Upper Moreland Township
Stormwater Management Improvement Implementation Plan

Board of Commissioners

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Prepared by the Stormwater Sub-Committee

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I. Executive Summary

Upper Moreland Township has significant existing stormwater and flooding issues throughout all areas of the Township that threaten the health, safety and welfare of the residents, business community and the general public that commutes through the Township each day. This report identifies and describes existing problem locations and develops a rating system to prioritize implementation of improvements to alleviate those problems. The report further identifies ways to address those specific problems, ways to reduce the overall effect of flooding in the municipality and downstream, ways to improve water quality and ways to educate and involve the public. Lastly, the report discusses how to execute stormwater management improvement projects by identifying potential funding sources and partnering opportunities.

II. Background

Upper Moreland is a relatively old community in comparison to the surrounding municipalities in the Delaware Valley. Much of the Township was developed prior to the inception of stormwater management ordinance requirements and prior to the innovative stormwater management techniques applied in newer communities. As such, the Township's stormwater infrastructure is undersized, deteriorating and all together non-existent in many places. Further, where stormwater infrastructure does exist it only serves to convey stormwater with little to no consideration for reduction in peak flows, runoff volume or water quality enhancement.

The resulting effect of a highly developed Township with limited stormwater infrastructure is a community that has significant stormwater and flooding problems when it rains. In many cases, these flooding events occur with minimal amounts of rain and occur numerous times per year. In turn, the Township's residents are negatively affected by road closures, yard damage, building damage, decreased property values and even delayed emergency service response times in some cases. All of these negative effects threaten the health, safety and welfare of the community. In addition to the Township residents, the business community is affected as patrons can not access their stores and some businesses incur water damage. Lastly, as the Township contains several main traffic routes (Easton Road, York Road, Welsh Road, Moreland Road, Davisville Road and County Line Road) as well as a major SEPTA transit line and the Pennsylvania Turnpike, the commuters that traverse the township each day are affected by increased travel times.

The daily operations of the Township are also affected by the flooding problems. Public Works must expend resources to clean up after flood events, must proactively close roads in anticipation of rain events to protect motorists, and clean and maintain the Township's stormwater infrastructure to prevent additional drainage issues. The Township's Emergency Service Personnel (the Police Department, Fire Marshal's office, etc.) are often involved in water rescues of motorists and residents who become trapped in their cars and homes by flood water. These rescues threaten the safety of the emergency service responders and cause a burden to the tax base when residents need to be provided with

temporary housing. The flood waters have caused fires, building collapses, road failures and loss of life, among other hazards.

In addition to the health, safety and welfare concerns described above, the Department of Environmental Protection (DEP), in recent years, has increased the requirements that municipalities must meet to reduce stormwater runoff rates, stormwater runoff volume and the water quality of stormwater runoff reaching natural watercourses. These requirements include educating the public, getting the public involved, mapping the entire stormsewer system, monitoring stormsewer outfalls for illicit discharges, enacting ordinances to require new development and redevelopment projects to meet enhanced stormwater quality standards, training of municipal employees, good housekeeping techniques for Township staff and improvement to stormwater runoff quality through implementation of stormwater best management practices (BMPs).

III. Purpose

The goals of this report seek to improve the health, safety and welfare of the residents, business community and commuters of Upper Moreland Township by improving water quality, reducing flooding and reducing the negative effects caused by flooding. A goal of this report is not to identify stormwater problems associated with the need for more proactive maintenance activities. To that end, specific goals of this report are:

- Goal 1: To identify existing stormwater problems in the Township.
- Goal 2: Develop a rating system for the existing problems in order to prioritize implementation of solutions.
- Goal 3: Identify potential ways to address stormwater management, both for specific stormwater problems as well as improving stormwater quality and quantity throughout the Township.
- Goal 4: Identify potential partnering options to address stormwater management.
- Goal 5: Identify potential funding sources to address stormwater management.
- Goal 6: Identify potential BMP implementation locations throughout the Township and develop a rating system to prioritize implementation.
- Goal 7: Keep major thoroughfares open so all points of the Township can be accessed by emergency service personnel.
- Goal 8: Taking into account the information compiled in Goals 1 through 7, compile a list of recommendation steps the Township should take to implement improvements as funding becomes available.

IV. Data Gathering Process

The information contained in this report was obtained from multiple sources which include: previous reports, interviews with elected officials, public input and institutional knowledge from Township employees. Specifically, information was obtained from:

A. Interviews with the 7 Commissioners in Office during 2012

B. Public Input at Various Community Development Committee meetings, complaints received by the Township and other informal requests

C. Institutional knowledge from current and former Township employees; John Primus, Jack Snyder, Paul Purtell, Robert Drennen, Pat Stasio and David Dodies

D. Township-Wide Stormwater Study for Upper Moreland Township prepared by Chambers & Associates, Inc., dated February 2009, updated September 2009

E. Norwyn Road Drainage Study prepared by Chambers & Associates, Inc., dated January 26, 1983

F. Norwyn Road Drainage Problem Letter Report prepared by Chambers & Associates, Inc., dated May 18, 1995

G. Pennsylvania Environmental Council PennVEST Grant Application with supporting materials submitted to DEP on May 5, 2009

H. Pennsylvania Environmental Council PennVEST Grant Application with supporting materials submitted to PennVEST on February 16, 2009

I. Pennypack Creek Watershed Letter Report prepared by Jacques Whitford (now Stantec) outlining potential regional basin locations within Hatboro Borough, Horsham Township and Upper Moreland Township submitted to the Pennsylvania Environmental Council on February 19, 2009

J. Temple University's Center for Sustainable Communities draft Pennypack Creek Act 167 Study

V. Stormwater Accomplishments to Date

Upper Moreland has implemented various projects and initiatives designed to reduce the frequency and severity of flooding within the Township. Many of the constructed stormwater facilities also function to improve the quality of runoff that reaches the waterways. The following is a list of accomplishments that have been completed in recent years:

A. Through the land development approval process the Township was able to have the developer of the Student Housing (a.k.a College Station) project on

York Road install a stormwater pipe at the intersection of York Road and Lincoln Avenue to alleviate localized flooding due to insufficient pipe and inlet capacity. The estimated value of this improvement is $41,500.

B. Through a Transportation Enhancement (TE) Grant obtained through Congresswoman Schwartz' office the Township stabilized roughly 700 feet of streambank within Memorial Park between York Road and Mineral Avenue. The streambank stabilization improves water quality and through the use of vegetative stabilization techniques also slows down water within the stream to further reduce erosion downstream.

C. Through funding obtain through Montgomery County, the Township installed a small parking lot expansion in Memorial Park. Associated with the parking lot is an over-sized rain garden to reduce stormwater runoff from the area and improve water quality.

D. As of January 1, 2013 the Township has accumulated a Stormwater Management fund supported solely by private development contributions in the amount of $72,500. The donations have been provided by the PA Turnpike, Giant Fueling Facility and Miller's Ale House and date back to 2010. In addition to the $72,500 an additional $27,000 is committed when the Rosen Automobile Storage Land Development approval is finalized.

E. Associated with the Transit Management Overlay District Zoning Amendment; the developer for the Wawa offered as a Declaration of Covenant running with the development of the property to improve roughly 365 feet of Phase II of the Memorial Park Streambank Project. The improvement is valued at $127,000.

F. Through the land development approval of the residential conversion at 718 Fitzwatertown Road the Applicant is stabilizing the streambank on the property to improve water quality.

G. With assistance from PEMA and FEMA the Township bought out several properties along Bonnett Lane that were subject to frequent and severe flooding.

H. Through the Sabia land development approval of townhouses on Blair Mill Road, the Township was able to have the developer install stormwater drainage improvements to reduce localized drainage issues for the adjacent residential properties located along Linden Avenue.

I. At the request of the Township, the Upper Moreland-Hatboro Joint Sewage Authority stabilized the streambank along 2306 Terwood Road to improve water quality downstream.

J. Through the Progressive Insurance land development approval, the Township was able to reduce the amount of impervious which previously existed on the property while also having the Applicant oversize the stormwater management basin to further reduce stormwater runoff.

K. The Township partnered with the Huntingdon Valley Golf Course to install several infiltration trenches on the property to reduce stormwater runoff into the watershed.

L. The Township partnered with the Borough of Hatboro to remove and replace the bridge on Monument Avenue whose opening was undersized and causing flooding on upstream properties.

M. The Township upgraded a stormsewer culvert on Greyhorse Road to reduce localized flooding.

N. The Township participated in a committee which planted hundred of trees within Horsham Township. The trees reduce stormwater flow to downstream municipalities such as Upper Moreland Township.

O. In 2011 the Township adopted numerous amendments to the Township's Zoning and Subdivision and Land Development Ordinances that promote best management practices with regards to stormwater management.

P. The Township participated in the Act 167 Plan prepared by Temple University and anticipates adopting a model ordinance consistent with the plan in the near future.

Q. The Township performs public education, outreach and participation through numerous outlets such as the website, cable channel, email alerts, Township newsletter, ongoing agenda item on the Community Development Committee monthly meeting, etc.

VI. Rating System For Existing Problems

In an effort to create a way to prioritize potential stormwater management and flood mitigation projects, a rating system was developed to act as a non-partial guideline to determine the order in which existing flooding problems will be remedied. The rating system utilizes the data gathered by the sub-committee for each of the existing drainage problems that were identified throughout the Township.

The first step of the rating system is to break down the existing drainage problems into the following three categories based on the type of damage that is caused by flooding events. For the basis of this system no project from a lower priority "category" can take precedence over a project from a higher priority "category". For example, no project from Category 2 will be implemented until solutions to all problems within Category 1 have been considered. Once all feasible solutions are achieved in the higher priority category, solutions will begin to be implemented in the lower priority category.

Category 1 – Flooding that result in damage to the homes of Township residents. The frequent flooding in these areas results in property damage directly to houses and therefore represents the highest priority

to try and reduce and / or eliminate the frequency that flood waters damage houses within the community.

Category 2 – Flooding that result in damage within the right-of-way of Township owned streets or in some cases PennDOT highways. The flood waters result in road closures that affect the travel patterns of township residents and commuters as well as create delays in the response time of emergency services personnel. Costs are incurred by the township during and after flood events for items such as; setting up barricades on closed roads, directing traffic around closures, cleanup of debris from floodwaters, etc.

Category 3 – Flooding is mainly contained within the yards of private property, both residential and non-residential. The flooding is generally outside of the public right-of-way and damage to buildings is not incurred. Since the flooding does not occur within public streets or right-of-way, traffic and emergency response time are generally not impacted.

After the potential projects were broken down into the three categories discussed above, a more in-depth rating system was developed in order to differentiate between projects within the same category and ultimately determine the order in which solutions will be explored. The following five criteria were utilized to rank projects within each category; Frequency of Flooding, Depth of Flooding, Duration of Flooding, Emergency Response Delay Time and Average Daily Traffic (ADT) affected.

Frequency of Flooding: (1) Flooding typically occurs more than 3 times per year
(2) Flooding typically occurs between 1-3 times per year
(3) Flooding typically occurs less than 1 time per year

Depth of Flooding: (1) Typically flood depths are in excess of 1 foot
(2) Typically between 6 to 12 inches is observed
(3) Typically less than 6 inches of flooding is observed

Duration of Flooding: (1) Flooding generally lasts in excess of 4 hours
(2) Flooding generally lasts between 2 and 4 hours
(3) Flooding generally lasts less than 2 hours

ADT Affected: (1) Greater than 10,000 ADT impacted
(2) Between 1,000 and 10,000 ADT impacted
(3) Less than 1,000 ADT impacted

Emergency Response Delay: (1) Major delay and road closures
(2) Slight delay and no road closures
(3) No delay

A comprehensive list of the projects within each category along with their rating for each of the five specific criteria is attached as an appendix to this report. Please note that some minor prioritization changes were made when previous

attempts to solve a problem weren't accepted by a resident (by-out). Individual descriptions of each project along with potential remedies can be found in the *Existing Stormwater & Flooding Problems* section of this report.

VII. Existing Stormwater & Flooding Problems

The rating system outlined in the previous section was utilized to put all of the existing stormwater and flooding problems, identified during the data gathering process, into one of three distinct categories. Projects are then assigned priority within the categories based on the five criteria discussed in the previous section.

A. Existing Problems – Category 1

Project Location	Report Exhibit #	Priority
Davisville Between Terwood & Carson-Simpson	6.1a	1
2603 Broadway	2.4	2
Robert Bruce Apartments	2.2	3
Mill & York Road	5.1a	4
Warminster Road near Lori & Surrey Lane	5.2a	5

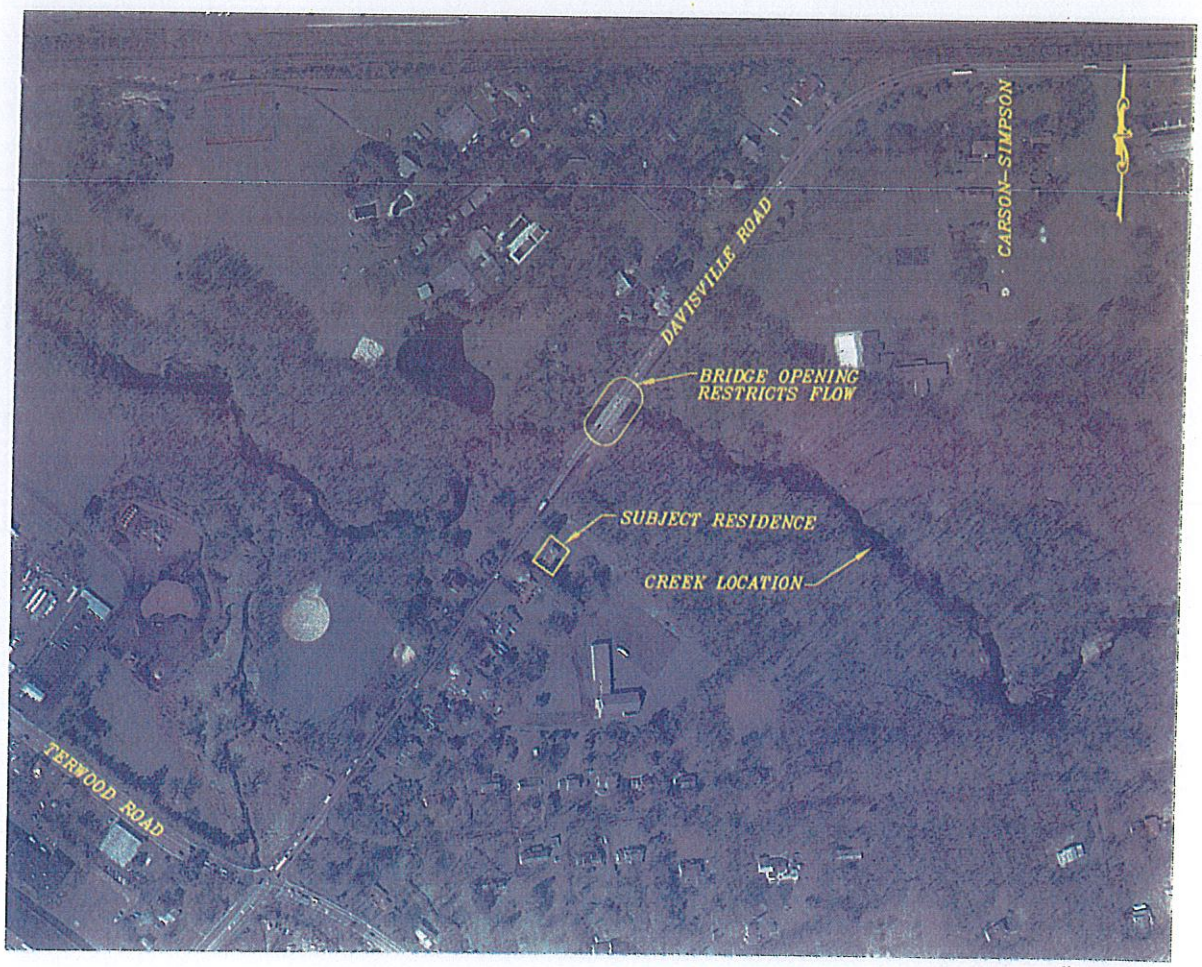
EXHIBIT 6.1a

Project Location:
Ward 6 – Davisville Road from Terwood Road to Carson-Simpson

Description of Problem:
Road & private property flooding is caused by flooding within the Pennypack Creek. The property highlighted below is known to experience building damage as a result of the severe creek flooding.

Potential Remedy:
Stream flooding is caused by regional drainage issues that are created by uncontrolled runoff from upstream areas within multiple adjacent municipalities. The only solution to try and correct the flooding in this area is to implement stormwater projects in upstream areas to reduce the volume of water within the Pennypack Creek, during rain events. A solution should first be explored to try and alleviate the flooding damage to the highlighted residence. Possible solutions could include a diversion / protective berm or to raise the elevation of the house above the flood line. It is quite possible that further investigation will conclude that the only viable option to alleviate the frequent building damage would be a buyout of the property.

Estimated Project Cost: $5,000



SCALE: 1"=500'

Project Location:
Ward 2 – 2603 Broadway Avenue

Description of Problem:
The rear yard of the highlighted property is the lowest point in the immediate area and does not have anywhere to drain. The backyard receives stormwater from the surrounding private properties as well as runoff during larger storm events from Broadway and Sycamore Avenues. A small inlet and trench were installed in the rear yard during the last 5-10 years in an attempt to infiltrate some of the water; however, the inlet is not connected to anything and does not function to reduce the flooding.

Potential Remedy:
The inlet on Broadway should be cleaned out to ensure that it is functioning as well as possible. Additionally, existing storm sewer in the area should be examined to determine if it is possible to install an inlet in the rear yard that could be tied into the existing system.

Estimated Project Cost: $10,000

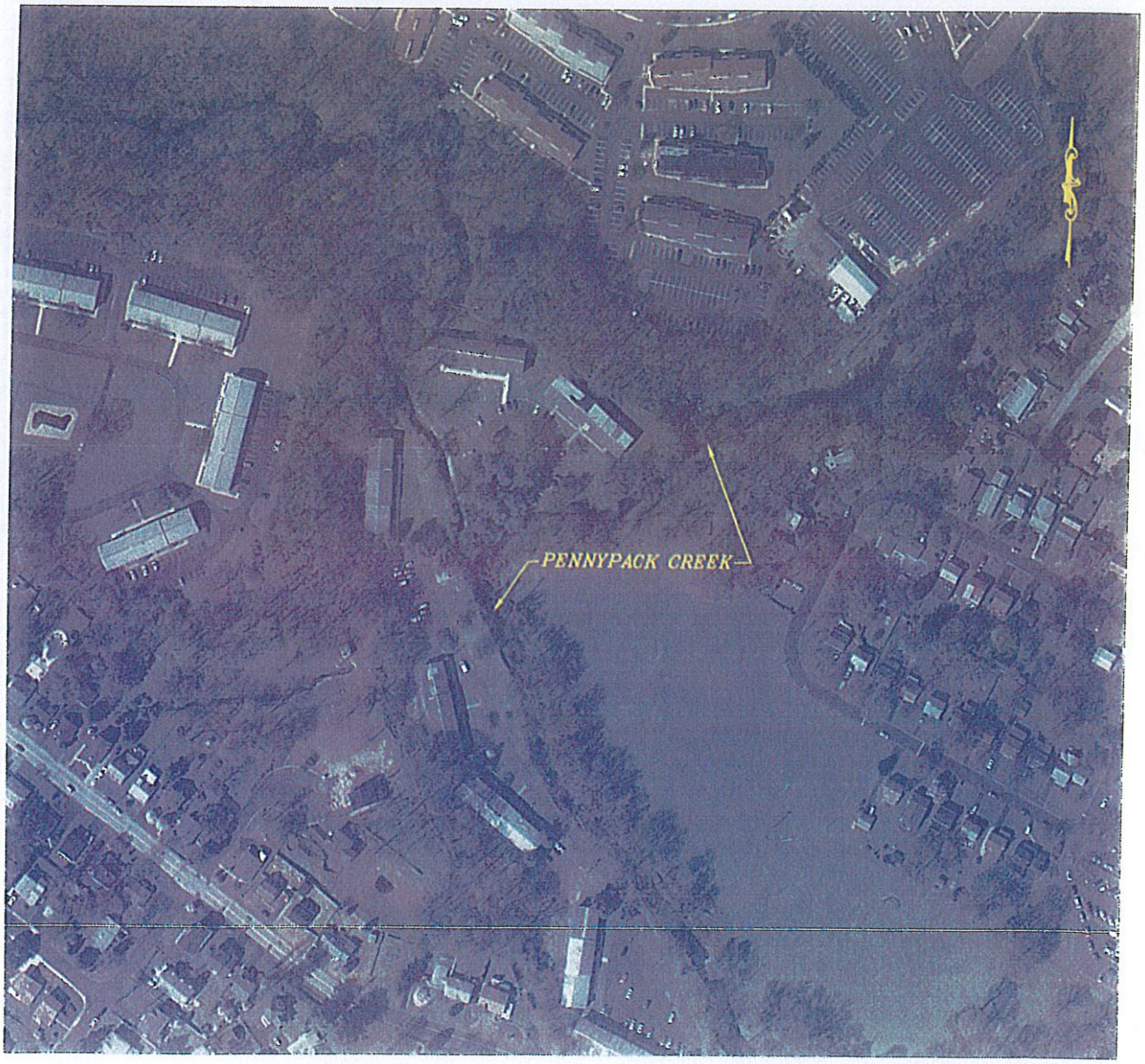
SCALE: 1"=200'

Project Location:
Ward 2 – Robert Bruce Apartments

Description of Problem:
Flooding within the Pennypack Creek causes damage to buildings within the apartment complex.

Potential Remedy:
The problem of flooding within the stream cannot be fixed on site. Basins need to be installed upstream in order to reduce the volume of water within the Pennypack Creek.

Estimated Project Cost: NA



SCALE: 1"=300'

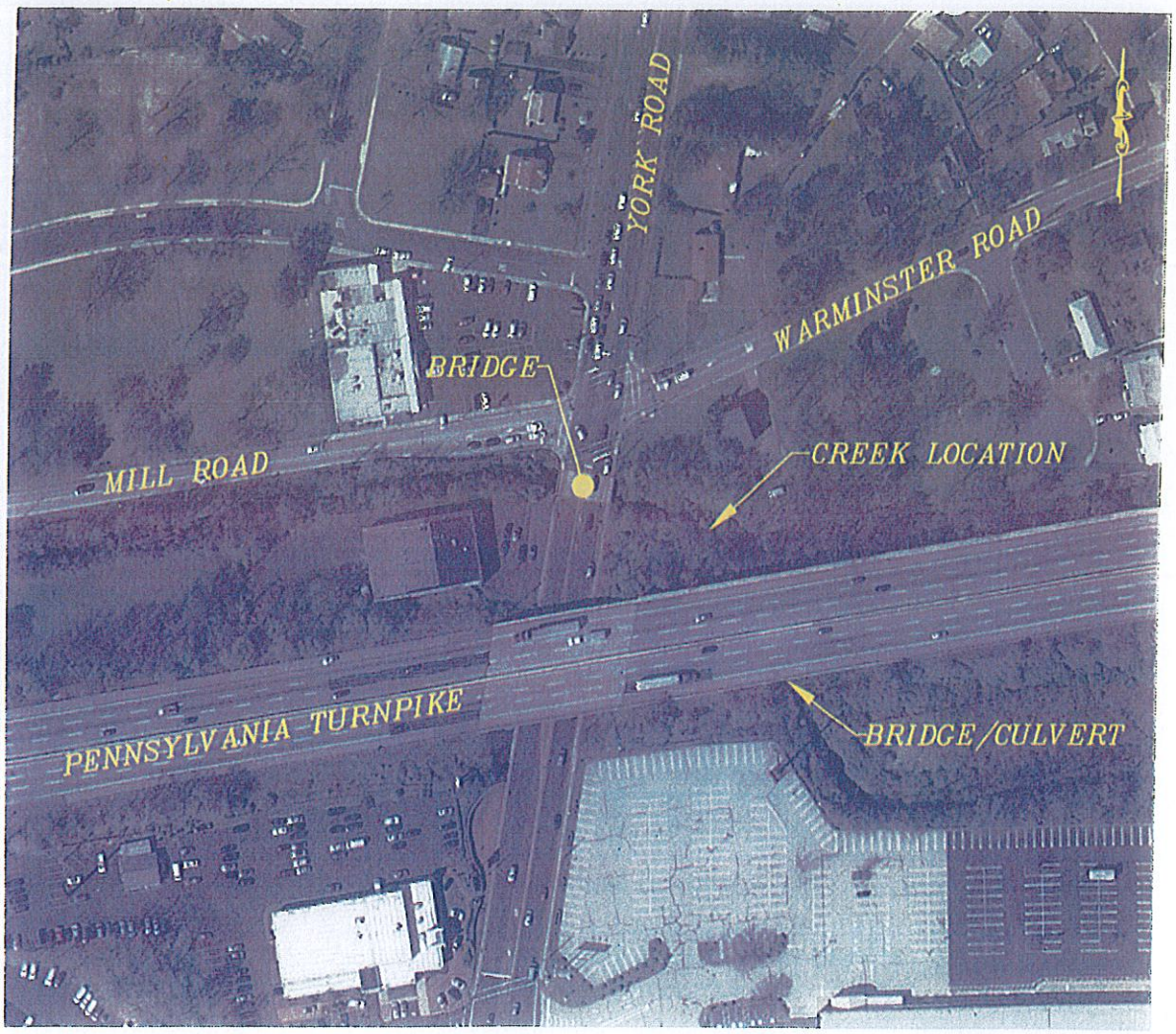
EXHIBIT 5.1a

Project Location:
Ward 5 – Mill Road & York Road

Description of Problem:
Intersection & private property flooding occurs due to flooding in the adjacent Pennypack Creek.

Potential Remedy:
The only viable solution to the problem is to implement stormwater basin projects in the areas upstream of this location to reduce the flooding in the creek. The other option would be to increase the stream opening under the Turnpike, but that would negatively affect downstream areas. It is our understanding that the property owners within this area that experience frequent flooding were offered buyout options. Some owners decided to take the buyout option and those houses have since been demolished, others decided to stay, essentially at their own risk. As such, this problem with regards to Category 1 can be eliminated for future consideration.

Estimated Project Cost: NA



SCALE: 1"=200'

EXHIBIT 5.2a

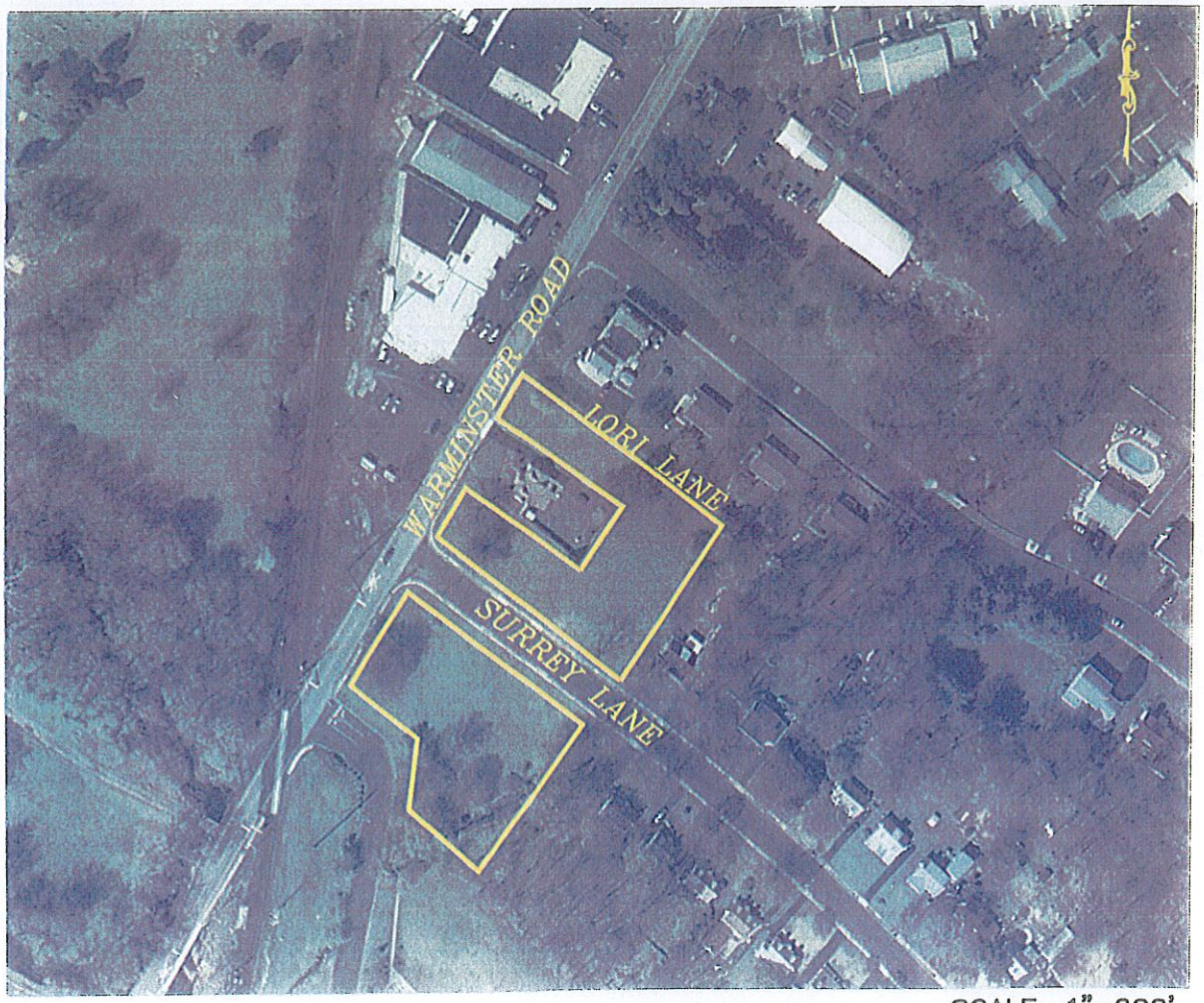
Project Location:
Ward 5 – Warminster Road near Lori Lane & Surrey Lane

Description of Problem:
There are no existing inlets or storm sewer system in this area. Roadway flooding occurs due to the lack of a proper drainage system.

Potential Remedy:
The Township owns property on both the north and south side of the intersection of Surrey Lane and Warminster Road (highlighted below). It is our understanding that the sole property on the north side of Surrey Lane that the Township does not own elected to decline buyout and to stay, essentially at their own risk.

This area has been identified as a potential location for the construction of a stormwater basin. If a basin were to be constructed in this area, the project would also need to incorporate a drainage system necessary to convey water to the basin.

Estimated Project Cost: NA



SCALE: 1"=200'

B. *Existing Problems – Category 2*

Project Location	Report Exhibit #	Priority
Davisville Between Terwood & Carson-Simpson	6.1b	1
Byberry Road Bridge near Pioneer	6.4	1
Mill & York Road	5.1b	1
Route 611 & Maryland Road	4.1	4
Mason's Mill Road Bridge	6.5	4
Blair Mill near County Line	2.8	6
Exton & Orangeman's Intersection	5.5	7
Terwood Road Tributary	6.2	7
Norwyn & Shirley Road	2.1	7
Whitehall Drive near Hideaway	4.2	10
Warminster Road near Lori & Surrey Lane	5.2b	10
Frazier & Evans Circle	1.4	10
Bonnett Lane at St. Dunstans Road	5.3	10
Church & Cherry Streets	1.8	14
Monument Avenue	2.3	15
Cameron & Sheldon Road	4.4	15
239 Cowbell Road	1.6	17
523 Grant Street	3.2	17
Duffield Street (natural spring)	3.3	19
Sheldon Road between Ellis & Fitzwatertown	4.5	19
1400 Terwood Road (PennDOT to fix)	6.3	21
Fern Village Park at Exton Road	7.1	22
Division & Krewson Street	1.7	22
Quigley Road	1.2	22

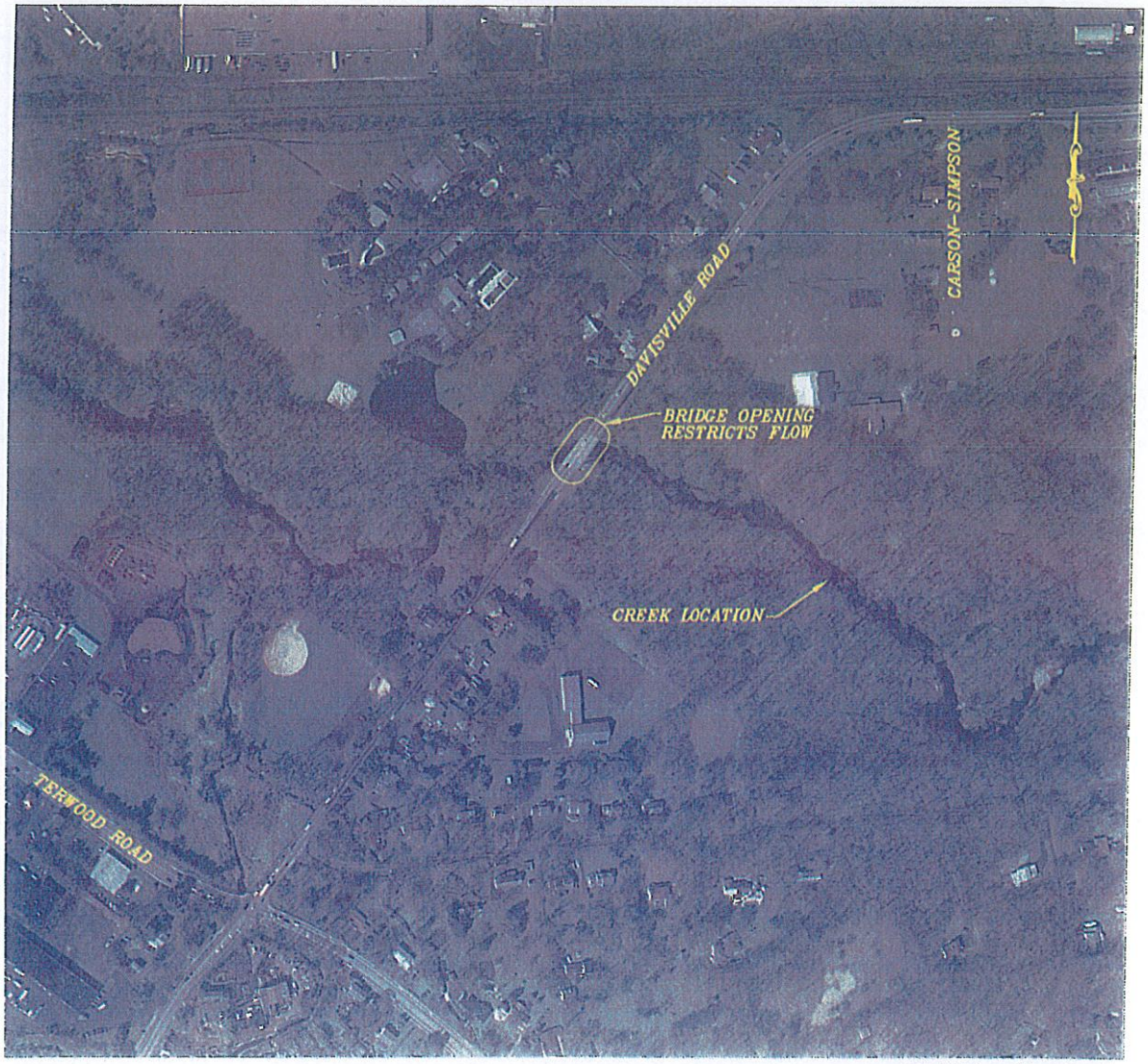
EXHIBIT 6.1b

Project Location:
Ward 6 – Davisville Road from Terwood Road to Carson-Simpson

Description of Problem:
Road flooding is caused by flooding within the Pennypack Creek.

Potential Remedy:
Stream flooding is caused by regional drainage issues that are created by uncontrolled runoff from upstream areas within multiple adjacent municipalities. The only solution to try and correct the flooding in this area is to implement stormwater projects in upstream areas to reduce the volume of water within the Pennypack Creek, during rain events.

Estimated Project Cost: NA



SCALE: 1"=500'

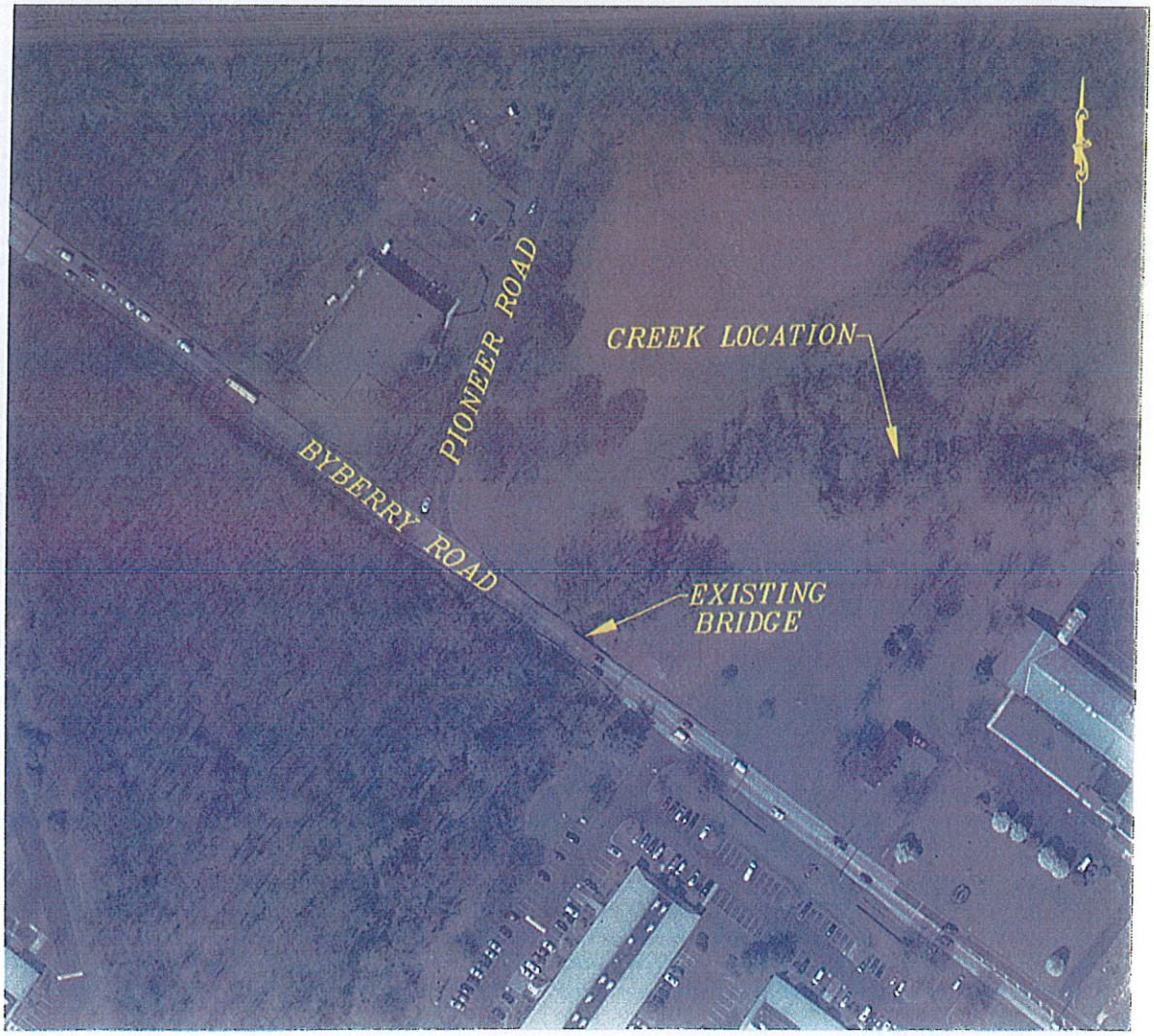
EXHIBIT 6.4

Project Location:
Ward 6 – Byberry Road near Pioneer Road

Description of Problem:
Road and bridge flooding occurs due to flooding within the adjacent Southampton Creek.

Potential Remedy:
The Township owns property upstream of this area at Pelleggi Park. If a stormwater basin were implemented upstream it could help to reduce flooding in this area. A study would need to be done in order to determine what, if any, measurable impacts the basin project would have on this and other areas of the Township. Another option would be to raise the road and bridge above the flood elevation height. Further solutions would require partnership with Warminster and Upper Southampton Townships.

Estimated Project Cost: $2M



SCALE: 1"=200'

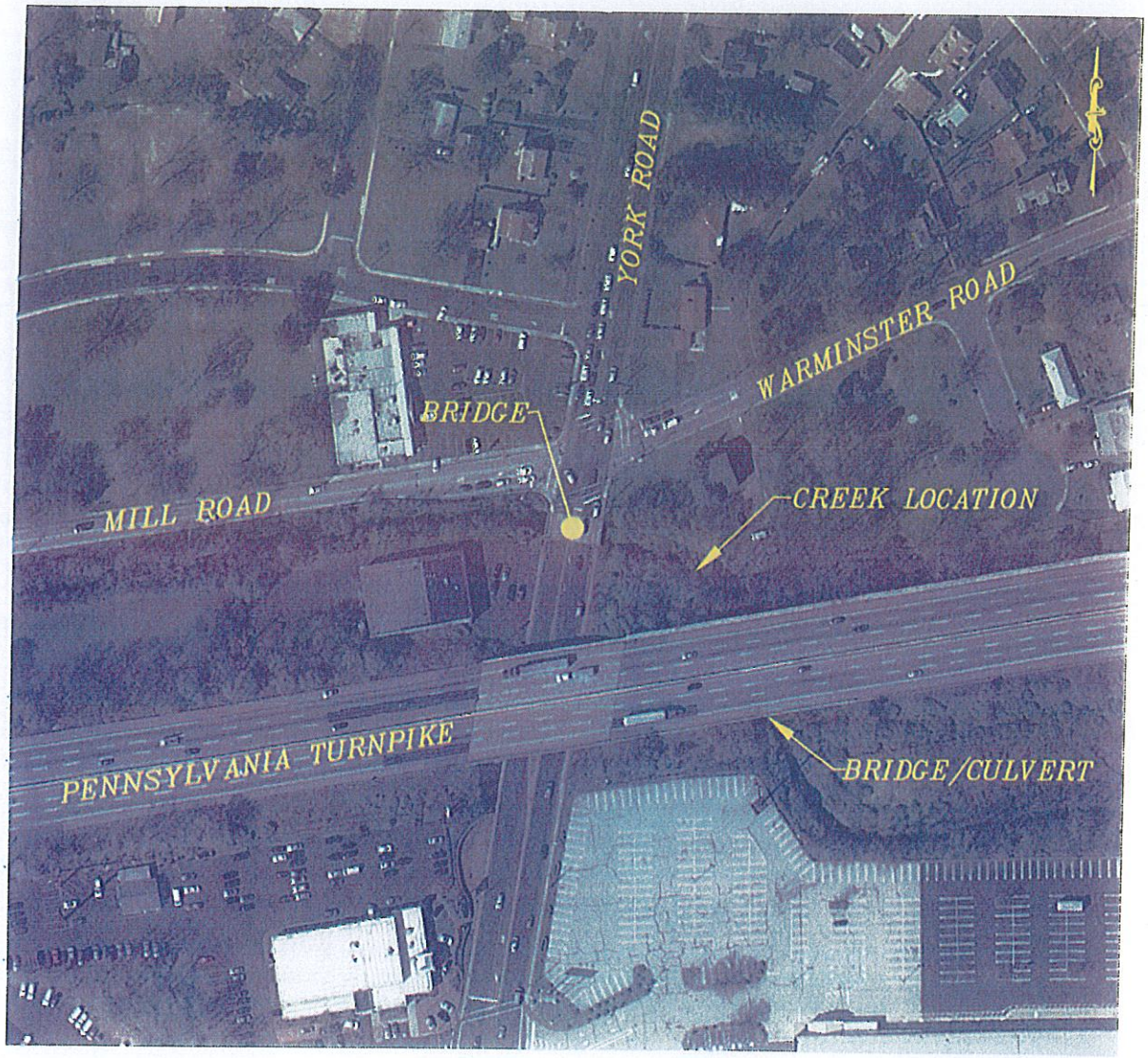
EXHIBIT 5.1b

Project Location:
Ward 5 – Mill Road & York Road

Description of Problem:
Intersection flooding occurs due to flooding in the adjacent Pennypack Creek.

Potential Remedy:
The only viable solution to the problem is to implement stormwater basin projects in the areas upstream of this location to reduce the flooding in the creek. The other option would be to increase the stream opening under the Turnpike, but that would negatively affect downstream areas.

Estimated Project Cost: NA



SCALE: 1"=200'

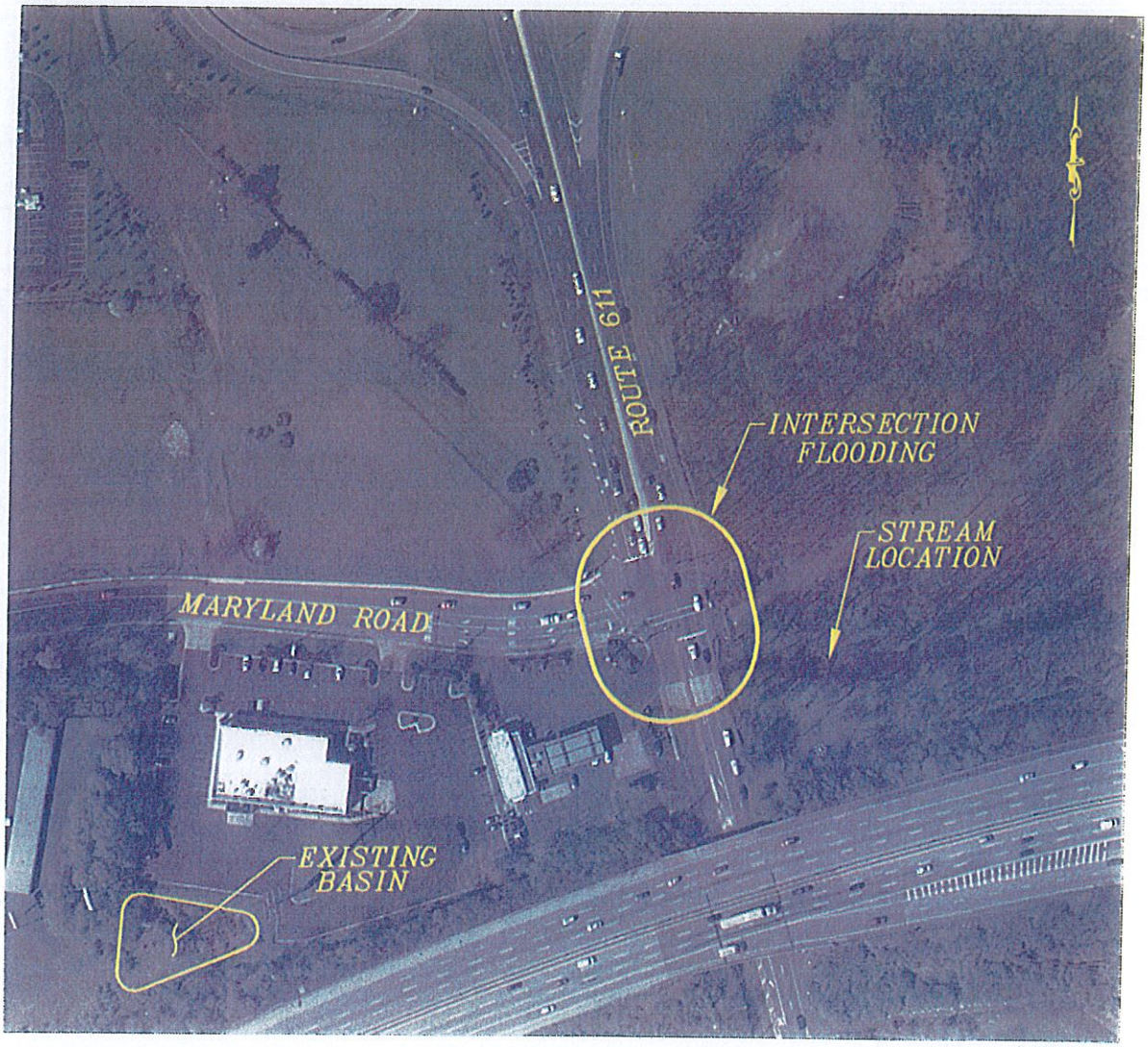
EXHIBIT 4.1

Project Location:
Ward 4 – Route 611 & Maryland Road

Description of Problem:
Intersection floods due to high water level in the adjacent stream.

Potential Remedy:
Stormwater basins and other improvements must be implemented upstream in order to reduce the volume of water within the stream. No improvement in the vicinity of this problem would have a measurable impact on the volume of water within the stream; however, the existing basin on the Carrabba's property, highlighted below, could be retrofitted to provide additional storage and also serve to increase water quality. It is worth noting that since UPS, Willow Point, and Horsham Gate were developed upstream the flooding has been significantly reduced at this location.

Estimated Project Cost: NA



SCALE: 1"=200'

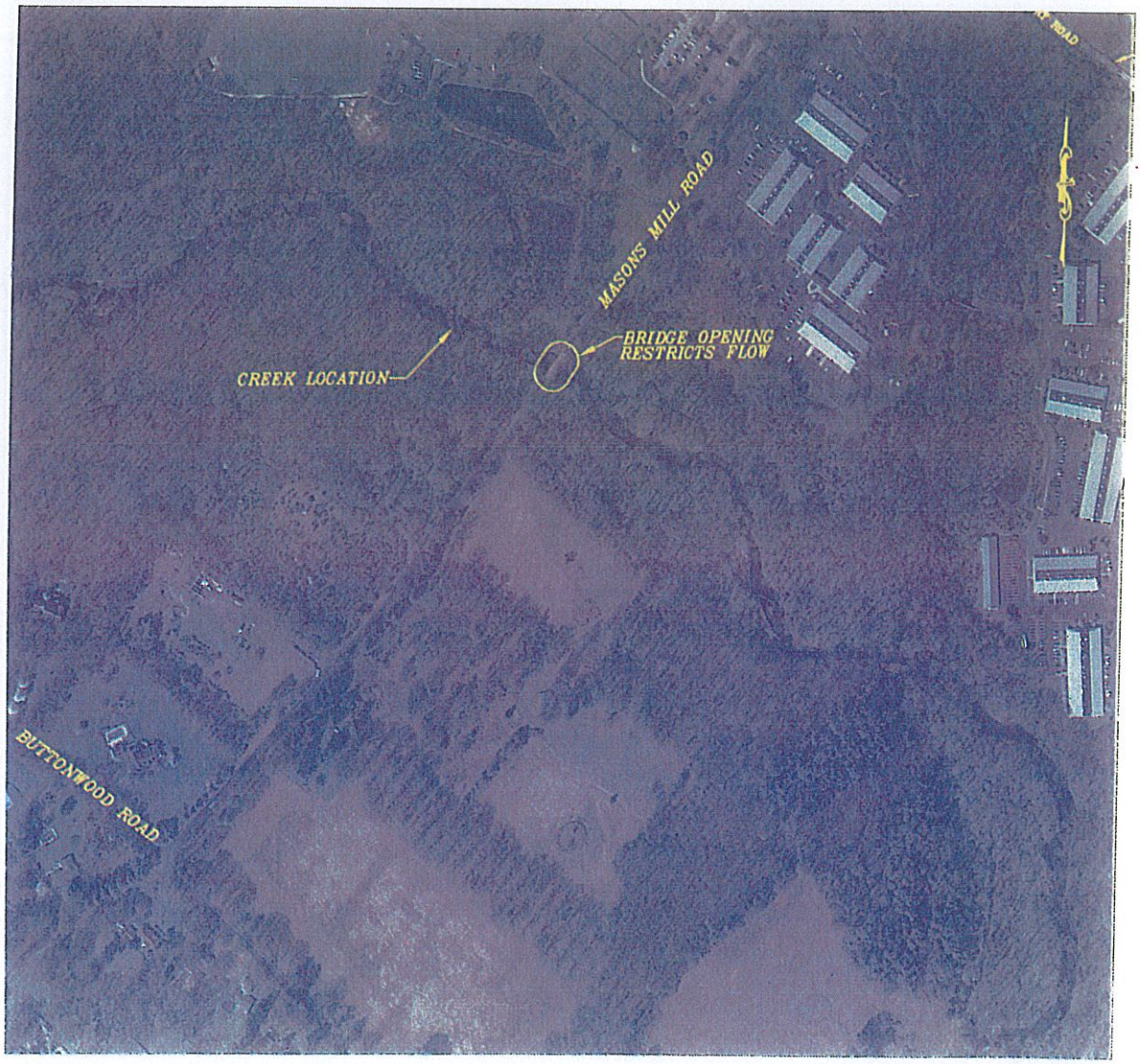
EXHIBIT 6.5

Project Location:
Ward 6 – Masons Mill Road between Buttonwood Road & Byberry Road

Description of Problem:
Road and bridge flooding occurs due to flooding in the adjacent creek.

Potential Remedy:
Stormwater projects need to be implemented upstream to reduce the water levels within the stream, during rain events. Another option would be to raise the road and bridge at this location.

Estimated Project Cost: $2M



SCALE: 1"=500'

EXHIBIT 2.8

Project Location:
Ward 2 – Blair Mill Road near County Line Road

Description of Problem:
Drainage system that originates in Horsham and Warminster Townships crosses under County Line Road and discharges to a swale / ditch along the west side of Blair Mill Road. Heavy flow from this system causes flooding at the intersection of Blair Mill and County Line Road.

Potential Remedy:
Blair Mill and County Line are both PennDOT roads and the adjacent Blair Mill Park is owned by Horsham Township and Hatboro Borough. The remedy to this problem is to install stormwater basins upstream in either Horsham or Warminster Township in order to reduce the volume of flow that discharges to the swale / ditch along Blair Mill Road. Alternatively, a storm sewer system could be installed in Upper Moreland on Blair Mill Road, but would need to be associated with a new basin at downstream end to mitigate negative effects of storm sewer system.

Estimated Project Cost: $1M – $1.5M

SCALE: 1"=200'