THE NESHANIC RIVER WATERSHED RESTORATION AND PROTECTION PLAN

DATA SUMMARY – JULY 2007 BIOLOGICAL ASSESSMENT

Rutgers Cooperative Extension Water Resources Program

Introduction

The watershed restoration and protection planning area for the Neshanic River Watershed is 31 square miles and includes Walnut Brook, First Neshanic River, Second Neshanic River, Third Neshanic River, and the Neshanic River mainstem immediately above the Back Brook drainage into the Neshanic River. Based upon numerous monitoring sources, including the New Jersey Department of Environmental Protection (NJDEP) Ambient Biomonitoring Network (AMNET), the NJDEP/United States Geological Survey (USGS) water quality monitoring network, and the Metal Recon Program, the Neshanic River and its branches are impaired for aquatic life, phosphorus, total suspended solids, and copper and are listed on Sublist 5 of the New Jersey 2004 Integrated Water Quality Monitoring and Assessment Report (NJDEP, 2004). According to the 2006 Integrated List, which uses a HUC-14 based water quality impairment listing methodology, the Neshanic River (HUC 02030105030010, 20, 30, 40, and 60) maintains the following listing: Sublist 4 for fecal coliform (primary recreation impairment) and aquatic life (general) and Sublist 5 for arsenic and total phosphorus (NJDEP, 2006).

A total maximum daily load (TMDL) for fecal coliform has been adopted for the Neshanic River. This TMDL requires 87% reductions in fecal coliform from medium/high density residential, low density/rural residential, commercial, industrial, mixed urban/other urban, forest, and agricultural lands. The goal of the overall project is to develop a watershed restoration and protection plan that achieves the required fecal coliform TMDL reductions, the attainment of the water quality standards for total phosphorus, total suspended solids, and a reduction in aquatic life impairments to a non-impaired level so that the water quality within the Neshanic River Watershed will be restored.

The following is a data summary of the biological assessment conducted by the Rutgers Cooperative Extension (RCE) Water Resources Program in July 2007 to collect water quality data needed to support the development of the watershed restoration and protection plan.

Biological Data Collection

A survey of the benthic macroinvertebrate community within the Neshanic River watershed was conducted by the RCE Water Resources Program on July 10-11, 2007 in accordance with a Quality Assurance Project Plan (QAPP) (Submitted January 2007, Approved June 2007). The sampling and data analysis procedures were conducted in accordance with the

Rapid Bioassessment Protocol (RBP) procedure used by the NJDEP Bureau of Freshwater and Biological Monitoring, which is based on USEPA's *Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers* ((Barbour et al., 1999). Benthic macroinvertebrates were collected at four locations as described below and identified in Figure 1

Station	Description	Coordinates
FN1	First Neshanic River at Route 202 crossing; AMNET #AN0330	N40˚29.400′ W74˚51.761′
SN1	Second Neshanic River at Route 202 crossing; AMNET #AN0331	N40˚29.401′ W74˚51.763′
TN3	Third Neshanic River at Route 202 crossing; AMNET #AN0332	N40˚28.484′ W74˚51.662′
N1	Neshanic River mainstem at Everitts Road and Reaville Road; AMNET #AN0333; USGS #01398000 (Neshanic River at Reaville, NJ)	N40˚16.908′ W74˚47.253′

A multi-habitat sampling approach, concentrating on the most productive habitat of the stream plus coarse particulate organic matter (CPOM) or leaf litter was used. Given the nature of the substrate and the flow conditions at Stations FN1, SN1, TN3, and N1, a Surber Square Foot Bottom Sampler was used to collect three grab type samples from the most productive habitat of the stream (i.e., riffle/run areas). Samples were sorted and processed in the field using a U.S. Standard No. 30 sieve, composited (i.e., the contents from the grab samples from each location were combined into a single container), and preserved in 80% ethanol for later subsampling, identification, and enumeration.

A composite collection of a variety of CPOM forms (e.g., leaves, needles, twigs, bark, or fragments of these) was collected. It is difficult to quantify the amount of CPOM collected in terms of weight or volume given the variability of its composition. Collection of several handfuls of material is usually adequate, and the material is typically found in depositional areas, such as in pools and along snags and undercut banks. The CPOM sample was processed using a U.S. Standard No. 30 sieve and was added to the composite of the grab samples for each location.

A 100-organism subsample of the benthic macroinvertebrate composite sample from each sampling location was taken in the laboratory according to the methods outlined in the Rapid Bioassessment Protocol used by the NJDEP Bureau of Freshwater & Biological Monitoring (Barbour et al., 1999). With the exception of any chironomids and oligochaetes, benthic macroinvertebrates were identified to genus. Chironomids were identified to subfamily as a minimum, and oligochaetes were identified to family as a minimum. Standard taxonomic references were used and included Merritt and Cummins, 1988; Pennak, 1989; Peckarsky, *et al*., 1990; and Thorp and Covich, 1991.

A habitat assessment was conducted in accordance with the methods used by the NJDEP Bureau of Freshwater & Biological Monitoring for high gradient streams (NJDEP, 2007). The habitat assessment, which has been designed to provide a measure of habitat quality, involves a visual based technique for assessing stream habitat structure. The findings from the habitat assessment are used to interpret survey results and identify obvious constraints on the attainable biological potential within the study area.

Results

Physicochemical Characteristics:

The stream width at Station FN1 was approximately 20 feet. The stream depth ranged from 0.05 feet to 0.25 feet in the riffle/run areas and was greater than 2.5 feet in some pool areas. The stream velocity ranged from 0 ft/sec to 0.09 ft/sec. The canopy was partly open at this location. The inorganic substrate at Station FN1 consisted mostly of small cobbles, gravel, and coarse sand. Although minimal, the organic substrate was comprised mainly of detritus in the form of sticks, decomposing leaves, and algae (i.e., *Cladophora sp.*). Petroleum sediment odors and slight sediment oils were noted. Surprisingly, minnows were observed at this location. The water was clear, and water odors of petroleum and flecks of surface oils were noted. The water temperature was 28.9˚C; the pH was 7.18 SU; the dissolved oxygen was 4.98 mg/L, and the concentration of total dissolved solids was 360 mg/L.

The predominant surrounding land uses at FN1 was industrial/commercial with a Midas Muffler franchise and the Route 202/31 road crossing. Erosion was moderate to heavy at this location, and obvious sources of local nonpoint sources of pollution were noted from the

surrounding land uses (e.g., road runoff, stormwater outfalls, a grassed area mowed to the edge of the stream, garbage/debris in and along the edge of the stream).

The stream width at Station SN1 was approximately 9 feet. The stream depth ranged from 0.1 feet to 0.3 feet in the riffle/run areas and was approximately 1.0 foot to 1.5 feet in the pool areas. The stream velocity ranged from 0.03 ft/sec to 0.36 ft/sec. The canopy was mostly closed at this location. The inorganic substrate at Station SN1 consisted mostly of small cobbles, gravel, and coarse sand with some outcropping of bedrock. The organic substrate was minimal and was comprised mainly of detritus in the form of sticks, decomposing leaves, and new fall. Sediment odors and oils were absent. The water was clear, and water odors and surface oils were absent. Minnows were observed. The water temperature was 25.6°C; the pH was 7.67 SU; the dissolved oxygen was 6.58 mg/L, and the concentration of total dissolved solids was 240 mg/L.

The predominant surrounding land uses at SN1 was commercial (i.e., a large storage facility) and forest. Local watershed erosion was noted as being moderate and obvious sources of nonpoint sources included a stormwater outfall in the vicinity of the sampling location, as well as runoff from the storage facility.

The stream width at Station TN3 was approximately 16 feet. The stream depth ranged from 0.05 feet to 1.0 foot in the riffle/run areas and was approximately 1.0 foot to 2.0 feet in the pool areas. The stream velocity ranged from 0.01 ft/sec to 0.80 ft/sec. The canopy was mostly closed at this location. The inorganic substrate at Station TN3 consisted mostly of small cobbles, and gravel, with some coarse sand and few boulders. The organic substrate was minimal and was comprised mainly of detritus in the form of sticks, decomposing leaves, and new fall. Sediment odors and oils were absent. The water was clear, and water odors and surface oils were absent. Fine grass clippings were prevalent in the shallows, as well as algae (i.e., *Cladophora sp.*). Minnows were observed. The water temperature was 25.0°C; the pH was 7.48 SU; the dissolved oxygen was 8.30 mg/L, and the concentration of total dissolved solids was 230 mg/L.

The predominant surrounding land uses for Station TN3 included forest, pasture/fallow fields, and some residential. Moderate erosion was noted, and obvious nonpoint sources of pollution included runoff from the dirt/gravel service road from Route 202/31 North to the Heron Glen Golf Course, as well as runoff from Route 202/31.

The stream width at Station N1 was approximately 32 feet. The stream depth ranged from 0.1 feet to 0.7 feet in the riffle/run areas and was approximately 1.5 foot to 2.0 feet in the pool areas. The stream velocity ranged from 0.04 ft/sec to 0.59 ft/sec. The canopy was partly to mostly open at this location. The inorganic substrate at Station N1 consisted mostly of small cobbles and boulders with gravel, coarse sand, and bedrock outcroppings present. The organic substrate was minimal and was comprised mainly of detritus in the form of sticks and new fall. Sediment odors and oils were absent. The water was slightly turbid, and water odors and surface oils were absent. Stands of *Elodea sp.* were observed, as well as large congregations of whirligig beetles and some minnows. The water temperature was 25.3˚C; the pH was 7.50 SU; the dissolved oxygen was 6.96 mg/L, and the concentration of total dissolved solids was 250 mg/L.

The predominant surrounding land uses for Station N1 included some forested areas, residential areas, and fields and pastures. Moderate erosion was observed, and obvious nonpoint sources of pollution included runoff from the surrounding roadways.

Habitat Assessment:

The habitat assessment is designed to provide an estimate of habitat quality based upon qualitative estimates of selected habitat attributes. The assessment involves the numerical scoring of ten habitat parameters to evaluate instream substrate, channel morphology, bank structural features, and riparian vegetation. Each parameter is scored and summed to produce a total score which is assigned a habitat quality category of optimal (excellent), sub-optimal (good), marginal (fair), or poor. Table 1 outlines the habitat scoring criteria for high gradient streams by the NJDEP Bureau of Freshwater & Biological Monitoring. Sites with optimal habitat conditions have total scores ranging from 160 to 200; sites with suboptimal habitat conditions have total scores ranging from 110 to 159; sites with marginal habitat conditions have total scores ranging from 60 to 109, and sites with poor habitat conditions have total scores less than 60. The scores for Stations FN1, SN1, TN3, and NI are summarized in Table 2. Station FN1 was found to have marginal habitat conditions, and Stations SN1, TN3, and N1 were found to have sub-optimal habitat conditions.

Benthic Macroinvertebrates:

The results of the benthic macroinvertebrate survey are presented in Table 3. These results are organized by the order, the family, and then by the generic taxonomic levels. The number of taxa and individuals collected from each sampling location is also summarized in Table 3. A total of 25 different taxa of benthic macroinvertebrates was collected within the study area, representing three phyla (i.e., flatworms, mollusks, and arthropods). The arthropods, in particular the insects, were the most strongly represented in terms of the number of different taxa present. A total of 17 insect families was represented.

To evaluate the biological condition of the sampling locations, several community measures were calculated from the data presented in Table 3 and included the following:

1. Taxa Richness: Taxa richness is a measure of the total number of benthic macroinvertebrate families identified. A reduction in taxa richness typically indicates the presence of organic enrichment, toxics, sedimentation, or other factors.

2. EPT (Ephemeroptera, Plecoptera, Trichoptera) Index: The EPT Index is a measure of the total number of Ephemeroptera, Plecoptera, and Trichoptera families (i.e., mayflies, stoneflies, and caddisflies). These organisms typically require clear moving water habitats.

3. %EPT: Percent EPT measures the numeric abundance of the mayflies, stoneflies, and caddisflies within a sample. A high percentage of EPT taxa are associated with good water quality.

4. % CDF (percent contribution of the dominant family): Percent CDF measures the relative balance within the benthic macroinvertebrate community. A healthy community is characterized by a diverse number of taxa that have abundances somewhat proportional to each other.

5. Family Biotic Index: The Family Biotic Index measures the relative tolerances of benthic macroinvertebrates to organic enrichment based on tolerance scores assigned to families ranging from 0 (intolerant) to 10 (tolerant) (Hilsenhoff, 1988).

This analysis integrates several community parameters into one easily comprehended evaluation of biological integrity referred to as the New Jersey Impairment Score (NJIS). The NJIS has been established for three categories of water quality bioassessment for New Jersey streams: non-impaired, moderately impaired, and severely impaired. A non-impaired site has a benthic community comparable to other high quality "reference" streams within the region. The community is characterized by maximum taxa richness, balanced taxa groups, and a good

representation of intolerant individuals. A moderately impaired site is characterized by reduced macroinvertebrate taxa richness, in particular the EPT taxa. Changes in taxa composition result in reduced community balance and intolerant taxa become absent. A severely impaired site is one in which the benthic community is significantly different from that of the reference streams. The macroinvertebrates are dominated by a few taxa which are often very abundant. Tolerant taxa are typically the only taxa present.

The scoring criteria used by the NJDEP Bureau of Freshwater & Biological Monitoring are outlined in Table 4. This scoring system is based on comparisons with reference streams and a historical database consisting of 200 benthic macroinvertebrate samples collected from New Jersey streams. While a low score indicates "impairment," the score may actually be a consequence of habitat or other natural differences between the subject stream and the reference stream. Non-impaired sites have total scores ranging from 24-30, moderately impaired sites have total scores ranging from 9 to 21, and severely impaired sites have total scores ranging from 0 to 6. Impairment scores for Stations FN1, SN1, TN3, and N1 are provided in Tables 5A, 5B, 5C, and 5D, respectively. Station FN1 was assessed as being moderately impaired, and Stations SN1, TN3, and N1 were assessed as being non-impaired.

Discussion

The NJDEP Bureau of Biological & Freshwater Monitoring maintains four Ambient Biomonitoring Network (AMNET) stations within the Neshanic River Watershed (i.e., Stations AN0330, AN0331, AN0332, and AN0333). Station FN1 corresponds to AN0330; SN1 corresponds to AN0331; TN3 corresponds to AN0332, and N1 corresponds to (NJDEP, 1995; NJDEP, 2000; NJDEP, 2008).

In 1994, 1999, and 2004, Station AN0330 was assessed as being moderately impaired by NJDEP. Habitat conditions were found to be suboptimal in 1999 and 2004. The 2007 assessment by the RCE Water Resources Program demonstrates that the biological condition remained as moderately impaired at this site, and the habitat conditions degraded to marginal conditions.

In 1994, Station AN0331 was assessed as being non-impaired, and in 1999 a decline in biological condition to moderately impaired was noted at this site. In 2004 an improvement to a non-impaired status was noted. Habitat conditions in 1999 and 2004 were found to be sub-

optimal. The 2007 assessment by the RCE Water Resources Program demonstrates that the biological condition remained at a non-impaired status, and the habitat condition remained as sub-optimal.

Similar to Station AN0331, in 1994 Station AN0332 was assessed as being non-impaired by NJDEP, and in 1999 a decline in biological condition to a moderately impaired status was determined at this site. In 2004 an improvement to the non-impaired status was noted. Habitat conditions in 1999 and 2004 were found to be sub-optimal. The 2007 assessment by the RCE Water Resources Program demonstrates that the biological condition remained at a non-impaired status, and the habitat condition remained as sub-optimal.

In 1994, 1999, and 2004, Station AN0333 was assessed as being moderately impaired by NJDEP. Habitat conditions were found to be suboptimal in 1999 and 2004. The 2007 assessment by the RCE Water Resources Program shows an improvement in biological condition to a non-impaired status, with the habitat condition remaining as sub-optimal.

The benthic macroinvertebrate community occurring within the vicinity of FN1 is apparently under some type of stress as evidenced by low taxa richness and poor representation of EPT taxa. Based on the calculated Family Biotic Index, the types of organisms found are indicative of very good water quality, but the index value suggests that there is possible slight organic pollution at the site (Hilsenhoff, 1988). In addition, the habitat assessment revealed marginal habitat conditions at FN1, which may also account for the impaired condition of the benthic macroinvertebrate community at this site. Also, although N1 was assessed as being non-impaired, the calculated Family Biotic Index was indicative of fairly poor water quality. The community at N1 may also be stressed.

Recommendations

Biological assessments have become an important tool for managing water quality to meet the goal of the Clean Water Act (i.e., to maintain the chemical, physical, and biological integrity of the nation's water). However, although biological assessments are a critical tool for detecting impairment, they do not identify the cause or causes of the impairment. The U.S. Environmental Protection Agency (USEPA) developed a process, known as the Stressor Identification (SI) process, to accurately identify any type of stressor or combination of stressors that might cause biological impairment (USEPA, 2000). The SI process involves the critical

review of available information, the formation of possible stressor scenarios that may explain the observed impairment, the analysis of these possible scenarios, and the formation of conclusions about which stressor or combination of stressors are causing the impairment. The SI process is iterative, and in some cases additional data may be needed to identify the stressor(s). In addition, the SI process provides a structure or a method for assembling the scientific evidence needed to support any conclusions made about the stressor(s). When the cause of a biological impairment is identified, stakeholders are then in a better position to locate the source(s) of the stressor(s) and are better prepared to implement the appropriate management actions to improve the biological condition of the impaired waterway. The SI process is recommended as the next step toward improving the biological condition within the Neshanic River Watershed, particularly in the vicinity of Station FN1 which was found to be moderately impaired.

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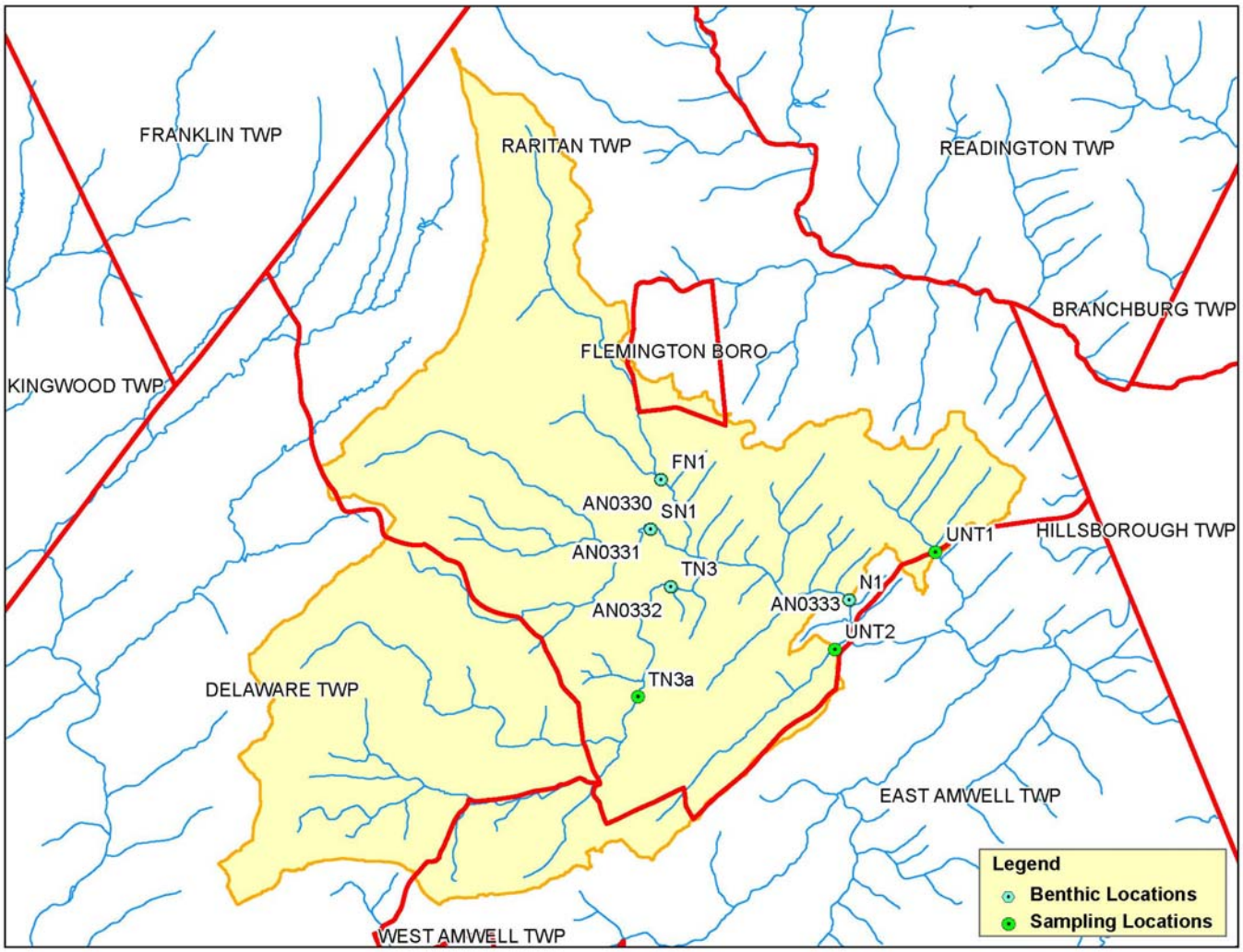

FIGURE 1. Sampling Locations

TABLE 1. Scoring Criteria for Habitat Assessment

Table 4 — **HABITAT ASSESSMENT FOR *HIGH* GRADIENT STREAMS**

Habitat Parameter	Condition Category			
	Optimal	**Suboptimal**	**Marginal**	**Poor**
1. Epifaunal Substrate/Available Cover	Greater than 70% 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).	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 0
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment.	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 0
3. Velocity/Depth Regimes	All 4 velocity/depth regimes 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 present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes 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 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% (< 20% for low-gradient streams) of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% (20-50% for low-gradient) of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% (50-80% for low-gradient) of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% (80% for low-gradient) 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 0
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 as standing pools.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
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, i.e., dredging, (greater than past 20 yrs.) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. In stream 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 0
7. Frequency of Riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream < 7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of > 25.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8. Bank Stability (score each bank) Note: determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. < 5% of 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 ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
9. Bank Vegetative Protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody 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 plant 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 vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	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 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone < 6 meters: little or no riparian vegetation due to human activities.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

HABITAT SCORES	VALUE
OPTIMAL	160 — 200
SUB-OPTIMAL	110 — 159
MARGINAL	60 — 109
POOR	< 60

TABLE 2. Habitat Assessment Results

Habitat Parameter	Scores			
	FN1	**SN1**	**TN3**	**N1**
1. Epifaunal Substrate/Available Cover	8	13	13	13
2. Embeddedness	13	13	13	13
3. Velocity/Depth Regime	8	8	13	8
4. Sediment Deposition	13	13	18	18
5. Channel Flow Status	8	13	13	13
6. Channel Alteration	8	18	18	13
7. Channel Sinuosity	8	18	13	13
8a. Bank Stability (Left Bank)	7	7	7	7
8b. Bank Stability (Right Bank)	7	9	7	7
9a. Vegetative Protection (Left Bank)	7	7	7	7
9b. Vegetative Protection (Right Bank)	7	9	10	4
10a. Riparian Vegetative Zone Width (Left Bank)	4	7	7	7
10b. Riparian Vegetative Zone Width (Right Bank)	7	9	10	4
Total Score	*105*	*144*	*149*	*127*
Condition Category	*marginal*	*sub-optimal*	*sub-optimal*	*sub-optimal*

TABLE 3. Results of the Benthic Macroinvertebrate Sampling

Taxa:	***Station FN1***	***Station SN1***	***Station TN3***	***Station N1***
Tricladida (flat worms)				
Planariidae				
Dugesia sp.	31	21	13	
Limnophila (snails)				
Physidae				
Physa sp.			1	27
Planorbidae				
Planorbella sp.				16
Sphaeracea (fingernail clams)				
Sphaeriidae				
Pisidium sp.				2
Amphipoda (scuds or side swimmers)				
Gammaridae				
Gammarus sp.	2	2	1	4
Ephemeroptera (mayflies)				
Baetidae				
Baetis sp.		1	2	3
Caenidae				
Caenis sp.				12
Heptageniidae				
Stenonema sp.		2	3	7
Hemiptera (true bugs)				
Veliidae				
Rhagovelia sp.		1		
Odonata (damselflies/dragonflies)				
Coenagrionidae				
Argia sp.				2
Gomphidae				
Stylogomphus sp.				1
Megaloptera (fishflies/dobsonflies)				
Sialidae				
Sialis sp.				1

TABLE 3. Results of the Benthic Macroinvertebrate Sampling (continued)

Taxa:	***Station FN1***	***Station SN1***	***Station TN3***	***Station N1***
Trichoptera (caddisflies)				
Hydropsychidae				
Cheumatopsyche sp.	1	9	17	1
Hydropsyche sp.		14	13	4
Leptoceridae				
Mystacides sp.	1			
Philopotamidae				
Chimarra sp.	1		20	2
Polycentropodidae				
Polycentropus sp.				2
Coleoptera (beetles)				
Elmidae				
Stenelmis sp.	17	35	21	13
Gyrinidae				
Dineutus sp.		1	3	2
Psephenidae				
Psephenus sp.		18	4	4
Scirtidae				
Cyphon sp.		1		
Diptera (true flies)				
Chironomidae				
Chironominae	42	2		
Tanypodinae		1		
Tipulidae				
Antocha sp.			2	
Tipula sp.	3	1	2	
Total # taxa:	***8***	***14***	***13***	***17***
Total # individuals:	***98***	***109***	***102***	***103***

TABLE 4. Scoring Criteria for Rapid Bioassessments in New Jersey Streams

Biological Condition Score:	***Non-impaired*** ***6***	***Moderately Impaired*** ***3***	***Severely Impaired*** ***0***
Biometrics:			
1. Taxa Richness	>10	10-5	4-0
2. EPT Index	>5	5-3	2-0
3. %CDF	<40	40-60	>60
4. %EPT	>35	35-10	<10
5. Family Biotic Index	<5	5-7	>7
Biological Condition:	Total Score		
Non-impaired	24-30		
Moderately Impaired	9-21		
Severely Impaired	0-6		

TABLE 5A. Calculation of Biological Condition for Station FN1

Taxa	*Tolerance Value*	*Station FN1 Number of Individuals*
Planariidae	1	31
Gammaridae	4	2
Hydropsychidae	4	1
Leptoceridae	4	1
Philopotamidae	3	1
Elmidae	4	17
Chironomidae	6	42
Tipulidae	3	3
Taxa Richness		8
EPT Index		3
%CDF		43% Chironomidae
%EPT		3%
Family Biotic Index		3.87 very good water quality; possible slight organic pollution
NJIS Rating		15
Biological Condition		moderately impaired

TABLE 5B. Calculation of Biological Condition for Station SN1

Taxa	*Tolerance Value*	*Station SN1 Number of Individuals*
Planariidae	1	21
Gammaridae	4	2
Baetidae	4	1
Heptageniidae	4	2
Veliidae	8	1
Hydropsychidae	4	23
Elmidae	4	35
Gyrinidae	4	1
Psephenidae	4	18
Scirtidae	5	1
Chironomidae	6	3
Tipulidae	3	1
Taxa Richness		12
EPT Index		3
%CDF		32% Elmidae
%EPT		24%
Family Biotic Index		3.51 excellent water quality; organic pollution unlikely
NJIS Rating		24
Biological Condition		non-impaired

TABLE 5C. Calculation of Biological Condition for Station TN3

Taxa	*Tolerance Value*	*Station TN3 Number of Individuals*
Planariidae	1	13
Physidae	8	1
Gammaridae	4	1
Baetidae	4	2
Heptageniidae	4	3
Hydropsychidae	4	30
Philopotamidae	3	20
Elmidae	4	21
Gyrinidae	4	3
Psephenidae	4	4
Tipulidae	3	4
Taxa Richness		11
EPT Index		4
%CDF		29% Hydropsychidae
%EPT		54%
Family Biotic Index		3.42 excellent water quality; organic pollution unlikely
NJIS Rating		24
Biological Condition		non-impaired

TABLE 5D. Calculation of Biological Condition for Station N1

Taxa	*Tolerance Value*	*Station N1 Number of Individuals*
Physidae	8	27
Planorbidae	8	16
Sphaeriidae	7	2
Gammaridae	4	4
Baetidae	4	3
Caenidae	7	12
Heptageniidae	4	7
Coenagrionidae	9	2
Gomphidae	1	1
Sialidae	4	1
Hydropsychidae	4	5
Philopotamidae	3	2
Polycentropididae	6	2
Elmidae	4	13
Gyrinidae	4	2
Psephenidae	4	4
Taxa Richness		16
EPT Index		6
%CDF		26% Physidae
%EPT		30%
Family Biotic Index		6.17 fairly poor; substantial pollution likely
NJIS Rating		24
Biological Condition		non-impaired