12. **Conclusions and Discussion**

The water quality monitoring data indicates the Neshanic River is severely impaired by sediment, nutrients and pathogens resulting from land use and landscape changes in the Neshanic River Watershed. This Plan analyzes the causes and sources of various kinds of water quality impairments, sets pollutant load reduction targets, discusses management measures for reducing pollutant loads and presents a road map for how management measures can be applied in various parts of the watershed to achieve the desired water pollutant load reduction targets for restoring water quality and watershed hydrology in the watershed.

This Plan also presents several BMPs for reducing the identified water quality impairments in the watershed. Each BMP varies by cost, physical and cost effectiveness, ease of use and applicability. Local communities often experience difficulties in choosing BMPs. The economic concept of cost-effectiveness was used to evaluate the efficacy of BMPs and select BMPs for implementation. Cost-effective analysis of BMPs is an important tool for developing a watershed restoration plan. As demonstrated in the Plan recommended here, the cost and cost-effectiveness of BMPs is highly variable. For example, some BMPs are a hundred times more expensive than others. Such information is valuable to watershed managers in allocating scarce financial resources to watershed restoration.

Many stormwater BMPs can improve water quality. Rain garden and roadside ditch retrofitting are examples. Selection and the cost of a stormwater best management practice will vary based on the volume of water to be drained the location and size of the drainage and the size of the area that the measure can be installed. For example, the total project costs for retrofitting a 250 feet long roadside ditch is estimated at $16,000 (see Section 7.4.2) with annual maintenance cost of $500. In some cases, basin retrofitting and vegetative buffers for developed lands can be more or as cost effective for controlling NPS.

Section 7.4.1 provides some information on estimates for installing rain gardens. These estimates should be observed by the acreage of the property which the rain garden will be draining. Total project costs for installing a rain garden can vary from $200 for a residential rain garden to $14,900 for Shoprite Parking Lot. The costs will vary based on the size of the rain garden, the type of materials chosen for construction and whether the work is completed by the homeowner, volunteers or paid labor. The annual operation and maintenance cost can be either negligible or vary dependant on material chosen at time of construction and if the performer of maintenance is volunteer or paid.

This Plan shows that BMPs for reducing NPS from agricultural lands are generally more cost-effective than stormwater BMPs, such as rain gardens and roadside ditch retrofitting. However, most of the agricultural BMPs have to be adopted by farmers through changes in agricultural practices. There are substantial barriers to implementing BMPs on private and active agricultural lands. Efforts should be undertaken to reduce implementation barriers for BMPs and encourage their adoption by farmers.

12.1. **EPA's Nine Minimum Elements of a Watershed Restoration Plan**

The Neshanic River Watershed Restoration Plan, November 2011 addresses the nine minimum elements as specified in the NJDEP "Request for Proposals for the SFY 2006 319(h) Grants for Nonpoint Source Pollution Control." The details are summarized below.

1. An identification of the causes of impairment and pollutant sources or groups of similar sources that need to be controlled

Water quality and quantity issues in the Neshanic River Watershed are the result of substantial land use changes in the watershed. There are dramatic increases in urban land uses and decreases in agricultural lands due to rapid suburbanization during the last two decades. The percentage of urban land in the watershed increased from 16.6 percent in 1986 to 25 percent in 1995, and was 31.2 percent in 2002 and 35.1 percent in 2007. The increases in urban land resulted primarily from the loss in agricultural land in the watershed. Agricultural lands in the watershed decreased from 51.4 percent in 1986 to 43 percent in 1995, and continued to decrease to 36.4 percent in 2002 and 35 percent in 2007. Other land uses were relatively steady with forest around 20-21 percent, wetlands at 10-11 percent, water at 0.2-0.5 percent and barren at 0.3-1.6 percent.

Land use changes dramatically alter watershed hydrology. As urban land increases, the impervious surfaces, such as rooftops, driveways, additional roads, and parking lots, increase whereas pervious surfaces, such as traditional agricultural lands decrease. Such land use changes usually decrease infiltration and groundwater recharge and increase surface runoff. Urban and suburban development requires additional roads and stormwater infrastructure, such as drainage pipes and ditches. The latter are designed to convey stormwater away from individual properties as quickly as possible. Tile drainage and swale infrastructure in agricultural lands quickly disperse agricultural runoff from agricultural fields. In general, agricultural and urban development lead to flashy watershed hydrology in which high-velocity flowing runoff reaches the streams quickly resulting in stream bank erosion, unstable channel conditions, and further sedimentation of streams and degradation of stream habitat.

Water quality and quantity are affected by not only quantitative changes in land use, but also the nature of the land use changes and where those changes occur on the landscape. Many intensive land uses, such as agriculture and urban development, took place in hydrologically sensitive areas, hydric soils and riparian areas of the streams, which intensifies the water quality and quantity issues in the watershed. Other sources of water quality degradation include: intensive uses of fertilizer and pesticides in agricultural production and lawn management; livestock production, such as cattle and horses; failing on-site wastewater treatment systems, such as OSDSs; animal manure mismanagement; and deposition of excrement of wildlife, such as deer and geese.

The SWAT watershed model was used to assess how various sources of water quality degradation affect water quality in the watershed. The SWAT modeling results were used to characterize the sources and root causes of water quality degradation.

Both fecal coliform and E. coli in water are indicators of pathogen contamination. In general, human and animal wastes are sources of pathogens in the Neshanic streams. Failing

OSDSs, which are the largest source of pathogens in the watershed, contribute 46 percent of the pathogen loads in the Neshanic streams. The second largest source is manure that is applied to the field for row-crop production, which accounts for 31 percent of the annual load of pathogens in the Neshanic streams. Livestock in the watershed is a significant contributor of pathogens to streams, including animals grazed on pasture and/or animals that enter streams. Livestock account for 19 percent of annual pathogen loads in the watershed, which make it the third largest contributor to pathogen loads. Another minor contributor is wildlife, such as geese and deer.

Nutrients include TN and TP. Water quality monitoring efforts by USGS, NJDEP and the project team indicate that TP is a significant source and TN is an insignificant source of water pollution in the watershed. The SWAT assessment shows that 229,119 pounds of TN and 12,282 pounds of TP leave the watershed through streamflow each year. The primary source of nutrients in the Neshanic River Watershed is agricultural land that is used for row-crop production, pasture and hay, accounting for 76 percent of the TN and 60 percent of the TP loads in the watershed. Fertilizers on urban lands are the second largest sources of nutrients, contributing 11 percent of the TN load and 29 percent of the TP load.

Sediment in streamflow is measured by TSS. Results of the SWAT model indicate that, each year, streamflow carries 1,715 tons of sediment out of the watershed. Streams are the primary source of sediments and contribute 1,021 tons of sediment per year, which accounts for 60 percent of the total annual sediment load. The source of sediments from the streams is soil eroded from the streambanks and resurfaced from the deposited sediments in the stream bed due to the high energy streamflow. The remaining 40 percent of sediments, roughly 694 tons, come from various land uses in the watershed, including row-crop agriculture (i.e., corn, soybean, wheat and rye production), which accounts for almost 57 percent of the sediment, urban land (27 percent) and other agricultural lands, such as pasture and hay (15 percent).

2. *An estimate of the load reductions expected from the management measures*

The NJDEP (2010a) designated the Neshanic River and its tributaries as FW2-NT. According to this designation from the New Jersey Surface Water Quality Standards (NJAC 7:9B) amended January 4, 2010 (42 N.J.R. 68a), the following surface water quality standards are applicable to the pollutants of concern in the Neshanic River and its tributaries:

- *E. coli* shall not exceed a geometric mean of 126 counts per 100 milliliter (mL) or a single sample maximum of 235 counts per 100 mL;
- Fecal coliform shall not exceed a geometric average of 200 counts per 100 mL, nor shall more than 10 percent of the total samples taken during any 30-day period exceed 400 counts per 100 mL;
- TP shall not exceed 0.1 mg/L;
- TSS shall be less than 40 mg/L; and
- TN shall be below 10 mg/L.

The NJDEP approved and adopted a TMDL for fecal coliform for the Neshanic River, which requires a 87 percent reduction in fecal coliform from medium/high density residential, low density/rural residential, commercial, industrial, mixed urban/other urban, forest, and agricultural lands (NJDEP, 2003). A nutrient TMDL for the Raritan Basin was developed and is still under review by NJDEP. However, the adopted fecal coliform TMDL and the nutrient

TMDL are based on the water quality monitoring data at the USGS Reaville Gage Station, and therefore cover only the upper portion of the Neshanic River Watershed. The project team developed its own load reduction targets for the pollutants of concern that enable the streams in the Neshanic River Watershed to meet the water quality standards for their designated uses. This project uses a more robust load duration curve method for setting TMDL targets. A duration curve is a graph representing the percentage of time during which the value of a given parameter (e.g. flow, load) is equaled or exceeded.

The load reduction target for the Neshanic River Watershed is defined as the total pollutant load reductions that are required to satisfy the water quality standards for the non-trout FW2 streams in the watershed as defined by NJDEP. A 10 percent margin of safety (MOS) and less than 10 percent exceedance threshold were adopted to determine the pollutant load reduction targets. The 10 percent MOS indicates the more stringent water quality targets at the 90 percent of the regulatory water quality standards. For example, the TN target is 9 mg/L instead of 10 mg/L when considering the MOS. Given the stochastic nature of water contamination, it is not practical to require the water quality standard to be achieved daily. The less than 10 percent exceedance threshold requires a frequency of violating the water quality standards and their MOS of less than 10 percent.

Three sets of load duration curves were developed for the watershed. Each set contains five load duration curves for TSS, TN, TP, fecal coliform and *E. coli*. The first set of load duration curves is based on observed streamflow and water quality data at the USGS Reaville Gage Station (N1 Station), above which is the upper portion of the watershed. Both TSS and TN satisfy the TMDL water quality goals at the N1 Station. The load reduction targets of 48, 90 and 91 percent for TP, fecal coliform and E. coli, respectively, are required to achieve the specified TMDL goals including MOS and the threshold for the frequency of exceedance at the N1 Station. The second set of load duration curves are based on the streamflow and water quality results simulated by the SWAT watershed model at the N1 station. To satisfy the TMDL requirements, the load reduction targets are 48 percent for TP, 90 percent for fecal coliform and 91 percent for *E. coli*. It is not necessary to reduce TN and TSS at the N1 station. These pollutant load reduction targets are essentially the same as those based on the monitoring data at the same station. Since there is no observed streamflow and water quality data at the watershed outlet, the third set of load duration curves are based on the streamflow and water quality results simulated by the SWAT model. The load reduction targets required to meet the TMDL goals at the watershed outlet are 9 percent for TSS, 49 percent for TP and 89 percent for both fecal coliform and *E. coli*.

3. *A description of the NPS management measures that will need to be implemented to achieve the estimated load reductions and an identification (using a map and description) of the critical areas in which those measures will be needed to implement this plan*

The Plan recommends 14 management measures to reduce pathogen, nutrients and sediment loads from various sources to the streams and to achieve the estimated load reductions. The 14 management measures include eight types of agricultural BMPs, four types of stormwater BMPs and two types of OSDS BMPs. The eight agricultural BMPs are:

- Cover Crops – are grasses, legumes, forbs or other herbaceous plants established for seasonal cover and other conservation purposes. Cover crops reduce soil erosion, help maintain soil moisture and improve nutrient and organic content of soils. Other potential benefits of cover crops include decreased farm operation costs, reduced tillage, less herbicide use and better overall soil health.

- Prescribed Grazing – is a system that helps agricultural producers to manage grazing and browsing of animals to ensure adequate ground cover and proper livestock nutrition. A prescribed grazing plan may require reducing the number of livestock in a given pasture, more frequent rotation of livestock across pastures, and using temporary fencing to exclude livestock from pastures recovering from past grazing activity. Prescribed grazing helps to maintain healthy and productive pastures. Healthy pastures have lower soil erosion rates, lower phosphorus and fecal matter in runoff, greater absorption of nutrients, and higher water infiltration.
- Livestock Access Control – livestock should be completely excluded from direct access to streams and their immediate riparian areas along pastures. The exclusion primarily focuses on the streams that pass through pasture and does not apply to temporary stream crossings for livestock. Livestock access control eliminates the chance of directly dropping livestock waste to the streams and therefore substantially reduces the pathogen loads into streams. The exclusion also eliminates livestock disturbances to streambanks and maintains streambank stability. A stable streambank results in less soil erosion and, therefore, less TSS load to the streams in the watershed.
- Contour Farming – uses ridges and furrows formed by tillage, planting and other farming operations to change the direction of runoff from directly downslope to around the hill slope. Contour farming reduces sediment from gully erosion, surface water runoff, and the transport of phosphorus and other contaminants to streams.
- Integrated Crop Nutrient Management – requires the amount of fertilizers applied to crops to be based on reasonable crop yield goals and available nutrients in soils as determined by soil testing. Such soil-testing based nutrient management reduces the farmers' fertilizer costs and at the same time eliminates the excess nutrients in soil and therefore reduces the nitrogen and phosphorus runoff.
- Conservation Buffers – are planned vegetative mixtures of trees, shrubs and grasses placed in landscapes to influence ecological processes and enhance ecosystem goods and services. There are many types of conservation buffers, such as contour buffer strips, field borders, grassed waterways, filter strips and riparian forest buffers. Conservation buffers have multiple water quality benefits and reduce both sediments and nutrient loads to streams. As runoff flows through a conservation buffer, dense vegetation in the buffer acts as a filter, blocking sediments and sediment-absorbed nutrients, pesticides and pathogens and preventing them from entering streams. Their efficiency in improving water quality can be significantly improved by strategically placing the conservation buffers in the critical source areas in a watershed.
- Animal Manure Management – in addition to implementing the Criteria and Standards for Animal Waste Management (N.J.A.C. 2:91) adopted by the New Jersey Department of Agriculture (NJDA) in the watershed, small scale regional manure composting and storage facilities should be established and operated to eliminate improper manure disposal.
- Manure Management – cropland should not be used as a dumping ground for animal manure. Manure application should be rotated among numerous fields to avoid

concentrating manure in a limited area. To protect water resources and promote crop growth and soil health, manure should be tested for nutrient content and applied according to crop needs. Manure incorporation technology should be developed and implemented when applying manure as fertilizer in row-crop and hay production.

Land use changes and associated stormwater infrastructure have significantly altered the hydrology of the Neshanic River Watershed. Watershed restoration should mitigate the negative impacts of land use changes on watershed hydrology. Stormwater BMPs not only help restore watershed hydrology, but also improve water quality in the watershed. The four stormwater BMPs are:

- Rain Gardens – traditional stormwater infrastructure is designed to quickly deliver stormwater from the sources to the streams. Rain gardens are designed to retain the stormwater first and then discharge it to the stormwater systems and/or the stream if necessary. These systems are designed to treat the retained stormwater to achieve substantial water quality benefits through various biological processes embedded in the system. The stormwater retained in those systems could also be infiltrated though the soils to recharge groundwater, thus reducing the amount of stormwater entering streams. Rain gardens include a series of bio-retention facilities that are maintained under different situations such as residential and commercial properties and along the roadsides.
- Roadside Ditch Retrofitting – roadside ditches in the watershed are actively eroding, thus adding sediment to stormwater that flows through them. Roadside ditch retrofitting can transform ditches into bio-retention systems that are very similar to constructed wetlands.
- Detention Basin Retrofitting – detention basins capture a large amount of stormwater runoff from medium and low density urban development where sediment, nutrients and pathogen sources could exist. Depending on the final design of a detention basin, the retrofitted detention basin can function like a bio-retention basin or a constructed wetland that removes sediment, nutrient and pathogen loads to the streams.
- Vegetated Buffers in Developed Lands – developed land uses such as residential, commercial, industrial, barren lands and park lands contribute to the phosphorus and TSS loads entering streams. Sources of pollutants are typically roadway sediment and lawn fertilizer, as well as soil erosion from unstable areas. A vegetated buffer is an area designed to remove suspended solids and other pollutants, as well as associated pollutants, such as hydrocarbons, heavy metals, and nutrients, from stormwater runoff. Pollutant removal mechanisms include sedimentation, filtration, adsorption, infiltration, biological uptake and microbial activity. Vegetated buffers are designed to receive stormwater runoff as sheet flow for maximum pollutant removal. Pollutant removal rates for vegetated buffers depend upon the type of vegetative cover in the buffer.

Failing OSDSs are one of the major pathogen sources in the watershed. The Plan calls for a comprehensive education campaign on OSDS operation and maintenance, a three-year inspection and certification program, and technical assistance and financial incentive programs to retrofit the failing OSDSs in the watershed. The two OSDS BMPs are:

- OSDS Inspection and Maintenance – technical assistance shall be offered one time to inspect all the existing OSDSs to help establish the three-year inspection and certification program. The subsequent OSDS inspection and maintenance shall be implemented through the operation of the three-year inspection and certification program.
- OSDS Retrofitting – the effective way to eliminate the pathogen loads from the failing OSDSs in the watershed is to repair and replace them and bring them up to the current state and local regulatory standards. OSDS repair and replacement could be expensive and the financial burden to the homeowners with the failing OSDS is the major obstacle to maintain the functioning OSDS. A financial incentive program shall be provided to motivate residents and businesses to properly maintain and care for their OSDSs. The program could include cost-sharing and low or no interest loan to homeowners to install OSDSs that comply with current state and local regulations, replace or repair failing systems, and inspect and maintain existing systems. These financial incentives could be combined with fines for failing to maintain properly functioning OSDSs in the watershed.

Table 12.1 presents the priority rankings for all the BMPs in term of reducing TP, sediment and pathogen loads to the streams. The priority rankings are based on the cost-effectiveness of these BMPs in reducing TP, sediment and pathogen. Cost-effectiveness measures the average reduction in the loading of pollutant achieved by a BMP per dollar spent on implementing that BMP. It is measured by the annual pollutant load reduction divided by the annual cost of implementing the BMP in the watershed.

Table 12.1: Priority ranks for all BMP projects in the Neshanic River Watershed

Type of BMP Project		Priority Rank in Reducing		
		TP	Sediment	Pathogen
1	Cover Crop	8	7	
2	Prescribed Grazing	5	6	6
3	Livestock Access Control	1	2	1
4	Contour Farming	4	3	
5	Nutrient Management	2		9
6	Conservation Buffers in Agricultural Lands	3	4	10
7	Livestock Waste Storage and Composting Structure	12		2
8	Manure Application Incorporation Technology	11		4
9	Rain Garden	10	9	
10	Road Ditches	9	8	11
11	Detention Basin Retrofitting	7	5	7
12	Vegetative Buffers in Developed Lands	6	1	8
13	OSDS Inspection and Maintenance	13		3
14	Failed OSDS Retrofitting	14		5

Note: A shaded area indicates that the impact of the BMP on the reduction of the pollutant is insignificant.

Table 12.2 presents the implementation targets for all of the recommended BMPs for achieving the desired pollutant load reduction. Targets are described in terms of physical dimensions of the applicable units for each BMP (implementation goal) and the amount or reduction achieved (reduction goal). The expected annual load reductions for the implementation plan are 6,632 pounds of TP and 324 tons of sediment, which is sufficient to achieve a 49 percent reduction in TP and greater than 9 percent of reduction in TSS. It is expected that the required 89 percent reduction in pathogen (both fecal coliform and *E. coli*) can be achieved by eliminating the failing OSDSs, improving manure application and completely excluding livestock access to streams in the watershed.

The estimated reduction in TP is on the conservative side for several reasons. First, almost all BMPs for reducing pathogen loads also reduce TP loads, but the reductions from some BMPs are difficult to quantify and are not included in the calculation. Second, the implementation of the newly enacted Fertilizer Control Law and the municipal low-phosphorus ordinances for lawn care should substantially reduce TP loads from the urban lands that contribute 28 percent of TP loads to the streams in the watershed. Third, targeting the application of BMPs in the critical pollution source areas should reduce pollutant loads much more than the average reduction rates used in this estimation.

Table 12.2: Implementation targets for the recommended BMPs in the Neshanic River Watershed

Types of BMP Projects		Implementation Goal	Reduction Goal		
			Pathogen (%)	TP (lbs)	Sed. (tons)
1	Cover Crop	2,006 acres		392	40
2	Prescribed Grazing	446 acres		190	8
3	Livestock Access Control	24,663 feet	Up to 19	913	52
4	Contour Farming	1,385 acres		380	55
5	Nutrient Management	5,734 acres		2,608	
6	Conservation Buffers in Agricultural Lands	494 acres		1,850	125
7	Livestock Waste Storage and Composting Structure	5 units	Up to 31		
8	Manure Application Incorporation Technology	248 acres			
9	Rain Garden	35 units			
10	Road Ditch Retrofitting	9 units		2	
11	Detention Basin Retrofitting	39 units		277	35
12	Vegetative Buffers on Developed Lands	13,802 feet		19	10
13	OSDS Inspection and Maintenance	1,490 units	Up to 46		
14	Failed OSDS Retrofitting	447 units			
Total			89	6,632	324

4. ***An estimate of the amounts of technical and financial assistance needed, associated costs, and/or the sources and authorities that will be relied upon to implement this plan***

The total cost for achieving implementation goals is about $14.6 million. That cost can be broken down into three components: (1) outreach and technical assistance costs for reaching out to stakeholders and designing BMP implementation plans, and obtaining the necessary permits to install the BMPs; (2) BMP installation costs for related materials, labor, equipment and other items; and (3) BMP maintenance costs that ensure proper operation of BMPs. Of the $14.6 million of implementation costs, $1.5 million is for outreach and technical assistance, $10.9 is for installation and $2.2 million is for maintenance.

The funding available for BMP implementation depends on the types of BMPs and the nature of the costs. USDA NRCS and Farm Service Agency (FSA) support installation of agricultural BMPs (1-8) through outreach, technical assistance and cost-sharing of installation costs. There are no consistent funding sources for implementing stormwater BMPs and no public funding sources available to support the OSDS inspection and maintenance and retrofitting because OSDSs are generally viewed as private properties.

The funding and technical assistance for the implementation plan are based on the following recommendations. First, all maintenance costs for installed BMPs should be the responsibility of stakeholders. For example, homeowners should pay for the maintenance cost for installed rain gardens. Local homeowners associations should be responsible for maintaining retrofitted detention basins in their neighborhoods. Residents should be responsible for operating their own OSDSs. Second, 50 percent of the outreach and technical assistance and installation costs for agricultural BMPs (1-8) should be secured through traditional Farm Bill programs, such as the Conservation Reserve Enhancement Program (CREP), Environmental Quality Incentive Program (EQIP) and Wildlife Habitat Incentive Program (WHIP). Third, to jump start the comprehensive OSDS certification and maintenance program and completely eliminate water pollution from the failing OSDSs, the implementation plan should consider funding the OSDS inspection and cost-share the retrofitting cost for failing OSDSs in the watershed.

Table 12.3: Potential sources of funding for implementation of BMPs

	Types of BMP Projects	Total Cost	Stake-holders	USDA	Other Sources	
					BMP Inst.	Tec. As.
1	Cover Crop	631,590	0	315,795	299,622	16,173
2	Prescribed Grazing	198,113	0	99,057	71,182	27,875
3	Livestock Access Control	284,512	49,326	117,593	70,733	46,860
4	Contour Farming	161,451	0	80,725	62,303	18,423
5	Nutrient Management	668,661	0	334,330	258,031	76,299
6	Conservation Buffers in Agricultural Lands	2,977,503	617,500	1,180,001	751,868	428,133
7	Livestock Waste Storage and Composting Structure	450,000	250,000	100,000	100,000	
8	Manure Application Incorporation Technology	38,610	0	19,305	19,305	
9	Rain Garden	147,118	53,175		58,493	35,450
10	Road Ditches	200,455	63,975		110,890	25,590
11	Detention Basin Retrofitting	1,135,750	288,750		654,500	192,500
12	Vegetative Buffers in Developed Lands	66,828	10,896		45,036	10,896
13	OSDS Inspection and Maintenance	894,000	670,500		223,500	
14	Failed OSDS Retrofitting	6,705,000	3,352,500		3,352,500	
Total		14,559,591	5,356,622	2,246,807	6,077,962	878,200

Table 12.3 summarizes the potential sources of funding for implementation of BMP projects. Stakeholders, such as farmers and residents, could pay $5.4 million of the total implementation costs. Of this amount, 50 percent is for retrofitting failing OSDSs and OSDS inspection and maintenance. The remaining stakeholders' costs are for the time and labor required for maintenance of installed BMPs. The USDA could contribute $2.25 million for agricultural BMPs. An additional $7 million is needed from other sources, of which $6.1 million is for BMP installation and $0.88 million is for outreach and technical assistance.

Other sources of funding for BMP projects include:

- NJDEP: the Clean Water Act 319(h) Nonpoint Source Pollution Control Grants program;
- U.S. Fish and Wildlife Service: the Partners for Fish and Wildlife program and the Bring Back the Natives; and
- U.S. EPA: Five Star Restoration Challenge Grants.

In addition to the standard funding that could be provided by the above agencies, there are alternative funding sources that can be developed for watershed restoration. Raritan Township currently operates a stormwater mitigation fund that collects funds from new developments on forest land in the township. The funds are used to implement stormwater management projects that mitigate the impacts of increased stormwater runoff. Such programs should be expanded to all new development projects in the watershed that increase impervious land surfaces.

A stormwater utility fund is a mechanism that allows municipalities to collect a fee from homeowners and businesses that discharge stormwater into the stormwater system. A stormwater utility fund has been authorized and used by many county and municipal governments to finance stormwater management and has proven effective in financing and improving stormwater management in many other states in the country. Implementation of a stormwater utility fund should not be considered as an additional financial burden on homeowners and businesses, but rather as a financial framework that motivates homeowners and businesses to be better environmental stewards. Credits should be given to homeowners and businesses that invest in stormwater management and control stormwater runoff from their properties. Such credits could offset their payment obligations to the stormwater utility fund. The stormwater utility fund collected from the properties with poor stormwater management practices could be used to finance large capital stormwater improvement projects.

Water quality trading uses the market to efficiently achieve an overall load reduction for water quality and watershed restoration goals. Different stakeholders face different costs for reducing same amount of pollutant loads into the streams. Water quality trading allows the stakeholders facing higher pollutant load reduction costs to meet their regulatory requirement in load reduction by purchasing the equivalent amount of pollution load reduction from other stakeholders who have lower pollutant load reduction costs. The Neshanic River Watershed may be too small for effective operation of a water quality trading market. However, the economic principle behind water quality trading can be applied to minimize the overall cost of achieving the watershed restoration goal. One way to apply the economic principle is to collect funds from the stakeholders in urban land and use the funds to pay farmers to implement agricultural BMPs to reduce the equivalent amount of phosphorus load from agricultural land. A regional water quality trading program in the Raritan River Basin would help implement the proposed BMPs in the watershed.

Implementing some BMPs proposed in the Plan requires a large amount of capital. Examples of such BMPs include the stormwater detention basin retrofitting and OSDSs replacement/retrofitting. Financial arrangements should be available that allow property owners to easily access the financial capital needed to carry out those projects. One way to do it is to provide low-interest or no-interest loans to qualified landowners. Such a program would be similar to various incentive programs for renewable energy and energy efficiency under the New Jersey Clean Energy Program. As the old energy inefficient homes waste energy and generate larger carbon footprint, the failing OSDSs in private homes causes public health and environmental hazards, and thereby should be addressed in a similar manner. There is no such program available to assist homeowners who undertake OSDS retrofitting projects. A funding source needs to be identified and developed to implement such program.

5. An information/education component used to enhance public understanding of the project

The success of any watershed restoration plan depends on the stakeholders' understanding of the water quality problems in the watershed, and their willingness and ability to take action to solve those problems. Education is the key to enhancing stakeholders' understanding and their willingness and ability to take action. It can take many different forms, such as public media, formal workshops and active participation in community programs offered by various agencies. Examples of such programs are:

- River-Friendly Programs
- Rain Garden Program
- Sustainable Jersey™
- Detention Basin Retrofits
- Agriculture Mini-Grant Program
- Soil Testing Program
- Nonpoint Education for Municipal Officials (NEMO)
- Greening of Department of Public Works (DPWs)

The ultimate goal of education is to improve stakeholders' awareness and promote behavior changes that are beneficial in achieving watershed restoration.

6. A schedule for implementing the NPS management measures identified in this plan that is reasonably expeditious

The implementation schedule considers how the BMPs are implemented in the watershed over space and time. Table 12.4 presents the implementation schedule within 2, 5 and 10 years in terms of the percentage of the applicable unit and the application unit for each BMP.

In addition to allocating the BMP projects across different timeframes, another important aspect of the implementation plan is the best place in the watershed to implement the BMP projects. In order to maximize the pollutant load reduction potential, especially during the first few years of implementation, BMP projects should be implemented in the high priority areas identified in the project.

The assumption of a 10-year planning horizon does not mean it takes 10 years to achieve the required pollutant load reduction targets. Depending on funding availability and the stakeholders' willingness to act, many recommended BMPs can be implemented at a much faster pace. However, attaining the required pollutant load reduction targets does not guarantee the restoration of water quality and biological integrity of the streams in the watershed because it takes time for reductions in pollutant loads to affect water quality.

Table 12.4: BMP implementation schedule in the Neshanic River Watershed

	Types of BMP Projects	In 2 Years		In 5 Years		In 10 Years	
		%	Unit	%	Unit	%	Unit
1	Cover Crop	10	401 acres	25	1,003 acres	50	2,006 acres
2	Prescribed Grazing	10	89 acres	25	223 acres	50	446 acres
3	Livestock Access Control	25	6,166 feet	50	12,332 feet	100	24,663 feet
4	Contour Farming	25	462 acres	50	923 acres	75	1,385 acres
5	Nutrient Management	25	1,911 acres	50	3,823 acres	75	5,734 acres
6	Conservation Buffers in Agricultural Lands	10	99 acres	25	247 acres	50	494 acres
7	Livestock Waste Storage and Composting Structure	20	1 unit	60	3 units	100	5 units
8	Manure Application Incorporation Technology	25	83 acres	50	165 acres	75	248 acres
9	Rain Garden	0.1	4 units	0.5	18 units	1	35 units
10	Road Ditches	0.1	1 unit	0.5	4 units	1	9 units
11	Detention Basin Retrofitting	5	8 units	15	23 units	25	39 units
12	Vegetative Buffers in Developed Lands	10	2,760 feet	25	6,901 feet	50	13,802 feet
13	OSDS Inspection and Maintenance	25	373 units	10 0	1,490 units	100	1,490 units
14	Failed OSDS Retrofitting	25	112 units	50	224 units	100	447 units

7. A description of interim, measurable milestones for determining whether NPS management measures or other control actions are being implemented

During the first two years after the Plan is adopted, the four municipalities in the watershed should:

- Educate the residents, farmers, and businesses on the water quality status of the Neshanic River and responsible stewardship in land use and management;
- Where applicable, establish concrete steps for implementing the New Jersey State Rules for improving water quality and/or preventing water quality from continuous deterioration. These rules includes New Jersey Pollutant Discharge Elimination System Stormwater Regulation Program rules (N.J.A.C. 7:14A), the Stormwater Management Rules (N.J.A.C. 7:8), the Flood Hazard Area Control Act rules (N.J.A.C. 7:13), the Freshwater Wetlands Protection Act Rules (N.J.A.C. 7:7A), the Criteria and Standards for Animal Waste Management(N.J.A.C. 2:91), and the newly

enacted Fertilizer Control Law for commercial and residential lawn care and management.

- Refine their open space and farmland preservation plan for protecting hydrologically sensitive areas from future development.
- Develop the municipal ordinance for OSDS inspection, maintenance and operation that requires a 3-year certification program.
- Work with federal, state, county governmental agencies, universities, non-governmental and non-profit agencies and local environmental consulting firms to apply for and secure the necessary funding and technical assistance and begin implementation of the proposed BMP projects in the watershed.

The implementation of the BMPs for the first two years are estimated to cost $3.4 million and achieve the following milestones toward the pollutant reduction goals and the attainment of water quality standards:

- Prevent further deterioration in water quality and watershed hydrology;
- Reduce annual TP load by 1,770 pounds, which is close to 30 percent of the required annual load reduction for TP;
- Reduce annual sediment load by 75 tons, which is equivalent to 50 percent of the required annual load reduction for sediment; and
- Reduce annual load of pathogens by 5 percent.

Implementation of the BMP projects during the first five years is estimated to cost $8 million and achieve the following milestones toward the pollutant reduction goals and the attainment of the water quality standards:

- Improve water quality and watershed hydrology;
- Reduce annual TP load by 3,800 pounds, which is equivalent to 60 percent of the required annual load reduction in TP;
- Reduce annual sediment load by 175 tons, which exceeds the required annual load reduction for sediment; and
- Reduce annual load of pathogens by 60 percent.

The completion of the 10-year implementation of the BMP projects is estimated to cost $14.6 million and achieve the following milestones toward the pollutant reduction goals and the attainments of the water quality standards:

- Improve the water quality and restore watershed hydrology;
- Reduce annual TP load by 6,000 pounds, which exceeds the required annual load reduction in TP and attains the water quality standard for TP;
- Reduce annual sediment load by 324 tons, which exceeds the required annual load reduction for sediment and achieves the water quality standard for TSS;
- Achieve an 89 percent annual load reduction for pathogens and attain the water quality standard for pathogens.

8. A set of criteria that can be used to determine whether loading reductions are being achieved over time and substantial progress is being made towards attaining water quality standards

Two criteria can be used to evaluate whether watershed restoration is successful. The first criterion relates to changes in land use management practices. This criterion evaluates whether: (1) the proposed BMP projects are implemented in the watershed; (2) stakeholders are more aware of the impacts of their land use and management decisions; and (3) stakeholders continue to practice environmentally friendly BMPs after initial BMP funding ends. The second criterion relates to the outcomes observed in streams and their riparian areas. This criterion evaluates whether such things as: (1) water quality and biological conditions in streams improve over time; and (2) stream channels become stabilized.

9. *A monitoring component to evaluate the effectiveness of the implementation efforts over time*

Based on these two criteria, a monitoring program can be used to determine the success of watershed restoration efforts. Such a program would involve the following elements:

- Establish a database to document the BMPs being implemented in different locations of the watershed and estimate their water quality impacts using quantitative models and tools, such as Spreadsheet Tool for Estimating Pollutant Load (STEPL) model;
- Continue the comprehensive streamflow, water quality and biological monitoring program at the USGS Reaville Gage Station in the watershed and compare the newly obtained water quality monitoring data to the previous data to determine whether water quality improves;
- Continue the long-term biological monitoring in four biological monitoring stations in the watershed to determine long-term changes in biological conditions in the Neshanic streams; and
- Use volunteers to periodically conduct stream visual assessment using VAPP to assess physical changes in the streams and their riparian zones.

The Plan demonstrates that it is possible to achieve the required pollutant load reductions and restore water quality and watershed hydrology through implementing various BMPs. Moreover, watershed restoration is not simply about adopting the proposed BMPs, but, in addition, a process of encouraging and stimulating stakeholders including municipalities, residents, businesses and farmers to permanently use those environmental friendly land use and management practices. Through the implementation of these BMPs and continuous education and outreach activities, the ultimate goal of this Plan to help the stakeholders develop new types of awareness, perception and behaviors with respect to using the lands and managing their water resources that lead to the permanent improvement in water quality in the Neshanic River Watershed.