Executive Summary

Stream visual assessments are commonly used by water resource managers to evaluate basic stream health. They are field evaluations of individual stream reaches, where observations of a stream's physical condition are documented and obvious problems are identified. Visual assessments can be incorporated into watershed planning projects to provide a better understanding of the issues affecting the watershed and more detailed information for restoration and protection activities.

A total of eighty-three (83) stream visual assessments were conducted throughout the Metedeconk River watershed during spring 2010 to support the development of a watershed protection and restoration plan. The visual assessments were performed in accordance with a Visual Assessment Project Plan and assessment protocol approved by the New Jersey Department of Environmental Protection.

A considerable amount of information was gathered during the visual assessments, including observations of the stream's physical condition, water quality appearance, riparian area, habitat, nearby land use types, stormwater infrastructure, utility facilities, and pollution sources. Each reach was scored on a 1-10 scale based upon a series of visual assessment indicators and categorized as Excellent, Good, Fair or Poor. The data from the visual assessments were entered into a custom database to facilitate accessibility, review and analysis. Digital photographs and GPS positions of important features were also collected at each site.

The stream visual assessment scores were statistically evaluated and summarized, both on a watershed-wide scale and by smaller HUC14 subwatersheds. A Geographic Information System (GIS) was used to examine the assessment scores in relation to HUC14 boundaries and land use. The assessment results were reviewed to identify common issues affecting the entire watershed, as well as specific problems that were documented along the individual stream reaches. The assessments were screened to identify sources of near-stream pollutant loading that may be causing water quality impairments, with particular focus on those pollutants that are subject to Total Maximum Daily Loads (TMDL's). Restoration and protection opportunities were summarized for each assessment site.

Of the 83 visual assessments conducted, one (1) site ranked Excellent (1%), thirty-three (33) ranked Good (40%), thirty (30) ranked Fair (36%), and nineteen (19) ranked Poor (23%). The results show a relationship between degraded stream condition and more intense land development/alteration in the surrounding area. Smaller tributary streams were clearly more sensitive to local urbanization and stormwater inputs than the larger branches of the Metedeconk River. Some tributaries have undergone substantial streamflow changes, causing erosion and sedimentation problems and, in effect, making them part of the stormwater conveyance system. The assessment data suggests that natural riparian buffer and wetland areas have been beneficial in helping offset the impacts of urbanization on streams in many areas. Very few clearly identifiable sources of pollution were documented at the assessment sites, which indicates that nonpoint source pollution is the primary cause of existing water quality impairments. Utility facilities located along the streams were found to be well maintained, though litter and dumping is a common problem.

Stormwater management is among the most pressing concerns for the watershed. Antiquated stormwater infrastructure, including direct discharge outfalls and detention basins, are prevalent throughout the watershed. There is considerable opportunity for the installation of stormwater BMP's and other restoration projects to address existing problems. There is also a need to ensure that future stormwater management practices are more protective of watershed function and incorporate progressive Low Impact Development (LID) concepts.

Introduction

The Metedeconk River Watershed Protection and Restoration Plan (MRWPRP) project has benefitted from a wealth of available information. Several independent studies and high-quality data from other sources have allowed for a relatively detailed assessment of the health and condition of the Metedeconk River watershed without a large and burdensome investment of project resources on collecting basic watershed data, such as water quality testing results and land use information.

Data collection activities under the MRWPRP project have focused on providing complementary and previously unavailable information in the form of stream visual assessments. Stream visual assessments are field evaluations of stream reaches where observations of the stream's physical condition are documented and obvious problems are identified. The incorporation of visual assessment observations into the watershed analysis provides a better understanding of issues affecting the watershed, additional information on features such as storm outfalls and drainage ditches, and clearly-identified problem areas and restoration targets. Because they provide a smaller scale snapshot of the condition of the watershed, the visual assessments can also be used as a benchmark for future restoration activities.

Visual Assessment Project Plan (VAPP) and Assessment Protocol

Stream visual assessments for this project were conducted in accordance with a Visual Assessment Project Plan (VAPP). The VAPP describes the purpose of the stream visual assessments, the sites to be evaluated and how they were selected, who would be performing the assessments, training procedures, the assessment protocol and information to be collected, quality control requirements, data management and reporting. The VAPP for the MRWPRP received formal approval from the New Jersey Department of Environmental Protection on January 27, 2010. The VAPP for this project can be found in Appendix A.

Stream visual assessments are a widely-accepted approach for collecting watershed information. The following standardized methodologies and guidance documents were referenced to develop the Metedeconk watershed VAPP and visual assessment protocol:

- USDA NWCC Technical Note 99–1, Stream Visual Assessment Protocol, December 1998.
- NJDEP Visual Assessment Project Plan (VAPP) Guidance, August 2007.
- NJDEP Volunteer Monitoring Program Visual Assessment Protocol, 2008-2009.
- Rutgers Cooperative Extension Water Resources Program Stream Visual Assessment Protocol, 2008.
- Center for Watershed Protection Unified Stream Assessment: A User's Manual, Manual 10, Version 2.0, February 2005.
- Center for Watershed Protection Unified Subwatershed and Site Reconnaissance: A Users' Manual, Manual 11, Version 2, February 2005.

The Metedeconk watershed visual assessment protocol was designed to provide a fairly detailed and comprehensive description of the selected sites. Each stream reach was evaluated for physical characteristics such as flow, channel condition, bank stability, habitat, riparian area and water appearance. These assessment categories were also scored and averaged to provide a quantitative measure of the condition of the reach. The protocol included an evaluation of land use along the reach and its relative proximity to the stream. Utility infrastructure and easements along the reach were documented, with slightly more detail collected for sanitary sewer infrastructure due to its potential as a pollutant source. Detailed information was compiled for stormwater infrastructure along the reach, particularly storm outfalls and drainage ditches. Suspected causes of problems and recommendations were also recorded.

Assessments were conducted using field forms to ensure completeness and consistency between sites. Photographs and GPS positions of key features were also collected at each site. Each visual assessment was reviewed, verified and validated by the project manager. A relational database was developed to house the assessment information and facilitate its evaluation and use for the MRWPRP. All assessments were conducted by Brick Utilities staff once trained and deemed proficient with the visual assessment protocol. Additional field assistance was provided by students from Georgian Court University's ecology program.

Stream visual assessment is an established approach for providing a basic level of stream health evaluation. A considerable amount of information was collected during the Metedeconk River watershed visual assessments. Every effort has been made to ensure that the information is accurate, that consistent methods were employed between sites, and that the data has been validated, verified and correctly documented. The individuals performing the assessments used their best professional judgment and a relative comparison to the other sites, including reference sites, when assigning indicator scores. Nonetheless, the scoring may be considered subjective. The assessment protocol examines conditions within the assessment area only and may not detect problems caused by factors outside the area being assessed. The single round of stream assessments conducted for this project cannot be used to evaluate trends or changes in condition over time. The assessments also may not be able to explain the exact cause or source of stream degradation. Users of the Metedeconk watershed visual assessment data for purposes outside the scope of this project should be aware of these potential limitations.

Stream Visual Assessment Results

A total of eighty-three (83) stream visual assessments were conducted throughout the Metedeconk watershed during winter and spring 2010 (Figure 1). The stream reaches were selected to be representative of the watershed and encompass a broad range of conditions, from forested headwater areas to heavily urbanized commercial centers closer to the coastline (Figure 2). The reaches varied in length depending on size of the stream channel and site conditions, and ranged from 129 feet to 3,650 feet with a median length of 480 feet. The assessment data includes 1,762 digital photographs and 914 GPS positions of important watershed features.

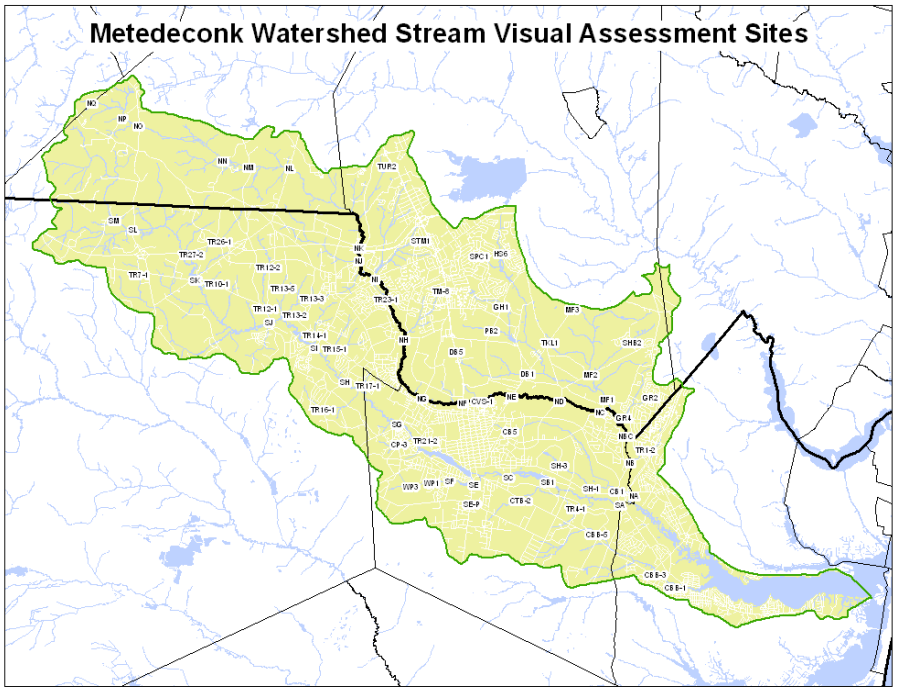


Figure 1


Figure 2 – Site NM (left) a high-quality headwater site and Site SHB2 (right) a degraded stream in a residential area

Each visual assessment reach was scored on a 1-10 scale, with the overall score determined by averaging the scores from a series of visual assessment indicators. A list of the indicators and description of each is presented in Table 1. The overall reach scores ranged from a minimum of 3.2 to a maximum of 9.5, with a mean of 6.8 and a median of 6.9. A summary of the scoring data is presented in Table 2.

Table 1 - Stream Visual Assessment Indicators

Indicator	Description
Channel condition	Natural versus altered channel (channelization; installation of riprap, dikes or levies; downcutting or aggradation)
Hydrologic alteration	Connectivity to the floodplain (flooding frequency; structures or channel incision that limit the stream's access to the floodplain)
Riparian zone - left bank Riparian zone - right bank	Natural vegetation on either side of stream (width of buffer area with respect to channel; compromised filtering function)
Bank stability - left bank Bank stability - right bank	Bank condition (stable vs. eroding; elevation of banks with respect to flood plain; overhanging vegetation or slope failures)
Water appearance	Water visual characteristics (clarity; visibility depth; color; presence of oil sheens, films, scums or pollutants; noticable odors)
Nutrient enrichment	Aquatic plant growth (abundance of algae and/or aquatic macrophytes; diverity of plant community; water clarity and color)
Barriers to fish movement	Presence of barriers that block movement of aquatic organisms (withdrawals, culverts or drop structures; dams and spillways; water diversions)
Instream fish cover	Available physical habitat for fish (variety and abundance of cover types, e.g., logs/woody debris, riffles, pools, root mats, etc.)
Pools	Abundance and variability of pools (deep and shallow pools; presence or absence; relative extent along reach)
Invertebrate habitat	Available substrate for insect/invertebrate colonization (number of different cover types, e.g. logs, fine woody debris, leaf packs, etc.)
Canopy cover	Shading of the stream (relative extent of stream surface area shaded; coldwater vs. warm water fishery)
Manure presence	Evidence of livestock in or near the stream (Not applicable in the project watershed)
Salinity	Evidence of high salinity (Not applicable in the project watershed)
Riffle embeddedness	Embeddedness of cobble, gravel or submerged object in sediment (infrequent occurrence in the project watershed)
Macroinvertebrates observed	Type and diversity of species present (Not evaluated in the project watershed)

Table 2 - Stream Visual Assessment Score Summary

Indicator	n	Mean	Median	Minimum	Maximum
Channel condition	83	6.4	7	1	10
Hydrologic alteration	83	7.5	8	1	10
Riparian zone-left bank	83	8.0	9	1	10
Riparian zone-right bank	83	7.9	9	1	10
Bank stability-left bank	83	7.6	8	3	10
Bank stability-right bank	83	7.5	8	3	10
Water appearance	83	7.5	8	1	10
Nutrient enrichment	83	7.8	8	1	10
Barriers to fish movement	83	7.3	8	1	10
Instream fish cover	83	5.5	5	1	10
Pools	83	5.1	5	1	10
Invertebrate habitat	83	5.7	7	1	10
Canopy cover	83	6.8	8	1	10
Manure presence *	0	n/a	n/a	n/a	n/a
Salinity *	0	n/a	n/a	n/a	n/a
Riffle embeddedness **	6	8.5	10	2	10
Macroinvertebrates observed *	0	n/a	n/a	n/a	n/a
Left bank score	83	6.9	7.0	3.2	9.5
Right bank score	83	6.8	6.9	3.2	9.5
Overall reach score	**83**	**6.8**	**6.9**	**3.2**	**9.5**

Note: Indicator scores were assigned using best professional judgment and a relative comparison to reference sites and other sites in the watershed and may be subjective.
* Not evaluated or not applicable in the project watershed
** Infrequent occurrence in the project watershed

Based upon the scores, the assessment reaches were categorized as Excellent (≥9.0), Good (7.5-8.9), Fair (6.1-7.4), or Poor (≤6.0). A breakdown of the scores is presented in Figure 3. Of the 83 visual assessments conducted, one (1) site ranked Excellent, thirty-three (33) ranked Good, thirty (30) ranked Fair, and nineteen (19) ranked Poor. In terms of percentages, 1% ranked Excellent, 40% ranked as Good, 36% ranked as Fair, and 23% ranked Poor. The geographic distribution of the assessment site rankings is shown in Figure 4. Using these same categories and the overall mean and median reach scores from Table 2, the watershed as a whole ranks as Fair.

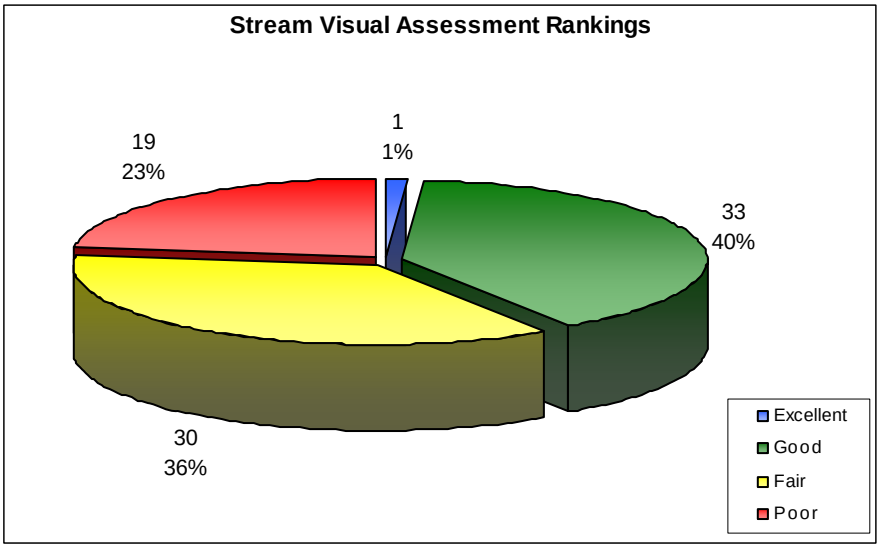


Figure 3

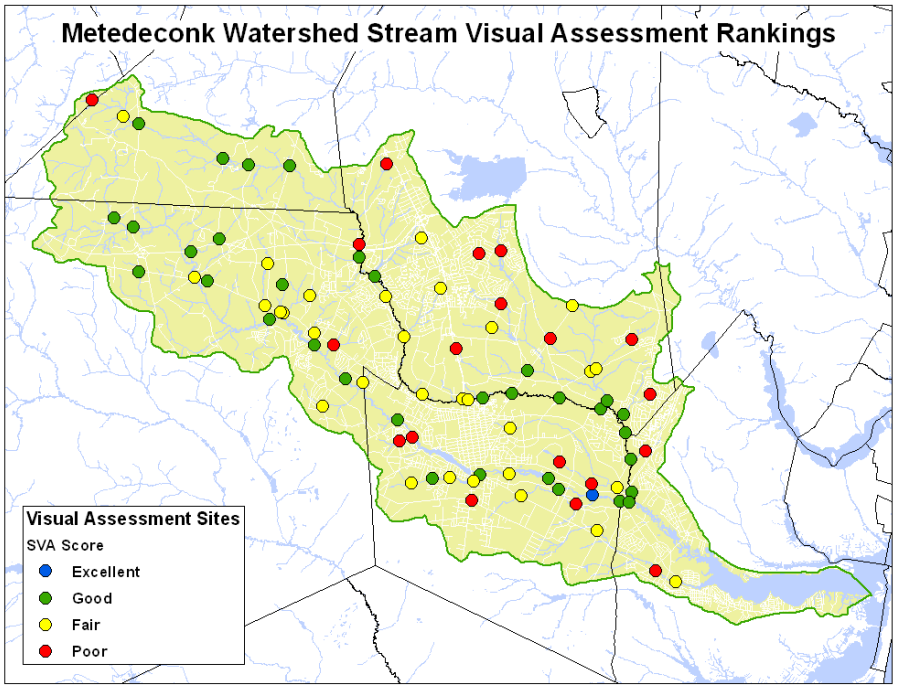


Figure 4

The NJDEP periodically evaluates statewide water quality using 14-digit Hydrologic Unit Code (HUC14) subwatersheds as the basis for its assessment units. The Metedeconk River Watershed Protection & Restoration Plan project area encompasses eleven (11) of these HUC14 subwatersheds. Table 3 summarizes the stream visual assessment scores by HUC14, and Figure 5 shows the site rankings along with the HUC14 subwatershed boundaries. Note that the stream visual assessment protocol is intended to evaluate freshwater streams. Because the Metedeconk River transitions to tidal estuary in the western portion of subwatershed CNFL-1, visual assessment opportunities in this HUC14 were limited to the Cedar Bridge Branch in Brick and Lakewood Townships.

Table 3

Sub-watershed	HUC14	Area (mi^2)	Subwatershed Name	Watershed Name	Assessment Sites*	No. SVA's	Score Average
NB-1	02040301020010	8.6	Metedeconk R NB (above I-195)	Metedeconk River NB	**NK**, NL, NM, NN, NO, NP, NQ, TUR2	8	7.1
NB-2	02040301020020	10.9	Metedeconk R NB (Rt 9 to I-195)	Metedeconk River NB	**NF**, NG, NH, NI, NJ, **NK**, STM1, TM-8, TR23-1	9	6.8
NB-3	02040301020030	6.1	Haystack Brook	Metedeconk River NB	DB1, DB5, GH1, HS6, PB2, SPC1	6	5.5
NB-4	02040301020040	4.8	Muddy Ford Brook	Metedeconk River NB	MF1, MF2, MF3, SHB1, SHB2, TKL1	6	6.4
NB-5	02040301020050	7.9	Metedeconk R NB (confluence to Rt 9)	Metedeconk River NB	CB1, CB5, CVS-1, GR2, GR4, NA, NB, NBC, NC, ND, NE, **NF**, NF14, SH-1, SH-3, TR1-2	16	7.0
SB-1	02040301030010	5.0	Metedeconk R SB (above I-195 exit 21 rd)	Metedeconk River SB	**SL**, SM	2	7.8
SB-2	02040301030020	5.6	Metedeconk R SB (74d19m15s to I-195 X21)	Metedeconk River SB	SK, **SL**, TR10-1, TR26-1, TR27-2	5	7.8

SB-3	02040301030030	7.6	Metedeconk R SB (Bennetts Pd to 74d19m15s)	Metedeconk River SB	**SI**, SJ, TR12-1, TR12-2, TR13-1, TR13-2, TR13-3, TR13-5, TR14-1, TR7-1	10	7.1
SB-4	02040301030040	7.8	Metedeconk R SB (Rt 9 to Bennetts Pond)	Metedeconk River SB	CP-3, **SE**, SF, SG, SH, **SI**, TR15-1, TR16-1, TR17-1, TR21-2, WP1, WP3	12	6.6
SB-5	02040301030050	4.8	Metedeconk R SB (confluence to Rt 9)	Metedeconk River SB	CTB-1, CTB-2, POND6, SA, SA-DEN, SB1, SC, SD, **SE**, SE-P, TR4-1	11	7.3
CNFL-1	02040301040020	9.2	Metedeconk R (Beaverdam Ck to confl)	Metedeconk River	CBB-1, CBB-3, CBB-5	3	5.6
* Assessment sites in **bold** are located at the boundary of two HUC14 subwatersheds; these sites were considered part of both the upstream and downstream HUC14 when calculating the mean scores.							

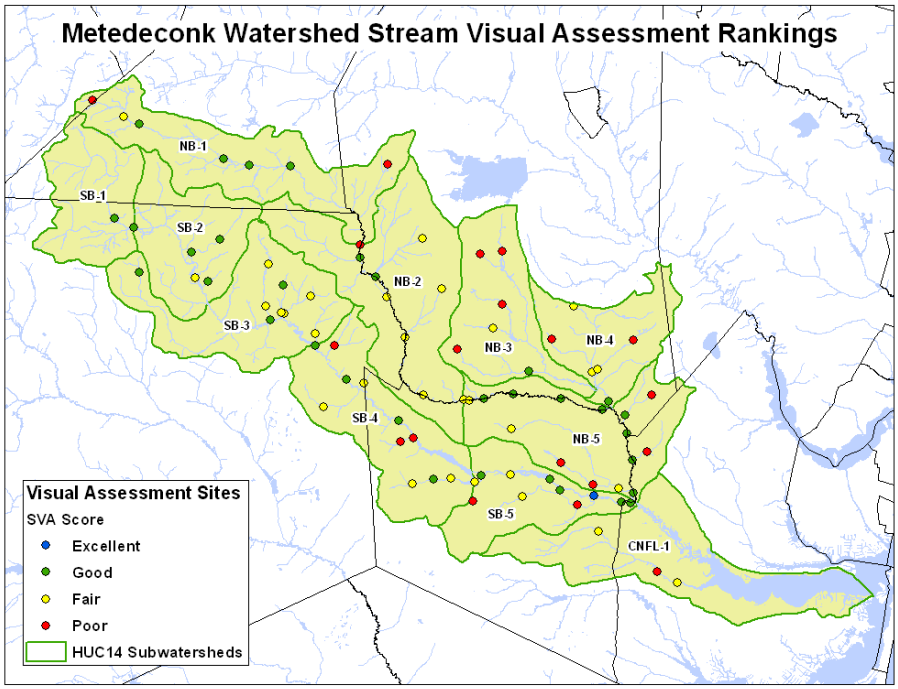


Figure 5

Findings and Discussion

Some general observations can be drawn from the stream visual assessment results. Signs of human activity, either present or past, are evident virtually everywhere in the watershed, even in the most pristine areas. There are some prominent watershed features that affect considerable stretches of the Metedeconk River and were factors at more than one assessment site. For example, five major man-made lakes are located along the South Branch, and a cleared high tension power line easement has affected the riparian characteristics of the North Branch along the entire border of Howell and Lakewood Townships.

It is notable that the detrimental effects of urbanization on local streams were offset at several sites by intact and healthy riparian buffers. The visual assessments identified numerous areas where encroachment into the riparian corridor has occurred and restoration of riparian vegetation would be beneficial.

For the most part, the Metedeconk River does not suffer from severe stream erosion problems that are common in similarly developed watersheds in the region (e.g. Manasquan River). It appears that the watershed's gentle topography, sandy soils and prevalent wetlands have thus far provided some level of stability despite measurable changes in stream flow characteristics. Erosion and sedimentation problems documented during the assessments are largely confined to the smaller tributaries that receive heavy stormwater flows (Figure 6).

Figure 6 – Heavy erosion along tributary site GH1 (left) compared with minimal erosion and a functional floodplain along North Branch Metedeconk River site ND (right).

As one would expect, streams in more urbanized areas tended to exhibit greater impairment and receive lower assessment scores, and vice versa. It appears from the assessment results that the higher-order streams (e.g. the north and south branches) maintain greater resilience to the effects of local urbanization than the lower-order streams (e.g. smaller tributaries). The lower-order streams with the lowest scores were in medium-density residential developments and, in these cases, the stream has in effect become part of the stormwater conveyance system. However, even minor alterations along the lower-order streams from their natural state were enough to cause lower assessment scores. Assessment indicators related to in-stream habitat (e.g. pools, in-stream fish cover and invertebrate habitat) appear to be the most sensitive to changes in stream condition and the first indicators of impaired stream health. A map of the assessment sites along with land cover categories associated with disturbance (i.e. urban, agriculture and barren lands) is shown in Figure 7.

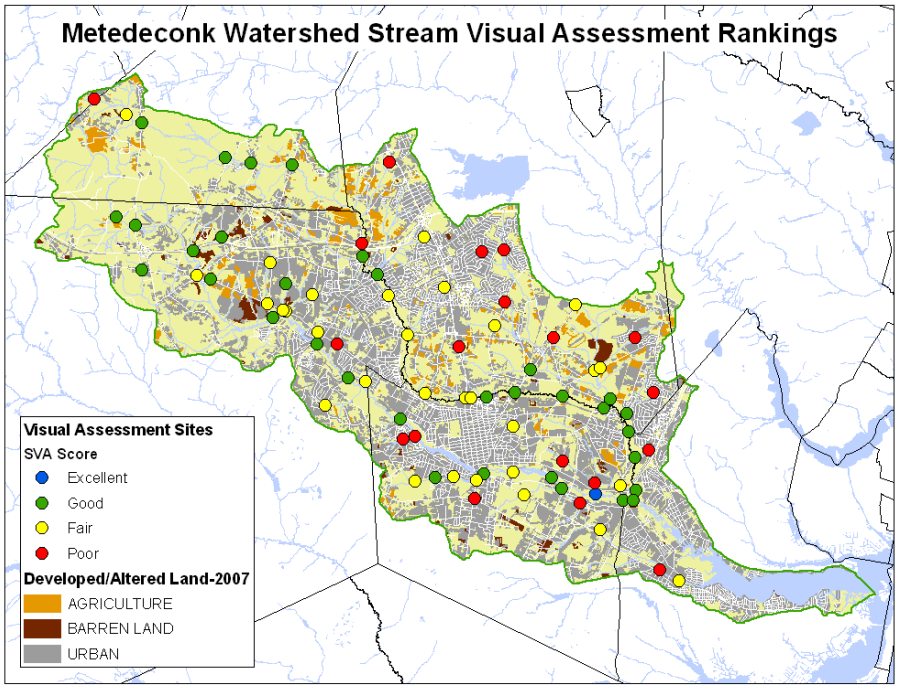
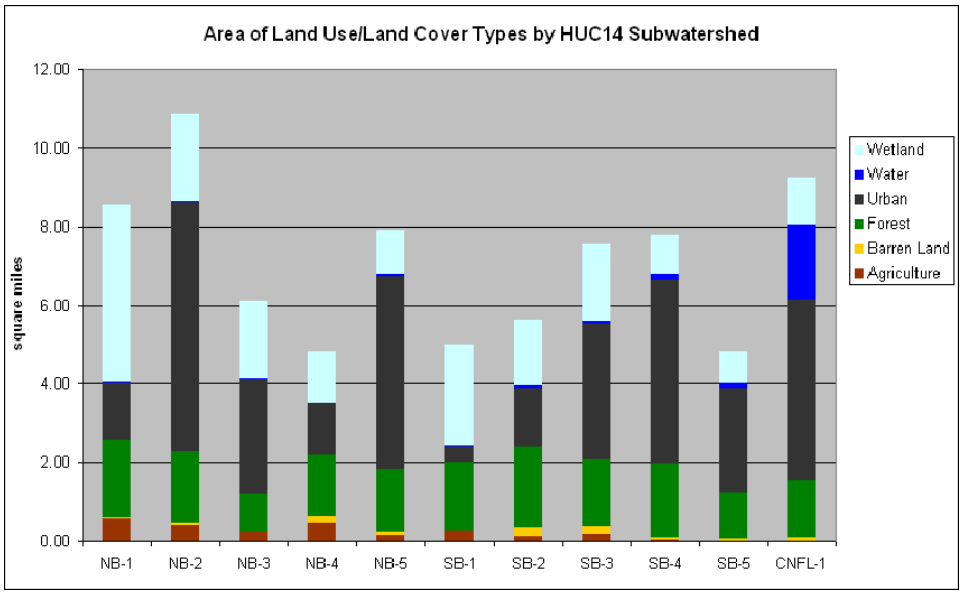


Figure 7

An analysis of the assessment data by HUC14 subwatershed provides further insight into the relationship between land use and stream health. Figure 8 shows the relative areal coverage of each landuse/landcover type by HUC14. Figure 9 shows a GIS classification (using Jenks natural breaks optimization) of HUC14 average assessment scores into five classes.

It is evident in Figure 9 that there is a general progression of higher to lower assessment scores from the relatively undeveloped headwaters in the western areas of the watershed to the more densely developed areas in the east. SB-1 and SB-2 are relatively undisturbed HUC14's and ranked in the highest class. NB-1 is similar to SB-1 and SB-2 in terms of land use and stream reach condition but also includes two sites along major transportation corridors (County 537 and State Highway 9) that scored poorly and brought down the average enough to place it in the middle-high class. The subwatersheds NB-3 and NB-4 drain a sizable portion of Howell Township along Hay Stack Brook and Muddy Ford Brook to a single point along the North Branch. These HUC14's are somewhat rural in nature, though NB-3 is more urbanized than NB-4. NB-3's headwaters have been affected by residential development and the Route 9 corridor, giving it the lowest average score of all the subwatersheds. NB-4 has headwaters in agricultural and low-density or rural residential areas. The lower classifications for both NB-3 and NB-4 can be attributed to the more sensitive nature of the smaller streams in this area to local land disturbance. SB-5 stands out because it ranks in the medium-high class despite being located along the Route 9 corridor in a heavily urbanized area of Lakewood Township. However, this HUC14 is also characterized by a riparian corridor that has been left intact and large contiguous areas of open space, including two Ocean County parks. Lakes Carasaljo and Manetta immediately upstream may also have a role in moderating South Branch flows entering SB-5. CNFL-1 is heavily urbanized and ranked in the lowest class, though it should be noted that stream assessments in this HUC14 were limited to the Cedar Bridge Branch due to the tidal influences on the Metedeconk River.


Area of Land Use/Land Cover Types by HUC14 Subwatershed
square miles
12.00
10.00
8.00
6.00
4.00
2.00
0.00
NB-1
NB-2
NB-3
NB-4
NB-5
SB-1
SB-2
SB-3
SB-4
SB-5
CNFL-1
Wetland
Water
Urban
Forest
Barren Land
Agriculture

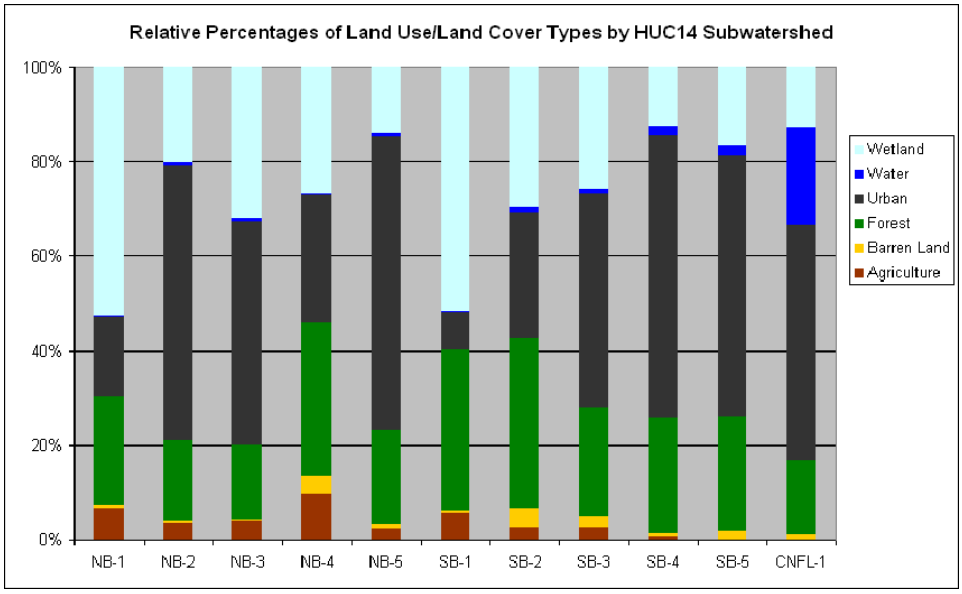

Relative Percentages of Land Use/Land Cover Types by HUC14 Subwatershed
100%
80%
60%
40%
20%
0%
NB-1
NB-2
NB-3
NB-4
NB-5
SB-1
SB-2
SB-3
SB-4
SB-5
CNFL-1
Wetland
Water
Urban
Forest
Barren Land
Agriculture

Figure 8

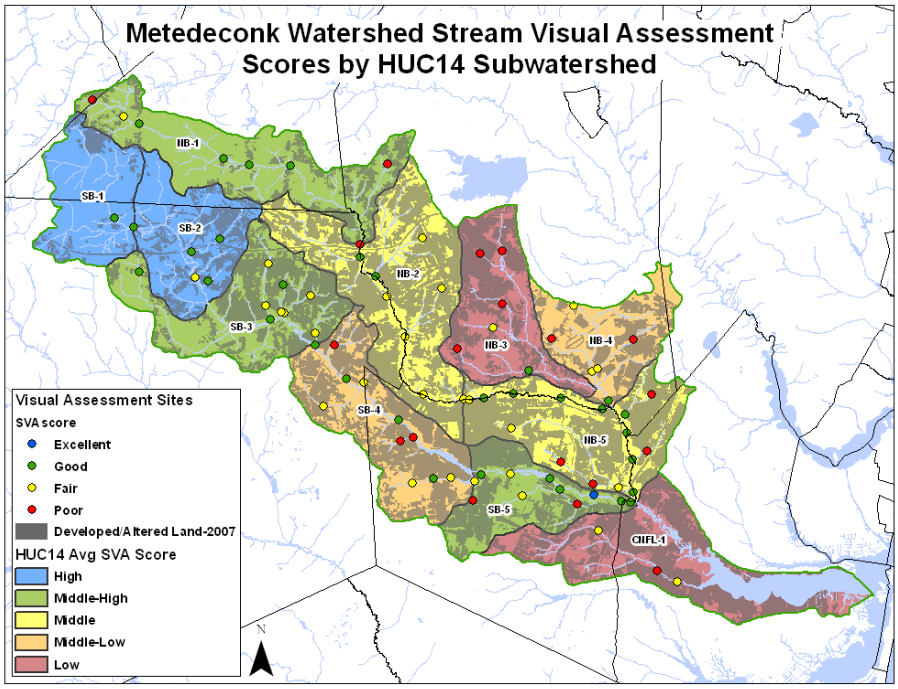


Figure 9

Stormwater management was a common issue documented in the assessments. Stormwater infrastructure that would be considered antiquated by today's standards is prevalent throughout the watershed. Older stormwater systems were designed to simply remove stormwater from a site, with the runoff either discharged directly to the nearest waterway or temporarily held in a detention basin prior to discharge (Figure 10). Direct stormwater discharges to the river were found at 68 sites, and a total of 117 storm outfalls and 24 drainage ditches were cataloged. Direct stormwater inputs typically present problems for Metedeconk River water quality and flow characteristics. Detention basins in varying condition were identified in close proximity to 20 assessment sites. These basins were designed to moderate runoff flows and prevent downstream flooding but do little to improve water quality or infiltrate stormwater.

Figure 10 – Direct stormwater discharge outfall from an older residential subdivision at site TUR2 (left) and a detention basin adjacent site TR13-1 (right)

There is considerable opportunity in the watershed to retrofit existing infrastructure with stormwater best management practices (BMP's) which would reduce nonpoint source pollutant loading, enhance groundwater recharge, and help restore a more natural hydrologic function to existing developed areas. The assessments documented 49 sites (59 % of the sites evaluated) where installation of stormwater BMP's or the retrofit of basins appears feasible and beneficial. Targeted BMP retrofit projects would effectively complement the activities required under New Jersey's stormwater management regulations to reduce nonpoint source pollution.

Other than stormwater, there were very few sources of near-stream pollutant loading identified by the visual assessments. Nearly the entire watershed is listed as impaired for fecal coliform, total coliform or pathogens and subject to adopted Total Maximum Daily Loads (TMDL's). Waterfowl were the only clear source of fecal coliform loading documented in the assessments (Figure 11, left). The results include observations of other potential sources of pathogen loading (e.g. agricultural livestock operations and septic systems) in the vicinity of the assessment sites, but no cases where these other factors were actually causing discernible problems along the reach.

Phosphorus impairments are also documented in the watershed. A TMDL has been established to address phosphorus loading in subwatershed NB-1, and the 2008 New Jersey Integrated Water Quality Monitoring and Assessment Report lists phosphorus impairment for subwatershed NB-4. The assessments identified only one site with a near-stream nutrient loading source, specifically site SHB1 which is located within subwatershed NB-4. In this instance, nutrient-rich runoff from an adjacent nursery operation was discovered draining toward the stream and causing unusually lush vegetative growth along the stream bank (Figure 11, right). Similar to case with fecal coliform above, the assessment results include observations of other potential sources of nutrient loading (e.g. agriculture, lawn/turf maintenance, etc.) that exist in the vicinity of the assessment sites, but no other clearly identifiable problem areas.

Figure 11 – Geese in the stream and on the banks at site TR21-2 (left) and unusually lush vegetative growth fueled by runoff from a nursery at site SHB1 (right).

An exorbitant amount of trash, mostly floatable debris, was observed during the assessments (Figure 12). Floatables do not necessarily impact water quality but can pose a hazard to wildlife. Further, their presence undermines the aesthetic qualities that are important to recreational uses and suggests a human disregard for local water resources. Perhaps most importantly, floatables serve as a clearly discernible sign of the impact that stormwater runoff is having on the Metedeconk River and its tributaries and can be an indicator of flashy or high stormwater flows. The retrofit of older storm grates, which is occurring to some extent as a result of New Jersey's stormwater management regulations, would help prevent floatables from entering waterways (Figure 13). Dumping was also a concern in the watershed (Figure 14). Dumping of yard waste or other vegetative debris was encountered at

numerous sites during the assessments. In several cases, dumping of other types of material was documented, including building materials, old appliances, scrap metal, oil tanks, tires, shopping carts, bicycles and children's toys. Poor housekeeping was also identified at a few commercial facilities that border streams in the watershed.

Figure 12 – Floatable debris at sites TUR2 (left) and CBB-1 (right)

Figure 13 – An older style storm inlet grate at site NE (left) and a newer style grate designed to prevent passage of floatable debris at site TR10 (right)


Figure 14 – Dumping of leaves, grass clippings and larger yard waste at site TR12 (left) and appliances, water tanks and other debris at site SHB2 (right)

Utility facilities such as electrical power lines, natural gas pipelines, and water and sewer mains and pumping stations are commonly encountered near streams throughout the watershed. The assessments found utility facilities and easements to be generally well maintained. Sanitary sewer infrastructure was closely scrutinized because failure of these systems can result in significant discharges of nutrients, pathogens and other pollutants. The assessments did not reveal any cases of poorly maintained or leaking sanitary sewer infrastructure in the watershed.

Table 4 (below) lists each stream visual assessment site along with the assigned assessment number, assessment date, waterway name, HUC14, municipality, and reach score and ranking. Table 5 summarizes potential restoration measures for each site that were identified during the assessments. Aerial photograph maps of each site can be found in Appendix B. The MRWPRP Project Task 3 - Technical Analysis includes further evaluation of the visual assessment results and a refined list of those sites that have been identified as potential candidates for restoration and/or stormwater BMP retrofit projects. The full visual assessment data set, including a Microsoft Access database, photographs, GIS shapefiles, and scanned field forms is available for download via the project e-room or by request from the project team.

Conclusions

The stream visual assessment results indicate that nonpoint source pollution is the major factor causing stream impairments in the Metedeconk River watershed. Only in rare cases did the visual assessments reveal clearly identifiable sources of pollutant loading that would be expected to contribute to existing impairments. The impacts that historical development and stormwater management practices have had on stream health in the watershed are well documented in the assessment data. The visual assessment scores indicate that more intensely developed areas tend to have the greatest negative impact on physical stream condition, especially when located near a headwater. New Jersey's stormwater management regulations are expected to result in some reduction in nonpoint source pollutant loading from developed areas. Addressing runoff to the river from antiquated stormwater infrastructure presents a key opportunity to further address water quality impairments and improve stream health.

On a positive note, the assessment results indicate that the Metedeconk River and its north and south branches have been surprisingly resilient to land use changes that have occurred in the watershed thus far. It is of critical importance that future development in the watershed be designed in a manner that will mitigate the problems commonly caused by stormwater runoff and incorporate more progressive Low Impact Development (LID) approaches. The State's stormwater management regulations, if

properly implemented, will help ensure these objectives are met. Alternatively, a set of stormwater BMP's and design standards specifically applicable to the conditions in the Metedeconk watershed could be collectively assembled, adopted and employed by the watershed community.

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Table 4 – Stream Visual Assessment Site Listing

Assess. No.	Segment ID	Date	Waterway	HUC14	Location	Municipality	SVA Score	SVA Rank
75	CB1	6/9/10	Cabinfield Branch (Schoolhouse Branch)	02040301020050	Lanes Mill Road	Lakewood Twp	6.90	Fair
73	CB5	6/8/10	Cabinfield Branch	02040301020050	East End Avenue	Lakewood Twp	6.20	Fair
77	CBB-1	6/10/10	Cedar Bridge Branch	02040301040020	Cedar Bridge Avenue & Brick Blvd	Brick Twp	7.00	Fair
69	CBB-3	6/4/10	Cedar Bridge Branch	02040301040020	Cedar Bridge Avenue & State Hwy 70	Brick Twp	3.30	Poor
76	CBB-5	6/10/10	Cedar Bridge Branch	02040301040020	Cedar Bridge Avenue	Lakewood Twp	6.50	Fair
78	CP-3	6/10/10	Unnamed tributary to South Branch Metedeconk River	02040301030040	Forest Drive	Lakewood Twp	3.90	Poor
53	CTB-1	5/22/10	Cotterals Brook	02040301030050	New Hampshire Avenue	Lakewood Twp	7.50	Good
49	CTB-2	5/19/10	Cotterals Brook	02040301030050	Cedar Bridge Avenue	Lakewood Twp	6.40	Fair
71	CVS-1	6/7/10	North Branch Metedeconk River	02040301020050	Kennedy Blvd	Lakewood Twp	8.50	Good
8	DB1	3/28/10	Dicks Brook	02040301020030	Lakewood-Farmingdale Road	Howell Twp	7.50	Good
56	DB5	5/24/10	Dicks Brook	02040301020030	Route 9	Howell Twp	5.30	Poor
4	GH1	3/11/10	Ground Hog Brook	02040301020030	Maxim-Southard Road	Howell Twp	5.50	Poor
20	GR2	4/14/10	Pine Creek (Gravelly Run)	02040301020050	Juniper Place	Howell Twp	5.70	Poor
21	GR4	4/14/10	Gravelly Run	02040301020050	Moses Milch Drive	Howell Twp	8.20	Good
3	HS6	3/10/10	Haystack Brook	02040301020030	Princeton Drive	Howell Twp	4.70	Poor
19	MF1	4/12/10	Muddly Ford Brook	02040301020040	Ramtown-Greenville Road	Howell Twp	8.50	Good
13	MF2	4/1/10	Muddy Ford Brook	02040301020040	Lakewood-Allenwood Road	Howell Twp	7.00	Fair
9	MF3	4/3/10	Muddy Ford Brook	02040301020040	Lakewood-Farmingdale Road	Howell Twp	6.20	Fair
66	NA	6/2/10	North Branch Metedeconk River	02040301020050	State Hwy 88	Brick Twp	8.30	Good
81	NB	6/14/10	North Branch Metedeconk River	02040301020050	Lanes Mill Road	Lakewood Twp	8.80	Good
68	NBC	6/3/10	North Branch Metedeconk River	02040301020050	Burnt Tavern Road	Lakewood Twp	8.50	Good
64	NC	6/1/10	North Branch Metedeconk River	02040301020050	Ridge Road	Lakewood Twp	7.90	Good
2	ND	3/9/10	North Branch Metedeconk River	02040301020050	Brook Road	Lakewood Twp	8.10	Good
63	NE	6/1/10	North Branch	02040301020050	Lakewood-	Lakewood	8.00	Good

			Metedeconk River		Farmingdale Road	Twp		
62	NF	5/28/10	North Branch Metedeconk River	02040301020020, 02040301020050	Route 9	Lakewood Twp	6.60	Fair
70	NF14	6/7/10	North Branch Metedeconk River	02040301020050	Clifton Ave	Lakewood Twp	6.40	Fair
61	NG	5/28/10	North Branch Metedeconk River	02040301020020	Kent Road	Lakewood Twp	6.30	Fair
60	NH	5/27/10	North Branch Metedeconk River	02040301020020	Church Road	Jackson Twp	7.40	Fair
51	NI	5/20/10	North Branch Metedeconk River	02040301020020	Aldrich Road	Jackson Twp	7.70	Good
52	NJ	5/21/10	North Branch Metedeconk River	02040301020020	Fort Plains Road/Larsen Road	Jackson Twp	7.90	Good
59	NK	5/27/10	North Branch Metedeconk River	02040301020010, 02040301020020	Hulses Corner Road	Jackson Twp	5.60	Poor
50	NL	5/20/10	North Branch Metedeconk River	02040301020010	Jackson Mills Road	Freehold Twp	8.20	Good
33	NM	4/30/10	North Branch Metedeconk River	02040301020010	Pittenger Pond Road	Freehold Twp	8.90	Good
22	NN	4/15/10	North Branch Metedeconk River	02040301020010	Nomoco Road	Freehold Twp	8.30	Good
44	NO	5/13/10	North Branch Metedeconk River	02040301020010	Siloam Road	Freehold Twp	8.50	Good
12	NP	4/5/10	North Branch Metedeconk River	02040301020010	Hendrickson Road	Freehold Twp	6.60	Fair
11	NQ	4/5/10	North Branch Metedeconk River	02040301020010	Monmouth Road (Rt. 537)	Millstone Twp	5.80	Poor
7	PB2	3/27/10	Polypod Brook	02040301020030	Maxim-Southard Road	Howell Twp	6.70	Fair
79	POND6	6/11/10	Metedeconk River	02040301030050	State Hwy 88	Brick Twp	8.90	Good
82	SA	6/15/10	South Branch Metedeconk River	02040301030050	Chambersbridge Road	Lakewood Twp	8.70	Good
83	SA-DEN	6/15/10	South Branch Metedeconk River	02040301030050	State Hwy 88	Lakewood Twp	9.50	Excellent
72	SB1	6/8/10	South Branch Metedeconk River	02040301030050	State Hwy 88	Lakewood Twp	7.80	Good
48	SC	5/19/10	South Branch Metedeconk River	02040301030050	Clover Street	Lakewood Twp	6.90	Fair
47	SD	5/17/10	South Branch Metedeconk River	02040301030050	Cedar Bridge Avenue	Lakewood Twp	8.20	Good
1	SE	3/8/10	South Branch Metedeconk River	02040301030040, 02040301030050	Route 9	Lakewood Twp	6.90	Fair
46	SE-P	5/17/10	Unnamed	02040301030050	Pine Street	Lakewood	4.00	Poor

			tributary to South Branch Metedeconk River			Twp		
45	SF	5/17/10	South Branch Metedeconk River	02040301030040	Sunset Road	Lakewood Twp	7.10	Fair
42	SG	5/11/10	South Branch Metedeconk River	02040301030040	Hope Chapel Road	Lakewood Twp	7.60	Good
18	SH	4/11/10	South Branch Metedeconk River	02040301030040	Brewers Bridge Road	Jackson Twp	8.40	Good
58	SH-1	5/26/10	Schoolhouse Branch	02040301020050	State Hwy 88	Lakewood Twp	4.90	Poor
57	SH-3	5/25/10	Schoolhouse Branch	02040301020050	State Hwy 88	Lakewood Twp	4.70	Poor
14	SHB1	4/1/10	Sandyhill Brook	02040301020040	Lakewood-Allenwood Road	Howell Twp	6.60	Fair
15	SHB2	4/7/10	Sandy hill Brook	02040301020040	Cascades Avenue	Howell Twp	5.20	Poor
39	SI	5/10/10	South Branch Metedeconk River	02040301030030, 02040301030040	Bennetts Mills Road	Jackson Twp	7.60	Good
37	SJ	5/5/10	South Branch Metedeconk River	02040301030030	Cooks Bridge Road	Jackson Twp	7.50	Good
26	SK	4/20/10	South Branch Metedeconk River	02040301030020	Jackson Mills Road	Jackson Twp	6.70	Fair
24	SL	4/19/10	South Branch Metedeconk River	02040301030010, 02040301030020	Cedar Swamp Road (Rt. 527)	Jackson Twp	7.80	Good
23	SM	4/19/10	South Branch Metedecon River	02040301030010	Diamond Road	Jackson Twp	7.70	Good
16	SPC1	4/10/10	Sparrow Creek	02040301020030	Taunton Drive	Howell Twp	3.20	Poor
6	STM1	3/19/10	Plover Brook (Toad Creek)	02040301020020	Stanley Blvd & Route 9	Howell Twp	6.30	Fair
10	TKL1	4/3/10	Tarklin Brook	02040301020040	Lakewood-Farmingdale Road	Howell Twp	5.00	Poor
55	TM-8	5/24/10	Sweetgum Brook (Titmouse Brook)	02040301020020	Route 9	Howell Twp	6.30	Fair
36	TR10-1	5/4/10	Unnamed tributary to South Branch Metedeconk River	02040301030020	W. County Line Road (Rt. 526)	Jackson Twp	7.90	Good
74	TR1-2	6/9/10	Unnamed tributary to South Branch Metedeconk River	02040301020050	Lanes Mill Road	Brick Twp	4.10	Poor
34	TR12-1	5/3/10	Unnamed tributary to South Branch Metedeconk River	02040301030030	W. County Line Road	Jackson Twp	6.80	Fair
31	TR12-2	4/27/10	Unnamed tributary to South Branch	02040301030030	Hyson Road	Jackson Twp	7.30	Fair

			Metedeconk River					
30	TR13-1	4/21/10	Unnamed tributary to South Branch Metedeconk River	02040301030030	W. County Line Road (Rt. 526)	Jackson Twp	6.50	Fair
29	TR13-2	4/21/10	Unnamed tributary to South Branch Metedeconk River	02040301030030	W. County Line Road (Rt. 526)	Jackson Twp	6.90	Fair
28	TR13-3	4/21/10	Unnamed tributary to South Branch Metedeconk River	02040301030030	Bartley Road	Jackson Twp	6.30	Fair
32	TR13-5	4/28/10	Unnamed tributary to South Branch Metedeconk River	02040301030030	Picadilly Drive	Jackson Twp	8.30	Good
38	TR14-1	5/8/10	Unnamed tributary to South Branch Metedeconk River	02040301030030	W. County Line Road (Rt. 526)	Jackson Twp	6.30	Fair
40	TR15-1	5/10/10	Unnamed tributary to South Branch Metedeconk River	02040301030040	W. County Line Road (Rt. 526)	Jackson Twp	6.00	Poor
17	TR16-1	4/11/10	Clear Stream	02040301030040	Brewers Bridge Road	Jackson Twp	6.50	Fair
41	TR17-1	5/11/10	Unnamed tributary to South Branch Metedeconk River	02040301030040	Iroquois Place	Jackson Twp	6.40	Fair
43	TR21-2	5/12/10	Unnamed tributary to South Branch Metedeconk River	02040301030040	South Lake Drive	Lakewood Twp	3.60	Poor
67	TR23-1	6/3/10	Unnamed tributary to North Branch Metedeconk River	02040301020020	Forest Drive	Jackson Twp	7.10	Fair
35	TR26-1	5/4/10	Unnamed tributary to South Branch Metedeconk River	02040301030020	Eltone Road	Jackson Twp	7.80	Good
25	TR27-2	4/20/10	Unnamed tributary to South Branch Metedeconk River	02040301030020	Jackson Mills Road	Jackson Twp	8.60	Good
54	TR4-1	5/22/10	Unnamed tributary to South Branch Metedeconk River	02040301030050	Swarthmore Avenue	Lakewood Twp	5.30	Poor
65	TR7-1	6/2/10	Unnamed	02040301030030	W. Commodore	Jackson	7.70	Good

			tributary to South Branch Metedeconk River		Blvd (Rt. 526)	Twp		
5	TUR2	3/19/10	Turtle Creek	02040301020010	Route 9	Howell Twp	4.60	Poor
27	WP1	4/17/10	Watering Place Brook	02040301030040	Glen Avenue South	Lakewood Twp	7.90	Good
80	WP3	6/14/10	Watering Place Brook	02040301030040	Regend Drive	Lakewood Twp	7.30	Fair

Table 5 - Potential Restoration Opportunities Identified from the Stream Visual Assessments

Segment ID	Direct Stormwater Discharge(s)	Stormwater BMP'S incl. onsite stormwater mgt. (e.g. rain gardens, etc.)	Storm Outfall Stabilization, Infrastructure Maintenance or Other Repair	Basin Retrofit or Maintenance	Storm Inlet Upgrade - Floatables Control	Streambank Restoration	Riparian Buffer Restoration	Agricultural BMP's	Nearby Landuse Issue	Lake/Lakeshore Management or Restoration	Waterfowl Control	Trash and/or dumping	Notes
CB1	X	X	X	X		X	X		X				Stormwater BMP's could address parking lot runoff; road drainage cut may need stabilization; agricultural BMP's may be applicable to nursery immediately upstream; possible retrofit of basin upstream of reach; possible riparian buffer restoration; reach may be impacted by upstream land use (stockpiles at stone supplier)
CB5	X	X			X		X					X	Stormwater BMP's could reduce NPS/runoff volumes; possible riparian buffer restoration along portion of reach; lots of garbage/debris along reach; NJPDES discharge upstream
CBB-1	X	X	X	X	X	X	X		X			X	Stormwater BMP's would reduce NPS/runoff volumes from large commercial area; some storm infrastructure requires maintenance; basins are possible candidates for retrofit; opportunity for restoration of unstable banks; some potential for riparian buffer restoration along portion of reach; lots of garbage/debris; poor housekeeping behind shopping center to north; illicit dumping of cooking grease discovered and reported; old landfill exists along reach
CBB-3	X	X	X		X							X	Stormwater BMP's would reduce NPS/runoff volumes from large commercial area; some storm infrastructure requires maintenance; floatable garbage/debris; much of the reach is culvert
CBB-5	X	X		X									There are stormwater discharges both upstream and downstream of the reach; area around reach is part of Lakewood Industrial Park and has lots of impervious cover - there are opportunities for stormwater BMP's and basin retrofits to address NPS pollution and runoff volumes along reach and throughout the general area
CP-3	X	X	X		X	X	X				X		Potential for BMP's incl. on-site stormwater management along reach and in lake drainage area to reduce stormwater flows; erosion at lake culvert manhole and storm outfall; restoration to address streambank erosion and reestablishment of riparian area would be beneficial; lots of waterfowl
CTB-1	X												Stream reach passes through east side of Lake Shenandoah Park; Lakewood Township's new DPW complex is near reach and includes covered salt storage areas and a contained truck wash; a former NJDEP known contaminated site is located upstream
CTB-2													Reach has undergone considerable channel alteration along Cedarbridge Road
CVS-1	X	X	X		X		X				X	X	Stormwater BMP's could reduce NPS/runoff volumes from apartment complex; silted-in storm outfall; potential for larger riparian area, particularly at east end of reach; lots of waterfowl (geese); dumping of apartment complex yard waste and trash/debris (bikes, toys, shopping carts, etc.) prevalent along entire reach; pond with thick blue-green algae scum (indicative of nutrient loading?); JCP&L lines along right bank
DB1	X	X	X		X		X	X					Road runoff could be redirected or channeled to a simple BMP to eliminate direct stormwater discharges; runoff is causing erosion and undermining a section of road; an herb farm is located adjacent to stream to the north - potential for agricultural BMP's and expansion of riparian corridor along this property
DB5	X	X			X								Reach receives runoff from Rt. 9 and an auto sales/service business - potential for stormwater BMP's to reduce NPS/runoff volumes
GH1	X	X	X	X	X	X	X				X	X	Stormwater BMP's would reduce NPS/runoff volumes from upstream residential development (appears that a nice constructed wetland handles a portion of neighborhood already); basin/structures north of reach in disrepair - good opportunity for retrofit; streambank exhibits erosion from heavy stormwater flows - would benefit from restoration; possible opportunity to restore significant riparian buffer area; evidence of numerous waterfowl in field; small man-made pond along reach with inlet/outlet; Howell fire department property
GR2	X	X		X	X	X						X	Stormwater likely accounts for majority of streamflow (developed headwater area) - BMP's would address NPS/runoff volumes from upstream residential development; some basins in the area may be good candidates for retrofit; reach is braided and swampy (possible restoration or converstion to stormwater BMP?); yard waste being dumped at beginning of reach
GR4	X	X	X	X	X								Retrofit of basins on either side of reach with stormwater BMP's would be beneficial for addressing NPS loading; siltation evident at basin outfall(s); some algae present near basin outfalls (indicative of nutrient loading from residential development?)
HS6	X	X		X	X							X	Stormwater BMP's incl. on-site stormwater management would reduce NPS/runoff volumes from adjacent and upstream residential development; basin retrofits in upstream areas are a possibility; some trash and large debris along reach

MF1	X	X	X		X	X	X	X				X	Opportunity for BMP's to address direct stormwater discharges; storm outfalls/drainage ditches are extremely silted-in and require maintenance; a deteriorating wooden bulkhead exists at beginning of reach - could be removed and streambank restored; reach is in an agricultural area - agricultural BMP's may be beneficial; potentially some opportunity to expand/restore riparian buffer along and upstream of reach; an old dump area was documented near the beginning of the reach; a 36'' concrete outfall of unknown origin exists just downstream of the the roadway
MF2	X	X					X	X					Opportunity for small stormwater BMP at drainage ditch along roadway; limited vegetated buffers on upstream side of road - potential site for riparian buffer restoration/expansion; some agriculture in the vicinity - agricultural BMP's may be beneficial; reach is adjacent WDI Landfill
MF3							X	X					Potential to increase riparian buffer area; a farm with grazing livestock exists next to reach - agricultural BMP's may be beneficial
NA	X	X	X		X								Possibility of BMP's to address direct storm water discharges at reach as well as upstream at GSP crossing; storm outfall on east side of river runs turbid during rain events - inspection would be prudent to ensure no repairs are necessary
NB	X	X			X								Opportunity for BMP's to address direct stormwater discharges and potentially at apartment complex just east of the reach
NBC													Relatively good quality reach located at old road crossing (Burnt Tavern Rd) near Ocean County garage/public works facility
NC	X	X			X			X					Potential for BMP to address direct stormwater discharge; some agriculture in vicinity of reach - agricultural BMP's may be beneficial
ND													Popular trout fishing location; it appears efforts have been made to stabilize road drainage cuts/ditches and reduce erosion potential
NE	X	X			X		X						Potential for BMP's to address direct stormwater discharge(s); an auto salvage yard (NJDEP KCSL) is located on south side of reach - good opportunity to restore riparian where this property borders river
NF	X	X			X		X		X			X	Stormwater BMP's could reduce NPS/runoff volumes from Route 9 and commercial areas/parking lots; potential for restoration of riparian corridor (unused parking lot and lawn area); restaurant upstream site of Rt 9 on right bank is dumping bamboo and has installed makeshift roof and parking lot drains to the river; JCP&L lines above reach
NF14	X	X			X		X				X	X	Stormwater BMP's could reduce NPS/runoff volumes from parking lot and apartment complex, and possibly larger drainage area contributing to major storm outfall; potential for restoration of riparian corridor (unused parking lot and lawn area); numerous waterfowl; illicit connections to storm outfall suspected
NG	X	X						X			X	X	Potential for BMP to address direct stormwater discharge; some agriculture in vicinity of reach - agricultural BMP's may be beneficial; some waterfowl observed; vegetative debris from clearing of utility power lines easesment has been dumped in stream and along banks; a wooden bulkhead re-routes stream around power lines tower downstream of the road
NH	X	X	X		X			X				X	Potential for BMP to address direct stormwater discharge; concrete bridge shows signs of deterioration and may need repair; some agriculture in vicinity of reach - agricultural BMP's may be beneficial; stream reach very turbid during assessment
NI	X	X	X		X					X	X		Stormwater discharge appears to come from adjacent residential development - BMP's throughout this area may be beneficial to reduce NPS/runoff volume; catch basin in road is almost entirely silted in and needs maintenance; Aldrich Lake is just upstream of reach - lake is shallow (some dredging recently by Howell Twp) and contains lots of aquatic vegetation (eutrophic?) and there may be opportunities for add'l lake/lakeshore management measures; waterfowl were observed
NJ	X	X	X	X	X						X		Potential for BMP to address direct stormwater discharge; erosion from runoff is undermining/cracking road; detention basins on either side of reach may be good retrofit opportunities; a few waterfowl observed
NK	X	X	X					X					Opportunity for small stormwater BMP(s) at drainage ditches along roadway; asphalt drainage ditch breaking apart and in need of maintenance; lots of agriculture in the area - agricultural BMP's may be beneficial; water very turbid; Ritz Farm (NJDEP KCSL) is near reach
NL	X							X					Drainage ditch appears to be grassed swale (recently constructed); considerable agriculture in the vicinity of the reach - agricultural BMP's may be beneficial; bridge reconstruction underway during assessment - good housekeeping and minimal impact to river observed from construction work
NM													Relatively undisturbed headwater area that could be considered a reference reach
NN							X						Camp Nomoco located south of stream; potentially some opportunity to expand riparian buffer near wooden bridge at end of reach
NO													Relatively undisturbed headwater area that could be considered a reference reach
NP									X				A large auto salvage/recycling facility is located near reach - facility has a

													detention basin though probably not a good candidate for retrofit/infiltration due to likelihood of source materials (should have stormwater permit); stream crosses power lines easement upstream of reach
NQ							X			X			Pond at beginning of reach with no vegetated buffer - potential to restore riparian buffer/lake shoreline vegetation
PB2		X	X		X					X	X		Opportunity for stormwater BMP's at Echo Lake Park immediately upstream of reach (e.g. parking areas); bridge bulkhead may need repair; Echo Lake recently dredged - lake shoreline buffer restoration would be beneficial; numerous waterfowl observed
POND6						X	X		X			X	Industrial site (NJDEP KCSL) located adjacent river - evidence of historical filling and dumping along banks; restoration of the streambank and reestablishment of the riparian buffer would be beneficial where river borders this property
SA	X	X	X		X								Stormwater BMP's or treatment would reduce heavy NPS loading from GSP and Chambersbridge Rd; evidence of erosion at outfall(s)
SA-DEN		X							X				Site could be considered "reference reach" due to healthy stream/riparian conditions and minimal disturbance; reach is bordered by Route 88 auto dealership corridor to north and Lakewood Industrial Park to south - large percentage of impervious surfaces in this area presents opportunities for stormwater BMP's; Rt.88 corridor has no sewer service and numerous cases of vehicle washing observed in the parking lots could serve as a significant source of NPS
SB1	X	X								X	X		Stormwater discharges to the lake upstream of the reach may present BMP opportunities; reach located in Lake Shandoah County Park and includes eastern side of lake - nuisance (invasive?) aquatic plant growth was observed (harvested periodically by Ocean County); some waterfowl were observed
SC	X	X	X		X		X			X	X	X	A stormwater BMP and/or stabilization measures would be beneficial for the Clover St. MS4 discharge; smaller BMP's could be employed around the basketball courts and parking lot at Lake Shenandoah County Park (good demonstration/public education site); reach includes western side of Lake Shenandoah - nuisance (invasive?) aquatic plant growth was observed; lakeshore vegetative buffers could potentially be improved; numerous waterfowl; floatables and litter were documented in various drainage ditches/swales; reach is adjacent former Lakewood Coal Gas Plant (NJDEP KCSL)
SD	X	X	X		X								Stormwater BMP's possible to reduce NPS/runoff volumes from impervious surfaces in the area and also at baseball complex; some erosion evident at storm outfall
SE		X			X		X		X	X	X	X	Lakes Carasaljo and Manetta are immediately upstream of reach and share a single spillway; stormwater from Rt.9 and vicinity discharges to the lakes - BMP's along this corridor would reduce NPS/runoff volumes; reach is adjacent former Peterson's Sunset Cabin (NJDEP KCSL) which is undergoing redevelopment - there is evidence of soil erosion from stockpiles next to the river; it may be possible to restore the riparian buffer along the Peterson's site to some extent; there are opportunities for establishment and/or improvement of lakeshore vegetative buffers at Lake Carasaljo; extensive trash and debris is evident along reach, particularly closer to Rt.9 and the RR tracks; lakes are drawn down annually during winter for control of nuisance aquatic plants
SE-P	X	X	X	X	X	X						X	Stormwater BMP's would reduce NPS/runoff volumes from impervious surfaces in the area; heavy sedimentation has greatly reduced capacity of road culvert; detention basins and wet ponds in the area may be candidates for retrofit; stream restoration would be beneficial given high stormwater flows and sedimentation problems; yard waste dumping along reach
SF	X		X		X		X			X			Some erosion evident at outfalls; reach is beginning of Lake Manetta - potential to improve riparian/lakeshore vegetated buffer, particularly at baseball field; a large pipeline from an unknown source (likely NJ-American WTP) discharges to river near end of reach
SG	X	X	X	X	X	X	X						Opportunity for BMP's along reach to address direct stormwater discharges; some erosion at outfalls; basin north of reach is a good candidate for retrofit; potential for streambank and riparian buffer restoration
SH	X	X	X		X								Stormwater BMP's could potentially be installed at this site to address direct stormwater discharges; some erosion/scouring evident at outfalls (significant drop to river); outfalls have constant flow - appear to be intercepting groundwater; heavily visited trout fishing area
SH-1	X	X	X		X							X	Stormwater BMP's could address parking lot runoff; silted-in storm inlet; garbage and debris along reach
SH-3	X	X					X			X	X		Stormwater BMP could be constructed to address parking lot runoff (via drainage ditch); good site for riparian buffer restoration; lake management measures may be beneficial for lake water quality; lots of waterfowl (control?); Ocean County Park - good demonstration/education and outreach site

SHB1							X	X	X				There is potentially some opportunity to improve the riparian buffers in this area; it appears nutrient-laden runoff is entering the stream from the adjacent nursery and causing unusually lush vegetative growth on the bank - agricultural BMP's would be prudent; reach is adjacent WDI Landfill; an artesian well is located at the residence on the left bank
SHB2	X	X		X	X		X					X	Stormwater BMP's possible for sports complex and parking lots as well as throughout residential subdivision; numerous detention basins throughout subdivision would be good candidates for retrofit; possibly some opportunity to expand riparian buffer area; dense algae growth along reach (indicative of nutirent loading?); dump area near reach (appliances; tanks; etc.)
SI	X						X			X	X		Lake Eno is immediately upstream of the reach - there is some opportunity to restore riparian/lakeshore vegetated buffer area along Bennetts Mills Rd; the lake is shallow, appears eutrophic and contains nuisance (likely invasive) aquatic plants - lake management/restoration would be beneficial; numerous waterfowl observed in the lake
SJ	X	X	X	X	X								Stormwater BMP's could potentially address direct stormwater discharges; metal storm outfall pipe is deteriorated; detention basins and wet ponds northwest of reach may present opportunities for retrofit; NJPDES discharge upstream of reach (Fountainhead mobile home park)
SK	X						X			X	X		Jackson Mills Lake is immediately upstream of the reach - there is some opportunity to restore riparian/lakeshore vegetated buffers along Jackson Mills Rd. and E. Commodore Blvd; the lake is shallow, appears eutrophic and contains nuisance (likely invasive) aquatic plants - lake management/restoration would be beneficial; some waterfowl were observed in the lake
SL	X	X	X		X								Stormwater BMP's could potentially address runoff from roadway; erosion is evident at storm outfall and drainage cut from road - stabilization would be beneficial; stream enters Metedeconk National Golf Club at end of reach
SM												X	Remnants from historical dumping was documented near an old building foundation at the beginning of the reach
SPC1	X	X	X		X		X						Stormwater accounts for majority of streamflow (developed headwater area) - BMP at this site would be feasible to help address NPS/runoff volumes from upstream residential development and school; there is an area of erosion behind outfall headwall; no riparian buffer along reach - restoration would be beneficial; site is located at Newbury Elementary School - excellent BMP demonstration site and public education opportunity
STM1	X				X		X					X	Expansion of riparian buffer along baseball field would be beneficial; dumping of yard waste is occuring along stream in sewer easement area; collapse of road around storm grate nearby caused temporary turbidity issue during assessment; heavy petroleum odor observed at downstream side of Rt. 9 culvert (none at upstream side); portion of reach upstream of Rt 9 could serve as reference reach
TKL1	X				X		X	X					Reach passes through farm and feeds irrigation ponds - potential to restore some riparian buffer area; lots of agriculture in the area - agricultural BMP's would likely provide benefits
TM-8	X	X	X	X	X	X						X	Stormwater BMP'S would help reduce flows and treat runoff from adjacent shopping center, Rt.9 and other impervious areas in the vicinity; detention basin and related storm infrastrucure is in poor condition - basin retrofit and streambank restoration (e.g. to address excessive sedimentation) would be beneficial; lots of floatables, trash and debris along reach
TR10-1	X						X	X					The riparian buffer area could potentially be expanded upstream, downstream and along the reach; agricultural BMP's may be beneficial in the vicinity
TR1-2	X	X			X	X							An opportunity exists for stormwater BMP'S to address runoff from the commuter parking lot and other impervious areas in the vicinity; streambank restoration may be beneficial; a chemical odor was observed downstream of the road - NJDEP known contaminated site(s) exist in the vicinity
TR12-1	X		X	X	X		X						Excessive sedimentation is evident at storm outfall; detention basins on either side of the reach may be good candidates for retrofit, particularly shopping center to the east (public visibility along County Line Rd);
TR12-2		X		X								X	A simple stormwater BMP could be installed at the drainage cut from the roadway; there are several detention basins in the vicinity of the reach that would be good candidates for retrofit; dumping of yard waste and other materials (scrap metal)
TR13-1	X			X		X	X						Several detention basins upstream of the reach may be good candidates for retrofit; restoration activities could be undertaken downstream of County Line Rd to address channel erosion and eliminate wooden and block bulkheads; there may be some opportunity to expand the riparian buffer area upstream of the reach; stream merges with same reach as TR13-2 - both share reach endpoints; Powers Farm (NJDEP KCSL) is located upstream of this reach
TR13-2	X			X			X					X	Detention basins upstream of the reach may be good candidates for retrofit, particularly one associated with a large shopping center to the west; there may be some opportunity to expand the riparian buffer area upstream of the

													reach; dumping of foam insulation was documented; stream merges with same reach as TR13-1 - both share reach endpoints; Powers Farm (NJDEP KCSL) is located upstream of this reach
TR13-3	X			X	X								Detention basins in the vicinity present opportunities for retrofit
TR13-5				X	X		X						Two large detention basins are located downstream of the reach on either side and handle runoff from the surrounding residential development - may be good candidates for retrofit, which may also serve to expand the riparian buffer area
TR14-1	X			X								X	The detention basin northwest of the reach is a good candidate for retrofit (public visibility along County Line Rd); dumping of leaves and building materials was documented
TR15-1	X	X	X	X	X	X						X	Potentially some opportunity for installation of stormwater BMP's to address direct storm discharge(s); some erosion evident at outfalls; detention basins in the vicinity present good opportunities for retrofits (public visibility along County Line Rd); portion of reach would benefit from restoration to address active erosion problems; lots of floatables, trash and large debris (e.g. shopping carts, tires)
TR16-1	X	X			X							X	Stormwater BMP's could potentially be installed at this site to address direct stormwater discharge; dumping of yard waste into stream near culvert
TR17-1	X		X		X	X					X	X	Erosion at storm outfall - stabilization may be beneficial; possibility for restoration of the streambank to address erosion along the reach downstream of the lake; waterfowl observed at lake upstream of reach; dumping of leaves and building materials
TR21-2	X	X			X	X	X			X	X		Potential for BMP's incl. on-site stormwater management along reach; restoration to address streambank erosion and reestablishment of riparian area would be beneficial; pond management may improve water quality; lots of waterfowl
TR23-1	X	X	X		X		X					X	A stormwater BMP is possible at Woodland Park to treat runoff from residential development discharged to river via storm outfall; storm outfall has left deep scour hole - stabilization may be helpful; potential for expansion/restoration of riparian area beneath power lines; vegetation cleared by power utility along easement is being discarding in stream
TR26-1				X									Possible opportunity to retrofit basins in the vicinity, particularly the detention basin east of the reach between Eltone Rd and I-195
TR27-2				X			X						A basin has been constructed near reach with future development pending (soccer complex?) - basin is possible candidate for retrofit; potential opportunity to restore/expand riparian buffer area
TR4-1	X	X		X	X								Reach passes through Lakewood Industrial Park and has undergone significant alteration ("hardening"); stormwater BMP's to address runoff from impervious surfaces throughout park would be beneficial; numerous basins and wetponds in the area present possible opportunities for retrofit; reach drains to large wet pond prior to discharge to the South Branch
TR7-1			X										Good headwater area reference reach; stream culvert under West Commodore Blvd in need of maintenance/repair; area is part of proposed Mitch Leigh Jackson Mews/Jackson Commons development
TUR2	X	X			X	X	X					X	Opportunity for BMP's to address runoff/NPS from nearby residential and commercial areas; stream crosses field at site of former truck salvage yard (NJDEP KCSL) - possible opportunity for stream and riparian buffer restoration; lots of garbage and floatable debris along reach
WP1													Heavy trash and debris along entire reach; residential development on either side of reach - frequent use of path and makeshift footbridge across stream by pedestrians; reach inadvertently assessed as WP3 - kept data for project as an additional site
WP3													Decent reference reach; Crystal Lake at start of reach - preservation of this headwater area by Lakewood Twp as Crystal Lake Preserve is possible