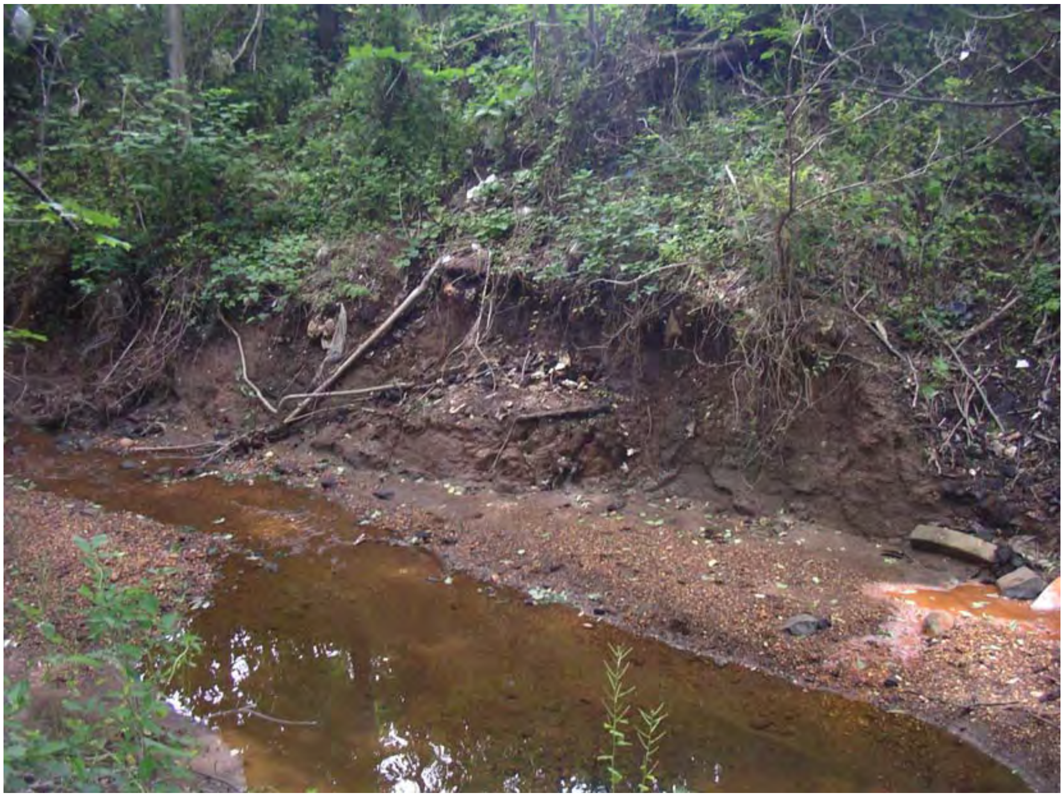
TRC Omni

RAMANESSIN BROOK
STORMWATER MANAGEMENT AND STREAM RESTORATION
IMPLEMENTATION PROJECTS



Prepared For:

Monmouth Coastal Watersheds Partnership
WMA 12

Prepared By:

TRC Omni Environmental Corporation

November 10, 2006 (Revised January 9, 2007)

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SFY 2007 319(h) Grant Application Cover Sheet for Watershed-Based Plan Implementation Projects

1) Implementation Project Name: Ramanessin Brook Restoration Projects
2) Watershed Plan Project is Implementing: Ramanessin Brook Nonpoint Source Pollution Source Assessment and Stormwater Impact Study and Addendum
3) Waterbody Primarily Affected: Ramanessin Brook
4) Type of NPS Implementation Project: Stormwater, Erosion Control, and Streambank Stabilization
5) Primary Pollutant Targeted: Phosphorus, Suspended Solids, Fecal Coliform
6) Additional Pollutants Addressed: N/A

Applicant Information

7) Applicant Organization Name: Monmouth Coastal Watersheds Partnership

8) Organization Address: (street name and #) Hall of Records Annex, One East Main Street

(city, state, zip code) Freehold, NJ 07728

9) Organization Numbers: Phone #: 732 - 431 - 7460 Fax #: 732 - 409 - 7540

10) Contact Person: K. Thomas Kellers (name), Chairman MCWP (title)

11) Contact's Phone: 732-431-7460

12) Contact's Email: TKellers@shore.co.monmouth.nj.us

Watershed Information

13) WMA: 12

14) List of All Waterbodies Affected by Project and Their Status:

A) Ramanessin Brook Status) Impaired for phosphorus, fecal coliform, and aquatic life
B) Swimming River Reservoir Status) Unassessed
C) ______ Status) ______
D) ______ Status) ______

Riparian Buffer and Streambank Projects

15) Linear Feet of Streambank to be Stabilized: TBD
16) Minimum Riparian Buffer Width Proposed: TBD
17) Maximum Continuous Linear Feet of Riparian Buffer Proposed: TBD
18) Total Linear Feet of Riparian Buffer: TBD
19) Total Acreage of Riparian Buffer: TBD

Project Information

20) Project Duration in Months: 48
21) Grant Amount Requested: $1,328,000 + Local Match: $0.00 =
Project Total: $ 1,328,000

* Grant administration and limited water quality monitoring to be provided by Monmouth County.

Applicant Certifications

The Division of Watershed Management (Division) requires certain standards to be followed. To meet these requirements, applicants must indicate compliance by initialing each statement below. Failure to comply with any of these requirements will render the application ineligible.

- Applicant agrees to coordinate all permitting through the Division Project Manager.
  KH (initial here)
- Applicant commits to providing complete and timely quarterly reports and a final report as described in the state guidance document for 319(h) projects for SFY 2007.
  KH (initial here)
- Applicant commits to conducting an evaluation of the effectiveness of the project, including a commitment to provide monitoring data or other information that documents improvement in water quality, the reduction of pollutant loads, or other project outcomes.
  KH (initial here)
- Applicant agrees that no water quality monitoring data may be collected prior to the Department's approval of a Quality Assurance Project Plan (QAPP). The procedures, number of sampling events, Quality Assurance/Quality Control procedures, as well as all other elements detailed in the approved QAPP will be followed.
  KH (initial here)

I certify that I have read the entirety of this project proposal and that the information in this proposal is complete and accurate. In addition, should this project be funded in the SFY 2007 319(h) grant funding cycle, I acknowledge that this proposal will be converted into a binding contract and that the entity that I represent is committed to fulfilling the contents of that contract.

22) Person w/ Grant Acceptance Authority: Thomas Kellers (name), Chairman MCWP (title)

Signature: [signature] Date: 6-30-06

(DII use only)

Received:	Tracking code:

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Attachments

I. ABSTRACT

The Ramanessin Brook Nonpoint Source Pollution Source Assessment and Stormwater Impact Study (TRC Omni, December 2005) was performed through a grant awarded to the Monmouth County Planning Board and initiated as a partnership among Monmouth County Planning Board, Navesink – Swimming River Group, and TRC Omni. Furthermore, an implementation plan was prepared as an Addendum to the report (TRC Omni, June 2006). Together, the study and addendum serve as the watershed-based plan this Proposal is designed to implement.

The proposed study area is the Ramanessin Brook watershed within Watershed Management Area 12 (WMA 12). The Ramanessin Brook Watershed, Hydrologic Unit Code (HUC) 02030104070010, is approximately six square miles in size. The study referenced above provided insight into the following characteristics of the watershed that affect the Ramanessin Brook:

- Retrofits focused on low-intensity storms in most sensitive sub-watersheds will have the greatest benefit in terms of peak flow and total volume reductions from stormwater.
- Instream erosion is a major source of phosphorus and suspended sediment.
- The erosion of glauconitic soils is a major source of phosphorus and suspended sediment.
- Fecal coliform analyses indicated a constant load that affects water quality during low flows, as well as a runoff load that affects water quality during high flows.

The goal of this project is to improve the water quality of the Ramanessin Brook by implementing stormwater management and stream restoration Best Management Practices (BMPs) that achieve reductions in NPS pollutant loading so that water quality standards may be met. The Ramanessin Brook Nonpoint Source Pollution Source Assessment and Stormwater Impact Study quantified and mapped sub-watersheds according to their vulnerability to erosion of glauconitic soils and specific pollutants. In addition, the study quantified and mapped stream reaches according to their vulnerability to instream erosion. Using these analyses, specific sub-watersheds and stream reaches were identified as having the greatest potential benefit from stormwater management and stream restoration practices. Field surveys were then completed to identify specific mitigation projects in sub-watersheds and stream reaches that would improve runoff quality, decrease peak flows rates, reduce runoff volume, stabilize eroding streambanks, and educate the public on the importance of non-point source pollution control and water quality.

Five individual project sites were identified and prioritized based on effectiveness, access to site, cost, and maintenance: 1) Holmdel High School, 2) Holmdel Park, 3) Holmdel Park Activity Center, 4) Holmdel Village Elementary School, and 5) Ramanessin Brook Greenway Nature Trails. A variety of BMPs, including streambank restoration structures, bioretention facilities, check dams, infiltration trenches, and riparian buffer plantings have been identified for the priority implementation sites. The BMPs focus on treating runoff in the smaller water quality events and protecting against instream erosion. Two additional projects were identified as well based on the results of the study referenced previously: a feasibility study on the use of sediment abatement structures at the outlet of Ramanessin Brook in order to reduce the impact to

Swimming River reservoir; and a trackback study on the stormwater and baseflow sources of fecal coliform.

This Proposal requests a total of **$1,383,900** ~~$1,407,900~~ in order to perform all seven restoration tasks and to monitor their effectiveness. The concept designs described in this Proposal would be developed into detailed design plans that can be implemented and constructed in the field. A monitoring component has been included to evaluate the effectiveness of the implementation efforts over time.

II. APPLICANT DESCRIPTION

TRC Omni will be working closely with Monmouth County in conducting the projects' tasks. The staff at TRC Omni includes landscape architects, civil and environmental engineers, chemists, geologists, and GIS specialists that are dedicated to seeing this project succeed. TRC Omni has a successful history with 319(h) implementation projects and has been conducting water quality studies throughout New Jersey for over 15 years. TRC Omni has been actively involved in the WMA 12 watershed management effort led by Monmouth County for about five years, volunteering time and experience to the effort. This direct link between the volunteer effort and the engineering firm is a unique advantage to this project. Furthermore, since this grant was first proposed, communication with Holmdel Township on the grant's prospects and goals has been continuous. The township will be kept aware of all implementation projects through Monmouth County.

III. SCOPE OF WORK

A. Background Information

The proposed watershed study area is the Ramanessin Brook Watershed in WMA 12. The Ramanessin Brook Watershed (HUC 02030104070010) is approximately six square miles in size. Two AMNET locations on the Ramanessin Brook identify the stream as severely to moderately impaired, respectively, north to south (ANO465 & ANO466). Furthermore, the Monmouth County Health Department collects water quality data under an approved QA/QC program and has identified water quality criteria exceedences for fecal coliform and total phosphorus in the Ramanessin Brook at Station No. 53 (Willow Road). According to the New Jersey 2004 Integrated Water Quality Monitoring and Assessment Report, the Ramanessin Brook is impaired for both fecal coliform and phosphorus. A TMDL for fecal coliform in the Ramanessin Brook was established in June 2003 and requires a 91% reduction in fecal coliform sources in order to attain water quality standards.

B. Root Cause Analysis

The Ramanessin Brook Nonpoint Source Pollution Source Assessment and Stormwater Impact Study was completed by TRC Omni in December of 2005. The purposes of the study included: 1) to evaluate the sources of fecal coliform and phosphorus in Ramanessin Brook; 2) to develop a hydrologic model and pollutant loading model of the stream; and 3) to assess water quality impacts due to nonpoint sources (NPS), specifically instream erosion and stormwater. A total of five stream sampling station locations were sampled bi-weekly from July 2004 to June 2005, and one background station was sampled six times from July 2004 to October 2004. TRC Omni also collected flow data and surveyed cross sections approximately every 500 feet along the mainstem of the stream.

Using watershed modeling tools developed during the course of the study, several analyses were performed, including:

- Evaluating and mapping glauconitic soil erosion potential;
- Calculating peak flows and total stormwater volumes for individual subwatersheds using pre-developed, existing, and projected build-out land use conditions;
- Calculating shear stress in the stream to understand erosion of sediment under various flow conditions;
- Evaluating pollutant loading for total suspended solids, total phosphorus, and fecal coliform in individual subwatersheds; and
- Assessing water quality for the entire watershed using all available data.

These analyses provide insight into characteristics of the watershed that affect the Ramanessin Brook. The peak flow and total stormwater volume calculations demonstrate that any changes in watershed land uses that affect runoff have a more significant impact during storms of lower intensities than during storms of higher intensities. The simulations indicate that stormwater and watershed management implemented at a sub-watershed level can significantly impact peak flow rates and volumes during the smaller, more frequent storms that contribute the majority of the rainfall in the State of New Jersey over a given year.

In addition, these analyses demonstrate that land use changes that have already occurred have produced a much larger impact on storm runoff than any changes that might result from future development. Since the analyses performed do not account for BMPs, including those required for new development, they tend to overestimate the impact of new development. Despite this, the analyses show that existing development has a more profound impact on stormwater characteristics than new development.

The pollutant loading and water quality analyses clearly illustrate the importance of erosion of glauconitic soils as a major source of phosphorus and suspended solids in the Ramanessin Brook. This erosion originates both from the watershed and within the stream itself. The study identified sub-watersheds with the most potential for erosion of glauconitic soil, while the shear stress hydraulic analysis also identified which reaches of the stream are most susceptible to instream erosion.

Fecal coliform analyses illustrate that high levels of bacterial contamination are observed at both low and high flows. During low flows, fecal coliform concentration increases as flow decreases, indicating a constant load that is being diluted by baseflow. During high flows, fecal coliform concentration increases as flow increases. This clearly indicates high runoff loads being delivered to the stream. Further study is necessary to track the bacterial contamination, particularly under low flows.

Based on these findings, the study recommends that mitigation efforts in the Ramanessin Brook watershed focus on stormwater improvements, in particular small storm retrofits. The study can be used to direct retrofits to the following areas:

- Areas that can produce the most reduction in peak flow and total volume;
- Areas with the highest potential fecal coliform load; and
- Areas with the highest potential for glauconitic soil erosion.

Since instream erosion and erosion of glauconitic soils by stormwater represent the major sources of phosphorus and suspended solids in Ramanessin Brook, focusing retrofits accordingly can be used to maximize restoration benefits. Furthermore, the study quantifies and maps stream reaches according to their vulnerability to instream erosion. Finally, the study recommends that fecal coliform trackdown focus on both runoff and baseflow, and should include localized stormwater and baseflow monitoring. The Addendum to the study (attached) identifies and prioritizes specific BMPs based on the findings of the study.

C. Goals, Objectives, and Tasks

1. Goals

The goal of this project is to implement watershed restoration projects that will reduce the pollutant loads that currently impair Ramanessin Brook and the Swimming River Reservoir. The implementation projects focus on stormwater and stream restoration BMPs. The goals of these BMPs are to reduce runoff volume and peak rates in the smaller water quality storms, reduce total phosphorus and sediment loads, and reduce instream erosion. The Ramanessin Brook Nonpoint Source Pollution Source Assessment and Stormwater Impact Study has defined specific subwatersheds and stream reaches that deliver the highest pollutant loads and would benefit the most from the installation of BMPs. Based on this information, five implementation project sites were selected on public property. Many of the sites are in areas of high public visibility, which will provide excellent opportunities for public education and outreach on the importance of stormwater management and water quality. The BMP projects consist of developing detailed design plans, installing the BMPs, and monitoring the success of the projects. Furthermore, the ultimate goal of the actions specified in the watershed-based plan (<u>Ramanessin Brook Nonpoint Source Pollution Source Assessment and Stormwater Impact Study</u> plus <u>Addendum</u>) is to improve water quality and aquatic life in the Ramanessin Brook.

Additional studies are proposed to address sediment delivery to the Swimming River Reservoir and to track fecal coliform sources. The goal of the first study is to assess the feasibility of sediment abatement structures at the outlet of Ramanessin Brook that would significantly reduce sediment and phosphorus loading to the Swimming River Reservoir. The goal of the second study is to perform stormwater and baseflow monitoring to identify local bacterial sources.

2. Objectives

Within 6 months of the initiation of the project, a bacterial tracking study will be designed to analyze potential bacterial sources. Stormwater and baseflow sampling will be designed at select locations to pinpoint local sources of fecal coliform.

Within one year of the initiation of this project, project partners will develop detailed design plans of all approved stormwater management and stream restoration BMPs. These plans will include detailed costs, materials, and schedules. The final designs will be provided to the various stakeholders for review. The stormwater management BMPs will be designed to treat and infiltrate all impervious runoff from contributory areas in the water quality event. The stream restoration BMPs will reduce shear stress and instream erosion along critical reaches of Ramanessin Brook.

Within 1½ years of the initiation of the project, a feasibility study will be performed on the use of sediment abatement structures, such as inline settling vaults, at the outlet of Ramanessin Brook at the Swimming River Reservoir to remove sediment. Because the glauconitic soils are high in iron and bind to phosphorus, the removal of sediment at the outlet of Ramanessin Brook will significantly reduce the phosphorus load to the Reservoir.

Within 3 years of the initiation of the project, the BMPs will be constructed and installed throughout the watershed. The construction of the BMPs will be performed by a contractor and built to the design specifications.

Within 4 years of the initiation of the project, monitoring will be performed to assess the success of the BMP implementation projects. Stream sampling, as well as BMP inlet and outlet sampling, will be performed to analyze improvements in water quality over time.

3. Tasks

The project will be coordinated with the existing Navesink/Swimming River RSWMP Committee. This Committee meets bimonthly and will discuss the development of detailed project designs, additional analyses, and monitoring methodologies.

Furthermore, the Committee will assist in identifying additional partners to participate in the project. The end result of working with the Committee in this work will be the successful installation of the recommended stormwater management and stream restoration BMPs, as well as the development of new ideas for future projects that will improve the water quality in Ramanessin Brook and the Swimming River Reservoir.

The five recommended BMP project sites in priority order are: 1) Holmdel High School, 2) Holmdel Park, 3) Holmdel Park Activity Center, 4) Holmdel Village Elementary School, and 5) Ramanessin Brook Greenway Nature Trails. The sites were prioritized based on effectiveness, access to site, cost, and maintenance, and are described in more detail in the Addendum (attached) to the Ramanessin Brook Nonpoint Source Pollution Source Assessment and Stormwater Impact Study. Tasks 1 through 5 describe the five proposed project sites along with concept designs for the stormwater management and stream restoration BMPs. Tasks 6 and 7 describe the additional analyses proposed.

Maps and photos of all five sites and proposed BMPs are in the attached Addendum.

Task 1: Design and install Holmdel High School BMPs.

The Holmdel High School site is located on the north side of Crawfords Corner Road near Longstreet Road. As part of this task, stream restoration structures will be implemented at the outfall of the east stormwater pipe to stabilize the eroding streambanks. The outfall structures on both the east and west stormwater pipes will be redesigned with energy dissipating structures and scour holes. Because the runoff from the High School is uncontrolled and there are large areas of unused open space, there is potential for installing a variety of stormwater BMPs. The proposed BMPs include the design of a bioretention swale with check dams and a bioretention facility on the eastern portion of the site, and bioretention facilities on the western and southern portions of the site. Water collected from parking lots and other impervious areas will be routed from the existing stormwater pipes through diversion structures into these decentralized BMPs. The facilities will also be used as a tool to educate high school students and the general public on the importance of stormwater management and water quality.

According to the Ramanessin Brook Nonpoint Source Pollution Source Assessment and Stormwater Impact Study, Holmdel High School is located in the subwatershed that would achieve the highest percent reduction in peak flow and total volume from small storm retrofits. Furthermore, the stream reach impacted by Holmdel High School is near the headwater and is among the most vulnerable to streambank erosion. Finally, the subwatershed in which Holmdel High School is located would produce the highest percent reduction of both phosphorus and suspended solids loads from small storm retrofits. Both the subwatershed and stream segment impacted by Holmdel High School exhibit a high potential for erosion of glauconitic soils. For all these reasons, Holmdel High School is an ideal location to perform streambank stabilization and stormwater infrastructure retrofits, as proposed, in terms of the benefits to the watershed as a whole.

The proposed BMPs at Holmdel High School are designed to reduce phosphorus, suspended solids, and bacterial loads, and the location will optimize the

benefits of those reductions. Phosphorus, suspended solids, and fecal coliform loads during a two-year storm were estimated to be 0.018 kg/acre/year, 5.1 kg/acre/year, and 1.50×10^{10} colonies/acre/day, respectively, in the subwatershed in which Holmdel High School is located (Ramanessin Brook Nonpoint Source Pollution Source Assessment and Stormwater Impact Study). Depending on the exact BMPs selected and the design of the BMPs, phosphorus and sediment reductions for the area that drains to each BMP can be expected to be at least 60 and 80 percent, respectively. Reductions in stormwater loads of fecal coliform will be substantial, but are not as well characterized. Post-construction monitoring for this project will allow for better characterization in the future.

In addition to the reduction of stormwater pollutant loads, the reduction of peak flows and stabilization of streambanks will also reduce the degree of instream erosion, another major source of both phosphorus and suspended solids. It is estimated that instream erosion loads are up to three and five times higher than stormwater loads for suspended solids and phosphorus, respectively. The stream segment impacted by Holmdel High School is highly susceptible to instream erosion, and the peak flow reductions will also reduce instream erosion in downstream segments where instream erosion represents a greater share of the total pollutant loads (Ramanessin Brook Nonpoint Source Pollution Source Assessment and Stormwater Impact Study). Finally, while not easily quantified, the proposed BMP projects at Holmdel High School include public education components that will stress the importance of individual homeowner efforts to control stormwater.

Task 2: Design and install Holmdel Park BMPs.

Holmdel Park is located on the west side of Longstreet Road. As part of this task, various low-impact development (LID) stormwater management practices, such as pervious pavement, rain gardens, filter strips, and infiltration areas will be designed to treat and infiltrate parking lot runoff. Unmowed filter strips along the edges of the mowed grass areas will be designed to trap sediment and other pollutants from entering the surface waters. Any project pursued in the park would also be visible to the public and increase public awareness of the importance of stormwater BMPs and water quality.

According to the Ramanessin Brook Nonpoint Source Pollution Source Assessment and Stormwater Impact Study, Holmdel Park drains a watershed with a high potential for erosion of glauconitic soils, and the park drains to a tributary that enters Ramanessin Brook at a location with a high susceptibility to instream erosion. The subwatershed in which Holmdel Park is located would achieve a substantial reduction in peak flow and total volume from small storm retrofits.

The proposed BMPs at Holmdel Park are designed to reduce phosphorus, suspended solids, and bacterial loads. Phosphorus, suspended solids, and fecal coliform loads during a two-year storm were estimated to be 0.011 kg/acre/day, 1.7 kg/acre/year, and 1.08×10^{10} colonies/acre/day, respectively, in the subwatershed in which Holmdel Park is located (Ramanessin Brook Nonpoint Source Pollution Source Assessment and Stormwater Impact Study). Depending on the exact BMPs selected and the design of the BMPs, phosphorus and sediment reductions for the area that drains to each BMP can be expected to be in the range of 30-60 and 60-80

percent, respectively. Reductions in stormwater loads of fecal coliform will be substantial, but are not as well characterized. Post-construction monitoring for this project will allow for better characterization in the future.

In addition to the reduction of stormwater pollutant loads, the reduction of peak flows will also reduce the degree of instream erosion within Ramanessin Brook, another major source of both phosphorus and suspended solids. It is estimated that instream erosion loads are up to three and five times higher than stormwater loads for suspended solids and phosphorus, respectively (<u>Ramanessin Brook Nonpoint Source Pollution Source Assessment and Stormwater Impact Study</u>). Finally, while not easily quantified, the proposed BMP projects at Holmdel Park include a public education component that will stress the importance of individual homeowner efforts to control stormwater.

<u>Task 3</u>: Design and install Holmdel Park Activity Center BMPs.

The Holmdel Park Activity Center is located north of the main park area on Longstreet Road. As part of this task, a rain garden will be designed on the east side of the parking lot median. Overflows from the rain garden will be routed to a sedimentation chamber before discharging to the tributary. The project is intended to be a demonstration on the use of stormwater management technologies that can be implemented by residential homeowners to disconnect impervious surfaces and improve water quality. In addition, TRC Omni will design step pool structures in the tributary to reduce stream erosion.

According to the <u>Ramanessin Brook Nonpoint Source Pollution Source Assessment and Stormwater Impact Study</u>, Holmdel Activity Center drains a watershed with a high potential for erosion of glauconitic soils, and the park drains to a tributary that enters Ramanessin Brook at a location with a high susceptibility to instream erosion. The subwatershed in which Holmdel Activity Center is located would achieve a substantial reduction in peak flow and total volume from small storm retrofits.

The proposed BMPs at Holmdel Activity Center are designed to reduce phosphorus, suspended solids, and bacterial loads. Phosphorus, suspended solids, and fecal coliform loads during a two-year storm were estimated to be 0.011 kg/acre/day, 1.8 kg/acre/year, and 1.02×10^{10} colonies/acre/day, respectively, in the subwatershed in which Holmdel Activity Center is located (<u>Ramanessin Brook Nonpoint Source Pollution Source Assessment and Stormwater Impact Study</u>). Depending on the exact BMPs selected and the design of the BMPs, phosphorus and sediment reductions for the area that drains to each BMP can be expected to be in the range of 30-60 and 60-80 percent, respectively. Reductions in stormwater loads of fecal coliform will be substantial, but are not as well characterized. Post-construction monitoring for this project will allow for better characterization in the future.

In addition to the reduction of stormwater pollutant loads, the reduction of peak flows will also reduce the degree of instream erosion within Ramanessin Brook, another major source of both phosphorus and suspended solids. It is estimated that instream erosion loads are up to three and five times higher than

stormwater loads for suspended solids and phosphorus, respectively (Ramanessin Brook Nonpoint Source Pollution Source Assessment and Stormwater Impact Study). Finally, while not easily quantified, the proposed BMP projects at Holmdel Activity Center revolve around public education components that will stress the importance of individual homeowner efforts to control stormwater.

Task 4: Design and install Holmdel Village Elementary School BMPs.

The Holmdel Village Elementary School is located at the intersection of Rt. 520 and Middlesex Road. The project partners will redesign the drainage of the existing parking lot to include curb cuts that allow water to flow to rain gardens. The roof leaders of the school will also be directed to the rain gardens. The disconnection of the large areas of impervious surface on the site will decrease runoff volumes and peak rates, improve infiltration, and reduce pollutant loadings to Ramanessin Brook.

According to the Ramanessin Brook Nonpoint Source Pollution Source Assessment and Stormwater Impact Study, the Holmdel Village Elementary School drains a watershed with a high potential for erosion of glauconitic soils, and the park drains to a tributary that enters Ramanessin Brook at a location with the highest susceptibility to instream erosion. The subwatershed in which Holmdel Village Elementary School is located would achieve a substantial reduction in peak flow and total volume from small storm retrofits.

The proposed BMPs at Holmdel Village Elementary School are designed to reduce phosphorus, suspended solids, and bacterial loads. Phosphorus, suspended solids, and fecal coliform loads during a two-year storm were estimated to be 0.021 kg/acre/day, 4.2 kg/acre/year, and 1.29×10^{10} colonies/acre/day, respectively, in the subwatershed in which Holmdel Village Elementary School is located (Ramanessin Brook Nonpoint Source Pollution Source Assessment and Stormwater Impact Study). Depending on the exact BMPs selected and the design of the BMPs, phosphorus and sediment reductions for the area that drains to each BMP can be expected to be in the range of 30-60 and 60-80 percent, respectively. Reductions in stormwater loads of fecal coliform will be substantial, but are not as well characterized. Post-construction monitoring for this project will allow for better characterization in the future.

In addition to the reduction of stormwater pollutant loads, the reduction of peak flows will also reduce the degree of instream erosion within Ramanessin Brook, another major source of both phosphorus and suspended solids. It is estimated that instream erosion loads are three and five times higher than stormwater loads for suspended solids and phosphorus, respectively, in the stream segments to which the Holmdel Village Elementary School drains (Ramanessin Brook Nonpoint Source Pollution Source Assessment and Stormwater Impact Study). Finally, while not easily quantified, the proposed BMP projects at Holmdel Village Elementary School include public education components that will stress the importance of individual homeowner efforts to control stormwater.

***Task 5*: Design and install Ramanessin Greenway Nature Trail BMPs.**

The Ramanessin Brook Greenway Nature Trail is located on the west side of Middletown Road. As part of this task, designs for streambank restoration structures such as root wads, log vanes, and crib walls that have the potential to reduce shear stress along the streambank and reduce erosion will be evaluated and installed as appropriate.

According to the Ramanessin Brook Nonpoint Source Pollution Source Assessment and Stormwater Impact Study, the segment of Ramanessin Brook adjacent to the Ramanessin Greenway Nature Trail exhibits a very high susceptibility to instream erosion, among the highest in the watershed. Therefore, streambank stabilization BMPs are proposed for the Ramanessin Brook segment adjacent to the Ramanessin Greenway Nature Trail in order to reduce instream loads of phosphorus and suspended solids. Phosphorus and suspended solids loads during a two-year storm were estimated to be 0.014 and 2.2 kg/acre/year, respectively, in the subwatershed in which the Ramanessin Greenway Nature Trail is located. It was further estimated that instream erosion loads are three and five times higher than stormwater loads for suspended solids and phosphorus, respectively, in the stream segment adjacent to Ramanessin Greenway Nature Trail (Ramanessin Brook Nonpoint Source Pollution Source Assessment and Stormwater Impact Study). Finally, while not easily quantified, the proposed BMP projects at Ramanessin Greenway Nature Trail include public education components that will stress the importance of individual homeowner efforts to control stormwater.

***Task 6*: Prepare feasibility study on the use of sediment abatement structures at the outlet of Ramanessin Brook.**

The project partners propose a feasibility study on the use of a sediment removal mechanism at the outlet of Ramanessin Brook to the Swimming River Reservoir. The Ramanessin Brook watershed contains large areas of glauconitic soils which contain high levels of iron. The iron binds to phosphorus, rendering phosphorus attached to the sediment and unavailable to plants in Ramanessin Brook. The sediment is then transported to the Swimming River Reservoir where the phosphorus can become reintroduced into the water column and stimulate algal blooms. A sediment abatement structure at the outlet of Ramanessin Brook would remove phosphorus-laden sediment and thereby reduce the phosphorus load to the Swimming River Reservoir dramatically. A feasibility study is required to evaluate whether the project is possible and what the associated costs and environmental benefits are.

***Task 7*: Prepare trackback study on the stormwater and baseflow sources of fecal coliform.**

In order to investigate the local bacterial sources, we propose a bacterial tracking study with local stormwater and baseflow monitoring. The study would occur in two phases: localized monitoring within the watershed to locate the geographic sources of baseflow and runoff loads of fecal coliform followed by intensive source identification. **As described previously in the Root Cause Analysis and more completely in the Ramanessin Brook Nonpoint Source Pollution Source Assessment and Stormwater Impact Study, bacterial contamination is observed at both low and high flows.**

During low flows, sampling results indicate the presence of a constant load that is being diluted by baseflow. On the other hand, bacterial concentrations also increase during high flows, indicating that high runoff loads are being delivered to the stream. While the high runoff loads can be partly explained by the stormwater loads expected based on the land uses present in the watershed, further study is necessary to track the bacterial contamination, particularly under low flows. The cause of the high bacterial concentrations observed under low flows must be better understood in order to design mitigating solutions.

IV. DRAFT QUALITY ASSURANCE PROJECT PLAN (QAPP)

For each of the five restoration projects, follow-up monitoring will be performed in order to measure the performance of the BMPs installed as well as to assess the impact of the improvements in the stream itself. A complete QAPP will be developed to describe the quality assurance procedures and quality control specifications for all follow-up monitoring activities. No follow-up monitoring will be performed until a QAPP is developed and approved by NJDEP. TRC Omni is very familiar with QAPP procedures and protocol, having developed dozens of QAPPs for various projects that have been approved by NJDEP. Sampling procedures, instrument calibration, sample containers, sample preservation, sample holding times, and laboratory analytical methods will all be described in the QAPP.

This Draft QAPP describes the follow-up monitoring proposed for each restoration project as well as the follow-up monitoring within Ramanessin Brook. A signatory page for the Draft QAPP is attached to this Proposal.

A. Follow-up Monitoring for Stormwater BMPs

The proposed restoration projects include stormwater BMPs at five locations in the Ramanessin Brook watershed. The BMPs will be designed to mimic natural hydrology by reducing runoff peak flows and volumes. These water quantity benefits result in water quality improvements, such as reduced non-point source loading and reduced instream erosion. Two stormwater BMPs will be selected for detailed post-construction performance evaluation. The two BMPs selected will include inlet and outlet discharge points that can be monitored or that can be modified temporarily in order to allow monitoring.

To ensure that the BMPs function as designed to reduce peak flow and volume, stormwater flow will be measured at the inlet and outlet structures of the two selected BMPs. Pressure transducers will be installed in the field to measure continuous depth within the inlet and outlet structures during three storm events. The pressure transducers will be connected to a datalogger to record continuous measurements. A rating curve will be established using field measurement of flow versus depth. By measuring depth and calculating flow continuously throughout the storm events, the functionality of the stormwater BMPs in reducing peak flows and volumes will be analyzed and compared with their designs.

Sampling of both BMP inlets and outlets, as well as an instream station downstream of each BMP, will be performed to evaluate the effectiveness of the BMPs in improving water quality. Water quality monitoring will be performed during three storm events as described below. Water quality parameters measured will include total suspended solids, fecal coliform, and total phosphorus. Velocity and depth measurements will also be performed in order to calculate flow. The analytical results will then be compared to evaluate the effectiveness of the BMPs.

Three stormwater BMP monitoring events will be performed at the inlets and outlet of BMPs and at one instream station downstream of each BMP during the summer period from May to September. Stormwater events will be performed during storms predicted to deliver at least 0.5 inches of rain that are preceded by at least 72 hours with no more than 0.1 inches of rain. Smaller storms will be targeted, and no storm larger than 2.9 inches (the one-year frequency storm in Monmouth County) will be sampled. Over the course of each storm event, a total of five grab samples will be collected at each inlet and outlet station. In addition, one grab sample will be collected at the downstream station towards the end of the storm. The first sample will be collected near the beginning of the storm and the remaining four samples will be collected during the storm to characterize the water quality over the hydrograph. After sample collection is complete, these grab samples will be composited into one sample for each station based on flow-weighting. As a result, two flow-weighted composite samples and one instream grab sample will be analyzed for each BMP (a total of six samples per storm).

In addition to the flow and water quality measurements at two BMPs, photo documentation will be performed at all BMP locations during three storm events. Photos will be time-stamped, sorted, and labeled in order to provide a visual survey of BMP performance during each storm.

B. Follow-up Monitoring for Ramanessin Brook

Three locations were selected in Ramanessin Brook to perform follow-up monitoring aimed at providing assessment information to NJDEP: RB1, RB3, and RB4 (see attached Sampling Map from Ramanessin Brook Nonpoint Source Pollution Source Assessment and Stormwater Impact Study). Station RB1 is downstream of the Holmdel High School restoration site; station RB3 is downstream of the Holmdel Activity Center and Holmdel Park restoration sites; station RB4 is downstream of the Ramanessin Brook Greenway Trail and Holmdel Village Elementary School restoration sites.

Eight water quality sampling events will be performed during ambient flow conditions from May to September. During each sampling event, one grab sample will be collected from each sampling location. Each sample will be analyzed *in-situ* for pH, temperature, and dissolved oxygen. In addition, laboratory analyses of total suspended solids, fecal coliform, and total phosphorus will be performed for each sample. As a result, eight water quality measurements at three locations in Ramanessin Brook will be obtained following installation of all BMPs.

~~In addition to the chemical water quality sampling described above, biological sampling will be performed at Stations RB1 and RB4, downstream of Holmdel High School and Greenway Trail restoration sites, respectively. Three macroinvertebrate surveys will be performed prior to BMP construction, and three more macroinvertebrate surveys will be performed each year for two years following installation of all BMPs. A total of nine benthic macroinvertebrate sampling events will be performed at both RB1 and RB4 (three prior to BMP construction and six after). All post-BMP macroinvertebrate surveys will be performed least six months after BMP installation.~~

~~All macroinvertebrate sampling procedures will be in conformance with the NJDEP's Rapid Bioassessment Protocol (RBP). TRC Omni will complete the surveys using the protocol and habitat assessment devised by the NJDEP's Bureau of Freshwater and Biological Monitoring, which is based on the United States Environmental Protection Agency (USEPA) protocol. TRC Omni will also use the NJDEP's five biometric scoring system to calculate a New Jersey Impairment Score (NJIS) for each of the sites. Macroinvertebrate sampling will be completed between May and November. Chemical~~

~~measurements of the stream will be collected concurrently with the biological sampling; a single sample will be collected mid-stream at mid-depth for immediate analysis of dissolved oxygen, pH, and temperature.~~

C. Budget for Follow-up Monitoring

The budget for follow-up monitoring as described above is provided in the table below.

Follow-up Monitoring Budget

Task	Budget
Preparation of Final QAPP	$6,000
BMP Sampling Labor and Equipment	$15,000
BMP Sampling Laboratory Analyses	$1,400
BMP Performance Photo Documentation	$2,600
Instream Sampling Labor and Equipment	$10,000
Instream Sampling Laboratory Analyses	$1,900
~~Benthic Macroinvertebrate Sampling~~	~~$24,000~~
Project Management and Follow Up Monitoring Report	$19,000
TOTAL	**$55.900** **~~$79,900~~**

V. SUPPORTING DOCUMENTATION

Costs and prioritization of restoration tasks for Ramanessin Brook are shown in the table on the following page. Attached to this grant Proposal is the *Identification and Prioritization of Ramanessin Brook Restoration Projects* (Addendum to the Ramanessin Brook Nonpoint Source Pollution Source Assessment and Stormwater Impact Study). Together, the study and addendum serve as the watershed-based plan this Proposal is designed to implement. An electronic CD is also enclosed with all geographic information system data.

Only species of plants native to Monmouth County will be utilized for the restoration projects in this Proposal. As required, a final species list indicating quantities and a planting plan will be submitted to the Division of Watershed Management for approval prior to purchase and installation of any plants. Furthermore, all permit pre-application meetings, applications, and application meetings will be coordinated with the Division of Watershed Management Project Manager. The Division of Watershed Management will be listed as a co-applicant for any NJDEP permit sought in connection with the restoration projects in this Proposal. A table of anticipated permit requirements for each project is provided at the end of this Proposal.

Also attached is a letter of support from Monmouth County Watersheds Partnership as well as a letter from the Bureau of Watershed Planning authorizing the use of WMA 12 funding to complete the watershed-based plan for Ramanessin Brook. A letter of commitment from TRC Omni is also included. TRC Omni has a proven record of accomplishment collaborating with Monmouth County to successfully implement watershed projects. Furthermore, Monmouth

County has a proven track record for administering grants. This partnership will ensure that grant money is utilized effectively to help restore Ramanessin Brook.

Costs and Prioritization of Restoration Tasks for Ramanessin Brook

Task #	Site Location	Project Name	Construction Cost Estimate	Design, Permitting, Bidding, & CM Costs	Total Cost	Priority
1a	Holmdel High School	East Stormwater Management Retrofit and Streambank Stabilization	$ 358,800	$ 82,500	$ 441,300	1
1b	Holmdel High School	West Stormwater Management Retrofit	$ 214,900	$ 49,400	$ 264,300	1
2a	Holmdel Park	Riparian Buffer and Filter Strip Plantings	$ 20,600	$ 4,700	$ 25,300	2
2b	Holmdel Park	Parking Lot Stormwater Management Retrofit	$ 196,000	$ 45,100	$ 241,100	2
3	Holmdel Park Activity Center	Streambank Restoration & Parking Lot Stormwater Management Retrofit	$ 55,200	$ 12,700	$ 67,900	3
4	Holmdel Village Elementary School	Parking Lot and Roof Runoff Rain Garden BMPs	$ 73,800	$ 17,000	$ 90,800	4
5	Ramanessin Brook Greenway Nature Trail	Streambank Restoration Structure	$ 127,900	$ 29,400	$ 157,300	5
6	-	Sediment Abatement Structure Feasibility Study	-	$ 25,000	$ 25,000	6
7	-	Fecal Coliform Trackback Study - Sampling Plan	-	$ 15,000	$ 15,000	7
				Follow-up Monitoring	$ 55,900	
		Total:	**$ 1,047,200**	**$ 280,800**	**$ 1,383,900**	

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Project Implementation Schedule
Ramanessin Brook Watershed Restoration Projects

TASK	RESPONSIBLE PARTY	TIMEFRAME	ANTICIPATED START MONTH	PROJECT DELIVERABLE	ANTICIPATED COMPLETION MONTH
Task 1	Project Consultant, Monmouth County Planning, & Holmdel Schools	Design (12 Months) Implementation (24 Months)	Design - Month 1 Implementation - Month 13	Design Plans, Permits, and BMP	Design - Month 12 Implementation - Month 36
Task 2	Project Consultant, Monmouth County Planning, & Holmdel	Design (12 Months) Implementation (24 Months)	Design - Month 1 Implementation - Month 13	Design Plans, Permits, and BMP	Design - Month 12 Implementation - Month 36
Task 3	Project Consultant, Monmouth County Planning, & Holmdel	Design (12 Months) Implementation (24 Months)	Design - Month 1 Implementation - Month 13	Design Plans, Permits, and BMP	Design - Month 12 Implementation - Month 36
Task 4	Project Consultant, Monmouth County Planning, & Holmdel Schools	Design (12 Months) Implementation (24 Months)	Design - Month 1 Implementation - Month 13	Design Plans, Permits, and BMP	Design - Month 12 Implementation - Month 36
Task 5	Project Consultant & Monmouth County Planning	Design (12 Months) Implementation (24 Months)	Design - Month 1 Implementation - Month 13	Design Plans, Permits, and BMP	Design - Month 12 Implementation - Month 36
Task 6	Project Consultant & Monmouth County Planning	6 months	Month 13	Sediment Abatement Feasibility Study	Month 18
Task 7	Project Consultant & Monmouth County Planning	6 months	Month 1	Bacterial Tracking Study Design/QAPP	Month 6
Follow-up Monitoring	Project Consultant & Monmouth County Planning	18 Months	Month 31	QAPP and Follow-Up Monitoring Report	Month 48

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Task #	Site Location	Project Name	NJDEP Flood Hazard Area Permit	NJDEP FWW Permit	Monmouth County Soil Conservation District	Priority
1a	Holmdel High School	East Stormwater Management Retrofit and Streambank Stabilization	Minor Stream Encroachment	GP11 and GP20	SESC Plan & Stormwater Mngmt Review	1
1b	Holmdel High School	West Stormwater Management Retrofit	Minor Stream Encroachment	GP11	SESC Plan & Stormwater Mngmt Review	1
2a	Holmdel Park	Riparian Buffer and Filter Strip Plantings	Minor Stream Encroachment	GP20	SESC Plan	2
2b	Holmdel Park	Parking Lot Stormwater Management Retrofit	NA	NA	SESC Plan & Stormwater Mngmt Review	2
3	Holmdel Park Activity Center	Streambank Restoration & Parking Lot Stormwater Management Retrofit	Minor Stream Encroachment	GP11 and GP20	SESC Plan & Stormwater Mngmt Review	3
4	Holmdel Village Elementary School	Parking Lot and Roof Runoff Rain Garden BMPs	NA	NA	SESC Plan & Stormwater Mngmt Review	4
5	Ramanessin Brook Greenway Nature Trail	Streambank Restoration Structure	Major Stream Encroachment	Individual Wetlands Permit	SESC Plan	5
6	-	Sediment Abatement Structure Feasibility Study				6
7	-	Fecal Coliform Trackback Study - Sampling Plan				7

DRAFT
QUALITY ASSURANCE PROJECT PLAN
RAMANESSIN BROOK STORMWATER MANAGEMENT AND STREAM RESTORATION IMPLEMENTATION PROJECTS
NOVEMBER 10, 2006

Prepared by: Thomas Amidon
TRC Omni Environmental Corporation

Signature Date 11-10-2006

Reviewed by: Turner Shell
Monmouth Coastal Watersheds Partnership

Signature Date 11/13/06

Reviewed by: David McPartland
NJDEP

Signature Date

Approved by: Marc Ferko
NJDEP, Office of Quality Assurance

Signature Date

Taken directly from the Ramanessin Brook Nonpoint Source Pollution Source Assessment and Stormwater Impact Study (TRC Omni, December 2005)

USGS Topography & Sampling Stations