2012

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 2012

Including
Sport Fish Restoration Grant F-48-R

Job Performance Reports Segment 25
(January 1, 2012 – October 31, 2012)

and

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.

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NEW JERSEY DIVISION OF
Fish and Wildlife

INVESTIGATIONS AND MANAGEMENT OF NEW JERSEY'S FRESHWATER FISHERIES RESOURCES 2012

BUREAU OF FRESHWATER FISHERIES

Report Prepared By:

Shawn Crouse Pat Hamilton Christopher Smith

Mark Boriek Lisa Barno

With the assistance of:

Scott Collenburg, Tom Peck, Ross Shramko, Stephanie George, Luke Diglio, Brian Neilan, Jamie Darrow, and Bill King

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 2012, the Bureau of Freshwater Fisheries Research and Management Unit conducted fisheries surveys at 80 different waterbodies throughout the state, demonstrating the diversity of the state's aquatic resources by covering a variety of project objectives. Largemouth and smallmouth bass, panfish, and/or lake trout were targeted at 21 lakes to gather data to better manage our fisheries. 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, makes New Jersey's fishing slogan, "It's Never Been Better" more true than ever before.

Of the 46 stream surveys, 26 were conducted as part of continuing efforts to assess and/or 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. Bureau personnel visited five waterbodies to document and/or remove invasive aquatic species.

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 and 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 areas once inhabited by rare species and to assess their statewide status and distribution.

Work critical to managing important anadromous species such as American shad, blueback herring, and alewife also continues. The final federal aid report was completed for a project in which a recovering population of American shad was monitored, intermittently from 1996 to 2012, via passage through the Raritan River's Island Farm Weir. Recent action was taken to improve fish passage on the Raritan River, as two of the lowermost fish passage impediments were removed, the Calco Dam (summer of 2011) and the Robert Street Dam (summer of 2012). The Nevius Street Dam is scheduled for removal in 2013.

Full-time Freshwater Fisheries personnel are complemented by a dedicated and talented seasonal staff, which provide incredible insight and enthusiasm necessary to raise fish

within our hatcheries and conduct fisheries inventories across the State, not to mention the countless tasks that ultimately maintain and enhance New Jersey's fisheries resources.

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 programs. Pequest also provides brown trout for the Division's elusive Sea Run Brown Trout program in the Manasquan River. The Hackettstown Hatchery raises 15 species of freshwater fish with over 1,500,000 million released each year throughout the state. The hatchery also supplies county Mosquito Control Commissions, under the direction of the State Mosquito Control Commission, with sunfish, killifish, and Gambusia to assist with the Commission's efforts for effective mosquito control. The Hackettstown Hatchery celebrated its 100th anniversary with an Open House on June 2 and 3rd. This was the first time in almost thirty years the hatchery was opened to the public. Over 15,000 attended the two day event making it one of the largest Division events. 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. The Bureau also has a fish pathologist.

Northwest Region:
(Upper Delaware, Central Delaware, & Wallkill Drainages)
Patricia Hamilton – Coldwater Research & Management
Federal Aid Coordinator

Northeast Region:
(Passaic, Hackensack, & Hudson and Upper Atlantic Drainages)
Mark Boriek – Anadromous Fish Management

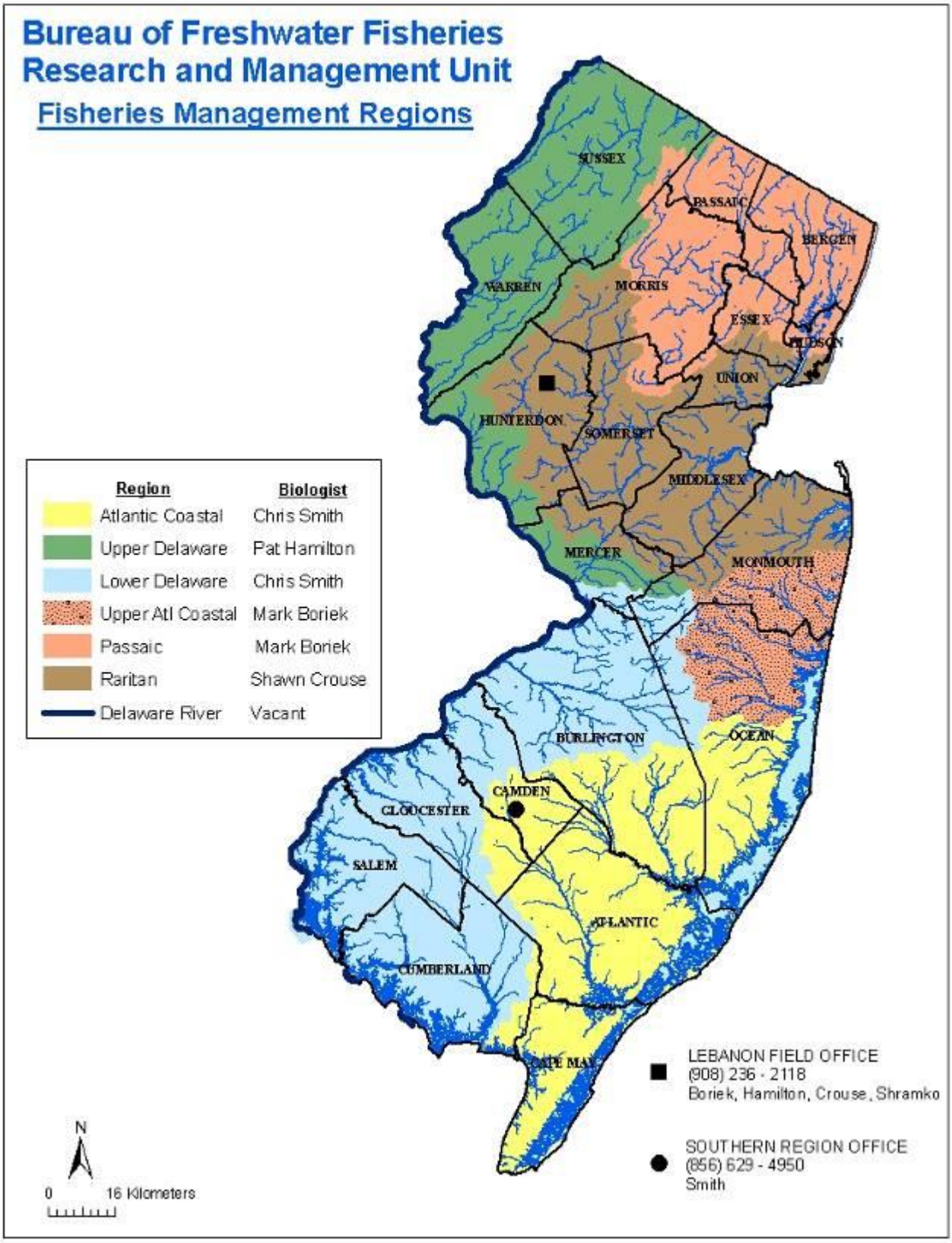
Raritan Region:
(Raritan, Arthurkill, Raritan Bay, Shrewsbury, & Navesink)
Shawn Crouse – Native Fishes and Index of Biotic Integrity

Southern Region:
(Lower Delaware & Lower Atlantic Coastal Drainages)
Chris Smith – Warmwater Research & Management
Anadromous Fish Management

Delaware River Region: - Delaware River Mainstem
VACANT

Fish Pathologist
Jan Lovy Ph.D.

Figure 1. Fisheries Management Regions.



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 (January 1, 2012 – October 31, 2012)	
Project I	**Investigations and Management of Anadromous Fisheries**
Job I-5	American Shad Restoration in the Raritan River
Project II	**Investigations and Management of Coldwater Fisheries**
Job II-7	Inventory of Trout Production Streams
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-3	Angler Attitude, Preference, and Use Survey
Job IV-5	Management of Diseases and Fish Health in Wild Populations
Inactive Jobs under Federal Aid Grant F-48-R-25 (January 1, 2012 – October 31, 2012)	
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-7	Inventory and Status of Anadromous Clupeid Spawning Migrations in New Jersey Freshwaters
Job I-9	Delaware River Creel Survey
Project II	**Investigations and Management of Coldwater Fisheries**
Job II-10	Evaluation of Landlocked Salmon Introductions
Project IV	**Assessments of the Biological Integrity and Recreational Use of New Jersey's Inland Waters**
Job IV-4	Index of Biotic Integrity for New Jersey's Piedmont Province

Table 2. 2012 Field Sampling Locations

Bureau of Freshwater Fisheries Research and Management Unit 2012 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**							
Southern Region (Lower Delaware River and Lower Atlantic Coastal)													
Bostwick Lake (Cumberland)										●		–	39
Cohansey River (Camden)										●		–	39
Cooper River Lake (Camden)						●						–	21, D
Daretown Lake (Cumberland)										●		–	39
Davis Millpond (Cumberland)										●		–	39
Glenn Lake (Gloucester)										●		–	39
Grenloch Lake (Gloucester)										●		–	39
Heritage Park Pond (Atlantic)										●		–	39
Hilliards Creek (aka Millard Creek UNT) (Gibbsboro, Camden)						●						No	20, D
Lake Audrey (Cumberland)										●		–	39
Maple Lake (Atlantic)										●		–	39
Mary Elmer Lake (Cumberland)										●		–	39
Patriot Lake (Atlantic)										●		–	39

NEW JERSEY DIVISION OF Fish and Wildlife **Bureau of Freshwater Fisheries Research and Management Unit 2012 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**							
Southern Region (Lower Delaware River and Lower Atlantic Coastal) (cont.)													
Silver Lake (Gibbsboro, Camden)						●						–	20, D
South Vineland Park Pond (Cumberland)	▲									●	▲	–	93, D
Stewart Lake (Gloucester)						●						–	21, D
Parvin Lake (Cumberland)										●		–	39
Northwest Region (Upper Delaware River, Central Delaware River, and Wallkill)													
Big Flat Brook													
-Between Rt. 206 and Rt. 560 bridge	▲	▲						▲		●		Yes	48
-Blewett Tract	▲	▲						▲		●		Yes	46
-Upstream of Blewett Tract	▲	▲						▲		●		Yes	47
Cranberry Lake (Sussex)	▲										●	–	94, D
Flat Brook	▲	▲						▲		●		Yes	49
Franklin Pond (Sussex)								▲		●		–	40
Gardner's Pond (Sussex)	▲										●	–	95, D
Hakihokake Creek (trib.) (Wydner)	▲	▲	●					▲				Yes	50, D

NEW JERSEY DIVISION OF Fish and Wildlife **Bureau of Freshwater Fisheries Research and Management Unit 2012 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**
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	IV-1	**II-11**	**II-7**	**I**	**III-1**	**III-2**							
Northwest Region (Upper Delaware River, Central Delaware River, and Wallkill) (cont.)													
Iliff Lake (Sussex)	▲										●	–	96, D
Lake Aeroflex (Sussex)	▲										●	–	97, D
Lake Hopatcong (Morris/Sussex)	▲										●	–	98, D
Lake Marcia (Sussex)	▲										●	–	99, D
Lake Rutherford (Sussex)	▲										●	–	100, D
Mountain Lake (Warren)	▲										●	–	101, D
Furnace Lake (Warren)	▲										●	–	102, D
Stony Lake (Sussex)	▲										●	–	103, D
Swartswood Lake (Sussex)	▲										●	–	104, D

NEW JERSEY DIVISION OF Fish and Wildlife **Bureau of Freshwater Fisheries Research and Management Unit 2012 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**							
Northeast Region (Passaic, Hackensack, and Hudson) and Upper Atlantic													
Apshawa Brook		●						▲				No	51, D
Bear Swamp Brook													
-Lower site		▲						▲		●		No	52
-Upper site		▲						▲		●		No	53
Canistear Reservoir (Passaic)	▲										●	–	108, D
Clinton Reservoir (Passaic)	▲										●	–	109, D
Den Brook		●						▲				No	54, D
Green Pond Brook	▲	▲	●					▲				Yes	55, D
Greenwood Lake (Passaic)						▲		●		▲		–	21 32 D
Macopin River (trib.) (Unnamed Trib 1)		●						▲				No	56, D
Mill Brook		●						▲				No	57, D
Mill Brook (trib.) (Unnamed Trib 1)		●						▲				No	58, D
Oak Ridge Reservoir (Passaic)	▲										●	–	110, D

NEW JERSEY DIVISION OF Fish and Wildlife **Bureau of Freshwater Fisheries Research and Management Unit 2012 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**
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	IV-1	**II-11**	**II-7**	**I**	**III-1**	**III-2**							
Northeast Region (Passaic, Hackensack, and Hudson) and Upper Atlantic (cont.)													
Passaic River													
-Site 1-below confl. w/ Indian Grove Bk		●						▲				No	59, D
-Site 2-Tempe Wick Road, Mendham		●						▲				No	60, D
-Site 3-Franklin Road cul-de-sac		●						▲				No	61, D
Passaic River (trib.) (UNT #1)		●						▲				No	62, D
Passaic River (trib.) (UNT #2)		●						▲				No	63, D
Passaic River (trib.) (UNT #3)		●						▲				No	64, D
Pequannock River (trib.) (UNT #1)		●						▲				No	65, D
Pequannock River (trib.) (UNT #2)		●						▲				No	66, D
Pequannock River (trib.) (UNT #3)		●						▲				No	67, D
Pequannock River (trib.) (UNT #4)		●						▲				No	68, D
Splitrock Reservoir (Morris)	▲										●	–	111, D
Wanaque River	●	▲						▲				Yes	69, D

NEW JERSEY DIVISION OF Fish and Wildlife **Bureau of Freshwater Fisheries Research and Management Unit 2012 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**
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	IV-1	**II-11**	**II-7**	**I**	**III-1**	**III-2**							
Northeast Region (Passaic, Hackensack, and Hudson) and Upper Atlantic (cont.)													
West Brook	▲	●						▲				Yes	70, D
West Brook (trib.) (UNT #1)		●						▲				No	71, D
West Brook (trib.) (UNT #2)		●						▲				No	72, D
West Brook (trib.) (UNT #3)		●						▲				No	73, D
Raritan Region (Raritan, Arthur Kill, Raritan Bay, Shrewsbury, and Navesink)													
Beaver Brook (Cokesbury)	▲	●						▲				Yes	74, D
Best Lake (Somerset)								▲		●		–	40
Electric Brook													
-East Spring Road		▲						▲	●			Yes	75
-Scenic Falls Road		▲						▲	●			Yes	76
Grover's Mill Pond (Mercer)								●		▲		–	32, 40
Lake Manalapan (Middlesex)	▲							▲		●	●	–	41 105 D
Nelson Lake (Middlesex)								▲		●		–	41

NEW JERSEY DIVISION OF Fish and Wildlife **Bureau of Freshwater Fisheries Research and Management Unit 2012 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**
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Raritan Region (Raritan, Arthur Kill, Raritan Bay, Shrewsbury, and Navesink) (cont.)													
Rahway River							●	▲				No	31
Rahway River Park Lake							●	▲				–	31
Raritan River, Farm Island Weir				●				▲				–	16, D
Raritan River, S/Br.													
-Svea Drive (Vasa Park)	▲	▲						▲	●			Yes	34, 77
-River Road, immediately above YMCA dam	▲	▲						▲	●			Yes	34, 78
-River Road, immediately below YMCA dam	▲	▲						▲	●			Yes	79
-Stephens Mill Road	▲	▲						▲	●			Yes	80
-River Road, Califon	●	▲						▲				Yes	81, D
Raritan River, S/Br. (trib.) (Diglio Ditch)		▲						▲	●			Yes	34, 82
Raritan River, S/Br. (trib.) (Dog Lady)		▲						▲	●			Yes	83
Raritan River, S/Br. (trib.) (Drakestown)		▲						▲	●			Yes	34, 84
Raritan River, S/Br. (trib.) (N of Drakestown)		▲						▲	●			Yes	34, 85

Bureau of Freshwater Fisheries Research and Management Unit 2012 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
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Raritan Region (Raritan, Arthur Kill, Raritan Bay, Shrewsbury, and Navesink) (cont.)													
Raritan River, S/Br. (trib.) (Red House)		▲						▲	●			Yes	86
Raritan River, S/Br. (trib.) (Rickie Lake)		▲						▲	●			Yes	87
Raritan River, S/Br. (trib.) (SW of Budd Lake)		▲						▲	●			Yes	34, 88
Raritan River, S/Br. (trib.) (Warmwater)		▲						▲	●			Yes	34, 89
Round Valley Reservoir (Hunterdon)	▲							▲		●	●	–	36 106 D
Spruce Run Reservoir (Hunterdon)	▲										●	–	107, D
Sun Valley Brook		▲						▲	●			Yes	34, 90
Turkey Brook		▲						▲	●			Yes	91
Watchung Lake (Somerset)								▲		●		–	41

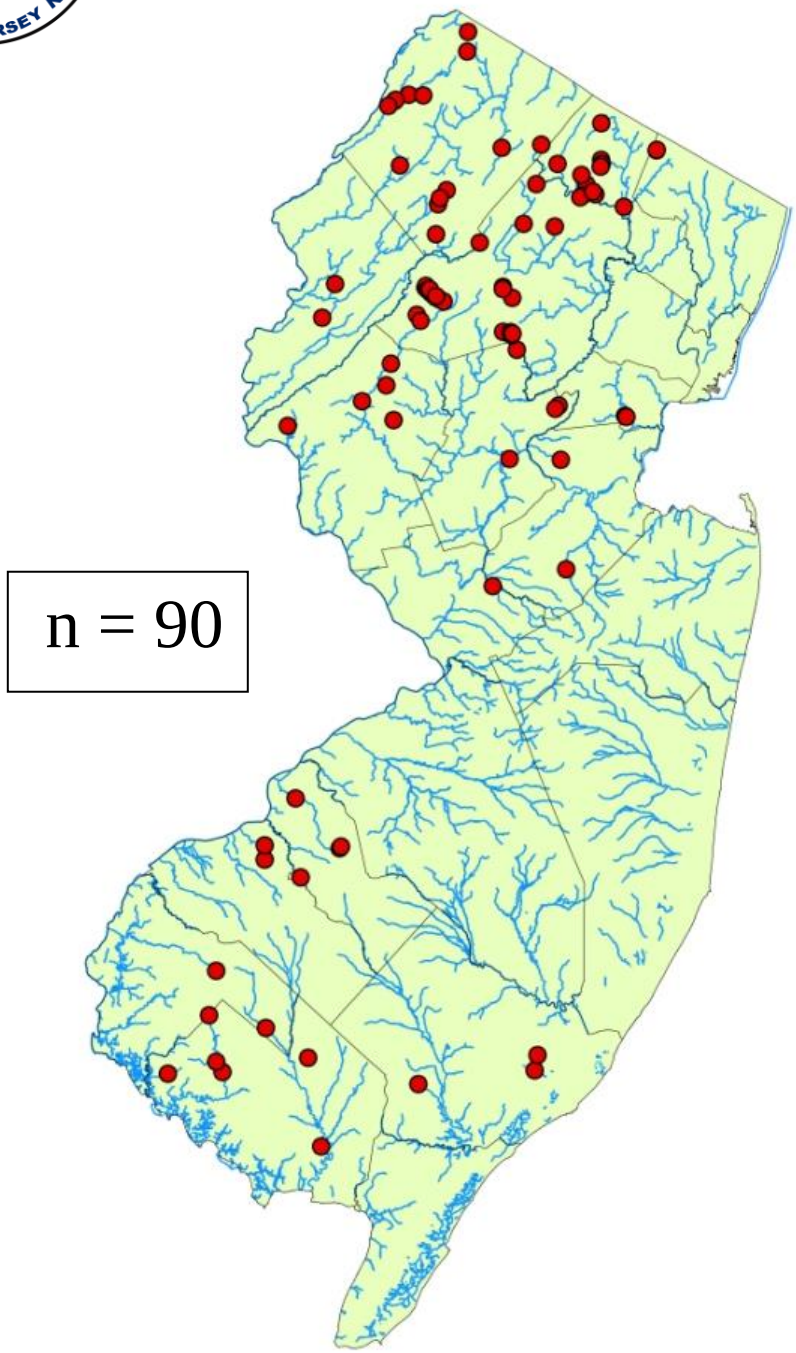
● Funding source or reason of data collection ▲ Data are applicable to additional projects

** 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.

2012 FIELD SAMPLING SITES
DIVISION OF FISH AND WILDLIFE
BUREAU OF FRESHWATER FISHERIES

NEW JERSEY DIVISION OF
Fish and Wildlife



FEDERAL FUNDED PROJECT SUMMARIES

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

The Raritan River historically supported a spawning run of American shad. 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, the Island Farm Weir (a dam the confluence of the Millstone and Raritan Rivers) was constructed 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.

American shad caught on film passing the Island Farm Weir.

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. For the last two years, a new digital recorder (instead of the antiquated VHS recorder) was used to record. The operation of the camera is labor intensive, requiring visits to the ladder to replace batteries and tapes / SD cards. The video tapes / SD cards were viewed (also labor intensive) at a later date at the Lebanon Field Office and individual fish passage data were recorded. Fish passage was routinely monitored during the spring (typically mid-March to mid-June) from 1996 through 2003, and in 2005, 2011, and 2012. Other parameters that were monitored included water temperature and water flow (cubic feet per second or cfs). In 2012, the final year of this Job, monitoring began on March 26 and continued through June 30 (97 days). During this time, a total of 5,133 fish migrated through the ladder, 465 of which were American shad.

All 11 years of data have been reviewed. At project completion, a total of 866 days were recorded, with a total of 684 days deemed viewable, due primarily to river conditions. A total of 63,829 fish migrated through the ladder, 3,752 of which were American shad. American Shad passed through the fish ladder in the most abundance between April 15th and May 29th. The highest abundance of American Shad travelled through the fish ladder in 2002 with 989 individuals. They tended to travel through the ladder at water temperatures between 10°C and 25°C and favored water flow rates between 250 and 1500 cfs. Possible reasons for this could be that with higher flow rates, turbidity was greater, making it more difficult to view the videos for those days. Also, at higher flow rates, the shad could swim over the weir, thus avoiding the ladder all together. The final report, which is a summary of the research efforts, was completed in 2012 (Appendix D).

Action recently taken to improve fish passage on the Raritan River includes the removal of two of the lowermost impediments. The only dam downstream of the Island Farm Weir, the Calco dam, was removed during the summer of 2011. Upstream, the Robert Street Dam, in the town of Raritan, was removed during the summer of 2012. The Nevius Street Dam, also in Raritan, is scheduled for removal in 2013. All of the above

dam removals are part of a settlement through NJDEP's Natural Resource Damages funds.

Inventory of Trout Production Streams (Job II-7)

Wild, self-sustaining populations of brook, brown, rainbow, and lake trout are found in New Jersey. Waters used by trout for spawning and nursery areas are classified as *trout production* under the state's Surface Water Quality Standards. Wild trout are important indicators of healthy ecosystems, requiring superior water quality and pristine habitat. Despite the protection that state regulatory programs afford *trout production* waters, ongoing changes in land use have impacted these 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 not been surveyed recently (typically within the 20 years). The data collected is evaluated to determine if population changes have occurred and to develop management strategies to protect this fragile resource.

Wild brown trout from Hakihokake Creek tributary.

In 2012, only two surveys were specifically conducted under Job II-11 due to other Bureau priorities (Appendix D). Trout reproduction was confirmed in two streams, Green Pond Brook and Hakihokake Creek (trib.) (Wydner). In addition to field surveys, an analysis of two data sets (historical survey data and more recently collected data) is underway to determine if trout population changes have occurred and if they can be attributed to changes in land use or other factors.

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.

Wild brook trout.

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 2012, 20 surveys were specifically conducted under Job II-11 to document the occurrence of wild brook trout (Appendix D). These surveys did not document young-of-the-year brook trout populations in any stream segments. In addition, 26 surveys conducted under a variety of other jobs and/or funding sources (Table 2) found wild brook trout present at 10 locations.

Inventory of Lakes, Ponds, and Rivers (Job III-1)

Successful management of New Jersey's warm and cool water fisheries resource is based upon specific knowledge of their 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.

Electrofishing boat.

Physical parameters include morphometry, bathymetry, access, watershed, and aquatic vegetation characteristics. Chemical parameters include general 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), 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 there were no lake inventory reports completed.

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 macrophytes 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 helps to 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., o*riental weatherfish, *Misgurnus anguillicaudatus,* silver carp, *Hypophthalmichthys molitrix*, and warmouth, *Lepomis gulosus*. These fish have the potential to become a significant threat to indigenous animals, the environment, or public safety. Possession and/or release of live potentially dangerous fish species is prohibited and when 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 the Divisions' Freshwater Fishing Digest and website.

Invasive Fish Species Management – Asian Swamp Eel
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. 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.

Asian swamp eel.

In 2012 the Bureau of Freshwater Fisheries sampled, via backpack electrofishing, Silver Lake and Hilliards Creek (aka Millard Creek unnamed tributary) for the presence of Asian swamp eels. Silver Lake was sampled three times for a total run time of 2.06 hours. The CPUE for 2012 was 44 fish per hour, which was higher than the 2011 CPUE of 39 fish per hour. There was a total of 91 swamp eels collected in 2012. Hilliards Creek was sampled once upstream and downstream of Silver Lake. One swamp eel was collected at each location on July 13th.

The Bureau of Freshwater Fisheries collected and removed 1018 Asian swamp eels from Silver Lake from 2008 to 2012. 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 backpack 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.

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.

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. The northern snakehead has a strong foothold in the tidal section of the lower Delaware River from Raccoon Creek to Bordentown.

Northern snakehead.

In 2012 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. Two locations were sampled during 2012 however no snakeheads were observed or collected (Table 3). 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.

Table 3. NJ DFW 2012 Field Sampling efforts for Snakeheads

Waterbody	Location	Snakeheads
Cooper River Lake	Cherry Hill, NJ – Perimeter of Lake	0
Stewart Lake	Woodbury, NJ – Perimeter of 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 10 counties. Most new sightings are brought out our attention by anglers, who typically mention that they were made aware of the problem via recent invasive species articles in the Freshwater Fisheries Digest.

In early September, an angler called in to report that they had seen water chestnut in the upper part of Greenwood Lake. The angler removed a couple of plants and took a photo, which was then provided to the Bureau. It was determined that the angler was in New York state waters when the discovery was made. In order to assess whether any water chestnut was in the New Jersey portion of the lake two seasonal workers were sent out on September 6. They made a full inspection of the eastern and northern shores of the lake and found the plant growing in the uppermost (northern) end of the lake. At first only small groups of plants 5-10 were discovered but soon larger infestations were found. An effort was made to remove all of the plants, but they were discovered to be too abundant. Approximately 3 to 4 cubic yards of plants were removed from the lake. GPS points were taken of all plants found. At the time of the removal the plants fruits/seeds

appeared fully developed, but not yet fully ripened. They were green in color as opposed to the dark black color the mature fruit exhibits. On September 10, workers returned to investigate the remaining unviewed areas of the lake. No plants were found in New Jersey waters and no new areas of colonization were observed in New York waters beyond what was found in the first search.

The Division of Fish and Wildlife's Bureau of Land Management continued herbicide treatments in 2012 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.

Water chestnut seed pods: immature (left) and mature (right).

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

Trout are useful bioindicators of stream health as excellent water quality and habitat are necessary for their survival and successful reproduction. 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.

Double backpack electrofishing crew.

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 2012, two electrofishing surveys were conducted strictly for classification purposes by the Bureau under Job IV-1, however data from 12 additional stream electrofishing 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 support the upgrade of two *trout maintenance* sections to *trout production* and one default *non-trout* stream segment was confirmed as *non-trout*. Five electrofishing surveys conducted in 2011 confirm existing surface water classifications, therefore no action is required. A complete list of streams sampled in 2012 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 and 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 and 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).

Nineteen dissolved oxygen and temperature profiles were conducted, under variety of other jobs and/or funding sources, on lakes throughout the State, in accordance with

surface water classification protocols. Review of profile data did not warrant any changes to the SWQS, however it confirmed trout supporting water at seven of the sixteen *trout maintenance* lakes (Appendix D).

Thirty-one lakes and reservoirs in New Jersey are classified as *trout maintenance.* A project was initiated (in 2012) to assess the current support trout capabilities of *trout maintenance* lakes during the critical summer months. Sixteen waters were surveyed (see below). Lakes and reservoirs are classified as *trout maintenance* using data from temperature/dissolved oxygen profiles conducted during the late summer (for classification methodology see section entitled *Assessment and Classification of New Jersey's Fresh Waters (Job IV-1).* The presence and amount of trout supporting water can vary from year to year, depending on air temperature and rainfall. Shallow lakes, particularly those less than 50 feet deep, often have little or no trout supporting water during the summer due to anoxic conditions in their colder bottom waters and warm surface waters. Many of these *trout maintenance* lakes and reservoirs waters do not have recent profile data, which limits Fish and Wildlife's ability to effectively manage these waters for existing or potential trout fisheries and trout stocking programs.

In 2012, 16 of 31 lakes and reservoirs classified as *trout maintenance* were assessed:

Morris County: Splitrock Reservoir
Hunterdon County: Spruce Run Reservoir
Passaic County: Clinton Reservoir, Oak Ridge Reservoir
Sussex County: Canistear Reservoir, Cranberry Lake, Gardner's Lake, Lake Aeroflex, Lake Hopatcong, Lake Iliff, Lake Marcia, Lake Rutherford, Stony Lake, Swartswood Lake
Warren County: Furnace Lake, Mountain Lake

Of these 16 waters, 7 had a layer of trout supporting water when surveyed. Those lakes which had a layer of trout supporting water (and the approximate "thickness" of the layer) were: Clinton Reservoir (3 ft), Furnace Lake (2 ft), Gardner's Lake (2 ft), Iliff Lake (2 ft), Lake Aeroflex (17 ft), Mountain Lake (5 ft), and Lake Rutherford (4 ft).

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 2012 the Bureau of Freshwater Fisheries continued to evaluate 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. A completed Anadromous GIS layer will be finalized and available in 2013.

Angler Attitude, Preference, and Use Survey (Job IV-3)

The objective of this job is to gather pertinent information related to trout angler attitudes and preferences on trout stocking programs and their use of the state's freshwater fisheries resources. In 2012, NJ Division of Fish & Wildlife Staff developed survey questions to obtain trout angler attitudes and preferences on key components of our trout stocking programs. Responsive Management of Harrisonburg, VA conducted the telephone portion of the trout angler survey analyzed the responses using their statistical software and prepared and submitted a report entitled *New Jersey Trout Anglers' Opinions on Stocking and Other Trout Regulations*. In addition to the telephone survey, the questions developed by Division Staff will also be used to gather angler feedback from an online/internet survey as well.

In October 2012, 1,311 licensed anglers who purchased a trout stamp in both 2011 and 2012 participated in the telephone survey to assess trout fishing participation and satisfaction. The survey covered topics including, but not limited to, what type of gear and bait trout anglers prefer to use, how often and how many trout are kept per trip, usage and preference of trout conservation areas, participation and satisfaction of our fall and winter trout stocking programs, along with species preference and creel limits for our fall trout program. Responses to this survey along with angler feedback obtained from meetings, forums and all other feedback we receive will be used towards possible future regulation changes and overall future structure of our trout stocking programs. Complete survey results can be found in the attached report, New Jersey Trout Anglers' Opinions on Stocking and Other Trout Regulations (Appendix D), prepared by Responsive Management in 2012.

Management of Diseases and Fish Health in Wild Populations (Job IV-5) and Diagnosis of Diseases in Fish (FW-69-R16 Job F-1)

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). A full-time Fish Pathologist was hired filling a six year vacancy in 2012, which is paramount to the protection of the state's aquatic resources. The pathologist leads investigational efforts of suspected disease outbreaks, performs proactive monitoring, and aids in administering regulatory programs geared to the protection of both cultured and wild populations.

Hatchery health inspections were completed on the three trout species reared at the Pequest trout hatchery and the warm/coolwater species raised at the Hackettstown hatchery; all fish examined were free from the diseases of concern. An elevated level of mortality occurred in intensively-reared muskellunge raised in Hackettstown this past year. Current research is focusing on identifying the cause of mortality and ways in which this may be avoided in future years.

Annual Fish Health History forms were sent to 57 commercial hatcheries throughout the United States. Fish Health forms, and related pathogen test results were submitted for review by 21 private culture facilities. Nineteen hatcheries (1 in-state and 18 out-of state) were approved to sell fish in New Jersey for stocking purposes.

A full-time fish pathologist, Dr. Jan Lovy, was hired in June 2012. New Jersey has been without a state fish pathologist for over six years. Having a full-time pathologist will greatly improve the ability of the Division to respond to fish kills, and better document the role of fish pathogens in these occurrences, as well as the monitoring of disease outbreaks and treatments at the Division two fish culture facilities.

In addition to activities related to regulatory compliance, field investigations are also conducted in response to reports of fish kills, distressed fish, or unknown fish parasites. These reports are investigated to document if the problem is fish pathogen related or the result of environmental conditions (low dissolved oxygen, elevated water temperatures, pollution etc.) At times, several factors may play a role. Five field investigations were conducted by Bureau of Freshwater Fisheries staff.

Private Pond (Warren County)

In early October an investigation of a private koi (carp) pond in Warren County with elevated mortality revealed that fish were dying from polycystic kidney disease, a disease that leads to large cysts in the kidney tissue. The condition is commonly reported world-wide, although the cause of the disease is currently unknown and in this case no pathogens were identified.

Game Creek (Salem County)

A fish kill was reported and investigated on August 15, 2012 at Game Creek. There were no fish observed. Temperature, pH, and oxygen were collected in three separate locations. Temperature ranged from 26.5 – 27.4 C, pH ranged 7.05 – 7.20, dissolved oxygen 4.40 – 6.15. The fish kill was witnessed and reported by multiple anglers however no fish were observed by Division staff. The fish kill was reported to have affected largemouth bass, some as large as four pounds and bluegill.

Memorial Lake (Salem)

A fish kill was reported on May 15, 2012 at Memorial Lake in Woodstown, Salem County. The report was received from the Salem County Health Department. The kill was investigated on May 16th. Approximately 50 dead carp and two catfish were observed. It is believed that the kill was caused by a bacterial infection in the fish. Fish had been dead for too long to collect a sample for testing.

Palantine Lake (Salem)

Another report of dead bluegills was reported on May 7, 2012 at Palatine Lake, Salem County which is located just downstream from Elmer Lake. Only one dead bluegill was observed on during the on-site inspection on May 8th. The fish may have been washed downstream from Elmer. No further reports were received.

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 increasing staff time is spent reviewing and approving these permits due to staffing reductions, increased complexity in the management of the state's water resources, and the variety of interests of user groups. In 2012, the Bureau addressed this growing demand by creating a webpage on the Division's website, dedicated to freshwater permits. The webpage elaborates information for applicants, identifying common mistakes on applications, outlines proper procedures and provides access to the most current application forms. These efforts should improve the quality of application submittals, encourage early coordination in application and project planning, thus avoiding delays via a more efficient review. Approximately 25% of applications received are determined to lack basic/critical data and/or proper signatures and must be returned to applicants.

Table 4. Permits issued by the BFF in 2012

Permit Type	Number Issued in 2012
Baitfish - Commercial	14
Fish Stocking	254
Gill Net – Staked - Commercial	1
Gill Net – Drifting - Commercial	0
Green Frog/ Bullfrog - Commercial	2
Haul Seine - Commercial	1
Miniature Fyke/pot	1
Scientific Collecting	48
Snapping Turtle - Commercial	113
Special Use Limited License	42
Water Lowering	154
Total	**630**

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 2012, the Bureau of Freshwater Fisheries issued 190 fishing tournament permits at 18 Wildlife Management Area locations throughout New Jersey. Thirty-seven organizations were involved in fishing these tournaments. The three most popular areas among tournament anglers were Salem Canal, Lake Assunpink, and Union Lake. This was the first year that permits were issued for Salem Canal. A new boat ramp was constructed on Fish and Wildlife property and allowed us the opportunity to collected valuable data from the catch reports. The largest bass of the year was caught at Lake Assunpink on July 5th and weighed 6.66 lbs. Catch and Release only tournaments were again allowed on Lake Audrey, only three permits were issued compared to five in 2011.

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 – Professional 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 2012, Research and Management staff attended the following meetings and workshop: East Coast Trout Management & Culture Workshop and an Eastern Brook Trout Joint Venture meeting (a Fish Habitat Partnership operating under the National Fish Habitat Action Plan).

Information and Education – Public 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 2012, presentations on the fisheries resources within the state were presented to:

- Coldwater Conservation Camp electrofishing demonstration
- Freshwater Fisheries Forum (North)
- Freshwater Fisheries Forum (South)
- Garden State Outdoor Sportmen's Show
- Meadowlands Environment Center, Lyndhurst
- Outdoor Writer's Workshop
- Round Valley Trout Association
- Union County BioBlitz
- Upper Deerfield Environmental Commission
- World Fishing & Outdoor Expo (Suffern, NY)

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. The event was held on September 15 and 16 in 2012, from 10 a.m. to 5 p.m. daily at the Colliers Mills Wildlife Management Area in Jackson Township, Ocean County. The 2013 dates are expected to be September 14 and 15. The Expo is an annual event which is free of charge and takes place rain or shine.

The WILD Outdoor Expo is hosted by the NJDEP Division of Fish and Wildlife, Division of Parks and Forestry, the Green Acres Program and the Conserve Wildlife Foundation of New Jersey. The event also has several sponsors, and exhibitors and vendors from the field of outdoor recreation will be on site. Food vendors will also participate; you are welcome to bring and enjoy your own in the picnic tent.

The Expo helps people connect with the natural world by providing a unique blend of conservation information, education and hands-on opportunities to learn outdoor skills and activities. Numerous environmental and conservation exhibits, demonstrations and seminars are planned for the weekend. Visitors can learn about, and try, a wide array of activities including fishing, hiking, shooting sports, kayaking, camping skills, rock climbing, wildlife watching and much more.

Fisheries biologists also attended the 9th annual **Teen Anglers NJDFW Day** at the Pequest Trout Hatchery.

Staff 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 Rahway River Park on June 9. Fish were collected at multiple sites along the Rahway River and Rahway River Park Lake. The team used a variety of sampling methods including electro-shocking and seining. The fish diversity is moderate, consisting of 16 species (Table 5), with the American eel the most prevalent. All but 5 species are native to New Jersey waters. Non-native species include green sunfish, bluegill, largemouth bass, common carp, and western mosquitofish. The warmwater fish assemblage encountered provides recreational opportunities for both the novice naturalist and the expert angler including largemouth bass, a variety of sunfish species, and common carp. 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. The presentation also touched upon the job of a fisheries biologist, a summary of fishes encountered, and field identification.

Table 5. Fish species encountered during the Union County 2012 BioBlitz.

Common Name	Historical Presence	Rahway River	Rahway River Park Lake
American eel	native	x	
common carp	non-native	x	x
golden shiner	native	x	
spottail shiner	native	x	
white sucker	native	x	
yellow bullhead	native	x	
banded killifish	native	x	
mummichog	native	x	
western mosquitofish	non-native	x	x
white perch	native		x
redbreast sunfish	native	x	x
green sunfish	non-native	x	x
pumpkinseed	native	x	x
bluegill	non-native	x	x
largemouth bass	non-native		x
tessellated darter	native	x	

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.

Blackbanded sunfish.

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, gathering additional fisheries data from other agencies, mapping, and Delphi process to determine status, all of which will result in the formation specific management objectives.

In 2012, only two surveys were conducted specifically targeting native fishes. Seining surveys at Greenwood Lake and Grover's Mill Pond did not yield promising results. Bridle shiners and bluespotted sunfish were documented in comprehensive surveys conducted in 1951, however neither species were encountered during this cursory survey in 2112. More discouraging, comprehensive surveys at Grover's Mill Pond in 1952 listed ironcolor shiners, mud, banded, bluespotted, and blackbanded sunfishes, swamp darter, and pirate perch (among other more common species), whereas none of these species were found during the 2012 cursory survey. It is believed, these observed trends may be representative of the loss of native fishes and the homogenization of our fisheries within New Jersey.

Surveys conducted on the Big Flat Brook and Flatbrook during 2012 yielded three species not widely found in New Jersey, the northern hog sucker, shield darter, and cutlip minnow were present. Although not surveyed with the intention of seeking these species, fieldwork such as this emphasizes the importance of actively collecting fisheries data in a diverse range of habitat types across an array of ecoregions as all fisheries surveys provide valuable data towards our understanding of the status and distribution of our native fish resource.

TROUT STOCKING PROGRAM: ALLOCATIONS

Annually, the Division of Fish & Wildlife's Freshwater Fisheries Research and Management Unit determines which waterbodies and how many trout per waterbody will be stocked statewide. The allocation methodology uses a combination of biological, physical, and social factors to equitably allocate trout over a 10-week period to all trout-stocked waters. A computerized database containing different variables for each stream, lake, and pond is used in conjunction with a formula to calculate individual weekly allotments of trout. The database is annually reviewed and updated by biologists.

There were no changes to the Trout Formula methodology used to determine spring trout allocations for 2012. We are continuing to use a spring baseline of 570,000 trout to determine individual weekly allocations. A summary of trout stocked during 2012, by season and species is found in Table 6.

Table 6. 2012 Trout stocking summary by season/program.

Spring 2012 Trout Stocking Summary				
Species	Type	Avg. Length	Lbs.	# Fish
Rainbow Trout	Production	11.2"	100,725	199,192
	Broodstock	16.3" & 23.5	5,529	1,788
Brook Trout	Production	11.1"	134,264	256,607
	Broodstock	16.7"	5,982	2,410
Brown Trout	Production	10.9"	86,558	157,895
	Broodstock	16.5" & 21.9	7,938	2,370
		Totals	340,996	620,262
Fall 2012 Trout Stocking Summary				
Species	Type	Avg. Length	Lbs.	# Fish
Rainbow Trout	Production	14.4"	13,826	9,190
	Broodstock	22.0"	3,242	640
Brook Trout	Production	14.8"	14,884	9,210
Brown Trout	Production	13.7"	4,038	3,185
		Totals	35,990	22,225
2012 Sea Run Brown Trout (Manasquan River)				
Species	Type	Avg. Length	Lbs.	# Fish
Brown Trout	surplus	8.2"	3,600	15,840
Winter 2012 Trout Stocked Lakes Program Summary				
Species	Type	Avg. Length	Lbs.	# Fish
Rainbow Trout	broodstock	15.0"	7,014	5,010

New waterbodies added to the trout stocking program in 2012 include Brookaloo Swamp (name change only), Ponderlodge Pond, and South Vineland Park Pond. Giampetro Park Pond will be stocked fewer times (pre-season only as opposed to pre-season and 3 in-season stockings) due to the proximity of the recently added South Vineland Park Pond. Waterbodies dropped in 2012 include Clarks Pond, Mullica Hill Pond, Riverview Beach Pond, and Trout Brook (Hope). Stream mileage was updated in the trout formula for the

D&R Canal (Mercer Co.), Honey Run, Manasquan River, Rockaway Creek, Rockaway River, Saddle River (below Annendale Road), and Stony Brook. The following lakes were not stocked in 2012 due to ongoing construction projects Prospertown Lake, Blue Mountain Lake, Blair Lake, Diamond Mill Pond, and Pohatcong Lake. Grenloch Lake was not stocked due to a diesel spill that ran into the lake.

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.

Wild brook trout marked with Visual Implant Elastomer (VIE).

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 2012. 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 7). During the summer of 2010, 427 trout were marked. When resampled the following winter, 346 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 501 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. Brook trout were marked (n=336) during the 2011 summer and data collection efforts were replicated, starting the 2011 winter through the 2012 summer Recapture results were nearly identical to those during the previous cycle. Upon conclusion of the project, 195 of the 763 marked fish were recaptured. Of those, 173 were found in the same waterbody and 22 were found in adjacent waterbodies (21 moved between mainstem and the tributaries and 1 between tributaries). Initial findings indicate high fidelity of brook trout to the same stream throughout sampling period (89%), however some movement was documented (11%). This study provides information on

Table 7. 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 (3%) 1 YL (1%)	0	0	2 RR (2%)	1 RR (1%)	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 (7%)
Spring recap. w/mark from another stream	0	0	0	0	0	0	0	0
Summer 2011 recapture (all)	3	178	105	180	31	4	0	501
Summer recap. w/mark from original stream	0	0	0	0	0	1 (17%)	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 2011 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 (2%)
Winter recap. w/mark from another stream	1 PL (33%) 2 PR (2%) 2 BR (2%) 1 BL (2%)	0	0	0	0	0	0	6 (2%)
Spring 2012 recap. (all)	91	76	46	276	8	6	0	503
Spring recap. w/mark from original stream	1 RR (1%)	4 (4%)	10 (10%)	7 (7%)	2 (7%)	0	0	24 (7%)
Spring recap. w/mark from another stream	4PR (4%) 1PL (33%) 3WR 10%) 2BR (2%)	0	0	0	0	0	0	9 (3%)
Summer 2012 recapture (all)	17	57	66	385	12	4	2	543
Summer recap. w/mark from original stream	0	1 (1%)	7 (7%)	7 (7%)	0	0	0	15 (4%)
Summer recap. w/mark from another stream	1 WR (3%)	0	0	1 PR (1%)	0	0	0	2 (0.6%)

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.

Species Management – Lake Trout

Lake trout (*Salvelinus namaycush*) fisheries exist in two waterbodies within New Jersey, Round Valley Reservoir and Merrill Creek Reservoir. Surplus lake trout have been stocked into Monksville Reservoir since at least 2004, however it does not seem to have developed into a significant fishery.

The lake trout 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 (yielded 85 lake trout in 2012). 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 (yielded 91 lake trout in 2012). 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.

Data indicate a stunted lake trout population with an abundance of small fish (22 under 1 lb., 53 from 1 to 2 lbs., 75 from 2 and 3 lbs., 22 from 3 to just over 4 lbs., 3 from 9 to 12 lbs., and the largest at 24.5 lbs. (38.8 inches)). The total number of lake trout captured was 176. Data will be analyzed and compared to 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 went go into effect in 2012. This 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.

Largest lake trout (24.5 lbs.) captured in Round Valley Reservoir in 2012.

Lake trout have been stocked annually at **Merrill Creek Reservoir** since 1988, when it first filled with water following construction. The reservoir's fishery is managed by the Merrill Creek Owners Group in cooperation with Fish and Wildlife. Fisheries surveys are conducted annually at this 650-acre reservoir by the owner's consultant to monitor lake

trout and other fish species inhabiting the reservoir. This year's annual survey of the Merrill Creek Reservoir lake trout fishery was completed in early December. Gill nets were used to capture lake trout of varying size and age. A total of 35 lake trout were captured and ranged from 10.8 – 30.7 inches, with the largest weighing 11.4 pounds. This data, along with survey data from recent years, provide mounting evidence that lake trout are successfully reproducing in the reservoir and indicate that stocking may no longer be necessary in order to maintain this fishery. Therefore, the number of lake trout stocked in 2012 was reduced by 60%, and stocking of this species will be discontinued in the future. The reservoir's fishery and natural reproduction of lake trout will continue to be monitored to assess the status of the fishery.

Largest lake trout (11.4 lbs.) captured in Merrill Creek Reservoir in 2012.

Species Management – Trout

Temperature data loggers were installed at three locations in the **Big Flat Brook/Flat Brook** special regulation area to monitor and record summer water temperature, at half-hour intervals, over a 45-day period (July 26 – September 8). The daily maximum water temperatures exceeded the desirable limit for trout (21°C (69.8°F)) on 13 – 23 days (depending on location). This temperature data will complement electrofishing data and angler survey information to not only assess the current fishing regulations, but also will aid managers and stakeholders in determining if regulation changes would benefit the fishery.

Angler logbooks were developed, assembled, and distributed to anglers who frequently fish the Year Round Trout Conservation Areas on the Musconetcong River and S/Br. Raritan River, and the special regulation area on the Big Flat Brook. Anglers recorded pertinent information related to their fishing trip (start and stop times, fishing location, number of fish caught, fish harvested, etc.) in the logbooks and returned them at the end of the calendar year (or sooner if done fishing for the year). The data from returned logbooks will be compiled and analyzed early in 2013. Results will be used to make fisheries management decisions related to trout stocking and fishing regulations in these special regulation areas.

Opening day angler counts and creel surveys are conducted annually, utilizing a network of Wildlife Conservation Corps (WCC) volunteers, assigned to various trout stocked waters. The surveys have two main objectives: (1) to record angler turnout on specific waterbodies and (2) to determine angler success. A complete list of angler turnout and catch data at the 25 lakes and ponds and 9 rivers and streams is found in Table 8.

The Bureau utilized the opening day angler counts and creek survey, to institute a pilot project, in which eight waterbodies were stocked during the pre-season with 50% of both brook and rainbow trout, rather than the traditional 100% brook trout, to evaluate species

Table 8: Opening Day angler counts and total trout caught on all waterbodies surveyed from 8:00am to 12:00pm, sorted by total number of trout caught.

County	Waterbody	Bonus Broodstock Stocked in 2012	Highest # of anglers in any given hour	Total # of Trout Caught
Warren	Musconetcong River (Stephens State Park)		74	390
Cape May	Ponderlodge	X	150	134
Hunterdon	Manny's Pond	X	102	115
Union	Seeley's Pond	X	67	91
Cumberland	Shaws Mill Pond		86	73
Hunterdon	Mountain Farm Pond		31	73
Hunterdon	Musconetcong R. Point Mtn.		19	72
Passaic	Barbour's Pond	X	107	65
Middlesex	Farrington Lake		34	64
Burlington	Crystal Lake	X	116	55
Union	Rahway River		70	54
Sussex	Lake Ocquittunk		62	52
Cumberland	Cohansey River		17	52
Bergen	Dahnert's Lake		74	47
Cumberland	South Vineland Park Pond	X	43	41
Hunterdon	Amwell Lake		36	41
Essex	Verona Park Lake	X	182	40
Cape May	Tuckahoe Lake		32	38
Monmouth	Echo Lake	X	91	35
Monmouth	Englishtown Mill Pond		32	27
Morris	India Brook		20	26
Camden	Gloucester City Pond		22	26
Hunterdon	S/Br. Raritan River - Gorge		34	24
Middlesex	Roosevelt Park Pond		64	22
Atlantic	Birch Grove Park Pond		110	16
Cumberland	Giampietro Park Pond		44	14
Cumberland	Mary Elmer Lake		32	10
Morris	Burnham Park Pond		37	10
Monmouth	Holmdel Park Pond	X	47	9
Middlesex	Lake Papaianni		27	8
Union	Green Brook		12	6
Passaic	Clinton Reservoir		47	1
Warren	Trout Brook - Hackettstown		0	0
Sussex	Flatbrook		48	not recorded

Note: Not all anglers that were counted were interviewed.

"cooperation" during the initial opening of the 2012 trout season. Assuming angler identification was accurate, the survey indicates anglers were more successful catching rainbow trout overall (257 rainbow trout compared to 102 brook trout) and on all waterbodies, except Amwell Lake (Table 9). The Bureau has intentions of expanding this pilot project to help guide its stocking program.

Table 9. Eight waterbodies stocked with 50% rainbow and 50% brook trout and results.

8 Waterbodies	Anglers	Rainbow Trout	Brook Trout	Total Caught	Trout caught per angler	Rainbow to Brook ratio
Dahnert's Lake	62	39	6	45	0.73	6.5
Roosevelt Park Pond	43	11	4	15	0.35	2.8
Verona Park Pond	160	31	16	47	0.29	1.9
Amwell Lake	26	15	23	38	1.46	0.7
Barbour's Pond	98	52	0	52	0.53	52 to0
Burnham Park Pond	20	13	1	14	0.70	13.0
Lake Ocquittunk	30	31	20	51	1.70	1.6
Seeley's Pond	47	45	22	67	1.43	2.0
Totals	486	237	92	329	0.68	2.6

Species Management – Largemouth and Smallmouth 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 2012 (Table 10). Several waters, including Lakes Audrey, Parvin Lake, and Salem Canal are sampled regularly, with recent management plans. Others such as Grenloch Lake and Bostwick Lake have not been sampled for over ten years.

Supplemental stockings of largemouth bass in Union Lake have helped to reverse the effects 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. 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 2012. 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 and Spruce Run Reservoir.

Table 10. List of waters sampled in central and southern New Jersey for largemouth and smallmouth bass.

2012 Waters Sampled for Bass	County	Sampling Method
Bostwick Lake	Cumberland	Electrofishing Boat
Cohansey River	Cumberland	Electrofishing Boat
Daretown Lake	Cumberland	20' Seine
Davis Millpond	Cumberland	Electrofishing Boat
Glenn Lake	Gloucester	20' Seine
Grenloch Lake	Gloucester	Electrofishing Boat
Grenloch Lake	Gloucester	20' Seine
Heritage Park Pond	Atlantic	20' Seine
Lake Audrey	Cumberland	Electrofishing Boat
Lake Audrey	Cumberland	20' Seine
Maple Lake	Atlantic	Electrofishing Boat
Mary Elmer Lake	Cumberland	20' Seine
Patriot Lake	Atlantic	20' Seine
Parvin Lake	Cumberland	Electrofishing Boat

General Warmwater Assessment of Lakes and Ponds

The Bureau conducts abbreviated fisheries surveys on lakes and ponds throughout the State to assess their status. This becomes more necessary following an event that may have impacted the fishery such as the draining of a lake or in response to a report of poor angling conditions. Six field investigations were conducted by Bureau of Freshwater Fisheries staff.

Best Lake (Somerset)

Shoreline seining was conducted at this 6-acre lake to assess the existing fish population, several years after the lake was drained in 2008 for a dam repair. At that time, a fish habitat project was implemented and warmwater fish were stocked in 2009 and 2010. Seining data indicate extensive sunfish (primarily bluegill) reproduction is taking place as hundreds of young-of-the-year were collected with nearly every seine haul. Few largemouth bass were encountered, so 50 averaging 4.5 inches were stocked by the Hackettstown Fish Hatchery in an attempt to balance the fishery. Unfortunately, green sunfish and mosquitofish were also abundant. It is recommended that additional surveys are conducted to monitor the fish population.

Franklin Pond (Sussex)

Shoreline seining was conducted at Franklin Pond to assess warmwater fish reproduction. Although sunfishes (primarily bluegill) were abundant, largemouth bass (young-of-the-year) were scarce. Stocking recommendations were submitted to the Hackettstown Fish Hatchery.

Grover's Mill Pond (Mercer)

Shoreline seining was conducted at this 28-acre lake to assess the existing fish population, several years after the lake was partially lowered in 2008 for dredging. An assortment of warmwater species were stocked in 2009 to bolster the fish population. Seining data

indicate adequate sunfish (primarily bluegill), largemouth bass, and black crappie reproduction is taking place. Unfortunately, many of the native species once found in this waterbody are no longer present.

Manalapan Lake (Middlesex)
Shoreline seining was conducted at this 40-acre lake to assess the existing fish population. Within the last few years the Township of Monroe and Middlesex County have demonstrated interest to improve the fishery and angler access of this waterbody and the Division of Fish and Wildlife supports recent actions they have taken. Seining data indicate adequate sunfish (primarily bluegill) and largemouth bass reproduction is taking place. This information will be useful when determining next steps in the management of this waterbody. An assortment of fish (325 crappie, 100 adult bluegill and 300 yoy, 17 brown bullhead, 35 yellow bullhead, 15 largemouth bass, 5 chain pickerel, 25 shiners) were salvaged from Brainerd Lake (Middlesex) due to a dam failure and relocated to Manalapan Lake to bolster the fish population.

Nelson Lake (Middlesex)
Shoreline seining was conducted at this 15-acre lake to assess the existing fish population, several years after the lake was drained in 2010 for a dam repair. An assortment of warmwater fish were stocked in 2011. Seining data indicate adequate sunfish (primarily bluegill) reproduction is taking place, however no young-of-the-year largemouth bass were encountered, however this does not warrant concern, as the largemouth bass stocked in 2011 were only 1.5 to 2 inches and would not be of age to have experienced a spawing season. To bolster the bass population, 375 largemouths, averaging 4.5 inches, were stocked by the Hackettstown Fish Hatchery. Unfortunately, mosquitofish were present. It is recommended that additional surveys are conducted to monitor the fish population.

Watchung Lake (Somerset)
Shoreline seining was conducted at this 15-acre lake to assess the existing fish population. Fish salvaged from the Best Lake, which is in very close proximity, were relocated into Watchung Lake in 2008. Seining data indicate sunfish (primarily bluegill) reproduction is taking place, however surprizingly no largemouth bass were encountered. As a result, 300 largemouth bass, averaging 4.5 inches, were stocked by the Hackettstown Fish Hatchery in an attempt to balance the fishery. Unfortunately, green sunfish were present. It is recommended that additional surveys are conducted to monitor the fish population.

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. In 2012, the Bureau conducted one fish salvage:

Brainerd Lake (Middlesex)
An emergency fish salvage was conducted on August 24 due to a breach in the Brainerd Lake dam. Fishes relocated to Manalapan Lake include 325 crappie, 100 adult bluegill and 300 young-of-the-year bluegill, 17 brown bullheads, 35 yellow bullheads, 15 largemouth bass, 5 chain pickerel, and 25 golden shiners. It is assumed that a number of fish escaped downstream into Cranbury Brook.

HABITAT RESTORATION and 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 2012, staff also provided technical assistance related to stream restoration and dam removal projects, as described below.

Mason's Run (Camden County)
Mason's Run supports the southernmost reproducing brook trout population in New Jersey. The Pine Hill Golf Course was constructed in the late 90's, in which parts of the course actual traverse this unique South Jersey resource. During construction in 1999, a large sedimentation event impacted the stream and trout population. Sediment was removed by Jim Gracie of Brightwater Environmental Consulting and the stream and trout population rebounded. In recent years, sedimentation from road run off, golf course input and unstable upstream habitat created heavy deposition of sediment in Mason's Runs. These issues and others were discussed at the Pine Hill Conservation Team annual meetings and a consultant was hired to draft a proposed restoration project which could be implemented in 2012/2013.

In 2012, a large sedimentation event was discovered at Mason's Run, on August 6th by a member of the Conservation Team and active Trout Unlimited member Brian Burns. The course staff indicated that on July 20th a lightning strike caused a failure of the irrigation system which in turn caused an undetermined amount of water and sand to enter the stream. This catastrophic event threatened this already impacted trout stream.

A sight visit by the members of the conservation group determined that approximately 150 meters of stream were affect by heavy sediment deposits. NJDEP Compliance and Enforcement, Trent Todash was on site on 8/15 to determine

if any enforcement action was required, no action was taken. Stream restoration experts were consulted and indicated that immediate removal of the sediment is recommended.

Volunteers, conservation group representatives, golf course staff and Division employees spent 14 days in the stream to remove the sediment via filling sand bags. Approximately 1465 sandbags were removed from the stream. The sand bags weighed approximately 50 pounds each and 36 tons total.

Further investigations by staff and trout unlimited member indicate that the brook trout were able to successfully spawn this year. Components of the proposed restoration project will be implemented in the future to address sedimentation issues.

Big Flatbrook (Sussex County)

Under the direction of Fish and Wildlife, a large woody debris jam on the Big Flat Brook, in the Flatbrook-Roy WMA, was removed by a private contractor. Numerous trees had lodged in a bend of the stream in 2011 (during hurricane Irene and tropical storm Lee) causing much of the flow to be diverted into the adjacent wooded floodplain. Many of the trees (30 estimated, 1-2 feet in diameter, with root-wads attached) were wedged across the stream, with smaller woody debris lodged in-between. Biologists were present to supervise this project and ensure that fish and wildlife resources were adequately protected. Fish inhabiting side channels that would be dewatered were captured by electrofishing and were relocated to the mainstem downstream of the log jam. A large snapping turtle was relocated and a beaver and opossum moved out on their own accord. A beaver dam across this prime trout stream would have had serious consequences for the trout, in terms of thermal warming during the summer (from water impounded behind a beaver dam). This one-day project was performed by a private contractor and funded by the Fred Burroughs North Jersey Chapter of Trout Unlimited.

Impeded flow of the Big Flatbrook during woody debris removal (left) and restored flow via the main channel following debris removal after (right).

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 2012 the Partnership began focusing on the removal of the Hughsville and Warren Glen dams and the Army Corps of Engineers continued to pursue removal of the Bloomsbury dam.

2012

SUMMARY
STREAM SURVEY DATA

This section of the report includes stream survey data completed by the Bureau of Freshwater Fisheries in 2012. 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 Upper Delaware River Basin

BIG FLAT BROOK

Project: Species Management	**Drainage:** Flat Brook
Location: Blewett tract - upstream from (Sta #1)	**County:** Sussex
Date: July 30, 2012	**Municipality:** Sandyston Twp.

Summary

This survey is one of four conducted in 2012 on the 4.1 mile special regulation area on the Big Flat Brook/Flat Brook (fly fishing only for all or most of the year). The survey station is located a short distance upstream from its confluence with the Little Flat Brook and is also upstream of the stream section known as the Blewett Tract. Two backpacks were used to electrofish this stream reach. Trout and other fish species commonly found with trout were present (14 species total). The seven brook trout encountered were all wild, naturally reproduced fish while the lone rainbow trout was a stocked fish of hatchery origin (wild vs. hatchery based upon fin erosion and wear). Although this stream section is classified as *trout production*, no young-of-the-year trout were found and limited numbers of older trout were present despite the presence of optimal physical habitat.

Water Chemistry & Habitat	
Water temperature	19.1°C
Dissolved oxygen	9.79 mg/L
pH	7.32
Alkalinity	24.5 mg/L as $CaCO_3$
Specific conductance	91.9 μS/cm
Sample length	150 m
Habitat assessment score	184 (optimal)

Fish species	Number
sea lamprey	12
American eel	8
cutlip minnow	3
common shiner	30
blacknose dace	12
longnose dace	6
creek chub	12
fallfish	1
white sucker	4
redfin pickerel	3
rainbow trout (older than y-o-y)	1 (284 mm)
brook trout (older than y-o-y)	7 (156-294 mm)
pumpkinseed	1
tessellated darter	9

Recommendation: The data from the four electrofishing surveys, along with continuous water temperature and angler survey data, will be used to assess the fishery and the special fishing regulations to determine if regulation changes are warranted.

BIG FLAT BROOK

Project: Species Management	**Drainage:** Flat Brook
Location: Upstream from Blewett tract (Sta #2)	**County:** Sussex
Date: July 30, 2012	**Municipality:** Sandyston Twp.

Summary

This survey is one of four conducted in 2012 on the 4.1 mile special regulation area on the Big Flat Brook/Flat Brook (fly fishing only for all or most of the year). The survey station is located a short distance upstream from its confluence with the Little Flat Brook and is also upstream of the stream section known as the Blewett Tract. Two backpacks were used to electrofish this stream reach. Trout and other fish species commonly found with trout were present (16 species total). The three brook trout encountered were all wild, naturally reproduced fish (based upon fin erosion and wear). Two species not widely found in New Jersey (northern hog sucker and shield darter) were present. Although this stream section is classified as *trout production*, no young-of-the-year trout were found and limited numbers of older trout were present despite the presence of optimal physical habitat.

Water Chemistry & Habitat	
Water temperature	20.8°C
Dissolved oxygen	9.05 mg/L
pH	7.21
Alkalinity	23.5 mg/L as $CaCO_3$
Specific conductance	91.9 μS/cm
Sample length	150 m
Habitat assessment score	190 (optimal)

Fish species	**Number**
sea lamprey	4
American eel	10
cutlip minnow	3
common shiner	24
blacknose dace	38
longnose dace	11
creek chub	1
fallfish	1
white sucker	15
northern hog sucker	5
margined madtom	1
redfin pickerel	3
brook trout (older than y-o-y)	3 (159-252 mm)
slimy sculpin	1
tessellated darter	16
shield darter	1

Recommendation: The data from the four electrofishing surveys, along with continuous water temperature and angler survey data, will be used to assess the fishery and the special fishing regulations to determine if regulation changes are warranted.

BIG FLAT BROOK

Project: Species Management	**Drainage:** Flat Brook
Location: Between Rt. 206 and Rt. 560 bridges	**County:** Sussex
Date: July 31, 2012	**Municipality:** Sandyston Twp.

Summary

This survey is one of four conducted in 2012 on the 4.1 mile special regulation area on the Big Flat Brook/Flat Brook (fly fishing only for all or most of the year). The survey station is located in the upper end of this special regulation area. Two backpacks and a two-electrode stream rig were used to electrofish the stream reach. Trout and other fish species commonly found with trout were present (15 species total). The three trout (one rainbow and two brown) were stocked fish of hatchery origin (wild vs. hatchery based upon fin erosion and wear). In addition to the ubiquitous white sucker, the uncommon northern hog sucker was also present. Although classified as *trout production,* this stream section yielded no young-of-the-year trout and a limited number of older trout despite the presence of optimal physical habitat. The size of the pools (deep and wide) hampered sampling efficiency.

Water Chemistry & Habitat	
Water temperature	19.9°C
Dissolved oxygen	9.24 mg/L
pH	7.62
Alkalinity	26.0 mg/L as $CaCO_3$
Specific conductance	91.1 µS/cm
Sample length	150 m
Habitat assessment score	174 (optimal)

Fish species	Number
sea lamprey	1
American eel	54
cutlip minnow	11
common shiner	16
blacknose dace	197
longnose dace	42
creek chub	12
white sucker	28
northern hog sucker	2
rainbow trout (older than y-o-y)	1 (266 mm)
brown trout (older than y-o-y)	2 (242-288 mm)
slimy sculpin	37
pumpkinseed	5
largemouth bass	14
tessellated darter	16

Recommendation: The data from the four electrofishing surveys, along with continuous water temperature and angler survey data, will be used to assess the fishery and the special fishing regulations to determine if regulation changes are warranted.

FLAT BROOK

Project: Species Management	**Drainage:** Flat Brook
Location: Upstream from Roy Bridge	**County:** Sussex
Date: July 31, 2012	**Municipality:** Sandyston Twp.

Summary

This survey is one of four conducted in 2012 on the 4.1 mile special regulation area on the Big Flat Brook/Flat Brook (fly fishing only for all or most of the year). The survey station is located in the lower end of this special regulation area. Two backpacks and a two-electrode stream rig were used to electrofish the stream reach. Trout and other fish species commonly found with trout were present (14 species total). Six trout representing three species were present and two of the fish (the brook trout and a 114 mm brown trout) appeared to be of wild origin (based upon fin erosion and wear). A limited number of trout were present, despite the presence of optimal physical habitat. The width of the stream may have affected sampling efficiency.

Water Chemistry & Habitat	
Water temperature	18.8°C
Dissolved oxygen	10.03 mg/L
pH	7.66
Alkalinity	72.0 mg/L as $CaCO_3$
Specific conductance	216.2 μS/cm
Sample length	150 m
Habitat assessment score	170 (optimal)

Fish species	Number
American eel	43
cutlip minnow	12
blacknose dace	57
longnose dace	35
creek chub	9
white sucker	27
redfin pickerel	1
rainbow trout (older than y-o-y)	2 (308-314 mm)
brown trout (older than y-o-y)	2 (284-296 mm)
brown trout (y-o-y)	1 (114 mm)
brook trout (older than y-o-y)	1 (180 mm)
slimy sculpin	13
pumpkinseed	74
tessellated darter	36
shield darter	1

Recommendation: The data from the four electrofishing surveys, along with continuous water temperature and angler survey data, will be used to assess the fishery and the special fishing regulations to determine if regulation changes are warranted.

HAKIHOKAKE CREEK (trib.) (Wydner)

Project: Trout Production Inventory	**Drainage:** Lockatong
Location: Rte 614, House #241 near pond by house off dirt lane with culvert. Sampled between two culverts.	**County:** Hunterdon
Date: July 26, 2012	**Municipality:** Holland Twp.

Summary

A reproducing wild brown trout population, previously documented in 1990, was thriving in this spring feed tributary which flows through farmland. Over a 150 m stream reach 178 brown trout (110 young-of-the-year, 68 older than y-o-y) were encountered. The abundance of slimy sculpin (102) reflects clean water and cold year-round temperatures. This is a very productive, small trout stream due in large part to cold summer water temperatures and the high alkalinity. This tributary is also stocked with trout in the spring (as part of the mainstem Hakihokake Creek) at several locations downstream of the survey location. Given the presence of wild brown trout, it may not be necessary to stock trout in this tributary to maintain a desirable trout fishery.

Water Chemistry & Habitat	
Water temperature	15.8°C
Dissolved oxygen	10.47 mg/L
pH	6.89
Alkalinity	155 mg/L as $CaCO_3$
Specific conductance	304.2 µS/cm
Sample length	150 m
Habitat assessment score	157 (suboptimal)

Fish species	Number
American eel	2
blacknose dace	28
creek chub	1
brown trout (y-o-y)	110 (61-115 mm)
brown trout (older than y-o-y)	68 (126-296 mm)
slimy sculpin	102

Recommendation: Additional assessments of both fish assemblages and angler usage at locations downstream of the 2012 survey location would aid managers in determining if trout stocking should be discontinued. Continue to monitor this stream in accordance with the established schedule (every 20 years).

Surveys in the Passaic River Basin

APSHAWA BROOK

Project: Brook Trout Assessment	**Drainage:** Pequannock River
Location: At Mt. Springs Road, West Bridge Crossing	**County:** Passaic
Date: July 18, 2012	**Municipality:** West Milford

Summary

This previously unsampled *trout production* catchment was investigated to determine the presence of brook trout for the EBTJV. No trout were collected in the 50 meter stretch. Low water and minimal flow were documented.

Water Chemistry & Habitat	
Water temperature	23.4°C
Dissolved oxygen	6.08 mg/L
pH	7.42
Alkalinity	90.0 mg/L as $CaCO_3$
Specific conductance	444.1 µS/cm
Sample length	50 m
Habitat assessment score	-

Fish species	Number
creek chub	27
chain pickerel	1
pumpkinseed sunfish	1

Recommendation: No need to sample again.

NON-STANDARDIZED SURVEY

BEAR SWAMP BROOK

Project: Stream Encroachment Review	**Drainage:** Ramapo River
Location: Above Bear Swamp Lake; Ramapo Valley Reservation (Lower Site)	**County:** Bergen
Date: September 20, 2012	**Municipality:** Mahwah Twp.

Summary

Conducted electrofishing on a 50 meter stretch of Bear Swamp Brook, upstream of Bear Swamp Lake in the Ramapo Reservation, Bergen County. A natural gas pipeline is slated to cross the brook at this point. The sampling was conducted to determine the presence, or absence, of native brook trout which inhabit this brook below Bear Swamp Lake. Two mudminnows and no brook trout were collected.

Water Chemistry & Habitat	
Water temperature	13.5°C
Dissolved oxygen	9.11 mg/L
pH	7.01
Alkalinity	-
Specific conductance	89.1 µS/cm
Sample length	50 m
Habitat assessment score	-

Fish species	Number
eastern mudminnow	2

Recommendation: No need to sample again.

NON-STANDARDIZED SURVEY

BEAR SWAMP BROOK

Project: Stream Encroachment Review	**Drainage:** Ramapo River
Location: Above Bear Swamp Lake; Ramapo Valley Reservation (Upper Site)	**County:** Bergen
Date: September 20, 2012	**Municipality:** Mahwah Twp.

Summary

Conducted electrofishing on a 50 meter stretch of Bear Swamp Brook, upstream of Bear Swamp Lake in the Ramapo Reservation, Bergen County. A natural gas pipeline is slated to cross the brook at this point. The sampling was conducted to determine the presence, or absence, of native brook trout which inhabit this brook below Bear Swamp Lake. Two mudminnows and no brook trout were collected.

Water Chemistry & Habitat	
Water temperature	14.1°C
Dissolved oxygen	9.28 mg/L
pH	6.81
Alkalinity	-
Specific conductance	91.2 µS/cm
Sample length	50 m
Habitat assessment score	-

Fish species	Number
eastern mudminnow	2

Recommendation: No need to sample again.

NON-STANDARDIZED SURVEY

DEN BROOK

Project: Brook Trout Assessment	**Drainage:** Passaic River
Location: Below Radtke Road	**County:** Morris
Date: August 2, 2012	**Municipality:** Randolph

Summary

This previously unsampled *trout production* catchment was investigated to determine the presence of brook trout for the EBTJV. No trout were collected in the 50 meter stretch.

Water Chemistry & Habitat	
Water temperature	20.3°C
Dissolved oxygen	7.30 mg/L
pH	7.04
Alkalinity	20.0 mg/L as $CaCO_3$
Specific conductance	520.4 µS/cm
Sample length	50 m
Habitat assessment score	-

Fish species	Number
blacknose dace	7
creek chub	33

Recommendation: No need to sample again.

NON-STANDARDIZED SURVEY

GREEN POND BROOK

Project: Trout Production Inventory	**Drainage:** Rockaway River
Location: At Picatinny Arsenal, 122 slug butt area	**County:** Morris
Date: August 30, 2012	**Municipality:** Picatinny Arsenal

Summary

Classified as *trout production*, this brook was first sampled by the USF&WS in 1987. At that time a reproducing brook trout population was present (3 young-of-the-year (yoy) and 7 older fish) along with rainbow trout (1), eastern mud minnow (14), and chain pickerel (2) were collected over 183 m. In 2012 a total of 14 brook trout were collected (12 yoy and 7 older fish) and no other fish were collected. Five additional yoy brook trout were observed but eluded capture. The largest brook trout captured was only 106 mm and the absence of larger adult brook trout in the survey is cause for concern. Perhaps older year classes of brook trout are prevalent upstream and downstream of the survey location. A perched culvert downstream is likely a barrier to upstream fish passage and the gorge upstream may also affect the movement of fish in this stream.

Water Chemistry & Habitat	
Water temperature	19.5°C
Dissolved oxygen	8.03 mg/L
pH	6.99
Alkalinity	-
Specific conductance	51.7 μS/cm
Sample length	150 m
Habitat assessment score	139 (suboptimal)

Fish species	Number
brook trout (y-o-y)	12 (67-88 mm)
brook trout	2 (102-106 mm)

Recommendation: Continue to monitor the stream in accordance with the established schedule (a minimum of once every 20 years). The perched culvert should be removed or replaced with a structure that does not obstruct fish passage and fragment the stream. This possibility should be further explored with the property owner.

MACOPIN RIVER (trib.) (Unnamed Tributary #1)

Project: Brook Trout Assessment	**Drainage:** Pequannock River
Location: Echo Lake Road Bridge Crossing @ Macopin Road Intersection	**County:** Passaic
Date: July 18, 2012	**Municipality:** West Milford

Summary

This previously unsampled *trout production* catchment was investigated to determine the presence of brook trout for the EBTJV. This stream was not electrofished due to low dissolved oxygen. The habitat was very swampy and the water was turbid and had no observable flow.

Water Chemistry & Habitat	
Water temperature	20.2°C
Dissolved oxygen	1.23 mg/L
pH	6.73
Alkalinity	-
Specific conductance	1651 µS/cm
Sample length	0
Habitat assessment score	-

Fish species	Number
No fish collected	

Recommendation: No need to sample again.

NON-STANDARDIZED SURVEY

MILL BROOK

Project: Brook Trout Assessment	**Drainage:** Passaic River
Location: Morris County Community College	**County:** Morris
Date: August 2, 2012	**Municipality:** Randolph

Summary

This previously un-sampled *trout production* catchment was investigated to determine the presence of brook trout for the EBTJV. No trout were collected in the 50 meter stretch.

Water Chemistry & Habitat	
Water temperature	20.6°C
Dissolved oxygen	6.66 mg/L
pH	6.72
Alkalinity	35.0 mg/L as $CaCO_3$
Specific conductance	532.1 µS/cm
Sample length	50 m
Habitat assessment score	-

Fish species	Number
blacknose dace	4
creek chub	4
white sucker	1
largemouth bass	1

Recommendation: No need to sample again.

NON-STANDARDIZED SURVEY

MILL BROOK (trib.) (Unnamed tributary #1)

Project: Brook Trout Assessment	**Drainage:** Passaic River
Location: Upstream of Wilkshire Road	**County:** Morris
Date: August 2, 2012	**Municipality:** Randolph

Summary

This previously unsampled *trout production* catchment was investigated to determine the presence of brook trout for the EBTJV. One adult brown trout was collected in the 50 meter stretch. Mill Brook is classified as trout production for brown & brook trout

Water Chemistry & Habitat	
Water temperature	21.4°C
Dissolved oxygen	7.14 mg/L
pH	7.14
Alkalinity	NA
Specific conductance	272.8 µS/cm
Sample length	50 m
Habitat assessment score	-

Fish species	Number
blacknose dace	24
brown trout (older than y-o-y)	1 (241 mm)

Recommendation: No need to sample again.

NON-STANDARDIZED SURVEY

PASSAIC RIVER (Site #1)

Project: Brook Trout Assessment	**Drainage:** Passaic River
Location: Below confluence with Indian Grove Brook	**County:** Morris
Date: July 25, 2012	**Municipality:** Basking Ridge

Summary

This previously unsampled *trout production* catchment was investigated to determine the presence of brook trout for the EBTJV. Eleven brown trout, including seven young-of-the-year (yoy), and six rainbow trout, including 5 yoy, were collected in the 50 meter stretch. The presence of native brown & rainbow trout is consistent with previous sampling conducted above and below this site.

Water Chemistry & Habitat	
Water temperature	20.5°C
Dissolved oxygen	8.80 mg/L
pH	7.22
Alkalinity	57.0 mg/L as $CaCO_3$
Specific conductance	245.2 µS/cm
Sample length	50 m
Habitat assessment score	-

Fish species	Number
common shiner	2
spottail shiner	1
blacknose dace	6
longnose dace	3
creek chub	6
white sucker	5
rainbow trout (y-o-y)	5 (59-72mm)
rainbow trout (older than y-o-y)	1 (292mm)
brown trout (y-o-y)	7 (54-89mm)
brown trout (older than y-o-y)	4 (184-271mm)
tessellated darter	7

Recommendation: No need to sample again.

NON-STANDARDIZED SURVEY

PASSAIC RIVER (Site #2)

Project: Brook Trout Assessment	**Drainage:** Passaic River
Location: 54 Tempe Wick Road	**County:** Morris
Date: July 25, 2012	**Municipality:** Mendham

Summary

This previously unsampled *trout production* catchment was investigated to determine the presence of brook trout for the EBTJV. No fish were collected in the 30 meter stretch. Only crayfish were observed.

Water Chemistry & Habitat	
Water temperature	21.7°C
Dissolved oxygen	6.79 mg/L
pH	6.88
Alkalinity	62.0 mg/L as $CaCO_3$
Specific conductance	360.3 µS/cm
Sample length	30 m
Habitat assessment score	-

Fish species	Number
No fish found	

Recommendation: No need to sample again.

NON- STANDARDIZED SURVEY

PASSAIC RIVER (Site #3)

Project: Brook Trout Assessment	**Drainage:** Passaic River
Location: Franklin Road cul-de-sac	**County:** Morris
Date: July 25, 2012	**Municipality:** Mendham

Summary

This previously unsampled *trout production* catchment was investigated to determine the presence of brook trout for the EBTJV. No trout were encountered in the 50 meter stretch. Low water and minimal flow were observed.

Water Chemistry & Habitat	
Water temperature	19.6°C
Dissolved oxygen	8.07 mg/L
pH	7.3
Alkalinity	100.0 mg/L as $CaCO_3$
Specific conductance	534.0 µS/cm
Sample length	50 m
Habitat assessment score	-

Fish species	Number
blacknose dace	27
creek chub	49
white sucker	1

Recommendation: No need to sample again.

NON-STANDARDIZED SURVEY

Passaic River (trib.) (UNT #1)

Project: Brook Trout Assessment	**Drainage:** Passaic River
Location: 63 Tempe Wick Rd and Corey Ln. Intersection	**County:** Morris
Date: July 26, 2012	**Municipality:** Mendham

Summary

This previously un-sampled *trout production* catchment was investigated to determine the presence of brook trout for the EBTJV. No trout were collected in the 50 meter stretch. Low water and minimal flow were observed.

Water Chemistry & Habitat	
Water temperature	19.3°C
Dissolved oxygen	6.97 mg/L
pH	7.01
Alkalinity	NA
Specific conductance	148.3 µS/cm
Sample length	50 m
Habitat assessment score	-

Fish species	Number
blacknose dace	11
creek chub	19

Recommendation: No need to sample again.

NON-STANDARDIZED SURVEY

PASSAIC RIVER (trib.) (UNT #2)

Project: Brook Trout Assessment	**Drainage:** Passaic River
Location: Redman Farm Rd. Bridge	**County:** Morris
Date: July 26, 2012	**Municipality:** Mendham

Summary

This previously unsampled *trout production* catchment was investigated to determine the presence of brook trout for the EBTJV. No trout were collected in the 50 meter stretch. Low water and minimal flow were observed

Water Chemistry & Habitat	
Water temperature	20.4°C
Dissolved oxygen	7.16 mg/L
pH	6.82
Alkalinity	40.0 mg/L as $CaCO_3$
Specific conductance	180.8 µS/cm
Sample length	50 m
Habitat assessment score	-

Fish species	Number
blacknose dace	33
creek chub	10
largemouth bass	8

Recommendation: No need to sample again.

NON-STANDARDIZED SURVEY

PASSAIC RIVER (trib.) (UNT #3)

Project: Brook Trout Assessment	**Drainage:** Passaic River
Location: 26 Corey Lane	**County:** Morris
Date: July 26, 2012	**Municipality:** Mendham

Summary

This previously unsampled *trout production* catchment was investigated to determine the presence of brook trout for the EBTJV. No trout were collected in the 50 meter stretch. Low water and minimal flow were observed.

Water Chemistry & Habitat	
Water temperature	19.7°C
Dissolved oxygen	7.34 mg/L
pH	7.18
Alkalinity	36.0 mg/L as $CaCO_3$
Specific conductance	114.2 µS/cm
Sample length	50 m
Habitat assessment score	-

Fish species	Number
brown bullhead	16
hybrid sunfish	1
green sunfish	1
bluegill sunfish	8

Recommendation: No need to sample again.

NON-STANDARDIZED SURVEY

PEQUANNOCK RIVER (trib.) (UNT #1)

Project: Brook Trout Assessment	**Drainage:** Pequannock River
Location: New City Road @ Eastern Bridge Crossing	**County:** Passaic
Date: July 18, 2012	**Municipality:** West Milford

Summary

Very little water was present. Sampled a single pool below a culvert, where no fish were encountered.

Water Chemistry & Habitat	
Water temperature	22.6°C
Dissolved oxygen	7.22 mg/L
pH	7.07
Alkalinity	172.0 mg/L as $CaCO_3$
Specific conductance	686 µS/cm
Sample length	NA
Habitat assessment score	-

Fish species	Number
No fish observed	0

Recommendation: No need to sample again.

NON-STANDARDIZED SURVEY

PEQUANNOCK RIVER (trib.) (UNT #2)

Project: Brook Trout Assessment	**Drainage:** Pequannock River
Location: New City Road @ Western Bridge Crossing	**County:** Passaic
Date: July 18, 2012	**Municipality:** West Milford

Summary

This previously unsampled *trout production* catchment was investigated to determine the presence of brook trout for the EBTJV. No water was present, therefore no trout were documented in this tributary.

Water Chemistry & Habitat	
Water temperature	NA
Dissolved oxygen	NA
pH	NA
Alkalinity	NA
Specific conductance	NA
Sample length	NA
Habitat assessment score	NA

Fish species	Number
No fish observed	0

Recommendation: No need to sample again.

NON-STANDARDIZED SURVEY

PEQUANNOCK RIVER (trib.) (UNT #3)

Project: Brook Trout Assessment	**Drainage:** Pequannock River
Location: Camp Vacama @ Western Bridge Crossing	**County:** Passaic
Date: July 18, 2012	**Municipality:** West Milford

Summary

This previously unsampled *trout production* catchment was investigated to determine the presence of brook trout for the EBTJV. No water was present, therefore no brook or brown trout were documented in this tributary.

Water Chemistry & Habitat	
Water temperature	NA
Dissolved oxygen	NA
pH	NA
Alkalinity	NA
Specific conductance	NA
Sample length	NA
Habitat assessment score	NA

Fish species	Number
No fish observed	0

Recommendation: No need to sample again.

NON-STANDARDIZED SURVEY

PEQUANNOCK RIVER (trib.) (UNT #4)

Project: Brook Trout Assessment	**Drainage:** Pequannock River
Location: Off trail at end of Ashbrook Road cul-de-sac	**County:** Passaic
Date: July 18, 2012	**Municipality:** West Milford

Summary

This previously unsampled *trout production* catchment was investigated to determine the presence of brook trout for the EBTJV. No water was present, therefore no brook or brown trout were documented in this tributary.

Water Chemistry & Habitat	
Water temperature	NA
Dissolved oxygen	NA
pH	NA
Alkalinity	NA
Specific conductance	NA
Sample length	NA
Habitat assessment score	NA

Fish species	Number
No fish observed	0

Recommendation: No need to sample again.

NON-STANDARDIZED SURVEY

WANAQUE RIVER

Project: Classification	**Drainage:** Wanaque River
Location: At Paterson Hamburg Turnpike; Pompton Lakes	**County:** Passaic
Date: August 23, 2012	**Municipality:** Pompton Lakes Twp.

Summary

This *trout maintenance* classified section was sampled at the suggestion of an angler who believed that trout might reproduce there, however no trout were collected.

Water Chemistry & Habitat	
Water temperature	21.6°C
Dissolved oxygen	8.04 mg/L
pH	7.42
Alkalinity	43.5 mg/L as $CaCO_3$
Specific conductance	296.4 µS/cm
Sample length	187 m
Habitat assessment score	153 (suboptimal)

Fish species	Number
spottail shiner	3
blacknose dace	10
creek chub	12
white sucker	6
pumpkinseed	4

Recommendation: No need to sample again.

NON-STANDARDIZED SURVEY

WEST BROOK

Project: Brook Trout Assessment	**Drainage:** Wanaque
Location: At Jehova Witness', West Brook Road	**County:** Passaic
Date: August 15, 2012	**Municipality:** West Milford Twp.

Summary

This catchment was not previously sampled, but is classified as *trout production*. It was investigated to determine the presence of brook trout for the EBTJV. Twenty-four rainbow trout, including 18 young-of-the-year were collected. The presence of native rainbow trout is consistent with previous sampling conducted above and below this site.

Water Chemistry & Habitat	
Water temperature	20.7°C
Dissolved oxygen	8.0 mg/L
pH	7.80
Alkalinity	49.3
Specific conductance	290.9 μS/cm
Sample length	150 m
Habitat assessment score	160 (optimal)

Fish species	Number
blacknose dace	13
creek chub	12
rainbow trout (y-o-y)	18 (58-81mm)
rainbow trout (older than y-oy)	6 (176-242)
pumpkinseed sunfish	4
largemouth bass	2

Recommendation: No need to sample again.

WEST BROOK (trib.) (UNT #1)

Project: Brook Trout Assessment	**Drainage:** Wanaque
Location: At 93 Morestown Rd., West Milford	**County:** Passaic
Date: August 15, 2012	**Municipality:** West Milford Twp.

Summary

This previously unsampled *trout production* catchment was investigated to determine the presence of brook trout for the EBTJV. No rainbow trout were present. Low water and minimal flow were documented.

Water Chemistry & Habitat	
Water temperature	21.1°C
Dissolved oxygen	6.25 mg/L
pH	7.65
Alkalinity	62.0 mg/L as $CaCO_3$
Specific conductance	277.0 µS/cm
Sample length	150 m
Habitat assessment score	63 (marginal)

Fish species	Number
creek chub	146
pumpkinseed	2

Recommendation: No need to sample again.

NON-STANDARDIZED SURVEY

WEST BROOK (trib.) (UNT #2)

Project: Brook Trout Assessment	**Drainage:** Wanaque
Location: Camp Wyanockie below dam of Boy Scout Lake	**County:** Passaic
Date: August 16, 2012	**Municipality:** West Milford Twp.

Summary

This previously unsampled *trout production* catchment was investigated to determine the presence of brook trout for the EBTJV. One adult rainbow trout was collected. Two additional, similarly sized rainbow trout were observed in the isolated pools, but evaded capture. The brook's flow appeared to be mainly underground. The presence of native rainbow trout is consistent with previous sampling conducted below this site.

Water Chemistry & Habitat	
Water temperature	20.2°C
Dissolved oxygen	6.86 mg/L
pH	6.96
Alkalinity	NA
Specific conductance	70.6 µS/cm
Sample length	150 m
Habitat assessment score	133 (suboptimal)

Fish species	Number
chain pickerel	1
rainbow trout	1 (231mm)

Recommendation: No need to sample again.

NON-STANDARDIZED SURVEY

WEST BROOK (trib.) (UNT #3)

Project: Brook Trout Assessment	**Drainage:** Wanaque
Location: Above Boy Scout lake, Camp Wyanockie, Snake Den Rd.	**County:** Passaic
Date: August 16, 2012	**Municipality:** West Milford Twp.

Summary

This previously unsampled *trout production* catchment was investigated to determine the presence of brook trout for the EBTJV. Very little water present and no fish were collected.

Water Chemistry & Habitat	
Water temperature	19.9°C
Dissolved oxygen	3.88 mg/L
pH	6.45
Alkalinity	23.5 mg/L as $CaCO_3$
Specific conductance	91.6 µS/cm
Sample length	75 m
Habitat assessment score	116 (suboptimal)

Fish species	Number
NO FISH COLLECTED	-

Recommendation: No need to sample again.

NON-STANDARDIZED SURVEY

Surveys in the Raritan River Basin

BEAVER BROOK

Project: Brook Trout Assessment	**Drainage:** Raritan River, S/Br.
Location: David Post Rd. – approx. 900m downstream of Cokesbury Rd. bridge.	**County:** Hunterdon
Date: July 25, 2012	**Municipality:** Clinton Twp.

Summary

Electrofished this tributary to the Raritan River, S/Br. in an attempt to fill a data gap for the Eastern Brook Trout Joint Venture by finding brook trout. Brown trout reproduction is well documented in the lower end of this stream and it was thought that brook trout may be relegated its headwaters. Many wild brown trout were encountered, the largest of which measured 326 mm (12.8 in.), however no brook trout were found. With the exception of sediment deposition, in-stream habitat was relatively good, consisting of optimal cover and riparian buffer width.

Water Chemistry & Habitat	
Water temperature	18.7°C
Dissolved oxygen	6.64 mg/L
pH	6.93
Alkalinity	47.0 mg/L as $CaCO_3$
Specific conductance	203.8 µS/cm
Sample length	150 m
Habitat assessment score	158 (sub-optimal)

Fish species	Number
American eel	7
blacknose dace	58
creek chub	40
white sucker	7
brown trout (y-o-y)	25 (59-85mm)
brown trout (older than y-o-y)	24 (129-326mm)
tessellated darter	22

Recommendation: Although no additional surveys are needed at this time, additional efforts higher up in the watershed may be necessary to determine if brook trout are present in this catchment.

ELECTRIC BROOK

Project: Raritan River S/Br Headwater Study	**Drainage:** Raritan River, S/Br
Location: East Spring Road. 30m upstream of bridge	**County:** Morris
Date: August 17, 2012	**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 stream is located upstream of the George Lake impoundment. Classified as *trout production*, brook trout were previously found both above and below the dam, while the downstream section was dominated by brown trout. This data set confirms the preexisting trout composition persists.

Water Chemistry & Habitat	
Water temperature	18.5°C
Dissolved oxygen	8.82 mg/L
pH	7.47
Alkalinity	50.0 mg/L as $CaCO_3$
Specific conductance	382.1 µS/cm
Sample length	150 m
Habitat assessment score	-

Fish species	Number
blacknose dace	67
creek chub	49
white sucker	39
brook trout (y-o-y)	5 (66-84mm)
brook trout (older than y-o-y)	17 (111-245mm)
pumpkinseed sunfish	17
tessellated darter	41

Recommendation: No additional surveys needed at this time.

ELECTRIC BROOK

Project: Raritan River S/Br Headwater Study	**Drainage:** Raritan River, S/Br
Location: Scenic Falls Rd. End survey at falls btw Houses #16&18	**County:** Morris
Date: August 17, 2012	**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 stream is located downstream of the George Lake impoundment. Classified as *trout production*, brook trout were previously found both above and below the dam, while the downstream section was dominated by brown trout. This data set confirms the preexisting trout composition persists.

Water Chemistry & Habitat	
Water temperature	20.2°C
Dissolved oxygen	8.38 mg/L
pH	7.72
Alkalinity	40.0 mg/L as $CaCO_3$
Specific conductance	240.6 μS/cm
Sample length	150 m
Habitat assessment score	-

Fish species	Number
blacknose dace	39
creek chub	1
brown trout (y-o-y)	44 (52-86mm)
brown trout (older than y-o-y)	8 (158-250mm)
brook trout (older than y-o-y)	1 (199mm)

Recommendation: No additional surveys needed at this time.

SOUTH BRANCH RARITAN RIVER

Project: Raritan River S/Br Headwater Study	**Drainage:** Raritan River, S/Br
Location: Svea Dr., end at the confluence with Raritan River S/Br (trib) (Diglio Ditch)	**County:** Morris
Date: August 22, 2012	**Municipality:** Mt. Olive Twp.

Summary

Electrofished this section of the river as part of the Raritan River S/Br Headwater Study. Classified as *non-trout*, by default, this stream was first sampled in 2010, where fish assemblage data confirmed the presence of young-of-the-year (yoy) brook trout. Subsequently, the Division recommended that the section of the Raritan River S/Br from its confluence with Raritan River S/Br (trib) (SW of Budd Lake) to its confluence with Sun Valley Brook be specifically listed in the state Surface Water Quality Standards as *trout production*. One of the five brook trout encountered was previously marked with Visible Implant Elastomer (VIE), indicating it was originally captured in Raritan River S/Br (trib) (Diglio Ditch). An additional 12 brook trout (89 – 233 m) were encountered beyond the 150 m sample reach within the South Branch. One presumably wild brown trout (321 mm) was found in the South Branch during the continuous 1.5 mile electrofishing recapture effort. This is 1 of approximately 5 or 6 brown trout encountered during seven electrofishing events since 2010 in this 1.5 mile section.

Water Chemistry & Habitat	
Water temperature	19.4°C
Dissolved oxygen	9.14 mg/L
pH	7.43
Alkalinity	39.0 mg/L as $CaCO_3$
Specific conductance	320.8 µS/cm
Sample length	150 m
Habitat assessment score	-

Fish species	**Number**
blacknose dace	102
longnose dace	40
creek chub	28
white sucker	30
margined madtom	6
brook trout (older than y-o-y)	5 (172-206mm)
pumpkinseed	14
tessellated darter	51

Recommendation: No additional surveys needed at this time, however this impounded section of the river is expected to change chemically, physically, and biologically if/when the dam is removed, therefore additional electrofishing surveys should be conducted at that time to document changes in the fish assemblage.

SOUTH BRANCH RARITAN RIVER

Project: Raritan River S/Br Headwater Study	**Drainage:** Raritan River, S/Br
Location: River Rd. upstream of Flanders-Drakestown Rd - Start at YMCA dam	**County:** Morris
Date: August 22, 2012	**Municipality:** Mt. Olive Twp.

Summary

Electrofished this section of the river as part of the Raritan River S/Br Headwater Study. This survey started at the YMCA camp dam. Classified as *non-trout*, by default, this stream was first sampled in 2010, where fish assemblage data confirmed the *non-trout* status. Incidence of Occurrence calculations revealed a score of 11.9 (Non-Trout). Consistent with previous sampling efforts, no marked trout were encountered during this survey.

Water Chemistry & Habitat	
Water temperature	17.0°C
Dissolved oxygen	9.14 mg/L
pH	8.10
Alkalinity	36.5 mg/L as $CaCO_3$
Specific conductance	316.8 µS/cm
Sample length	150 m
Habitat assessment score	-

Fish species	Number
blacknose dace	2
creek chub	23
white sucker	39
yellow bullhead	1
eastern mudminnow	2
banded killifish	1
white perch	2
pumpkinseed sunfish	33
bluegill sunfish	1
largemouth bass	10
tessellated darter	97

Recommendation: No additional surveys needed at this time, however this impounded section of the river is expected to change chemically, physically, and biologically if/when the dam is removed, therefore additional electrofishing surveys should be conducted at that time to document changes in the fish assemblage.

SOUTH BRANCH RARITAN RIVER

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 1, 2012	**Municipality:** Mt. 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*, however one yoy brown trout was collected. In addition, twelve adult brown trout, which were assumed to be wild based on their appearance and the known brown trout reproduction that is documented downstream. Three rainbow trout suspected to have originated from the Pequest Trout Hatchery (as indicated by substantial fin erosion) ranging from 244 to 318mm. Habitat through this reach previously scored sub-optimal and appears to be significantly impacted by sediment deposition.

Water Chemistry & Habitat	
Water temperature	20.9°C
Dissolved oxygen	8.74 mg/L
pH	7.62
Alkalinity	36.0 mg/L as $CaCO_3$
Specific conductance	276.9 µS/cm
Sample length	150 m
Habitat assessment score	-

Fish species	**Number**
American eel	7
blacknose dace	147
longnose dace	61
creek chub	18
white sucker	40
brown bullhead	2
margined madtom	3
rainbow trout (older than y-o-y)	3 (244-318mm)
brown trout (y-o-y)	1 (79mm)
brown trout (older than y-o-y)	12 (168-424mm)
brook trout (older than y-o-y)	1 (198mm)
pumpkinseed	3
black crappie	1
tessellated darter	58

Recommendation: The presence of 1 yoy brown trout during this survey and 32 at a nearby downstream location, indicates consideration to upgrade this stream segment's classification from *trout maintenance* to *trout production*.

SOUTH BRANCH RARITAN RIVER

Project: Raritan River S/Br Headwater Study	**Drainage:** Raritan River, S/Br
Location: Stephens Mill Rd – upstream – start at old dam and end at outcrop falls – Park near house #60.	**County:** Morris
Date: August 1, 2012	**Municipality:** Mt. 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 thirty-two young-of-the-year (yoy) were found (64-95mm). Eight of the nine larger brown trout (168-300mm) appeared to be of wild origin were collected along with one rainbow trout suspected to have originated from the Pequest Trout Hatchery (as indicated by substantial fin erosion) were collected. During a previous survey, habitat through this reach scored at the high end of sub-optimal.

Water Chemistry & Habitat	
Water temperature	21.0°C
Dissolved oxygen	8.45 mg/L
pH	7.47
Alkalinity	37.0 mg/L as $CaCO_3$
Specific conductance	284.2 µS/cm
Sample length	150 m
Habitat assessment score	-

Fish species	**Number**
blacknose dace	44
longnose dace	33
creek chub	9
fallfish	1
white sucker	13
yellow bullhead	1
rainbow trout (older than y-o-y)	1 (280mm)
brown trout (y-o-y)	32 (64-95mm)
brown trout (older than y-o-y)	9 (168-300mm)
slimy sculpin	1
white perch	2
pumpkinseed sunfish	5
bluegill sunfish	4
largemouth bass	1
tessellated darter	6

Recommendation: The presence of 32 yoy brown trout during this survey deserves consideration to upgrade its classification from *trout maintenance* to *trout production*.

SOUTH BRANCH RARITAN RIVER

Project: Classification	**Drainage:** Raritan River, S/Br
Location: River Rd., Califon (locally referred to as "Brown's Corner")	**County:** Hunterdon
Date: August 29, 2012	**Municipality:** Califon Borough

Summary

This section of the river is currently classified as *trout maintenance*. The survey was conducted approximately 0.8 miles downstream of the Middle Valley section of *trout production* water which extends from the confluence with Turkey Brook downstream to the Route 512 bridge in Califon. The survey was also conducted approximately 0.9 miles upstream of the recently recommended section from the Hoffman's Crossing bridge downstream to, but not including Lake Solitude. Species richness was relatively high with 15 cold and coolwater species represented. Two young-of-the-year (yoy) brown trout were documented as well as eight larger fish, half of which appeared to be of hatchery origin due to significant fin erosion. Two yoy brook trout along with three larger specimens of apparent wild origin were also captured. Finally, a rainbow trout measuring 177 mm (7 in) was encountered, also appearing to be of wild origin. A possible source is a known wild rainbow population in Hickory Run, a tributary, approximately 0.4 miles away.

Water Chemistry & Habitat	
Water temperature	20.0°C
Dissolved oxygen	7.99 mg/L
pH	7.68
Alkalinity	39.5 mg/L as $CaCO_3$
Specific conductance	330.0 µS/cm
Sample length	150 m
Habitat assessment score	-

Fish species	Number
American brook lamprey	1
American eel	11
blacknose dace	98
longnose dace	92
creek chub	1
white sucker	108
margined madtom	35
rainbow trout (older than y-o-y)	1 (177mm)
brown trout (y-o-y)	2 (102-106mm)
brown trout (older than y-o-y)	8 (185-342mm)
brook trout (y-o-y)	2 (93-94mm)
brook trout (older than y-o-y)	3 (117-181mm)
rock bass	2
Lepomis sp. hybrid	2
redbreast sunfish	14
green sunfish	4
smallmouth bass	71
tessellated darter	165

Recommendation: The presence of yoy brook and brown trout deserves consideration to upgrade its classification from *trout maintenance* to *trout production*.

SOUTH BRANCH RARITAN RIVER (trib.) (Diglio Ditch)

Project: Raritan River S/Br Headwater Study	**Drainage:** Raritan River, S/Br
Location: Svea Drive, through field to Raritan River S/Br. Then left downstream to confluence. Trib. flows in from west. Start 25 m upstream from S/Br confluence	**County:** Morris
Date: August 15, 2012	**Municipality:** Mt. Olive Twp.

Summary

Electrofished this tributary to the Raritan River, S/Br. as part of the Raritan River S/Br Headwater Study. This stream is located upstream of the 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 reproducing 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. The 5 brook trout were not previously marked with Visible Implant Elastomer (VIE). An additional 7 brook trout (83 - 187 mm) were encountered immediately upstream, within the 400 m recapture reach.

Water Chemistry & Habitat	
Water temperature	17.7°C
Dissolved oxygen	8.66 mg/L
pH	7.49
Alkalinity	33.0 mg/L as $CaCO_3$
Specific conductance	376.9 μS/cm
Sample length	150 m
Habitat assessment score	-

Fish species	Number
blacknose dace	17
creek chub	18
eastern mudminnow	4
brook trout (y-o-y)	1 (79mm)
brook trout (older than y-o-y)	4 (99-117mm)

Recommendation: No additional surveys needed at this time.

SOUTH BRANCH RARITAN RIVER (trib.) (Dog Lady)

Project: Raritan River S/Br Headwater Study	**Drainage:** Raritan River, S/Br
Location: River Rd., behind house #148. 46 m upstream of Raritan S/Br confluence	**County:** Morris
Date: August 13, 2012	**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 downstream of the impounded section of the South Branch of the Raritan River above the YMCA camp dam. Classified as Trout-Production, by default, this stream was first sampled in 2010, where 18 brook trout, including young-of-the-year (yoy) were encountered. Subsequently, the Division recommended that Raritan River S/Br (trib) (Dog Lady) be specifically listed in the state Surface Water Quality Standards as Trout Production. The 2012 survey revealed a shift in the trout species since 2010, as brown trout (4) showed up and fewer brook trout (8) were found.

Water Chemistry & Habitat	
Water temperature	18.1°C
Dissolved oxygen	7.16 mg/L
pH	6.95
Alkalinity	36.0 mg/L as $CaCO_3$
Specific conductance	113.1 μS/cm
Sample length	150 m
Habitat assessment score	-

Fish species	Number
blacknose dace	99
creek chub	14
brown trout (y-o-y)	4 (62-86mm)
brook trout (y-o-y)	7 (69-85mm)
brook trout (older than y-o-y)	1 (150mm)
slimy sculpin	1

Recommendation: No additional surveys needed at this time.

SOUTH BRANCH RARITAN RIVER (trib.)(Drakestown)

Project: Raritan River S/Br Headwater Study	**Drainage:** Raritan River, S/Br
Location: Joy Drive, 25 m upstream from confluence with S/Br. Raritan	**County:** Morris
Date: August 21, 2012	**Municipality:** Mt. Olive

Summary

Electrofished this tributary to the Raritan River, S/Br. as part of the Raritan River S/Br Headwater Study. This stream is located upstream of the 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 reproducing 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. 163 brook trout were encountered within the 150 m sample reach. An additional 222 brook trout were encountered within the larger 400 m recapture reach, 7 of the 385 total were marked during the summer of 2011 in the same tributary. One brook trout was marked in a nearby tributary (N. of Drakestown) during the previous summer.

Water Chemistry & Habitat	
Water temperature	16.6°C
Dissolved oxygen	9.13 mg/L
pH	7.36
Alkalinity	31.5 mg/L as $CaCO_3$
Specific conductance	235.9 µS/cm
Sample length	150 m
Habitat assessment score	-

Fish species	Number
blacknose dace	85
longnose dace	9
creek chub	20
white sucker	4
mudminnow	10
brook trout (y-o-y)	104 (52-86mm)
brook trout (older than y-o-y)	59 (92-224mm)
pumpkinseed sunfish	5
tessellated darter	1

Recommendation: No additional surveys needed at this time, however this impounded section of the river is expected to change chemically, physically, and biologically if/when the dam is removed, therefore additional electrofishing surveys should be conducted at that time to document changes in the fish assemblage.

SOUTH BRANCH RARITAN RIVER (trib.) (North of Drakestown)

Project: Raritan River S/Br Headwater Study	**Drainage:** Raritan River, S/Br
Location: Joy Drive 25 m upstream of confluence with S/Br	**County:** Morris
Date: August 20, 2012	**Municipality:** Mt. Olive Twp.

Summary

Electrofished this tributary to the Raritan River, S/Br. as part of the Raritan River S/Br Headwater Study. This stream is located upstream of the 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 reproducing 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. 26 brook trout were encountered within the 150 m sample reach. An additional 40 brook trout were encountered within the larger 400 m recapture reach, 7 of the 66 total were marked during the summer of 2011 in the same tributary.

Water Chemistry & Habitat	
Water temperature	14.4°C
Dissolved oxygen	10.04 mg/L
pH	6.98
Alkalinity	33.0 mg/L as $CaCO_3$
Specific conductance	520.3 µS/cm
Sample length	150 m
Habitat assessment score	-

Fish species	**Number**
blacknose dace	19
creek chub	7
brook trout (y-o-y)	12 (66-99mm)
brook trout (older than y-o-y)	14 (134-221mm)

Recommendation: No additional surveys needed at this time.

SOUTH BRANCH RARITAN RIVER (trib.) (Red House)

Project: Raritan River S/Br Headwater Study	**Drainage:** Raritan River, S/Br
Location: River Rd., behind house #93. 64 m upstream of S/Br. Confluence	**County:** Morris
Date: August 13, 2012	**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 downstream of the impounded section of the South Branch of the Raritan River above the YMCA camp dam. Classified as Trout-Production, by default, this stream was first sampled in 2010, where 3 brook trout (including 2 young-of-the-year (yoy)) and 1 brown trout, were encountered. Subsequently, the Division recommended that Raritan River S/Br (trib) (Red House) be specifically listed in the state Surface Water Quality Standards as Trout Production. No fish were encountered during the 2012 survey, however many brown trout yoy were captured in this stream just downstream of the 150 m survey boundaries.

Water Chemistry & Habitat	
Water temperature	19.3°C
Dissolved oxygen	8.16 mg/L
pH	7.35
Alkalinity	39.5 mg/L as $CaCO_3$
Specific conductance	201.1 µS/cm
Sample length	150 m
Habitat assessment score	-

Fish species	Number
No fish found in survey area	

Recommendation: No additional surveys needed at this time.

SOUTH BRANCH RARITAN RIVER (trib.) (Rickie Lake)

Project: Raritan River S/Br Headwater Study	**Drainage:** Raritan River, S/Br
Location: River Rd., behind house #11. 33 m upstream of S/Br. Confluence	**County:** Morris
Date: August 13, 2012	**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 downstream of the impounded section of the South Branch of the Raritan River above the YMCA camp dam. Classified as Trout-Production, by default, this stream was first sampled in 2010, where 24 brook trout, all but 2 being young-of-the-year (yoy) were encountered. Subsequently, the Division recommended that Raritan River S/Br (trib) (Rickie Lake) be specifically listed in the state Surface Water Quality Standards as Trout Production. The 2012 survey revealed a shift in the trout species since 2010, as brown trout (1) showed up and fewer brook trout (10) were found.

Water Chemistry & Habitat	
Water temperature	19.2°C
Dissolved oxygen	7.33 mg/L
pH	7.07
Alkalinity	29.5 mg/L as $CaCO_3$
Specific conductance	161.3 μS/cm
Sample length	150 m
Habitat assessment score	-

Fish species	Number
blacknose dace	77
creek chub	1
brown trout (y-o-y)	1 (82mm)
brook trout (y-o-y)	9 (64-81mm)
brook trout (older than y-o-y)	1 (177mm)

Recommendation: No additional surveys needed at this time.

SOUTH BRANCH RARITAN RIVER (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 S/Br	**County:** Morris
Date: August 20, 2012	**Municipality:** Mt. Olive Twp.

Summary

Electrofished this tributary to the Raritan River, S/Br. as part of the Raritan River S/Br Headwater Study. This stream is located upstream of the 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 reproducing 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. The 20 brook trout were not previously marked with Visible Implant Elastomer (VIE). An additional 37 brook trout were encountered immediately upstream, within the 400 m recapture reach, one of which was marked during the summer of 2011 in the same tributary.

Water Chemistry & Habitat	
Water temperature	16.9°C
Dissolved oxygen	9.09 mg/L
pH	6.65
Alkalinity	33.0 mg/L as $CaCO_3$
Specific conductance	466.5 µS/cm
Sample length	150 m
Habitat assessment score	-

Fish species	**Number**
blacknose dace	95
creek chub	17
brook trout (y-o-y)	1 (98mm)
brook trout (older than y-o-y)	19 (111-299mm)

Recommendation: No additional surveys needed at this time.

SOUTH BRANCH RARITAN RIVER (trib.) (Warmwater)

Project: Raritan River S/Br Headwater Study	**Drainage:** Raritan River, S/Br
Location: River Rd., pull off of intersection with Flanders-Drakestown Rd., 25 m upstream of Confluence with Raritan S/Br; 1st trib above YMCA dam.	**County:** Morris
Date: August 14, 2012	**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 impounded section of the South Branch of the Raritan River above the YMCA camp dam. Classified as Non-Trout, by default, this classification was confirmed in recent years. No brook trout were found within the 150 m sample reach, however two (137 & 167 mm) were encountered immediately upstream, within the 400 m recapture reach. Neither fish was previously marked with Visible Implant Elastomer (VIE).

Water Chemistry & Habitat	
Water temperature	18.6°C
Dissolved oxygen	8.88 mg/L
pH	7.36
Alkalinity	33.0 mg/L as $CaCO_3$
Specific conductance	168.8 µS/cm
Sample length	150 m
Habitat assessment score	-

Fish species	Number
blacknose dace	53
longnose dace	2
creek chub	63
white sucker	2
eastern mudminnow	1
tessellated darter	1

Recommendation: Due to the presence of 2 brook trout encountered on August 14, this stream holds potential for being upgraded to Trout Maintenance status, however because the only trout were found outside of the standardized 150 m survey distance no recommendation for upgrade can be made at this time. Future sampling is recommended, especially because there is interest in possibly removing the dams along two small onstream impoundments along this watercourse.

SUN VALLEY BROOK

Project: Raritan River S/Br Headwater Study	**Drainage:** Raritan River, S/Br
Location: Wolfe Rd. - 28 m upstream of confluence with S/Br	**County:** Morris
Date: August 15, 2012	**Municipality:** Mt. Olive Twp.

Summary

Electrofished this tributary to the Raritan River, S/Br. as part of the Raritan River S/Br Headwater Study. This stream is located upstream of the impounded section of the South Branch of the Raritan River above the YMCA camp dam. Classified as Trout Production, this stream is of particular interest due to the relatively few number to brook trout that are consistently caught during electrofishing surveys. No brook trout were found within the 150 m sample reach, however four (94 - 208 mm) were encountered immediately upstream, within the 400 m recapture reach.

Water Chemistry & Habitat	
Water temperature	19.1°C
Dissolved oxygen	8.51 mg/L
pH	7.40
Alkalinity	39.0 mg/L as $CaCO_3$
Specific conductance	364.0 µS/cm
Sample length	150 m
Habitat assessment score	-

Fish species	Number
blacknose dace	31
longnose dace	5
creek chub	21
white sucker	2
pumpkinseed sunfish	4

Recommendation: Due to the small number to of trout encountered, this stream should be monitored over time.

TURKEY BROOK

Project: Raritan River S/Br Headwater Study	**Drainage:** Raritan River, S/Br
Location: Stephens Mill Rd. 25 m upstream of S/Br confluence	**County:** Morris
Date: August 15, 2012	**Municipality:** Mt. Olive Twp.

Summary

Electrofished this tributary to the Raritan River, S/Br. as part of the Raritan River S/Br Headwater Study. This stream enters the South Branch nearly 1 mile downstream of the impounded YMCA camp dam. Classified as Trout Production, confluence of this stream is the uppermost boundary of TP water on the South Branch. No slimy sculpin have been found in any waters upstream of this location in the watershed.

Water Chemistry & Habitat	
Water temperature	18.0°C
Dissolved oxygen	8.97 mg/L
pH	7.82
Alkalinity	24.0 mg/L as $CaCO_3$
Specific conductance	302.8 µS/cm
Sample length	150 m
Habitat assessment score	-

Fish species	Number
blacknose dace	40
longnose dace	14
creek chub	3
brown trout (y-o-y)	85 (50-90mm)
brown trout (older than y-o-y)	6 (134-300mm)
brook trout (y-o-y)	2 (80-81mm)
brook trout (older than y-o-y)	1 (169mm)
slimy sculpin	66
tessellated darter	3

Recommendation: Although no additional surveys needed at this time, the ratio of brook trout to brown trout along this stream continuum should be monitored.

2012

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).

Results of a temperature-dissolved oxygen profile conducted on **South Vineland Park Pond** in 2012 to determine its fish supporting capabilities. Shading depicts depths having trout supporting water (temperature $\leq$ 21ºC and dissolved oxygen $\geq$ 4 mg/L).

Waterbody	South Vineland Park Pond
Basin	Maurice, Salem, & Cohansey
Drainage	Maurice River
County	Cumberland
Survey date	8/1/12
Secchi Disk	na

Depth from surface (ft)	Water temp. (°C)	Dissolved oxygen (mg/L)
0	28.5	6.96
1	28.5	6.56
2	28.5	6.53
3	28.5	6.42
4	28.5	6.85
5	28.4	6.97
6	28.4	1.09
7	28.4	6.63
8	28.4	7.07
9	28.4	7.01
10	28.4	6.05
11	28.4	6.07
12	28.1	6.09
13	27.3	6.18
14	24.8	4.45
15	21.8	4.66
16	19.5	3.66
17	18.4	3.07
18	16.7	1.30
19	15.8	.85
20	14.5	.45
21	13.8	.32
22	13.1	.27
23	12.2	.14
24	11.3	.09
25	10.6	.07
26	10.2	.14
27	10.0	.07
28	9.5	.10
29	9.4	.06
30	9.3	.08
31	9.2	.04
32	9.2	.04

Results of a temperature-dissolved oxygen profile conducted on **Cranberry Lake** in 2012 to determine its trout supporting status for the purpose of classification. Shading depicts depths having trout supporting water (temperature $\leq$ 21ºC and dissolved oxygen $\geq$ 4 mg/L).

Waterbody	Cranberry Lake
Basin	Upper Delaware
Drainage	Musconetcong River
County	Sussex
Survey date	7/26//12
Secchi Disk	6 ft.

Depth from surface (ft)	**Water temp. (°C)**	**Dissolved oxygen (mg/L)**
0	26.5	8.36
1	26.5	8.35
2	26.5	8.26
3	26.5	8.24
4	26.5	8.20
5	26.5	8.30
6	26.5	8.19
7	26.5	8.22
8	26.5	8.11
9	26.4	8.10
10	26.3	7.50
11	26.2	7.53
12	26.0	6.01
13	25.4	2.4
14	24.9	0.1
15	24.6	0.02

Results of a temperature-dissolved oxygen profile conducted on **Gardners Pond** in 2012 to determine its trout supporting status for the purpose of classification. Shading depicts depths having trout supporting water (temperature $\leq$ 21ºC and dissolved oxygen $\geq$ 4 mg/L).

Waterbody	Gardners Pond
Basin	Upper Delaware
Drainage	Pequest River
County	Sussex
Survey date	8/31/12
Secchi Disk	10.5 ft.

Depth from surface (ft)	Water temp. (°C)	Dissolved oxygen (mg/L)
0	24.7	5.56
2	24.7	5.51
4	24.6	5.36
6	24.5	5.30
8	24.4	4.75
10	24.2	4.39
12	23.2	5.46
14	21.1	13.10
16	18.0	9.46
18	16.4	1.98
20	13.5	0.00
22	11.0	0.00
24	9.5	0.00
26	8.6	0.00
28	7.7	0.00
30	7.4	0.00
32	7.2	0.00
34	7.1	0.00
36	6.9	0.00
38	6.8	0.00
40	7.1	0.00
41	7.1	0.00

Results of a temperature-dissolved oxygen profile conducted on **Iliff Lake** in 2012 to determine its trout supporting status for the purpose of classification. Shading depicts depths having trout supporting water (temperature $\leq$ 21ºC and dissolved oxygen $\geq$ 4 mg/L).

Waterbody	Iliff Lake
Basin	Upper Delaware
Drainage	Pequest River
County	Sussex
Survey date	8/6/07
Secchi Disk	17 ft.

Depth from surface (ft)	Water temp. (°C)	Dissolved oxygen (mg/L)
0	28.0	5.83
2	24.4	5.79
4	27.2	5.15
5	27.1	6.04
6	26.9	5.46
7	26.7	4.38
8	26.5	4.34
9	25.9	3.59
10	25.5	4.19
11	24.5	4.65
12	23.2	4.56
13	21.9	4.81
14	20.8	4.61
15	19.3	4.23
16	18.1	3.41
17	16.5	2.83
18	14.9	2.01
20	12.3	0
22	10.6	0
24	9.5	0
26	8.5	0
28	8.0	0
30	8.0	0
32	8.0	0
33	8.0	0

Results of a temperature-dissolved oxygen profile conducted on **Lake Aeroflex** in 2012 to determine its trout supporting status for the purpose of classification. Shading depicts depths having trout supporting water (temperature $\leq$ 21ºC and dissolved oxygen $\geq$ 4 mg/L).

Waterbody	Lake Aeroflex
Basin	Upper Delaware
Drainage	Pequest River
County	Sussex
Survey date	8/7/12
Secchi Disk	12 ft.

Depth from surface (ft)	Water temp. (°C)	Dissolved oxygen (mg/L)
0	27.7	7.76
5	27.2	7.49
10	27.1	7.71
12	26.9	6.56
14	24.9	10.63
16	22.3	14.13
18	18.7	16.95
20	15.7	17.82
22	13.0	17.52
24	10.8	16.03
26	9.5	16.13
28	8.5	15.64
30	7.7	14.90
32	6.8	11.65
34	6.1	4.96
36	5.8	3.70
38	5.5	3.70
40	5.3	3.62
45	5.2	2.79
50	5.2	0.02
55	5.1	0
60	5.1	0
65	5.1	0
70	5.1	0
75	5.1	0
80	5.1	0
85	5.1	0
90	5.1	0
95	5.1	0
100	5.2	0
102	5.2	0

Results of a temperature-dissolved oxygen profile conducted on **Lake Hopatcong** in 2012 to determine its trout supporting status for the purpose of classification. Shading depicts depths having trout supporting water (temperature $\leq$ 21ºC and dissolved oxygen $\geq$ 4 mg/L).

Waterbody	Lake Hopatcong
Basin	Upper Delaware
Drainage	Musconetcong River
County	Morris/Sussex
Survey date	8/2/12
Secchi Disk	6 ft.

Depth from surface (ft)	Water temp. (°C)	Dissolved oxygen (mg/L)
0	26.5	9.63
1	26.6	9.81
2	26.5	9.76
3	26.2	10.03
4	26.1	10.07
5	25.8	10.13
6	25.7	10.10
7	25.4	9.91
8	25.3	9.32
9	25.3	9.27
10	25.3	9.32
11	25.2	9.38
12	25.2	9.43
13	25.2	9.03
14	25.1	8.91
15	25.0	8.04
16	24.8	6.13
17	24.7	5.77
18	24.7	4.86
19	24.5	5.21
20	23.8	2.76
21	22.8	1.22
23	19.8	0.53
25	18.0	0
27	15.9	0
29	14.6	0
31	13.6	0
33	13.2	0
35	12.7	0
37	12.4	0
39	12.1	0
41	11.9	0
43	11.8	0
45	11.7	0
47	11.7	0
49	11.6	0
51	11.9	0

Results of a temperature-dissolved oxygen profile conducted on **Lake Marcia** in 2012 to determine its trout supporting status for the purpose of classification. Shading depicts depths having trout supporting water (temperature $\leq$ 21ºC and dissolved oxygen $\geq$ 4 mg/L).

Waterbody	Lake Marcia
Basin	Upper Delaware
Drainage	Shimers Brook
County	Sussex
Survey date	8/28/12
Secchi Disk	7 ft.

Depth from surface (ft)	Water temp. (°C)	Dissolved oxygen (mg/L)
0	24.9	9.08
1	24.8	9.22
2	24.6	9.41
3	24.5	9.30
4	24.4	9.24
5	24.3	9.33
6	24.2	9.30
7	24.1	9.17
8	24.0	8.98
9	23.9	8.65
10	23.7	8.18
11	23.7	8.31
12	23.6	8.20
13	23.2	6.92
14	22.2	4.10
15	21.0	2.64
16	20.0	1.68
17	18.5	0.00
18	16.6	0.00
19	15.4	0.00
20	14.3	0.00

Results of a temperature-dissolved oxygen profile conducted on **Lake Rutherford** in 2012 to determine its trout supporting status for the purpose of classification. Shading depicts depths having trout supporting water (temperature $\leq$ 21ºC and dissolved oxygen $\geq$ 4 mg/L).

Waterbody	Lake Rutherford
Basin	Wallkill, Pochuck, Papakating
Drainage	Papakating Creek
County	Sussex
Survey date	8/28/12
Secchi Disk	21 ft.

Depth from surface (ft)	Water temp. (°C)	Dissolved oxygen (mg/L)
0	24.1	8.35
5	24.1	8.13
10	24.1	8.24
12	24.0	8.31
14	24.0	8.31
16	23.9	8.18
18	22.5	8.12
20	19.0	10.27
21	17.5	9.8
22	16.3	6.8
23	15.4	5.6
24	14.5	2.69
25	13.9	2.26
27	13.0	1.83
30	11.5	0.00
35	9.8	0.00
37	10.6	0.00

Results of a temperature-dissolved oxygen profile conducted on **Mountain Lake** in 2012 to determine its trout supporting status for the purpose of classification. Shading depicts depths having trout supporting water (temperature $\leq$ 21ºC and dissolved oxygen $\geq$ 4 mg/L).

Waterbody	Mountain Lake
Basin	Upper Delaware
Drainage	Pequest River
County	Warren
Survey date	8/8/12
Secchi Disk	9 ft.

Depth from surface (ft)	Water temp. (°C)	Dissolved oxygen (mg/L)
0	29.0	8.41
5	27.7	8.24
10	27.3	8.12
12	26.2	10.10
14	23.6	14.48
15	22.0	15.40
16	20.0	14.64
17	18.5	10.51
18	16.4	9.79
19	15.3	8.77
20	14.3	4.85
21	13.3	0.35
22	12.0	0
24	10.5	0
26	9.3	0
28	8.7	0
30	8.1	0
32	7.8	0
35	7.7	0
37	7.6	0

Results of a temperature-dissolved oxygen profile conducted on **Furnace Lake** in 2012 to determine its trout supporting status for the purpose of classification. Shading depicts depths having trout supporting water (temperature $\leq$ 21ºC and dissolved oxygen $\geq$ 4 mg/L).

Waterbody	Furnace Lake
Basin	Upper Delaware
Drainage	Pequest River
County	Warren
Survey date	8/8/12
Secchi Disk	7.5 ft.

Depth from surface (ft)	Water temp. (°C)	Dissolved oxygen (mg/L)
0	28.5	8.53
5	26.8	7.68
10	24.2	7.82
12	21.8	8.67
13	20.5	8.73
14	19.3	9.85
15	17.6	3.83
16	15.5	0
18	13.0	0
20	11.4	0
22	10.7	0
24	10.2	0
26	10.0	0
28	9.8	0
30	9.4	0
31	9.4	0

Results of a temperature-dissolved oxygen profile conducted on **Stony Lake** in 2012 to determine its trout supporting status for the purpose of classification. Shading depicts depths having trout supporting water (temperature $\leq$ 21ºC and dissolved oxygen $\geq$ 4 mg/L).

Waterbody	Stony Lake
Basin	Upper Delaware
Drainage	Flat Brook
County	Sussex
Survey date	8/28/12
Secchi Disk	7 ft.

Depth from surface (ft)	Water temp. (°C)	Dissolved oxygen (mg/L)
0	26.8	5.57
1	25.4	4.80
2	24.6	4.55
3	24.3	4.26
4	24.0	3.88
5	23.6	1.41
6	23.0	1.70
7	22.5	1.02
8	21.9	0.00
9	20.6	0.42
10	19.1	0.00
11	17.6	0.00
12	16.0	0.00
13	14.7	0.00
14	14.7	0.00

Results of a temperature-dissolved oxygen profile conducted on **Swartswood Lake** in 2012 to determine its trout supporting status for the purpose of classification. Shading depicts depths having trout supporting water (temperature $\leq$ 21ºC and dissolved oxygen $\geq$ 4 mg/L).

Waterbody	Swartswood Lake
Basin	Upper Delaware
Drainage	Paulinskill River
County	Sussex
Survey date	8/2/12
Secchi Disk	7 ft.

Depth from surface (ft)	Water temp. (°C)	Dissolved oxygen (mg/L)	Depth from surface (ft)	Water temp. (°C)	Dissolved oxygen (mg/L)
0	27.8	8.58	22	16.6	0
1	27.1	8.20	23	16.1	0
2	26.6	8.49	24	15.3	0
3	26.3	8.40	25	14.3	0
4	26.2	7.86	26	12.3	0
5	26.1	7.63	27	11.7	0
6	26.1	7.68	28	11.3	0
7	26.0	8.26	29	11.2	0
8	26.0	8.05	30	11.2	0
9	25.9	7.66	31	11.1	0
10	25.6	5.49	32	11.1	0
11	25.2	4.99	33	11.0	0
12	25.2	4.80	34	11.0	0
13	25.1	4.72	35	11.0	0
14	25.0	4.13	36	10.9	0
15	24.9	3.55	37	10.8	0
16	24.7	3.12	38	10.7	0
17	24.4	2.92	39	10.7	0
18	23.9	2.24	40	10.9	0
19	22.3	0	41	11.1	0
20	21.0	0	41.5	11.0	0
21	18.0	0			

Results of a temperature-dissolved oxygen profile conducted on **Lake Manalapan** in 2012 to determine its trout supporting status for the purpose of classification. Shading depicts depths having trout supporting water (temperature $\leq$ 21ºC and dissolved oxygen $\geq$ 4 mg/L).

Waterbody	Lake Manalapan
Basin	Raritan
Drainage	South River
County	Middlesex
Survey date	8/8/12
Secchi Disk	-

Depth from surface (ft)	Water temp. (°C)	Dissolved oxygen (mg/L)
0	29.3	8.86
1	27.6	8.80
2	27.2	9.40
3	24.7	6.47
4	24.5	4.62
5	24.2	3.79
6	23.9	1.98
7	23.3	0.00
8	22.5	0.00
9	21.8	0.00
10	22	0.27

Results of a temperature-dissolved oxygen profile conducted on **Round Valley Reservoir** in 2012 to determine its trout supporting status for the purpose of classification. Shading depicts depths having trout supporting water (temperature $\leq$ 21ºC and dissolved oxygen $\geq$ 4 mg/L).

Waterbody	Round Valley Reservoir
Basin	Raritan River
Drainage	Raritan River South Branch
County	Hunterdon
Survey date	07/27/12
Secchi Disk	36 ft.

Depth from surface (ft)	Water temp. (°C)	Dissolved oxygen (mg/L)	Depth from surface (ft)	Water temp. (°C)	Dissolved oxygen (mg/L)
0	25.4	7.87	50	11.4	12.67
2	25.4	7.88	55	10.8	11.84
4	25.4	7.94	60	10.1	11.51
6	25.3	7.99	70	9.7	10.49
8	25.3	8.18	75	9.3	10.47
10	25.3	8.20	80	9.2	9.22
12	25.3	8.13	85	9.0	9.22
14	25.2	8.13	90	8.9	8.58
16	25.2	8.18	95	8.8	8.50
18	25.1	7.99	100	8.8	8.16
20	25.1	8.10	105	8.7	8.14
22	25.0	8.14	110	8.7	8.06
24	24.8	8.59	115	8.6	7.89
26	24.3	9.04	120	8.6	7.65
28	23.5	9.91	125	8.6	7.62
30	21.5	11.53	130	8.6	7.59
32	19.0	12.63	135	8.6	7.16
34	17.1	12.85	140	8.5	6.99
36	16.2	12.91	145	8.5	6.39
38	14.9	13.06	150	8.5	6.19
40	14.6	13.15	155	8.5	0.41
42	14.0	12.91	160	8.5	0.41
44	13.6	12.88	165	8.5	0.45
46	13.1	12.87	167	8.5	0.45
48	12.4	12.77			

Results of a temperature-dissolved oxygen profile conducted on **Spruce Run Reservoir** in 2012 to determine its trout supporting status for the purpose of classification. Shading depicts depths having trout supporting water (temperature $\leq$ 21ºC and dissolved oxygen $\geq$ 4 mg/L).

Waterbody	Spruce Run Reservoir
Basin	Raritan River
Drainage	Raritan River S/Br
County	Hunterdon
Survey date	07/27/12
Secchi Disk	6 ft.

Depth from surface (ft)	Water temp. (°C)	Dissolved oxygen (mg/L)
0	27.2	8.14
1	27.1	8.12
2	27.1	8.12
3	27.1	8.23
4	27.1	8.27
5	27.1	8.30
6	27.1	8.26
7	27.1	8.28
8	27.1	8.28
9	27.1	8.39
10	27.1	8.56
11	27.1	8.64
12	27.1	8.57
13	27.1	8.43
14	27.0	8.17
15	25.8	5.73
16	23.6	1.99
17	21.4	0
18	18.8	0
19	16.6	0
20	15.1	0
25	13.0	0
30	11.8	0
35	11.3	0
40	11.0	0
45	10.8	0
50	10.7	0
55	10.6	0
60	10.6	0
65	10.6	0
68	10.6	0

Results of a temperature-dissolved oxygen profile conducted on **Canistear Reservoir** in 2012 to determine its trout supporting status for the purpose of classification. Shading depicts depths having trout supporting water (temperature $\leq$ 21ºC and dissolved oxygen $\geq$ 4 mg/L).

Waterbody	Canistear Reservoir
Basin	Passaic
Drainage	Pequannock River
County	Sussex
Survey date	8/3/12
Secchi Disk	6 ft.

Depth from surface (ft)	Water temp. (°C)	Dissolved oxygen (mg/L)
0	27.4	9.29
2	26.5	9.50
4	26.4	9.48
6	26.1	9.16
8	24.9	8.18
10	24.4	8.29
11	24.1	7.89
12	23.6	6.50
13	23.1	5.74
14	22.6	5.26
15	21.9	4.42
16	20.8	3.44
17	19.9	2.31
18	18.3	0.0
19	16.3	0.0
21	14.4	0.0
23	13.4	0.0
25	12.9	0.0
27	12.7	0.0
29	12.6	0.0
31	12.4	0.0
33	12.4	0.0
35	12.3	0.0
37	12.1	0.0
39	11.6	0.0

Results of a temperature-dissolved oxygen profile conducted on **Clinton Reservoir** in 2012 to determine its trout supporting status for the purpose of classification. Shading depicts depths having trout supporting water (temperature $\leq$ 21ºC and dissolved oxygen $\geq$ 4 mg/L).

Waterbody	Clinton Reservoir
Basin	Passaic
Drainage	Pequannock River
County	Passaic
Survey date	8/3/12
Secchi Disk	9 ft.

Depth from surface (ft)	Water temp. (°C)	Dissolved oxygen (mg/L)
0	27.0	8.90
2	26.8	8.73
4	26.2	8.83
6	26.1	8.80
8	25.9	8.83
10	25.5	8.92
12	25.2	9.06
13	25.0	8.48
14	24.2	8.07
15	23.1	7.26
16	21.6	6.14
17	19.9	4.98
18	18.7	4.90
19	17.7	4.40
20	16.8	3.84
22	14.1	3.02
24	13.2	3.05
26	12.3	2.89
28	11.7	2.62
30	11.3	2.08
32	10.9	1.53
34	10.6	0.66
36	10.4	0.50
38	10.1	0.00
40	9.9	0.00
41	9.9	0.00

Results of a temperature-dissolved oxygen profile conducted on **Oak Ridge Reservoir** in 2012 to determine its trout supporting status for the purpose of classification. Shading depicts depths having trout supporting water (temperature $\leq$ 21ºC and dissolved oxygen $\geq$ 4 mg/L).

Waterbody	Oak Ridge Reservoir
Basin	Passaic
Drainage	Pequannock River
County	Passaic
Survey date	8/13/12
Secchi Disk	8.5 ft.

Depth from surface (ft)	Water temp. (°C)	Dissolved oxygen (mg/L)
0	26.4	7.83
5	26.2	7.94
10	26.2	7.65
12	26.1	7.88
14	26.0	7.72
15	25.9	7.49
16	25.9	7.71
17	25.0	7.11
18	23.8	5.91
19	23.4	5.12
20	22.7	5.01
21	22.2	4.65
22	21.6	4.76
23	21.3	4.50
24	20.9	3.80
25	20.4	2.56
30	18.6	0.90
35	16.2	0.22
40	13.9	0.00
45	12.6	0.00
50	11.6	0.00
52	11.2	0.00

Results of a temperature-dissolved oxygen profile conducted on **Splitrock Reservoir** in 2012 to determine its trout supporting status for the purpose of classification. Shading depicts depths having trout supporting water (temperature $\leq$ 21ºC and dissolved oxygen $\geq$ 4 mg/L).

Waterbody	Splitrock Reservoir
Basin	Passaic
Drainage	Rockaway River
County	Morris
Survey date	8/31/12
Secchi Disk	10 ft.

Depth from surface (ft)	Water temp. (°C)	Dissolved oxygen (mg/L)
0	25.4	7.98
1	25.3	7.98
3	24.9	8.06
5	24.6	8.15
7	24.6	8.14
9	24.5	8.02
11	24.4	8.01
13	24.4	7.75
15	23.8	3.02
17	22.8	1.90
19	22.2	1.16
21	18.5	1.00
23	16.1	0.14
25	14.0	0
27	12.9	0

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 – Dissolved Oxygen and Temperature Profiles

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

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

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

Wadeable Streams - Electrofishing

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

by battery or generator, has been used almost exclusively since 1980. A battery-powered D.C. backpack unit, having one paddle-type electrode and used by an operator and one or two netters, has been in used since 1980 to sample small streams. On larger streams a gas generator is used in conjunction with a conversion box (to convert A.C. to D.C.), two or three electrodes, and a five to seven person field crew.

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

Sampling methods follow those outlined by Kurtenbach (Kurtenbach, 1994) and as defined in the EPA manual "Rapid Bioassessment Protocols for Use in Wadeable Streams and Rivers" (Barbour 1999) and are consistent, for comparative purposes, with data collection efforts for other 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	cutlip 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	redbreast 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.