichthys molitrix*, and warmouth, *Lepomis gulosus*. These fish are considered to possess the potential for becoming a significant threat to indigenous animals, the environment, or public safety. Possession and/or release of live potentially dangerous fish species is now prohibited and if these species are encountered while angling they must be destroyed.

Freshwater anglers are also encouraged to report sightings of invasive non-native fish and aquatic plants (such as water chestnut) to NJDFW and to submit specimens or photos for verification. The Division's Bureau of Freshwater Fisheries staff investigates reported sightings of suspicious fish and aquatic plants. Sightings are confirmed through photos, samples, or site visits. Sites where invasive fish species have been previously documented are periodically monitored and invasive fish species captured are not returned to the water. The Bureau works in educating the public on the identification and issues surrounding invasive species through its Fish and Wildlife Digest publication.

Invasive Fish Species Management – Asian Swamp eel

The Asian swamp eel was first collected by the NJ Division of Fish and Wildlife Biologists in June 2008. Based on the size range of those individuals collected, the swamp eels were present prior to 2008 and had successfully reproduced in Silver Lake.

Swamp eels were first introduced to the United States in Hawaii some time around 1990. It was first identified as being present in the continental United States in 1994 based on specimens collected in ponds at the Chattahoochee Nature Center, located north of Atlanta, Georgia. They were first found in Florida in 1997. Three populations are known.

In 2011 the Bureau of Freshwater Fisheries sampled, via backpack electrofishing, Silver Lake and Hilliards Creek for the presence of Asian swamp eels (Table 2). Silver Lake was sampled six times for a total run time of 4.09 hours. The CPUE for 2011 was 39 fish per hour, which was higher than the 2010 CPUE of 29 fish per hour. There was a total of 159 swamp eels collected in 2011. Hilliards Creek was sampled once upstream and twice

downstream of Silver Lake. Three swamp eels were collected at the upstream location on July 14th.

The Bureau of Freshwater Fisheries collected and removed 768 Asian swamp eels from Silver Lake during the period of June 2008 to November 2010. In addition to Silver Lake, the Asian swamp eel has also been found in the waters directly upstream and downstream of Silver Lake in Hilliards Creek. Locations sampled were the vicinity of Alton Ave. (upstream) and Foster Ave (downstream).

Monitoring and control of the Asian Swamp eel has been limited to back pack electrofishing removal methods. Additional methods of removal are still being investigated to determine the feasibility of a large scale eradication project. The complexity of the habitat and physiological adaptability of the Asian Swamp eel significantly hinders a successful eradication.

Invasive Fish Species Management – Snakehead

Extensive sampling of New Jersey waters began in 2010 to identify the distribution of the northern snakehead in tributaries of the Delaware River. Sampling efforts were concentrated in the tributaries directly across the river from the Schuylkill River, however, were expanded after snakeheads were confirmed by anglers in the Rancocas Creek. In 2010 the Bureau sampled six tributaries of the Delaware River which included Big Timber Creek, Little Mantua Creek, Mathews Branch, Pennsauken Creek, Rancocas Creek and Woodbury Creek. Two impoundments (Stewart Lake and Cooper River Lake), which contain fish ladders and located within these drainages, were sampled. Young of the year snakeheads were confirmed by Bureau staff while electrofishing in Stewart Lake, Woodbury Creek drainage.

In 2011 reports of snakehead catches by anglers started around mid-April and continued through September. Most calls were received during May, June and July during the spawning season. Sampling at previously confirmed areas and newly reported locations began in July. Six different locations were sampled during the 2011 sampling period (Table 3). There were nine surveys completed of which northern snakeheads were encountered three separate times, all of which were at Stewart Lake, located in Woodbury, Gloucester County. A total of 6 adults and 356 young of the year snakeheads were collected in Stewart Lake.

Anglers have observed or caught snakeheads at all locations sampled. The snakehead population appears to be growing and expanding its distribution rapidly. Due to the extensive favorable habitat and sheer size of the Delaware River, eradication of the species does not appear to be feasible.

All locations that have been previously confirmed for the presence of invasive species will continue to be monitored in the future. Sampling for northern snakeheads should begin earlier in the season before spawning activity begins. Locations which have been determined to be spawning locations should be targeted utilizing boat electrofishing equipment. Other gear types including trap nets and seines should be considered for assisting in the capture of northern snakeheads where appropriate. Boat electrofishing equipment has proven to be rather inefficient for snakeheads. High conductivity within the Delaware River and tributaries appears to have a negative effect on electrofishing

efficiency. Targeting sampling locations earlier in the spring when salinity and conductivity is lower would most likely increase catch rates of snakeheads.

Monitoring efforts at Silver Lake and Hilliards Creek should continue on a weekly basis during the warmer months of May to October when the swamp eels appear to be more active. Additional locations downstream and upstream of Silver Lake should be sampled to ascertain if the distribution has expanded. Other sampling methods such as eel pots or minnow traps should be experimented with.

Table 3. NJ DFW 2011 Field Sampling efforts for Snakeheads

Waterbody	Location	Snakeheads
Cooper River Lake	Cherry Hill, NJ – Perimeter of Lake	0
Delaware River	Downstream of Woodbury Creek	0
Little Mantua Creek	Tributary to Delaware River	0
Newton Lake	Collingswood, NJ – Perimeter of Lake	0
Stewart Lake	Woodbury, NJ – Perimeter of Lake	6 adults, 356 young of the year
Woodbury Creek	Downstream of Woodbury Lake	0

Invasive Plant Species Management – Water Chestnut

Water chestnut, a non-native aquatic plant species that can rapidly colonize a waterbody once it is established, is becoming increasingly prevalent in New Jersey's waters. Early detection is the key to water chestnut control since smaller populations are easier to eliminate than larger ones. It also costs less to control a small infestation because plants can be individually hand-pulled. A large population requires the use of mechanical harvesters or application of aquatic herbicides to achieve control. It can be difficult and costly to eradicate water chestnut given this plant's hardiness (seed pods remain viable for 10+ years) and abundance.

Water chestnut is now found in approximately 20 waterbodies in 9 counties. Two new locations were noted in 2012, including Etra Lake in East Windsor, Mercer County and at several locations within Hunterdon County's Hoffman Park. Seasonal fisheries workers Tom Peck and Paul Saunders worked with park naturalist Tom Sheppard to conduct a site visit to the park, map water chestnut locations, and hand-pull individual plants in Manny's Pond, one of the Division's trout stocked waters. The Bureau will continue to work with Hunterdon County Parks to monitor water chestnut. Most new sightings are brought out our attention by anglers, who claim to have been make aware of the problem via recent invasive species articles in the Freshwater Fisheries Digest

The Division of Fish and Wildlife's Bureau of Land Management continued herbicide treatments in 2011 Baldwin Lake and Amwell Lake, both located on Wildlife Management Areas. The Division remains optimistic that herbicide treatments may control water chestnut in targeted waters.

Assessment and Classification of New Jersey's Fresh Waters (Job IV-1)

High water quality and habitat standards necessary for the survival and successful reproduction of trout have made these fishes useful bio-indicators of stream health. In 1968, the Bureau of Freshwater Fisheries initiated the process of identifying and classifying New Jersey waters according to their suitability to support trout. Five years later, a classification system for New Jersey waters was developed. The Bureau's classification system, although already in use by various programs within the Department, was formally recognized in 1981 under the State's newly adopted *Surface Water Quality Standards*.

Today, waters of the state are classified according to their suitability to support trout. Lakes are classified on their ability to support trout year round, whereas streams are classified on the occurrence of natural reproduction and the presence or absence of trout and/or trout associated species (Hamilton and Barno 2006). Ultimately, the more suitable a waterway is to supporting trout the higher the classification and the more protection it will receive. The Department's Land Use Regulation Program, through Stream Encroachment, Freshwater Wetlands, and the more recently developed storm water rules acknowledge the fragile nature of these ecosystems and provide additional protective measures.

Assessment and Classification of New Jersey's Fresh Waters - Streams

During the summer months a 150 meter section of stream is electrofished (single-pass) using one or more backpack electrofishing unit or a generator positioned on land or in a barge, with 2-3 hand-held anodes. All fish are captured and enumerated by species (total length measurements taken on all salmonids). Physicochemical parameters measured include water temperature, dissolved oxygen, pH, alkalinity, conductivity, specific conductance, and stream width, depth, and substrate type. The EPA Rapid Bioassessment habitat assessment protocol is used to assess in-stream habitat and riparian conditions (Barbour et al. 1999) with regional modifications (Appendix B).

Although a vast amount of work has been accomplished in classifying New Jersey waters, waters continue to be classified and reclassified according to their trout supporting capabilities, when justified by additional field investigation data collected by the Bureau. The official surface water classification of waters is changed by NJDEP's Bureau of Freshwater and Biological Monitoring through an established rule making process.

In 2011, no electrofishing surveys were conducted, strictly for classification purposes, by the Bureau of Freshwater Fisheries (BFF) under Job IV-1. Eleven additional surveys

were conducted under a variety of other jobs and/or funding sources including, but not limited to, this Grant and the *New Jersey Hunter and Angler Fund* (Table 2). Data collected during 2011 support the upgrade of three nontrout (NT) stream segments to trout production (TP), and one default NT water confirmed as NT, however data collected at the same locations in 2010, yielded similar results, and were previously submitted to Bureau of Water Monitoring and Standards (BWMS) as recommended changes to individual surface water classifications. Classification assignments were confirmed at three streams segments. Young-of-the-year (y-o-y) brook trout were found at only one of three locations within Masons Run; no changes to the SWQS are recommended.

A complete list of streams sampled in 2011 and resulting SWQS classification implications can be found in Appendix D.

Assessment and Classification of New Jersey's Fresh Waters - Lakes and Reservoirs

As part of the continued assessment of New Jersey waters dissolved oxygen/temperature profiles are performed to determine a lakes ability to support trout throughout the harsh summer months. During the summer most New Jersey lakes deeper than 3 m (10 ft) thermally stratify. The epilimnion (surface waters) become 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. A water temperature-dissolved oxygen profile is conducted in the deepest part of a lake using a YSI 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. The criteria used to determine trout-supporting water is water temperature $\leq$ 21ºC (69.8ºF) and dissolved oxygen $\geq$ 4 mg/L (Appendix A).

In 2011 one dissolved oxygen/temperature profile was conducted under this Job at Manalapan Lake (Middlesex Co.). An additional profile was conducted at Alloway Lake (Salem County) under Grant F-48-R-24, Job III-1, *Inventory of Lakes, Ponds, and Rivers*. Profile data are used to determine and/or confirm their trout-supporting capabilities and surface water classifications. Profiles conducted at Alloway Lake (120 ac) on August 24 and at Manalapan Lake (51 ac) on July 30 indicated summer trout supporting water was absent, confirming the current FW2-NT classification. Actual dissolved oxygen and temperature measurements are depicted on page 57 and 58. Both waters have a maximum depth of 10 feet.

Mapping of the State's Aquatic Resources (Job IV-2)

The identification of high quality resources is the initial step in protecting the state's natural resources. Environmental regulations play an integral role in balancing the needs of the natural environment with those of society. As NJ Fish and Wildlife furthers its efforts in identifying high quality aquatic resources, the need to incorporate this information into GIS layers to be utilized by other facets of the Department is long overdue. GIS layers will serve to document important migratory pathways, spawning areas, high quality resources, species distribution, and a form a basis for potential listing for threatened and endangered species status. These data layers will also serve a dual purpose in providing a basis for publications to promote angling opportunities within the state.

In 2011 the Bureau of Freshwater Fisheries continued evaluated the GIS Anadromous Layer that the Stockton Coastal Resources Center prepared for the Division. A number of errors have been identified in the maps that have been supplied to the Division which stem from the use of information acquired from the FishTrack database. Sampling records for "landlocked" alewives created false positives in a number of the drainages in North Jersey. During the next round of changes these inaccuracies will need to be rectified.

A critical component to mapping the state's freshwater resources is the Division's FishTrack database. The database houses the results of over fifty years of freshwater fisheries research and management field activities. QA/QC of this expansive dataset is a huge undertaking. The addition of a GIS staff person to the Bureau in 2010 has greatly increased progress in the QA/QC undertaking.

Management of Diseases and Fish Health in Wild Populations (Job IV-5)

In recent years several fish pathogens have spread through several regions of the United States and Canada causing fish kills that have alarmed fisheries agencies and anglers. In response to growing concern over the health of fishes in the wild, regional guidelines have been developed for northeast state fisheries management agencies that set forth essential requirements for the prevention and control of fish pathogens (Northeast Black Bass Technical Committee Report in 2006 and the Northeast Fish Health Committee Guidelines for Fish Importation in 2008). Investigations of suspected disease outbreaks, proactive monitoring, and administering regulatory programs aid managers in responding to problems and protecting fish health in wild populations. Regulations pertaining to fish stocking permits in New Jersey were strengthened in 2009 to help restrict the spread of fish pathogens. In 2011, Fish Health History forms were sent to 61 commercial hatcheries throughout the United States. Fish Health forms, and related pathogen test results were submitted for review by 25 private culture facilities. Twenty hatcheries (1 in-state and 19 out-of state) were approved to sell fish in New Jersey for stocking purposes.

In addition to regulatory protections, field investigations are also conducted in response to fish kills, reports of fish in distress, or unknown parasites. These reports are investigated to document if the mortality is disease related or the result of environmental

conditions (low dissolved oxygen, elevated water temperatures, pollution etc.) At times, several factors may have played a role in a fish kill. In 2011, field investigations were conducted on six waterbodies by Bureau of Freshwater fisheries staff. Five were conducted in response to reported fish kills, and one in response to the reported presence of *Argulus,* a fish parasite not commonly found in New Jersey.

Lake Musconetcong (Sussex County)

In late March, not long after ice out, the public first observed and reported dead fish on Lake Musconetcong, a shallow 329 acre lake managed by the NJ Division of Parks & Forestry. This incident was first believed to be the result of a "winter kill", which can occur during the winter but the effects of which may not be seen until spring. In a winter kill, fish die from a lack of dissolved oxygen, caused when the ice cover blocks sunlight from reaching aquatic plants, thereby interrupting the photosynthetic process that produces oxygen. A shallow, productive waterbody like Lake Musconetcong, that has extensive beds of aquatic vegetation and organic material, is especially vulnerable to this type of fish kill because of high rates of oxygen-consuming decomposition. However, unlike a "winter kill", in which the dead fish become visible after ice-out and then disappear, the public continued to report distressed and dying fish weeks after the dead fish were first noticed.

During a field survey on April 14 hundreds of dead fish in varying stages of decomposition were observed. The majority of the dead fish were sunfish (4-5 inches), but several dead adult chain pickerel and largemouth bass were also observed. Ten distressed, live fish (sunfish and one bass) were collected with a long handled net. Because NJ Division of Fish and Wildlife does not currently have a state fish pathologist on staff, the specimens were analyzed by the NJ Department of Agriculture lab in Trenton. All 10 of the fish tested had systemic infections caused by bacteria *Pseudomonas fluorescens*. This bacterium is an opportunistic pathogen that is always present in the environment. Infections such as these often occur in the spring and stress is thought to be a contributing factor, as fish enter the spring period are typically in a weakened condition because they've been eating at a reduced rate all winter. In this case, additional stress caused by the combination of the water lowering and the heavy and extended ice/snow cover on the lake, may well have contributed to the outbreak.

Lake Nummy (Cape May County)

A fish kill was investigated on July 26 at Lake Nummy, located in Belleplain State Forest, Dennis Township. Yellow perch were the only species affected, with approximately 200 dead fish observed by Parks staff. Surface temperatures ranged from 31.6 – 34.2°C and dissolved oxygen ranged from 5.4 – 6.32 mg/L. Stress brought on by the high temperatures and drought conditions caused this fish kill.

Unnamed detention Pond (Gloucester County)

A fish kill was investigated on June 13 at an unnamed detention pond in located at the intersection Regulus Drive and Altair Drive in Washington Township. One largemouth bass and one catfish were observed dead along the shoreline (out of the water). Live fish were observed swimming in the pond and there were no indicators

of an ongoing fish kill. The dead fish may have died earlier in the week during the hot temperatures or from pollutants that may have entered the pond from street runoff during thunderstorms the previous day.

Westville Pond (Gloucester County)
A fish kill at Westville Pond (Westville Boro), involving over 200 fish (largemouth bass, sunfish, golden shiner, brown bullhead, and common carp), was investigated on June 13. All dead fish were confined to the pond; no dead fish were observed in the tributary feeding the pond. This observation suggested that chemical pollutants did not enter the pond and cause the fish kill, as first believed by local residents. Based on the condition and decomposition of the dead fish, fish mortality most likely occurred following extremely high temperatures that occurred during the previous week, and not as a result of runoff entering the impoundment from a localized thunderstorm two days prior.

Field Investigation – Willow Crest Lake (Sussex County)
Willow Crest Lake, a 28-acre state owned lake in Stillwater Township within Swartswood State Park, was scheduled for lowering (for dam repairs) late March/early April. Near the end of March, just as the lowering was about to commence, and live fish salvaged and transferred to Swartswood Lake (located 2 miles downstream), an angler reported the presence of fish lice, *Argulus* (an external fish parasite), on fish inhabiting the lake. Trap nets set overnight yielded 300 – 400 yellow perch, 100 sunfish (bluegill and pumpkinseed combined) and about 20 other fish (chain pickerel, largemouth bass, and creek chubsuckers).

Initially *Argulus* were not observed attached to fish, however, some free-swimming lice were found in the fish holding tank. Although *Argulus* is visible to the naked eye, they have dorsoventrally flattened bodies that appear like a raised scale and are not readily discerned by an untrained eye. A more thorough inspection of a small subsample of fish found *Argulus* attached to the sunfish. A fair number of the fish, particularly yellow perch but also sunfish, were also infected with yellow grub (*Clinostomum complanatum*), a trematode parasite that is sometimes present in wild fish. Similar sampling and inspection of fish at Swartswood Lake also confirmed the presence of *Argulus* on walleyes, pumpkinseeds, and bluegills. Since this parasite was found on fish inhabiting both lakes it was determined that the impact of relocating the Willow Crest Lake fish population to the much larger Swartswood Lake (494 acres) would be negligible.

Field Investigation – Banchoff Park Pond (Mercer County)
A fish kill in Banchoff Park Pond, a small ¼ acre pond owned by Ewing Township was investigated on December 20. Dead catfish (channels and brown bullheads), largemouth bass, and bluegills were observed. There appeared to be a moderate algal bloom, however, water temperature and dissolved oxygen were normal. Distressed bluegills and a catfish were collected and taken to the NJ Dept. of Agriculture for fish pathogen analysis. Their bacteriology and virology results were inconclusive. The cause of the fish kill could not be determined.

HUNTERS AND ANGLERS FUNDED PROJECTS AND ACTIVITIES

FRESHWATER PERMITS

The Bureau of Freshwater Fisheries reviews and issues approximately 600 permits each year to provide for the effective management and protection of the State's aquatic resources (Table 4). These permits encompass eleven specific permits which include commercial harvest of aquatic species, water level management (for the protection of aquatic species), the introduction of aquatic species into waters of the state as well as the collecting of aquatic species for scientific purposes and special use permits. These permits and their review and approval not only include protection for freshwater fish, but also protection for other aquatic species such as frogs and turtles during critical spawning and hibernating periods. In addition to permits directly issued by the Bureau, the BFF also reviews Aquatic Use Permit Applications issued by the Department's Pesticide Control Program for the use of copper in waters known to be stocked or inhabited with trout. Trout are particularly sensitive to copper which is a basic agent for algal control treatments throughout the state.

Each year more and more staff time is spent in the review and approval of these permits due to staffing reductions and increased complexity in the management of the state's water resources and the variety of interests of their user groups. The Bureau throughout 2011 has attempted to proactively address this growing demand by providing more developed written guidelines to applicants, providing and updating on-line applications, as well as, performing mass mailings to applicant groups urging early coordination in application and project planning to avoid project and permitting delays.

Table 4. Permits issued by the BFF in 2011

Permit	Number Issued in 2011
Baitfish - Commercial	9
Fish Stocking	261
Gill Net – Staked - Commercial	0
Gill Net – Drifting - Commercial	0
Green Frog/ Bullfrog - Commercial	2
Haul Seine - Commercial	1
Miniature Fyke/pot	0
Scientific Collecting	59
Snapping Turtle - Commercial	80
Special Use Limited License	47
Water Lowering	140
Total	**599**

Freshwater Permits - Tournament Report Summary

The popularity of recreational and tournament bass fishing was elevated to a new level during the 1960's. In an effort to unite bass anglers nationwide Ray Scott created the Bass Anglers Sportsmen Society (B.A.S.S). The goal of BASS was to emphasize conservation, education, and sportsmanship.

Since 1996 the Division of Fish and Wildlife has required a permit to hold fishing tournaments on Wildlife Management Area Lakes. Permits are necessary to regulate the number of tournaments held on WMA Lakes, due to an increasing demand on our public waterbodies. The Divisional collects valuable information from tournament reports to supplement existing fisheries data.

In 2011, the Bureau of Freshwater Fisheries issued 168 fishing tournament permits at 18 Wildlife Management Area locations throughout New Jersey. Thirty-two organizations were involved in fishing these tournaments. The three most popular areas among tournament anglers were Lake Assunpink, Stone Tavern Lake and Union Lake. Thirty-nine permits were issued to 16 different organizations at Assunpink Lake. Thirty permits were issued to 12 organizations at Stone Tavern Lake. Twenty-nine permits were issued to 18 organizations at Union Lake. The largest bass of the year was again caught at Lake Assunpink and weighed 7.22 lbs. Lake Audrey had its first year in which tournament fishing was permitted and five permits were issued to five different organizations.

INFORMATION AND EDUCATION

In addition to a multitude of research and management activities, the Bureau of Freshwater Fisheries actively participates in a number of Information and Education activities each year. Several such as two annual Fisheries Forums, a Public Trout Meeting, and biennial Public Hearing are directly tied to research and management activities and promulgation of rules governing the state's freshwater aquatic resources. In addition, Bureau staff actively participates in the preparation of the Freshwater Fishing Digest. The Freshwater issue of the Digest is perhaps the most widely distributed publication throughout the Department.

Information and Education – Meetings/Conferences

New Jersey participates in a number of regional initiatives geared towards the protection of the nation's freshwater fisheries resources. As such, state fisheries biologists participate in a number of regional panels and workshops to share information and experiences with biologists in other states on a variety of topics in the realm of fisheries management.

In 2011, Research and Management staff attended the following meetings and workshops:

Fish Identification Course - Funded through the Sport Fish Restoration Program, this fish identification course was held at the US Fish and Wildlife's National Conservation

Training Center. The week long course promoted interagency collaboration while improving participants' fish identification skills and knowledge of freshwater fish species. Garnered from the course was an overall system for identifying fish, including collection labeling and preservation, sample processing, use of distribution maps, use of dichotomous keys, and taxonomic procedures.

Wildlife and Sport Fish Restoration (WSFR) Program Grant Leaders Training Course
Funded through the Sport Fish Restoration Program, USFWS instructors provided training on the fundamentals of grant administration. Valuable instruction was received regarding planning, procedural, and compliance issues associated with federal grants, as well as the process for preparing new jobs and five-year grant agreements.

Information and Education –Stream sampling demonstration
An electrofishing demonstration was performed for DeSales University professor Joseph Colosi and his General Ecology class on the Pohatcong Creek in Warren County on October 24. Students are eager to learn about fisheries management, hatchery operations, fish identification, and environmental stewardship. Species typically encountered during this survey include young-of the-year (yoy) and adult wild brown trout, stocked trout species, margined madtom, American brook lamprey, American eel, blacknose dace, longnose dace, cutlips minnow, tessellated darter, shield darter, creek chub, and white sucker (page 43).

Information and Education – Presentations
Each year state fisheries biologists attend meetings of a variety of organizations which may include angling clubs, watershed groups, local planning boards, and sportsmen shows. In 2011, presentations on the fisheries resources within the state were presented to:

- Garden State Outdoor Sportmen's Show
- World Fishing & Outdoor Expo (Suffern, NY)
- Sportmen's Show
- Freshwater Fisheries Forum (South)
- Outdoor Writer's Workshop
- Round Valley Trout Association
- Ridge & Valley Chapter of Trout Unlimited
- Lyon's Club of Gloucester County

Information and Education – Public Events
Every year the Division holds an annual **Open House** at the Pequest Trout Hatchery and Natural Resource Education Center, prior to the opening of trout season. Each year thousands of people of all ages come to the hatchery to see the trout that are raised, and participate in many activities including kids fishing, shooting sports, fisherman's flea market, and much more. Staff assist in a number of facets including assisting at the Fishing Education Pond, providing demonstrations on the stripping an fertilization of eggs, providing fish for the kiddy pool, and answering questions from the general public.

The **New Jersey WILD Outdoor Expo** is an event celebrating the state's bountiful natural resources and rich outdoor heritage. Timed to coincide with National Hunting and Fishing Day, the first ever NJ WILD Outdoor Expo was held on Saturday and Sunday, September 17-18, in 2011 at the division's Colliers Mills Wildlife Management Area. The event featured exhibits, seminars, demonstrations, and activities for the entire family, blending conservation information, education, and hands-on opportunities to learn outdoor skills and activities. Activities included fishing, hiking, shooting sports, kayaking, camping, wildlife watching and much more. Turn Mill Lake was stocked with over 2,500 fish collected from Prospertown Lake as the result of the dam failure in September 2011, just prior to the Outdoor Expo.

Fisheries biologists also attend the annual **Teen Anglers NJDFW Day** at the Pequest Trout Hatchery.

Staff also participated in the **Union County's Annual BioBlitz**. The goal of the Bio-Blitz was to quantify species diversity within the public park system and to educate the public. This year the event was held at Passaic River Parkway Park on June 11. Fish were collected at multiple sites along the Passaic River in Berkeley Heights, New Providence, and Summit (page 44). The team used a variety of sampling methods including electro-shocking and seining. The fish diversity was high, consisting of 21 species, a new Union County BioBlitz record. Fish species include common carp, golden shiner, creek chub, spottail shiner, eastern silvery minnow, satinfin shiner, longnose dace, blacknose dace, white sucker, banded killifish, western mosquitofish, chain pickerel, white perch, tessellated darter, green sunfish, pumpkinseed, redbreast sunfish, bluegill, black crappie, yellow bullhead, and one stocked rainbow trout. The warmwater fish assemblage encountered provides recreational opportunities for both the novice naturalist and the expert angler including plenty of redbreast sunfish, common carp, and even stocked trout. The fish team also conducted one waterfront public presentation, consisting of a fish collection demonstration by means of the use of a backpack electrofishing unit and a twenty-foot seine.

ANADROMOUS FISHES AND CONNECTIVITY

River herring stocks have drastically declined since the 1960's throughout their entire range. Though fisheries managers have not been able to pinpoint one reason for this decline, probable causes include ecological changes, habitat loss, water quality degradation, overfishing, and predation. The Batsto River and Mullica River have exhibited a decline similar to those observed in many of New Jersey's major watersheds and throughout the entire range. In order to increase the population and restore it to sustainable levels, nationwide changes in the factors contributing to the decline are needed. Continued efforts to remove impediments, increase habitat, reduce overfishing, reduce by-catch, and reduce predation will ultimately determine the abundance of the river herring population.

Working towards this goal, the Bureau of Freshwater Fisheries participates in the **Northeast Regional Connectivity Assessment Project**, which intends to support state's natural resource agencies within the project area to reconnect fragmented river, stream, coastal, reservoir, lake, and estuarine habitat by removing or bypassing key barriers to fish passage thereby enhancing populations of fish including: diadromous fish, coldwater species, and other species of greatest conservation need (SGCN). This project will compile region-wide spatial data and protocols, and develop spatial analysis products, that will assist in the prioritization of fish barrier mitigation projects in order to more efficiently conserve and restore target species.

Specifically, the Workgroup will assist TNC in the following tasks:

- Assemble existing spatial data on dams, fish passage facilities, and likely impassable culverts from state and federal agencies
- Assemble existing data on the relative condition of watersheds (at relevant scales) into a GIS database.
- Assemble existing data on locations and populations of diadromous fish, brook trout and the locations of federal/state listed species into a GIS database
- Develop evaluation criteria to identify priority river and stream networks
- Develop evaluation criteria to identify priority barriers that if mitigated, will improve connectivity within systems
- Support development of a regional landscape scale management strategy by using the information compiled and developed to prioritize key systems and barriers

The Bureau of Freshwater Fisheries participated in monthly online conference calls to review and establish proposed matrix. In addition to conference calls we reviewed and edited GIS fish distribution maps of the six critical species and their spawning habitats.

NATIVE FISHES

New Jersey is home to nearly 60 native fish species, which form a significant component of the State's aquatic biological diversity and natural resource heritage. A list of fish species found in New Jersey can be found in Appendix C. While many native fish species are common, abundant, and widely distributed, there also some that are of conservation concern including, but are not limited to the bridle shiner, ironcolor shiner, comely shiner, swallowtail shiner, northern hog sucker, mud sunfish, blackbanded sunfish, bluespotted sunfish, banded sunfish, shield dater, and slimy sculpin. Many factors including landuse changes, habitat loss, decline in water quality, and presence of invasive species threaten the survival of all aquatic biota, primarily those most sensitive.

A formal review process to determine the status is needed so that protection and management strategies can be implemented. The loss of any of these unique fish species through human impact is an undesirable outcome and represents a failure of our resource stewardship. In addition, natural factors such as climatic variations and watershed succession may dictate the future decline or expansion of fishes that are on the periphery of their established ranges. Further study is required to determine the current abundance and distribution of these nongame fishes throughout the state. Next steps include database QA/QC, additional fisheries surveys, mapping, and Delphi process to determine status, all of which will result in the formation specific management objectives.

Two important meetings were held in 2011 intended to jumpstart future work, ensuring the proper management of our most imperiled native fish species. A presentation was given on the status of blackbanded sunfish to staff from the Endangered and Nongame Species Program and Freshwater Fisheries on February 17. Based on data shared at a blackbanded sunfish workgroup meeting held in 2010, the New Jersey Pinelands have the greatest abundance and distribution of this species anywhere in the world. Although the Pinebarrens serves as a refugium, suitable habitat is shrinking with altered water quality, allowing non-native fishes to compete with and predate upon this intolerant species. New predators such as the snakehead and flathead catfish may contribute towards the decline of this species.

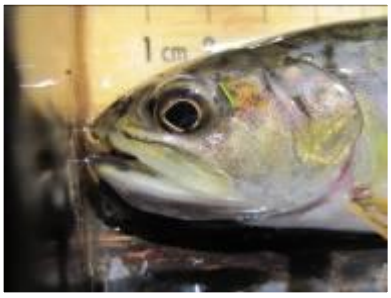
A presentation titled, "Native Nongame Fish Status," was given to the Division's Endangered and Nongame Species Advisory Committee on November 16 explaining various BFF Research and Management activities and preliminary status of select native species the Bureau's FishTrack database. Next steps include gathering additional fisheries data from other agencies, creation of distribution maps, and initiation of the Delphi process to address the status of native fishes.

In 2011, no electrofishing surveys were conducted specifically targeting native fishes. However, all fisheries surveys provide valuable data towards our understanding of the status and distribution of our native fish resource (Table 2).

SPECIES MANAGEMENT
Species Management – Brook Trout

The Bureau of Freshwater Fisheries worked closely with Montclair State University Department of Biology and Molecular Biology doctoral candidate Luke Diglio, as part of a dissertation proposal, titled *The Impact of Dam Removal Upon Population Dynamics of Native Relict Brook Trout (Salvelinus fontinalis) and Exotic Brown Trout (Salmo trutta) in the Headwaters of a Northern New Jersey Stream System*. This study will provide not only valuable information in regards to the status and distribution of brook trout and update New Jersey's Surface Water Quality Standards, but also a better understanding of this unique brook trout metapopulation(s) and it's interaction with brown trout once the dam is removed, allowing for protection and enhancement of this and other similar fisheries.

An important component of is the **Raritan River S/Br Headwater Study**. A series of electrofishing surveys were conducted at many sites on the Raritan River South Branch and on 10 of its tributaries in Morris County during the summers of 2009 through 2011 (Table 2). Brook trout were marked during the summers of 2010 and 2011 from 6 different streams with unique locations and color combinations of Visible Implant Elastomers (VIEs) as part of a mark / recapture study of brook trout metapopulation dynamics (Table 5). During the summer of 2010, 427 trout were marked. When resampled the following winter, 345 trout were captured, consisting of 48 previously marked fish (11%), found in their original stream, while 5 marked fish (1%) were found in waters other than their original streams. During the spring of 2011, 263 trout were collected, consisting of 28 marked fish, found in their original stream, and 0 marked fish, found elsewhere. During the summer of 2011, 576 trout were captured, however only 1 marked trout was captured. Of the 576 trout, 337 were marked with new color combinations to be recaptured in subsequent sampling events. When resampled the following winter, 436 trout were captured, consisting of 57 previously marked fish, found in their original stream, while 6 marked fish were found in waters other than their original streams. Initial data indicate that although marked brook trout tended to be recaptured in their "home stream" most of the time, 6 fish were found in adjacent streams, indicating moderate movement.



These waters will be electrofished again during the spring and summer in an effort to recapture these VIE marked fish. Documentation of their location will provide information on metapopulation dynamics, specifically whether each population functions independently or if there is a greater likelihood of gene flow between populations. The presence of a failing dam on the South Branch, which will likely be removed, presents an interesting component to the study. Wild brook trout are found both above and below the dam, whereas wild brown trout are primarily found below dam.

Table 5. Data for brook trout marked and recaptured during various seasons for Raritan River S/Br Headwater Study using Visible Implant Elastomers (VIE).

	Raritan River S/Br	R.R. S/Br (trib) (SW of Budd Lake)	R.R. S/Br (trib) (N of Drakestown)	R.R. S/Br (trib) (Drakestown)	R.R. S/Br (trib) (Diglio Ditch)	Sun Valley Brook	R.R. S/Br (trib) (warmwater)	Total
Summer 2010 marked	84	100	100	100	35	6	0	427
Summer 2010 VIE color	red	yellow	green	yellow	red	green	NA	
Summer 2010 VIE location	right	right	left	left	left	right	NA	
*2 trout marked with green-left were found in the Raritan River S/Br during the 2010 marking period.								
Winter recapture (all)	40	78	43	164	16	5	0	346
Winter recap. w/mark from original stream	9 (11%)	10 (10%)	8 (8%)	14 (14%)	7 (20%)	0	0	48 (11%)
Winter recap. w/mark from another stream	1 RL 1 YL	0	0	2 RR	1 RR	0	0	5 (1%)
Spring 2011 recap. (all)	18	67	52	116	4	6	0	263
Spring recap. w/mark from original stream	2 (2%)	12 (12%)	7 (7%)	6 (6%)	1 (3%)	0	0	28 (6%)
Spring recap. w/mark from another stream	0	0	0	0	0	0	0	
Summer 2011 recapture (all)	3	178	105	180	31	4	0	576
Summer recap. w/mark from original stream	0	0	0	0	0	1 (20%)	0	1 (0.2%)
Summer recap. w/mark from another stream	0	0	0	0	0	0	0	0
Summer 2011 marked	3	100	100	100	30	3	0	336
Summer 2011 VIE color	white	blue	purple	blue	white	purple	NA	
Summer 2011 VIE location	left	left	right	right	right	left	NA	
Winter recapture (all)	34	112	56	204	29	1	0	436
Winter recap. w/mark from original stream	1 WL (33%) 1 RR (1%)	14 (14%)	14 (14%)	21 (21%)	6 (20%)	0	0	56 (17%) 57 (17%)
Winter recap. w/mark from another stream	1 PL 2 PR 2 BR 1 BL	0	0	0	0	0	0	6 (2%)

Species Management – Lake Trout

Lake trout are found in only two waterbodies within New Jersey, Round Valley Reservoir and Merrill Creek Reservoir. The populations in both reservoirs are surveyed annually. The Merrill Creek population is surveyed by a private consultant hired by the Merrill Creek Owners Group. The lake trout (*Salvelinus namaycush*) population in Round Valley Reservoir is surveyed each fall by the Division of Fish and Wildlife to evaluate the status of this trophy trout fishery. Lake trout reared at the Hackettstown Hatchery were stocked in this deep reservoir (maximum depth 160 feet) from 1977 until 1995. In 1985, evidence that natural reproduction was occurring within the reservoir was documented. By 1995, it was determined that the population was capable of maintaining itself by natural reproduction, thus stocking was discontinued. Gillnet surveys are conducted every fall, when mature lake trout seek out suitable spawning habitat along the boulders lining the reservoir's dams. Eight experimental gillnets, each having three different small mesh size openings, are used to capture a range of lake trout from juveniles to sub-adults. Eight large-mesh gillnets (6" stretch mesh) are set near the reservoir's north and south dams to capture mature adult lake trout as they begin congregating to spawn over the rocky substrate. Length and weight information is collected to assess physical condition of the fish using relative weight analysis. In addition, sex, finclips, and sexual development information are also recorded.

A salmonid diet study was also initiated at Round Valley Reservoir in 2006, in which volunteer anglers provide their catches to the Division. Stomachs are dissected and their contents observed. The most prevalent food items are gammarus, choronomids, and isopods, while less than 10% of all trout had items identifiable as fish. Most ingested fish were young sunfish. Alewives were only found in salmonid stomachs following the stocking of alewives.

In 2011, eight experimental gillnets were retrieved on October 21 and 26 resulting in the capture of 105 lake trout ranging from juveniles to sub-adults. On November 8 and 9, eight large-mesh gillnets were retrieved near RVR's north and south dams capturing 32 sub-adult and adult lake trout. Mature fish congregate over the rip-rap as they approach the dams to spawn. The total number of lake trout captured was 137. Fifty-nine lake trout weighed less than 1 lbs., twenty-five between 1 and 2 lbs., thirty-seven between 2 and 3 lbs., twelve between 3 and 4 lbs., two between 9 and 10 lbs. and one over 12 lbs. The largest lake trout weighed in at 9.6 lbs. and measured 30.2 inches. Data will be analyzed and compared to lake trout data collected in previous years. In an effort to further liberalize the take of lake trout, a new regulation was adopted by the Fish and Game Council and will go into effect on January 1, 2012. The new regulation allows the harvest of 6 lake trout from 15 inches to less than 24 inches and one additional lake trout 24 inches or greater.

Species Management – Largemouth Bass

Increasing angler demand for quality largemouth bass fisheries and the recent confirmation of largemouth bass virus in New Jersey has elevated the need to establish more active bass management techniques. Fourteen waterbodies were sampled for large and smallmouth bass in 2011 (Table 6). Several waters, including Union Lake, and Lakes Audrey and Musconetcong are sampled regularly, with recent management plans. Others such as Elmer Lake and Davis Millpond have not been sampled for over ten years.

Supplemental stockings of largemouth bass in Union Lake have helped to reverse the affects of largemouth bass virus. Stocking smallmouth bass in Union Lake and Lake Audrey have provided South Jersey anglers with new fishing opportunities that were once only available in North Jersey. Alloway Lake continues to be one of the most talked about new public waterbodies in New Jersey. A dam repair project completed in 2008 opened up a new public fishing opportunity on this once private lake. Bass in excess of five pounds were collected during electrofishing in 2009 and 2010. Though sampling efforts on the Delaware River and its tributaries were focused on invasive species, valuable bass data was collected while electrofishing. Extensive submerged aquatic vegetation throughout the lower tidal Delaware has increased habitat for both largemouth and smallmouth bass. Both species were well represented and were in good condition.

A number of waters were stocked with largemouth and smallmouth bass in 2011. Waterbodies that were sampled in recent years, those that had dam replacements and those that have been affected by largemouth bass virus were stocked with 2" fingerlings raised at Hackettstown Hatchery. Lakes with developing smallmouth bass populations were also stocked including Lake Audrey, Manasquan Reservoir, Union Lake, and Splitrock Reservoir.

Table 6. List of waters sampled for Largemouth and Smallmouth bass.

2011 Waters Sampled for Bass	County
DOD Lake	Salem
Lake Audrey	Cumberland
Elmer Lake	Salem
Union Lake	Cumberland
Main Ditch / Delaware River	Gloucester
Higbee Lake	Cape May
Davis Mill Pond	Cumberland
Woodbury Creek	Gloucester
Stewart Lake	Gloucester
Newton Lake	Camden
Prospertown Lake	Burlington
Lake Musconetcong	Morris

Species Management – Muskies

The DOD Lake, located in Pennsgrove, Salem County was stocked with muskies in 2009. Muskies have been stocked in a number of waters in the southern portion of the State since the stocking program began; however have never become well established. Mercer Lake, Mercer County is currently the southern most waterbody with an established musky population. Electrofishing was completed on July 27th to evaluate the budding musky population at DOD Lake. Although no muskies collected, it is anticipated that anglers will begin catching them in the next couple of years.

FISH SALVAGES

Permitted fish salvages are necessary under a variety of circumstances, such as substantial water lowering events related to projects such as the dredging of a lake or a the repair of a dam. These salvages are typically conducted by trained private aquatic consultants and are conducted under controlled circumstances, during the more favorable conditions encountered in the fall and can be a relatively simple exercise. On the other hand, every year as the result of a catastrophic dam failure or merely a minor leak, compounded with increased water temperatures and diminished oxygen levels during the summer, countless fish are threatened with demise. During emergency situations on State owned property such as Wildlife Management Areas or those managed by the Division of Parks and Forestry, the Bureau of Freshwater Fisheries may mobilize to conduct fish salvages to rescue fish and relocate them to suitable waters.

A fish salvage was completed at Prospertown Lake on September 12th, 13th, 15th and 20th. The lake level had dropped approximately one foot per day since September 3rd as a result of the dam failure caused by Hurricane Irene. A total of 4200 fish were collected and relocated. Approximately 3000 fish were relocated to Turnmill Pond, located in the Colliers Mills WMA. The remaining fish were relocated to Pemberton Lake WMA. All fish were collected via boat electrofishing and transported via hatchery trucks from borrowed from the Hackettstown State Fish Hatchery. Crews from the Bureau of Land Management assisted with the project. The lake will be restocked once the dam is repaired.

TECHNICAL ASSISTANCE

In order to protect New Jersey's critical aquatic resources fisheries biologists provide input on a number of land use projects each year. Coordinated through the Division's Bureau of Environmental Review, this input is directed towards minimizing land use change impacts on state's fisheries resources. This is typically accomplished through the use of timing restrictions during critical fish spawning periods, protection of riparian buffers, and project modification, assuring best use practices are implemented at all times. However, at times a more in depth review and comments are necessary on specific projects.

In 2011, staff also provided technical assistance related to stream restoration and dam removal projects, as described below.

West Brook Pollution Incident

Multiple inspections were conducted on a small, un-named tributary to West Brook (Passaic County) following the accidental discharge of silt-laden water from an adjacent quarry. The extensive silt deposition threatened the reproducing trout populations in both the tributary and West Brook. Technical guidance relative to procedures to remove the silt was provided and close supervision of the clean-up, in concert with NJDEP - Northern Bureau Water Compliance and Enforcement, resulted in a successful restoration.

Lower Muscontecong River Restoration Partnership

The Bureau actively participates in this Partnership, comprised of state and federal agencies (NJDEP, NRCS, NOAA, USFWS, NPS), and nonprofit organizations (Musconetcong Watershed Association, Trout Unlimited, American Rivers, and North Jersey RC&D). This group works with willing dam owners and obtains grants for dam removals to improve the health of the river and restore pathways for migratory fishes. In 2011 the Partnership was successful in removing two obsolete dams located less than two miles upstream from the Delaware River. The dam in the town of Finesville was removed, capping an effort initiated four years ago. The other dam removed was the Riegelsville dam, an old mill dam partially located within the Division's Musconetcong River Wildlife Management Area.

2011

SUMMARY
STREAM SURVEY DATA

This section of the report includes stream survey data completed by the Bureau of Freshwater Fisheries in 2011. 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 A. 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 B). 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 by which it was funded. 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.

Surveys in the Lower Delaware River Basin

MASON RUN

Project: Species Study	**Drainage:** Lower Delaware River Tributaries
Location: Pine Hill Golf Course (Trump National). Upstream golf cart path.	**County:** Camden
Date: August 9, 2011	**Municipality:** Pine Hill Borough

Summary

Electrofished first of four stream segments on Mason Run (Camden County), Southern New Jersey's only reproducing brook trout population. The population appears to be severely impacted by sedimentation and possibly high flow conditions. There were numerous young of the year observed early in the spring however no young-of-the-year (yoy) trout were collected. One adult brook trout was collected (252 mm). Water temperatures were good and consistent with past findings.

Water Chemistry & Habitat	
Water temperature	18.5°C
Dissolved oxygen	7.6 mg/L
pH	-
Alkalinity	-
Specific conductance	-
Sample length	150 m
Habitat assessment score	120 (sub-optimal)

Fish species	Number
mud sunfish	1
American eel	4
brook trout (older than y-o-y)	1 (251)

Recommendation: The entire stream appears to have significantly changed in the last few years with the addition of large quantities of sediment. The source of this sedimentation needs to be identified and eliminated in order to protect this valuable resource.

MASON RUN

Project: Species Study	**Drainage:** Lower Delaware River Tributaries
Location: Pine Hill Golf Course (Trump National). Upstream gabion wall by apartments.	**County:** Camden
Date: August 9, 2011	**Municipality:** Pine Hill Borough

Summary

Electrofished second of four stream segments on Mason Run (Camden County), Southern New Jersey's only reproducing brook trout population. The population appears to be severely impacted by sedimentation and possibly high flow conditions. There were numerous young of the year observed early in the spring however no young-of-the-year (yoy) trout were collected. One adult brook trout was collected (233 mm). Water temperatures were good and consistent with past findings.

Water Chemistry & Habitat	
Water temperature	16.9°C
Dissolved oxygen	7.84 mg/L
pH	-
Alkalinity	-
Specific conductance	-
Sample length	150 m
Habitat assessment score	148 (sub-optimal)

Fish species	Number
mud sunfish	2
American eel	5
chain pickerel	1
brook trout (older than y-o-y)	1 (233)

Recommendation: The entire stream appears to have significantly changed in the last few years with the addition of large quantities of sediment. The source of this sedimentation needs to be identified and eliminated in order to protect this valuable resource.

MASON RUN

Project: Species Study	**Drainage:** Lower Delaware River Tributaries
Location: Pine Hill Golf Course (Trump National). Recreated section from culvert section upstream.	**County:** Camden
Date: August 9, 2011	**Municipality:** Pine Hill Borough

Summary

Electrofished third of four stream segments on Mason Run (Camden County), Southern New Jersey's only reproducing brook trout population. The population appears to be severely impacted by sedimentation and possibly high flow conditions. There were numerous young of the year observed early in the spring however only one young-of-the-year (yoy) trout was collected. Two adult brook trout were collected. Water temperatures were good and consistent with past findings.

Water Chemistry & Habitat	
Water temperature	18.7°C
Dissolved oxygen	8.26 mg/L
pH	-
Alkalinity	-
Specific conductance	-
Sample length	150 m
Habitat assessment score	135 (sub-optimal)

Fish species	Number
tessellated darter	13
American eel	7
eastern mudminnow	2
brook trout (y-o-y)	1 (72)
brook trout (older than y-o-y)	2 (270 - 308)

Recommendation: The entire stream appears to have significantly changed in the last few years with the addition of large quantities of sediment. The source of this sedimentation needs to be identified and eliminated in order to protect this valuable resource.

MASON RUN

Project: Species Study	**Drainage:** Lower Delaware River Tributaries
Location: Pine Hill Golf Course (Trump National). Downstream location of trout production area.	**County:** Camden
Date: August 9, 2011	**Municipality:** Pine Hill Borough

Summary

Electrofished fourth of four stream segments on Mason Run (Camden County), Southern New Jersey's only reproducing brook trout population. The population appears to be severely impacted by sedimentation and possibly high flow conditions. There were numerous young of the year observed early in the spring however no young-of-the-year (yoy) trout were collected. No adults brook trout were collected. Water temperatures were good and consistent with past findings.

Water Chemistry & Habitat	
Water temperature	20.2°C
Dissolved oxygen	8.41 mg/L
pH	-
Alkalinity	-
Specific conductance	-
Sample length	150 m
Habitat assessment score	147 (sub-optimal)

Fish species	Number
tessellated darter	1
American eel	3
creek chubsucker	2
chain pickerel	1

Recommendation: The entire stream appears to have significantly changed in the last few years with the addition of large quantities of sediment. The source of this sedimentation needs to be identified and eliminated in order to protect this valuable resource.

Surveys in the Upper Delaware River Basin

POHATCONG CREEK

Project: Electrofishing Demonstration	**Drainage: Pohatcong Creek**
Location: Ravine Road	**County: Warren**
Date: October 24, 2011	**Municipality: Pohatcong Twp.**

Summary

Performed annual backpack electrofishing demonstration for DeSales University professor Joseph Colosi and his General Ecology class on the Pohatcong Creek in Warren County on October 24. Students are eager to learn about fisheries management, hatchery operations, fish identification, and environmental stewardship. Species typically encountered during this survey include young-of the-year (yoy) and adult wild brown trout, stocked trout species, margined madtom, American brook lamprey, American eel, blacknose dace, longnose dace, cutlips minnow, tessellated darter, shield darter, creek chub, and white sucker.

Water Chemistry & Habitat	
Water temperature	- °C
Dissolved oxygen	- mg/L
pH	-
Alkalinity	- mg/L as $CaCO_3$
Specific conductance	- µS/cm
Sample length	- m
Habitat assessment score	-

Fish species	Fish species
American eel	tessellated darter
blacknose dace	shield darter
longnose dace	cutlips minnow
creek chub	brown trout
white sucker	American brook lamprey
margined madtom	

Recommendation: Continue to educate students by conducting electrofishing demonstrations for college and high school classes.

Surveys in the Passaic River Basin

PASSAIC RIVER

Project: Union County Bio-Blitz	**Drainage:** Passaic River
Location: multiple locations from within the Passaic River Parkway	**County:** Union
Date: June 11, 2011	**Municipalities:** Berkeley Heights, New Providence, & Summit

Summary

At the request of Union County Dept. of Parks & Community Renewal, fish were collected at multiple sites along the Passaic River in Berkeley Heights, New Providence, and Summit during the county's annual BioBlitz on June 11. The goal of the Bio-Blitz was to quantify species diversity within the public park system and to educate the public. The team used a variety of sampling methods including electro-shocking and seining. The fish diversity was high, consisting of 21 species, a new Union County BioBlitz record. The warmwater fish assemblage encountered provides recreational opportunities for both the novice naturalist and the expert angler including plenty of redbreast sunfish, common carp, and even stocked trout. The fish team also conducted one waterfront public presentation, consisting of a fish collection demonstration by means of the use of a backpack electrofishing unit and a twenty-foot seine.

Water Chemistry & Habitat	
Water temperature	- °C
Dissolved oxygen	- mg/L
pH	-
Alkalinity	- mg/L as $CaCO_3$
Specific conductance	- µS/cm
Sample length	- m
Habitat assessment score	-

Fish species	Fish species
longnose dace	white perch
blacknose dace	tessellated darter
creek chub	green sunfish
golden shiner	redbreaset sunfish
spottail shiner	pumpkinseed
satinfin shiner	bluegill
eastern silvery minnow	black crappie
common carp	chain pickerel
banded killifish	yellow bullhead
mosquitofish sp.	rainbow trout
white sucker	

Recommendation: Continue to participate in Union County's annual Bio-Blitz by leading the Fish Team.

Surveys in the Raritan River Basin

ELECTRIC BROOK

Project: Raritan River S/Br Headwater Study	**Drainage:** Raritan River S/Br
Location: East Spring Road; 30 m upstream of bridge	**County:** Morris
Date: August 9, 2011	**Municipality:** Washington Twp.

Summary

Electrofished this small tributary to the Raritan River, S/Br. as part of the Raritan River S/Br Headwater Study. This survey was conducted upstream of the impounded section of Electric Brook known as George Lake. Electric Brook is classified as Trout Production above (brook trout only) and below the lake (brook and brown trout). Results from this survey are similar to when it was last surveyed in 2007 and in both surveys, relatively few young-of-the-year (yoy) brook trout were encountered, raising some alarm. Below the lake was not surveyed this year, however when sampled in 2007, brown trout dominated the assemblage, outnumbering brook trout by a 72 to 2 margin.

Water Chemistry & Habitat	
Water temperature	19.4°C
Dissolved oxygen	8.15 mg/L
pH	7.70
Alkalinity	49.5 mg/L as $CaCO_3$
Specific conductance	395.2 μS/cm
Sample length	150 m
Habitat assessment score	-

Fish species	Number
blacknose dace	71
tessellated darter	72
white sucker	57
creek chub	65
pumpkinseed	33
brook trout (y-o-y)	5 (76 - 82)
brook trout (older than y-o-y)	31 (129 - 250)

Recommendation: Periodically monitor the trout populations above and below George Lake to investigate its impacts on corresponding fish assemblages, in particular the observation that only brook trout are found above the dam, while brook and brown trout are found below.

RARITAN RIVER S/BR (trib) (Diglio Ditch)

Project: Raritan River S/Br Headwater Study	**Drainage:** Raritan River S/Br
Location: Svea Drive (Vasa Park); 25 m upstream of confluence with Raritan River S/Br	**County:** Morris
Date: August 31, 2011	**Municipality:** Mt. Olive Twp.

Summary

Electrofished this small unnamed tributary to the Raritan River, S/Br. as part of the Raritan River S/Br Headwater Study. This stream is located upstream of the previously impounded section of the South Branch of the Raritan River above the YMCA camp dam. Classified as Non-Trout, by default, this stream was first sampled in 2010, where a robust population of brook trout were encountered. Subsequently, the Division recommended that Raritan River S/Br (trib) (Diglio Ditch) be specifically listed in the state Surface Water Quality Standards as Trout Production. Twenty-four brook trout were encountered, with one previously marked during summer 2010, originating from Sun Valley Brook (right-green). All brook trout, including an additional 7 brook trout collected beyond this reach, were marked on the right side with white Visible Implant Elastomer (VIE) for future recapture, totaling 31 marked trout. The goal of marking 100 trout was not met.

Water Chemistry & Habitat	
Water temperature	14.0°C
Dissolved oxygen	10.27 mg/L
pH	6.81
Alkalinity	31.0 mg/L as $CaCO_3$
Specific conductance	369.04 µS/cm
Sample length	150 m
Habitat assessment score	-

Fish species	Number
blacknose dace	9
eastern mudminnow	4
brook trout (y-o-y)	9 (52 - 86)
brook trout (older than y-o-y)	15 (95 - 166)

Recommendation: Conduct subsequent electrofishing surveys in the South Branch and five of its tributaries again during the winter, spring, and summer in an effort to recapture these VIE marked fish and again if/when the YMCA Camp dam is breached as part of the Raritan River S/Br Headwater Study. Documentation of their location will provide information on metapopulation dynamics, specifically whether each population functions independently or if there is a greater likelihood of gene flow between populations.

RARITAN RIVER S/BR (trib) (Drakestown)

Project: Raritan River S/Br Headwater Study	**Drainage:** Raritan River S/Br
Location: Joy Drive; 25 m upstream of confluence with Raritan River S/Br	**County:** Morris
Date: September 1, 2011	**Municipality:** Mt. Olive Twp.

Summary

Electrofished this small unnamed tributary to the Raritan River, S/Br. as part of the Raritan River S/Br Headwater Study. This stream is located upstream of the previously impounded section of the South Branch of the Raritan River above the YMCA camp dam. Classified as Non-Trout, by default, this stream was first sampled in 2010, where a robust population of brook trout were encountered. Subsequently, the Division recommended that Raritan River S/Br (trib) (Drakestown) be specifically listed in the state Surface Water Quality Standards as Trout Production. All brook trout were marked on the right side with blue Visible Implant Elastomer (VIE) for future recapture. An additional 16 brook trout were marked beyond this reach, totaling 100 marked trout.

Water Chemistry & Habitat	
Water temperature	17.2°C
Dissolved oxygen	9.66 mg/L
pH	7.6
Alkalinity	31.5 mg/L as $CaCO_3$
Specific conductance	237.6 µS/cm
Sample length	150 m
Habitat assessment score	-

Fish species	Number
blacknose dace	11
creek chub	7
white sucker	1
eastern mudminnow	2
longnose dace	8
pumpkinseed	18
tessellated darter	3
brook trout (y-o-y)	64 (52 – 92)
brook trout (older than y-o-y)	20 (102 - 206)

Recommendation: Conduct subsequent electrofishing surveys in the South Branch and five of its tributaries again during the winter, spring, and summer in an effort to recapture these VIE marked fish and again if/when the YMCA Camp dam is breached as part of the Raritan River S/Br Headwater Study. Documentation of their location will provide information on metapopulation dynamics, specifically whether each population functions independently or if there is a greater likelihood of gene flow between populations.

RARITAN RIVER S/BR (trib) (N of Drakestown)

Project: Raritan River S/Br Headwater Study	**Drainage:** Raritan River S/Br
Location: Joy Drive; 25 m upstream of confluence with Raritan River S/Br	**County:** Morris
Date: September 2, 2011	**Municipality:** Mt. Olive Twp.

Summary

Electrofished this small unnamed tributary to the Raritan River, S/Br. as part of the Raritan River S/Br Headwater Study. This stream is located upstream of the previously impounded section of the South Branch of the Raritan River above the YMCA camp dam. Classified as Non-Trout, by default, this stream was first sampled in 2010, where a robust population of brook trout were encountered. Subsequently, the Division recommended that Raritan River S/Br (trib) (N of Drakestown) be specifically listed in the state Surface Water Quality Standards as Trout Production. All brook trout were marked on the right side with purple Visible Implant Elastomer (VIE) for future recapture. An additional 6 brook trout were marked beyond this reach, totaling 100 marked trout.

Water Chemistry & Habitat	
Water temperature	14.7°C
Dissolved oxygen	9.18 mg/L
pH	7.38
Alkalinity	40.0 mg/L as $CaCO_3$
Specific conductance	553.0 µS/cm
Sample length	150 m
Habitat assessment score	-

Fish species	Number
blacknose dace	6
longnose dace	3
brook trout (y-o-y)	82 (52 - 112)
brook trout (older than y-o-y)	12 (119 - 212)

Recommendation: Conduct subsequent electrofishing surveys in the South Branch and five of its tributaries again during the winter, spring, and summer in an effort to recapture these VIE marked fish and again if/when the YMCA Camp dam is breached as part of the Raritan River S/Br Headwater Study. Documentation of their location will provide information on metapopulation dynamics, specifically whether each population functions independently or if there is a greater likelihood of gene flow between populations.

RARITAN RIVER S/BR (trib) (SW of Budd Lake)

Project: Raritan River S/Br Headwater Study	**Drainage:** Raritan River S/Br
Location: Joy Drive; 25 m upstream of confluence with Raritan River S/Br	**County:** Morris
Date: August 11, 2011	**Municipality:** Mt. Olive Twp.

Summary

Electrofished this small unnamed tributary to the Raritan River, S/Br. as part of the Raritan River S/Br Headwater Study. This stream is located upstream of the previously impounded section of the South Branch of the Raritan River above the YMCA camp dam. Classified as Non-Trout, by default, this stream was first sampled in 2010, where a robust population of brook trout were encountered. Subsequently, the Division recommended that Raritan River S/Br (trib) (SW of Budd Lake) be specifically listed in the state Surface Water Quality Standards as Trout Production. All brook trout were marked on the left side with blue Visible Implant Elastomer (VIE) for future recapture. An additional 26 brook trout were marked beyond this reach, totaling 100 marked trout.

Water Chemistry & Habitat	
Water temperature	17.9°C
Dissolved oxygen	7.79 mg/L
pH	7.65
Alkalinity	36.0 mg/L as $CaCO_3$
Specific conductance	500.4 μS/cm
Sample length	150 m
Habitat assessment score	-

Fish species	Number
blacknose dace	67
creek chub	10
white sucker	3
eastern mudminnow	2
pumpkinseed	1
brook trout (y-o-y)	49 (40 - 105)
brook trout (older than y-o-y)	25 (115 - 212)

Recommendation: Conduct subsequent electrofishing surveys in the South Branch and five of its tributaries again during the winter, spring, and summer in an effort to recapture these VIE marked fish and again if/when the YMCA Camp dam is breached as part of the Raritan River S/Br Headwater Study. Documentation of their location will provide information on metapopulation dynamics, specifically whether each population functions independently or if there is a greater likelihood of gene flow between populations.

RARITAN RIVER S/BR (trib) (Warmwater)

Project: Raritan River S/Br Headwater Study	**Drainage:** Raritan River S/Br
Location: River Road pulloff, upstream of Flanders-Drakestown Road, 25 m upstream of confluence with Raritan River S/Br	**County:** Morris
Date: August 11, 2011	**Municipality:** Mt. Olive Twp.

Summary

Electrofished small unnamed tributary to the Raritan River, S/Br. as part of the Raritan River S/Br Headwater Study. This stream is located just upstream of the previously impounded section of the South Branch of the Raritan River above the YMCA camp dam. Classified as Non-Trout, by default, this stream was not previously surveyed, but the data confirmed its classification, as no trout were found and the stream supports a warmwater fish assemblage. Species encountered include blacknose dace, creek chub, white sucker, tessellated darter, pumpkinseed, and largemouth bass. The water temperature was 19.6ºC. No previously marked trout were encountered.

Water Chemistry & Habitat	
Water temperature	19.6°C
Dissolved oxygen	8.83 mg/L
pH	7.72
Alkalinity	53.5 mg/L as $CaCO_3$
Specific conductance	199.4 µS/cm
Sample length	150 m
Habitat assessment score	-

Fish species	Number
blacknose dace	93
creek chub	59
white sucker	2
pumpkinseed	1
largemouth bass	1
tessellated darter	2

Recommendation: Conduct subsequent electrofishing surveys in the South Branch and five of its tributaries again during the winter, spring, and summer in an effort to recapture these VIE marked fish and again if/when the YMCA Camp dam is breached as part of the Raritan River S/Br Headwater Study. Data indicate no additional surveys are required in regards to establishing stream classification. The Division recommends that Raritan River S/Br (trib) (warmwater) be specifically listed in the state Surface Water Quality Standards as non-trout.

RARITAN RIVER S/BR

Project: Raritan River S/Br Headwater Study	**Drainage:** Raritan River S/Br
Location: Stephens Mill Rd, start at old dam upstream of road	**County:** Morris
Date: August 8, 2011	**Municipality:** Mount Olive Twp.

Summary

This fisheries survey was the first of two sites electrofished downstream of the YMCA camp dam located along River Road, just upstream of Stephens Mill Road. This section of the river is currently classified as Trout Maintenance. This survey was conducted one half mile downstream of the Mt. Olive Complex dam as part of the Raritan River S/Br Headwater Study and began at the remains of breached dam. In addition to a typical cool/coldwater fishery, brown trout reproduction was noted as three young-of-the-year (yoy) were found (67-75mm). Eleven larger, apparently wild brown trout (159-301mm). were collected along with two rainbow trout suspected to have originated from the Pequest Trout Hatchery (as indicated by substantial fin erosion) were collected. Habitat through this reach scored at the high end of sub-optimal.

Water Chemistry & Habitat	
Water temperature	22.8°C
Dissolved oxygen	8.4 mg/L
pH	7.93
Alkalinity	37.0 mg/L as $CaCO_3$
Specific conductance	359.2 µS/cm
Sample length	150 m
Habitat assessment score	155 (sub-optimal)

Fish species	Number
blacknose dace	53
longnose dace	38
creek chub	11
white sucker	9
chain pickerel	1
bluegill	6
largemouth bass	1
fallfish	4
pumpkinseed	12
white perch	1
tessellated darter	5
brown trout (y-o-y)	3 (67 - 75)
brown trout (older than y-o-y)	11 (159 - 301)
rainbow trout (older than y-o-y)	2 (285 -292)

Recommendation: Although the presence of three yoy brown trout indicates possible consideration to upgrade the current classification from Trout Maintenance to Trout Production, an additional survey conducted in close proximity on the same day did not yield any yoy brown trout. Conduct a subsequent electrofishing survey as part of the Raritan River S/Br Headwater Study if/when the YMCA Camp dam is breached. Data indicate additional surveys are required in regards to establishing stream classification

RARITAN RIVER S/BR

Project: Raritan River S/Br Headwater Study	**Drainage:** Raritan River S/Br
Location: Flanders Drakestown Rd; ended at base of Mount Olive Complex (YMCA) dam	**County:** Morris
Date: August 8, 2011	**Municipality:** Mount Olive Twp.

Summary

This fisheries survey was the second of two sites electrofished downstream of the YMCA camp dam located along River Road, just upstream of Stephens Mill Road. This survey was conducted as part of the Raritan River S/Br Headwater Study and ended at the base of The YMCA dam. This section of the river is currently classified as Trout Maintenance and scored an incidence of occurrence value of 26.5, confirming the current classification. In addition to a typical cool/coldwater fishery, three rainbow trout suspected to have originated from the Pequest Trout Hatchery (as indicated by substantial fin erosion) ranging from 282 to 340mm, were collected in addition to 8 adult brown trout, which were assumed to be wild based on their appearance and the known brown trout reproduction that is documented downstream. Habitat through this reach scored sub-optimal and appears to be significantly impacted by sediment deposition.

Water Chemistry & Habitat	
Water temperature	21.6°C
Dissolved oxygen	8.24 mg/L
pH	7.69
Alkalinity	38.5 mg/L as $CaCO_3$
Specific conductance	343.7 µS/cm
Sample length	150 m
Habitat assessment score	131 (sub-optimal)

Fish species	Number
blacknose dace	194
longnose dace	127
creek chub	42
white sucker	78
chain pickerel	1
bluegill	2
brown bullhead	2
American eel	10
fallfish	1
margined madtom	3
pumpkinseed	6
yellow perch	2
tessellated darter	61
brown trout (older than y-o-y)	8 (185-260)
rainbow trout (older than y-o-y)	3 (282 - 340)

Recommendation: Although the presence of three yoy brown trout indicates possible consideration to upgrade the current classification from Trout Maintenance to Trout Production, an additional survey conducted in close proximity on the same day did not yield any yoy brown trout. Conduct a subsequent electrofishing survey as part of the Raritan River S/Br Headwater Study if/when the YMCA Camp dam is breached. Data indicate additional surveys are required in regards to establishing stream classification.

RARITAN RIVER S/BR

Project: Raritan River S/Br Headwater Study	**Drainage:** Raritan River S/Br
Location: River Rd, upstream of Flanders-Drakestown Road, start at Mount Olive Complex (YMCA) dam	**County:** Morris
Date: August 10, 2011	**Municipality:** Mount Olive Twp.

Summary

This fisheries survey was the first of four sites electrofished upstream of the YMCA camp dam located along River Road, just upstream of Flanders-Drakestown Road. This section of the river is currently classified as Non-Trout. This survey was conducted as part of the Raritan River S/Br Headwater Study and began immediately upstream of the dam, where habitat is extremely poor, with substrate composed almost exclusively of sand and clay. Although the riparian buffer is good on the right, as one looks downstream, the left bank is composed of sediment that has filled in the pond over the years and colonized primarily with grasses only. Species encountered were typical of a warmwater stream fish assemblage. Data indicate the current classification, Non Trout, is appropriate.

Water Chemistry & Habitat	
Water temperature	19.5°C
Dissolved oxygen	8.06 mg/L
pH	7.58
Alkalinity	41.0 mg/L as $CaCO_3$
Specific conductance	347.8 μS/cm
Sample length	150 m
Habitat assessment score	-

Fish species	Number
blacknose dace	5
creek chub	5
white sucker	35
eastern mudminnow	3
banded killifish	3
golden shiner	2
margined madtom	1
yellow bullhead	2
pumpkinseed	55
chain pickerel	4
tessellated darter	36

Recommendation: Conduct a subsequent electrofishing survey as part of the Raritan River S/Br Headwater Study if/when the YMCA Camp dam is breached. Data indicate no additional surveys are required in regards to establishing stream classification.

RARITAN RIVER S/BR

Project: Raritan River S/Br Headwater Study	**Drainage:** Raritan River S/Br
Location: Svea Drive (Vasa Park) 264 m downstream	**County:** Morris
Date: August 10, 2011	**Municipality:** Mount Olive Twp.

Summary

This electrofishing survey was conducted as part of the Raritan River S/Br Headwater Study. This location is adjacent to the Vasa Park housing development, in a section of the South Branch of the Raritan River classified as Non-Trout. Although nineteen brook trout (including 16 young-of-the-year (yoy)) were encountered in a similar location during 2010, only 2 brook trout were encountered in 2011. In 2010, all 19 brook trout were marked posterior to their right eye with a red pigmented Visual Implant Elastomer (VIE) marker, however none of these fish were recaptured. The two brook trout encountered were marked on the left side with white VIE for future recapture. One additional brook trout was captured in the S/Br and was also marked. Habitat was adequate for brook trout. The water temperature this year was warmer (21.5°C) than it was during the 2010 survey (18.0ºC).

Water Chemistry & Habitat	
Water temperature	21.5°C
Dissolved oxygen	7.71 mg/L
pH	7.50
Alkalinity	40.0 mg/L as $CaCO_3$
Specific conductance	364.8 S/cm
Sample length	150 m
Habitat assessment score	-

Fish species	Number
blacknose dace	75
longnose dace	31
creek chub	26
white sucker	37
pumpkinseed	5
margined madtom	10
brook trout (y-o-y)	1 (76)
brook trout (older than y-o-y)	1 (174)
tessellated darter	35

Recommendation: In 2010, electrofishing data were submitted to the Bureau of Water Monitoring and Standards to recommended to upgrade the surface water classification from Non-Trout to Trout Production. Data collected in 2011 confirm this recommendation. The South Branch and five of its tributaries will be electrofished again during the winter, spring, and summer in an effort to recapture these VIE marked fish. Documentation of their location will provide information on metapopulation dynamics, specifically whether each population functions independently or if there is a greater likelihood of gene flow between populations. Conduct a subsequent electrofishing survey as part of the Raritan River S/Br Headwater Study if/when the YMCA Camp dam is breached.

Sun Valley Brook

Project: Raritan River S/Br Headwater Study	**Drainage:** Raritan River S/Br
Location: Wolf Road; 25 m upstream of confluence with Raritan River S/Br	**County:** Morris
Date: August 31, 2011	**Municipality:** Mt. Olive Twp.

Summary

Electrofished this small tributary to the Raritan River, S/Br. as part of the Raritan River S/Br Headwater Study. This stream is located upstream of the previously impounded section of the South Branch of the Raritan River above the YMCA camp dam. Classified as Trout Production, this was the only known brook trout population upstream of the YMCA dam. Data indicate a very small brook trout population that is appears to be declining over time. Subsequently, no brook trout were found in the standard 150m stream survey. Four brook trout were found upstream of the sample reach and all were marked on the left side with purple Visible Implant Elastomer (VIE) for future recapture. The goal of marking 100 trout was not met.

Water Chemistry & Habitat	
Water temperature	16.8°C
Dissolved oxygen	9.34 mg/L
pH	7.22
Alkalinity	33.0 mg/L as $CaCO_3$
Specific conductance	369.4 µS/cm
Sample length	150 m
Habitat assessment score	-

Fish species	Number
blacknose dace	27
creek chub	23
white sucker	3
longnose dace	3
pumpkinseed	1

Recommendation: Conduct subsequent electrofishing surveys in the South Branch and five of its tributaries again during the winter, spring, and summer in an effort to recapture these VIE marked fish and again if/when the YMCA Camp dam is breached as part of the Raritan River S/Br Headwater Study. Documentation of their location will provide information on metapopulation dynamics, specifically whether each population functions independently or if there is a greater likelihood of gene flow between populations.

2011

DISSOLVED OXYGEN/ TEMPERATURE PROFILE DATA

Dissolved oxygen/temperature profiles are performed to determine a lakes ability to support trout throughout the harsh summer months. During the summer most New Jersey lakes deeper than 3 m (10 ft) thermally stratify. The epilimnion (surface waters) become 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. A water temperature-dissolved oxygen profile is conducted in the deepest part of a lake using a YSI 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. The criteria used to determine trout-supporting water is water temperature $\leq$ 21ºC (69.8ºF) and dissolved oxygen $\geq$ 4 mg/L (Appendix A).

TABLE 7. Temperature and dissolved oxygen profiles conducted at Alloway Lake in 2011. Shading depicts depths having trout supporting water (temperature ≤ 21ºC and dissolved oxygen ≥ 4 mg/L).

Waterbody	**Alloway Lake**
Basin	Delaware River – Lower
Drainage	Lower Delaware River Tributaries
County	Salem
Surface area	49 ha (120 ac)
Trout reg.	Statewide General
Survey date	8/24/11
Secchi Disk	N/A

Depth from surface (ft)	Water temp. (°C)	Dissolved oxygen (mg/L)
1	25.2	9.98
2	24.8	9.50
3	24.2	8.80
4	24.0	7.53
5	23.5	6.98
6	23.1	4.00
7	22.3	1.70
8	22.0	0.66
9	22.1	0.66
10	22.2	0.80

TABLE 8. Temperature and dissolved oxygen profiles conducted at Manalapan Lake in 2011. Shading depicts depths having trout supporting water (temperature $\leq$ 21ºC and dissolved oxygen $\geq$ 4 mg/L).

Waterbody	**Manalapan Lake**
Basin	Lower Raritan, South River, Lawrence Brook
Drainage	South River
County	Middlesex
Surface area	21 ha (51 ac)
Trout reg.	Statewide General
Survey date	7/30/11
Secchi Disk	N/A

Depth from surface (ft)	Water temp. (°C)	Dissolved oxygen (mg/L)
0	27.4	8.67
1	27.4	8.63
2	27.3	8.60
3	27.3	8.58
4	26.7	6.92
5	26.2	3.97
6	24.4	0.68
7	22.6	0.03
8	22.1	0.02
9	21.4	0.04
10	21.3	0.03

LITERATURE CITED

Barbour, M. T., J. Gerritsen, B. D. Snyder and J. B. Stribling 1999. Rapid bioassessment protocols for use in streams and wadeable rivers: periphyton, benthic macroinvertebrates, and fish, 2nd edition. EPA 841-B-99-002. U. S. Environmental Protection Agency, Office of Water, Washington, D.C.

Hamilton, P. L. and L. M. Barno. 2006. New Jersey Coldwater Fisheries Management Plan. New Jersey Division of Fish and Wildlife, Trenton, New Jersey.

APPENDIX A

Field Sampling Protocols

Lakes – Suitability for Trout

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

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 projects. 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.

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APPENDIX B

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
	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 C

New Jersey Division of Fish & Wildlife
List of New Jersey Freshwater Fishes
(Revised 2005)

Scientific Name	Common Name	Trophic Guild	Tolerance	**Historical Presence**
Petromyzontidae:				
Lampetra appendix	American brook lamprey	NF	IS	N
Petromyzon marinus	sea lamprey	PF	MT	N
Acipenseridae:				
Acipenser oxyrhynchus	Atlantic sturgeon	BI	IS	N
Acipenser brevirostrum	shortnose sturgeon	BI	IS	N
Lepisosteidae:				
Lepisosteus osseus	longnose gar	P	M	EX
Amiidae:				
Amia calva	bowfin	P	TS	US
Anguillidae:				
Anguilla rostrata	American eel	P	TS	N
Clupeidae:				
Alosa aestivalis	blueback herring	PL	MT	N
Alosa mediocris	hickory shad	I/P	US	N
Alosa pseudoharengus	alewife	PL	MT	N
Alosa sapidissima	American shad	PL	MT	N
Drosoma cepedianum	gizzard shad	G	TS	N
Salmonidae:				
Oncorhynchus mykiss	rainbow trout	I/P	IS	NN
Salmo trutta	brown trout	I/P	IS	E
Salvelinus fontinalis	brook trout	I/P	IS	N
Salvelinus namaycush	lake trout	P	IS	NN
Osmeridae:				
Osmerus mordax	rainbow smelt	I	IS	N
Umbridae:				
Umbra pygmaea	eastern mudminnow	I	TS	N
Esocidae:				
Esox americanus	redfin pickerel	P	MT	N
Esox lucius	northern pike	P	IS	NN
Esox niger	chain pickerel	P	MT	N
Esox masquinongy	muskellunge	P	IS	NN

Scientific Name	Common Name	Trophic Guild	Tolerance	Historical Presence
Cyprinidae:				
Carassius auratus	goldfish	G	TS	E
Cyprinus carpio	common carp	G	TS	E
Carpiodes cyprinus	quillback	BI	TS	N
Exoglossum maxillingua	cutlips minnow	BI	IS	N
Hybognathus regius	eastern silvery minnow	H	MT	N
Notemigonus crysoleucas	golden shiner	G	TS	N
Notropis amoenus	comely shiner	I	TS	N
Cyprinella analostana	satinfin shiner	I	TS	N
Cyprinella spiloptera	spotfin shiner	I	TS	N
Notropis bifrenatus	bridle shiner	I	IS	N
Notropis chalybaeus	ironcolor shiner	I	IS	N
Luxilis cornutus	common shiner	I	MT	N
Notropis husdonius	spottail shiner	I	MT	N
Notropis procne	swallowtail shiner	I	MT	N
Pimephales promelas	fathead minnow	G	TS	NN
Pimephales notatus	bluntnose minnow	G	TS	NN
Rhinichthys atratulus	blacknose dace	BI	TS	N
Rhinichthys cataractae	longnose dace	BI	MT	N
Semotilus atromaculatus	creek chub	I	TS	N
Semotilus corporalis	fallfish	I	MT	N
Ctenopharyngodon idella	grass carp	H	MT	E
Catostomidae:				
Catostomus commersoni	white sucker	BI	TS	N
Erimyzon oblongus	creek chubsucker	BI	MT	N
Hypentelium nigricans	northern hog sucker	BI	IS	N
Ictaluridae:				
Ameiurus catus	white catfish	I/P	MT	N
Ameiurus melas	black bullhead	BI	MT	NN
Ameiurus natalis	yellow bullhead	BI	MT	US
Ameiurus nebulosus	brown bullhead	BI	TS	N
Ictalurus punctatus	channel catfish	I/P	MT	NN
Noturus gyrinus	tadpole madtom	BI	MT	N
Noturus insignis	margined madtom	BI	IS	N
Aphredoderidae:				
Aphredoderus sayanus	pirate perch	I	MT	N
Cyprinodontidae:				
Fundulus diaphanus	banded killifish	I	TS	N
Fundulus heteroclitus	mummichog	I	TS	N
Poeciliidae:				
Gambusia holbrooki	eastern mosquitofish	I	TS	N
Gambusia affinis	mosquitofish	I	TS	NN

Scientific Name	Common Name	Trophic Guild	Tolerance	Historical Presence
Gasterosteidae:				
Apletes quadracus	fourspine stickleback	I	MT	N
Gasterosteus aculeatus	threespoine stickleback	I	MT	N
Pungitius pungitius	ninespine stickleback	I	MT	N
Moronidae:				
Morone americana	white perch	I/P	MT	N
Morone saxatilis	striped bass	P	MT	N
Centrarchidae:				
Acantharchus pomotis	mud sunfish	I	MT	N
Ambloplites rupestris	rock bass	I/P	MT	NN
Enneacanthus chaetodon	blackbanded sunfish	I	IS	N
Enneacanthus gloriosus	bluespotted sunfish	I	IS	N
Enneacanthus obesus	banded sunfish	I	IS	N
Lepomis cyanellus	green sunfish	I/P	TS	NN
Lepomis gibbosus	pumpkinseed	I	MT	N
Lepomis macrochirus	bluegill	I	TS	NN
Lepomis auritus	redbreasted sunfish	I	MT	N
Lepomis gulosus	warmouth	I/P	TS	NN
Micropterus dolomieu	smallmouth bass	I/P	MT	NN
Micropterus salmoides	largemouth bass	P	MT	NN
Pomoxis annularis	white crappie	I/P	TS	NN
Pomoxis nigromaculatus	black crappie	I/P	MT	NN
Percidae:				
Etheostoma fusiforme	swamp darter	BI	IS	N
Etheostoma olmstedi	tessellated darter	BI	MT	N
Perca flavescens	yellow perch	I/P	MT	N
Percina peltata	shield darter	BI	IS	N
Sander vitreus	walleye	P	IS	NN
Cottidae:				
Cottus cognatus	slimy sculpin	BI	IS	N
Cobitidae:				
Misgurnus anguillicaudatus	oriental weatherfish	G	TS	E
Soleidae:				
Trinectes maculatus	hogchoker	G	IS	N

Key:

Abbreviation	Term	Definition
Trophic Guild		
BI	Benthic Insectivore	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 Filterer	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 Filterer	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.
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.
Miscellaneous		
US	Uncertain Status	An assignment in which there is not enough data or no general consensus to mak a confident classification at this point in time.