
Lockatong Creek

Stream Visual Assessment Results and Restoration Plan



**New Jersey Water Supply Authority
Final Report: September 2008**

Acknowledgements

Primary Author:

Kathleen Hale, Principal Watershed Protection Specialist
Watershed Protection Programs, NJ Water Supply Authority

Contributing Author:

Tara Petti, Assistant Watershed Protection Specialist
Watershed Protection Programs, NJ Water Supply Authority

New Jersey Water Supply Authority Commissioners:

Lisa P. Jackson, Chairman
Commissioner, NJ Department of Environmental Protection,
Serves as Chair of the Authority
Gary Sondermeyer, Chief of Staff, NJDEP (Chairman pro tem)
Susan Blew
Donald L. Correll
Shing-Fu Hsueh
Robert J. Iacullo
Louis C. Mai
Steven J. Picco

Executive Director: Henry S. Patterson, III

Director, Watershed Protection Programs:
1999-2007: Daniel J. Van Abs, PhD, PP/AICP

2008 – present: Kenneth H. Klipstein

Introduction

In 2005, the New Jersey Water Supply Authority (NJWSA) received a Section 319(h) Nonpoint Source Grant from the New Jersey Department of Environmental Protection (NJDEP) to develop a watershed restoration plan for the Lockatong Creek and Wickecheoke Creek watersheds. As part of that project, NJWSA performed stream visual assessments within the two watersheds to gain an overall assessment of stream health.

Stream Visual Assessment Protocol (SVAP)

NJWSA used the United States Department of Agriculture – Natural Resources Conservation Service (USDA-NRCS) Stream Visual Assessment Protocol (SVAP) to gather baseline data for this project. The SVAP is used to score a site based on a set of 15 indicators, including:

- Channel condition: Natural vs. altered channel (e.g. channelization; installation of riprap, dikes or levies; or downcutting or incision).
- Hydrologic alteration: Connectivity to the floodplain (e.g., structures or channel incision that limit the stream's access to the floodplain).
- Riparian zone: Stream's buffer area (e.g., a perfect score requires natural vegetation to extend at least two active channel widths on each side of the stream. A lower score, for instance a 5, is given when natural vegetation extends only half the active channel width on each side of the stream).
- Bank stability: Bank condition (banks are either level with the floodplain and stable or are higher and eroding; banks have exposed roots or slope failures present with the reach).
- Water appearance: Water clarity (clear with visible bottom or cloudy/murky).
- Nutrient enrichment: Presence of algae and/or aquatic macrophytes (A stream with a diverse plant community and clear water scores a 10; a stream with greenish water and an overabundance of algae and/or macrophytes scores a 3).
- Barriers to fish movement: Withdrawals, culverts, dams or diversions both up and downstream of the reach. This was particularly important in the project area, as the dam for Spruce Run Reservoir is within approximately three miles of many of the sites.
- Instream fish cover: Available cover types for fish habitat (e.g., woody debris, riffles, pools, and cobble).
- Pools: Abundance and depth of pools within the reach.
- Invertebrate habitat: Number of cover types available as habitat.
- Canopy cover: Coldwater versus warmwater fisheries. The project area is considered a coldwater fishery, thus a reach that is well shaded would score high, whereas a reach that is minimally shaded would score low.
- Manure presence: Evidence of livestock in or near the stream; it was not scored for any of the project sites.
- Salinity: Non-applicable for the project watershed.
- Riffle embeddedness: Embeddedness of cobble or gravel in sediment.
- Macroinvertebrates observed: Type and diversity of species present. A site with a good diversity of pollution intolerant species received a score of 15, while a site dominated by more pollution tolerant organisms might receive a 6. It should be noted that several of the SVAPs were performed during the fall and winter months, which are not ideal months for the observation of macroinvertebrates.

Once the team chose a segment for assessment, the active channel width was measured. A reach that was 12 times the active channel width was then scored from one to 10 (one to 15 for Macroinvertebrates observed and one to five for Manure presence) based on the 15 parameters described above; any parameter that was not applicable to a particular site was not scored. In the project watershed, salinity was determined to be not applicable; manure presence was not identified and thus not scored at any sites. The scores for each parameter were summed and divided by the total number of parameters scored to yield the SVAP score.

The SVAP relies heavily on relative comparison of sites, rather than a rigorous quantitative analysis; it is a screening assessment tool rather than a site-specific monitoring protocol, and therefore is subjective. Each parameter is scored based on the assessor's observations of a particular reach. For this reason, NJWSA ensured consistency of assessors among all of the sites. Two staff members formed the core assessment team; additional team members included other NJWSA staff and the NJDEP Americorps Watershed Ambassador for the Lower Raritan Watershed Management Area.

The SVAP provided a great deal of useful information regarding Lockatong Creek. The shortfall of the protocol is that it fails to provide a mechanism for identifying the cause of identified problems.

Preliminary Visual Assessments

The Raritan Basin Watershed Alliance Road Crossing Protocol, developed by NJWSA, was utilized to collect information on each road crossing within the watershed. The information collected included land use, type of crossing, suitability for stream assessment (with respect to channel size, accessibility and safety) and the need for riparian buffer restoration. Photographs were taken at each crossing.

From that list, NJWSA selected a subset of sites for stream assessment to perform an overall assessment of stream health in the watershed.

Summary of Results

The 22 SVAP locations were chosen based on the preliminary visual assessments, land use patterns (e.g. weirs, development, agriculture), tributary patterns and accessibility. The objective was to collect enough information to assess overall stream health and to identify potential restoration sites. Stream assessment activities conducted by the assessment team identified areas of impaired streams throughout the watershed.

Observed impairments included:

- Destabilization and erosion of stream banks due to high flows;
- Disconnection of the stream from the flood plain due to downcutting of the stream channel;
- Inadequate riparian zones and loss of riparian zones;
- Inadequate instream habitat; and
- Elevated nutrient inputs.

Overall scores ranged from 6.1 (Fair) to 8.5 (Good). No sites scored in the ‘Excellent’ range. The parameters ranged from a low of 1 in the riparian zone category (at two sites) to a high of 10 in the barriers to fish movement, water appearance and invertebrate habitat categories and scores of 9 in several other categories.

Detailed Stream Visual Assessment Results

Figure 1 shows the 22 SVAP locations; the data are summarized in Table 1. It should be noted that when the range of scores for each site is discussed, barriers to fish movement and macroinvertebrates observed were not taken into account. The barriers to fish movement score is generally high (10), unless an obvious barrier was identified. The macroinvertebrates observed parameter is scored on a 0-15 scale, and was not scored for all sites.



SVAP L-5

SVAP # L-5 (8/good) is located on a tributary to the main stem just upstream of Lower Oak Grove Road. The scores for this site were mostly 8 to 10, although a 6 was given for instream fish cover.

The riparian buffer on each bank is minimal, approximately 10 to 25 feet wide and of poor quality. The reach was identified as a good site for **riparian buffer restoration**. The stream banks were two to three feet high, giving the stream access to the floodplain during storm flows. The substrate was dominated by large shale, and some fine sediment was observed. The channel was sinuous with deep pools and in-

stream cover for fish and macroinvertebrates, although few riffles were observed. A small weir was observed in this reach, constructed of rock and geotextile. The weir backed up water slightly; fewer riffles were observed upstream of the weir than downstream. Land use in the vicinity of the reach consisted of residential property and large fields.



SVAP L-6

SVAP # L-6 (6.4/fair) is located on a small tributary just downstream of SVAP #L-5 and Lower Oak Grove Road, between the bridge and the confluence with the mainstem of Locketong Creek. The assessment was performed from the road, as the reach was fenced. The scores for this reach ranged from a 1 for the riparian zone and a 2 for canopy cover to a 9 for channel condition.

The riparian buffer on each side was grass to the top of the banks with a sparse overstory of mature trees and no understory. The stream banks were approximately two feet high and the stream had good floodplain access. Good meanders were

observed. Livestock appeared to have access to the stream, although none were observed at the time of the assessment. The land use on the left bank was residential, and on the right bank was residential and agriculture. The reach was identified as a good site for **riparian buffer restoration** and the **River-Friendly Farm program**.



SVAP I.-13

SVAP # L-13 (7.5/good) is located on the Lockatong Creek mainstem downstream of the Route 12 bridge. The scores at this site ranged from a 5 for instream fish cover to a 9 for several parameters.

The riparian corridor was forested on both sides of the channel, with moderate coverage by invasive species, particularly multi-flora rose. The stream banks were two to four feet high, allowing access to the floodplain during large storm events (three to five year events). Erosion was observed along both banks. The dominant substrate observed was gravel, with some larger

material. Algae and sediment covered a majority of the substrate. The channel was relatively straight with little change in the velocity regime until the end of the survey reach, where meanders and riffles were observed. The land use in the vicinity of this reach was primarily forest.



SVAP L-1

SVAP #L-1 (6.8/fair) is located in Kingwood Park on the upstream side of Union Road on the main stem of Lockatong. The scores for this reach ranged from a 1 for pools and a 3 for instream fish cover to a 9 for water appearance.

The riparian corridor was forested with some disturbance from public access on the park side. The banks were one to three feet in height and some areas of erosion were observed. Access to the floodplain was moderate. The dominant substrate observed was gravel; very little fine sediment or sand was observed. The channel lacked sinuosity and riffle pool morphology. Exposed roots on the banks and mid-channel bar

formation were indicative of active widening and deposition in the reach. The land use in the vicinity of this reach was forest and park land.



SVAP L-2

SVAP # L-2 (7.1/fair) is located downstream of Union Road and SVAP #L-1. The scores for this reach ranged from a 6 for bank stability and pools to a 10 for invertebrate habitat.

The riparian corridor was mainly forested with some open areas associated with residential and agricultural land use. The stream banks were approximately one foot high on the left bank and up to three feet high on the right, giving the stream good access to its floodplain during flow events. Some evidence of erosion existed on the outside of bends.

The substrate was dominated by cobble, as opposed to the gravel substrate observed upstream of the Union Road bridge. The surrounding land use consisted of forest and residential / agricultural fields.



SVAP L-11

SVAP # L-11 (8.1/good) is located on the upstream side of Thatcher Road on the mainstem of Lockatong Creek. The scores for this reach ranged from a 5 for bank stability to a 9 for invertebrate habitat.

The reach was mainly forested with one residential property. The riparian buffer was adequate, although a fair amount of invasive species such as multi-flora rose was present. The banks were two to four feet high, allowing access to the floodplain during larger storm events.

There were areas of active erosion along both banks from high flow events. The substrate composition was dominated by gravel, and some mid-channel bars were present. The reach had a meandering pattern with a riffle and glide sequence, and some pools. The land use in the vicinity of this reach was primarily forest.



SVAP L-12

SVAP # L-12 (8.2/good) is located downstream of Thatcher Road and SVAP #L-11. The scores for this reach ranged from a 5 for pools and a 6 for bank stability to 9 for several parameters.

The riparian corridor was forested with minimal invasive species present in the understory. The banks were two to four feet high, allowing access to the floodplain during larger storm events. There was active erosion along both banks. The substrate was dominated by gravel.

A tributary on the right bank at the end of the reach was an active sediment source. Several abandoned vehicles were observed along the

tributary. The channel was mainly shallow with some riffles and an absence of pools. The land use near this reach included forest.



SVAP L-4

SVAP #L-4 (7.5/Good) is located on the mainstem of the Lockatong, upstream of Barbertown-Point Breeze Road. The scores for this reach ranged from 5 for instream fish cover and pools to 9 for riparian zone, bank stability and water appearance.

The riparian corridor was primarily forested. The banks were approximately two to four feet high, but were in good condition, well vegetated and gently sloped. The channel was relatively straight, but did not appear to have been altered. The reach contained little in-stream habitat diversity, lacking a good pool/riffle structure. Some algae was observed in the channel.

The land uses near this reach include forest and agriculture, which did not appear to be negatively impacting the stream. The nearby agricultural properties could be targeted for the **River-Friendly Farm** program.



SVAP L-3

SVAP # L-3 (8.2/good) is located on the mainstem of the Lockatong, downstream of Barbertown-Point Breeze Road and SVAP L-4.

This reach had good access to the floodplain, and the banks were in average condition, although some exposed tree roots were observed. Exposed roots can be an indicator of erosive flows and channel movement. Some sediment deposition was observed on the inside of slight bends. No significant erosion of the banks was observed. Good riffle and some average pools were observed within the reach. As observed at SVAP #L-3, the reach was relatively straight, but did not

appear to have been altered. The channel narrowed significantly approximately 150 feet below the Barbertown-Point Breeze Road bridge.

The land uses near this reach included forest, a small amount of residential and agriculture. None of these land uses appeared to be negatively impacting the reach.



SVAP L-09

SVAP #L-09 (7.9/Good) is located on a tributary known as Muddy Run, which enters the mainstem Lockatong east of Route 519, between SVAP #L-3 and SVAP #L-17. SVAP #L-09, located upstream of Union Road, was the most upstream of the five assessments performed on Muddy Run. The scores for this reach ranged from a 6 for pools to a 9 for canopy cover.

The banks in this reach were one to three feet in height with some undercutting. The stream had good floodplain access on at least one bank in all areas of the reach. Some erosion of the banks was observed. There was a bankfull bench formed by point bars on some bends. The bench

contained some vegetation, but also appeared to be submerged at times. The riparian corridor was forested and contained some invasive species, including multiflora rose, and the understory was sparse. The sinuosity of this reach was considered good. Land use within the vicinity of the reach was primarily forest and one residential property.



SVAP L-10

SVAP #L-10 (8.1/Good) is located on Muddy Run, downstream of Union Road. Two tributaries entered this reach of Muddy Run, one on the left bank approximately 150 feet downstream of Union Road and the second also on the left bank farther downstream. The first tributary was undercut and incised, while the second appeared to be in good condition. The scores for this reach ranged from a 6 for pools and a 6.5 for riparian zone to a 9 for water appearance and nutrient enrichment.

The reach exhibited banks of one to three feet with average flood plain access. The riparian corridor was primarily forested on the left bank, and some areas on the right bank were forested. The area adjacent to the agricultural property on the right bank was a potential **riparian buffer improvement site**.

The land use in the vicinity of this reach included forest, agriculture and residential. The agricultural use on the right bank included houses, barns, a meadow area and pasture containing horses. A fence was present along the stream, there was no apparent animal access to the stream and no apparent manure impact to the stream. The property could be targeted for the **River-Friendly Farm** program.



SVAP L-07

SVAP #L-07 (7.3/Fair) was located on the upstream side of Muddy Run Road on Muddy Run. The scores for this reach ranged from 6 for several parameters, including bank stability, to 8 for other parameters.

The banks in this reach were three to four feet in height with some erosion. The stream's floodplain access was poor. This reach was relatively straight, and the dominant substrate was mixed, including cobble, shale and a small amount of sand. The sinuosity improved farther upstream. A few good riffles were observed, but the majority of the reach was flat water. The riparian corridor was adequate within the reach; upstream of the reach, a residential yard was a recommended **riparian buffer improvement site**. A drain was also observed from beneath the yard, and was likely yard drainage. A road ditch was present on the left bank, and created a scour hole where it entered the stream. The land use in the vicinity of this reach was primarily forested, with a few residential properties.



SVAP L-08

SVAP #L-08 (6.1/Fair) is located downstream of Muddy Run Road on Muddy Run. The scores for this reach ranged from a 1 for riparian zone to 8 for channel condition, hydrologic alteration and bank stability.

The banks in this reach were low and not well defined. The edges were marshy. Good floodplain access existed in this reach. The dominant substrate was gravel and fine sediment. This reach was fairly straight, with minimal fish or macroinvertebrate habitat. The land use in this reach included an agricultural field on the left bank, that appeared to be mowed, and a pasture containing horses on the right bank. The horses

did not have access to the stream, and there was no direct evidence of manure runoff into the reach. Approximately 30 to 40 feet of mowed grass existed between the pasture fence and the stream.

This site is a candidate for **riparian buffer improvement** and for the **River-Friendly Farm** program. Due to the plant communities present, the improvement could be as simple as establishing no-mow corridors. Agricultural best management practices should be considered for the adjacent property. The riparian zone and canopy cover scores were the primary reasons for the very low SVAP score of this reach.



SVAP L-20

SVAP #L-20 (7.7/Good) is located downstream of Muddy Run Road, on Muddy Run. This reach is downstream of SVAP #L-08 and continues to the confluence of Muddy Run with the mainstem Locketong Creek. The scores for this reach ranged from 5 for bank stability to 9 for riparian zone.

This reach exhibited banks much higher than those observed upstream, adjacent to Muddy Run Road at SVAP #L-08. The floodplain access was poor in this reach. The banks were eroded in several areas. The sinuosity in this reach was considered good. The dominant substrate was gravel and larger shale; there were areas of fine

sediment deposition. Average riffles were observed, and some point bars had formed. The reach was overwidened, due to the excessive quantity and velocity of water moving through the reach. There was also evidence of ATV traffic through the stream channel.

Land use in the vicinity of this reach was primarily forest; the reach is downstream of an

agricultural property (see SVAP #L-08). The use of ATVs in the stream should be addressed. The reach could be considered for **structural bank stabilization**, such as reconnection with the floodplain, if the cause of the stream incision is addressed. Without addressing the cause of the incision, any structural stabilization will fail.



SVAP L-17

SVAP #L-17 (7.8/Good) was located on the upstream side of Route 519, slightly west of Byram-Kingwood Road. The stream flows quite close to Route 519 in the more downstream portion of the reach. The scores for this reach ranged from 6 for pools, water appearance and nutrient enrichment to 9 for invertebrate habitat and canopy cover.

The banks were one to four feet in height, and the stream's access to the floodplain was better in the downstream part of the reach. Slight to moderate bank erosion was observed, but not at a level that was considered a problem. This reach was relatively straight, movement is constrained by

the nearby road. The water was slightly murky; significant rain fell a few days prior to the SVAP. The channel bed exhibited a great deal of topographic variation. A few good riffles were observed, but the spacing in between the riffles was very long. A few average pools were also observed. Some deposits of sand, perhaps from road runoff, were observed. A tributary was observed on the left bank near the downstream end of the reach and a drainage swale from the road was observed mid-reach (right bank).

The land uses near this reach include forest, roadway, agriculture and residential; with the exception of the road, none appeared to be negatively impacting the reach.



SVAP L-16

SVAP #L-16 (7.9/Good) is located on a small tributary to Lockatong Creek, upstream of Byram-Kingwood Road. This tributary enters the left bank of the mainstem, west of Route 519. The scores for this reach ranged from 7 for bank stability, water appearance and nutrient enrichment to 9 for riparian zone and invertebrate habitat. Despite the high quality riparian habitat, the site received a very low score for observed macroinvertebrates.

The riparian corridor was primarily forested, including a forest stewardship area on the left bank. Some fields were observed set back from the stream somewhat. The right bank near the road crossing is a potential target for **riparian buffer improvement**. The banks varied in height from less than one foot to three feet. The stream had access to the floodplain on at least one side of the channel in all areas. It appeared that the stream overtops the bank occasionally, but there is room for water to dissipate energy and sediment. The dominant substrate was cobble and larger material, with some bedrock. The reach contained a few good meanders, and the sinuosity through the reach was average. Many downed trees were observed, along with some areas of erosion.

The stream appears to experience high flows, which could account for the low macroinvertebrate score. Some fine sediment deposition was observed, primarily on point bars and in meanders. The rocks were somewhat slimy and green, indicating potential nutrient enrichment. The water was slightly murky, but heavy rain fell the day prior to the assessment, which also could contribute to the low macroinvertebrate score. Road ditches were present on both banks. This reach looks ‘messy’ or problematic in the photographs, but the assessment indicated that it was actually in reasonable condition.



SVAP L-22

SVAP #L-22 (8.0/Good) is located on a small tributary that enters the right bank of the mainstem Lockatong Creek west of Route 519. The SVAP site was located upstream of Federal Twist Road. This tributary had less flow than some other areas that were assessed, the assessors anticipated that this reach is dry much of the year. The scores for this reach ranged from 6 for instream fish cover and pools to 8 for several parameters.

The banks were mostly low, with a few higher points. The stream had good floodplain access. The reach contained decent riffles, but no significant pools were observed. One area of

severe erosion was observed. It appeared as if lawn debris was dumped in a drainage swale or headcut on the left bank. The riparian corridor was primarily forested; there is an area upstream of the reach where a residential yard is relatively close to the stream. Ditches were observed on both banks of the stream at the road crossing; these ditches were sources of sediment to the stream. Some rip rap was placed on the left bank at the road crossing.

The land use in the vicinity of this reach included forest and residential. An agricultural property was present downstream where livestock potentially had access to the stream. That property should be targeted for the **River-Friendly Farm** program.



SVAP L-21

SVAP #L-21 (8.5/Good) is located on a small tributary that enters the right bank of the mainstem Lockatong Creek west of Route 519, downstream of the #L-22 tributary. This site was located downstream of Federal Twist Road.

The banks were relatively low in this reach and the stream had good access to the floodplain. The channel did not contain much water, the reach likely goes dry for much of the year. The reach contained good meanders and riffles and adequate pools. The assessed reach contained a fair amount of algae, but this was not present downstream of the assessed reach. Water appears

to move quickly through this reach during storm events. Some trees have fallen in the stream and some areas were undercut. The dominant substrate in this reach was shale, with some fine sediment deposits.

The land use adjacent to this reach included forest, field and one residential property. The landowner planted many new trees on the right bank and was planting on the left bank in April

2008. This reach could be a target for **riparian buffer improvement** to complement what the landowner has already accomplished. A large amount of multi-flora rose was observed in the riparian corridor.



SVAP L-18

SVAP #L-18 (7.7/Good) is located downstream of Milltown Road on the mainstem of the Lockatong. The scores for this reach ranged from a 6 for pools to 9 for several parameters.

The riparian corridor was forested on both sides of this reach. The left bank was somewhat high, but the right bank was low with good floodplain access. Although the channel was not very sinuous, water was moving within the channel in a meandering pattern. The dominant substrate was cobble and boulder. A pond was present upstream of Milltown Road, and is at a much higher elevation than the stream channel. It is likely that the channel incised when the pond was

built; the road and dam act as a boundary feature for the incision. The stream had a moderate gradient with good riffles and few pools. The channel appeared to be stable.

The channel split after the end of the assessed reach; a large island that appeared to have been in existence for many years was between the channels, which rejoined downstream of the island. The right channel appeared to be the main channel. Two rocky swales were present on the island, and water appeared to flow over the island at higher flows. The highest point of the island was approximately four to six feet above the bed of the stream channel.

The land use in the vicinity of the reach was primarily forested. A state wildlife management area was present on the right bank. Milltown Road was present on the right bank, but was an adequate distance from the stream.



SVAP L-19

SVAP #L-19 (7.8/Good) is located downstream of Strimples Mill Road on the mainstem of the Lockatong. The scores for this reach ranged from 7 for instream fish cover and canopy cover to 9 for riparian zone.

The left bank contained a steep, natural slope, the right bank was one to three feet in height. The riparian buffer was forested on each side of the stream. Although this reach exhibited good riffles and pools, it was not very sinuous. The water was slightly murky, but was clear in still areas. Significant rain fell a few days prior to the assessment. The channel was slightly incised, as evidenced by exposed tree roots above the water

elevation. The banks were very rocky and in good condition, with no erosion observed. The rocks had a slight coat of fine sediment. A drainage swale was present on the left bank near the downstream end of the reach.

Although the riparian corridor of the assessed reach consisted of forest, upstream of Strimples Mill Road the land use included an old saw mill, an autobody shop/junkyard and pasture containing a few sheep. Peacocks were also observed near the reach.



SVAP L-14

SVAP #L-14 (7.4/Fair) is adjacent to the Wescott Preserve, adjacent to Raven Rock Road. The Preserve is owned by Hunterdon County. The scores for this reach ranged from 6 for nutrient enrichment and instream fish cover to 9 for water appearance.

The riparian corridor was primarily forested, with one residential property present in the upstream portion of the reach. This reach was very rocky, the channel bed was bedrock in some areas. The left bank by the Wescott Preserve was a very high, bedrock cliff. The right bank in this area was approximately seven feet in height. The banks were lower upstream and downstream

where the bedrock cliff was not a boundary condition and the stream can move. Despite the high banks, the stream appeared to be in a stable condition. Good riffles and some deep pools were observed, and the sinuosity was average. Rocky point bars were observed. Many exposed tree roots were observed, but the banks were protected from erosion by rocks.

Several small drainages and overland flow originated in the Wescott Preserve and a tributary (mapped) entered the left bank mid-reach. The water was clear, but the rocks were slimy and green. The residential area on the left bank in the upstream section of the reach should be targeted for a **riparian buffer improvement** effort, as lawn area was present adjacent to the stream.



SVAP L-15

SVAP #L-15 (7.6/Fair) is located upstream of Raven Rock-Rosemont Road. The scores for this reach ranged from 7 for instream fish cover and pools to 9 for riparian zone and water appearance.

The banks were higher nearer to the road crossing, but were mostly low with moderate floodplain access. The stream had access to floodplain areas on at least one bank throughout the reach. The stream had room to move within the floodplain. Prominent rock point bars were observed, and some sand deposition was present on the bars. Good riffles and a few good pools were observed. There were some fallen trees in the reach, and the banks were undercut in some

areas, more prominently toward the road crossing. The reach exhibited good sinuosity and was very rocky. The land use in the vicinity of this reach included forest, semi-wild preserve and one residential property. The residential property contained lawn area near the stream, which could be targeted for a **riparian buffer improvement** project.

Recommendations

As detailed in Figure 2 and Table 2, 40 sites were identified for riparian buffer restoration, nine properties were recommended for the River-Friendly Farm program, and one site was recommended for structural stabilization. The recommendations were developed based on the road crossing inventory, stream visual assessments and review of aerial photographs.

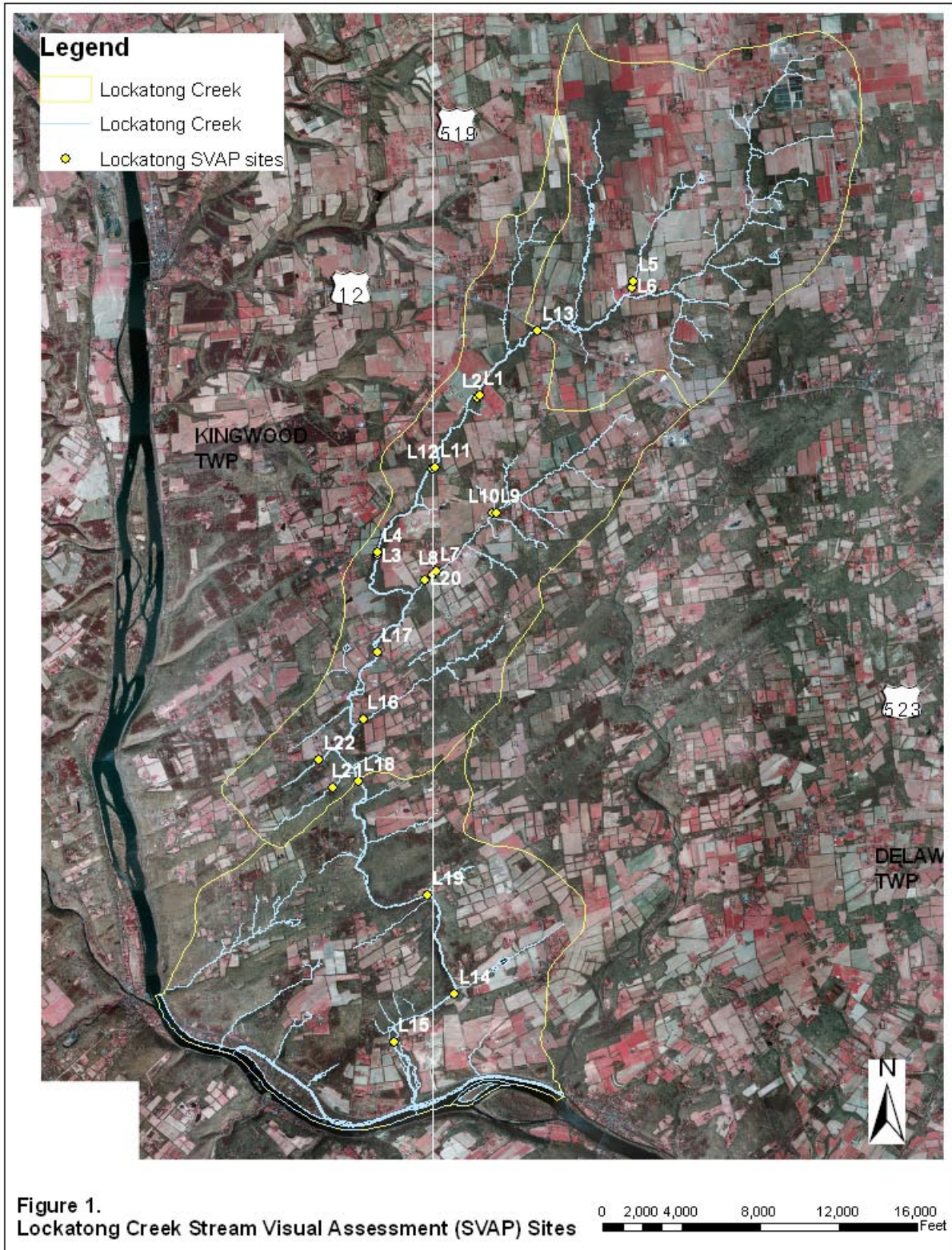
Riparian buffer restoration includes forest and herbaceous plantings. A cost estimate was prepared for each recommended site. For riparian buffer restoration cost estimates, the target buffer was 20 feet on each side of the stream. Approximately 62,300 linear feet of riparian buffer restoration was recommended, for a total of 30 acres of riparian buffer restoration. In some areas, the actual buffer that can be achieved may be less than 20 feet, in other areas it will be much greater. The estimated cost per acre for materials was \$3,000, plus staff time for an estimated total cost of \$113,000. Each site can be implemented independently of the others; however, cost savings will be achieved when multiple sites are completed in a single season due to the benefit of ordering plant materials in bulk. For each site, NJWSA recommends developing a planting plan prior to restoration. Potential funding sources include the Section 319(h) Nonpoint Source grant program, various programs led by the Natural Resources Conservation Service (NRCS, e.g. Conservation Reserve Enhancement Program, Conservation Reserve Program, Wildlife Habitat Incentives Program) and other similar programs.

Nine sites were recommended for the River-Friendly Farm program, based on the SVAP and road crossing inventory (Table 3 and Figure 3). There are many additional agricultural properties in the watershed; however NJWSA estimated that an additional 15 farms, for a total of 24 participants within the watershed, is a feasible target.

This program is administered by North Jersey Resource Conservation & Development Council (RC&D), the Raritan Watershed Agricultural Committee and NJWSA. The program is currently implemented throughout much of Hunterdon County, although the target areas are the Mulhockaway Creek Watershed, Spruce Run Watershed, South Branch Raritan Watershed and Neshanic River Watershed. An agricultural outreach specialist from North Jersey RC&D performs a review of the farm's management activities, in particular soil loss management, nutrient management, pest management, riparian buffer management and irrigation water management. If the farm meets the criteria, it is certified River-Friendly. If the farm does not meet the criteria, the agricultural outreach specialist works with the farmer and with a conservation planner from NRCS to develop a conservation plan so that the farm can meet the River-Friendly criteria and to identify potential cost-share programs. The estimated cost to implement the River-Friendly Farm program in the Lockatong Watershed is \$38,200 (Table 4), assuming extension of the existing program to this watershed. This estimate does not include implementation of conservation practices that may be needed for the farms to meet the River-Friendly criteria.

Structural stabilization was recommended at one site on Muddy Run Road (SVAP #L-20). This reach exhibited poor floodplain access, eroded banks and overwidening. Structural stabilization could include installation of structures such as vanes, J-hooks or barbs constructed of rock or

wood. Depending on the extent of the restoration needed, such projects may cost from \$25,000 to \$500,000 for construction.



**Table 1.
Lockatong Creek Stream Visual Assessment Scores**

SVAP #	L-1	L-2	L-3	L-4	L-5	L-6	L-7
Location	US Side Union Road, Kingwood Park	DS of Union Road	Barbertown- Point Breeze Road			DS	
<i>Assessment Scores:</i>							
Channel condition	8	8	8	8	8	9	7
Hydrologic alteration	7	7	8	8	8	7	7
Riparian zone	7	8	8	9	8	1	8
Bank stability	6	6	8	9	7	7	6
Water appearance	9	8	8	9	8	8	8
Nutrient enrichment	7	7	7	6	8	7	8
Barriers to fish movement	10	10	10	10	10	10	10
Instream fish cover	3	7	7	5	6	na	6
Pools	1	6	6	5	8	na	6
Invertebrate habitat	5	10	10	7	10	na	8
Canopy cover (if applicable)	8	7	8	7	7	2	6
Manure presence (if applicable)	na	na	na	na	na	na	na
Salinity (if applicable)	na	na	na	na	na	na	na
Riffle embeddedness (if applicable)	7	8	8	7	8	na	7
Macroinvertebrates observed (optional)	10	na	10	na	na	na	na
Overall Score (Total divided by number scored) Poor = <6.0; Fair = 6.1 - 7.4; Good = 7.5 - 8.9; Excellent = >9.0	6.8	7.1	8.2	7.5	8.0	6.4	7.3

**Table 1.
Lockatong Creek Stream Visual Assessment Scores (continued)**

SVAP #	L-8	L-9	L-10	L-11	L-12	L-13	L-14
Location	DS of Muddy Run Road	US of Union Road	Ds of Union Road	US of Thatcher Road	DS of Thatcher Road	DS of Fitzer/Old Rt 12	Wescott Preserve
<i>Assessment Scores:</i>							
Channel condition	8	8	8	6	8	8	8
Hydrologic alteration	8	8	8	7	8	7	7
Riparian zone	1	8	6.5	8	9	9	7
Bank stability	8	7	7	5	6	6	7
Water appearance	7	8	9	8	10	9	9
Nutrient enrichment	5	8	9	na	9	7	6
Barriers to fish movement	10	10	10	10	10	10	3
Instream fish cover	6	7	8	8	7	5	6
Pools	7	6	6	7	5	6	8
Invertebrate habitat	7	7	10	9	9	8	7
Canopy cover (if applicable)	1	9	8	8	9	9	8
Manure presence (if applicable)	na	na	na	na	na	na	na
Salinity (if applicable)	na	na	na	na	na	na	na
Riffle embeddedness (if applicable)	5	8	8	na	8	7	8
Macroinvertebrates observed (optional)	6	9	na	13	na	7	12
Overall Score (Total divided by number scored) Poor = <6.0; Fair = 6.1 - 7.4; Good = 7.5 - 8.9; Excellent = >9.0	6.1	7.9	8.1	8.1	8.2	7.5	7.4

**Table 1.
Lockatong Creek Stream Visual Assessment Scores (continued)**

SVAP #	L-15	L-16	L-17	L-18	L-19	L-20	L-21	L-22
Location	US Raven Rock Road	US Byram- Kingwood Road	US Route 519	DS Milltown Road	DS Strimples Mill Road	DS Reach 2 @ 85	DS	US
<i>Assessment Scores:</i>								
Channel condition	8	8	8	8	8	7	8	8
Hydrologic alteration	9	8	7	9	8	6	9	8
Riparian zone	8	9	7	9	9	9	9	8
Bank stability	8	7	6	9	8	5	8.5	7.5
Water appearance	9	7	6	7.5	8	7	9	8
Nutrient enrichment	8	7	7	8	8	8	7.5	7
Barriers to fish movement	3	10	10	3	3	10	10	10
Instream fish cover	7	8	8	8	7	8	7	6
Pools	7	8	6	6	8	8	6	6
Invertebrate habitat	8	9	9	9	8	8	9	8
Canopy cover (if applicable)	8	8	9	8	7	8	8	8
Manure presence (if applicable)	na	na	na	na	na	na	na	na
Salinity (if applicable)	na	na	na	na	na	na	na	na
Riffle embeddedness (if applicable)	8	8	8	8	8	7	9	8
Macroinvertebrates observed (optional)	8	6	11	7	11	9	11	11
Overall Score (Total divided by number scored) Poor = <6.0; Fair = 6.1 - 7.4; Good = 7.5 - 8.9; Excellent = >9.0	7.6	7.9	7.8	7.7	7.8	7.7	8.5	8.0

**Table 2.
Lockatong Creek Recommended Riparian Buffer Restoration Sites**

Stream	Site Crossing ID	SVAP #	Nearest Road	Municipality	Buffer Restoration Location		DS RB	DS LB	Length/ description (for each designated location)	Estimated Buffer Cost
					US RB	US LB				
Lockatong	1002		Old Franklin School Rd	Franklin Twp	x	x			650	\$2,300
Lockatong	1003		Oak Grove Rd	Franklin Twp	x	x	x	x	1000	\$6,100
Lockatong	1004		Oak Grove Rd	Franklin Twp	x	x	x	x	600	\$3,800
Lockatong	1006		Old Franklin School Rd	Franklin Twp	x	x	x	x	850	\$5,600
Lockatong	1010		Old Franklin School Rd	Franklin Twp	x	x			950	\$3,200
Lockatong	1011		Old Franklin School Rd	Franklin Twp	x	x			850	\$3,000
Lockatong	1012		Old Franklin School Rd	Franklin Twp	x	x	x		1500	\$7,000
Lockatong	1016		Kingwood Stockton Rd	Delaware Twp	x				1500	\$400
Lockatong	1021		Barbertown Point Breeze Rd	Kingwood Twp			x	x	400	\$1,700
Lockatong	1025		Kingwood Stockton Rd	Delaware Twp	x	x	x	x	1000	\$6,100
Canal	1026		Daniel Brae Hwy	Delaware Twp	x	x			650	\$2,300
Lockatong	1040		Union Rd	Kingwood Twp	x		x		400	\$1,700
Lockatong	1041		Union Rd	Delaware Twp	x		x		750	\$2,600
Lockatong	1045		Slacktown Rd	Kingwood Twp		x		x	1000	\$3,700
Muddy Run	1000		Locktown Rd	Kingwood Twp	x	x	x	x	750	\$5,000
Muddy Run	1017		Barbertown-Point Breeze Rd	Kingwood Twp	x	x	x	x	1800	\$11,000
Muddy Run	1037		Barbertown Point Breeze Rd	Kingwood Twp	x	x		x	400	\$2,300
Lockatong	1038		Thatcher Rd	Kingwood Twp		x		x	450	\$1,700
Muddy Run	1039		Locktown Rd	Kingwood Twp	x		x		550	\$2,000
Lockatong	195	SVAP L-14	Worman Road	Delaware Twp			x		350	\$1,000
Muddy Run		SVAP L-20	Muddy Run Road	Kingwood Twp						
Lockatong	Lock104		Pittstown Rd	Franklin Twp		x		x	250	\$1,400

Lockatong	Lock106		Lower Oak Grove Rd	Kingwood Twp	x	x	x	x	900	\$6,000
Muddy Run	Lock441		Stanbury La	Kingwood Twp	x	x	x	x	450	\$3,500
Lockatong	Lock480		Old Franklin School Rd	Franklin Twp	x	x	x	x	400	\$2,800
Lockatong	Lock481		Old Franklin School Rd	Franklin Twp	x		x	x	450	\$2,600
Muddy Run	Lock494		Locktown Rd	Kingwood Twp	x	x	x	x	550	\$3,700
Lockatong	Lock497		Hampton Rd	Kingwood Twp			x	x	600	\$2,300
Muddy Run	Lock498		Hammar Rd	Kingwood Twp		x			200	\$700
Muddy Run	Lock499		Hammar Rd	Kingwood Twp			x	x	350	\$1,400
Muddy Run	Lock5		Barbertown-Point Breeze Rd	Kingwood Twp			x	x	200	\$1,000
Lockatong	Lock73		Pittstown Rd	Franklin Twp			x		100	\$400
Lockatong	Lock74		Pittstown Rd	Franklin Twp	x	x			1000	\$3,700
Lockatong	Lock75		Oak Grove Rd	Franklin Twp			x	x	800	\$2,800
Lockatong	Lock76	SVAP L-05 SVAP L-06	Lower Oak Grove Rd	Kingwood Twp			x	x	450	\$1,700
Lockatong	Lock79		12	Kingwood Twp			x		200	\$700
Lockatong	Lock84	SVAP L-03 SVAP L-04	Barbertown-Point Breeze Rd	Kingwood Twp						na
Muddy Run	Lock85	SVAP L-07 SVAP L-08	Muddy Run Rd	Kingwood Twp	x	x			400	\$1,700
Muddy Run	Lock86	SVAP L-09 SVAP L-10	Union Rd	Kingwood Twp			x		200	\$700
Lockatong	Lock88		Kingwood Rd	Kingwood Twp						na
Lockatong	Lock89	SVAP L-22	Federal Twist Rd	Kingwood Twp						na
Lockatong	Lock90	SVAP L-21	Federal Twist Rd	Kingwood Twp				x	350	\$1,000
Lockatong	Lock92	SVAP L-15	Raven Rock-RosemontRd	Delaware Twp		x			300	\$1,000
Lockatong	Lock93		Kingwood-Stockton Rd	Delaware Twp						na
Lockatong	Lock96		Federal Twist Rd	Delaware Twp						na
Lockatong	Lock98	SVAP L-16	Byram - Kingwood Rd	Kingwood Twp	x		x		200	\$1,000

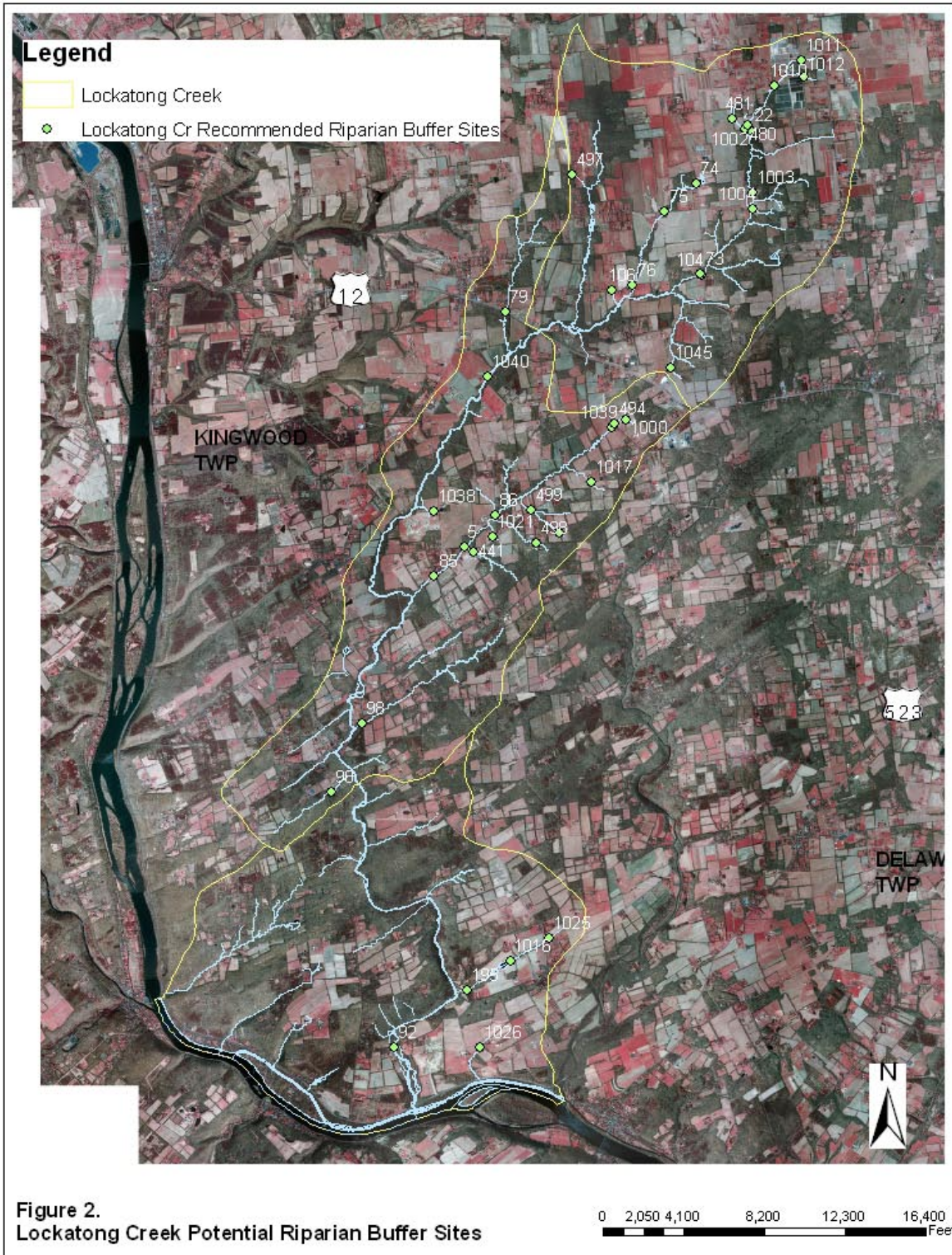


Table 3.					
Lockatong Creek Potential River-Friendly Farm Locations					
(based on SVAP and Road Crossing Inventory)					
Stream	Site Crossing ID	SVAP #	Nearest Road	Municipality	Estimated Cost River-Friendly Farm
Lockatong	Lock74		Pittstown Rd	Franklin Twp	\$1500
Lockatong	Lock76	SVAP L-05 SVAP L-06	Lower Oak Grove Rd	Kingwood Twp	\$1500
Lockatong	Lock84	SVAP L-03 SVAP L-04	Barbertown-Point Breeze Rd	Kingwood Twp	\$1500
Muddy Run	Lock 85	SVAP L-07 SVAP L-08	Muddy Run Road	Kingwood Twp.	\$1500
Muddy Run	Lock86	SVAP L-09 SVAP L-10	Union Rd	Kingwood Twp	\$1500
Lockatong	Lock88		Kingwood Rd	Kingwood Twp	\$1500
Lockatong	Lock89	SVAP L-22	Federal Twist Rd	Kingwood Twp	\$1500
Lockatong	Lock93		Kingwood-Stockton Rd	Delaware Twp	\$1500
Lockatong	Lock96		Federal Twist Rd	Delaware Twp	\$1500

Table 4.		
Lockatong Creek River-Friendly Farm Project		
Estimated Budget		
Farms Identified through SVAP/Road Crossing	9 farms	\$13,500
Additional Farms	Estimate 15 additional farms entering the program	\$22,500
Outreach		\$2200
Total		\$38,200

