



**Impervious Cover Assessment
And Reduction Action Plan
Prepared For**

**West Amwell Township, Hunterdon County,
New Jersey**

*by the
Watershed Institute*

December 30, 2020

Acknowledgements

Designed as a blueprint for municipalities to take action to reduce impacts of stormwater runoff from impervious surfaces to New Jersey's Waterways, this document was created by The Watershed Institute staff with Water Quality Restoration Grant funding from the New Jersey Department of Environmental Protection under the Federal Clean Water Act, Section 319(h). This study was created with guidance from, and in supplement to, similar work performed by the Rutgers Cooperative Extension Water Resources Program, and we would like to thank them for their input and support.



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Executive Summary

Stormwater runoff occurs when precipitation falls on hard surfaces like roofs, parking lots, and roadways that are impervious to water. Stormwater runoff can cause flooding and pollute waters, and these concerns have grown more pronounced with increasing development and larger storm events that scientists attribute to climate change. The Watershed Institute created this Impervious Cover Assessment (ICA) and Reduction Action Plan (RAP) to 1) assess the extent of impervious cover in West Amwell Township, as well as the amount of the resultant stormwater runoff and associated pollutant loading (i.e. perform an ICA), 2) perform a more detailed ICA and stormwater assessment for a select number of commercial properties within the municipality, 3) provide a select number of preliminary designs that act as examples of possible actions that can be taken to reduce or mitigate the amount of stormwater runoff and associated pollutants (i.e. create an RAP), and 4) review any policies and ordinances that the municipality may have that are relevant to stormwater management and make recommendations for changes in policy that will reduce stormwater runoff and its impacts in the future.

In Summary:

1. Impervious surfaces cover approximately 2.68 percent of West Amwell Township's land area. This is well below the 10% threshold above which a subwatershed is considered to be impaired for water quality.
2. The municipality has five subwatersheds which have impervious cover (IC) ranging from 1.71-4.08 % IC; the recommendation of this report is that any Green Infrastructure restorations efforts should be focused in the subwatersheds with the highest acreage of IC, such as the Alexauken Creek and Swan Creek subwatersheds; We recommend strong limitations on development to maintain the township's low level of IC.
3. Stormwater runoff volume from the municipality IC is over 471 million gallons of stormwater annually.
4. Using Geographical Information Systems, we identified 29 sites where actions could be taken to mitigate stormwater runoff. For 19 of those sites, we conducted more detailed on-site stormwater assessments and prepared Green Infrastructure conceptual designs. Those 19 projects have a total stormwater mitigation potential of more than 31 million gallons of runoff.
5. While West Amwell Township has some regulations in place for Tree Protection, Stream Corridor Protection, and Stormwater Management Rules, the creation of new and updating / strengthening of current ordinances for all three of these categories are recommended to help with mitigation and resiliency for both surface water pollution, flooding events, and habitat degradation (See [Policy Review](#)).

Introduction

Pervious and impervious are terms that are used to describe the ability or inability of water to flow through a surface. Pervious surfaces are those which allow stormwater to readily soak into the soil and recharge groundwater. When rainfall drains from a surface, it is called "stormwater runoff". Impervious cover (IC) is any material that has been placed over soil that prevents

water from soaking into the ground. Impervious surfaces include paved roadways, parking lots, sidewalks, rooftops, and most aspects of development. As impervious areas increase, so does the volume of stormwater runoff. Impervious surfaces alter the natural hydrologic cycle, causing runoff to increase dramatically from ~ 10% of annual rainfall in an undeveloped watershed to > 50% in a highly urbanized watershed (Figure 1).²

As stormwater flows over the ground, it picks up pollutants, including salts, animal waste, sediment, excess fertilizers, pesticides, motor oil, and other toxic substances. It is no surprise then, that impervious cover can be linked to the quality of water in lakes, reservoirs, estuaries, and aquifers, and the amount of impervious cover in a watershed can be used to project the current and future quality of streams.³ However, there are many other consequences associated with high amounts of runoff.

Problems in New Jersey due to stormwater runoff include:

- **Pollution:** According to the 2010 New Jersey Water Quality Assessment Report, 90% of the assessed waters in New Jersey are impaired, with urban-related stormwater runoff listed as the most probable source of impairment.⁴
- **Flooding:** Over the past century, the state has seen an increase in flooding (Figure 2). Communities around the state have been affected by these floods. The amount of damage caused also has increased greatly with this trend, costing billions of dollars over this time span.
- **Erosion:** Increased stormwater runoff causes an increase in the velocity of flows in our waterways. The increased velocity after storm events erodes stream banks and shorelines,

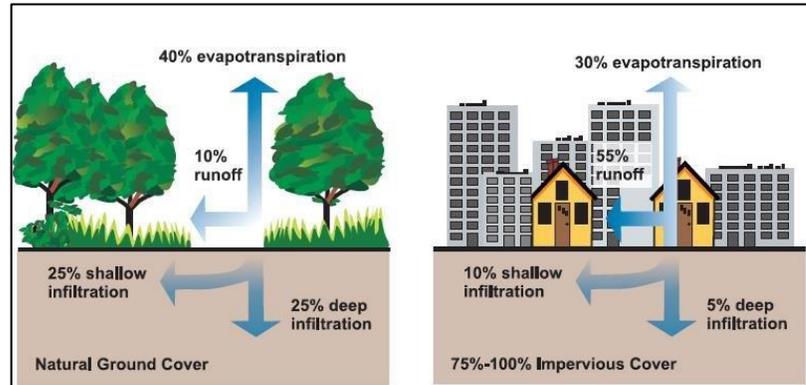


Figure 1: Relationship between impervious surfaces and stormwater runoff.¹

¹ Figure and caption recreated from United States Environmental Protection Agency (USEPA). 2003 Protecting Water Quality from Urban Runoff. National Service Center for Environmental Publications - EPA-841-F-03-003

² Paul MJ & Meyer JL. 2001. The ecology of urban streams. Annual Review of Ecology & Systematics 32:333-365

³ Caraco, D., et. al. 1998. Rapid Watershed Planning Handbook. A Comprehensive Guide for Managing Urbanizing Watersheds. Prepared by Center For Watershed Protection, Ellicott City, MD. Prepared for U.S. Environmental Protection Agency, Office of Wetlands, Oceans and Watersheds and Region V. October 1998.

⁴ United States Environmental Protection Agency (USEPA). 2013. Watershed Assessment, Tracking, and Environmental Results, New Jersey Water Quality Assessment Report.

http://ofmpub.epa.gov/waters10/attains_state.control?p_state=NJ

degrading water quality. This erosion can damage local roads and bridges and cause harm to wildlife.

The primary cause of the pollution, flooding, and erosion problems is the quantity of impervious surfaces draining directly to local waterways. New Jersey is one of the most developed states in the country, and has the highest percent of

impervious cover in the country at 12.1% of its total area.⁵ Most of these surfaces are directly connected to local waterways (i.e., every drop of rain that lands on these impervious surfaces and does not evaporate ends up in a local river, lake, or bay without any chance of being treated to remove pollutants or opportunity for it to recharge ground water). To repair our waterways, reduce flooding, recharge groundwater and reduce erosion of streambanks, stormwater runoff from IC has to be better managed. Surfaces need to be disconnected with green infrastructure or other Best Management Practices (BMPs) to restore the natural hydrological cycle by preventing stormwater runoff from flowing directly into New Jersey's waterways.

The first step to reducing the impacts from impervious surfaces is to conduct an impervious cover and stormwater management assessment to determine the sources and volumes of runoff water. Once impervious surface have been delineated, there are three primary actions that can be designed to restore an area's proper hydrology:

1. **Eliminate impervious cover that is not necessary.** For example, a paved courtyard at a public school could be converted to a garden or grassy area.
2. **Reduce or convert impervious surfaces.** There may be surfaces that are required to be hardened, such as roadways or parking lots, but could be reduced in size and/or converted to pervious surface. This can be achieved by reducing car-lanes sizes or replacing hardscaping with permeable paving materials such as porous asphalt, pervious concrete, or permeable paving stones that could be substituted for impermeable paving materials.

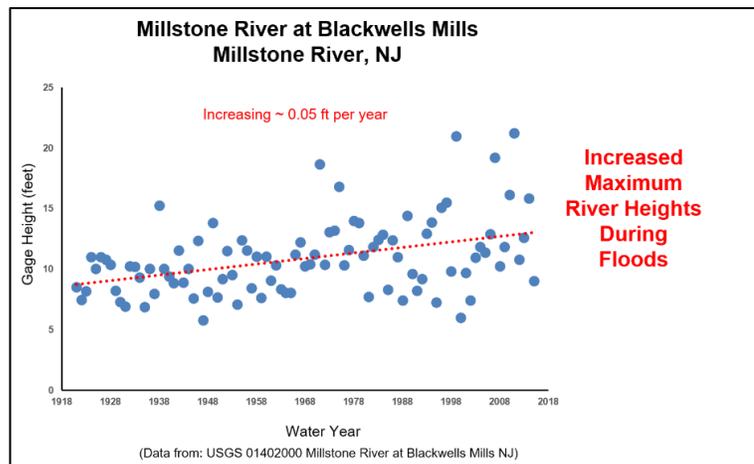


Figure 2: Annual Maximum River Height at Blackwells Mills Dam, Franklin Twp, NJ

⁵ Nowak, D. J., and E. J. Greenfield, 2012. Trees and Impervious Cover in the United States. *Landscape and Urban Planning* 107 (2012): 21-30. http://www.nrs.fs.fed.us/pubs/jrnl/2012/nrs_2012_nowak_002.pdf

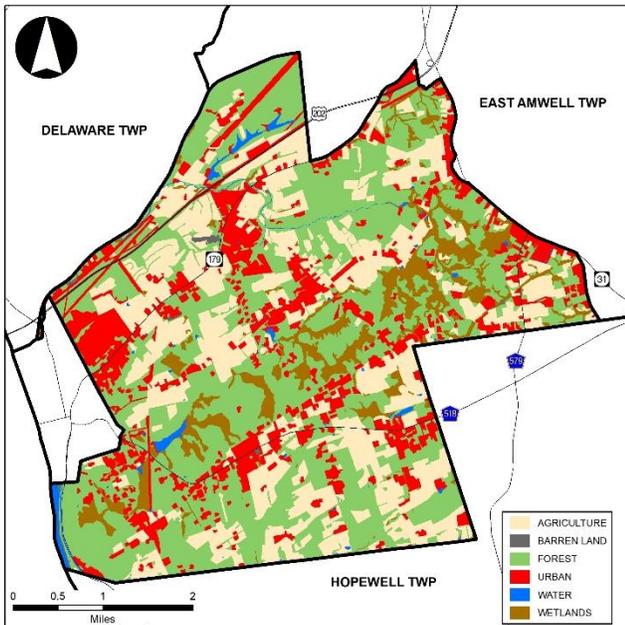


Figure 3: Land-use aerial of West Amwell

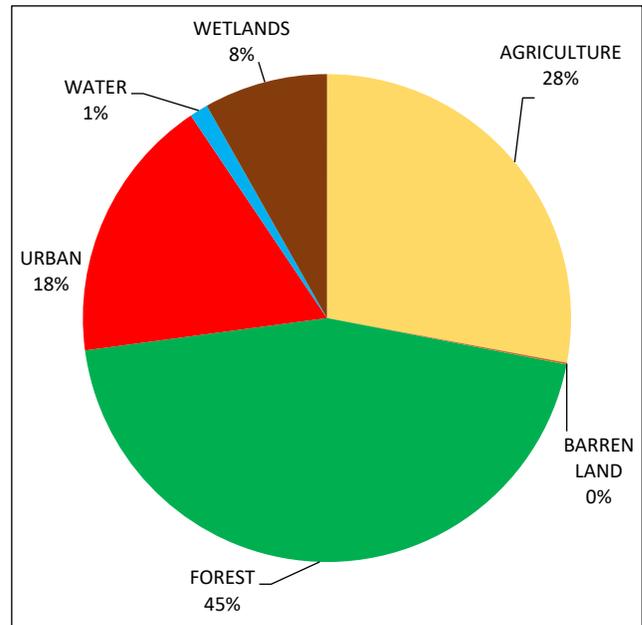


Figure 4: Land-use composition (%) in West Amwell

3. **Disconnect impervious surfaces from flowing directly to local waterways.** There are many ways to capture and treat stormwater runoff from impervious surfaces and subsequently either reuse the water or allow the water to infiltrate into the ground restoring aquifers (See [Green Infrastructure & Best Management Practices](#)).

This report details the results of an Impervious Cover Assessment (ICA) performed during 2016/2017 for West Amwell Township at several different scales: by municipality, subwatershed, and individual lots. In addition, a concept design to reduce or mitigate stormwater runoff, here called a Reduction Action Plan or RAP, was created for a subset of the individual lots that were assessed. Finally, a review of the municipality’s ordinances and/or Master Plan sections that are relevant to the control of stormwater runoff was completed, with suggestions for making changes towards resiliency for flooding and improved water quality.

Impervious Cover Analysis: West Amwell Township

Municipal Subwatershed Assessment

Located in Hunterdon County in central New Jersey, West Amwell Township covers nearly 22 square miles. The township is dominated by forest and agricultural land-use types, with urban land-use estimated to be 18% of the total town (Figures 3 & 4). Rural residential was determined to be the dominant type of urban land at 64% (Figure 5). Impervious surfaces were estimated to cover 2.68% of West Amwell’s land area (Figure 6). The municipality is divided into five individual subwatershed units (Figure 7, colored areas), all of which eventually drain to either the Delaware or Millstone Rivers.

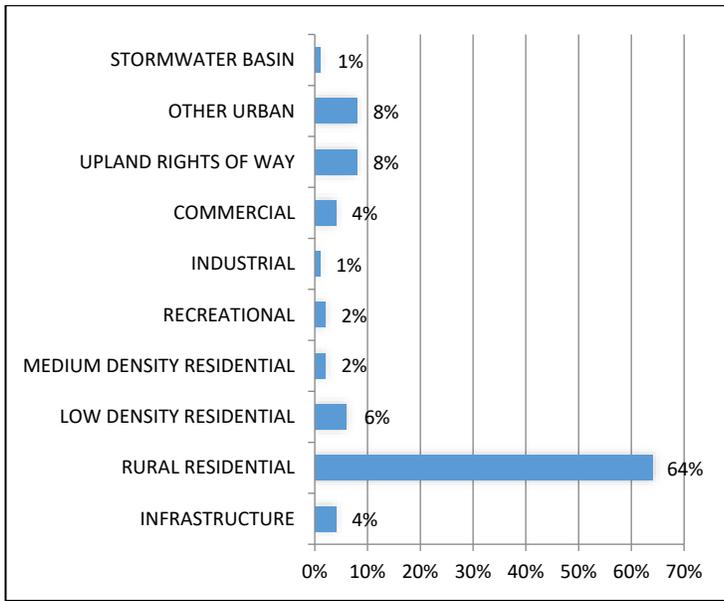


Figure 5: Urban land-use composition in West Amwell

Analysis of the sections of those drainage areas that fall within the municipality’s boundaries showed a variable amount of IC, ranging from 1.71% in the Moore Creek subwatershed to 4.08% in the Back Brook subwatershed (Table 1).

Runoff volumes caused by impervious surfaces was modeled for the entire municipality as well as for each of the subwatersheds for the following categories of rainfall events: 1) The New Jersey’s water quality design storm (the storm event used to analyze and design stormwater management systems (equal to 1.25 inches of rain over a 2 hour period),

2) the 2-year design storm (3.33 inches in 24 hours), 3) the 10-year design storm (4.94 inches in 24 hours), 4) the 100-year design storm (7.92 inches in 24 hours), and 5) New Jersey’s total average annual rainfall of 46.94 inches (Table 2).^{6,7} Impervious surfaces in West Amwell result in over 471.1 million gallons of annual stormwater runoff. The Water Quality Design storm would produce 12.5 million gallons in just a two hour period, while the 2, 10, and 100 year storms would generate 33.4, 49.6, and 79.5 million gallons within a 24 hour period respectively.

The 5 main subwatersheds within West Amwell Township can be delineated further into 6 larger tributary subwatersheds, or HUC 14 basins (delineated by yellow perimeters, Figure 7). Existing conditions for impervious cover and runoff calculations for the entirety of each HUC 14 (which includes the areas outside of the municipal boundaries) were also calculated.

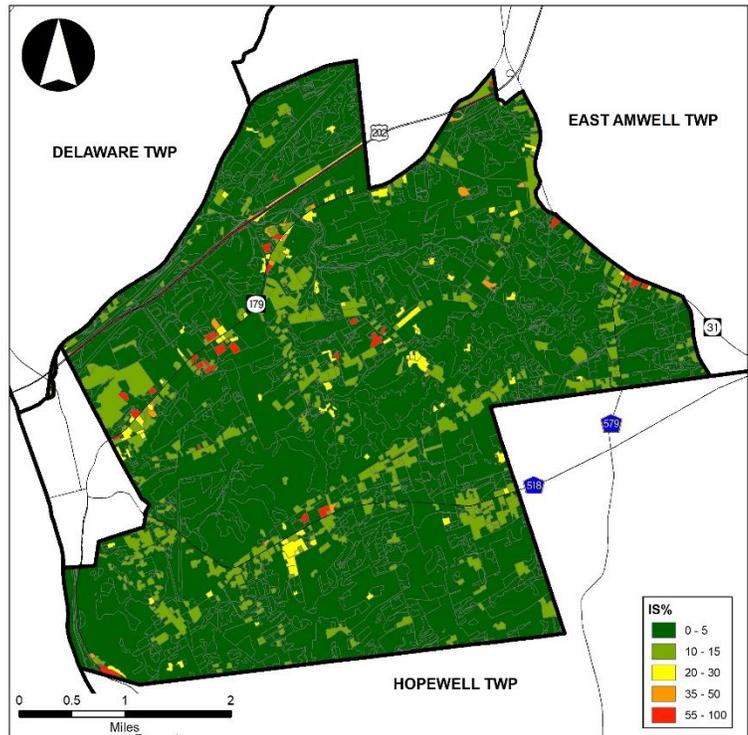


Figure 6: Amount of Impervious Surfaces (% IS) by parcel in West Amwell

⁶ NJ Stormwater Best Management Practices Manual – see https://www.njstormwater.org/bmp_manual2.htm

⁷ Based on New Jersey’s average annual rainfall as of 2017 – Office of the NJ State Climatologist, Rutgers University

Table 1: Impervious cover analysis by subwatershed for West Amwell

Subwatershed	Total Area		Land Use Area		Water Area		Impervious Cover		
	(ac)	(mi ²)	(ac)	(mi ²)	(ac)	(mi ²)	(ac)	(mi ²)	(%)
Alexauken Creek	5,924.99	9.26	5,852.41	9.14	72.58	0.11	163.51	0.26	2.79%
Back Brook	451.92	0.71	451.88	0.71	0.04	0.00	18.44	0.03	4.08%
Moore's Creek	2,837.13	4.43	2,830.33	4.42	6.8	0.01	48.4	0.08	1.71%
Swan Creek	2,891.69	4.52	2,811.77	4.39	79.92	0.12	95.3	0.15	3.39%
Upper Stony Brook	1,875.98	2.93	1,863.19	2.91	12.79	0.02	44.01	0.07	2.36%
Total	13,981.71	21.85	13,809.58	21.58	172.13	0.27	369.66	0.58	2.68%

Table 2: Stormwater runoff volumes (million gallons) from impervious surfaces by subwatershed in West Amwell

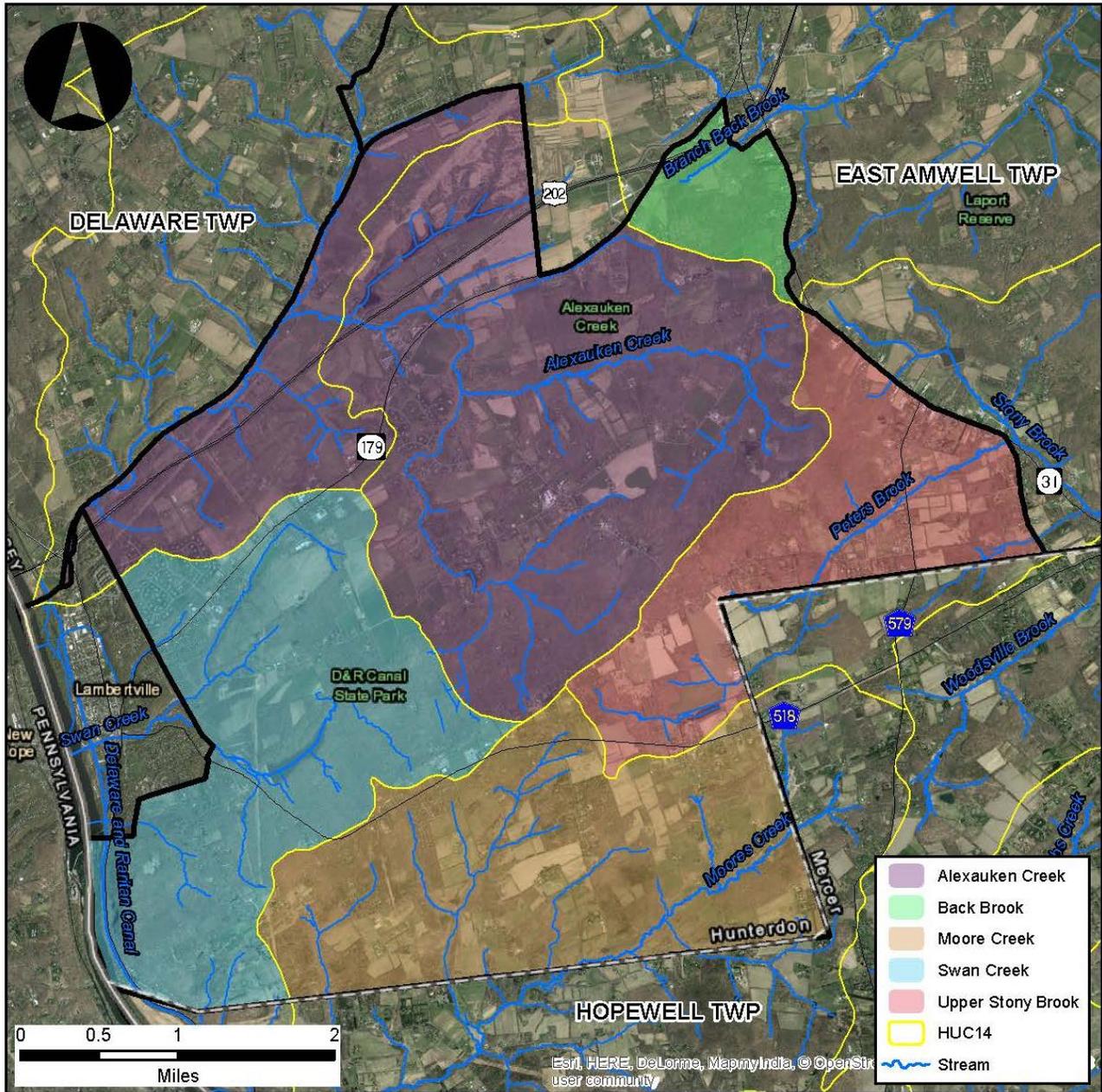
Subwatershed	Total Runoff Volume for the 1.25" NJ Water Quality Storm (MGal)	Total Runoff Volume for the NJ Annual Rainfall of 46.94" (MGal)	Total Runoff Volume for the 2-Year Design Storm (3.33") (MGal)	Total Runoff Volume for the 10-Year Design Storm (4.94") (MGal)	Total Runoff Volume for the 100-Year Design Storm (7.92") (MGal)
Alexauken Creek	5.5	208.4	14.8	21.9	35.2
Back Brook	0.6	23.5	1.7	2.5	4.0
Moore's Creek	1.6	61.7	4.4	6.5	10.4
Swan Creek	3.2	121.5	8.6	12.8	20.5
Upper Stony Brook	1.5	56.1	4.0	5.9	9.5
Total	12.5	471.1	33.4	49.6	79.5

Results for land and water area as well as impervious cover can be found in Appendix A. Runoff values for the different rain event categories were also modeled for each HUC 14 basin and can be found in Appendix B.

Individual Lot Assessment

More specific impacts of runoff due to impervious surfaces can be modeled on a lot by lot basis once priorities have been identified through municipal and subwatershed scale assessments. An ICA was performed for 29 individual lots in West Amwell that contained particularly high levels of impervious cover (see colored lots, Figure 8 or visit <https://thewatershed.org/impervious-cover-assessments/>). Existing runoff volumes caused only by the sites' IC were modeled for the Water Quality Design Storm, the 2 year storm, and for the state's total annual rainfall (See Appendix C). Estimates for the annual amount of

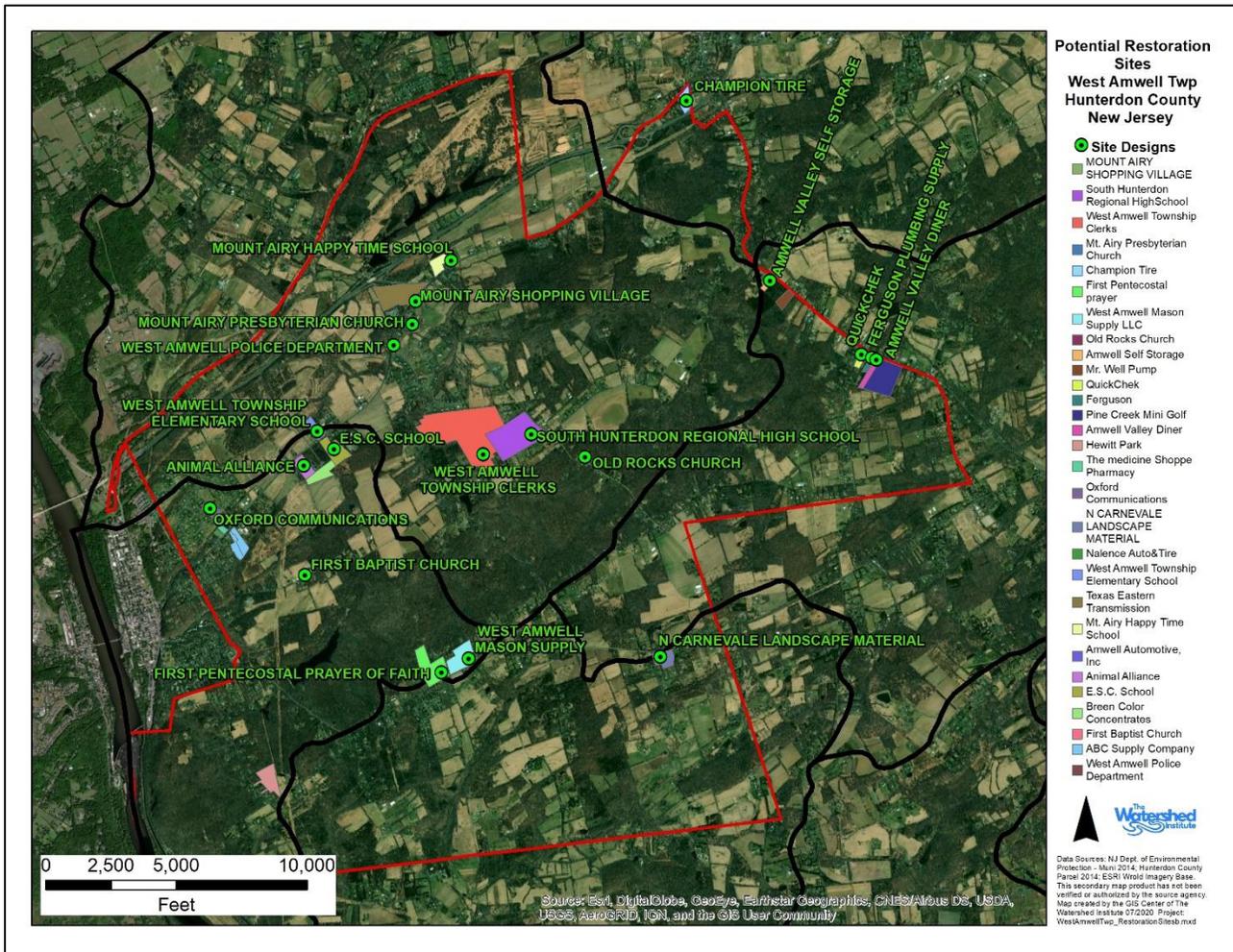
Figure 7: Map of subwatersheds in West Amwell



select pollutants (lb/year) that will runoff with the stormwater into waterways were also generated, including total nitrogen (TN), total phosphorous (TP), and total suspended solids (TSS).

Those 29 properties alone accounted for over 84 acres of impervious cover and over 107.2 million gallons of the town’s annual stormwater runoff. This volume of runoff from impervious surfaces carries an estimated 134 lb of total phosphorous, 1,381 lb of total nitrogen, and 13,692 lb of total suspended solids into the streams of West Amwell Township, and downstream to the Delaware and Millstone Rivers. The summary of existing individual lot conditions can be found in Appendix C or online at <https://thewatershed.org/impervious-cover-assessments/>.

Figure 8: Map of individual lots that received an ICA in West Amwell



Reduction Action Plans: West Amwell Township

Of the 29 individual ICAs performed at the single lot scale, 19 were selected for RAP designs (see Fig 8, green labels). For each RAP, we analyzed close up maps of the sites (Figure 9a) with ArcGIS to calculate the total impervious cover (Figure 9b). Site visits were then conducted to survey for precise slope, drainage and existing stormwater management features, and to determine the sites' potential to host a stormwater management project (see Appendix D for example Site Assessment Template). Drainage areas, defined as any area that drains to a similar point on-site, were then delineated, and non-structural stormwater management features were then designed to capture select drainage areas (Figure 9c). These stormwater features were designed to either remove and/or convert impervious surfaces to pervious surfaces, or otherwise disconnect drainage areas from the local waterways by creating bioretention systems or other Green Infrastructure/Best Management Practices (BMPs) (See [Green Infrastructure and Best Management Practices](#) section below).

A summary of BMP designs, the impacts of the proposed BMPs for the site, along with an overview map of each RAP can be found in Appendix E. Wherever possible BMPs were designed with the intent to capture the volume of runoff equivalent to that of the 2 Year Storm for the intended drainage

area, however this was not always possible. The modeled runoff reduction for individual and combined BMPs for each site is expressed here in two ways. First, the Maximum Volume Reduction Potential of the green infrastructure expressed as gallons per storm, i.e. the instantaneous capacity of all BMPs installed. The second value is the total annual Recharge Potential (gallons / year), or the total amount of average annual rainfall that is estimated to be infiltrated into the ground to recharge groundwater and is therefore intercepted before reaching local waterways.

A summary of individual and combined BMPs for all West Amwell RAPs by subwatershed is found in Appendix F. Combined the RAP designs are estimated to have a Maximum Volume Reduction Potential of over 2.3 million gallons/storm, and a Recharge Potential of approximately 31.3 million gallons/year. This will mitigate over 55% of a 2 Year Storm event, and infiltrate slightly nearly 53% of the annual rainfall that runs off of the IC from these 19 sites combined. The potential for pollution removals was also estimated, and the RAPs for these sites will collectively intercept more than 7 lb of TP, 63 lb of TN, and 1,524 lb of TSS, preventing these pollutants from entering local waterways. Finally, we provide a robust cost estimate for each feature based on previous experience and professional conversations.

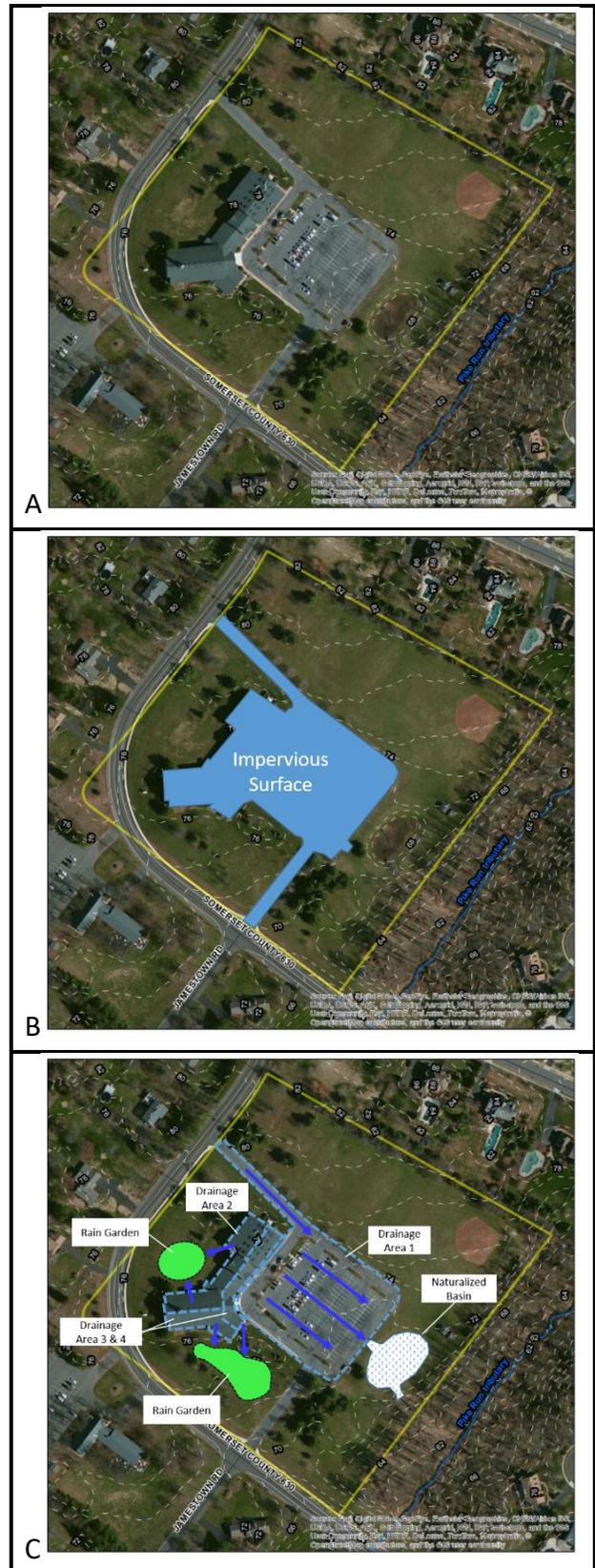


Figure 9: Example site-specific ICA & RAP process

Policy Review: West Amwell Township

West Amwell has taken steps in recent years to enact ordinances that align with their 2012 master plan in regards to woodland management and stream corridor protection. Their commitment to ensuring that the natural resources of the municipality are preserved has been demonstrated time and again. As we discover more effective best management practices and strategies for stormwater management, we hope that West Amwell continues to be a leader in their adoption and implementation.

Tree Protection

Trees and forestlands play an important part in reducing flooding and soil erosion. Having fewer trees compounds the effects of impervious cover on flooding and pollution, especially when trees are replaced with impervious cover. Strengthening protections for trees is important in limiting the spread of impervious cover as well as reducing its impacts.

Current Policy: West Amwell has a Woodlands Protection ordinance (Chapter 109, Section 144 of the municipal code). The ordinance states "Protection and retention of woodlands helps to control the velocity and amount of stormwater runoff, thereby reducing flooding; filters sediments and pollutants before they reach streams" as well as to promote groundwater recharge; stabilize the soil and reduce soil erosion; improve air quality; preserve scenic views; offer a stable habitat for associated plant species and for animal wildlife; and provide shade and windbreaks that help moderate the effects of climate conditions. The ordinance requires a woodland preservation plan be submitted with any application seeking a major site plan or major subdivision for a lot with woodlands on it. However, this only applies to lots within the Sourlands Regional Planning District, and the Northern, Central, and Southern Rural Residential districts.

West Amwell has a Community Forestry Management Plan, however, the term of the Plan expired in 2010.

Recommendation: While requiring the preservation is a good start, the current ordinance only protects trees on lots being developed and only in certain sections of town. We recommend the following actions to strengthen tree protection in West Amwell:

1. **Enact a tree protection ordinance** that requires a permit for removal of any tree in the municipality, whether it is related to a subdivision or site plan approval or not. Such an ordinance should prohibit the removal of healthy trees over 3 inches in diameter, limit the number and size of trees (measured by cumulative diameter) that can be removed on any lot per year (outside of an approved development application), and specify a replacement plan that does not result in significant canopy loss.

2. **Review and update the Community Forestry Management Plan**, and renew approval through the New Jersey Forest Service.

We also recommend specifying that native species be planted as an additional requirement in Chapter 109-199. Native trees are preferable because they provide food and habitat to native wildlife. Moreover, they are adapted to our region which means they resist damage from freezing, common diseases, and drought. Their long root systems both hold soil in place, controlling erosion and floods but also protect water quality. Native trees require very little long term maintenance if installed properly and do not require as much water as ornamentals.

Stream Corridors

A stream corridor is composed of several essential elements including the stream channel itself, floodplains, and forests. Where stream corridors are maintained in their natural condition with minimum disturbance, they are instrumental in removing sediment, nutrients, and pollutants by providing opportunities for filtration, absorption and decomposition by slowing stormwater velocity, which aids in allowing stormwater to be absorbed in the soil and taken up by vegetation. They also reduce stream bank erosion, displace potential sources of non-point source pollution from the water's edge, and prevent flood-related damage and associated costs to surrounding communities. Impervious cover does the opposite of these things, so prohibiting the placement of impervious cover near streams is an important goal.

Current Policy: West Amwell's current stream corridor protections (Chapter 109, Section 143) vary in width based on a variety of factors. Category One waters and trout maintenance and production waters are given the limits set by the state in N.J.A.C. 7:13. For developed residential properties existing as of the ordinance's adoption in 2014, the stream corridor is 75 ft. perpendicular from either side of the stream. For "undeveloped residential properties greater than six acres in existence as of the adoption of this article, where construction of a single-family home would be permitted pending issuance of a building permit", the buffer is 100 ft. All other properties are given a 150 ft buffer. In areas with a 100 year floodplain, the stream corridor will include the entirety of the floodplain.

The stream corridor is considered to be an overlay zone, providing additional restrictions on top of the underlying zones. Defined headwaters, such as a spring, are given 150 ft buffers, with exception for existing developed residential lots, where the buffer is 75 ft.

Recommendation: In order to better protect riparian areas in West Amwell, we make the following recommendation:

1. **Specify the 300 foot buffer for Category One waters and 150 foot buffer for Trout Maintenance and Production Waters in the existing ordinance.** Unfortunately, there is always

the chance that the rules governing environmental protection at the state level can be weakened or changed, leaving areas that were once protected vulnerable again. As West Amwell has, municipalities can adopt ordinances that are more stringent than the state regulations, so by specifying 300 and 150 foot buffers, West Amwell will be able to continue to provide an adequate buffer for these important waters regardless of future changes to the state regulations.

2. West Amwell should consider enlarging all of its stream corridors to 150' regardless of whether it was developed, is residential development or not.

Stormwater Management

Impervious cover creates more stormwater run-off as the rain is unable to infiltrate into the ground. Impervious cover also speeds the runoff of rain water from the property, which carries with it whatever litter and chemicals are on the surface. Proper stormwater management can mitigate the worst impacts of impervious cover on the environment.

Current Policy: West Amwell's current stormwater management requirements have the same threshold as the state requirements. Stormwater management is only required of any new major developments or redevelopments in West Amwell, as described in Chapter 109, Section 253, Design and Performance Standards for Stormwater Management Measures. Major development is defined as any development one or more acres of land or results in 1/4 acre or more of new impervious surface. The ordinance specifies that this should be applied to both development and redevelopment; however, redevelopment is not specified in the definition of "major development". The zoning ordinance calls non-structural stormwater management practices to be implemented "to the maximum extent practicable", and suggests using a number of best practices to reduce run-off, including limiting the area of disturbance and reducing soil compaction.

In Chapter 109-199, Stormwater Management Areas, specifications are laid out for reforestation of basins, recreation/open space features, and retention basins.

Recommendation: The current ordinance does not address the collective impact of smaller developments in West Amwell, nor does it account for current impairments to waterways affected by stormwater runoff from sites within the municipality. Our recommendations are to:

1. **Decrease the threshold for a development to be considered "major"** to half an acre of soil disturbance or 5,000 sq ft. of new or replacement impervious cover. Disturbance should also include repaving activities that do not necessarily disturb bare soil as well as other redevelopment activities.
2. Require the retention and treatment of the 95th percentile storm on site.

3. **Create a definition of “minor development” and require stormwater management for all such developments.** Specifically, require stormwater mitigation for 250 sq. ft. or greater of any new development or new impervious cover. Along with the change in definition, minor development should require stormwater management that would treat on site 2 gallons of stormwater per square foot of impervious cover predominantly through the use of green infrastructure and non-structural stormwater management best practices. Of the 2 gallons per square foot, the 95th percentile storm should be retained onsite.
4. **The regulatory thresholds for major and minor development should be evaluated** for the total cumulative earth disturbance and/or additional impervious cover.
5. **The stormwater management design must recognize the existence of a TMDL** or impaired waters in the watershed and enhance the stormwater management requirements to meet the reductions set out in the TMDL or to reduce pollution in impaired waters.
6. **Porous pavement should be required** in any reconstruction project, except where heavy sediment loading, traffic, or truck weight is expected.
7. **A strict adherence to the non-structural requirements** should be met and enforced.

Discussion and Conclusions

The literature suggests a link between impervious cover and stream ecosystem impairment starting at approximately 10% impervious cover, but has also been seen to impact water quality at 5% or lower depending on the parameter and conditions being studied.^{8,9,10} Having a collective level of impervious cover of under 3% suggests that streams in West Amwell Township are not yet likely to be impaired due to impacts associated with stormwater runoff. Evaluating impervious cover on a subwatershed basis reveals that all areas are well below the 10 % criteria for impaired watersheds (see Table 1). However this allows mitigation efforts to be focused in areas with the highest amounts of runoff, and likelihood of future flooding and impairment, i.e. in the subwatersheds with the most amount of land area composed of impervious cover. In the case of West Amwell, concentrating efforts in the Alexauken Creek (163.5 acres of IC) and Swan Creek (95.3 acres of IC) subwatersheds would have the greatest effect at lowering the municipality’s overall impact to watershed health.

The recommended green infrastructure practice and the drainage area that the practice will treat are identified for each site in Appendix E. While the designs reported here account for approximately 55% of the 2 Year Storm, they do account for 148% of a Water Quality Design Storm, for which precipitation rate is much higher and flooding much more likely. For context, if the stormwater runoff from one Water Quality Design Storm (1.25 inches of rain) in West Amwell was harvested and purified, it could supply water to more than 114 homes for one year.¹¹ Additionally, the calculations herein

⁸ Schueler, T. 1994. The Importance of Imperviousness. *Watershed Protection Techniques* 1 (3): 100-111.

⁹ Arnold, C.L. Jr. and C.J. Gibbons. 1996. Impervious Surface Coverage The Emergence of a Key Environmental Indicator. *Journal of the American Planning Association* 62(2): 243-258.

¹⁰ Walsh CJ, Roy AH, Feminella JW, Cottingham PD, Groffman PM, Morgan RP II (2005) The urban stream syndrome: Current knowledge and the search for a cure. *Journal of the North American Benthological Society* 24(3):706-723.

¹¹ Assuming 300 gallons per day per home

consider instantaneous capacity which does not account for infiltration into the ground, when in reality each BMP will infiltrate water at rates that are geology-dependent. This can be interpreted as providing a robust *underestimate* of feature capability. Consequently, capacity of each BMP should be higher than estimated in this report, and will increase with higher soil infiltration rates.

This report contains information on specific *potential* project sites where *potential* green infrastructure practices could be installed to provide examples of steps that can be taken towards stormwater runoff mitigation. They do not represent the only possibilities on each site. Variations, subsets, or alternatives to each design exist and this report is not exhaustive. There are also many other projects not considered by this report that may be implemented at public/commercial organizations, schools, faith-based and nonprofit organizations, and other community locations not included in this report. Robust cost estimates have also been included which may not be representative of actual project costs, and likely will be lower depending on the contractor, materials, and methods.

Here we report on the state of impervious cover and resultant runoff impacts for West Amwell Township, and provide examples of how the municipality can reduce flooding and improve its waterways by better managing stormwater runoff from impervious surfaces. Assessing impervious cover is the first step toward better managing stormwater runoff. The impervious cover reduction action plans are meant to provide West Amwell with a blueprint for implementing green infrastructure practices that will reduce the impact of stormwater runoff. These practices can be implemented in other public spaces including along roadways and throughout the entire community. Furthermore, development projects that cannot satisfy the New Jersey stormwater management requirements for major development can also use these plans or others like them to provide off-site compensation from stormwater impacts to offset a stormwater management deficit.¹² Finally, West Amwell can quickly convert this impervious cover reduction action plan into a stormwater mitigation plan and incorporate it into the municipal stormwater control ordinance.

¹² New Jersey Administrative Code, N.J.A.C. 7:8, Stormwater Management, Statutory Authority: N.J.S.A. 12:5-3,13:1D-1 et seq., 13:9A-1 et seq., 13:19-1 et seq., 40:55D-93 to 99, 58:4-1 et seq., 58:10A-1 et seq., 58:11A-1 et seq. and 58:16A-50 et seq., *Date last amended: April 19, 2010.*

Methodology

Municipal Impervious Cover Assessments:

Watersheds were delineated, and land-use types, composition, and impervious cover percentages for the entire municipality and for each of the subwatersheds was determined using ArcGIS.¹³ Runoff volume caused by impervious cover was modeled for the entire municipality as well as for each subwatershed for the following categories of rainfall events: 1) The New Jersey's water quality design storm (the storm event used to analyze and design stormwater management systems: equal to 1.25 inches of rain over a 2 hour period), 2) the 2-year design storm, 3) the 10-year design storm, 4) the 100-year design storm, and 5) New Jersey's total average annual rainfall of 46.94 inches.^{14,15}

Runoff volume was modeled using equation 1:

$$\text{Eq 1: Runoff Volume (gal)} = \left[\text{IC Area (ft}^2\text{)} \times \left(\text{Rainfall (in)} \times \frac{1 \text{ (ft)}}{12 \text{ (in)}} \right) \right] \times \frac{7.48052 \text{ (gal)}}{1 \text{ (ft}^3\text{)}}$$

Where IC is impervious cover. Rain volumes for each storm event used for each municipality can be found in Table 3. These values were determined by the precipitation values for a municipality's dominant subwatershed, and were taken from NOAA's Atlas 14 Point Precipitation Frequency Estimates for New Jersey.¹⁶

Individual Lot Impervious Cover Assessments:

Public or commercial sites were selected based on the following primary criteria: amount of impervious cover; proximity to and/or potential impact to a stream; and where practicable, the nature of the commercial or public property (e.g. ease of access, potential for partnerships or project implementation, etc.). Percent area of impervious cover for lots was taken from NJ-GeoWeb's 2012 aerial imagery. Total impervious cover for each site was estimated as the percent IC (as determined in the Land Use/Land Cover 2012 data layer) times the lot size.

Existing runoff volumes caused only by the sites' impervious cover were modeled for the Water Quality Design Storm, the 2 year storm, and for the state's total annual rainfall as described above. Annual loading estimates for the associated select pollutants (lb/year), including total nitrogen (TN), total phosphorous (TP), and total suspended solids (TSS) were calculated for each site after the NJDEP method for calculating Total Maximum Daily Loads. The specific aerial loading coefficients were taken

¹³ Land Use/Land Cover 2012 [New Jersey Department of Environmental Protection (NJDEP), Office of Information Resources Management (OIRM), Bureau of Geographic Information Systems (BGIS)]; HUC14 2011 [Department of Environmental Protection (NJDEP), New Jersey Geological Survey (NJGS)]; Municipality 2014 [New Jersey Office of Information Technology (NJOIT), Office of Geographic Information Systems (OGIS)]

¹⁴ NJ Stormwater Best Management Practices Manual – see https://www.njstormwater.org/bmp_manual2.htm

¹⁵ Based on New Jersey's average annual rainfall as of 2017 – Office of the NJ State Climatologist, Rutgers University

¹⁶ NOAA Precipitation Frequency Data Servers: https://hdsc.nws.noaa.gov/hdsc/pfds/pfds_map_cont.html?bkmrk=nj

from the NJ Stormwater Best Management Practices Manual, are determined by Land Cover and can be found in Table 4.¹⁷

Reduction Action Plans (RAPs):

A select number of lots were chosen for RAPs from the individual ICA list using the criteria described above. For each RAP, we analyzed close up maps of the sites and performed hand-drawn calculations for total impervious cover using ArcGIS measurement tools. Preliminary soil assessments were conducted for each potential project site identified using the U.S. Department of Agriculture Natural Resources Conservation Service GIS soil layer, which utilizes regional soil data to predict soil types in an area. Several key soil parameters were examined (e.g.,

hydrologic soil group, drainage class, depth to water table) to evaluate the suitability of each site’s soil for type of green infrastructure practices. Site visits were then conducted to survey for precise slope, drainage and existing stormwater management features, and to determine the sites’ potential to host, and placement of, stormwater management features (see Appendix D for example Site Assessment Template).

Table 3: Stormwater volumes by storm event

HUC-13 Watershed	2-Year Storm (in/24 hrs)	10-Year Storm (in/24 hrs)	100-Year Storm (in/24 hrs)
Cranbury Twp	3.31	5.07	8.57
East Windsor Twp	3.31	5.07	8.57
Hightstown Bor	3.31	5.07	8.57
Hopewell Bor	3.30	4.96	8.12
Hopewell Twp	3.32	4.98	8.14
Lawrence Twp	3.32	4.98	8.14
Millstone Bor	3.32	5.07	8.54
Montgomery Twp	3.30	4.96	8.12
Pennington Bor	3.32	4.98	8.14
Plainsboro Twp	3.30	5.01	8.32
Princeton	3.30	5.01	8.32
Robbinsville Twp	3.32	5.07	8.54
Rocky Hill Bor	3.30	5.01	8.32
Roosevelt Bor	3.32	5.07	8.54
West Amwell Twp	3.33	4.94	7.92
West Windsor Twp	3.30	5.01	8.32

Table 4: Nutrient loading coefficients by Land Cover type

Land Cover	TP load (lbs/acre/yr)	TN load (lbs/acre/yr)	TSS load (lbs/acre/yr)
High, Medium Density residential	1.4	15	140
Low Density, Rural Residential	0.6	5	100
Commercial	2.1	22	200
Industrial	1.5	16	200
Urban, Mixed Urban, Other Urban	1	10	120
Agriculture	1.3	10	300
Forest, Water, Wetlands	0.1	3	40
Barrenland/Transitional Area	0.5	5	60

¹⁷ NJ Stormwater Best Management Practices Manual – see https://www.njstormwater.org/bmp_manual2.htm

Non-structural stormwater Green Infrastructure, or Best Management Practice (BMP), features were then designed to capture select drainage areas based on the above assessments and with respect to the two year storm event.

The BMP area required for each identified drainage area was calculated using equation 2:

$$Eq\ 2: BMP\ Area\ (ft^2) = \left[Drainage\ Area\ (ft^2) \times \left(2\ year\ storm\ (in) \times \frac{1\ (ft)}{12\ (in)} \right) \right] \div BMP\ Capacity\ (ft)$$

The Maximum Volume Reduction Potential for each individual BMP, or the volume of runoff captured per storm event (gal), was then calculated using equation 3:

$$Eq\ 3: Maximum\ Volume\ Reduction\ Potential\ (gal) = (Drainage\ Area\ (ft^2) \times 2\ Year\ Storm(ft)) \times \frac{7.48052\ (gal)}{1\ (ft^3)}$$

Annual Recharge Potential (gallons / year), or the total amount of average annual rainfall that is estimated to be captured by individual BMPs was calculated using equation 4:

$$Eq\ 4: Recharge\ Potential\ (gal) = \left\{ \left[Drainage\ Area\ (ft^2) \times \left(Annual\ Rainfall\ (in) \times \frac{1\ (ft)}{12\ (in)} \right) \times 0.95 \right] \times \frac{7.48052\ (gal)}{1\ (ft^3)} \right\}$$

Finally, the potential for each BMP to remove TSS, TP, and TN was estimated using BMP-dependent removal coefficients (Table 5), and calculated using equation 5:

$$Eq\ 5: Removal\ Potential\ (lb/yr) = \left(Area\ of\ BMP\ (ft^2) \times \frac{1\ (acre)}{43560\ (ft^2)} \right) \times Loading\ Coefficient\ \left(\frac{lb}{acre\ year} \right) \times Removal\ Coefficient$$

Table 5: BMP-specific nutrient removal potential coefficients.

BMP Practice	TSS Removal Potential	TP Removal Potential	TN Removal Potential
Pervious Pavement	0.8	0.6	0.5
Bioretention system	0.9	0.6	0.3
Downspout planter boxes	ND*	ND*	ND*
Rainwater harvesting system	ND*	ND*	ND*
Curb Cuts	ND*	ND*	ND*
Dry well	ND*	ND*	ND*
Extended Detention Basin	0.5	0.2	0.2
Infiltration Structure	0.8	0.6	0.5
Sand Filter	0.8	0.5	0.35
Vegetative Filter	0.7	0.3	0.3
Wet Pond	0.7	0.5	0.3

*No Data

Green Infrastructure & Best Management Practices

Section 502 of the Clean Water Act defines green infrastructure as "...the range of measures that use plant or soil systems, permeable pavement or other permeable surfaces or substrates, stormwater harvest and reuse, or landscaping to store, infiltrate, or evapotranspire stormwater and reduce flows to sewer systems or to surface waters." Whereas gray infrastructure is a conventional piped drainage system that quickly moves urban stormwater downstream and away from the built environment.



Figure 10: Rapid Infiltration of water through pervious pavement

Stormwater runoff is a major cause of water pollution in urban areas. The concern with the conventional system is that it does not allow water to soak into the ground and instead sends it flowing off hardscaped surfaces such as parking lots, roads and roofs, to gutters and storm sewers and other engineered collection systems where it is discharged into local streams. These stormwater flows carry with it nutrients, bacteria, trash, and other contaminants. Larger storms result in higher stormwater volumes, which cause erosion and flooding in streams, damaging property, infrastructure and habitat. However when rain falls in natural, undeveloped areas, water is absorbed and filtered by soil and plants.

Green infrastructure mimics these natural systems and treats runoff as a resource by capturing, filtering, and absorbing stormwater. As a general principal, green infrastructure practices use soil and vegetation to recycle stormwater runoff through infiltration and evapotranspiration. When used as components of a stormwater management system, green infrastructure practices such as bioretention, porous pavement, rain gardens, and vegetated swales can produce a variety of environmental benefits. In addition to effectively retaining and infiltrating rainfall, these practices can simultaneously help filter



Figure 11: Example of Depaving project
Image credit: Habitat Network, yardmap.org

air pollutants, reduce energy demands, mitigate urban heat islands, and sequester carbon while also providing communities with aesthetic and natural resource benefits.¹⁸

Elimination of Impervious Surfaces (De-paving)

One method to reduce impervious cover is to "depave" (Figure 11). Depaving is the act of removing paved impervious surfaces and replacing them with pervious soil and vegetation that will allow for the infiltration of

rainwater. Depaving leads to the re-creation of natural space that will help reduce flooding, increase wildlife habitat, and positively enhance water quality as well as beautify neighborhoods. Depaving can also bring communities together around a shared vision to work together to reconnect their neighborhood to the natural environment.

Pervious Pavements

A pervious paving system (Figure 10 & 12) is a stormwater management facility that filters stormwater runoff as it moves vertically through the system by either infiltrating through the void spaces in the hardscaped surface course or infiltrating through the joints in paver units. The system consists of a surface course, a transition layer and a storage bed of open-graded aggregate, where runoff is temporarily stored. Discharge of runoff from pervious paving systems is either through an underdrain or through infiltration into the subsoil. In order to receive a TSS removal rate for Water Quality, these systems must be designed to treat the entire Water Quality Design Storm volume without overflow; the adopted total suspended solids (TSS) removal rate is 80%.¹⁹

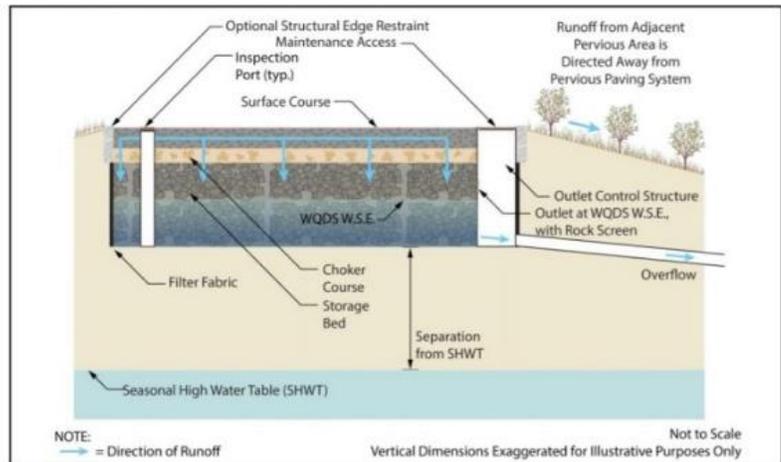


Figure 12: Basic components diagram common to a variety of pervious pavement systems.

Image Credit – NJ-BMP Manual

¹⁸ United States Environmental Protection Agency (USEPA), 2013. Watershed Assessment, Tracking, and Environmental Results, New Jersey Water Quality Assessment Report.

http://ofmpub.epa.gov/waters10/attains_state.control?p_state=NJ

¹⁹ New Jersey Stormwater Best Management Practices Manual, Chapter 9.7 Pervious Paving Systems, p. 2,

<https://www.njstormwater.org/pdf/2016-11-07-pervious-paving-final.pdf>

Disconnected Downspouts

Often referred to simply as disconnection, this is the easiest and least costly method to reduce stormwater runoff for smaller storm events. Rather than flowing out toward the street, and then into the sewer system, a downspout is redirected over a grassed area to allow the water to be filtered by the grass and soaked into the ground (Figure 13). A healthy lawn can typically absorb the first inch of stormwater runoff from a rooftop in a slow rain event. Alternatively, downspouts can also be diverted to a vessel such as a rainbarrel in order to harvest and reuse the rainwater.

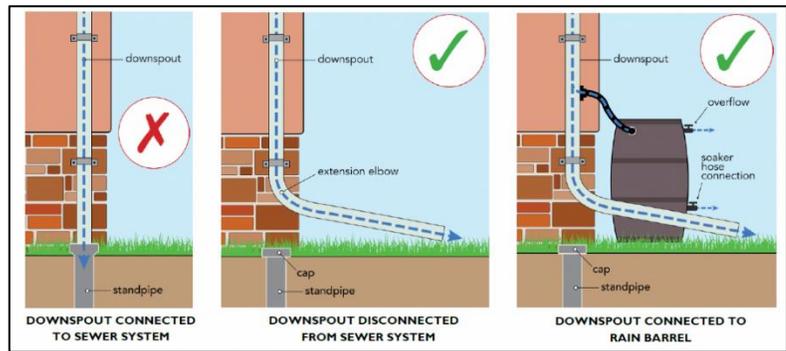


Figure 13: Downspout disconnection
Image credit: DC-Water

Alternatively, downspouts can also be diverted to a vessel such as a rainbarrel in order to harvest and reuse the rainwater.

Bioretention Systems

Bioretention systems are vegetated stormwater management facilities that are used to address the stormwater quality and quantity impacts of land development. They filter a wide range of pollutants from land development sites through both the native vegetation and the soil bed, including suspended solids, nutrients, metals, hydrocarbons and bacteria. Vegetation provides uptake of pollutants and runoff, and the root system helps maintain the infiltration rate in the soil bed before discharging excess downstream through an underdrain or infiltrating into the subsoil.

The total suspended solids (TSS) removal rate is 80 - 90%; this rate will depend on the depth of the soil bed and the type of vegetation selected. These systems provide an opportunity to intercept and slow stormwater, as well as filter and cool the water that has flowed off of a hot, polluted surface before it enters the sewer system.

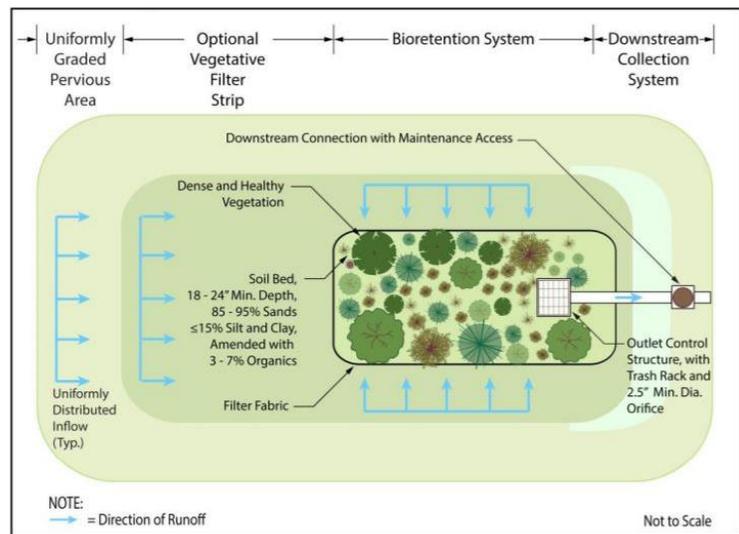


Figure 14: Basic bioretention system design.
Image credit: NJ-BMP Manual

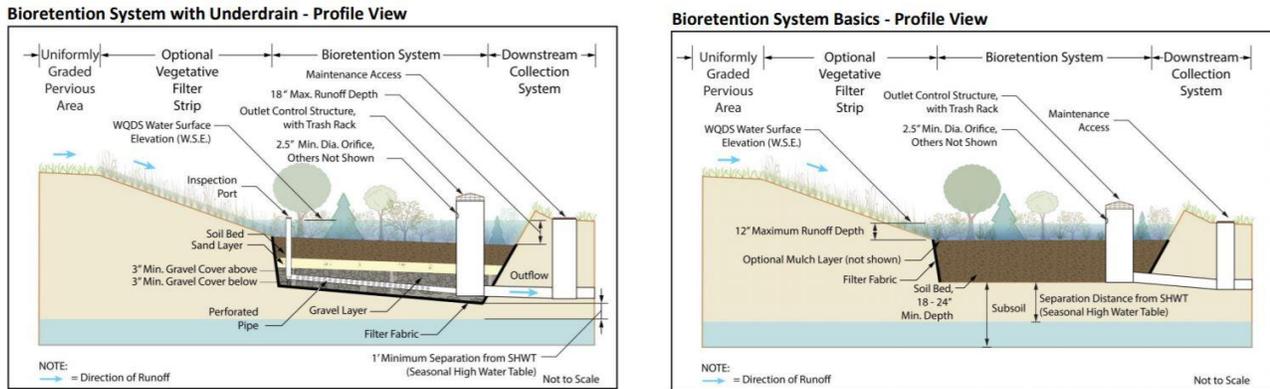


Figure 15: Bioretention facility cross section with underdrains.
Image credit: NJ-BMP Manua

Dry Wells

A dry well is an underground chamber that is used to collect and store stormwater runoff from rooftops while allowing it to infiltrate into the soil. Dry wells are limited to the collection of roof runoff and is prohibited in areas where there is high pollution or sediments are anticipated. Treatment from all other surfaces is not allowed. Dry wells are mainly used in areas where stormwater quality is not a concern, as this type of structure will not remove pollutants from stormwater.

Tree Filter Boxes

Tree box filters are in-ground containers typically containing street trees in urban areas. Runoff is directed to the tree box, where it is filtered by vegetation and soil before entering a catch basin. Tree box filters adapt bioretention principles used in rain gardens to enhance pollutant removal, improve reliability, standardize and increase ease of construction, and reduce maintenance costs. Individual tree box filters hold a relatively small volume of stormwater (100 - 300 gallons), but concerted use throughout a stormwater drainage area will decrease the total volume of discharged stormwater.

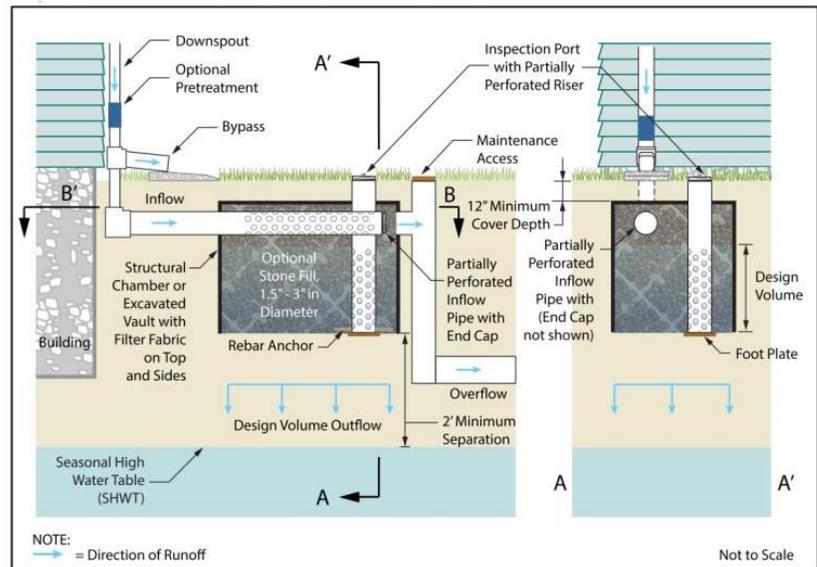


Figure 16: Dry well basics diagram.
Image credit: NJ-BMP Manual

Tree box filters decrease peak discharge by detaining stormwater volume and by increasing discharge duration. Use of numerous tree box filters in a stormwater drainage area can have an impact on total discharge energy and flow rates. Tree box filters have a high removal rate of pollutants in stormwater, as they have similar mechanisms and pollutant removal capabilities as rain gardens and vegetated roofs. They also provide the added value of aesthetics while making efficient use of available land for stormwater management.²⁰

Stormwater Planters

A stormwater planter is a specialized planter installed in the sidewalk area that is designed to manage street and sidewalk runoff. It is normally rectangular, with four concrete sides providing structure and curbs for the planter. The planter is lined with a permeable fabric, filled with gravel or stone, and topped off with soil, plants, and sometimes trees. The top of the soil in the planter is lower in elevation than the sidewalk, allowing for runoff to flow into the planter through an inlet at street level. These planters manage stormwater by providing storage, infiltration and evapotranspiration of runoff. Excess runoff is directed into an overflow pipe connected to the existing combined sewer pipe.²¹

Rainwater Harvesting Systems

Cisterns are stormwater management practices used to capture similar to rain barrels, but collect and reuse roof runoff on a much larger scale. Cisterns are ideal for harvesting rainwater for non-potable uses including vehicle washing or toilet flushing. Cisterns are extremely versatile and may be used on a variety of sites ranging from small-scale residential sites to large-scale industrial or commercial sites; they may be placed either indoors or outdoors and above, at, or below grade. They can also be found in various shapes

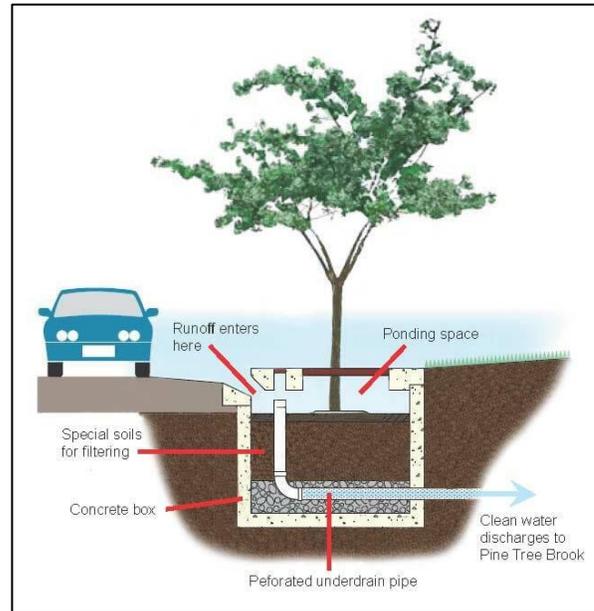


Figure 17: Basic tree filter box diagram
Image credit: Town of Milton, MA Dept. of public works stormwater



Figure 18: Street-side stormwater planter diagram
Image credit: Philly Water

²⁰ Water Environment Research Foundation, Tree Box Filters, 12/2019

<https://www.werf.org/liveablecommunities/toolbox/treebox.htm>

²¹ Phillywatershed.org, Stormwater Planter, 12/2019,

http://archive.phillywatersheds.org/what_were_doing/green_infrastructure/tools/stormwater-planter

and sizes. Cisterns must be sized based upon on-site water needs; an under-sized cistern may not store sufficient water for site demands, and an over-sized cistern may remain full or near-full most of the time, and thus be unable to provide storage during rain events.

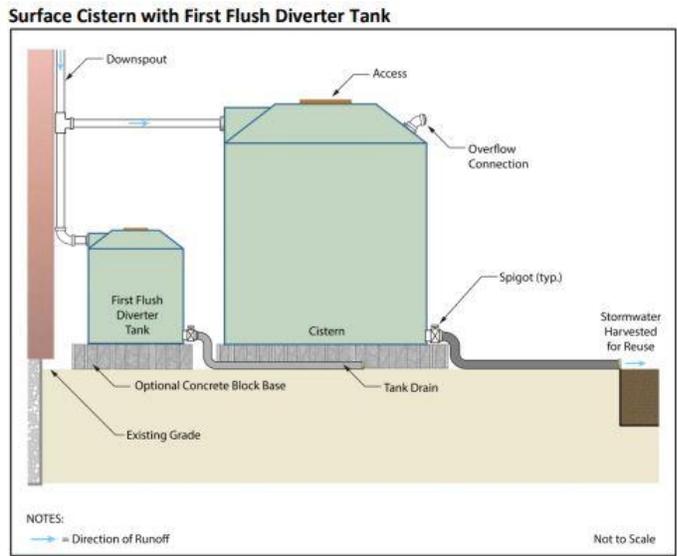


Figure 19: Example of above ground cistern including first flush diverter. Image credit: NJ BMP Manual

Appendix A

Municipality's HUC 14 Existing Impervious Surface Conditions

HUC 14 NAME	HUC13 NAME	HUC14 CODE	Total Area		Land Use Area		Water Area		Impervious Cover		
			(ac)	(mi ²)	(ac)	(mi ²)	(ac)	(mi ²)	(ac)	(mi ²)	(%)
Back Brook	Back Brook	02030105030050	7,460.78	11.66	7,404.82	11.57	55.96	0.09	226.87	0.35	3.06%
Stony Bk (above 74d 49m 15s)	Upper Stony Brook	02030105090010	4,090.52	6.39	4,058.27	6.34	32.25	0.05	79.90	0.12	1.97%
Alexauken Ck (above 74d 55m)	Alexauken Creek	02040105210010	4,885.56	7.63	4,824.28	7.54	61.28	0.10	137.94	0.22	2.86%
Alexauken Ck (below 74d 55m to 11BA06)	Alexauken Creek	02040105210020	4,798.29	7.50	4,766.17	7.45	32.12	0.05	138.76	0.22	2.91%
Swan Creek (Moore Ck to Alexauken Ck)	Swan Creek	02040105210030	4,046.02	6.32	3,769.69	5.89	276.33	0.43	287.10	0.45	7.62%
Moore Creek	Moore Creek	02040105210040	6,030.06	9.42	6,001.26	9.38	28.80	0.05	95.27	0.15	1.59%
Total			31,311.23	48.92	30,824.49	48.16	486.74	0.76	965.84	1.51	3.13%

Appendix B

Municipality's HUC 14 Existing Runoff Conditions

HUC 14 NAME	HUC13 NAME	HUC14 CODE	Total Runoff Volume for the 1.25" NJ Water Quality Storm (MGal)	Total Runoff Volume for the NJ Annual Rainfall of 46.94" (MGal)	Total Runoff Volume for the 2-Year Design Storm (3.30-3.33") (MGal)	Total Runoff Volume for the 10-Year Design Storm (4.94-5.07") (MGal)	Total Runoff Volume for the 100-Year Design Storm (7.92-8.57") (MGal)
Back Brook	Back Brook	02030105030050	7.7	289.2	20.5	30.4	48.8
Stony Bk (above 74d 49m 15s)	Upper Stony Brook	02030105090010	2.7	101.8	7.2	10.8	17.7
Alexauken Ck (above 74d 55m)	Alexauken Creek	02040105210010	4.7	175.8	12.5	18.5	29.7
Alexauken Ck (below 74d 55m to 11BA06)	Alexauken Creek	02040105210020	4.7	176.9	12.5	18.6	29.8
Swan Creek (Moore Ck to Alexauken Ck)	Swan Creek	02040105210030	9.7	365.9	26.0	38.5	61.7
Moore Creek	Moore Creek	02040105210040	3.2	121.4	8.6	12.9	21.1
Total			32.8	1,231.0	87.3	129.7	208.7

Appendix C – Page 1 of 2 – Summary of Existing Conditions for Individual Lot ICAs

SITE NAME	LOCATION				EVALUATED AREA		IMPERVIOUS COVER			EXISTING ANNUAL LOADS (lb/yr)			RUNOFF VOLUME (gal)		
	ADDRESS	BLOCK	LOT	HUC-14	(ac)	(sq ft)	(ac)	(sq ft)	Percent	TP	TN	TSS	Water Quality Storm	Two Year Storm	Annual Rainfall
ALEXAUKEN CREEK SUBWATERSHED															
* Mount Airy Happy Time School	1293 NJ Route 179	7.01	10	Alexauken Ck (above 74d 55m)	4.38	190,913	0.87	37,701	19.7%	0.87	8.65	103.86	29,378	78,262	1,103,185
* Mount Airy Presbyterian Church	39 Mt Airy Village Road	11	7	Alexauken Ck (above 74d 55m)	2.28	99,125	0.51	22,122	22.3%	0.51	5.08	60.94	17,238	45,922	647,325
* Mount Airy Shopping Village	1326 NJ Route 179	10	9	Alexauken Ck (above 74d 55m)	1.94	84,528	1.01	43,836	51.9%	2.11	22.14	201.27	34,158	90,996	1,282,696
* Old Rocks Church	260 Mt Airy-Harbourton Road	20	20	Alexauken Ck (above 74d 55m)	0.63	27,306	0.43	18,508	67.8%	0.42	4.25	50.98	14,421	38,419	541,555
* South Hunterdon Regional High School	301 Mt Airy-Harbourton Road	11	16	Alexauken Ck (above 74d 55m)	50.40	2,195,378	7.33	319,439	14.6%	7.33	73.33	880.00	248,913	663,105	9,347,194
Texas Eastern Transmission	1325 NJ Route 179	5	6	Alexauken Ck (above 74d 55m)	30.91	1,346,388	13.46	586,237	43.5%	28.26	296.08	2,691.60	456,808	1,216,938	17,154,083
* West Amwell Police Department	24 Mt Airy Village Road	9	3	Alexauken Ck (above 74d 55m)	0.80	34,812	0.56	24,218	69.6%	0.56	5.56	66.72	18,871	50,273	708,658
* West Amwell Township Clerks	150 Rocktown-Lambertville Road	11	18	Alexauken Ck (above 74d 55m)	32.78	1,428,015	3.74	162,790	11.4%	3.74	37.37	448.46	126,850	337,927	4,763,462
Alexauken Creek Subwatershed Total					124.12	5,406,465	27.89	1,214,851	22.5%	43.80	452.46	4,503.83	946,637	2,521,842	35,548,158
BACK BROOK SUBWATERSHED															
* Champion Tire	1130 Old York Road	14.02	9	Back Brook	6.00	261,337	2.19	95,473	36.5%	4.60	48.22	438.35	74,394	198,186	2,793,657
Back Brook Subwatershed Total					6.00	261,337	2.19	95,473	36.5%	4.60	48.22	438.35	74,394	198,186	2,793,657
MOORE CREEK SUBWATERSHED															
* N. Carnevale Landscape Material	529 Brunswick Pike	33	1		9.81	427,143	2.57	111,726	26.2%	5.39	56.43	512.97	87,059	231,925	3,269,243
Moore Creek Subwatershed Total					9.81	427,143	2.57	111,726	26.2%	5.39	56.43	512.97	87,059	231,925	3,269,243
SWAN CREEK SUBWATERSHED															
ABC Supply Company	1496 NJ Route 179	8	7&8	Swan Creek (Moore Ck to Alexauken Ck)	10.42	453,833	6.86	298,736	65.8%	14.40	150.88	1,371.60	232,782	620,130	8,741,426
Amwell Automotive	1490 NJ Route 179	8	12	Swan Creek (Moore Ck to Alexauken Ck)	0.43	18,885	0.33	14,268	75.6%	0.69	7.22	65.60	11,118	29,617	417,491
* Animal Alliance	1432 NJ Route 179	8	23.01	Swan Creek (Moore Ck to Alexauken Ck)	8.78	382,325	2.94	128,026	33.5%	2.94	29.39	352.69	99,761	265,763	3,746,219
Breen Color Concentrates	11 Kari Drive	8	23.03	Swan Creek (Moore Ck to Alexauken Ck)	9.92	431,944	5.24	228,037	52.8%	10.99	115.17	1,047.00	177,691	473,370	6,672,674
* E.S.C. School	1422 NJ Route 179	8	23.02	Swan Creek (Moore Ck to Alexauken Ck)	14.00	609,809	5.71	248,591	40.8%	5.71	57.07	684.82	193,707	516,035	7,274,088
First Baptist Church	50 Rocktown-Lambertville Road	8	39	Swan Creek (Moore Ck to Alexauken Ck)	0.76	33,126	0.47	20,404	61.6%	0.47	4.68	56.16	15,900	42,356	597,061
* First Pentecostal Prayer of Faith	638 Brunswick Pike	16	17.02	Swan Creek (Moore Ck to Alexauken Ck)	14.87	647,500	3.75	163,395	25.2%	3.75	37.51	450.12	127,321	339,183	4,781,161
Hewitt Park	39 Hewitt Road	28	19	Swan Creek (Moore Ck to Alexauken Ck)	6.68	290,878	1.34	58,179	20.0%	1.34	13.36	160.32	45,334	120,770	1,702,393
Nalence Auto & Tire	1511 NJ Route 179	35	1&6	Swan Creek (Moore Ck to Alexauken Ck)	1.41	61,443	0.93	40,606	66.1%	1.96	20.50	186.40	31,641	84,293	1,188,200
* Oxford Communications	11 Music Mountain Boulevard	3.02	1	Swan Creek (Moore Ck to Alexauken Ck)	5.91	257,346	2.00	87,209	33.9%	4.20	44.05	400.41	67,955	181,033	2,551,859
The Medicine Shoppe Pharmacy	1509 NJ Route 179	3	18	Swan Creek (Moore Ck to Alexauken Ck)	1.90	82,650	1.44	62,888	76.1%	1.44	14.44	173.28	49,004	130,546	1,840,184
* West Amwell Mason Supply	624 Brunswick Pike	18	1	Swan Creek (Moore Ck to Alexauken Ck)	16.75	729,625	3.38	147,175	20.2%	7.10	74.33	675.73	114,682	305,512	4,306,533
* West Amwell Township Elementary School	1417 NJ Route 179	5	22	Swan Creek (Moore Ck to Alexauken Ck)	5.91	257,448	2.33	101,299	39.3%	2.33	23.26	279.06	78,934	210,281	2,964,148
Swan Creek Subwatershed Total					97.72	4,256,812	36.71	1,598,815	37.6%	57.31	591.85	5,903.20	1,245,830	3,318,890	46,783,435

Appendix C – Page 2 of 2 – Summary of Existing Conditions for Individual Lot ICAs

SITE NAME	LOCATION				EVALUATED AREA		IMPERVIOUS COVER			EXISTING ANNUAL LOADS (lb/yr)			RUNOFF VOLUME (gal)		
	ADDRESS	BLOCK	LOT	HUC-14	(ac)	(sq ft)	(ac)	(sq ft)	Percent	TP	TN	TSS	Water Quality Storm	Two Year Storm	Annual Rainfall
UPPER STONY BROOK SUBWATERSHED															
* Amwell Valley Self Storage	470 NJ Route 31	21	50.01	Stony Bk (above 74d 49m 15s)	3.18	138,364	2.16	93,923	67.9%	4.53	47.44	431.24	73,187	194,970	2,748,320
* Amwell Valley Diner	400 NJ Route 31	23	6	Stony Bk (above 74d 49m 15s)	2.87	125,195	1.47	64,101	51.2%	1.47	14.72	176.59	49,949	133,063	1,875,668
* Ferguson Plumbing Supply	404 NJ Route 31	23	4	Stony Bk (above 74d 49m 15s)	2.96	128,947	1.71	74,460	57.7%	3.59	37.61	341.87	58,021	154,568	2,178,807
Mr. Well Pump	462 NJ Route 31	21	7	Stony Bk (above 74d 49m 15s)	5.63	245,344	1.27	55,242	22.5%	2.66	27.90	253.60	43,045	114,673	1,616,445
Pine Creek Mini Golf	394 NJ Route 31	23	5	Stony Bk (above 74d 49m 15s)	28.03	1,220,840	6.30	274,262	22.5%	6.30	62.96	755.52	213,710	569,325	8,025,261
* QuickChek	410 NJ Route 31	23	1	Stony Bk (above 74d 49m 15s)	4.49	195,501	1.87	81,651	41.8%	3.94	41.24	374.89	63,624	169,495	2,389,222
Upper Stony Brook Subwatershed Total					47.16	2,054,191	14.78	643,639	31.3%	22.48	231.85	2,333.71	501,537	1,336,094	18,833,722
WEST AMWELL TOWNSHIP TOTAL					284.80	12,405,948	84.13	3,664,503	29.5%	133.58	1,380.81	13,692.06	2,855,457	7,606,938	107,228,215

*Denotes a site that a Reduction Action Plan was created for; see Appendix E.

Appendix D – Example Site assessment Form



**IMPERVIOUS COVER ASSESSMENT AND REDUCTION
SITE ASSESSMENT FORM**

**Name of person(s)
completing assessment:**

Assessment date:

SITE INFORMATION

Site ID:	Site Name:
Site address:	
Block/Lot:	Property owner:
Size of site:	Percent impervious coverage:
Proximity to waterway:	Name of nearest waterway:
Subwatershed (HUC-14):	
Soil type(s) on-site: (Indicate drainage capability)	

AERIAL MAP KEY (Write in additional symbols as needed)
installations

Note: Use silver pen for existing infrastructure, other color for potential new installations

Stormwater flow (arrows): 	Sedimentation (dots): 
Erosion (hatched lines): 	Existing curb cuts (oval circling cuts): 
Storm drain (box with vertical lines): 	Ponding (concentric circles): 
Downspouts (small filled-in circle): 	

EXISTING STORMWATER FLOW	OBSERVATIONS	COMMENTS
What is the source of stormwater runoff?	<input type="checkbox"/> Rooftop <input type="checkbox"/> Parking lot <input type="checkbox"/> Sidewalk <input type="checkbox"/> Compacted grass	
Is the site sloped? (Indicate stormwater flow direction on aerial map with arrows)	<input type="checkbox"/> Yes, there is a defined slope <input type="checkbox"/> Yes, somewhat <input type="checkbox"/> No, the site is flat	
Are there areas of pronounced erosion? (Indicate stormwater erosion on aerial map with hatched lines)	<input type="checkbox"/> Yes, there is serious erosion <input type="checkbox"/> Yes, there is mild erosion <input type="checkbox"/> There is evidence of healed erosion <input type="checkbox"/> No	
Are there areas of pronounced sedimentation? (Indicate sedimentation on aerial map with dots)	<input type="checkbox"/> Yes <input type="checkbox"/> No	

<p>Is there evidence of ponding? Are these low-lying areas on impervious or grassy surfaces? (Indicate areas of ponding on aerial map with concentric circles)</p>	<input type="checkbox"/> Yes, ponding visible on grassy area <input type="checkbox"/> Yes, ponding visible on asphalt/concrete <input type="checkbox"/> No	
<p>Does stormwater runoff flow directly into sewer system? (Indicate storm sewers on aerial map with hatched boxes)</p>	<input type="checkbox"/> Yes, downspouts connected to sewer <input type="checkbox"/> Yes, downspouts directed toward sewers <input type="checkbox"/> Yes, stormwater flows toward sewers <input type="checkbox"/> No, stormwater flows away from sewers OR there are no sewers nearby	
<p>Are there existing curb cuts to direct stormwater flow? (Indicate curb cuts on aerial map with ovals)</p>	<input type="checkbox"/> Yes, there are existing curb cuts <input type="checkbox"/> No, there are no curb cuts <input type="checkbox"/> N/A	
<p>Are there existing stormwater BMPs on site? (Write in BMP types on aerial map)</p>	<input type="checkbox"/> Yes, indicate type and number in comments <input type="checkbox"/> No	

DEPAVING/DISCONTINUOUS PAVING/GRAVEL FILTER	OBSERVATIONS	COMMENTS
<p>Is there a potential to remove existing paved areas?</p>	<input type="checkbox"/> Yes <input type="checkbox"/> Portions of pavement can be removed <input type="checkbox"/> No	

PERVIOUS PAVEMENT	OBSERVATIONS	COMMENTS
<p>Is any asphalt or other paved area in disrepair?</p>	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A, there is no paved area	

Are there areas of asphalt that are lightly used, like parking spaces or fire lanes?	<input type="checkbox"/> Yes <input type="checkbox"/> No	
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RAINWATER HARVESTING/STORAGE	OBSERVATIONS	COMMENTS
Are there downspouts visible on the building? Do they direct onto the ground or into a pipe underground? (Indicate downspouts on aerial map with circles)	<input type="checkbox"/> Yes, external downspouts <input type="checkbox"/> Yes, internal downspouts <input type="checkbox"/> No <input type="checkbox"/> N/A, there is no building on-site	
Is there a garden or athletic field nearby that may use collected rainwater?	<input type="checkbox"/> Yes <input type="checkbox"/> No	
Is there space next to the downspout for a BMP placement?	<input type="checkbox"/> Yes, enough space for a cistern <input type="checkbox"/> Yes, enough space for a rain barrel or downspout planter <input type="checkbox"/> No <input type="checkbox"/> N/A, there are no downspouts	

STORMWATER BASIN NATURALIZATION	OBSERVATIONS	COMMENTS
Is there an existing stormwater detention basin?	<input type="checkbox"/> Yes, with short mowed grass <input type="checkbox"/> Yes, with concrete low-flow channel <input type="checkbox"/> No	

RAIN GARDEN	OBSERVATIONS	COMMENTS
Are there unpaved areas on-site suitable and large enough for landscaping?	<input type="checkbox"/> Yes, grassy areas can be landscaped <input type="checkbox"/> No, grassy areas cannot be landscaped <input type="checkbox"/> No, no grassy areas on-site	

What type(s) of plants would be appropriate in these areas?	<input type="checkbox"/> Full sun <input type="checkbox"/> Shade <input type="checkbox"/> Mix of sun and shade	
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TREE FILTER BOX (recommended for more urban areas)	OBSERVATIONS	COMMENTS
Does stormwater flow across sidewalks, curbs, or along the street?	<input type="checkbox"/> Yes <input type="checkbox"/> No	
Is there a sufficient amount of space to install a tree filter box along the sidewalk or road?	<input type="checkbox"/> Yes <input type="checkbox"/> No	
Are there existing trees along the sidewalk or road that could be used in a filter box design?	<input type="checkbox"/> Yes <input type="checkbox"/> No	

BIOSWALE	OBSERVATIONS	COMMENTS
Does stormwater need to travel from its source to the selected BMP?	<input type="checkbox"/> Yes <input type="checkbox"/> No	

GI RECOMMENDATIONS		
Based on your observations, what GI practices would you recommend for this site? (Indicate placement of these practices on the aerial map using alternate pen color)	<input type="checkbox"/> Rooftop disconnection <input type="checkbox"/> Pervious pavement <input type="checkbox"/> Rain barrel <input type="checkbox"/> Rain garden <input type="checkbox"/> Basin naturalization <input type="checkbox"/> OTHER _____	<input type="checkbox"/> Depaving <input type="checkbox"/> Cistern <input type="checkbox"/> Downspout planter <input type="checkbox"/> Bioswale <input type="checkbox"/> Tree filter box <input type="checkbox"/> Sand/Gravel Filter Pit/Strip <input type="checkbox"/> Discontinuous pavement (partial depaving)

Appendix E – Site-Specific Reduction Action Plans

ATTACHED SEPERATELY

Appendix F – Summary of Reduction Action Plans for West Amwell Township

STORMWATER BMP BY SITE	POTENTIAL MANAGEMENT AREA		SIZE OF BMP		PERCENTAGE OF IMPERVIOUS COVER TREATED	REMOVAL POTENTIAL			MAXIMUM VOLUME REDUCTION POTENTIAL (gal/storm)	RECHARGE POTENTIAL (gal/year)	ESTIMATED COST
	(ac)	(sq ft)	(ac)	(sq ft)		TP	TN	TSS			
ALEXAUKEN CREEK SUBWATERSHED											
Mount Airy Happy Time School											
Cistern	0.04	1,787	0.09	3,800	4.7%	0.00	0.00	0.00	3,710	49,683	\$7,600.00
Rain Garden	0.02	1,066	0.01	408	2.8%	0.01	0.03	1.01	2,213	29,638	\$2,040.95
Vegetated Filter	0.02	902	0.03	1,126	2.4%	0.01	0.08	2.17	1,873	25,087	\$3,376.65
Bioswale	0.39	16,854	0.09	3,851	44.7%	0.05	0.27	9.55	34,986	468,505	\$19,255.15
Site Total	0.47	20,610	0.21	9,185	54.7%	0.07	0.37	12.73	42,783	572,913	\$32,272.75
Mount Airy Presbyterian Church											
Bioswale	0.18	8,027	0.03	1,513	36.3%	0.01	0.21	3.75	16,663	223,140	\$7,565.35
Rain Garden 1	0.02	686	0.01	282	3.1%	0.00	0.04	0.70	1,423	19,062	\$1,409.35
Rain Garden 2	0.02	1,067	0.01	416	4.8%	0.00	0.06	1.03	2,215	29,668	\$2,079.95
Site Total	0.22	9,780	0.05	2,211	44.2%	0.02	0.30	5.48	20,302	271,870	\$11,054.65
Mount Airy Shopping Village											
Stormwater Basin Naturalization	0.82	35,554	0.10	4,440	81.1%	0.13	0.67	18.35	73,804	988,336	\$22,198.65
Site Total	0.82	35,554	0.10	4,440	81.1%	0.13	0.67	18.35	73,804	988,336	\$22,198.65
Old Rocks Church											
Rain Garden	0.03	1,380	0.01	530	7.5%	0.01	0.04	1.31	2,865	38,370	\$2,650.05
Porous Pavement	0.27	11,738	0.04	1,924	63.4%	0.03	0.22	4.24	24,366	326,293	\$23,085.72
Site Total	0.30	13,118	0.06	2,454	70.9%	0.03	0.26	5.55	27,231	364,663	\$25,735.77
South Hunterdon Regional High School											
Rain Garden 1	0.51	22,118	0.20	8,495	6.9%	0.12	0.59	21.06	45,913	614,829	\$42,474.95
Bioswale 1	0.53	23,280	0.09	3,824	7.3%	0.05	0.26	9.48	48,325	647,129	\$19,119.15
Rain Garden 2	0.23	10,141	0.09	3,895	3.2%	0.05	0.27	9.66	21,051	281,897	\$19,474.65
Bioswale 2	0.29	12,442	0.05	2,045	3.9%	0.03	0.14	5.07	25,827	345,860	\$10,225.50
Bioswale 3	0.49	21,167	0.08	3,547	6.6%	0.05	0.24	8.79	43,939	588,403	\$17,733.75
Site Total	2.05	89,147	0.50	21,806	27.9%	0.30	1.50	54.06	185,055	2,478,119	\$109,028.00

Appendix F – Summary of Reduction Action Plans for West Amwell Township

STORMWATER BMP BY SITE	POTENTIAL MANAGEMENT AREA		SIZE OF BMP		PERCENTAGE OF IMPERVIOUS COVER TREATED	REMOVAL POTENTIAL			MAXIMUM VOLUME REDUCTION POTENTIAL (gal/storm)	RECHARGE POTENTIAL (gal/year)	ESTIMATED COST
	(ac)	(sq ft)	(ac)	(sq ft)		TP	TN	TSS			

West Amwell Police Department											
Depave	0.30	13,243	0.30	13,243	54.7%	0.00	0.00	0.00	27,491	368,140	\$26,486.62
Vegetated Filter	0.23	9,966	0.30	13,243	41.1%	0.09	0.91	25.54	20,687	277,024	\$39,729.93
Bioswale	0.10	4,508	0.02	743	18.6%	0.01	0.05	1.84	9,358	125,322	\$3,713.20
Porous Pavement	0.23	9,852	0.04	1,616	40.7%	0.02	0.19	3.56	20,450	273,858	\$19,391.04
Site Total	0.86	37,569	0.66	28,845	155.1%	0.12	1.15	30.94	77,987	1,044,344	\$89,320.79
West Amwell Township Clerks											
Vegetated Swale 1	0.58	25,119	0.74	32,315	15.4%	0.22	2.23	62.32	52,143	698,266	\$96,944.52
Vegetated Swale 2	0.83	36,299	1.07	46,510	22.3%	0.32	3.20	89.69	75,351	1,009,041	\$139,530.09
Site Total	1.41	61,418	1.81	78,825	37.7%	0.54	5.43	152.00	127,494	1,707,307	\$236,474.61
Alexauken Subwatershed Total	6.13	267,195	3.39	147,765		1.21	9.68	279.12	554,656	7,427,551	\$526,085.22

BACK BROOK SUBWATERHSED											
Champion Tire											
Porous Pavement	0.41	17,699	0.06	2,456	18.5%	0.07	0.62	9.02	36,740	491,997	\$29,468.64
Rain Garden	0.15	6,600	0.06	2,535	6.9%	0.07	0.38	10.48	13,701	183,475	\$12,675.20
Bioswale 1	0.35	15,432	0.06	2,577	16.2%	0.07	0.65	9.47	32,034	428,975	\$12,884.65
Vegetated Filter	0.07	3,099	0.10	4,142	3.2%	0.06	0.63	13.31	6,432	86,136	\$12,424.59
Bioswale 2	0.19	8,377	0.03	1,365	8.8%	0.04	0.21	5.64	17,389	232,864	\$6,825.45
Site Total	1.18	51,206	0.30	13,074	53.6%	0.32	2.49	47.91	106,297	1,423,447	\$74,278.53
Back Brook Subwatershed Total	1.18	51,206	0.30	13,074.31		0.32	2.49	47.91	106,297	1,423,447	\$74,278.53

Appendix F – Summary of Reduction Action Plans for West Amwell Township

STORMWATER BMP BY SITE	POTENTIAL MANAGEMENT AREA		SIZE OF BMP		PERCENTAGE OF IMPERVIOUS COVER TREATED	REMOVAL POTENTIAL			MAXIMUM VOLUME REDUCTION POTENTIAL (gal/storm)	RECHARGE POTENTIAL (gal/year)	ESTIMATED COST
	(ac)	(sq ft)	(ac)	(sq ft)		TP	TN	TSS			

MOORE CREEK SUBWATERSHED											
N Carnevale Landscape Material											
Depave	0.05	2,138	0.05	2,138	1.9%	0.00	0.00	0.00	4,437	59,420	\$4,275.10
Rain Garden 1	0.13	5,533	0.05	2,138	5.0%	0.06	0.32	8.83	11,486	153,816	\$10,687.75
Rain Garden 2	0.07	3,039	0.03	1,229	2.7%	0.04	0.19	5.08	6,308	84,471	\$6,146.50
Rain Garden 3	0.18	7,654	0.08	3,458	6.9%	0.10	0.52	14.29	15,889	212,769	\$17,289.00
Site Total	0.42	18,364	0.21	8,962	16.4%	0.20	1.03	28.20	38,120	510,476	\$38,398.35
Moore Creek Subwatershed Total	0.42	18,364	0.21	8,962.10		0.20	1.03	28.20	38,120	510,476	\$38,398.35

SWAN CREEK SUBWATERSHED											
Animal Alliance											
Rain Garden 1	0.95	41,346	0.58	25,127	32.3%	0.35	1.73	62.30	85,827	1,149,339	\$125,636.10
Rain Garden 2	0.14	5,917	0.05	2,346	4.6%	0.03	0.16	5.82	12,284	164,493	\$11,727.75
Rain Garden 3	0.04	1,678	0.02	663	1.3%	0.01	0.05	1.64	3,484	46,659	\$3,314.30
Porous Pavement	0.58	25,220	0.08	3,539	19.7%	0.05	0.41	7.80	52,352	701,063	\$17,697.15
Site Total	1.70	74,161	0.73	31,675	57.9%	0.44	2.34	77.56	153,947	2,061,553	\$158,375.30
ESC School											
Porous Pavement 1	0.37	15,994	0.05	2,307	6.4%	0.03	0.26	5.08	33,202	444,618	\$27,685.32
Porous Pavement 2	1.00	43,466	0.14	6,043	17.5%	0.08	0.69	13.32	90,229	1,208,285	\$72,513.72
Bioswale 1	0.62	27,141	0.10	4,394	10.9%	0.06	0.30	10.89	56,341	754,481	\$21,969.20
Bioswale 2	0.58	25,195	0.09	4,059	10.1%	0.06	0.28	10.06	52,300	700,365	\$20,294.65
Vegetated Filter	0.08	3,271	0.16	6,847	1.3%	0.05	0.47	13.20	6,790	90,931	\$20,539.95
Site Total	2.64	115,068	0.54	23,649	46.3%	0.28	2.01	52.56	238,863	3,198,681	\$163,002.84
First Pentacostal Prayer of Faith											
Stormwater Basin Naturalization	2.48	108,177	0.44	19,356	66.2%	0.27	1.33	47.99	224,559	3,007,136	\$96,782.20
Site Total	2.48	108,177	0.44	19,356	66.2%	0.27	1.33	47.99	224,559	3,007,136	\$96,782.20

Appendix F – Summary of Reduction Action Plans for West Amwell Township

STORMWATER BMP BY SITE	POTENTIAL MANAGEMENT AREA		SIZE OF BMP		PERCENTAGE OF IMPERVIOUS COVER TREATED	REMOVAL POTENTIAL			MAXIMUM VOLUME REDUCTION POTENTIAL (gal/storm)	RECHARGE POTENTIAL (gal/year)	ESTIMATED COST
	(ac)	(sq ft)	(ac)	(sq ft)		TP	TN	TSS			
Oxford Communications											
Bioswale 1	0.16	6,791	0.03	1,119	7.8%	0.03	0.17	4.63	14,098	188,787	\$5,596.35
Bioswale 2	0.92	39,998	0.15	6,444	45.9%	0.19	0.98	26.63	83,030	1,111,878	\$32,219.15
Vegetated Filter	0.57	24,950	1.11	48,540	28.6%	0.70	7.35	156.00	51,792	693,558	\$145,619.01
Site Total	1.65	71,739	1.29	56,103	82.3%	0.92	8.50	187.26	148,920	1,994,223	\$183,434.51
West Amwell Mason Supply											
Vegetated Filter	3.35	145,935	4.21	183,492	99.2%	2.65	27.80	589.73	302,939	4,056,735	\$550,474.77
Site Total	3.35	145,935	4.21	183,492	99.2%	2.65	27.80	589.73	302,939	4,056,735	\$550,474.77
West Amwell Township Elementary School											
Bioswale 1	0.29	12,789	0.05	2,060	12.6%	0.03	0.14	5.11	26,548	355,514	\$10,301.80
Vegetated Filter	0.63	27,318	0.77	33,689	27.0%	0.23	2.32	64.96	56,708	759,396	\$101,066.04
Porous Pavement	0.22	9,432	0.03	1,309	9.3%	0.02	0.09	3.24	19,579	262,191	\$6,543.40
Rain Garden	0.35	15,078	0.13	5,791	14.9%	0.08	0.40	14.36	31,299	419,132	\$28,955.35
Bioswale 2	0.31	13,684	0.05	2,335	13.5%	0.03	0.16	5.79	28,407	380,403	\$11,676.15
Site Total	1.80	78,301	1.04	45,184	77.3%	0.39	3.11	93.47	162,541	2,176,635	\$158,542.74
Swan Creek Subwatershed Total	13.62	593,382	8.25	359,459.22		4.95	45.10	1,048.57	1,231,769	16,494,964	\$1,310,612.36
UPPER STONY BROOK SUBWATERSHED											
Amwell Valley Diner											
Porous Pavement	0.77	33,625	0.11	4,712	52.5%	0.06	0.54	10.38	69,801	934,728	\$56,545.08
Vegetated Filter	0.33	14,565	0.32	14,145	22.7%	0.10	0.97	27.28	30,235	404,892	\$42,435.18
Site Total	1.11	48,191	0.43	18,857	75.2%	0.16	1.52	37.66	100,037	1,339,619	\$98,980.26
Amwell Valley Self Storage											
Stormwater Basin Naturalization	0.88	38,271	0.10	4,300	40.7%	0.12	0.65	17.77	79,444	1,063,858	\$21,501.70
Porous Pavement	0.54	23,678	0.08	3,439	25.2%	0.10	0.87	12.63	49,152	658,203	\$41,269.08
Site Total	1.42	61,949	0.18	7,739	66.0%	0.22	1.52	30.40	128,596	1,722,061	\$62,770.78

Appendix F – Summary of Reduction Action Plans for West Amwell Township

STORMWATER BMP BY SITE	POTENTIAL MANAGEMENT AREA		SIZE OF BMP		PERCENTAGE OF IMPERVIOUS COVER TREATED	REMOVAL POTENTIAL			MAXIMUM VOLUME REDUCTION POTENTIAL (gal/storm)	RECHARGE POTENTIAL (gal/year)	ESTIMATED COST
	(ac)	(sq ft)	(ac)	(sq ft)		TP	TN	TSS			
Ferguson Plumbing Supply											
Stormwater Basin Naturalization	0.23	10,221	0.03	1,167	13.7%	0.03	0.18	4.82	21,217	284,127	\$5,832.70
Porous Pavement	0.42	18,241	0.06	2,552	24.5%	0.07	0.64	9.37	37,865	507,066	\$30,623.40
Rain Garden	0.14	6,039	0.05	2,325	8.1%	0.07	0.35	9.61	12,536	167,869	\$11,625.30
Site Total	0.79	34,501	0.14	6,044	46.3%	0.17	1.17	23.80	71,618	959,063	\$48,081.40
Quick Chek											
Stormwater Basin Naturalization	1.07	46,689	0.11	4,759	57.2%	0.14	0.72	19.67	96,920	1,297,883	\$23,794.90
Rain Garden	0.11	4,669	0.05	2,302	5.7%	0.07	0.35	9.51	9,692	129,795	\$11,512.45
Site Total	1.18	51,359	0.16	7,061	62.9%	0.20	1.07	29.18	106,612	1,427,678	\$35,307.35
Upper Stony Brook Subwatershed Total	4.50	195,999	0.91	39,701.60		0.77	5.28	121.05	406,863	5,448,420	\$245,139.79
WEST AMWELL TOWNSHIP TOTAL	25.86	1,126,147	13.06	568,962.13		7.44	63.59	1,524.85	2,337,705	31,304,858	\$2,194,514.25