Tiber-Hudson & Plumtree Branch Stream Corridor Assessment 2012

Point # 1016
Location: -76.800255 39.268813
Description: Downstream end of large culvert.

Point # 1015
Location: -76.800172 39.268942
Description: Failing cinderblock wall.

Point # 1012
Location: -76.799508 39.268230
Description: Failing rock wall.

Tiber-Hudson and Plumtree Branch Stream Corridor Assessment

S&S Planning and Design, LLC.

12/12/2012

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Section 1
Introduction

Contents of this Section

1.1 2011 Ellicott City Flood Event

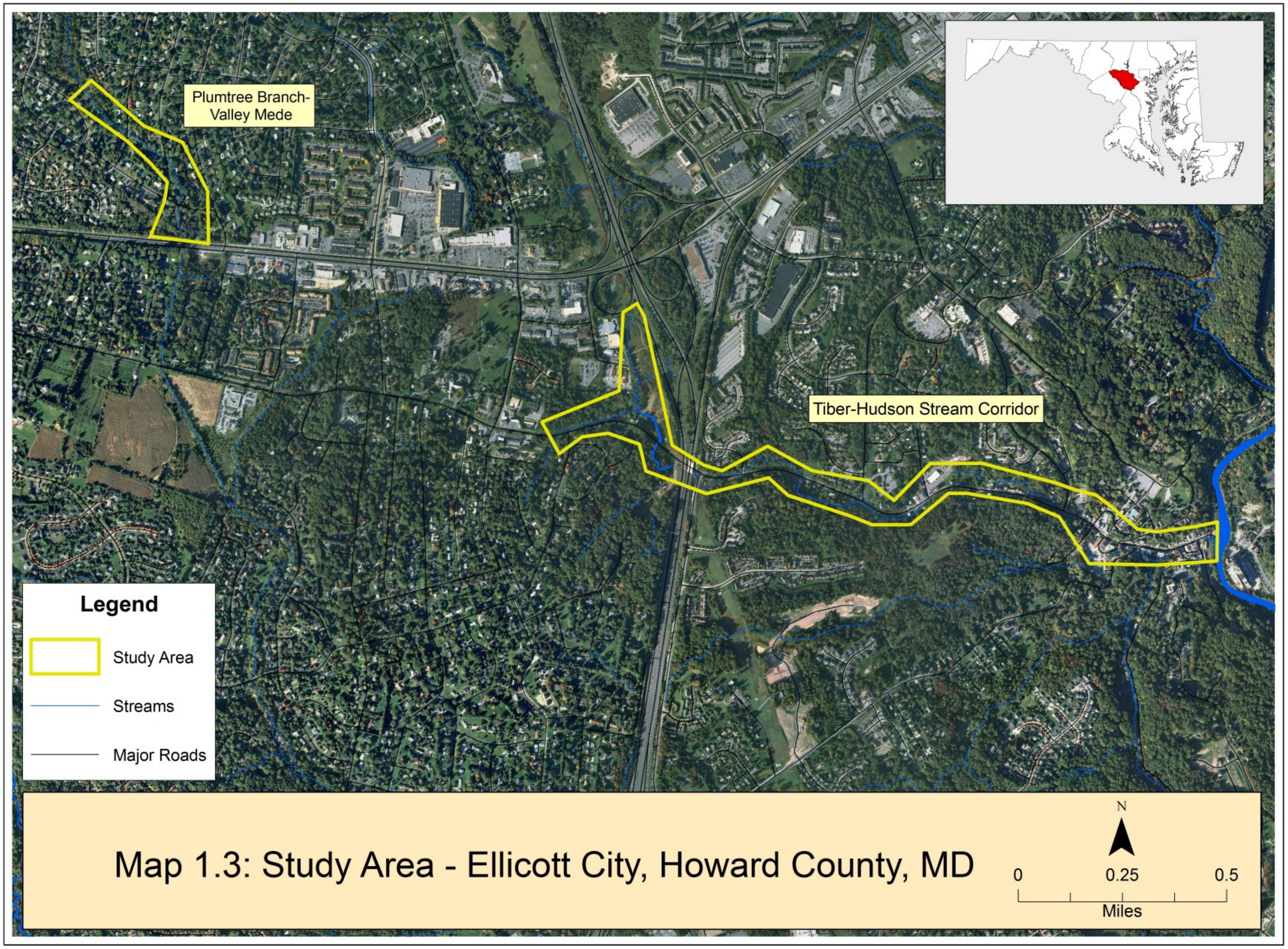
On September 7, 2011 remnants of Tropical Storm Lee passed through Howard County and caused significant flooding throughout areas of historic Ellicott City. Heavy rainfall, estimated by rain gauge data at 3.55 inches per hour during the most intense hour, inundated local stream channels and resulted in a significant flood event. Additionally, the ground was already saturated by previous precipitation, which significantly reduced infiltration, and resulted in an increased flood response by the watershed greater than what would be typical for a rain event of this depth and intensity. Due to the city's proximity to waterways, the flood event caused considerable property damage. As a counterpart to this report, a Case Study of the referenced flood was prepared for the Howard County Office of Emergency Management to document information pertaining to those properties affected by the referenced flood event. Based on data gathered via 76 interviews, 49 properties were negatively affected by the flood, with 20 properties reporting damages; the total estimated cost of these damages was $528,800.00.

1.2 Scope of Assessment

This Stream Corridor Assessment (SCA) was prepared for the Howard County Department of Public Works – Bureau of Environmental Services – Stormwater Management Division. The SCA evaluated two stream corridors: 1) The Tiber-Hudson corridor is located in historic downtown Ellicott City and the Hudson Branch contributing corridor to the west along Frederick Road; and, 2) The Plumtree Branch corridor located in the nearby subdivision of Valley Mede. The scope of the assessment is to perform a visual survey of the stream corridor in order to document specific conditions within the stream system that have the potential to exacerbate flood conditions and/or result in potential threats to property and infrastructure. Specific conditions documented by the assessment include: road crossings (bridges), erosion sites, debris blockages, damaged or failing culverts or channel walls, and channelization. The study will include mapped, written, and photographic documentation of any and all of these conditions found within the study area.

1.3 Study Area

The two assessment areas, as shown in Map 1.3, are located within two separate watersheds. The Tiber-Hudson Branch is located in the Patapsco River Watershed; Plumtree Branch is located within the Little Patuxent River Watershed. The majority of the study area focuses on the Hudson Branch, which falls within the Tiber-Hudson sub-watershed of the Patapsco. This branch flows through historic Ellicott City, and in many cases it travels beneath the City. This part of the study area spans roughly 2.1 miles in length. The second part of the study area includes the Plumtree Branch, which falls within the Little Patuxent River Watershed. This branch flows through the residential area known as Valley Mede, which is just northwest of historic Ellicott City. This portion of the study area spans roughly a quarter of a mile in length.



Map 1.3: Study Area - Ellicott City, Howard County, MD

Section 2

Methodology

Contents of this Section

2.1 The Stream Corridor Assessment Survey

In order to determine potential problem areas within the study area, a modified Stream Corridor Assessment (SCA) survey was utilized. This survey, developed by the Watershed Restoration Division of the Maryland Department of Natural Resources, has four primary objectives:

- To provide a list of observable environmental problems present within a stream system and along its riparian corridor.

- To provide sufficient information on each problem so that a preliminary determination of both severity and correctability of a problem can be made.

- To provide sufficient information so that restoration efforts can be prioritized.

- To provide a quick assessment of both in- and near-stream habitat conditions so that comparative assessments can be made of the condition of different stream segments.

The SCA survey is not meant to replace more in-depth scientific studies, specifically those relating to chemical, biological or geomorphological surveys. Instead, the SCA provides a quick and simple means of examining a stream reach so that future monitoring, management, and/or conservation efforts can be targeted more effectively.

2.2 Data Collection

The SCA survey of each study area was conducted by ‘walking’ the entire stream reach, within the stream channel, and recording potential problem areas/conditions on a field data sheet (See Figure 1). Each “problem” site within the Tiber-Hudson Branch was assigned a unique four-digit number (e.g. 1001), while each site within Plumtree Branch – Valley Mede was assigned a unique three-digit number (e.g. 101). At each site, relevant information was recorded either on a data form, or in a field notebook. Most of the data was collected visually; however, physical measurements were recorded where determined to be necessary, such as measuring a culvert circumference or bridge opening. Simultaneously, a hand held GPS unit, the TopSurv GMS-2, was used to collect coordinate data at each location to be later converted into a shapefile for further analysis in ArcGIS. Additionally, pictures were taken at each site with either the GPS unit or a digital camera.

Upon completion of the survey, information from the field data sheets and notebooks was recorded in Microsoft Excel. Furthermore, the point information gathered by the GPS unit was imported into ArcGIS to create both maps to be presented in this report, as well as a clickable map containing pictures and important information relevant to each point.

Figure 1.

STREAM WALK ASSESSMENT DATA FORM

Date:
Observers:

Road Crossing — Pt. No:

Type: Bridge, Pipe Culvert, Box Culvert, Arch, Other
Material: Concrete, Corrugated Metal, Smooth Metal, Round, Corrugated Plastic, Smooth Plastic, Elliptical
Number of Cells:
Pipe Dimension: — Embeddedness: Yes / No
Fish Blockage? Yes / No
Erosion Below Outfall: Yes / No
Notes:

Erosion Site — Pt. No:

Type: Downcutting, Lateral
Cause:
Bank Height: — Length:
Threat to Infrastructure: Yes / No
Severity: Severe, Moderate, Minor
Correctability: Limited, Moderate, Easy
Access: Limited, Moderate, Easy
Notes:

Debris Blockage — Pt. No:

Description:
Extent: Complete, Half, Minor
Impacts: Left Bank, Right Bank, Scour, All
Notes:

Channelization — Pt. No:

Type/Description:
Bank Affected: Left, Right, Both
Deposition: Yes / No
Vegetation: Yes / No
Flood Wall: Yes / No
If yes, Condition:
Notes:

2.3 Problem Types

For purposes of this assessment, the survey focused on four major problem types: road crossings, erosion sites, debris blockages, and channelization. The data collection form for each problem type borrowed heavily from the DNR SCA survey methodology and further details regarding data collected at each type of site can be found below.

Road Crossings

Sites included in this category consisted of bridges (including foot bridges), pipe culverts, box culverts, and arches. In nearly all cases these structures were built beneath a road, hence the category name. These four structural types were further defined by their material: concrete, corrugated metal, smooth metal, corrugated plastic, smooth plastic, or stone. The shape of the structure was also taken into consideration and was defined as being either round or elliptical. Other data to be recorded, if applicable, included the number of cells (for culverts), bridge/pipe dimensions, whether the structure was partly embedded, if a fish blockage existed, and if there was erosion below the pipe outfall.

Erosion Sites

Sites included in this category were first defined as either downcutting or lateral erosion. The apparent cause of the erosion at the site was recorded if it could be deduced by the observer. Other data recorded for erosion sites included bank height, length, and whether or not they presented a threat to nearby infrastructure. In keeping in line with typical SCA surveys, each site had its severity, correctability, and accessibility ranked. Severity rating, usually considered to be the most useful rating when comparing one site with another, was measured as being minor, moderate or severe. The correctability rating, defined as being either limited, moderate, or easy, provides a measurement of how easily a site might be fixed in the future. Finally, the accessibility rating is useful in determining the physical level of difficulty of gaining access to a problem site so that it may be corrected, typically with heavy construction equipment. The accessibility ranking does not factor or account for landowner access permissions, easements, or multiple property owner situations. Accessibility was defined as being limited, moderate, or easy. It should be noted that these ratings represent the overall impressions of the data collection team, for each site, at the time the survey was conducted.

Debris Blockages

A site was considered to be a debris blockage if the observed obstruction was large or accumulative enough to create a significant impediment, or potential impediment, to the flow of water. Sites considered to be debris blockages included, but were not limited to, fallen trees, root masses, branches, material from destroyed man-made objects such as walls or foot bridges, and other human-derived material. For sites defined as debris blockages, the extent was ranked, and the impact was categorized. Extent was ranked as being either complete, half or minor. Impact categorized the blockages based on their location within the channel and were labeled as affecting the left bank, right bank, scour, or all.

Channelization

While many sites within the study area were channelized, a site was only listed under this category if it was considered to be a failed channelization effort. For example, if the concrete lining of a channel was cracked or eroded it would be considered to be failed channelization. In addition, failing or crumbling rock or concrete walls were also included in the channelization category. Data recorded for these sites included the bank affected (left, right, or both), deposition (yes or no), presence of vegetation, and whether or not the site includes a flood wall.

Section 3
Results

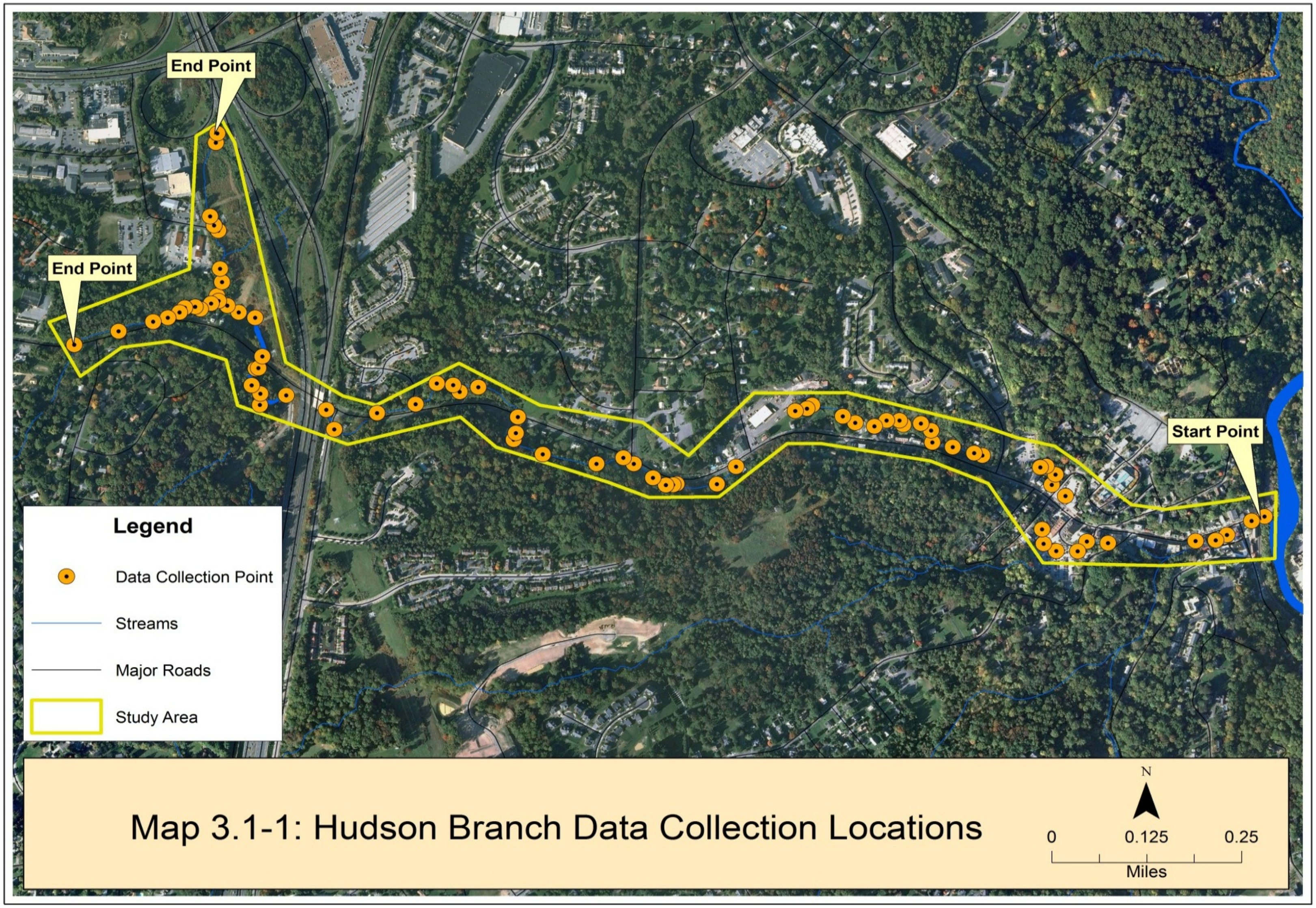
Contents of this Section

3.1 Overview

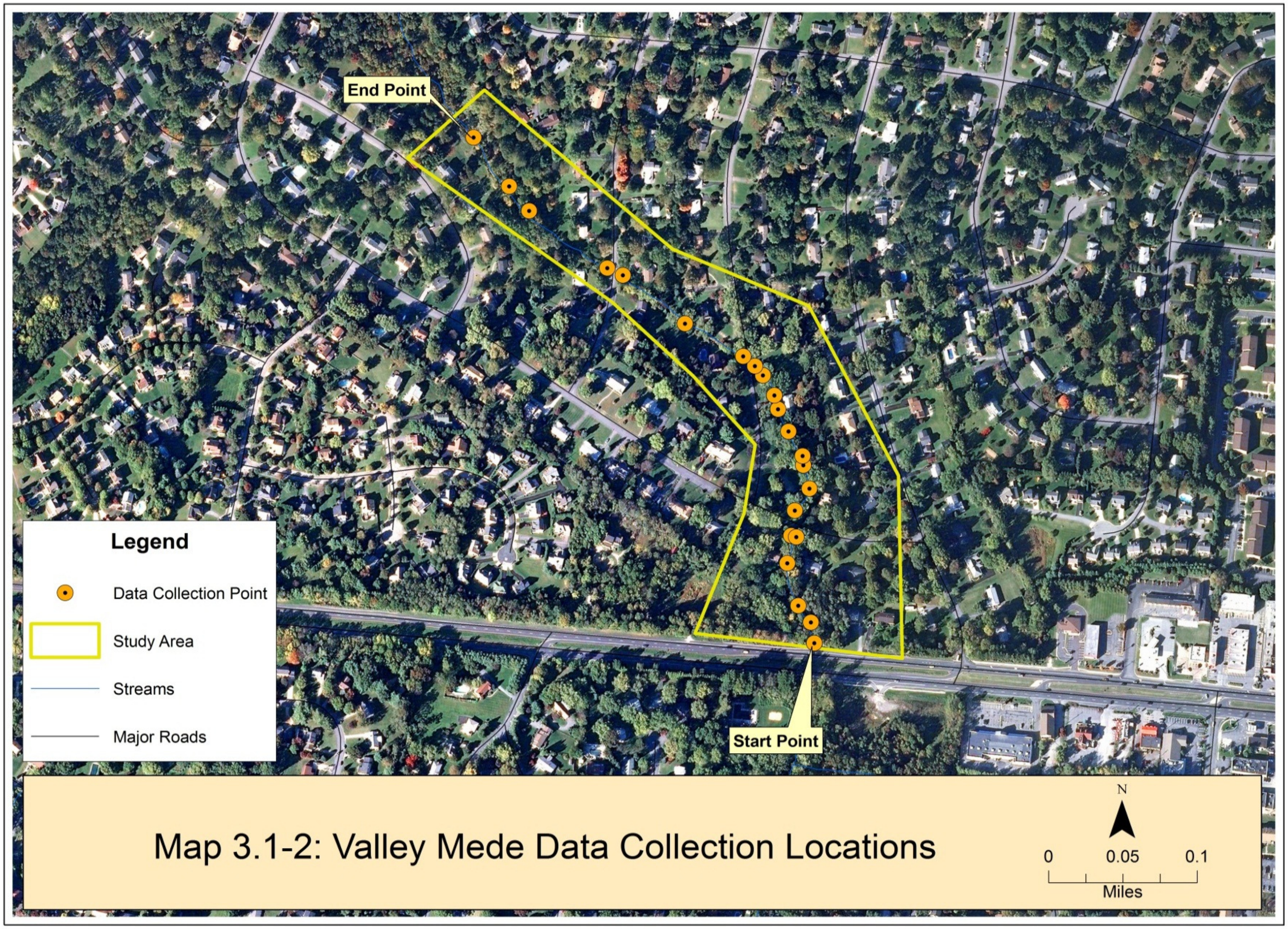
The Stream Corridor Assessment resulted in data collected for a total of 102 points. Eighty (80) of these points were in the Hudson Branch portion of the study area, and the remaining 22 were in the Valley Mede area. Maps 3.3 and 3.4 provide a visual reference to the data collection points located in the Hudson Branch and Valley Mede areas, respectively.

3.2 Problem Type Summaries

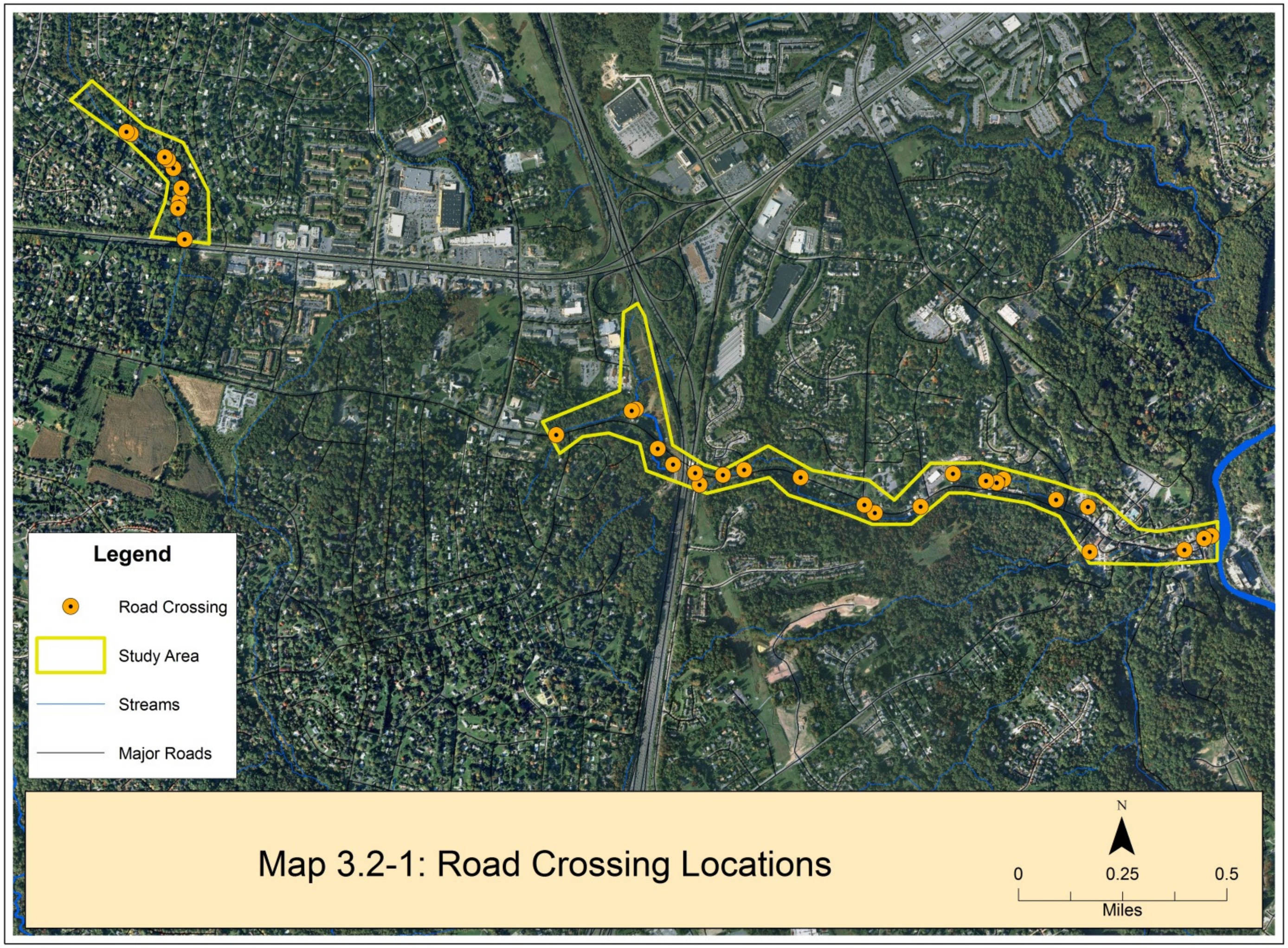
In total, the survey team recorded 30 Road Crossings, 24 Erosion Sites, 26 Debris Blockages, and 7 Channelization sites. The following sections summarize each problem type area and include tables that total the important information gathered for each problem type. Each section also includes a map that shows were each problem type is located. The entirety of the data collected for this survey is available in Appendix A.



Map 3.1-1: Hudson Branch Data Collection Locations


End Point
Start Point
Legend
Data Collection Point
Study Area
Streams
Major Roads
Map 3.1-2: Valley Mede Data Collection Locations
N
0
0.05
0.1
Miles

Road Crossings



<table>
<tr><th colspan="5">Table 1 – Total Road Crossings: 30</th></tr>
<tr><th>Type</th><th>Bridge</th><th>Pipe Culvert</th><th>Box Culvert</th><th>Arch</th></tr>
<tr><td>Total</td><td>12</td><td>14</td><td>2</td><td>2</td></tr>
<tr><th>Material</th><th>Concrete</th><th colspan="2">Corrugated Metal</th><th>Stone</th></tr>
<tr><td>Total</td><td>10</td><td colspan="2">10</td><td>2</td></tr>
<tr><th>Shape</th><th colspan="2">Round</th><th colspan="2">Elliptical</th></tr>
<tr><td>Total</td><td colspan="2">6</td><td colspan="2">4</td></tr>
<tr><th>Number of Cells</th><th colspan="2">One</th><th colspan="2">Two</th></tr>
<tr><td>Total</td><td colspan="2">23</td><td colspan="2">7</td></tr>
<tr><th>Fish Blockage</th><th colspan="2">Yes</th><th colspan="2">No</th></tr>
<tr><td>Total</td><td colspan="2">8</td><td colspan="2">17</td></tr>
<tr><th>Erosion Below Outfall</th><th colspan="2">Yes</th><th colspan="2">No</th></tr>
<tr><td>Total</td><td colspan="2">2</td><td colspan="2">22</td></tr>
<tr><th>Embeddedness</th><th colspan="2">Yes</th><th colspan="2">No</th></tr>
<tr><td>Total</td><td colspan="2">0</td><td colspan="2">25</td></tr>
</table>

During a high water event, road/stream crossing failure or inundation presents itself as unique hazard to humans. Many of the road crossings atop streams are bridges, which means people will either be driving or walking over them. If a stream is forced out of its banks and over a bridge crossing it may not only prevent passage by emergency personnel, but it could also cause harm to motorists or pedestrians who may be in the path of the moving water.

In total, 30 road crossings were recorded during the stream walk. Of these, 12 were bridges, 16 were culverts, and 2 were arches. Of the bridges, 5 were foot bridges (including one which is closed, Point No. 1010) and 3 are larger automobile/pedestrian bridges located in downtown Historic District of Ellicott City. The majority of road crossings were one-celled culverts made of corrugated metal. It is particularly important that these culverts remain open and free of debris so that during a high rainfall event they will function properly and not cause water to spill over into adjacent land or roadways.

Erosion Sites

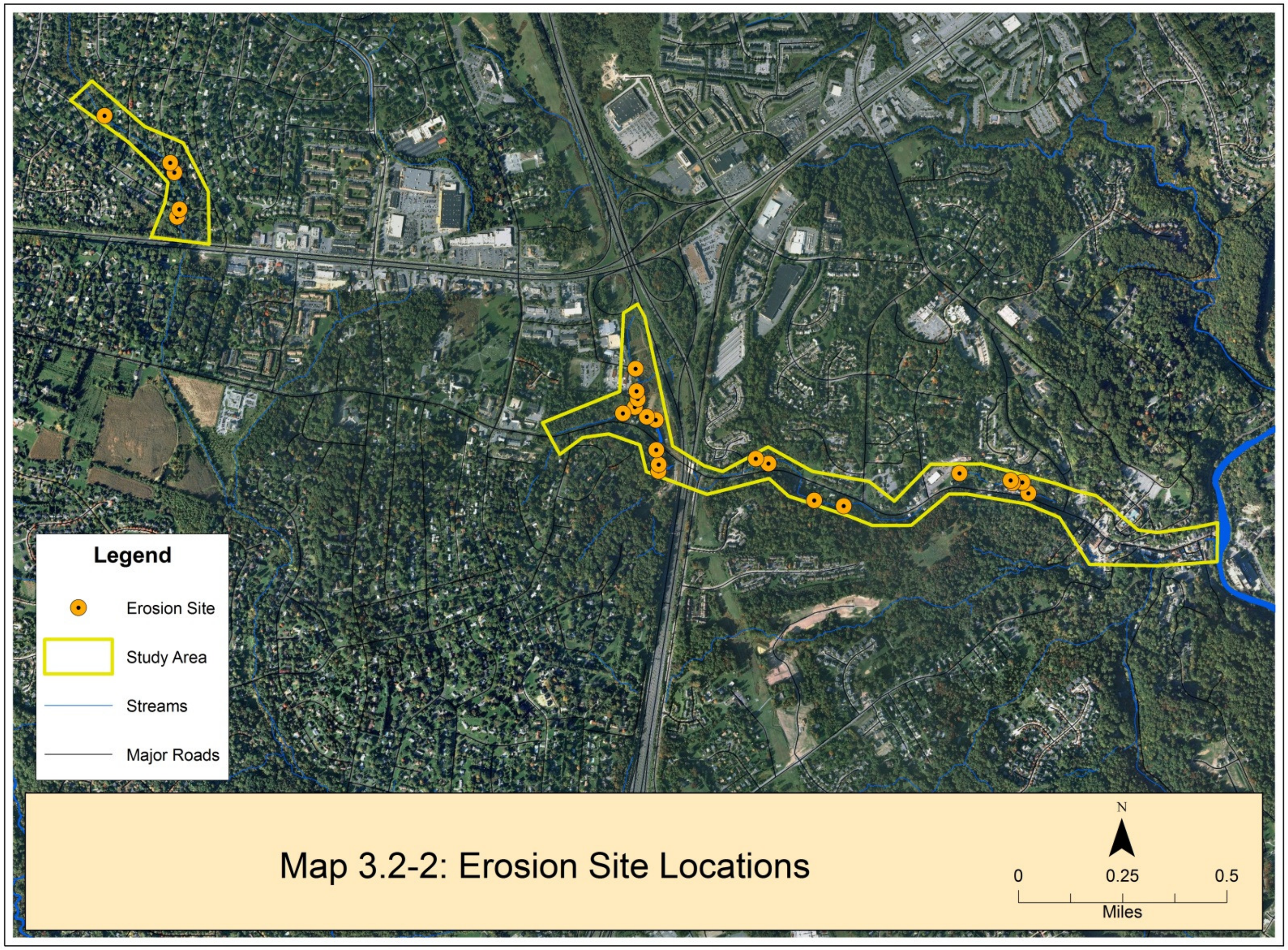


Table 2 – Total Erosion Sites: 24			
Type	Downcutting		Lateral
Total	0		21
Threat to Infrastructure	Yes		No
Total	2		22
Severity	Severe	Moderate	Minor
Total	4	13	5
Correctability	Limited	Moderate	Easy
Total	0	7	15
Access	Limited	Moderate	Easy
Total	0	6	16

Erosion is both natural and necessary to maintain a healthy stream environment, but too much erosion can have undesirable effects. Negative consequences of too much erosion can include the destabilization of stream banks, destruction of in-stream habitat, and significant sediment pollution conditions downstream. These types of problems are largely the result of significant changes in a streams hydrology or sediment supply, which is often related to land use changes within a watershed.

Twenty four (24) erosion sites were observed within the study area, and of these, only two (2) locations were recorded to be a threat to infrastructure. The majority of sites, 18 in total, were considered to be either moderate (13) or minor (5) in their severity. Furthermore, 15 sites were ranked 'easy' for correctability, and 16 were ranked 'easy' for access. This data suggests that not only are the majority of sites moderate or minor in their severity, but also that it will take minimal resources to fix these problem areas because they are both easy to correct and physically access.

Debris Blockages

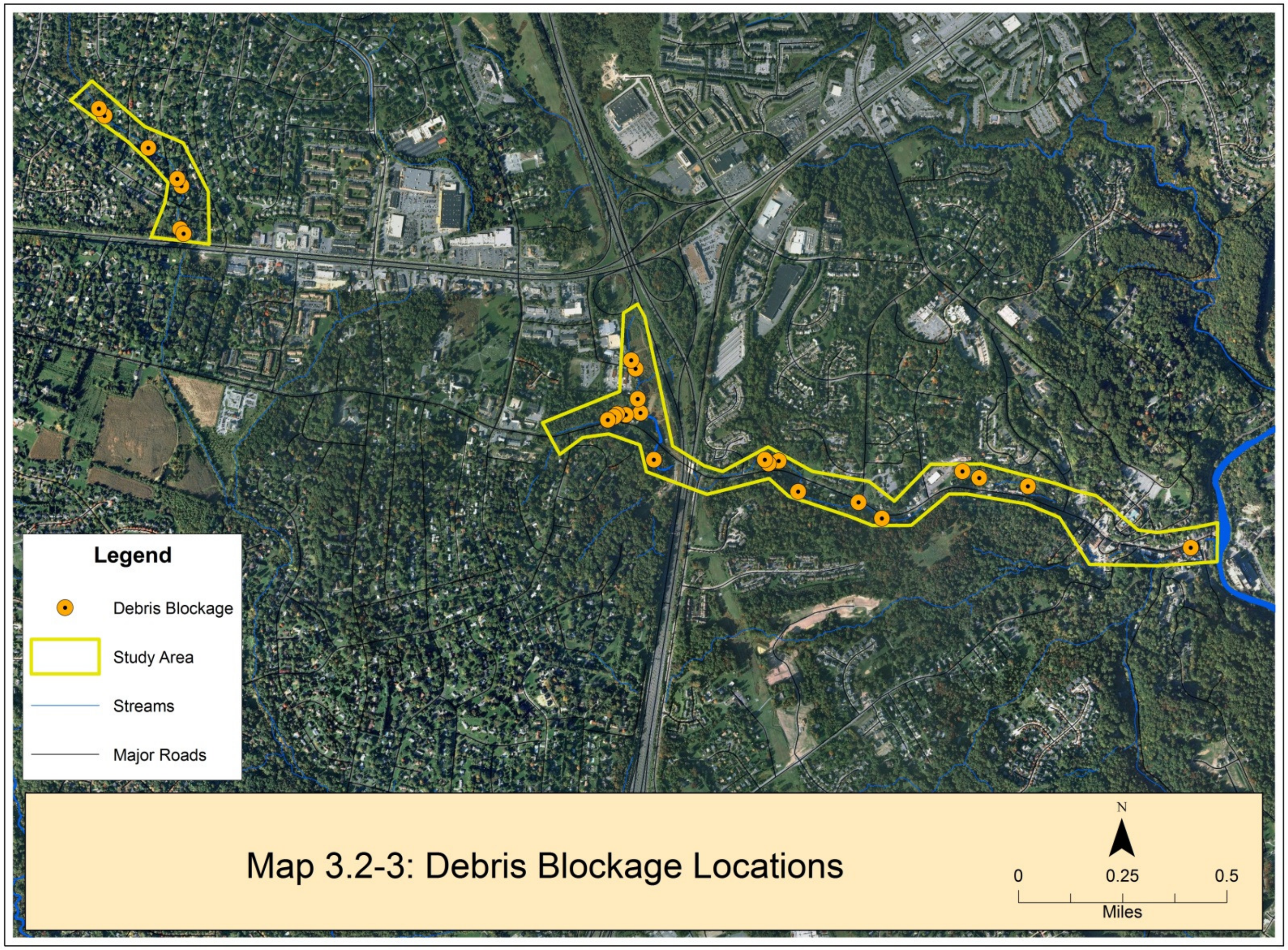


Table 3 – Total Debris Blockages: 26				
Extent	Complete		Half	Minor
Total	7		6	5
Impact	Left Bank	Right Bank	Scour	All
Total	4	4	4	5

Debris blockages, especially large blockages created by fallen trees, can trap smaller debris and create temporary dams which can then lead to flooding of adjacent land. If a debris blockage occurs near a road crossing or culvert inlet during an elevated flow event, flood waters can overtop the road. Once flood waters overtop a road crossing, particularly if the road and stream are somewhat parallel and share the same valley, flood waters will flow down the road until a low point where water will reenter the channel. Therefore, debris available to the stream system and in close proximity to culverts can cause unforeseen flooding scenarios that flood models do not anticipate.

In total, 26 debris blockages were recorded by the survey team and of these sites, 11 were tree blockages. Fourteen of these debris blockages, more than half, were determined to be within 250 feet of a road crossing, which for the purposes of this survey, included bridges and culverts. At each location, both the extent and impact of the blockage was recorded. Of the sites with a measurable extent, 7 were considered to be 'complete', which means the debris blocked all or most of the channel. Six were considered to be 'half' extent and 5 were considered to be of 'minor' extent. The impact of the debris blockages was measured in terms of whether the blockage affected the left or right bank, if it was contributing to scour, or whether it affected all parts of the stream. As shown in Table 3, the affected areas were quite even across the board, with sites being classified as 'all' having the lead by a small margin of one.

Channelization

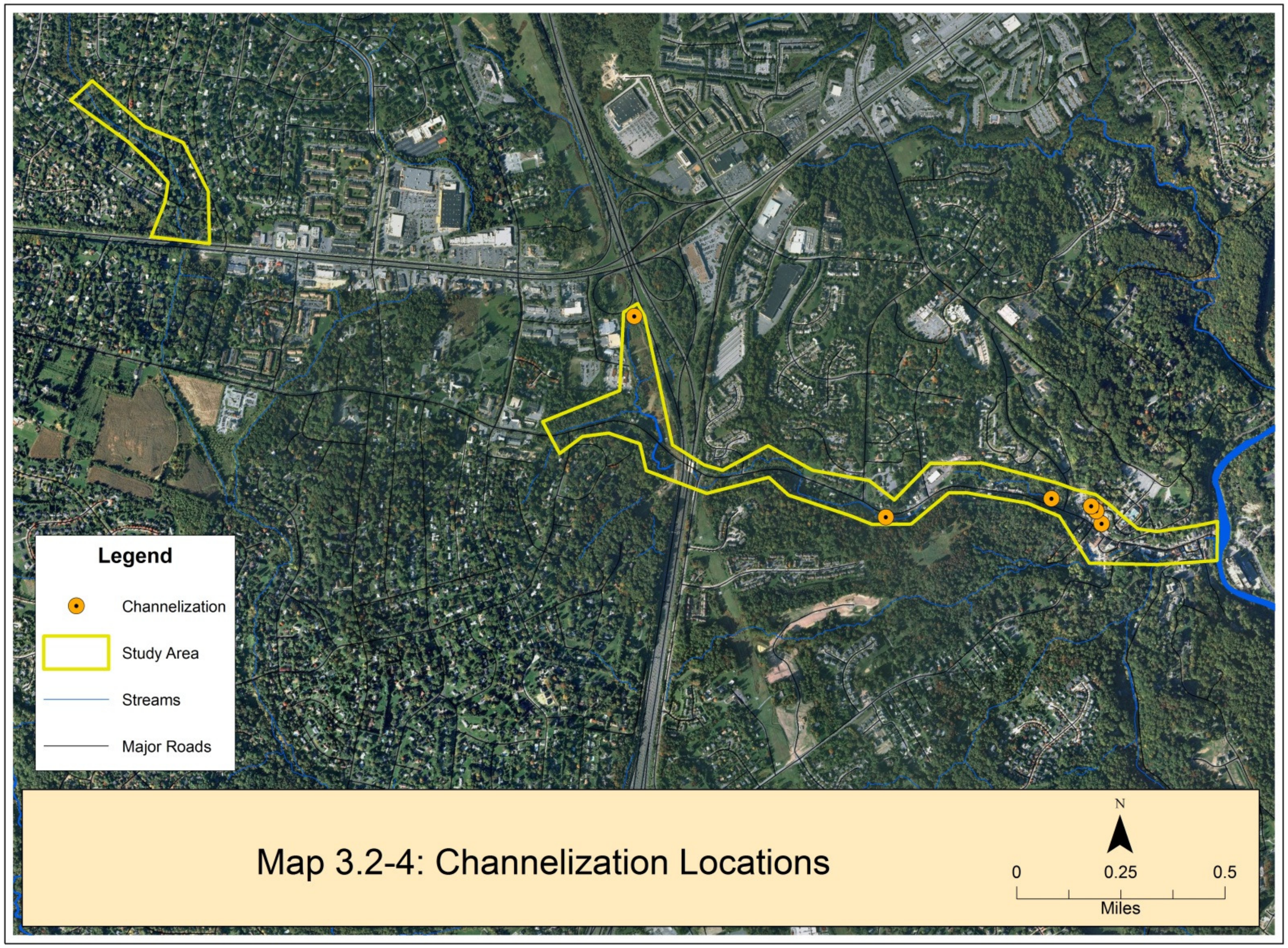


Table 4 – Total Channelization: 7			
Bank Affected	Left	Right	Both
Total	0	1	1
Deposition	Yes		No
Total	0		1
Vegetation	Yes		No
Total	0		1
Flood Wall	Yes		No
Total	7		1

An area of stream corridor is considered channelized when the stream banks and/or channel have been drastically altered from their natural state. Such alterations include replacing the stream bed and/or banks with concrete, installing flood walls, straightening the channel, bank hardening with rocks, and the use of gabion baskets.

For this study, the survey team only recorded locations where stream channelization had failed or was failing. In total, 6 locations were classified as being failed or failing channelization sites. The majority of these sites were composed of failing rock walls which were built to replace the natural bank. These types of areas are not unexpected in an historic urban area that is built in such close proximity to a stream. The most unique instance of failed channelization, point 1069 in the Hudson Branch, comprised of a shattered concrete stream bed. Because the majority (4) of the sites within this category were recorded within the downtown historic district of Ellicott City, it is likely that most of these sites represent some level of threat to adjacent infrastructure.

3.3 Point Locations & Descriptions – Map Plates

Point # 1002
Location: -76.794935 39.267737
Description: Road crossing. Bridge.

Point # 1001
Location: -76.794685 39.267801
Description: Rail road crossing. Bridge; beginning of study area.

Point # 1005
Location: -76.796517 39.267352
Description: Road/building crossing.

Point # 1003
Location: -76.795726 39.267545
Description: Debris blockage. Diverting flow directly into stone wall.

Point # 1004
Location: -76.795934 39.267319
Description: Road crossing. Bridge.

Point # 1007

Location: -76.798472 39.267226

Description: Failing riprap outfall to channel.

Point # 1006

Location: -76.798472 39.267226

Description: Building crossing w/ pillars.

Point # 1008

Location: -76.798472 39.267226

Description: Road crossing.


Point # 1010
Location: -76.798472 39.267226
Description: Road crossing. Closed footbridge.
Point # 1011
Location: -76.798472 39.267226
Description: Building and road crossing.
Point # 1009
Location: -76.798472 39.267226
Description: Road crossing.

Point # 1015
Location: -76.800172 39.268942
Description: Failing cinderblock wall.

Point # 1014
Location: -76.799923 39.268748
Description: Failing bank, large amount of wall in stream.

Point # 1013
Location: -76.799965 39.268457
Description: Road Crossing

Point # 1016
Location: -76.800255 39.268813
Description: Downstream end of large culvert.

Point # 1012
Location: -76.799508 39.268230
Description: Failing rock wall.

Point # 1020

Location: -76.802916 39.269303

Description: Erosion site. High shear on outside bank, root structure holding for now; eventual failure.

Point # 1017

Location: -76.801585 39.269171

Description: Upstream end of large culvert.

Point # 1019

Location: -76.802292 39.269205

Description: Between foot bridge and utility bridge spanning river.

Point # 1018

Location: -76.801918 39.269139

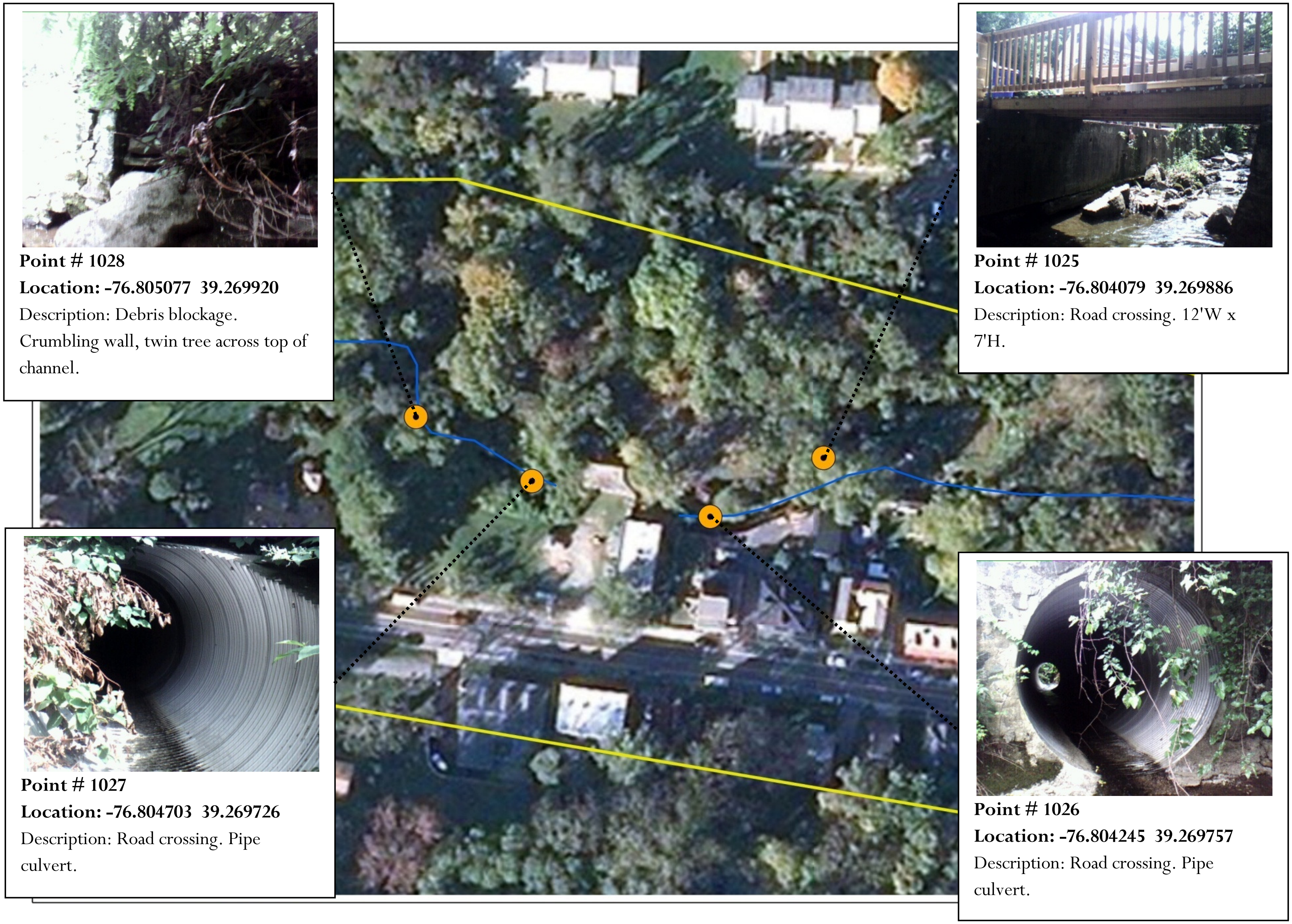
Description: Failing wall below house.

Point # 1024
Location: -76.803704 39.269886
Description: Erosion site. Outside meander, bank blown out.

Point # 1022
Location: -76.803081 39.269755
Description: Erosion site. Failing wall and erosion site.

Point # 1023
Location: -76.803580 39.269756
Description: Erosion site. Cinder blocks in stream.

Point # 1021
Location: -76.802832 39.269561
Description: Debris blockage. Heavy point bar formation on inside of meander.



Point # 1028

Location: -76.805077 39.269920

Description: Debris blockage. Crumbling wall, twin tree across top of channel.

Point # 1025

Location: -76.804079 39.269886

Description: Road crossing. 12'W x 7'H.

Point # 1027

Location: -76.804703 39.269726

Description: Road crossing. Pipe culvert.

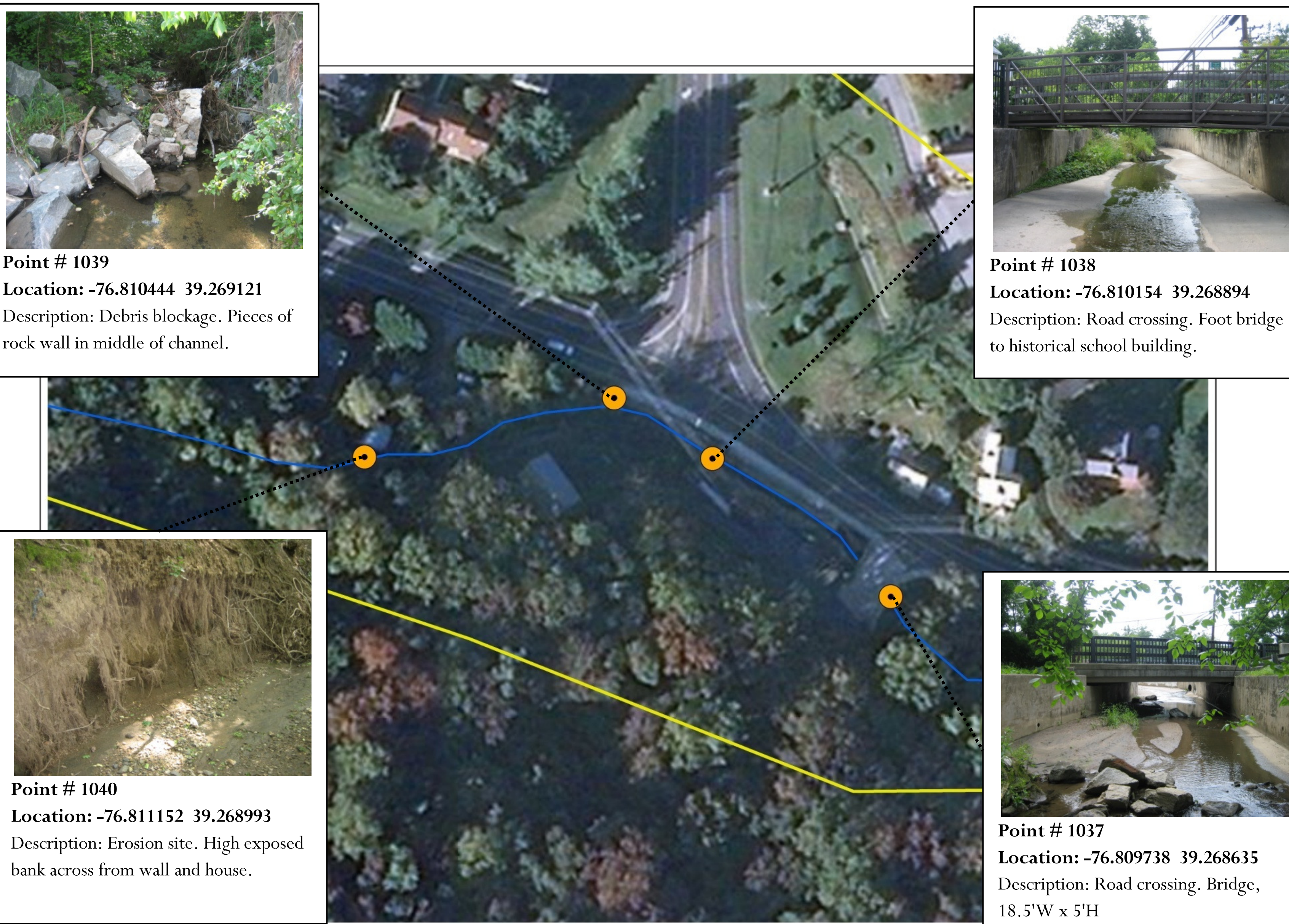
Point # 1026

Location: -76.804245 39.269757

Description: Road crossing. Pipe culvert.


Point # 1029
Location: -76.805742 39.270180
Description: Debris blockage. Debris piled up along left bank.
Point # 1031
Location: -76.806283 39.270084
Description: Road crossing. Pipe culvert near West End.
Point # 1030
Location: -76.806033 39.270116
Description: Erosion site. Blown out bank, downstream of West End culvert.


Point # 1036
Location: -76.809448 39.268441
Description: Debris blockage. Tree in creek catching debris.
Point # 1033
Location: -76.808158 39.268503
Description: House overhanging stream.
Point # 1032
Location: -76.807700 39.268890
Description: Road crossing. Pipe culvert near West End.
Point # 1035
Location: -76.809364 39.268570
Description: Failed rock wall.
Point # 1034
Location: -76.809115 39.268569
Description: House crossing.



Point # 1039

Location: -76.810444 39.269121

Description: Debris blockage. Pieces of rock wall in middle of channel.

Point # 1038

Location: -76.810154 39.268894

Description: Road crossing. Foot bridge to historical school building.

Point # 1040

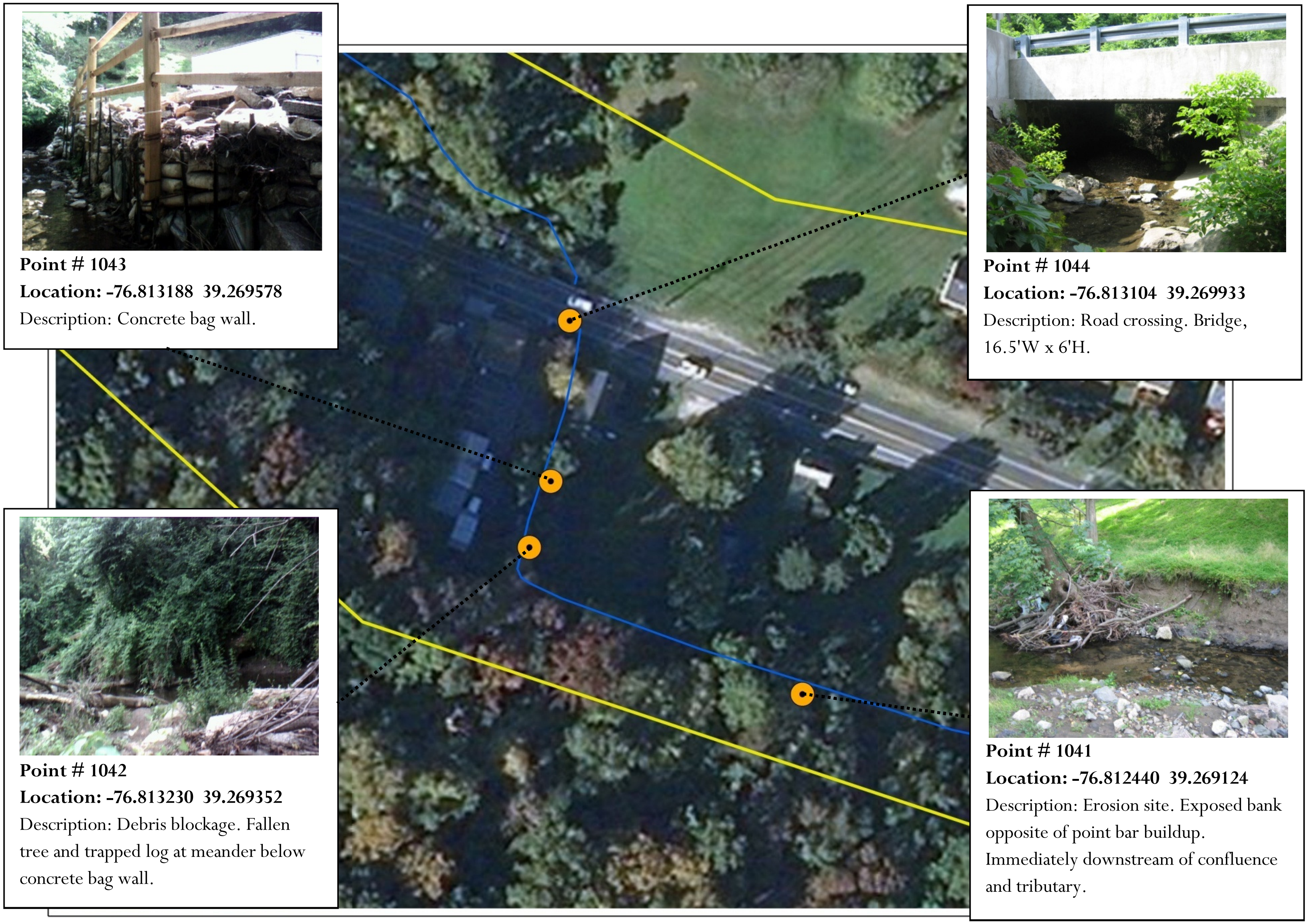
Location: -76.811152 39.268993

Description: Erosion site. High exposed bank across from wall and house.

Point # 1037

Location: -76.809738 39.268635

Description: Road crossing. Bridge, 18.5'W x 5'H



Point # 1043
Location: -76.813188 39.269578
Description: Concrete bag wall.

Point # 1044
Location: -76.813104 39.269933
Description: Road crossing. Bridge, 16.5'W x 6'H.

Point # 1042
Location: -76.813230 39.269352
Description: Debris blockage. Fallen tree and trapped log at meander below concrete bag wall.

Point # 1041
Location: -76.812440 39.269124
Description: Erosion site. Exposed bank opposite of point bar buildup. Immediately downstream of confluence and tributary.

Point # 1048
Location: -76.815140 39.270648
Description: Erosion site. High bank, outside meander.

Point # 1045
Location: -76.813976 39.270581
Description: Debris blockage. Fallen sycamore across channel.

Point # 1047
Location: -76.814724 39.270583
Description: Debris blockage. Tree across channel. Tree is ~24" DBH and ~ 2' above water surface.

Point # 1046
Location: -76.814558 39.270453
Description: Erosion site/Debris blockage. Outside meander eroding, debris catching on walnut roots nearing failure.


Point # 1052
Location: -76.817761 39.270135
Description: Road crossing. Bridge, box culvert.
Point # 1050
Location: -76.816556 39.270004
Description: Road crossing. Pipe culvert, arch. 12'W x 8'H.
Point # 1051
Location: -76.817680 39.269650
Description: Road crossing. Bridge.
Point # 1049
Location: -76.815640 39.270099
Description: Road crossing. Pipe culvert.

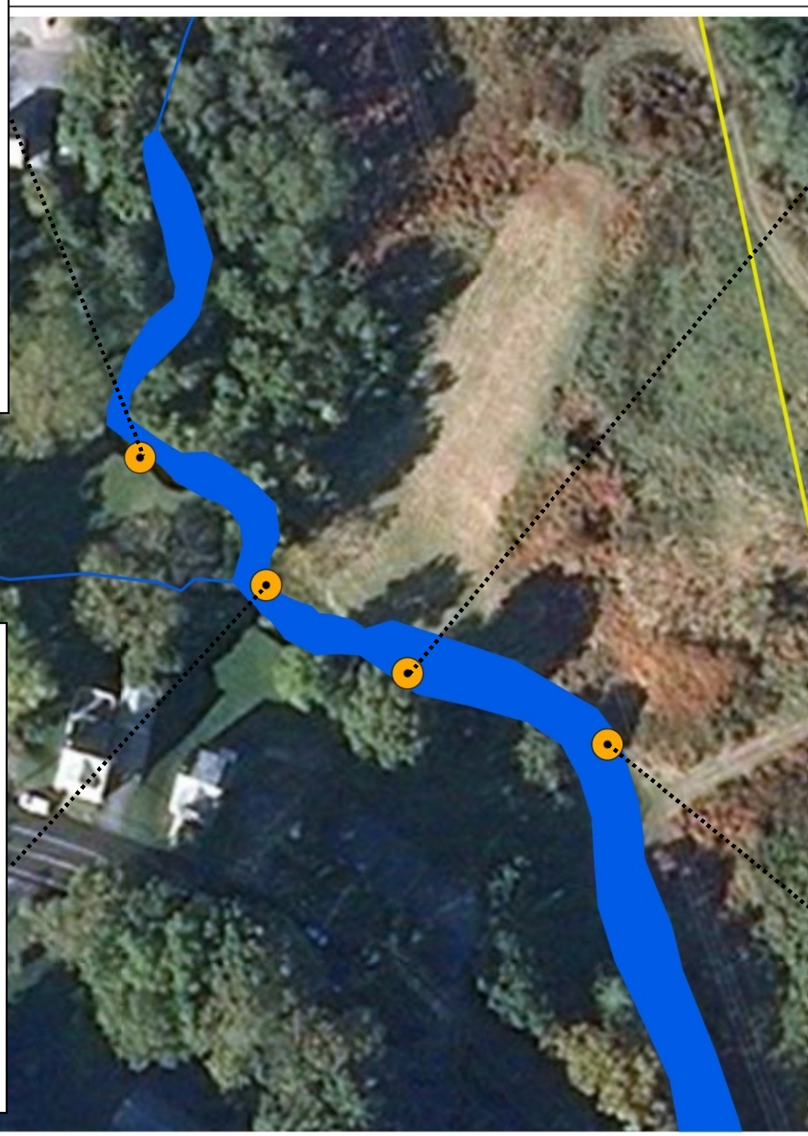
Point # 1056
Location: -76.819674 39.270526
Description: Debris blockage. Tree across channel.

Point # 1053
Location: -76.818801 39.270363
Description: Upstream end of box culvert.

Point # 1055
Location: -76.819466 39.270396
Description: Erosion site. Outside meander.

Point # 1054
Location: -76.819383 39.270170
Description: Erosion site. Outside of meander, Japanese Knotweed.


Point # 1057
Location: -76.819631 39.270881
Description: Erosion site. High bank.
Point # 1059
Location: -76.819422 39.271204
Description: Exposed sewer line at upstream edge of bridge.
Point # 1058
Location: -76.819382 39.270881
Description: Road crossing. Bridge.



Point # 1063
Location: -76.820501 39.272305
Description: Erosion site. Mowed lawn up to top of bank.

Point # 1061
Location: -76.820003 39.272013
Description: Erosion site. Lack of vegetation, mowed lawn up to top of bank.

Point # 1062
Location: -76.820210 39.272175
Description: Debris blockage. Twin bole root wad in middle of channel.

Point # 1060
Location: -76.819545 39.271980
Description: Erosion site. Lack of vegetation.

Point # 1067

Location: -76.820580 39.273792

Description: Confluence of two channels, left one coming from pipe.

Point # 1066

Location: -76.820414 39.273663

Description: Erosion site/Debris blockage. Down volley meander migration, miscellaneous limbs.

Point # 1065

Location: -76.820458 39.272919

Description: Erosion site. High exposed bank.

Point # 1064

Location: -76.820458 39.272661

Description: Erosion site/Debris blockage. High outside of meander,


Point # 1070
Location: -76.820576 39.275700
Description: Terminal end of study area at large culvert.
Point # 1069
Location: -76.820535 39.275473
Description: Channelization. Failing concrete lining.
Point # 1068
Location: -76.820663 39.274019
Description: Debris blockage. Tree across channel, lying lengthwise. miscellaneous debris.

Point # 1074
Location: -76.821125 39.272177
Description: Erosion site. Outside meander.

Point # 1071
Location: -76.820460 39.272208
Description: Road crossing. Foot bridge on small tributary.

Point # 1073
Location: -76.820834 39.272047
Description: Debris blockage. Debris and sediment built up at inlet.

Point # 1072
Location: -76.820626 39.272273
Description: Road crossing. Pipe culvert.

Point # 1077

Location: -76.821750 39.271887

Description: Debris blockage. Leaning tree and root ball blocking channel.

Point # 1075

Location -76.821333 39.272209

Description: Debris blockage. Various debris in channel.

Point # 1076

Location: -76.821417 39.272015

Description: Debris blockage. Tree across channel, backing up sediment.

Point # 1078

Location: -76.822124 39.271855

Description: Old pipe in channel.

Point # 1080
Location: -76.823955 39.271470
Description: Road crossing. Stone arch, 10'W x 5'H. End of study area.

Point # 1079
Location: -76.822915 39.271630
Description: Recent grading.

Point # 101

Location: -76.840812 39.279565

Description: Road crossing. Stacked stone headwall, ~8 feet above culvert inlet.

Point # 104

Location -76.840632 39.279754

Description: Bank height transition point. 4-6 ft banks to 8 ft banks.

Point # 102

Location: -76.840877 39.279324

Description: Road crossing. Stacked stone headwall, ~8 feet above culvert inlet.

Point # 103

Location: -76.840812 39.279274

Description: Erosion site. Appears to have taken out a split rail fence.

Point # 108
Location: -76.840812 39.279565
Description: Road crossing. Stacked stone headwall, ~8 feet above culvert inlet.

Point # 107
Location -76.840632 39.279754
Description: Bank height transition point. 4-6 ft banks to 8 ft banks.

Point # 105
Location: -76.840877 39.279324
Description: Road crossing. Stacked stone headwall, ~8 feet above culvert inlet.

Point # 106
Location: -76.840812 39.279274
Description: Erosion site. Appears to have taken out a split rail fence.

Point # 112
Location: -76.841476 39.281097
Description: See Point # 111.

Point # 110
Location -76.841248 39.280920
Description: Erosion site. No vegetation or roots on bank.

Point # 111
Location: -76.841346 39.280958
Description: Minor debris in right cell, excessive point bar formation with heavy vegetation immediately upstream of inlets of both cells. Stacked stone headwalls, ~8' above invert.

Point # 109
Location: -76.841102 39.280692
Description: Road crossing. Destroyed bridge, just abutments and beams left. 19'W x 102"L.

Point # 113

Location: -76.840943 39.279021

Description: Erosion site. Threat to split rail fence.

Point # 115

Location -76.840667 39.278438

Description: Potential debris blockage.

Point # 114

Location: -76.840765 39.278603

Description: Debris blockage. Creating some backwater.

Point # 116

Location: -76.840603 39.278223

Description: Road crossing. Some debris at inlet.

Point # 119

Location: -76.843216 39.281960

Description: Left cell approx. half filled, upstream sediment accumulation. Stacked stone headwall, ~8 feet.

Point # 117

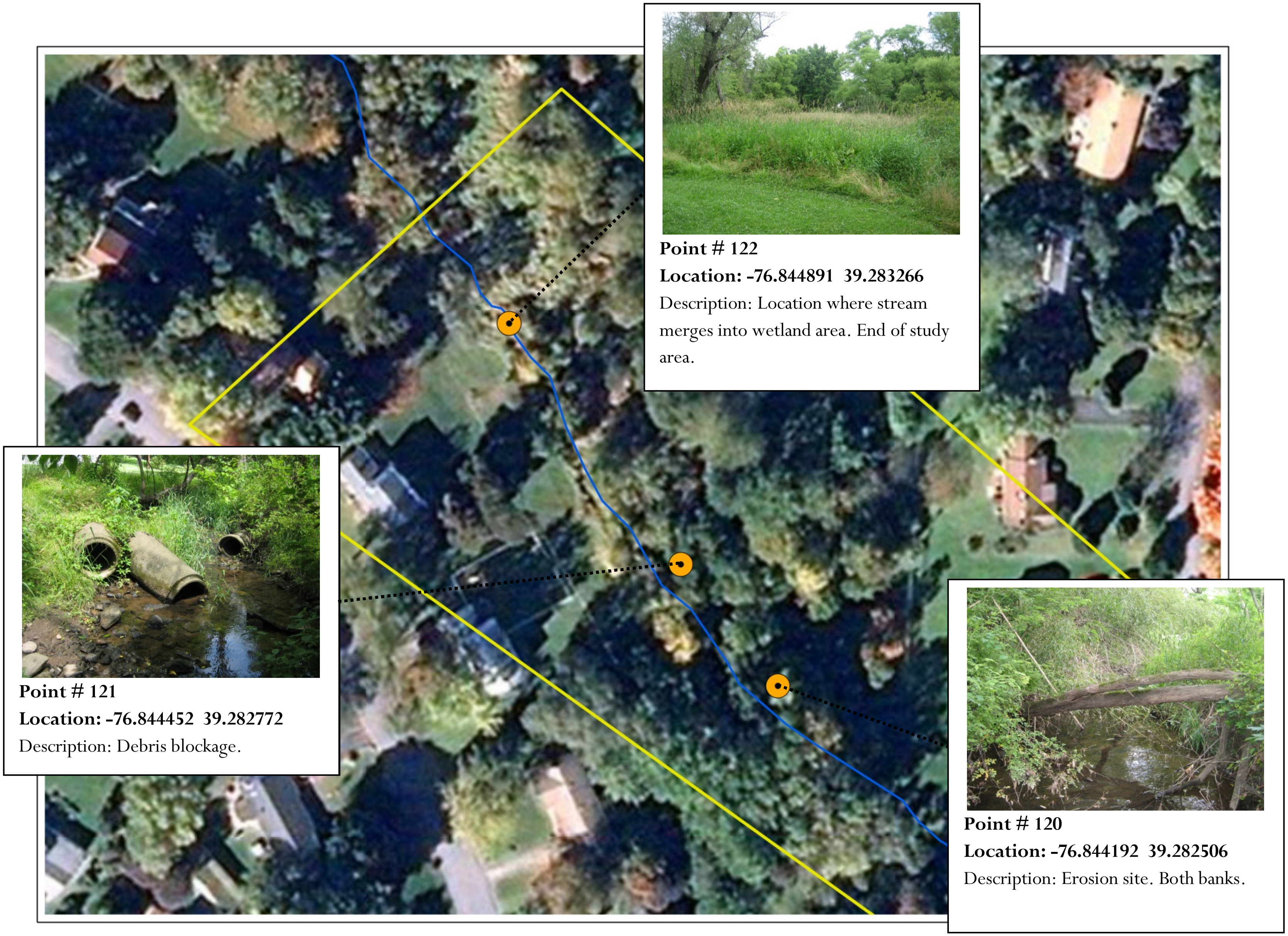
Location: -76.842192 39.281389

Description: Debris blockage.

Point # 118

Location: -76.843021 39.281897

Description: See Point # 119



Point # 122
Location: -76.844891 39.283266
Description: Location where stream merges into wetland area. End of study area.

Point # 121
Location: -76.844452 39.282772
Description: Debris blockage.

Point # 120
Location: -76.844192 39.282506
Description: Erosion site. Both banks.

Section 4
Recommendations and Conclusions

Contents of this Section

4.1 Recommendations

Plumtree Branch – Valley Mede Discussion

The Stream Corridor Assessment of Plumtree Branch within the Valley Mede subdivision identified several areas of concern. Due to the age of the subdivision, it is very likely that the stream was straightened and channelized at some point in the past. This is evident by the lack of meanders and the observed degree of incision within the channel. Straightened channels that become incised experience increased boundary shear stress that results in lateral and accelerated streambank erosion. Many sections of the study reach are exhibiting these conditions. Bank erosion is one of the primary causes of sediment pollution within many Maryland watersheds. Localized bank restoration/stabilization projects could be implemented to reduce and/or eliminate many of the eroding banks; however, due to the location of the stream channel within a residential neighborhood, landowner cooperation and participation would be critical to implement these types of projects.

The culverted road crossings within the Valley Mede subdivision were designed in accordance with design standards applicable at the time; however, these culvert crossings appear, based solely on visual observation, to be undersized according to today's current design standards. During significant storm events, specifically those events with intense rainfall over a short duration of time that create flash-type flooding conditions, undersized road culverts may not be able to accommodate the volume of water generated by these types of storms as was evinced by the September 7, 2011 Tropical Storm Lee flood event.

Any debris accumulation at the culvert inlet can exacerbate flooding conditions by limiting the flow conveyance through the culvert, resulting in the crossing being overtopped with flood waters more quickly. As such, a debris maintenance and management plan could be implemented that could minimize the amount of debris within the stream channel. However, during any significant storm event within an unstable channel with eroding streambanks, additional debris can be introduced to the stream as banks fail and any woody vegetation along those banks gets caught in the flood flow. The implementation of effectiveness of such a plan is limited by the degree of cooperation among the stakeholders involved. Stream channels traverse both public and private land. Often stakeholder groups are formed such as watershed associations, stream watches, or other partnerships, that work together to manage and report on stream conditions. Additionally, watershed groups may attain non-profit status thereby making them eligible for grants to perform maintenance and restorative projects.

Stream crossings are typically designed to pass a specific design storm. According to the Howard County Design Manual, bridges, culverts, and arches located on public roads and are located in the mapped 100-year floodplain are designed to pass the 100-year storm event. At a minimum, a minor collector roadway stream crossing is designed to pass the 25-year storm event. Based on the observations in this assessment, it is recommended that a Hydraulic & Hydrologic (H&H) analysis be performed for each of the three road crossings of Plumtree Branch within Valley Mede. Specifically, the culvert crossings of Plumtree Branch include Long View Drive, Brookmeade Road, and Hearthstone Road. The H&H studies will provide critical information necessary to determine the most cost effective type and design of crossing that would need to be implemented to accommodate and pass the appropriate design storm. These measures, if implemented, could mitigate the potential for flood damage to properties and infrastructure.

<u>Tiber-Hudson Corridor Discussion</u>

The Tiber-Hudson stream corridor exhibited many of conditions and problems, ranging from minor to severe. This stream corridor, especially in the lower reaches, is almost completely contained within stone flood walls. Additionally, many of the buildings within the historic district are constructed directly over the stream channel. The prevalence of flood walls diminish as one travels upstream; however, there are walled portions of streambank in the upper reaches of the corridor as well. Flood walls can be effective at containing flood conditions within a channel; however, there are limitations and problems associated with walled stream channels. Constructing flood walls on both sides of a channel can result in an enormous amount of shear force on the streambed during high flow events, inducing downcutting, which can eventually undermine and cause the collapse of the floodwalls. Additionally, walled systems typically have buildings and other infrastructure constructed immediately adjacent to the top of the wall, or even across the walls, as is the case in historic Ellicott City. Therefore, a collapsing floodwall with adjacent infrastructure can pose a much greater risk to life and property than the inundation caused by flooding. While flood walls have both benefits and risks, once a town is constructed around and, as is the case of historic Ellicott City, incorporated into, the flood walls, there are not many options for flood mitigation. However, the flood walls should be monitored and evaluated annually to determine if the structural integrity of the wall is being compromised. As problems are identified, repairs can be implemented that will reduce the chances of wall failure. Additionally, hydraulic structures could be designed and implemented within the channel to reduce the shear forces along the walls; however, the construction of these structures would be limited by access to the channel.

Debris blockages and accumulation within the stream corridor should be monitored and maintained. During the Tropical Storm Lee flood event, debris accumulation at the upstream end of culverts and bridges most likely resulted in the flood water 'jumping out' of the channel and continuing down Frederick Road or otherwise bypassing the structure. Therefore, a debris maintenance and management plan should be implemented that could minimize the amount of debris that accumulates within the stream channel. However, during any significant storm event within an unstable channel with eroding streambanks, additional debris can be introduced to the stream as banks fail and any woody vegetation along those banks gets introduced into the flood flow.

Stream restoration and bank stabilization techniques can be implemented throughout the watershed to reduce the overall bank erosion within the system thereby reducing the amount of woody material introduced during a flood event due to bank failure. Bank erosion is one of the primary contributing factors to sediment pollution and downstream sedimentation. Additionally, excess sediment within a stream system affects many critical biological and chemical processes as well.

4.2 Specific Selected Problem Sites – Potential Mitigation Projects

The Stream Corridor Assessment identifies, maps, and describes the problems observed during the stream walk at the time the assessment is performed. It is important to note that the assessment cannot account for changes within the watershed due to temporal and anthropogenic factors. As such, several priority problem sites are selected and described for further investigation as potential mitigation projects. Appendix B contains a table of various Federal and State Funding Sources and grant programs for mitigation projects.

Site 1

Site 1 is identified as Point 1003 within the SCA and is located in the historic downtown section of Ellicott City. More specifically, it is located immediately downstream of the footbridge at Tiber Park. It is categorized as a debris blockage and consists primarily of boulder and cobble accumulation within the channel. This accumulation is occurring due to the slope reduction at the Tiber-Hudson nears its confluence with the Patapsco River. A reduction in slope reduces stream competence, or the ability of the stream system to carry its sediment load. This site is identified as a potential problem/mitigation area because the boulder/cobble accumulation is shifting stream flow directly into a corner created by a ninety degree bend in the stone flood wall. Over time, the continued assault of flowing water on the flood wall can compromise the grouting within the walls and eventually result in failure. One recommendation would be to clean out some of the accumulated material and grade the channel such that flow is redirected away from the walls. A hydraulic structure could be incorporated; however, access to the channel is very limited at this location.

Site 2

Site 2 is identified as Point No. 1010 within the SCA and is located between two parking lots in the downtown area, immediately upstream of the Tiber Branch/Hudson Branch confluence; it consists of an I-beam supported, timber-decked footbridge that provided pedestrian traffic to flow between the businesses arranged around the parking lots. This footbridge was damaged during the flood event and is closed to traffic. Visually, the cross-sectional area available to flood conveyance through this structure is not commensurate with the area provided by the rest of the channel or other flow conveyances. The depth at the center point in the channel to the bottom of the I-beam is 4 feet, 8 inches; the depth at the one-third and two-thirds locations along the span is 3 feet, 6 inches, and 3 feet, 8 inches, respectfully. Flow depths greater than 4 feet will continue to impact this structure and potentially result in flood water 'jumping' into the adjacent parking lots. It is recommended that the footbridge be removed or replaced with a structure that provides greater cross-sectional area for flood conveyance. One potential structure would be an archway.

Site 3

Site 3 is identified as Point No. 1012 within the SCA and is located near the upper or western end, of historic downtown Ellicott City. This site encompasses two separate issues; the first is a failing rock wall adjacent to a public parking lot, the second is an archway within and integral to the channel conveyance beneath Main Street.

The failing rock wall is located in a small open channel section that has buildings bridging the channel immediately upstream and downstream, and is adjacent to a public parking lot behind the Ellicott Mills brew pub. In the event of a wall failure, several parking places would likely be included. Additionally, if the wall should fail during a flood event, the introduction of the wall materials, including material behind the wall or near the parking places, would create a 'slug' of material immediately upstream of the channel constriction discussed below as part of this site. The structural integrity of this wall should be evaluated and repaired before it deteriorates any further.



The second issue associated with this site is an archway located within the channel beneath Main Street and several businesses. This archway represents a channel constriction that significantly reduces the cross-sectional area of the potential flood conveyance. Once the flow capacity of the archway reaches its limit during a flood event, it will create a backwater condition within the upstream portion of the channel. Additionally, constriction of the channel increases the possibility that debris can get impinged at the opening, thereby exacerbating the backwater condition and potentially resulting in the flood water 'jumping' from the channel into Main Street. It is recommended to have the archway inspected by a structural engineer to evaluate if its removal would jeopardize the structural integrity of the rectangular conveyance or the surrounding buildings built over this location.

Site 4

Site 4 is identified as Point No. 1015 within the SCA and is located adjacent to a parking lot for an apartment complex. It consists of a failing cinder block wall built on a stacked stone wall. The stacked stone wall is not mortared or grouted and it failing in locations as well. Where the stacked stone wall has completely failed, the block wall is ‘hanging’ without any base or support and the bottom of the wall is visible. In the event of a complete wall collapse, a portion of the parking lot above and adjacent to the wall would be compromised as well. This wall should be further evaluated for repair and/or replacement.

Site 5

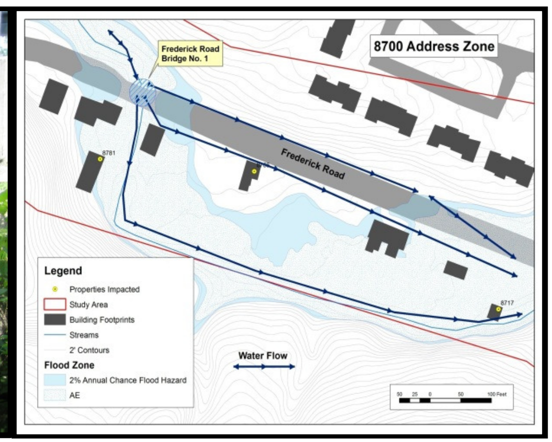
Site 5 encompasses the stream reach between Point No. 1021 and Point No. 1031 within the SCA. This reach experienced accelerated bank erosion, losing approximately 10 to 13 feet of streambank laterally in some locations during the September flood event. One house structure in this reach is in jeopardy if accelerated erosion continues. It is recommended that this reach be evaluated for additional stabilization and restoration alternatives.



This reach also contains a large corrugated metal culvert described as Points 1026 and 1027 for the downstream and upstream locations, respectively. The following statement is an excerpt from the *Case Study* that compliments this report: “The channel approaching the culvert inlet is armored with gabions in a trapezoidal shape. A preponderance of Japanese Knotweed is located along both banks. An eye witness stated that an approximately 8-10” Red Maple had been leaning diagonally across the culvert inlet during the flood event. Witnesses stated that the inlet was almost completely blocked with debris. Therefore, this culvert inlet also created additional backwater and another location where flood flow ‘jumped’ from the channel.” It is recommended that an H&H analysis be performed for this culvert and the upstream channel to verify its design storm flow capacity. Additionally, an invasive species eradication plan, including revegetation of the streambanks with native species, could be initiated to eliminate the Japanese Knotweed. The aforementioned debris monitoring and maintenance plan could prevent debris accumulations from occurring.

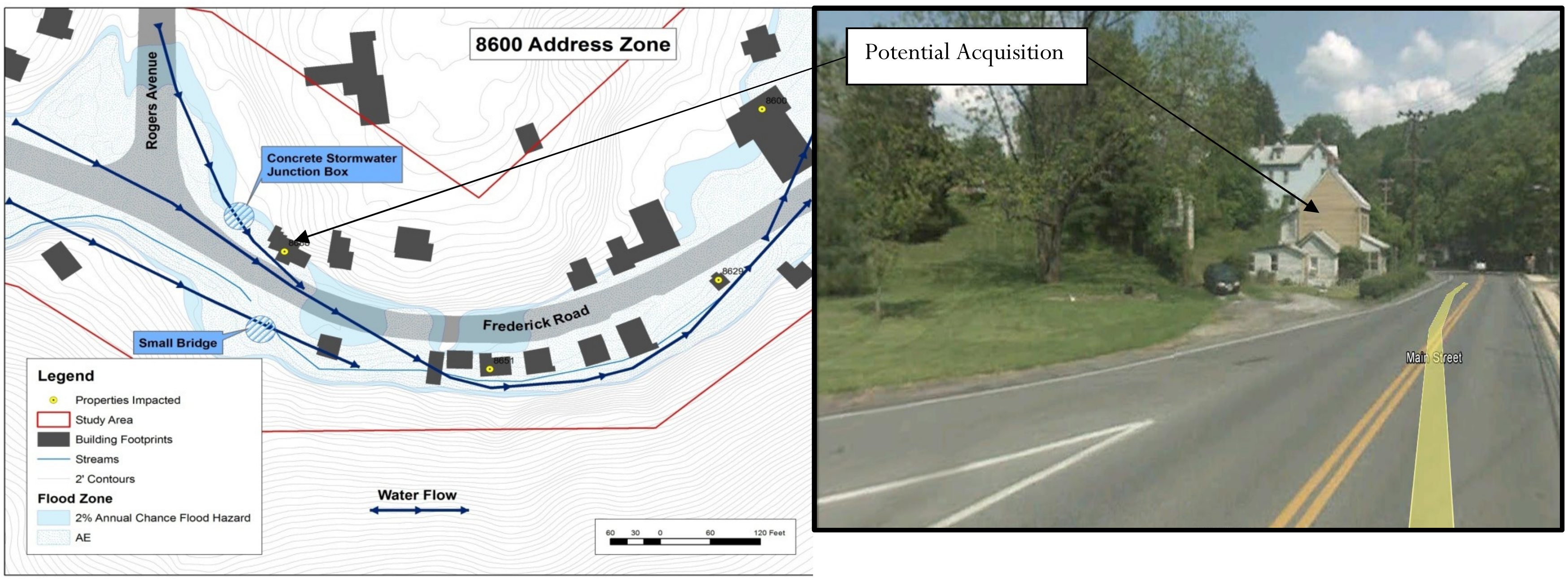
Site 6

Site 6 encompasses Point Nos. 1043 and 1044 within the SCA and due to their spatial proximity. Point No. 1043 is a concrete bag retaining wall installed to protect the driveway of a commercial property. It is recommended that this structure be replaced with an appropriate retaining wall. Point No. 1044 is identified in the *Case Study* as Frederick Road Bridge No. 1 and is the reported location where the stream 'jumped' the channel and flowed down Frederick Road. It is recommended that an H&H analysis be performed for this crossing location to determine its design storm flow capacity. The debris maintenance and monitoring plan would help minimize debris accumulation at this location.



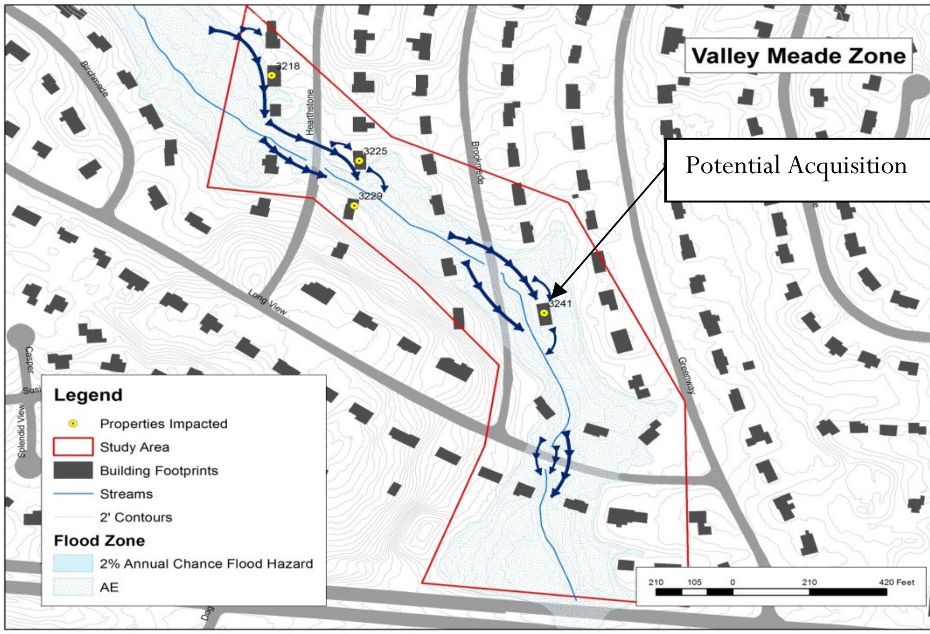
Site 7

Site 7 consists of a potential flood acquisition project and a stormwater management investigation in the vicinity of the Rogers Avenue and Frederick Road intersection. This area was identified and described within the *Case Study* as the 8600 Address Zone. One structure in particular, located at 8688 Frederick Road, experienced first floor flooding through the windows at the side of the house approximately 3 feet above grade and is recommended as a flood acquisition buyout candidate. Additionally, it was reported that a significant amount of stormwater was flowing down Rogers Avenue to combine with the flows along Frederick Road. A concrete stormwater junction box is located to the northeast of the Rogers Avenue/Frederick Road intersection. Witnesses reported that the manhole access cover was 'blown off' the lid of the box. Additionally, they reported that the concrete top was being elevated. This observation would indicate that the junction box and the stormwater pipes leading to it were at capacity, creating sufficient hydraulic pressure to lift the top and remove the manhole cover. With the stormwater system at capacity, excess stormwater would utilize the roadways as the storm conveyance. It is recommended that a stormwater management investigation be conducted to determine the feasibility of installing additional stormwater management facility(s) within this area.



<u>Site 8</u>

Site 8 consists of a potential flood acquisition project within the Valley Mede subdivision and is located at 3241 Brookemeade Road. This structure was described within the *Case Study* as having four feet of water in the first floor of the dwelling, rendering the entire home uninhabitable and is recommended as a potential flood acquisition buyout.



4.3 Next Steps

- Develop partnerships between both public and private stakeholders in the form of watershed associations, stream watch groups, or other cooperative agreements, for both Plumtree Branch in Valley Mede and the Tiber-Hudson Corridor.

- Conduct additional investigations within the Plumtree Branch – Valley Mede and Tiber-Hudson corridors to assess and develop potential streambank stabilization/restoration projects to reduce bank erosion and land loss.

- Perform a Hydraulic and Hydrologic (H&H) analysis for each of the three culvert crossings within the Valley Mede Subdivision.

- Utilizing the watershed/stream partnerships, implement a debris maintenance and management plan.

- Prioritize potential mitigation projects.

- Based on project prioritization, conduct additional study and investigations into the Potential Mitigation Projects identified herein as Sites 1 through 8 and described in Section 4.2, including:
  - Determine property ownership and identify project specific stakeholders;
  - Develop conceptual designs;
  - Estimate project costs;
  - Determine feasibility of implementation and estimated project timeline;
  - Investigate Public-Private cost sharing options for those projects located on private property; and,
  - Ascertain grant funding options.

APPENDIX A: POINT REFERENCE DATABASE

Tiber-Hudson Branch - Road Crossings

Point #	Coordinates (Decimal Degrees)	General Description	Type	Material	Shape	# of Cells	Pipe Dimension	Fish Blockage	Erosion Below Outfall	Embeddedness	Notes
1001	-76.794685 39.267801	-	Bridge	Stone	-	1	-	No	No	No	-
1002	-76.794935 39.267737	-	Bridge	Concrete	-	1	-	No	No	No	-
1004	-76.795934 39.267319	-	Bridge	-	-	1	-	No	No	No	-
1010	-76.800093 39.267261	-	Foot Bridge	-	-	1	-	No	No	No	-
1016	-76.800255 39.268813	Downstream end of large	Pipe Culvert	Corrugated Metal	Round	1	-	No	No	No	-
1017	-76.801585 39.269171	Upstream end of large	Pipe Culvert	Corrugated Metal	Round	1	-	No	No	No	-
1025	-76.804079 39.269886	-	Foot Bridge	-	-	1	-	No	No	No	12'W x 7'H
1026	-76.804245 39.269757	-	Pipe Culvert	Corrugated Metal	-	1	~ 8 ft	Yes	No	No	-
1027	-76.804703 39.269726	-	Pipe Culvert	Corrugated Metal	-	1	~ 8 ft	Yes	No	No	-
1031	-76.806283 39.270084	-	Pipe Culvert	Corrugated Metal	Round	1	9 ft	Yes	Yes	No	-
1032	-76.807700 39.268890	-	Pipe Culvert	Corrugated Metal	Round	1	9 ft	Yes	Yes	No	-
1037	-76.809738 39.268635	-	Bridge	Concrete	-	1	-	No	No	No	18.5'W x 5'H
1038	-76.810154 39.268894	Foot bridge to historical school building	Bridge	-	-	-	-	-	-	-	-
1044	-76.813104 39.269933	-	Bridge	Concrete	-	1	-	No	No	No	16.5'W x 6'H
1049	-76.815640 39.270099	-	Pipe Culvert	Corrugated Metal	Round	2	7 ft	No	No	No	-
1050	-76.816556 39.270004	-	Pipe Culvert, Arch	Corrugated Metal	-	1	-	Yes	No	No	12'W x 8'H
1051	-76.817680 39.269650	-	Bridge	Concrete	-	1	-	No	No	No	-
1052	-76.817761 39.270135	-	Bridge, Box Culvert	-	-	1	-	No	No	No	-
1053	-76.818801 39.270363	Upstream end of box culvert	Bridge, Box Culvert	-	-	1	-	No	No	No	-
1058	-76.819382 39.270881	-	Bridge	-	-	1	-	Yes	No	No	-
1069	-76.820535 39.275473	-	-	-	-	-	-	-	-	-	-
1071	-76.820460 39.272208	Foot bridge on small tributary	-	-	-	-	-	-	-	-	-
1072	-76.820626 39.272273	-	Pipe Culvert	Corrugated Metal	-	1	5 ft	-	-	-	-
1080	-76.823955 39.271470	-	Arch	Stone	-	1	-	No	No	No	10'W x 5'H

Tiber-Hudson Branch - Erosion Sites

Point #	Coordinates (Decimal Degrees)	General Description	Type of Erosion	Cause	Bank Height	Length	Threat to Infrastructure	Severity	Correctability	Access	Notes
1020	-76.802916 39.269303	-	Lateral	Outside Meander High Bank	20 ft	140 ft	No	Moderate	Moderate	Moderate	High shear on outside bank, root structure holding for now; eventual failure.
1022	-76.803081 39.269755	Failing wall and erosion site	-	-	-	-	-	-	-	-	-
1023	-76.803580 39.269756	Erosion site, cinder blocks	-	-	-	-	-	-	-	-	-
1024	-76.803704 39.269886	-	Lateral	Outside Meander, bank blow out	4 ft	60 ft	No	Severe	Moderate	Moderate	-
1030	-76.806033 39.270116	-	Lateral	Blown out bank, downstream of West End culvert	3 ft	40 ft	No	Moderate	Easy	Easy	-
1040	-76.811152 39.268993	-	Lateral	High exposed bank across from wall and house	30 ft	50 ft	No	Severe	Moderate	Moderate	-
1041	-76.812440 39.269124	-	Lateral	Exposed bank opposite of point bar buildup. Immediately downstream of	5 ft	25 ft	No	Minor	Easy	Easy	Two trees failing/leaning
1046	-76.814558 39.270453	Erosion site and debris	Lateral	Outside meander eroding, debris catching on walnut roots nearing failure	5 ft	40 ft	No	Moderate	Easy	Easy	-
1048	-76.815140 39.270648	-	Lateral	High bank, outside meander	15 ft	30 ft	No	Severe	Easy	Easy	-
1054	-76.819383 39.270170	-	Lateral	Outside of meander, Japanese Knotweed	6 ft	50 ft	No	Moderate	Easy	Easy	-
1055	-76.819466 39.270396	-	Lateral	Outside meander	6 ft	45 ft	No	Moderate	Easy	Easy	-
1057	-76.819631 39.270881	-	Lateral	High bank	7 ft	35 ft	No	Moderate	Easy	Easy	-
1060	-76.819545 39.271980	-	Lateral	Lack of vegetation	5.5 ft	12 ft	No	Minor	Easy	Easy	-
1061	-76.820003 39.272013	-	Lateral	Lack of vegetation, mowed lawn up to top of bank.	4 ft	100 ft	No	Moderate	Easy	Easy	-
1063	-76.820501 39.272305	-	Lateral	Mowed lawn up to top of bank	5 ft	150 ft	No	Severe	Moderate	Easy	-
1064	-76.820458 39.272661	-	Lateral	High outside of meander	5 ft	40 ft	No	Moderate	Easy	Easy	-
1065	-76.820458 39.272919	-	Lateral	High exposed bank	8 ft	40 ft	No	Moderate	Moderate	Moderate	-
1066	-76.820414 39.273663	-	Lateral	Down volley meander migration	6 ft	30 ft	No	Moderate	Moderate	Moderate	-
1074	-76.821125 39.272177	-	Lateral	Outside meander	4 ft	50 ft	No	Minor	Moderate	Moderate	-

Tiber-Hudson Branch - Debris Blockages						
Point #	**Coordinates (Decimal Degrees)**	**General Description**	**Description of Debris**	**Extent**	**Impact**	**Notes**
1003	-76.795726 39.267545	-	Heavy boulder and cobble accumulation	-	-	Diverting flow directly into stone wall
1021	-76.802832 39.269561	-	Debris along left bank, outside meander	Minor	Left bank	Heavy point bar formation on inside of meander
1028	-76.805077 39.269920	Crumbling wall, twin tree across top of channel	-	-	-	-
1029	-76.805742 39.270180	-	Debris piled up along left bank	Half	Left bank	-
1036	-76.809448 39.268441	-	Tree in creek catching debris	Half	Scour	Scour is minor
1039	-76.810444 39.269121	-	Pieces of rock wall in middle of channel	Half	-	Center catching debris
1042	-76.813230 39.269352	-	Fallen tree and trapped log at meander below bag wall	-	-	Middle of channel
1045	-76.813976 39.270581	-	Fallen sycamore across channel	Complete	Scour, All	Tree is ~20" DBH, deep pool below tree
1046	-76.814558 39.270453	Erosion site and debris	-	-	-	-
1047	-76.814724 39.270583	-	Tree across channel	Complete	All	Tree is ~24" DBH and ~ 2' above water surface
1056	-76.819674 39.270526	-	Tree across channel	Complete	All	-
1062	-76.820210 39.272175	-	Twin bole root wad in middle of channel	-	Left Bank, Right Bank, Scour	-
1064	-76.820458 39.272661	-	Misc. debris	Complete	All	-
1066	-76.820414 39.273663	-	Misc. limbs	Complete	-	-
1068	-76.820663 39.274019	-	Tree across channel, laying lengthwise	Half	-	-
1073	-76.820834 39.272047	Debris and sediment built up at inlet	-	-	-	-
1075	-76.821333 39.272209	Debris in channel	-	-	-	-
1076	-76.821417 39.272015	Tree across channel, backing up sediment	-	-	-	-
1077	-76.821750 39.271887	-	Leaning tree and root ball blocking channel	Complete	Scour, All	-

Tiber-Hudson Branch - Channelization

Point #	Coordinates (Decimal Degrees)	General Description	Type/Desc	Bank Affected	Deposition	Vegetation	Flood Wall
1012	-76.799508 39.268230	Failing rock wall	-	-	-	-	-
1014	-76.799923 39.268748	Failing bank, large amount of wall in stream	-	-	-	-	-
1015	-76.800172 39.268942	Failing cinderblock wall	-	-	-	-	-
1018	-76.801918 39.269139	Failing wall below house	-	-	-	-	-
1035	-76.809364 39.268570	Failed rock wall	-	-	-	-	-
1043	-76.813188 39.269578	Concrete bag wall	-	-	-	-	-
1069	-76.820535 39.275473	-	Failing Concrete Lining	Both	No	No	No

Plumtree Branch-Valley Mede - Road Crossings

Point #	Coordinates (Decimal Degrees)	Type	Material	Shape	# of Cells	Pipe Dimension	Fish Blockage	Erosion Below Outfall	Embeddedness	Notes
101	-76.840812 39.279565	Pipe Culvert	Corrugated Metal	Elliptical	2	70"W x 48"H	Yes	No	No	Stacked stone headwall,
102	-76.840877 39.279324	Pipe Culvert	Corrugated Metal	Elliptical	2	70"W x 48"H	Yes	No	No	Stacked stone headwall,
105	-76.840745 39.279982	Bridge	Concrete	-	-	-	-	-	-	Foot bridge, concrete
109	-76.841102 39.280692	Bridge	-	-	-	-	-	-	-	Destroyed bridge, just
111	-76.841346 39.280958	Pipe Culvert	Concrete	Round	2	~48 inches	No	No	No	Minor debris in right cell,
112	-76.841476 39.281097	Pipe Culvert	Concrete	Round	2	~48 inches	No	No	No	Minor debris in right cell,
116	-76.840603 39.278223	Box Culvert	Concrete	-	1	8'W x 5'H	No	No	No	Some debris at inlet.
118	-76.843021 39.281897	Pipe Culvert	Concrete	Elliptical	2	48 inches	No	No	No	Left cell approx. half
119	-76.843216 39.281960	Pipe Culvert	Concrete	Elliptical	2	48 inches	No	No	No	Left cell approx. half

Plumtree Branch-Valley Mede - Erosion Sites										
Point #	**Coordinates (Decimal Degrees)**	**Type of Erosion**	**Cause**	**Bank Height**	**Length**	**Threat to Infrastructure**	**Severity**	**Correctability**	**Access**	**Notes**
103	-76.840812 39.279274	-	Flood water scour when reentering the channel	-	-	No	Minor	Easy	Easy	Appears to have taken out split rail fence.
108	-76.841054 39.280540	Lateral	High bank, no vegetation	6 ft	~40 ft	No	Moderate	Easy	Easy	Directly across from blown out house, SW corner, 3241 Brookmede.
110	-76.841248 39.280920	Lateral	High right bank, just down stream of brookmede road crossing	5.5 ft	45 ft	No	Moderate	Easy	Easy	No vegetation or roots on bank.
113	-76.840943 39.279021	Lateral	High bank, no root mass.	6 ft	60 ft	Yes	Moderate	Easy	Easy	Threat to split rail fence
120	-76.844192 39.282506	Lateral	Silt/Clay undercut banks	3 ft	40 ft	No	Minor	Easy	Easy	Both banks

Plumtree Branch-Valley Mede - Debris Blockages					
Point #	**Coordinates (Decimal Degrees)**	**Description of Debris**	**Extent**	**Impact**	**Notes**
106	-76.840745 39.280109	Partial tree in channel, ~9"	Minor	-	~30 feet upstream of bridge.
107	-76.840907 39.280362	Remnant partial footbridge	Complete	Left and Right Bank	Creating backwater.
114	-76.840765 39.278603	Tree across channel	Half	All	Creating some backwater.
115	-76.840667 39.278438	Trees across channel, top of	Minor	-	-
117	-76.842192 39.281389	Minor debris accumulation	Minor	All	-
120	-76.844192 39.282506	Tree across channel	Minor	Left and Right Bank	-
121	-76.844452 39.282772	Concrete culvert pipes in channel	Half	Right Bank	-

APPENDIX B: FEDERAL & STATE GRANT FUNDING SOURCES

FEDERAL & STATE GRANT FUNDING SOURCES

The following is a list of Federal and State Grants that may assist in implementing mitigation projects.
This information is subject to change at any time; contact the federal or state agency for current grant status.

Grant Program Name	Address and Telephone Contact Information	Eligible Activities	Federal, State and Local Cost Share Requirements	Other Program Characteristics	Grant Application Due Date
Continuing Authorities Program (CAP)	USACE Washington DC 20314; 202-761-4561	Initiates a short reconnaissance effort to determine Federal interest in proceeding. If there is interest, a feasibility study is preformed.	Federal - 65% Local- 35%	A local sponsor must identify the problem and request assistance. Small flood control projects are also available.	Anytime
Federal Emergency Management Agency, Hazard Mitigation Grant Program (HMGP)	Maryland Emergency Management Agency 5401Rue Saint Lo Drive Reisterstown, MD 21401	Grants can be used for management costs, information dissemination, planning, technical assistance and mitigation projects.	Federal - 75% Local - 25%	Local governments must be in compliance with the National Flood Insurance Program to be eligible. Projects must be environmentally sound and cost effective.	TBD
Federal Emergency Management Agency, Pre Disaster Mitigation Grant Program (PDM)	Maryland Emergency Management Agency 5401Rue Saint Lo Drive Reisterstown, MD 21401	Funding these plans and projects reduces overall risks to the population and structures, while also reducing reliance on funding from actual disaster declarations.	Federal - 75% Non Federal - 25%	PDM grants are to be awarded on a competitive basis and without reference to state allocations, quotas, or other formula-based allocation of funds.	TBD
Federal Emergency Management Agency, Flood Mitigation Assistance Program (FMA)	Maryland Emergency Management Agency 5401Rue Saint Lo Drive Reisterstown, MD 21401	Assist States and communities to implement measures that reduce or eliminate the long-term risk of flood damage to buildings, manufactured homes, and other structures insured under the National Flood Insurance Program.	Federal - 75% Non Federal - 25%	Available once a Flood Mitigation Plan has been developed and approved by FEMA.	TBD
Small Business Administration (SBA) Pre-disaster Mitigation Loan Program	Herbert L. Mitchell, Office of Disaster Assistance, Small Business Administration, 409 3rd Street, SW, Washington, DC 20415;202-205-6734	Activities done for the purpose of protecting real and personal property against disaster related damage.	No information	The mitigation measures must protect property or contents from damage that may be caused by future disasters and must conform to the priorities and goals of the state or local government's mitigation plan.	Anytime

Grant Program Name	Address and Telephone Contact Information	Eligible Activities	Federal, State and Local Cost Share Requirements	Other Program Characteristics	Grant Application Due Date
Community Development Block Grants / Entitlement Grants	Office of Block Grant Assistance, 451 Seventy Street SW., Washington, DC 20410-7000;202-708-3587	Used for long-term recovery needs, such as: rehabilitation residential and commercial building; homeownership assistance, including down-payment assistance and interest rate subsidies; building new replacement housing; code enforcement; acquiring, construction, or reconstructing public facilities.	No information	Citizen participation procedures must be followed. At least 70 percent of funds must be used for activities that principally benefit persons of low and moderate income. Formula grants to entitlement communities.	After a Presidential Disaster Declaration
Emergency Watershed Protection Program	Natural Resources Conservation Service 14th and Independence Avenue, SW Washington, DC 20250	Implementing emergency recovery measures for runoff retardation and erosion prevention to relieve imminent hazards to life and property created by a natural disaster that causes a sudden impairment of a watershed.	Federal - 75% Local - 25%	It cannot fund operation and maintenance work or repair private or public transportation facilities or utilities. The work cannot adversely affect downstream water rights and funds cannot be used to install measures not essential to the reduction of hazards.	TBD
Watershed Protection and Flood Prevention Program	Natural Resources Conservation Service 14th and Independence Avenue, SW Washington, DC 20250	To provide technical and financial assistance in carrying out works of improvement to protect, develop, and utilize the land and water resources in watersheds.	Varies due to project type.	Watershed area must not exceed 250,000 acres. Capacity of a single structure is limited to 25,000 acre-feet of total capacity and 12,500 acre-feet of floodwater detention capacity.	TBD
Watershed Surveys and Planning	Natural Resources Conservation Service 14th and Independence Avenue, SW Washington, DC 20250	To provide planning assistance to Federal, State, and local agencies for the development of coordinated water and related programs in watersheds and river basins. Emphasis is on flood damage reduction, erosion control, water conservation, preservation of wetlands and water quality improvements.	No information	These watershed plans form the basis for installing needed works of improvement and include estimated benefits and costs, cost-sharing, operation and maintenance arrangements, and other information necessary to justify the need for Federal assistance in carrying out the plan.	Anytime

Grant Program Name	Address and Telephone Contact Information	Eligible Activities	Federal, State and Local Cost Share Requirements	Other Program Characteristics	Grant Application Due Date
Emergency Advance Measures for Flood Prevention	USACE Washington DC 20314; 202-761-4561	To perform activities prior to flooding or flood fight that would assist in protecting against loss of life and damages to property due to flooding.	No information	There must be an immediate threat of unusual flooding present before advance measures can be considered. Any work performed under this program will be temporary in nature and must have a favorable benefit cost ratio.	TBD
Emergency Streambank and Shoreline Protection	USACE Washington DC 20314; 202-761-4561	Authorizes the construction of emergency streambank protection measures to prevent damage to highways, bridge approaches, municipal water supply systems, sewage disposal plants, and other essential public works facilities endangered by floods or storms due to bank erosion.	No information	Churches, hospitals, schools, and other non-profit service facilities may also be protected under this program. This authority does not apply to privately-owned property or structures.	TBD
Small Flood Control Projects	USACE Washington DC 20314; 202-761-4561	Authorizes the construction of small flood control projects that have not already been specifically authorized by Congress.	No information	There are two general categories of projects: structural and nonstructural. Structural projects may include levees, floodwalls, diversion channels, pumping plants, and bridge modifications. Nonstructural projects have little or no effect on water surface elevations, and may include flood proofing, the relocation of structures, and flood warning systems.	TBD
Flood: Emergency Advance Measures for Flood Prevention	USACE Washington DC 20314; 202-761-4561	To mitigate, before an event, the potential loss of life and damages to property due to floods.	No information	Assistance may consist of temporary levees, channel cleaning, preparation for abnormal snowpacks, etc.	Anytime
Cooperating Technical Partners	CFDA Number: 97.045	Flood Hazard Mapping products	Federal - 100%	Provides technical assistance, training, and/or data to support flood hazard data development activities.	TBD

Grant Program Name	Address and Telephone Contact Information	Eligible Activities	Federal, State and Local Cost Share Requirements	Other Program Characteristics	Grant Application Due Date
Map Modernization Management Support	CFDA Number: 97.070	Community outreach on Flood Mapping	Federal - 100%	Provides funding to supplement, not supplant, ongoing flood hazard mapping management efforts by the local, regional, or State agencies.	TBD