# TOWNSHIP OF PARSIPPANY-TROY HILLS

## MORRIS COUNTY, NEW JERSEY

# MUNICIPAL STORMWATER MANAGEMENT PLAN

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**PREPARED FOR:**
TOWNSHIP OF PARSIPPANY-TROY HILLS
MORRIS COUNTY, NEW JERSEY

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## INTRODUCTION

This Municipal Stormwater Management Plan (MSWMP) documents the strategy for the Township of Parsippany-Troy Hills ("the Township") to address stormwater-related impacts. The creation of this Plan is required by N.J.A.C. 7:14A-25 Municipal Stormwater Regulations. This Plan contains all of the required elements described in N.J.A.C. 7:8 Stormwater Management Rules. The Plan addresses groundwater recharge, stormwater quantity, and stormwater quality impacts by incorporating stormwater design and performance standards for new major development, defined as projects that disturb one or more acre of land. These standards are intended to minimize the adverse impact of stormwater runoff on water quality and water quantity and the loss of groundwater recharge that provides base flow in receiving water bodies. The Plan describes long-term operation and maintenance measures for existing and future stormwater facilities.

A "build-out" analysis has been included in this Plan based upon existing zoning and land available for development. The Plan addresses the review of existing ordinances and the Township Master Plan for incorporation of low impact development techniques. The final component of this Plan is a mitigation strategy for when a variance is sought from the design and performance standards of the stormwater management rules.

## GOALS

The general goals of this MSWMP are to present an overview of the Township's waterways and to establish a framework for compliance with the Municipal Stormwater Regulations. The specific goals of this Plan are to:

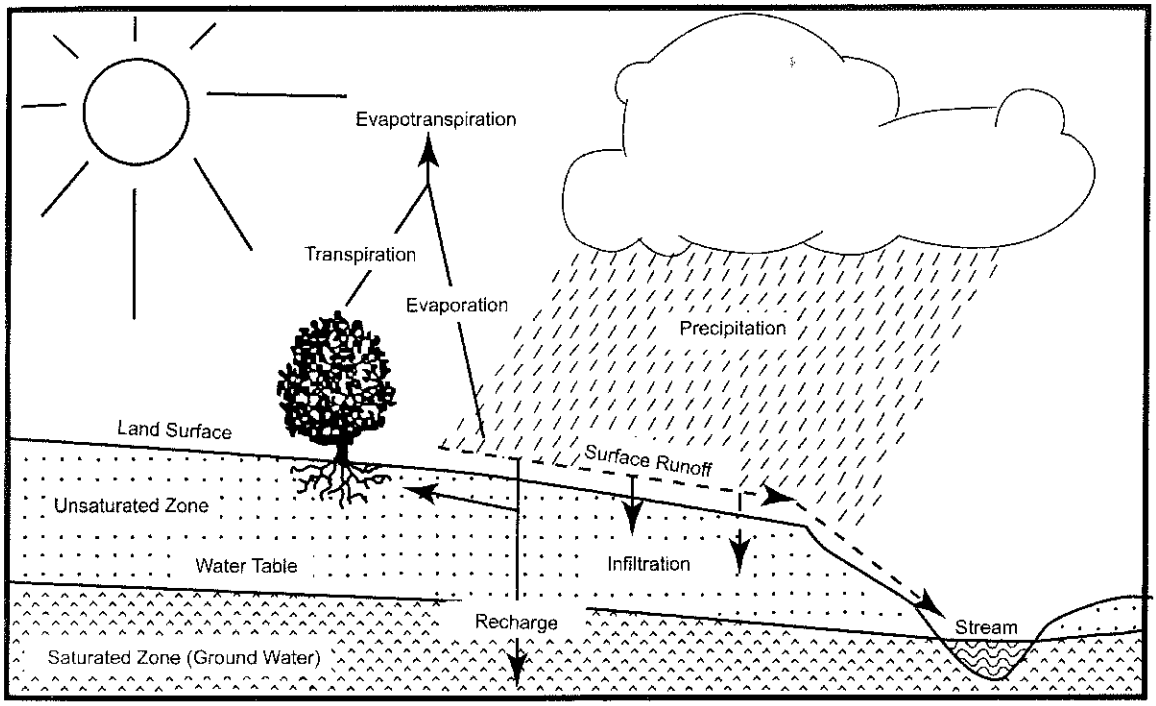
1) Reduce flood damage, including damage to life and property;
2) Minimize, to the maximum extent practical, any increase in stormwater runoff from any new development;
3) Reduce soil erosion from any development or construction project;
4) Assure the adequacy of existing and proposed culverts and bridges, and other in-stream structures;
5) Maintain groundwater recharge;
6) Prevent, to the greatest extent feasible, any increase in nonpoint pollution (pollution caused by rainfall or snowmelt moving over and through the ground and contacting items such as fertilizers, pet waste, and litter);
7) Maintain the integrity of stream channels for their biological functions, as well as for drainage;
8) Minimize pollutants in stormwater runoff from new and existing development to restore, enhance, and maintain the chemical, physical, and biological integrity of the water of the state, to protect public health, to safeguard fish and aquatic life and scenic and ecological values and to enhance the domestic, municipal, recreational, industrial, and other uses of water; and
9) Protect public safety through the proper design and operation of stormwater basins.

To achieve these goals, this Plan outlines specific stormwater design and performance standards for new development. Additionally, the Plan proposes stormwater management controls to address impacts from existing development. Preventative and corrective maintenance strategies are included in the Plan to ensure long-term effectiveness of stormwater management facilities. The Plan also outlines safety standards for stormwater infrastructure to be implemented to protect public safety.

## STORMWATER DISCUSSION

Land development can dramatically alter the hydrologic cycle (see figure below) of a site and, ultimately, an entire watershed. Prior to development, native vegetation can either directly intercept precipitation or draw that portion of the precipitation that has infiltrated into the ground and return it to the atmosphere through evapotranspiration. Development can remove this beneficial vegetation and replace it with lawn or impervious cover, reducing the site's evapotranspiration infiltration rates. Clearing and grading a site can remove depressions that store rainfall, and construction activities may also compact the soil and diminish its infiltration ability, resulting in increased volumes and rates of stormwater runoff from the site.

**Groundwater Recharge in the Hydrologic Cycle**




Source: New Jersey Geological Survey Report GSR-32.

Impervious areas that are connected to each other through gutters, channels, and storm sewers can transport runoff more quickly than naturally vegetated areas. This decrease of the transport time quickens the rainfall-runoff response of the drainage area, causing flow in downstream waterways to peak more quickly and higher than in natural conditions. These increases can create new and aggravate existing downstream flooding and erosion problems and increase the quantity of sediment in the waterway. Additionally, storm sewers that discharge runoff directly into a stream eliminate filtration of runoff and removal of pollutants by surface and channel vegetation. Increases in impervious area can also decrease opportunities for infiltration, which, in turn, reduces stream base flow and groundwater recharge. Reduced baseflows and increased peak flows produce greater fluctuations between normal and storm flow rates, which can increase channel erosion. Reduced baseflows can also negatively impact the hydrology of

adjacent wetlands and the health of biological communities that depend on baseflows. Finally, erosion and sedimentation can destroy habitat from which some species cannot adapt.

In addition to increases in runoff peak flows and volumes, and loss of groundwater recharge, land development often results in the accumulation of pollutants on the land surface that runoff can mobilize and transport to streams. New impervious surfaces and cleared areas created by development can accumulate a variety of pollutants from the atmosphere, fertilizers, animal wastes and leakage from vehicles. Pollutants can include metals, suspended solids, hydrocarbons, pathogens, and nutrients.

Land development can adversely affect water quality and stream biota in more subtle ways. For example, stormwater falling on impervious surfaces or stored in detention or retention basins can become heated and raise the temperature of the downstream waterway, adversely affecting cold water fish species such as trout. Development can remove trees along stream banks that normally provide shading, stabilization, and leaf litter that falls into streams and becomes food for the aquatic community.

## BACKGROUND OF PARSIPPANY-TROY HILLS WATERWAYS

The Township of Parsippany-Troy Hills can be characterized as a large size, suburban community with mixed type uses. The Township is located in the eastern-central section of Morris County. It has a land area of approximately 25 square miles and water area of 1.48 square miles. Parsippany-Troy Hills is bounded to the north by the Borough of Mountain Lakes, the Town of Boonton, and the Township of Montville, to the east by the Townships of Hanover and East Hanover, to the south by the Borough of Morris Plains, and to the west by the Township of Denville. The Morris County Seat is located in Morristown, which lies approximately 3 miles to the south of the Township. Additionally, New York City is less than 25 miles to the east.

### Population Growth

The following table shows the general population characteristics of the Township of Parsippany-Troy Hills and compares them to those of the county and state. It reveals that the population growth rate of the Township, during the past decade, has not risen as quickly as the County and State.

| | 1990 Population | 2000 Population | % Change |
|---|---|---|---|
| New Jersey | 7,730,188 | 8,115,011 | +4.98% |
| Morris County | 421,353 | 459,896 | +9.14% |
| Parsippany Township | 48,478 | 50,649 | +4.47% |

The Township of Parsippany-Troy Hills has a well-designed network of public streets and highways. It is readily accessible for residents or commercial and industrial businesses. Parsippany's location, at the crossroad of several major highways, has greatly contributed to its economic development in recent years.

Parsippany-Troy Hills has a diversified economic base and relatively low unemployment. A mix of corporate headquarters, office/business parks and firms involved in research and development and data processing support a stable, high-paid professional/technical and managerial/administrative labor force. The proximity to New York City, New York State, and New England enables it to pursue its own economic development plans, but it is also able to benefit from the commercial and industrial development occurring throughout the New York Metropolitan area.

The Township of Parsippany-Troy Hills has been very active in pursuing drainage improvements in several sections of the Township. The Township has constructed a floodwall and pumping station to eliminate flooding from the Rockaway River. Over 300 hundred-property owners have benefited from this improvement. In addition to the floodwall, other improvements in the Lake Hiawatha area include improvements to Berries Brook, and road improvements to the street network including installation of storm drains, granite block curbing and road resurfacing.

Similar improvements have been made in the Lake Parsippany section of the Township. Sediment basins have been constructed in Lake Parsippany to collect sediment and floatables before they enter the main portion of the Lake. In the Lake Intervale section of the Township, multi-barrel drainage pipes have been replaced with box culverts to reduce flooding and overtopping of the roadways. Along a portion of the Rockaway River near the Knoll East Golf Course, de-snagging of the river and the installation of trees along the riverbank has been completed.

Currently the Township is participating in a study of Troy Brook with both upstream and downstream municipalities to look at flooding, stream bank erosion and water quality issues. It is anticipated that this study will lead to a Regional Stormwater Management Plan (RSWMP) for Troy Brook. This will ultimately become an amendment to this MSWMP.

A significant portion of the culverts were designed for much different hydrologic conditions (i.e. less impervious area) than presently exists in the Township. As the imperviousness increased in the Township, the peak and volumes of stream flows correspondingly increased. The increased amount of water resulted in stream bank erosion, which resulted in unstable areas at roadway/bridge crossings, and degraded stream habitats. The increased imperviousness of the Township has decreased groundwater recharge, which decreases base flows in streams during dry weather periods. Lower base flows can have a negative impact on instream habitat during the summer months.

With all of the improvements denoted above there are still several areas in the municipality that still experience flooding and stream bank erosions issues. They are the following:

- Hills of Troy Section
- Watnong Brook (Tabor Lake)
- New Road Area
- Scow Ditch (tributary to Troy Brook)
- West Brook

The Township is basically divided into two watersheds. The first being the Rockaway River and the other is the Whippany River. The larger watershed is the Whippany River. As shown in Figure A the watersheds are divided into sub-watersheds also known as HUC14s. The term "HUC14" is from the hydrologic unit code system developed by the United States Geological Service for delineating and identifying drainage areas. The system starts with the largest possible drainage areas and progressively smaller subdivisions of the drainage area are delineated and numbered in a nested fashion. A drainage area with a HUC designation with 14 numbers, or HUC14, is one of several sub-watersheds of a larger watershed with 11 numbers, or a HUC11. There are 921 HUC14 sub-watersheds in New Jersey that range in size from 0.1 to 42 square miles. In Parsippany-Troy Hills the following are the nine HUC14s:

- Den Brook (HUC14 ID # 02030103030120)
- Rockaway River-Boonton Dam to Stony Brook (HUC14 ID # 02030103030150)
- Rockaway River-Passaic River to Boonton Dam (HUC14 ID # 02030103030170)

- Greystone/Watnong Mountain Tributary (HUC14 ID # 02030103020030)
- Malapardis Brook (HUC14 ID # 02030103020060)
- Troy Brook above Reynolds Avenue (HUC14 ID # 02030103020080)
- Troy Brook below Reynolds Avenue (HUC14 ID # 02030103020090)
- Whippany River-Rockaway River to Malapardis Brook (HUC14 ID # 02030103020100)
- Lake Pocahontas to Washington Valley Road (HUC14 ID # 02030103020040)

The soil types with in the Township vary greatly. Figure B illustrates a map showing the soil types. Figure C indicates the ground water recharge areas. Figure D shows the wellhead protection areas (including tiers) for the Township water wells. The Township's Planning Board has acknowledged that the protections of the wellheads are important. The Planning Board is considering a wellhead protection ordinance to protect the potable water supply. The Township has over 20 active wells, which supply this potable water.

There are several streams which cross the Township of Parsippany-Troy Hills. The Rockaway River has a drainage area of 204 square miles at its confluence with the Passaic River, and it provides a natural border with the Township of Montville along the northeast side of the Township. The Whippany River has a drainage area of 69 square miles and is located along the southeast side of the Township. Troy Brook, which drains a large portion of the Township, has a drainage area of 15 square miles at its confluence with the Whippany River, and flows west to east through the center of the Township. There are also several other smaller streams, lakes, and ponds within the Township.

The NJDEP has established an Ambient Biomonitoring Network (AMNET) to document the health of the State's waterways. There are over 800 AMNET sites throughout the State of New Jersey. According to the latest AMNET data, the monitoring sites closest to Parsippany-Troy Hills are as follows:

- Troy Brook at Lake Drive in Mountain Lakes
- Troy Brook at Beverwyck Road in Troy Hills
- Whippany River at Jefferson Road in East Hanover Township
- Whippany River at Edwards Road in East Hanover Township
- Rockaway River at Morris Avenue in Boonton
- Rockaway River at River Road in Boonton

These sites are sampled for benthic macroinvertebrates by the NJDEP on a five-year cycle. Streams are classified as non-impaired, moderately impaired, or severely impaired based on the AMNET data. This data is used to generate a New Jersey Impairment Score (NJIS), which is based on a number of biometrics related to benthic macroinvertebrate community dynamics.

In 1993 and 1998, the NJDEP listed the sampling station along Troy Brook in Mountain Lakes as moderately impaired. In 1993, the NJDEP listed the second station along Troy Brook near the confluence of the Whippany River as moderately impaired. In 1998, the same station was classified as non-impaired. The Whippany River at both sampling stations is currently classified as moderately impaired. The Rockaway River at both sampling stations (which are located

immediately upstream and downstream from the Jersey City Reservoir) is also classified as moderately impaired.

In addition to the AMNET data, the NJDEP and other regulatory agencies collect water quality chemical data on the streams and waterbodies in the State. This data shows that several water bodies in the Township exceed the State's criteria for fecal coliform. Accordingly, the NJDEP has adopted a Total Maximum Daily Load (TMDL) for fecal coliform for the Whippany River Watershed and portions of the Rockaway River. The Whippany River Watershed includes Troy Brook, Watnong Brook, Eastmans Brook, West Brook, Lake Parsippany, Powder Mill Pond, Mount Tabor Lake, Rainbow Lakes, Forge Pond, and Intervale Lake.

A TMDL is the amount of a pollutant that can be accepted by a waterbody without causing an exceedance of water quality standards or interfering with the ability to use a waterbody for one or more of its designated uses. The allowable load is allocated to the various sources of the pollutant, such as stormwater and wastewater discharges, which require a New Jersey Pollutant Discharge Elimination System (NJPDES) permit to discharge, and nonpoint sources, which include stormwater runoff from agricultural areas and residential areas, along with a margin of safety. Provisions may also be made for future sources in the form of reserve capacity. An implementation plan is developed to identify how the various sources will be reduced to the designated allocations. For further information on biological monitoring (AMNET data) the NJDEP web site is www.state.nj.us/dep/wmm/bfbm.

The Whippany River Watershed TMDL indicates that a 58.5% reduction on overall nonpoint source loads is necessary to achieve the target conditions for fecal coliform concentrations. The TMDL identified the sources of fecal coliform as malfunctioning or older, improperly sized septic systems; Canada geese, waterfowl, and other wildlife; pet waste; and stormwater basins which act as an accumulation point for fecal matter. Implementation strategies may include the following measures:

- Conducting sanitary surveys and septic system management programs;
- Adoption of waterfowl and wildlife feeding ordinances, and providing shoreline fencing or other habitat alteration to eliminate access to grassed area along the waterways;
- Adoption of ordinances addressing pet waste and providing plastic bag dispensers in public recreation areas;
- Retrofitting and cleaning stormwater basins; and
- Other stormwater best management practices (BMPs).

There is also an Interim Total Phosphorous Reduction Plan for the Whippany River Watershed. A TMDL for phosphorous is not required at this time because the River is in compliance with surface water quality standards. However, due to elevated phosphorous levels in the watershed and downstream in the Passaic River, it is recommended that current phosphorous levels not be exceeded. Sources of phosphorous may include common fertilizers used for lawn care and septic systems.

A TMDL for fecal coliform has recently been developed for the Rockaway River. The TMDL indicates that a 91% reduction of source loads is necessary in the portion of the River near

Parsippany-Troy Hills to achieve the target conditions for fecal coliform concentrations. The sources of the fecal coliform and the implementation strategies are similar to those for the Whippany River Watershed.

The New Jersey Integrated Water Quality Monitoring and Assessment Report (305(b) and 303(d)) (Integrated List) is required by the federal Clean Water Act to be prepared biennially and is a valuable source of water quality information (the Integrated List is published by the NJDEP Bureau of Water Quality Standards and Assessment, website: www.state.nj.us/dep/wmm/sgwqt/wat/index.html). This combined report presents the extent to which New Jersey waters are attaining water quality standards, and identifies waters that are impaired. Sublist 5 of the Integrated List constitutes the list of waters impaired or threatened by pollutants, for which one or more TMDL is needed. This data shows that several waterbodies in the Township are impaired for fecal coliform. The waterbodies that have fecal coliform impairments are Intervale Lake, Parsippany Lake, Powder Mill Pond, and Rainbow Lakes. The Jersey City Reservoir has an impairment listing for mercury; the Whippany River and the Watnong Brook both have low impairment rating for benthic macroinvertebrates; and the Rockaway River in Boonton (immediately upstream from the Jersey City Reservoir) has an impairment rating for benthic macroinvertebrates, arsenic, cadmium, chromium, lead, selenium, tetrachloroethylene, trichloroethylene, and zinc.

## DESIGN AND PERFORMANCE STANDARDS

The Township of Parsippany-Troy Hills will adopt the design and performance standards for stormwater management measures as presented in N.J.A.C. 7:8-5 to minimize the adverse impact of stormwater runoff on water quality and water quantity and loss of groundwater recharge in receiving water bodies. The implementation of water quality standards will help to achieve Goals 6, 7, and 8 by minimizing the pollutants in stormwater runoff. The standards for water quantity reduction will help to achieve Goals 1 and 2 by reducing stormwater runoff for sites with new development and redevelopment. The water quantity standards will also help to achieve Goals 4 and 7 by preventing increases in stormwater runoff from sites being developed. The implementation of the standards for groundwater recharge will help to achieve Goal 5 by maintaining groundwater recharge at sites being developed.

In order to ensure adequate long-term operation and maintenance of stormwater management measures in the Township, the design and performance standards include the requirements for maintenance of stormwater management measures consistent with the stormwater management rules at N.J.A.C. 7:8-5.8 (Maintenance Requirements). The design and performance standards will also include the requirements for safety standards consistent with N.J.A.C. 7:8-6 (Safety Standards for Stormwater Management Basins). These safety standards include requirements for trash racks, overflow grates, and escape provisions for stormwater management basins. These standards will help to achieve Goal 9, and shall be implemented in all new and/or rehabilitated stormwater management basins.

The Jersey City Reservoir is designated as Category One (C1) waterbody. The Stormwater Management Rules require that Special Water Resource Protection Areas (SWRPAs) be established along all waters designated C1, and all perennial or intermittent streams within the associated HUC14 drainage area that drain into or upstream of the C1 waters (in this case there are no other streams within the Township located upstream of the Reservoir). Accordingly, a SWRPA shall be established along the Jersey City Reservoir. This area shall be established for the protection of water quality, aesthetic value, exceptional ecological significance, exceptional recreational significance, exceptional water supply significance, and exceptional fisheries significance of those Category One waters. A 300-foot SWRPA shall be provided on all sides of the Reservoir, measured perpendicular to the waterway from the top of the bank outwards. Development within the 300-foot SWRPA is limited to only certain activities.

The Township is located in the Highlands Planning Area. Under the Highlands Water Protection and Planning Act, there are no special stormwater or SWRPA provisions in the Planning Area. The Highlands Master Plan, which is currently under development, should be evaluated to determine the stormwater and SWRPA requirements that are included for the Planning Area.

It should be noted that the according to the NJAC 7:8, development and redevelopment in a large portion of Parsippany-Troy Hills is exempt from the groundwater recharge requirements of the new Stormwater Management Rules. The groundwater recharge requirement does not apply to projects within an "urban redevelopment area". The urban redevelopment area is defined, among other criteria, as previously developed portions of areas delineated on the State Plan Policy Map (SPPM) as Metropolitan Planning Area 1 (PA1) designated centers. The majority of

the Township, with the exception of areas located in the southwest and southeast corners of the Township, along with an area immediately adjacent to the Jersey City Reservoir, is a PA1 designated center. Despite this, development and redevelopment projects in the Township will be encouraged to implement groundwater recharge where feasible. A large portion of the Township where groundwater recharge may not be required actually has soil conditions conducive to groundwater recharge (refer to Figure C for Groundwater Recharge Areas).

Along with implementing the ordinances to address stormwater management design, maintenance, and safety, Township inspectors will observe the construction of the project to ensure that the stormwater management measures are constructed and function as designed.

## PLAN CONSISTENCY

There is currently not a RSWMP specifically for any of the waterways in the Township, although a RSWMP is currently being developed for the Troy Brook. However, as noted in the *Background* section, a TMDL has been adopted for the Whippany River Watershed. This MSWMP will be consistent with the goals of the TMDL. The primary stormwater related goals of the TMDL are the implementation the Municipal Stormwater Regulation Program, implementation of the new Stormwater Management Rules, and establishment of a 300-foot SWRPA around C1 waters. The Township will implement the Stormwater Regulation Program and the Stormwater Management Rules as required by the NJDEP in order to help achieve these goals. The Township's Stormwater Control Ordinance will address requirements for operation and maintenance of stormwater basins associated with development and redevelopment, and the Township will also be required to conduct cleaning and maintenance of municipal stormwater facilities. If any RSWMP or new TMDL is developed in the future, this Municipal Stormwater Management Plan shall be reviewed in comparison to the goals and implementation criteria of the RSWMP and/or TMDL, and be updated to be consistent with any new criteria. This review and update shall, at a minimum, occur when the Municipal Stormwater Management Plan is updated as part of required municipal master plan review, or within one (1) year of adoption of a RSWMP. The Regional Master Plan being developed by the New Jersey Highlands Council may have stormwater related impacts, and should similarly be reviewed in comparison to this Municipal Stormwater Management Plan.

This Municipal Stormwater Management Plan is consistent with the Residential Site Improvement Standards (RSIS) at N.J.A.C. 5:21. The Township will utilize the most current update of the RSIS in the stormwater management review of residential areas. This MSWMP will be updated to be consistent with any future updates to the RSIS. This review and update shall, at a minimum, occur when the Municipal Stormwater Management Plan is updated as part of required municipal master plan review.

The Township's Stormwater Control Ordinance will require all new development and redevelopment plans to comply with New Jersey's Soil Erosion and Sediment Control Standards. Township inspectors (or their representatives) will observe on-site soil erosion and sediment control measures during construction and report any inconsistencies to the Morris County Soil Conservation District. This will help in achieving Goal 3 by reducing soil erosion from new development or redevelopment projects.

## NONSTRUCTURAL STORMWATER MANAGEMENT STRATEGIES

Land development can have severe adverse stormwater impacts, particularly if the land is converted from woods, meadow, or other natural condition to a highly disturbed area with large percentages of impervious and non-native vegetated covers. Such impacts typically include an increase in stormwater runoff volume, rate, velocity, and pollutants and a corresponding decrease in the quality of runoff and stream flow. Frequently, management of these impacts has focused on collecting and conveying the runoff from the entire site through a structural conveyance system to a centralized facility (e.g., detention basin, wet pond) where it is stored and treated prior to discharge downstream. In effect, such practices first allow the adverse runoff impacts to occur throughout the site and then provide remedial and/or restorative measures immediately prior to releasing the runoff downstream.

Since the 1960s, the range of remedial measures provided in centralized stormwater management facilities has increased from merely 100-year peak flow attenuation, to the range of peak flow, volume, and nonpoint source pollutant controls required by New Jersey's current Stormwater Management Rules at N.J.A.C. 7:8. This has required modifications to established methods of runoff computation and the development of alternative treatment methods to be used in centralized facilities.

However, with the increasing emphasis on nonpoint source pollution and concerns over the environmental impacts of land development, it has become necessary to develop effective alternatives to the centralized conveyance and treatment strategy that has been the basis for much of the stormwater management systems and programs in the State. New strategies must be developed to minimize and even prevent adverse stormwater runoff impacts from occurring and then to provide necessary treatment closer to the origin of those impacts. Such strategies, known collectively as Low Impact Development (LID), seek to reduce and/or prevent adverse runoff impacts through sound site planning and both nonstructural and structural techniques that preserve or closely mimic the site's natural or pre-developed hydrologic response to precipitation. Rather than responding to the rainfall-runoff process like centralized structural facilities, low impact development techniques interact with the process, controlling stormwater runoff and pollutants closer to the source and providing site design measures that can significantly reduce the overall impact of land development on stormwater runoff. As such, low impact development promotes the concept of designing with nature.

Effective low impact development includes the use of both nonstructural and structural stormwater management measures that are a subset of a larger group of practices and facilities known as Best Management Practices (BMPs). The BMPs utilized in low impact development, known as LID-BMPs, focus first on minimizing both the quantitative and qualitative changes to a site's pre-developed hydrology through nonstructural practices and then providing treatment as necessary through a network of structural facilities distributed throughout the site. In doing so, low impact development places an emphasis on nonstructural stormwater management measures, seeking to maximize their use prior to utilizing structural BMPs.

Nonstructural BMPs used in low impact development seek to reduce stormwater runoff impacts through sound site planning and design. Nonstructural LID-BMPs include such practices as

minimizing site disturbance, preserving important site features, reducing and disconnecting impervious cover, flattening slopes, utilizing native vegetation, minimizing turf grass lawns, and maintaining natural drainage features and characteristics. Structural BMPs used to control and treat runoff are also considered LID-BMPs if they perform these functions close to the runoff's source. As such, they are typically smaller in size than standard structural BMPs. Structural LID-BMPs include various types of basins, filters, surfaces, and devices located on individual lots in a residential development or throughout a commercial, industrial, or institutional development site in areas not typically suited for larger, centralized structural facilities.

Finally, low impact development promotes the view of rainwater as a resource to be preserved and protected, not a nuisance to be eliminated. For example, with low impact development, roof runoff can be captured and stored in rain barrels for plant watering or other uses. Runoff can also be directed to small on lot bioretention or infiltration basins, also known as rain gardens, to provide both runoff treatment and landscape enhancements.

Unfortunately, low impact development techniques and strategies are considered by some to be applicable only to land development sites with limited impervious cover. However, it has been clearly demonstrated that low impact development techniques can be applied to virtually any development site, regardless of impervious coverage, to produce enhanced site designs and "lower" stormwater impacts.

The use of nonstructural and structural LID-BMPs can be a significant improvement over the more centralized approach to stormwater management traditionally used in New Jersey. Even in those instances where centralized structural BMPs are still required to fully provide downstream areas with effective pollution, erosion, and flood protection, LID-BMPs can help to reduce the number and/or size of such facilities, further reducing site disturbance. And, in certain instances, it may be possible to satisfy all stormwater management requirements through the use of nonstructural LID-BMPs alone, thereby eliminating the need for any structural BMPs. In all instances, specific site and downstream conditions must be evaluated to determine the range of standard and low impact development BMPs that can be utilized at a land development site.

It is also important to note that, since low impact development typically relies on an array of nonstructural and relatively small structural BMPs distributed throughout a land development site, ownership and maintenance of the various BMPs may be similarly distributed over an array of property owners. As such, it is vital to have public understanding of and support for the various LID-BMPs officially authorized for use in a particular municipality. Such understanding and support must include an appreciation for the role that the LID-BMPs play in the site's or watershed's stormwater management program and a commitment to preserve and maintain them.

The use of both nonstructural and structural BMPs in low impact development is governed by certain principles, objectives and requirements. It should be noted that, while consideration of nonstructural stormwater management techniques at land development sites is required by the NJDEP Stormwater Management Rules at N.J.A.C. 7:8, the NJDEP believes that effective, state-wide use of such practices can be best achieved through municipal master plans and land development ordinances that mandate specific LID goals and authorize the use of specific LID-BMPs.

To achieve the Rules' design and performance standards, Subchapter 5 of the NJDEP Stormwater Management Rules requires the maximum practical use of the following nine nonstructural strategies at all major developments:

1. Protect areas that provide water quality benefits or areas particularly susceptible to erosion and sediment loss.
2. Minimize impervious surfaces and break up or disconnect the flow of runoff over impervious surfaces.
3. Maximize the protection of natural drainage features and vegetation.
4. Minimize the decrease in the pre-construction "time of concentration."
5. Minimize land disturbance including clearing and grading.
6. Minimize soil compaction.
7. Provide low maintenance landscaping that encourages retention and planting of native vegetation and minimizes the use of lawns, fertilizers, and pesticides.
8. Provide vegetated open-channel conveyance systems discharge into and through stable vegetated areas.
9. Provide preventative source controls.

While the nonstructural stormwater management strategies listed above represent a wide range of both objectives and practices, Strategies 1 through 8 can be directly addressed through the use of specific nonstructural LID-BMPs that can be grouped into four general categories:

1. Vegetation and Landscaping;
2. Minimizing Site Disturbance;
3. Impervious Area Management; and
4. Time of Concentration Modifications.

## Review of Township Master Plan and Ordinances

The Township has reviewed the master plan and ordinances and has provided a list of the sections in the Township land use and zoning ordinances that are to be modified to incorporate nonstructural stormwater management strategies. These are the ordinances identified for revisions. Once the ordinance texts are completed they will be submitted to Morris County Planning Department for review and approval. A copy will be sent to the NJDEP at the time of submission.

Chapter 225 of the Township Code entitled Land Use, Subdivisions and Site Plans was reviewed with regard to nonstructural stormwater strategies and compliance with the stormwater rules and regulations.

Section 225-36 Definitions: General Requirements: Additional definitions outlined in the new stormwater rules and regulations must be included.

Section 225-45B (25) Preliminary Site Plan: the proposed stormwater drainage system design must be changed to conform to the residential site standards.

Section 225-62 Road and Sidewalk Construction: This section must be changed to comply with the residential site standards. Under section 225-62F Curbing: This section requires that curbing be installed along every street within and fronting on a development. This should be amended to allow for curb cuts or flush curbs with allowing vegetated swales to be used for stormwater conveyance and to allow the disconnection of impervious areas.

Section 225-64L Storm drainage: This section must be changed to comply with the residential site standards. In addition this section should be amended to allow the use of natural vegetative swales in lieu of inlets and pipes.

Section 225-70 Streets: Portions of this section must be changed to comply with the residential site standards.

Section 225-80 Regulation of land constraints areas: This section needs to be changed to increase the buffer from lakes and streams to comply with the stormwater rules and regulations. In addition this section should be expanded to protect forested areas on the site.

Section 225-93 Affordable Housing: This section must be changed to comply with the residential site standards.

Section 430-274 Off-Street Parking and Loading: This section should include a provision which will allow curb cuts or flush curb to encourage discharge of impervious areas into landscape areas for stormwater management. Also language to allow natural vegetated swales for water quality design storms with the overflow for larger storm events into storm sewers. Consideration should be given to bank parking, vertical-parking structures and shared parking.

## LAND USE/BUILD-OUT ANALYSIS

A detailed land use analysis was conducted assuming full development in the Township under existing zoning for each HUC14 drainage area. The result of the build-out analysis is the maximum anticipated acreage of impervious surfaces in each HUC14 and the associated nonpoint stormwater pollutant loadings that can be expected to reach the Township waterways under full build-out conditions. The pollutant load computation is a planning tool that helps municipalities evaluate anticipated pollutant loads from future development. A vacant land analysis to determine the area of vacant and agricultural land within the Township has not been performed.

There are four steps to prepare a build-out analysis for the municipal stormwater management plan:

1. Determine the total land area within each of the HUC14s. Existing Geographic Information System (GIS) information was used in the development of this plan.

2. Determine the area of constrained lands within each HUC14. Constrained lands include land that cannot be developed because of legal restrictions, physical constraints, or environmental sensitivity.

3. Determine the land available for development by subtracting the constrained lands from the total land area for each HUC14. This may include developed areas within the Township that have significant redevelopment potential and that have not been developed to the maximum allowed. The municipal zoning map and applicable ordinances were used to determine the acreage of new development. Figure E shows the existing land use in the Township and Figure F shows the Township zoning districts. The results of the build-out analysis are shown in the table below. The developable area values do not include lands that are not developable due to deed restrictions, steep slopes, floodplains, and other similar items. The build-out values represent existing impervious, impervious from underutilized areas, and impervious from undeveloped areas.

**Township of Parsippany-Troy Hills**
**Build-Out Analysis**

| HUC 14 | Total Area (acres) | Existing Impervious (%) | Existing Impervious (acres) | Wetlands / Water Area (acres) | Developable Area (acres) | Allowable Impervious (%) | Build-Out Impervious (acres) |
|---|---|---|---|---|---|---|---|
| 02030103020040 | 57 | 16% | 9 | 0 | 57 | 20% | 11 |
| 02030103020030 | 2,938 | 17% | 511 | 125 | 2,813 | 26% | 719 |
| 02030103030120 | 249 | 18% | 45 | 19 | 231 | 32% | 75 |
| 02030103020060 | 1,296 | 34% | 437 | 182 | 1,114 | 51% | 573 |
| 02030103020080 | 4,336 | 34% | 1,461 | 455 | 3,880 | 52% | 2,021 |
| 02030103030150 | 1,368 | 9% | 120 | 750 | 618 | 42% | 260 |
| 02030103030170 | 2,453 | 26% | 640 | 332 | 2,121 | 36% | 756 |
| 02030103020090 | 3,095 | 12% | 376 | 1,686 | 1,409 | 40% | 562 |
| 02030103020100 | 388 | 27% | 105 | 146 | 242 | 59% | 142 |
| **Township Total** | **16,180** | **23%** | **3,703** | **3,696** | **12,484** | **41%** | **5,119** |

4. Once the build-out acreage of each land use is determined for each HUC14, nonpoint source loadings can be determined for the build-out (full development) scenario. To calculate pollutant loads from various land uses, the table of values below for Total Suspended Solids (TSS), Nitrogen (TN), and Phosphorus (TP) were used as a broad perspective of anticipated pollutant loadings on a municipal level. The database of TP, TN, and TSS values were assembled by the NJDEP and include approximately 4,000 values accompanied by site-specific characteristics such as location, soil type, mean annual rainfall, and site percent-impervious. The TP, TN, and TSS values were selected based on best professional judgment for eight land use categories.

**Pollutant Loads by Land Cover**

| Land Cover | Total Phosphorous Load (lbs/acre/year) | Total Nitrogen Load (lbs/acre/year) | Total Suspended Solids Load (lbs/acre/year) |
|---|---|---|---|
| High, Medium Density Residential | 1.4 | 15 | 140 |
| Low Density, Rural Residential | 0.63 | 5 | 100 |
| Commercial | 2.1 | 22 | 200 |
| Industrial | 1.5 | 16 | 200 |
| Urban, Mixed Urban, Other Urban | 1.0 | 10 | 120 |
| Agricultural | 1.3 | 10 | 300 |
| Forest, Water, Wetlands | 0.1 | 3 | 40 |
| Barrenland/Transitional Area | 0.5 | 5 | 60 |

The table below is a summary of the projected pollutant loadings at full build-out. This table combines data from the build-out analysis with the typical pollutant loads.

**Township of Parsippany-Troy Hills**
**Pollutant Loading Calculations**

| HUC 14 | Developable Area (acres) | TP (lbs/yr) | TN (lbs/yr) | TSS (lbs/yr) |
|---|---|---|---|---|
| 02030103020040 | 57 | 36 | 284 | 5,685 |
| 02030103020030 | 2,813 | 2,313 | 21,042 | 309,721 |
| 02030103030120 | 231 | 306 | 3,244 | 31,421 |
| 02030103020060 | 1,114 | 1,310 | 13,549 | 143,693 |
| 02030103020080 | 3,880 | 4,460 | 45,617 | 496,385 |
| 02030103030150 | 618 | 768 | 8,027 | 81,614 |
| 02030103030170 | 2,121 | 2,708 | 28,215 | 288,402 |
| 02030103020090 | 1,409 | 1,426 | 14,097 | 167,378 |
| 02030103020100 | 242 | 383 | 4,058 | 43,820 |
| **Total for Township** | **12,484** | **13,709** | **138,133** | **1,568,119** |

Detailed build-out and pollutant loading calculations for each HUC14 drainage area are presented in Appendix A.

To calculate pollutant loads from various land uses, the table of values below for Total Suspended Solids (TSS), Nitrogen (TN), and Phosphorus (TP) were used as a broad perspective of anticipated pollutant loadings on a municipal level. The database of TP, TN, and TSS values were assembled by the NJDEP and include approximately 4,000 values accompanied by site-specific characteristics such as location, soil type, mean annual rainfall, and site percent-impervious. The TP, TN, and TSS values were selected based on best professional judgment for eight land use categories.

There is the potential for significant levels of TSS, TN, and TP to enter the Township's waterways. The BMPs that are required by regulations for the development of undeveloped or underdeveloped areas will impact (reduce) the pollutant loadings from future development. As the Township continues to develop, it is critical that appropriate BMPs be used so that these pollutant loadings are not reached. Land use changes, such as the conversion of agricultural land or forests to urban development, can significantly influence stormwater runoff. When impervious cover such as roofs, roads and parking lots exceeds 10% of an area, water quality can become impaired by stormwater runoff. When impervious cover exceeds 30%, studies have documented impairments to water quality, aquatic diversity and habitat function.

While certain levels of TSS, TN, and TP are normal and essential to waterways, increased levels (as would happen at full build-out without appropriate BMPs) will have significant negative impacts to the Township's waterways. A summary of these pollutants is presented below.

### Total Suspended Solids (TSS)

Total Suspended Solids (TSS) are solids in water that can be trapped by a filter. TSS can include a wide variety of material, such as silt, decaying plant and animal matter, industrial wastes, and sewage. High concentrations of suspended solids can cause many problems for stream health and aquatic life. There are several factors which contribute to TSS loadings. Stormwater related factors include soil erosion caused by disturbance of a land surface including building and road construction, logging, and mining. The eroded soil particles can be carried by stormwater to surface water. During storm events, soil particles and debris from streets and industrial, commercial, and residential areas can be washed into streams. Because of the large amount of pavement in urban areas, infiltration is decreased, and natural settling areas have been removed. Consequently, sediment is carried through storm drains directly to creeks and rivers. For nonpoint sources (stormwater), control measures can be implemented to reduce loadings of suspended solids to streams, rivers and lakes. For construction sites, controls such as silt fences and sedimentation basins are designed to prevent eroding soils from reaching surface waters. In urban areas, use of stormwater ponds, manufactured treatment devices, or a regular schedule of street sweeping may be effective in reducing the quantity of suspended solids in stormwater runoff.

### Total Nitrogen (TN) and Total Phosphorous (TP)

Runoff from developed land has elevated concentrations of both nitrogen and phosphorous, which result in accelerated growth of algae and aquatic plants. This can be detrimental to aquatic life and the use of waterways for recreation. Significant sources of nitrogen and phosphorus include fertilizers, atmospheric deposition, animal waste, organic matter, and stream bank erosion. Data suggests that lawns are a significant contributor, with concentrations as much as four times higher than other land uses, such as streets, rooftops, or driveways. Nutrients are of particular concern in lakes and estuaries, and are a source of degradation in many waters. Additional potential nonpoint sources of phosphorus include malfunctioning sewage conveyance systems, failing or inappropriately located septic systems, and direct contributions from wildlife (particularly geese), livestock and pets.

The BMPs and control measures required through the stormwater permits are generally expected to aid in achieving load reductions. These control measures include adoption and enforcement of a pet waste disposal ordinance, prohibiting the feeding of unconfined wildlife on public property, cleaning catch basins, performing good housekeeping at maintenance yards, providing related public education and employee training, and the use of low or no phosphorous fertilizers. Additional measures that may be considered include, for example, more frequent street sweeping and inlet cleaning, or the retrofit of stormwater management facilities to include nutrient removal.

## MUNICIPAL STORMWATER MITIGATION PLAN

In situations where a proposed development cannot meet the design and performance standards for stormwater runoff quality, stormwater runoff quantity, and groundwater recharge, as established by the Municipal Stormwater Management Plan or the Residential Site Improvement Standards, the Township of Parsippany-Troy Hills (the Township) may grant a variance from the performance standards. For each variance, a mitigation project must be performed which offers an option that clearly offsets the effect of groundwater recharge, stormwater quantity control, and/or stormwater quality control that was created by granting the variance (to be granted by the Planning Board). The NJDEP has published a document titled *Guidance for the Development of Municipal Mitigation Plans (February 2006)*, which was used as the basis for this Plan.

The existence of a mitigation plan does not preclude the requirements that an applicant meet the design and performance standards for stormwater runoff quality, stormwater runoff quantity, and groundwater recharge on the project site. Instead, it allows the Township, in limited circumstances, to waive the strict compliance with one or more of the performance standards, where full compliance cannot be reasonably accommodated on-site, including through a reduction in the size or scale of the development. In accordance with the NJDEP guidance document, a variance cannot be issued if the need for the variance is created by the proposed development. A variance cannot be granted if the project requesting a variance would result in a localized adverse impact or create a compliance deficit that cannot be compensated for by off-site mitigation. In addition, non-structural measures shall be implemented to the maximum extent practicable prior to consideration of a mitigation variance. Under no circumstance will the Township grant a variance for the Special Water Resource Protection Area requirements established under the Stormwater Management Rules at N.J.A.C. 7:8-4.

The Township may grant a variance for any or all of the design and performance standards for projects reviewed under the Municipal Land Use Law (MLUL), or for projects undertaken by the Township that are not subject to the MLUL. Any variance granted by the Township for its own projects must include a report for the project addressing the requirements for mitigation projects. A summary of each variance granted must be included in the Annual Report prepared by the Township as part of the compliance with the Township's NJPDES General Permit. Variances for linear development projects must be evaluated using the requirements under N.J.A.C. 8:8-5.2(e), which includes the requirements to address mitigation for the performance standard for which compliance was not obtained. The issuance of a permit by the NJDEP, that includes a stormwater management review and an associated waiver under the provisions of the specific permit, does not automatically waive the requirements for mitigation to be performed under the Township review. The Township may choose to require mitigation for projects receiving a waiver from the Department.

The mitigation project must provide additional groundwater recharge benefits, or protection from stormwater runoff quality and quantity from previously developed property that does not currently meet the design and performance standards outlined in the Municipal Stormwater Management Plan. The applicant must ensure the long-term maintenance of the project, including the maintenance requirements under Chapters 8 and 9 of the NJDEP Stormwater BMP Manual. If a suitable mitigation site cannot be located in the same drainage area as the

proposed development, the mitigation project may provide mitigation that is not equivalent to the impacts for which the variance or exemption is sought, but that addresses the same issue. For example, if a variance is given because the 80 percent total suspended solids (TSS) removal requirement is not met; the selected project may address water quality impacts due to a fecal impairment. Figure G is a map of areas within the Township which feature soils with poor groundwater recharge suitability, contaminated sites, and redevelopment areas, which are features which may preclude adherence to the stormwater management design and performance standards. This map is not inclusive, nor does it imply that any proposed development does not have to meet the requirements of this Plan.

## Specific Mitigation Projects

The different performance standards require different ways to look at mitigation projects for each performance standard identified. Stormwater quality is intended to prevent an increase in pollutants from entering the waterbodies. Stormwater quantity focuses on the impacts of increased runoff on flooding, and groundwater recharge maintains the water that feeds baseflow in streams and aquifers. Mitigation projects can be retrofits of an existing system, such as pre-existing development where stormwater management was not sufficiently addressed based on the new performance standards. They may also be new projects designed to provide control of stormwater runoff where none previously existed.

Sensitive receptors are areas with specific sensitivity to impacts of stormwater, whether through changes to stormwater runoff quality, stormwater runoff quantity, and groundwater recharge. Examples of sensitive receptors are trout associated waters, threatened and endangered species, impaired waterways, inadequate culverts, property subject to flooding, Category One waters, and aquifers. The sensitive receptor that is affected by the performance standard for which a variance is sought should be identified and considered when selecting the mitigation project. Figure H is a map of some of the sensitive receptors within the Township. This map is not inclusive of all types of sensitive receptors described in this Plan. Township officials may require that additional sensitive receptors be identified as part of the mitigation planning.

### Mitigation Projects for Stormwater Quality

Stormwater quality is regulated for the purpose of minimizing/preventing non-point pollution from reaching a waterway. Mitigation for stormwater quality can be achieved by directing the runoff from the water quality design storm into a natural area where it can be filtered and/or infiltrated into the ground; by constructing a new BMP to intercept previously untreated runoff; or by retrofitting existing stormwater systems that previously did not provide sufficiently for water quality.

Some examples of areas or features sensitive to water quality changes include:

- *Trout associated waters* - chemical pollutants and temperature effects can diminish viability of trout populations;
- *Lakes, ponds or other impoundments* - these waterways are sensitive to the addition of nutrients;

- *Threatened and endangered species or their habitats* - sensitive to both water quality and quantity changes;
- *Drinking water supplies* - adverse affects on quality can increase the cost of treatment or threaten the use of drinking water supplies;
- *Category One waters* - an issue for those streams where quality was basis of the designation; and
- *Waterways with water quality or use impairment* – non-point pollution may result in further deterioration of water quality.

Mitigation Projects for Stormwater Quantity

Increased stormwater runoff volume from new development can cause damage to property and habitat due to increased flood elevations and/or flood velocities. Mitigation project areas can include locations that will provide for additional storage and slower release of excess stormwater. Mitigation of stormwater quantity can be accomplished by increasing existing ponding areas along a waterway, creating new BMPs to control previously uncontrolled runoff, or by retrofitting existing stormwater structures to decrease the volume and peak of stormwater runoff.

In areas adjacent to a stream, a hydrologic and hydraulic analysis can be performed to determine if increasing storage capacity would offset the additional volume of runoff from sites upstream of the storage area. Areas that may provide storage are lakes, ponds, parkland, or other land upstream of constrictions such as inadequately sized bridges or culverts. Increases in the storage capacity of an existing structure, such as upstream of a bridge or culvert, can also be considered provided that it is demonstrated that such as increase does not exacerbate flooding at other areas.

Some examples of areas or features sensitive to changes with regard to flooding include:

- *Culverts and bridges* - these features may constrict flow and cause flooding or may provide storage that, if lost, would cause downstream flooding problems;
- *Property subject to flooding* - areas of concern include those where there is historical evidence of recurrent problems, particularly if exacerbated over time because of increasing impervious surface in the contributing watershed;
- *Eroding/widening stream banks or channels* - particularly if due to changes in hydrology due to the effects of development;
- *Category One waters* - flooding affects could alter habitat that was the basis for the designation; and
- *Wetlands* - changes in hydrology can affect viability of wetlands, either by increasing or decreasing volumes and velocities of water discharging to the wetlands.

Mitigation Projects for Groundwater Recharge

Groundwater recharge is regulated to maintain the groundwater hydrology of the project area. Recharge is the portion of the infiltrated stormwater runoff that makes it below the root mass and becomes groundwater. There are two (2) options to demonstrate compliance with the

groundwater recharge standards. The first is that 100 percent of the site's average annual pre-developed groundwater recharge volume be maintained after development, and the second is that 100 percent of the difference between the sites pre-and post-development 2-year runoff volumes be infiltrated. To mitigate for groundwater recharge, either computational method can be utilized to determine the deficit that needs to be provided by the mitigation project.

Some examples of areas or features sensitive to groundwater recharge changes include:

- *Springs, seeps, wetlands, white cedar swamps* – these features are sensitive to changes in ground water level/hydrology;
- *Threatened and endangered species or their habitats* - some are sensitive to changes in ambient groundwater levels;
- *Streams with low base flow or passing flow requirements* – these features may be particularly sensitive to changes in hydrology;
- *Aquifer recharge zones* - loss of recharge in these areas can adversely affect groundwater supply; and
- *Category One waters* - loss of base flow may affect the basis for the designation.

## Selection of Mitigation Projects

Mitigation projects shall be proposed by the applicant. The applicant shall locate an appropriate project and site for the mitigation of the performance standard for which they are requesting a variance. The applicant shall look at existing problems related to stormwater runoff quality, stormwater runoff quantity, and groundwater recharge to assist in the identification of appropriate projects. The process of selecting mitigation projects must incorporate the following requirements:

1. The mitigation project must be within the same drainage area that would contribute to the sensitive receptor impacted by the project. If there is no specific sensitive receptor impacted, then the location of the mitigation project can be located anywhere with the Township, preferably at a location that would provide the most benefit relative to an existing stormwater problem in the same category (i.e. quality, quantity, or recharge).

2. Legal authorization must be obtained to construct the project at the location selected. This includes the maintenance and any access needs for the project in the future.

3. The project should be close to the location of the original project, and if possible, be located upstream at a similar distance from the identified sensitive receptor. This distance should not be based on actual location, but on a similar hydraulic distance to the sensitive receptor. For example, if the project for which a variance is obtained discharges to a tributary, but the closest location of the application project discharges to the main branch, it may be more beneficial to identify a location for mitigation which discharges to the same tributary.

4. It is preferable to have one location that addresses any and all performance standards waived rather than one location for each performance standard.

5. The project location must demonstrate no adverse impacts to other properties.

6. Mitigation projects that address stormwater runoff quantity can choose to provide storage for proposed increases in runoff volume, as opposed to a direct peak flow reduction.

7. Mitigation projects that address stormwater runoff quality can choose to address another pollutant, other than TSS, which has been demonstrated to be of particular concern such as streams listed as an impaired waterbody on the Integrated List. Care should be taken to ensure that variances from the TSS requirement do not result in impairment of an existing unimpaired area.

## Requirements for Mitigation Projects

The following requirements for mitigation projects must be included in the project submission:

1. **Impact from noncompliance:** Provide a table to show the required values, and the values provided in the applicant's project, the corresponding deficit(s) from the performance standard(s), and include an alternatives analysis demonstrating that on-site compliance was maximized.

2. **Narrative and supporting information regarding the need for the variance:**
   - The variance cannot be due to a condition created by the applicant. If the applicant can provide compliance with the Stormwater Management Rules through a reduction in the scope of the project, the applicant has created the condition and a variance cannot be issued.
   - A discussion and supporting information of the site conditions that would not allow the construction of a stormwater management facility to provide compliance with the performance standards, and/or if the denial of the application would impose an extraordinary hardship on the applicant brought about by circumstances particular to the subject property. Site conditions to be considered are soil type, the presence of karst geology, acid soils, a high groundwater table, unique conditions that would create an unsafe design, as well as conditions that may provide a detrimental impact to public health, welfare and safety. Demonstrate that the grant of the requested variance will not result in an adverse impact that will not be compensated for by off-site mitigation.

3. **Sensitive Receptor:** Identify the sensitive receptor to the performance standard from which a variance is sought. Demonstrate that the mitigation site contributes to the same sensitive receptor.

4. **Design of Mitigation Project:** Provide the design of the mitigation project. This includes, but is not limited to, drawings, calculations, and other information needed to evaluate the mitigation project.

5. **Responsible Party:** List the party or parties responsible for the construction and the maintenance of the mitigation project. Documentation must be provided to demonstrate that the responsible party is aware of, has authority to perform, and accepts the responsibility for the construction and maintenance of the mitigation project. Under no circumstances shall the responsible party be an individual single-family homeowner.

6. **Maintenance:** Include a maintenance plan that addresses the maintenance criteria at N.J.A.C. 7:8-5.8 as part of the mitigation plan. In addition, if the maintenance responsibility is being transferred to the Township (if such an arrangement is approved by the Township), or other entity, the entity responsible for the cost of the maintenance must be identified. The Township may provide the option for the applicant to convey the mitigation project to the Township (if such an arrangement is approved by the Township), if the applicant provides the cost of maintenance in perpetuity.

7. **Permits:** Obtain any and all local, State or other applicable permits for the mitigation measure or project. These must be obtained prior to the Township approval of the project for which mitigation is being provided.

8. **Construction:** Demonstrate that the construction of the mitigation project coincides with the construction of the proposed application project. A certificate of occupancy or final approval by the Township for the application project cannot be issued until the mitigation project or measure receives final approval by the Township and/or other agencies requiring approval. Any mitigation project proposed by the Township to offset the stormwater impacts of the Township's own projects must be completed within 6 months of the completion of the Township project, in order to remain in compliance the NJPDES General Permit.

## Funding Municipal Projects

The Township may allow an applicant to fund analyses to identify potential mitigation projects that could be used to address deficits in complying with each of the performance standards. However, this funding option shall only be allowed where the project requesting the variance will have no measurable impact with respect to flooding, erosion, water quality degradation, etc. and will have no immediate impact to a sensitive receptor. The funding option may also be used in situations where the size of an individual project requesting a variance is small, or the degree of deficit in complying with the design and performance standard(s) is small. Also, if the project requiring mitigation is for one individual single family home, a financial contribution may be a preferred option. In these situations, it may not be practical to implement a commensurate mitigation project and may be preferable to accumulate funds to implement an analysis and construction of a larger mitigation project. In such cases, the receipt of the financial contribution shall satisfy the mitigation obligation for the applicant. This funding option will only be used in

limited circumstances after all other mitigation options have been considered. The Township becomes responsible to ensure that the mitigation occurs in a timely fashion and must provide a detailed discussion of the status of the mitigation fund and funded projects in the annual report required under the NJPDES municipal stormwater permit.

# APPENDIX A

Build-Out Calculations & Nonpoint Source Loads at Build-Out

**Township of Parsippany-Troy Hills**
**Build Out Calculations**

| HUC14 & Zone | Total Area (acres) | Existing Impervious (%) | Existing Impervious (acres) | Wetlands / Water Area (acres) | Developable Area (acres) | Allowable Impervious (%) | Build-Out Impervious (acres) |
|---|---|---|---|---|---|---|---|
| **02030103020040** | | | | | | | |
| Residential 1 (R-1) | 46.65 | 18% | 8.20 | 0.00 | 46.65 | 20% | 9.33 |
| Residential District (R-R) | 10.20 | 9% | 0.87 | 0.00 | 10.20 | 20% | 2.04 |
| | | | | | | | |
| Total for HUC14 02030103020040 | 56.85 | 16% | 9.07 | 0.00 | 56.85 | 20% | 11.37 |
| **02030103020030** | | | | | | | |
| Residential District (R-R) | 887.41 | 12% | 108.14 | 48.42 | 838.99 | 20% | 167.80 |
| Residential 1 (R-1) | 594.96 | 13% | 75.65 | 32.39 | 562.57 | 20% | 112.51 |
| Residential 2 (R-2) | 13.20 | 20% | 2.63 | 0.66 | 12.54 | 20% | 2.51 |
| Residential 3 (R-3) | 413.71 | 24% | 97.35 | 7.34 | 406.37 | 30% | 121.91 |
| Residential 5 (R-5) | 66.47 | 61% | 40.81 | 0.56 | 65.91 | 75% | 49.43 |
| Mixed Residential Option District (R-1M r) | 304.04 | 10% | 30.51 | 15.77 | 288.27 | 20% | 57.65 |
| Residential 1 Mixed Use Option (R-1M) | 381.64 | 24% | 92.11 | 2.93 | 378.71 | 20% | 75.74 |
| Highway Commercial District (B-1) | 27.46 | 31% | 8.61 | 0.00 | 27.46 | 80% | 21.97 |
| Highway Development District (B-2) | 6.93 | 24% | 1.63 | 1.51 | 5.42 | 90% | 4.88 |
| Local Business District 3 (B-3) | 19.55 | 35% | 6.86 | 1.63 | 17.92 | 75% | 13.44 |
| Affordable Housing District No. 2 (AHD-2) | 106.49 | 12% | 12.33 | 9.35 | 97.14 | 30% | 29.14 |
| Office Transitional District (O-T) | 58.89 | 53% | 31.40 | 2.10 | 56.79 | 60% | 34.07 |
| Office Service District (O-S) | 12.26 | 22% | 2.69 | 1.11 | 11.15 | 80% | 8.92 |
| Recreation, Conservation, and Wildlife District (RCW) | 27.76 | 0% | 0.00 | 0.54 | 27.22 | 15% | 4.08 |
| Highway [1] | 16.78 | 0% | 0.02 | 0.54 | 16.24 | 90% | 14.62 |
| | | | | | | | |
| Total for HUC14 02030103020030 | 2937.55 | 17% | 510.74 | 124.85 | 2812.70 | 26% | 718.68 |
| **02030103030120** | | | | | | | |
| Residential 1 (R-1) | 15.49 | 13% | 2.00 | 0.00 | 15.49 | 20% | 3.10 |
| Residential 3 (R-3) | 222.00 | 16% | 36.60 | 18.77 | 203.23 | 30% | 60.97 |
| Highway | 11.83 | 55% | 6.50 | 0.00 | 11.83 | 90% | 10.65 |
| | | | | | | | |
| Total for HUC14 02030103030120 | 249.32 | 18% | 45.10 | 18.77 | 230.55 | 32% | 74.71 |
| **02030103020060** | | | | | | | |
| Residential 1 (R-1) | 38.98 | 18% | 7.17 | 1.92 | 37.06 | 20% | 7.41 |
| Residential 2 (R-2) | 6.59 | 27% | 1.76 | 0.00 | 6.59 | 20% | 1.32 |

| HUC14 & Zone | Total Area (acres) | Existing Impervious (%) | Existing Impervious (acres) | Wetlands / Water Area (acres) | Developable Area (acres) | Allowable Impervious (%) | Build-Out Impervious (acres) |
|---|---|---|---|---|---|---|---|
| Residential 3 (R-3) | 401.22 | 28% | 110.72 | 8.38 | 392.84 | 30% | 117.85 |
| Residential 4 (R-4) | 118.65 | 31% | 36.46 | 14.55 | 104.10 | 40% | 41.64 |
| Highway Development A District (B-2A) | 8.25 | 76% | 6.30 | 0.00 | 8.25 | 90% | 7.43 |
| Local Business District 3 (B-3) | 2.06 | 67% | 1.39 | 0.00 | 2.06 | 75% | 1.55 |
| Local Business District 4 (B-4) | 1.58 | 100% | 1.58 | 0.00 | 1.58 | 80% | 1.26 |
| Specialized Economic Development District 3 (SED-3) | 0.84 | 14% | 0.12 | 0.37 | 0.47 | 90% | 0.42 |
| Specialized Economic Development District 5 (SED-5) | 20.55 | 28% | 5.74 | 3.06 | 17.49 | 80% | 13.99 |
| Specialized Economic Development District 10 (SED-10) | 401.89 | 28% | 111.78 | 140.23 | 261.66 | 70% | 183.16 |
| Research, Office, & Laboratory District (ROL) | 286.56 | 52% | 148.40 | 13.59 | 272.97 | 70% | 191.08 |
| Office Transitional District (O-T) | 4.70 | 59% | 2.75 | 0.00 | 4.70 | 60% | 2.82 |
| Office Professional District 1 (O-1) | 4.20 | 56% | 2.36 | 0.00 | 4.20 | 75% | 3.15 |
| | | | | | | | |
| Total for HUC14 02030103020060 | 1296.07 | 34% | 436.53 | 182.10 | 1113.97 | 51% | 573.08 |
| **02030103020080** | | | | | | | |
| Residential 1 (R-1) | 236.95 | 20% | 48.46 | 0.77 | 236.18 | 20% | 47.24 |
| Residential 2 Mixed Use Option (R-2M) | 67.18 | 14% | 9.20 | 13.61 | 53.57 | 20% | 10.71 |
| Residential 2 (R-2) | 310.57 | 22% | 67.25 | 31.72 | 278.85 | 20% | 55.77 |
| Residential 3 (R-3) | 980.43 | 25% | 240.86 | 77.24 | 903.19 | 30% | 270.96 |
| Residential 3 RCA (R-3 RCA) | 187.17 | 6% | 11.33 | 72.46 | 114.71 | 40% | 45.88 |
| Residential 4 (R-4) | 546.10 | 25% | 134.67 | 155.61 | 390.49 | 40% | 156.20 |
| Residential 5 (R-5) | 96.29 | 63% | 60.44 | 0.14 | 96.15 | 75% | 72.11 |
| Highway Commercial District (B-1) | 99.72 | 65% | 64.57 | 1.71 | 98.01 | 80% | 78.41 |
| Highway Development District (B-2) | 18.80 | 70% | 13.24 | 0.44 | 18.36 | 90% | 16.52 |
| Local Business District 3 (B-3) | 14.79 | 81% | 12.01 | 0.00 | 14.79 | 75% | 11.09 |
| Local Business A District (B-3A) | 3.87 | 5% | 0.19 | 2.59 | 1.28 | 54% | 0.69 |
| Local Business District 4 (B-4) | 18.29 | 44% | 7.98 | 0.00 | 18.29 | 80% | 14.63 |
| Specialized Economic Development District 3 (SED-3) | 40.80 | 52% | 21.12 | 2.38 | 38.42 | 90% | 34.58 |
| Specialized Economic Development District 3A (SED-3A) | 55.32 | 57% | 31.74 | 6.27 | 49.05 | 90% | 44.15 |
| Specialized Economic Development District 5 (SED-5) | 320.66 | 51% | 162.12 | 8.95 | 311.71 | 80% | 249.37 |
| Specialized Economic Development District 5A (SED-5A) | 363.23 | 57% | 207.43 | 18.78 | 344.45 | 80% | 275.56 |
| Research, Office, & Laboratory District (ROL) | 182.56 | 39% | 71.83 | 10.13 | 172.43 | 70% | 120.70 |
| Office Professional District 1 (O-1) | 37.21 | 56% | 20.84 | 0.00 | 37.21 | 75% | 27.91 |
| Office Professional District 3 (O-3) | 73.03 | 41% | 30.21 | 1.31 | 71.72 | 90% | 64.55 |
| Office Service District (O-S) | 12.72 | 72% | 9.21 | 0.00 | 12.72 | 80% | 10.18 |
| Planned Office District (POD) | 117.10 | 41% | 48.41 | 4.64 | 112.46 | 45% | 50.61 |
| Corporation Office District (COD) | 95.80 | 25% | 24.41 | 10.15 | 85.65 | 80% | 68.52 |

| HUC14 & Zone | Total Area (acres) | Existing Impervious (%) | Existing Impervious (acres) | Wetlands / Water Area (acres) | Developable Area (acres) | Allowable Impervious (%) | Build-Out Impervious (acres) |
|---|---|---|---|---|---|---|---|
| Planned Residential Development 2 District (PRD-2) | 113.72 | 9% | 10.20 | 20.45 | 93.27 | 30% | 27.98 |
| Affordable Housing District No. 1 (AHD-1) | 5.00 | 58% | 2.88 | 0.00 | 5.00 | 30% | 1.50 |
| Recreation, Conservation, and Wildlife District (RCW) | 34.06 | 6% | 1.93 | 0.93 | 33.13 | 15% | 4.97 |
| Highway | 304.33 | 49% | 148.18 | 15.17 | 289.16 | 90% | 260.24 |
| | | | | | | | |
| Total for HUC14 02030103020080 | 4335.70 | 34% | 1460.71 | 455.45 | 3880.25 | 52% | 2021.02 |
| **02030103030150** | | | | | | | |
| Residential 1 (R-1) | 61.46 | 7% | 4.04 | 5.17 | 56.29 | 20% | 11.26 |
| Residential 3 (R-3) | 1119.40 | 3% | 38.48 | 738.27 | 381.13 | 30% | 114.34 |
| Residential 4 (R-4) | 28.32 | 35% | 9.88 | 0.00 | 28.32 | 40% | 11.33 |
| Residential 5 (R-5) | 11.36 | 62% | 7.07 | 0.02 | 11.34 | 75% | 8.51 |
| Local Business District 3 (B-3) | 1.80 | 87% | 1.56 | 0.00 | 1.80 | 75% | 1.35 |
| Affordable Housing District No. 1 (AHD-1) | 0.27 | 67% | 0.18 | 0.00 | 0.27 | 30% | 0.08 |
| Specialized Economic Development District 3 (SED-3) | 43.18 | 24% | 10.41 | 5.13 | 38.05 | 90% | 34.25 |
| Planned Office District (POD) | 24.97 | 65% | 16.17 | 0.00 | 24.97 | 45% | 11.24 |
| Office Service District (O-S) | 5.51 | 72% | 3.97 | 0.00 | 5.51 | 80% | 4.41 |
| Highway | 71.73 | 39% | 28.08 | 1.29 | 70.44 | 90% | 63.40 |
| | | | | | | | |
| Total for HUC14 02030103030150 | 1368.00 | 9% | 119.84 | 749.88 | 618.12 | 42% | 260.15 |
| **02030103030170** | | | | | | | |
| Residential 1 (R-1) | 441.37 | 10% | 45.67 | 21.74 | 419.63 | 20% | 83.93 |
| Residential 3 (R-3) | 1170.92 | 21% | 248.13 | 238.01 | 932.91 | 30% | 279.87 |
| Residential 4 (R-4) | 475.89 | 33% | 157.66 | 24.50 | 451.39 | 40% | 180.56 |
| Residential 5 (R-5) | 83.99 | 76% | 64.19 | 0.12 | 83.87 | 75% | 62.90 |
| Highway Commercial District (B-1) | 64.24 | 78% | 50.31 | 5.95 | 58.29 | 80% | 46.63 |
| Highway Development District (B-2) | 24.85 | 52% | 12.90 | 5.50 | 19.35 | 90% | 17.42 |
| Local Business District 3 (B-3) | 10.94 | 84% | 9.20 | 0.44 | 10.50 | 75% | 7.88 |
| Business District (B-5) | 18.15 | 89% | 16.17 | 0.00 | 18.15 | 90% | 16.34 |
| Corridor Redevelopment Area A (CRD-A) | 7.97 | 37% | 2.95 | 0.00 | 7.97 | 90% | 7.17 |
| Recreation, Conservation, and Wildlife District (RCW) | 29.44 | 0% | 0.00 | 2.96 | 26.48 | 15% | 3.97 |
| Planned Residential Development District (PRD) | 44.41 | 37% | 16.57 | 9.85 | 34.56 | 30% | 10.37 |
| Limited Industrial Wholesale District 2 (LIW-2) | 74.78 | 18% | 13.59 | 21.13 | 53.65 | 70% | 37.56 |
| Limited Industrial-Wholesale/Residential District (LIW2/R-3) [3] | 6.45 | 45% | 2.91 | 2.02 | 4.43 | 25% | 1.11 |
| | | | | | | | |
| Total for HUC14 02030103030170 | 2453.40 | 26% | 640.25 | 332.22 | 2121.18 | 36% | 755.69 |
| **02030103020090** | | | | | | | |

| HUC14 & Zone | Total Area (acres) | Existing Impervious (%) | Existing Impervious (acres) | Wetlands / Water Area (acres) | Developable Area (acres) | Allowable Impervious (%) | Build-Out Impervious (acres) |
|---|---|---|---|---|---|---|---|
| Residential 1 (R-1) | 431.87 | 3% | 11.73 | 141.58 | 290.29 | 20% | 58.06 |
| Residential 2 (R-2) | 228.28 | 17% | 39.55 | 4.50 | 223.78 | 20% | 44.76 |
| Residential 3 (R-3) | 328.13 | 24% | 77.96 | 25.28 | 302.85 | 30% | 90.86 |
| Residential 3 RCA (R-3 RCA) | 6.11 | 28% | 1.73 | 0.14 | 5.97 | 40% | 2.39 |
| Residential 5 (R-5) | 69.39 | 66% | 45.51 | 0.00 | 69.39 | 75% | 52.04 |
| Highway Commercial District (B-1) | 78.36 | 64% | 50.36 | 17.42 | 60.94 | 80% | 48.75 |
| Highway Development District (B-2) | 59.70 | 73% | 43.60 | 0.16 | 59.54 | 90% | 53.59 |
| Office Professional District 1 (O-1) | 12.33 | 45% | 5.50 | 0.00 | 12.33 | 75% | 9.25 |
| Office Professional District 3 (O-3) | 56.57 | 43% | 24.10 | 0.00 | 56.57 | 90% | 50.91 |
| Planned Residential Development District (PRD) | 0.53 | 83% | 0.44 | 0.00 | 0.53 | 30% | 0.16 |
| Recreation, Conservation, and Wildlife District (RCW) | 1565.03 | 0% | 1.85 | 1399.22 | 165.81 | 15% | 24.87 |
| Residential 1/Recreation, Conservation, & Wildlife (R-1/RCW)[2] | 12.12 | 36% | 4.39 | 3.28 | 8.84 | 7.5% | 0.66 |
| Limited Industrial Wholesale District 5 (LIW-5) | 62.85 | 1% | 0.59 | 58.10 | 4.75 | 60% | 2.85 |
| Limited Industrial Wholesale District 2 (LIW-2) | 0.19 | 79% | 0.15 | 0.00 | 0.19 | 70% | 0.13 |
| Limited Industrial-Wholesale/Residential District (LIW2/R-3) | 35.84 | 20% | 7.00 | 21.67 | 14.17 | 25% | 3.54 |
| Highway | 147.73 | 42% | 62.03 | 14.99 | 132.74 | 90% | 119.47 |
| | | | | | | | |
| Total for HUC14 02030103020090 | 3095.03 | 12% | 376.49 | 1686.34 | 1408.69 | 40% | 562.28 |
| **02030103020100** | | | | | | | |
| Residential 3 (R-3) | 41.84 | 23% | 9.80 | 6.62 | 35.22 | 30% | 10.57 |
| Residential 5 (R-5) | 21.03 | 63% | 13.20 | 0.98 | 20.05 | 75% | 15.04 |
| Highway Commercial District (B-1) | 10.57 | 25% | 2.63 | 0.04 | 10.53 | 80% | 8.42 |
| Highway Development District (B-2) | 46.00 | 73% | 33.48 | 0.00 | 46.00 | 90% | 41.40 |
| Recreation, Conservation, and Wildlife District (RCW) | 69.65 | 0% | 0.00 | 60.81 | 8.84 | 15% | 1.33 |
| Limited Industrial Wholesale District 2 (LIW-2) | 64.02 | 47% | 29.96 | 8.23 | 55.79 | 70% | 39.05 |
| Limited Industrial Wholesale District 5 (LIW-5) | 58.21 | 5% | 2.98 | 31.82 | 26.39 | 60% | 15.83 |
| Limited Industrial-Wholesale/Residential District (LIW2/R-3) | 76.29 | 16% | 12.54 | 37.48 | 38.81 | 25% | 9.70 |
| Corridor Redevelopment Area A (CRD-A) | 0.24 | 33% | 0.08 | 0.00 | 0.24 | 90% | 0.22 |
| | | | | | | | |
| Total for HUC14 02030103020100 | 387.85 | 27% | 104.67 | 145.98 | 241.87 | 59% | 141.56 |

**Township of Parsippany-Troy Hills**
**Nonpoint Source Loads at Build-Out**

| Zone | Build-Out Zoning | Developable Area (acres) | TP (lbs/acre/yr) | TP (lbs/yr) | TN (lbs/acre/yr) | TN (lbs/yr) | TSS (lbs/acre/yr) | TSS (lbs/yr) |
|---|---|---|---|---|---|---|---|---|
| | **02030103020040** | | | | | | | |
| Residential 1 (R-1) | Low Density Residential | 46.65 | 0.63 | 29 | 5 | 233 | 100 | 4,665 |
| Residential District (R-R) | Low Density Residential | 10.20 | 0.63 | 6 | 5 | 51 | 100 | 1,020 |
| | **Total for HUC14 02030103020040** | **56.85** | | **36** | | **284** | | **5,685** |
| | **02030103020030** | | | | | | | |
| Residential District (R-R) | Low Density Residential | 838.99 | 0.63 | 529 | 5 | 4,195 | 100 | 83,899 |
| Residential 1 (R-1) | Low Density Residential | 562.57 | 0.63 | 354 | 5 | 2,813 | 100 | 56,257 |
| Residential 2 (R-2) | Low Density Residential | 12.54 | 0.63 | 8 | 5 | 63 | 100 | 1,254 |
| Residential 3 (R-3) | Medium, High Density Residential | 406.37 | 1.4 | 569 | 15 | 6,096 | 140 | 56,892 |
| Residential 5 (R-5) | Medium, High Density Residential | 65.91 | 1.4 | 92 | 15 | 989 | 140 | 9,227 |
| Mixed Residential Option District (R-1M r) | Low Density Residential | 288.27 | 0.63 | 182 | 5 | 1,441 | 100 | 28,827 |
| Residential 1 Mixed Use Option (R-1M) | Low Density Residential | 378.71 | 0.63 | 239 | 5 | 1,894 | 100 | 37,871 |
| Highway Commercial District (B-1) | Commercial | 27.46 | 2.1 | 58 | 22 | 604 | 200 | 5,492 |
| Highway Development District (B-2) | Commercial | 5.42 | 2.1 | 11 | 22 | 119 | 200 | 1,084 |
| Local Business District 3 (B-3) | Commercial | 17.92 | 2.1 | 38 | 22 | 394 | 200 | 3,584 |
| Affordable Housing District No. 2 (AHD-2) | Medium, High Density Residential | 97.14 | 1.4 | 136 | 15 | 1,457 | 140 | 13,600 |
| Office Transitional District (O-T) | Urban, Mixed Urban, Other Urban | 56.79 | 1.0 | 57 | 10 | 568 | 120 | 6,815 |
| Office Service District (O-S) | Urban, Mixed Urban, Other Urban | 11.15 | 1.0 | 11 | 10 | 111 | 120 | 1,338 |
| Recreation, Conservation, and Wildlife District (RCW) | Barrenland/Transitional Area | 27.22 | 0.5 | 14 | 5 | 136 | 60 | 1,633 |
| Highway | Urban, Mixed Urban, Other Urban | 16.24 | 1.0 | 16 | 10 | 162 | 120 | 1,949 |
| | **Total for HUC14 02030103020030** | **2,812.70** | | **2,313** | | **21,042** | | **309,721** |
| | **02030103030120** | | | | | | | |
| Residential 1 (R-1) | Low Density Residential | 15.49 | 0.63 | 10 | 5 | 77 | 100 | 1,549 |
| Residential 3 (R-3) | Medium, High Density Residential | 203.23 | 1.4 | 285 | 15 | 3,048 | 140 | 28,452 |
| Highway | Urban, Mixed Urban, Other Urban | 11.83 | 1.0 | 12 | 10 | 118 | 120 | 1,420 |
| | **Total for HUC14 02030103030120** | **230.55** | | **306** | | **3,244** | | **31,421** |
| | **02030103020060** | | | | | | | |
| Residential 1 (R-1) | Low Density Residential | 37.06 | 0.63 | 23 | 5 | 185 | 100 | 3,706 |
| Residential 2 (R-2) | Low Density Residential | 6.59 | 0.63 | 4 | 5 | 33 | 100 | 659 |
| Residential 3 (R-3) | Medium, High Density Residential | 392.84 | 1.4 | 550 | 15 | 5,893 | 140 | 54,998 |
| Residential 4 (R-4) | Medium, High Density Residential | 104.10 | 1.4 | 146 | 15 | 1,562 | 140 | 14,574 |
| Highway Development A District (B-2A) | Commercial | 8.25 | 2.1 | 17 | 22 | 182 | 200 | 1,650 |
| Local Business District 3 (B-3) | Commercial | 2.06 | 2.1 | 4 | 22 | 45 | 200 | 412 |
| Local Business District 4 (B-4) | Commercial | 1.58 | 2.1 | 3 | 22 | 35 | 200 | 316 |

| Zone | Build-Out Zoning | Developable Area (acres) | TP (lbs/acre/yr) | TP (lbs/yr) | TN (lbs/acre/yr) | TN (lbs/yr) | TSS (lbs/acre/yr) | TSS (lbs/yr) |
|---|---|---|---|---|---|---|---|---|
| Specialized Economic Development District 3 (SED-3) | Urban, Mixed Urban, Other Urban | 0.47 | 1.0 | 0 | 10 | 5 | 120 | 56 |
| Specialized Economic Development District 5 (SED-5) | Urban, Mixed Urban, Other Urban | 17.49 | 1.0 | 17 | 10 | 175 | 120 | 2,099 |
| Specialized Economic Development District 10 (SED-10) | Urban, Mixed Urban, Other Urban | 261.66 | 1.0 | 262 | 10 | 2,617 | 120 | 31,399 |
| Research, Office, & Laboratory District (ROL) | Urban, Mixed Urban, Other Urban | 272.97 | 1.0 | 273 | 10 | 2,730 | 120 | 32,756 |
| Office Transitional District (O-T) | Urban, Mixed Urban, Other Urban | 4.70 | 1.0 | 5 | 10 | 47 | 120 | 564 |
| Office Professional District 1 (O-1) | Urban, Mixed Urban, Other Urban | 4.20 | 1.0 | 4 | 10 | 42 | 120 | 504 |
| | **Total for HUC14 02030103020060** | **1113.97** | | **1,310** | | **13,549** | | **143,693** |
| | | | | | | | | |
| | **02030103020080** | | | | | | | |
| Residential 1 (R-1) | Low Density Residential | 236.18 | 0.63 | 149 | 5 | 1,181 | 100 | 23,618 |
| Residential 2 Mixed Use Option (R-2M) | Low Density Residential | 53.57 | 0.63 | 34 | 5 | 268 | 100 | 5,357 |
| Residential 2 (R-2) | Low Density Residential | 278.85 | 0.63 | 176 | 5 | 1,394 | 100 | 27,885 |
| Residential 3 (R-3) | Medium, High Density Residential | 903.19 | 1.4 | 1,264 | 15 | 13,548 | 140 | 126,447 |
| Residential 3 RCA (R-3 RCA) | Medium, High Density Residential | 114.71 | 1.4 | 161 | 15 | 1,721 | 140 | 16,059 |
| Residential 4 (R-4) | Medium, High Density Residential | 390.49 | 1.4 | 547 | 15 | 5,857 | 140 | 54,669 |
| Residential 5 (R-5) | Medium, High Density Residential | 96.15 | 1.4 | 135 | 15 | 1,442 | 140 | 13,461 |
| Highway Commercial District (B-1) | Commercial | 98.01 | 2.1 | 206 | 22 | 2,156 | 200 | 19,602 |
| Highway Development District (B-2) | Commercial | 18.36 | 2.1 | 39 | 22 | 404 | 200 | 3,672 |
| Local Business District 3 (B-3) | Commercial | 14.79 | 2.1 | 31 | 22 | 325 | 200 | 2,958 |
| Local Business A District (B-3A) | Commercial | 1.28 | 2.1 | 3 | 22 | 28 | 200 | 256 |
| Local Business District 4 (B-4) | Commercial | 18.29 | 2.1 | 38 | 22 | 402 | 200 | 3,658 |
| Specialized Economic Development District 3 (SED-3) | Urban, Mixed Urban, Other Urban | 38.42 | 1.0 | 38 | 10 | 384 | 120 | 4,610 |
| Specialized Economic Development District 3A (SED-3A) | Urban, Mixed Urban, Other Urban | 49.05 | 1.0 | 49 | 10 | 491 | 120 | 5,886 |
| Specialized Economic Development District 5 (SED-5) | Urban, Mixed Urban, Other Urban | 311.71 | 1.0 | 312 | 10 | 3,117 | 120 | 37,405 |
| Specialized Economic Development District 5A (SED-5A) | Urban, Mixed Urban, Other Urban | 344.45 | 1.0 | 344 | 10 | 3,445 | 120 | 41,334 |
| Research, Office, & Laboratory District (ROL) | Urban, Mixed Urban, Other Urban | 172.43 | 1.0 | 172 | 10 | 1,724 | 120 | 20,692 |
| Office Professional District 1 (O-1) | Urban, Mixed Urban, Other Urban | 37.21 | 1.0 | 37 | 10 | 372 | 120 | 4,465 |
| Office Professional District 3 (O-3) | Urban, Mixed Urban, Other Urban | 71.72 | 1.0 | 72 | 10 | 717 | 120 | 8,606 |
| Office Service District (O-S) | Urban, Mixed Urban, Other Urban | 12.72 | 1.0 | 13 | 10 | 127 | 120 | 1,526 |
| Planned Office District (POD) | Urban, Mixed Urban, Other Urban | 112.46 | 1.0 | 112 | 10 | 1,125 | 120 | 13,495 |
| Corporation Office District (COD) | Urban, Mixed Urban, Other Urban | 85.65 | 1.0 | 86 | 10 | 857 | 120 | 10,278 |
| Planned Residential Development 2 District (PRD-2) | Medium, High Density Residential | 93.27 | 1.4 | 131 | 15 | 1,399 | 140 | 13,058 |
| Affordable Housing District No. 1 (AHD-1) | Medium, High Density Residential | 5.00 | 1.4 | 7 | 15 | 75 | 140 | 700 |
| Recreation, Conservation, and Wildlife District (RCW) | Barrenland/Transitional Area | 33.13 | 0.5 | 17 | 5 | 166 | 60 | 1,988 |
| Highway | Urban, Mixed Urban, Other Urban | 289.16 | 1.0 | 289 | 10 | 2,892 | 120 | 34,699 |
| | **Total for HUC14 02030103020080** | **3880.25** | | **4,460** | | **45,617** | | **496,385** |
| | | | | | | | | |
| | **02030103030150** | | | | | | | |
| Residential 1 (R-1) | Low Density Residential | 56.29 | 0.63 | 35 | 5 | 281 | 100 | 5,629 |
| Residential 3 (R-3) | Medium, High Density Residential | 381.13 | 1.4 | 534 | 15 | 5,717 | 140 | 53,358 |
| Residential 4 (R-4) | Medium, High Density Residential | 28.32 | 1.4 | 40 | 15 | 425 | 140 | 3,965 |

| Zone | Build-Out Zoning | Developable Area (acres) | TP (lbs/acre/yr) | TP (lbs/yr) | TN (lbs/acre/yr) | TN (lbs/yr) | TSS (lbs/acre/yr) | TSS (lbs/yr) |
|---|---|---|---|---|---|---|---|---|
| Residential 5 (R-5) | Medium, High Density Residential | 11.34 | 1.4 | 16 | 15 | 170 | 140 | 1,588 |
| Local Business District 3 (B-3) | Commercial | 1.80 | 2.1 | 4 | 22 | 40 | 200 | 360 |
| Affordable Housing District No. 1 (AHD-1) | Medium, High Density Residential | 0.27 | 1.4 | 0 | 15 | 4 | 140 | 38 |
| Specialized Economic Development District 3 (SED-3) | Urban, Mixed Urban, Other Urban | 38.05 | 1.0 | 38 | 10 | 381 | 120 | 4,566 |
| Planned Office District (POD) | Urban, Mixed Urban, Other Urban | 24.97 | 1.0 | 25 | 10 | 250 | 120 | 2,996 |
| Office Service District (O-S) | Urban, Mixed Urban, Other Urban | 5.51 | 1.0 | 6 | 10 | 55 | 120 | 661 |
| Highway | Urban, Mixed Urban, Other Urban | 70.44 | 1.0 | 70 | 10 | 704 | 120 | 8,453 |
| | **Total for HUC14 02030103030150** | **618.12** | | **768** | | **8,027** | | **81,614** |
| | | | | | | | | |
| | **02030103030170** | | | | | | | |
| Residential 1 (R-1) | Low Density Residential | 419.63 | 0.63 | 264 | 5 | 2,098 | 100 | 41,963 |
| Residential 3 (R-3) | Medium, High Density Residential | 932.91 | 1.4 | 1,306 | 15 | 13,994 | 140 | 130,607 |
| Residential 4 (R-4) | Medium, High Density Residential | 451.39 | 1.4 | 632 | 15 | 6,771 | 140 | 63,195 |
| Residential 5 (R-5) | Medium, High Density Residential | 83.87 | 1.4 | 117 | 15 | 1,258 | 140 | 11,742 |
| Highway Commercial District (B-1) | Commercial | 58.29 | 2.1 | 122 | 22 | 1,282 | 200 | 11,658 |
| Highway Development District (B-2) | Commercial | 19.35 | 2.1 | 41 | 22 | 426 | 200 | 3,870 |
| Local Business District 3 (B-3) | Commercial | 10.50 | 2.1 | 22 | 22 | 231 | 200 | 2,100 |
| Business District 5 (B-5) | Commercial | 18.15 | 2.1 | 38 | 22 | 399 | 200 | 3,630 |
| Corridor Redevelopment Area A (CRD-A) | Commercial | 7.97 | 2.1 | 17 | 22 | 175 | 200 | 1,594 |
| Recreation, Conservation, and Wildlife District (RCW) | Barrenland/Transitional Area | 26.48 | 0.5 | 13 | 5 | 132 | 60 | 1,589 |
| Planned Residential Development District (PRD) | Medium, High Density Residential | 34.56 | 1.4 | 48 | 15 | 518 | 140 | 4,838 |
| Limited Industrial Wholesale District 2 (LIW-2) | Industrial | 53.65 | 1.5 | 80 | 16 | 858 | 200 | 10,730 |
| Limited Industrial Wholesale / Residential District(LIW-2/R-3) | Industrial | 4.43 | 1.5 | 7 | 16 | 71 | 200 | 886 |
| | **Total for HUC14 02030103030170** | **2,121.18** | | **2,708** | | **28,215** | | **288,402** |
| | | | | | | | | |
| | **02030103020090** | | | | | | | |
| Residential 1 (R-1) | Low Density Residential | 290.29 | 0.63 | 183 | 5 | 1,451 | 100 | 29,029 |
| Residential 2 (R-2) | Low Density Residential | 223.78 | 0.63 | 141 | 5 | 1,119 | 100 | 22,378 |
| Residential 3 (R-3) | Medium, High Density Residential | 302.85 | 1.4 | 424 | 15 | 4,543 | 140 | 42,399 |
| Residential 3 RCA (R-3 RCA) | Medium, High Density Residential | 5.97 | 1.4 | 8 | 15 | 90 | 140 | 836 |
| Residential 5 (R-5) | Medium, High Density Residential | 69.39 | 1.4 | 97 | 15 | 1,041 | 140 | 9,715 |
| Highway Commercial District (B-1) | Commercial | 60.94 | 2.1 | 128 | 22 | 1,341 | 200 | 12,188 |
| Highway Development District (B-2) | Commercial | 59.54 | 2.1 | 125 | 22 | 1,310 | 200 | 11,908 |
| Office Professional District 1 (O-1) | Urban, Mixed Urban, Other Urban | 12.33 | 1.0 | 12 | 10 | 123 | 120 | 1,480 |
| Office Professional District 3 (O-3) | Urban, Mixed Urban, Other Urban | 56.57 | 1.0 | 57 | 10 | 566 | 120 | 6,788 |
| Planned Residential Development District (PRD) | Medium, High Density Residential | 0.53 | 1.4 | 1 | 15 | 8 | 140 | 74 |
| Recreation, Conservation, and Wildlife District (RCW) | Barrenland/Transitional Area | 165.81 | 0.5 | 83 | 5 | 829 | 60 | 9,949 |
| Residential 1/Recreation, Conservation, and Wildlife District (R1/RCW) | Low Density Residential | 8.84 | 0.63 | 6 | 5 | 44 | 100 | 884 |
| Limited Industrial Wholesale District 5 (LIW-5) | Industrial | 4.75 | 1.5 | 7 | 16 | 76 | 200 | 950 |
| Limited Industrial Wholesale District 2 (LIW-2) | Industrial | 0.19 | 1.5 | 0 | 16 | 3 | 200 | 38 |
| Limited Industrial Wholesale / Residential District (LIW-2/R-3) | Industrial | 14.17 | 1.5 | 21 | 16 | 227 | 200 | 2,834 |

| Zone | Build-Out Zoning | Developable Area (acres) | TP (lbs/acre/yr) | TP (lbs/yr) | TN (lbs/acre/yr) | TN (lbs/yr) | TSS (lbs/acre/yr) | TSS (lbs/yr) |
|---|---|---|---|---|---|---|---|---|
| Highway | Urban, Mixed Urban, Other Urban | 132.74 | 1.0 | 133 | 10 | 1,327 | 120 | 15,929 |
| | **Total for HUC14 02030103020090** | **1408.69** | | **1,426** | | **14,097** | | **167,378** |
| | | | | | | | | |
| | **02030103020100** | | | | | | | |
| Residential 3 (R-3) | Medium, High Density Residential | 35.22 | 1.4 | 49 | 15 | 528 | 140 | 4,931 |
| Residential 5 (R-5) | Medium, High Density Residential | 20.05 | 1.4 | 28 | 15 | 301 | 140 | 2,807 |
| Highway Commercial District (B-1) | Commercial | 10.53 | 2.1 | 22 | 22 | 232 | 200 | 2,106 |
| Highway Development District (B-2) | Commercial | 46.00 | 2.1 | 97 | 22 | 1,012 | 200 | 9,200 |
| Recreation, Conservation, and Wildlife District (RCW) | Barrenland/Transitional Area | 8.84 | 0.5 | 4 | 5 | 44 | 60 | 530 |
| Limited Industrial Wholesale District 2 (LIW-2) | Industrial | 55.79 | 1.5 | 84 | 16 | 893 | 200 | 11,158 |
| Limited Industrial Wholesale District 5 (LIW-5) | Industrial | 26.39 | 1.5 | 40 | 16 | 422 | 200 | 5,278 |
| Limited Industrial Wholesale / Residential District (LIW-2/R-3) | Industrial | 38.81 | 1.5 | 58 | 16 | 621 | 200 | 7,762 |
| Corridor Redevelopment Area A (CRD-A) | Commercial | 0.24 | 2.1 | 1 | 22 | 5 | 200 | 48 |
| | **Total for HUC14 02030103020100** | **241.87** | | **383** | | **4,058** | | **43,820** |
| | | | | | | | | |
| | **Total for Township** | **12,484** | | **13,709** | | **138,133** | | **1,568,119** |

TP: Total Phosphorous
TN: Total Nitrogen
TSS: Total Suspended Solids

# FIGURES