Stantec

Upper Bynum Run Watershed Assessment Report

This report is a summary of the Upper Bynum Run Watershed. This report meets all the requirements of the 319 Grant application.

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Prepared for:

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ACRONYMS AND ABBREVIATIONS

BANCS	Bank Assessment for Non-point Sources Consequences of Sediment
BayFAST	Chesapeake Bay Facility Assessment Scenario Tool
BEHI	Bank Erosion Hazard Index
BMP	Best Management Practice
BR	Bynum Run
CAST	Chesapeake Assessment Scenario Tool
COMAR	Code of Maryland Regulations
CWA	Clean Water Act
DNR	Department of Natural Resources
DPW	Department of Public Works
ESD	Environmental Site Design
EPA	Environmental Protection Agency
FIBI	Fish Index of Biotic Integrity
FID	Forest Interior Dwelling
GIS	Geographic Information System
HSG	Hydrologic Soil Group
MBSS	Maryland Biological Stream Survey
MDE	Maryland Department of Environment
MDOT	Maryland Department of Transportation
MEP	Maximum Extent Practicable
MERLIN	Maryland's Environmental Resources and Land Information Network
MGS	Maryland Geological Survey
MS4	Municipal Separate Storm Sewer System
NBS	Near Bank Stress
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service
NWI	National Wetlands Inventory
PCBs	Polychlorinated Biphenyls
ROW	Right of Way
RSC	Regenerative Stormwater Conveyance
RTE	Rare Threatened Endangered
SCA	Stream Corridor Assessment
SHA	State Highway Association
SWM	Storm Water Management
TMDL	Total Maximum Daily Load
TSS	Total Suspended Solids
USDA	United States Department of Agriculture
USFWS	United States Fish and Wildlife Services
USGS	United States Geological Survey
UT	Unnamed Tributary
WQv	Water Quality Volume

1.0 INTRODUCTION

1.1 PROJECT BACKGROUND

Stantec Consulting Services, Inc. (Stantec), under contract with the Harford County Department of Public Works (DPW), completed an assessment of the Upper Bynum Run watershed. The assessment, which was conducted from August 2017 through June 2018, included baseline stream surveys along Bynum Run and its tributaries, stormwater management facility assessments, and a documentation of upland conditions. The purpose of the assessment was to determine baseline conditions for this medium to high density residential and commercial watershed to meet current National Pollutant Discharge Elimination System (NPDES) Municipal Separate Storm Sewer System (MS4) and Total Maximum Daily Load (TMDL) requirements. In addition, the watershed assessment resulted in the identification of restoration opportunities that could be implemented to improve water quality from nonpoint source runoff and provide ecological uplift and habitat enhancement along stream corridors throughout the watershed. The anticipated benefits of implementation and associated costs of the restoration opportunities have also been evaluated.

The study area includes the drainage area of Upper Bynum Run beginning at its headwaters near Friends Community Park in Forest Hill and extending downstream to Churchville Road (MD 22) in the Town of Bel Air. Assessment activities completed to date have included a community awareness survey, an upland assessment, identification of stormwater retrofit opportunities and nonpoint source best management practices (BMPs), physical and geomorphic survey of streams, riparian condition surveys, baseline water quantity and quality assessments, in-stream biological condition surveys and analysis, and an evaluation of natural resource restoration opportunities.

This report covers the assessment and monitoring activities and includes descriptions of assessment methodologies as well as a summary of baseline conditions. Supporting survey data, and associated mapping are included in the attached appendices.

1.2 PROJECT LOCATION AND DESCRIPTION

The Upper Bynum Run Watershed study area is located within central Harford County and consists of the headwaters of the Bynum Run watershed, which contributes to the Bush River in the Upper Western Shore Basin of the Chesapeake Bay. The study area includes approximately one-third (5,347 acres/8.35 mi^2) of the entire Bynum Run watershed area. The relationship of the study area to the overall watershed is depicted on the Project Vicinity Map (Figure 1). The project area is generally bounded by East Jarrettsville Road and Conowingo Road (US Route 1) to the north, North Fountain Green Road (MD 543) and Prospect Mill Road to the east, Rock Spring Road/North Main Street (MD 24/MD 924) to the west, and Churchville Road (MD 22) to the south.

Major stream segments within the Upper Bynum Run Watershed study area include:

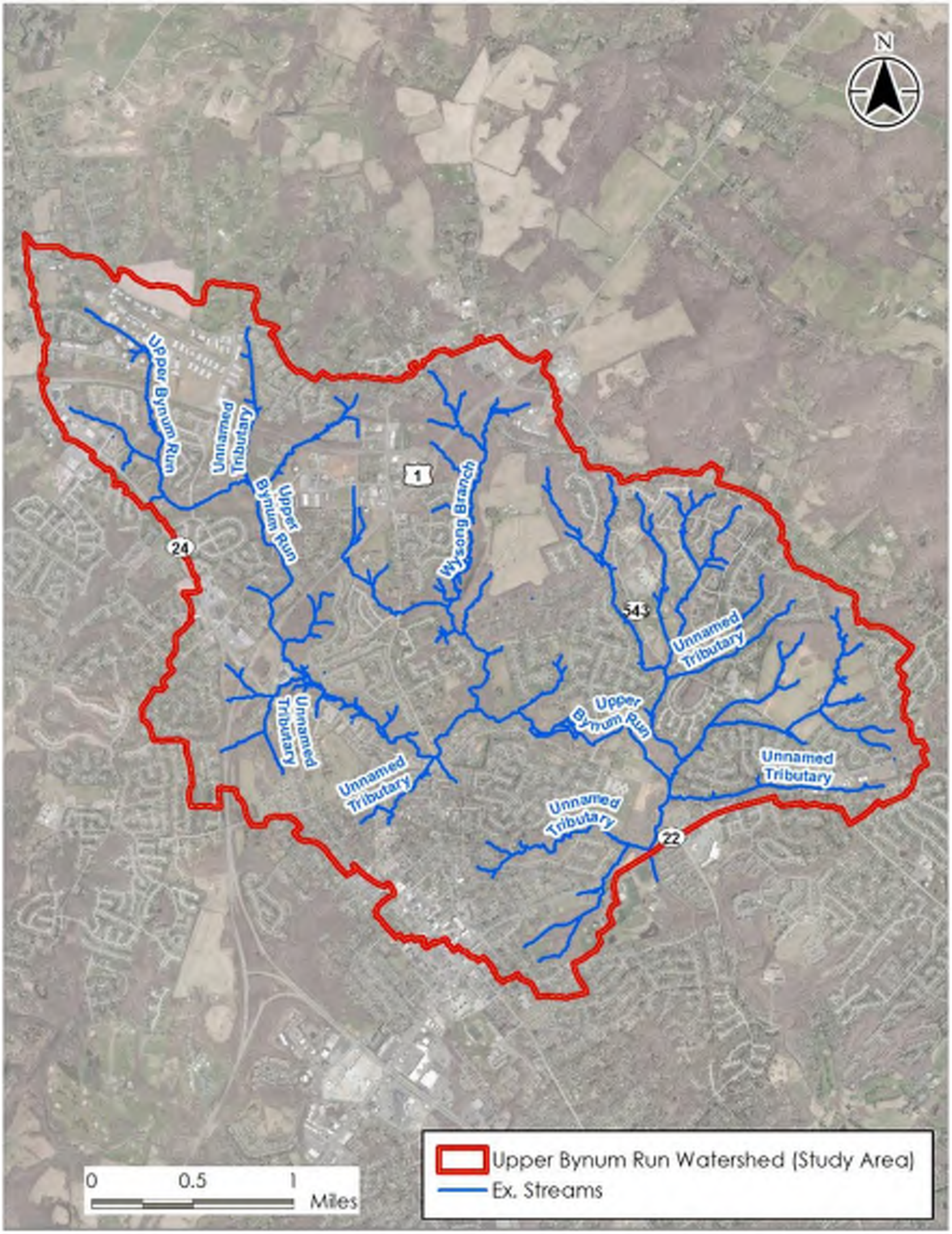
- the headwaters of Bynum Run and an unnamed tributary beginning near the Village of Forest Hill in the northwest portion of the watershed;

- Wysong Branch and unnamed tributaries beginning near Hickory in the northeast portion of the watershed;
- four unnamed tributaries beginning east of MD 543 in the eastern portion of the watershed;
- three unnamed tributaries beginning near MD 22 in the southern portion of the watershed; and
- the mainstem of Bynum Run.

The study area continues south to where the mainstem and tributaries confluence in the Town of Bel Air, ending where Bynum Run flows beneath MD 22, just north of the Bynum Run Park area (Figure 2).

Figure 1 - Vicinity Map

Figure 2 - Watershed Map



1.3 WATERSHED TMDL STATUS

The Clean Water Act (CWA) requires states to adopt water quality standards for all waters of the U.S. that are listed as impaired. The Chesapeake Bay and its tidal waters are listed as impaired because of excess nitrogen, phosphorus and sediment. In December 2010 the EPA established the Chesapeake Bay TMDL to restore clean water to the Chesapeake Bay. The most prominent way to enforce the Chesapeake Bay TMDL is through the NPDES permit program. NPDES regulations require MS4 permits for non point sources for jurisdiction over 100,000 residents, which includes Harford County. MDE issued Harford County its first MS4 permit, ID 11-DP-3310 (MD0068268), on May 17, 1994 and reissued permits on August 13, 1999, November 1, 2004 and December 20,2014. Local TMDL's have also been established by the U.S. Environmental Protection Agency (EPA) for the Bynum Run watershed (Maryland 8-Digit Watershed No. 02130704) and downstream receiving waters within the Bush River and upper Chesapeake Bay.

The waters of the Bynum Run watershed have been identified by The Maryland Department of the Environment (MDE) on the State's 2008 Integrated Report as impaired by sediments (1996), nutrients – nitrogen and phosphorus (1996), impacts to biological communities (2002) and polychlorinated biphenyls (PCBs) (2006) (MDE, 2008). In response to the watershed impairments, MDE has established a local TMDL to address the 1996 sediments listing to ensure that watershed sediment loads, and aquatic habitat are at a level to support the watershed's Use III designation. MDE's Biological Stressor Identification (BSID) analysis of the watershed concluded that biological communities are likely impaired by flow/sediment stressors associated with urban land use and its concomitant effects (MDE, 2012).

Bynum Run's water quality impairment addressed by this TMDL is caused by an elevated sediment load which is beyond a level that the watershed can sustain, and the goal is to reduce the sediment/total suspended solids (TSS) by 14% from current baseline levels. To meet this goal, reductions will be applied to urban land (76.7% of the total watershed sediment load) which has been identified as the predominant controllable source within the watershed.

In addition, according to the Harford County 2017 Annual MS4 report, the County shall complete the implementation for 20% of the County's impervious surface area, by the end of the NPDES MS4 permit (MD0068268) cycle (Harford County , 2017). MDE has also expanded the watershed restoration component of the MS4 permits by stating "Theoretically extending these permitting requirements to all urban stormwater sources (i.e., not solely those sources regulated via Phase I MS4 permits) would require that all impervious areas developed prior to 1985 be retrofitted at this pace." It is estimated by MDE, in the Bynum Run sediment TMDL, that these future retrofits will result on average a 65% reduction of TSS. At a 65% TSS reduction efficiency, the reductions needed to meet this TMDL will involve approximately 52% of the urban area (developed prior to 1985) within the overall watershed to be retrofitted (MDE, 2011).

In addition to failing and out of date stormwater facilities, a significant portion of sediment loading within the watershed can be attributed to streambank erosion. Identifying stream reaches with high sheer stress and bank erosion and reducing the associated sediment outputs through stream restoration can address and limit the current urban sediment load while simultaneously improving habitat for biological communities.

According to the Bynum Run TMDL Restoration Plan (prepared by URS for Harford County in 2016) the TMDL for sediment in the watershed will be addressed approximately by the year 2032. The County notes that although a target of 2032 is estimated, the pace of implementation will be driven by the maximum extent practicable (MEP) compliance standard for MS4s.

1.4 PROJECT GOALS AND OBJECTIVES

The goals of the Upper Bynum Run Small Watershed Assessment are to develop a watershed management plan focused on identifying water quality problems and developing strategies for correcting those problems, and to identify restoration projects focused on remediating erosion and sedimentation problems caused by uncontrolled or inadequately controlled stormwater runoff. These projects include installation of new water quality BMPs, installation and retrofitting Storm Water Management (SWM) ponds, and implementation of stream restoration projects.

DPW intends to control runoff from developed areas, to correct stream channel instability problems, to reduce sediment and nutrient loading, and to improve the overall water quality of Bynum Run. Water quality goals are driven by the goals of the Chesapeake Bay watershed and local Bynum Run watershed TMDLs.

2.0 UPPER BYNUM RUN WATERSHED CHARACTERIZATION

2.1 GENERAL BASIN CHARACTERISTICS

2.1.1 Physiography and Basin Morphology/Topography

The *Physiographic Map of Maryland* along with the maps explanatory text document and attribute database information (Cleaves & Reger, 2008) was reviewed to determine the physiography of the watershed. Bynum Run is located within the Upland Section of the Piedmont Plateau Physiographic Province of Maryland. The Piedmont Upland Region (ID #420000) is characterized as exhibiting gently rolling upland terrain of low relief to very rolling and hilly terrain, with distinctive broad-bottomed valleys underlain by marble. Major streams within this region are typically incised and narrow, with steep-sided valleys.

A further division of the physiography of the watershed indicates that most of its area is within the Bel Air Upland District (#422100) of the Harford Plateaus and Gorges Region except for a small portion in the northwest corner which is located within the Hampstead Upland District (#422300).

The Bel Air Upland District is characterized as having lithologies or physical characteristics consisting of metamorphosed intrusives that include meta-gabbro, ultramafics, and gneiss, which corresponds to the Bel Air Belt and the Cecil County Volcanic Complex, as depicted on the *Geologic Map of Maryland* (Cleaves, Edwards, & Glaser, 1968). The geologic structure is moderately to strongly deformed, with all rocks are foliated and many sheared. Preservation of original igneous textures and compositions ranges from very poor to very good. The landform description is an upland characterized by gently rolling to flat surfaces, with a dendritic drainage pattern with angular imprint in places. The relief within this District ranges from 240 feet near where Bynum Run passes beneath MD 22 to 500 feet in the Village of Forest Hill. The typical local relief is 40-150 feet, with less on uplands and more in the valleys.

The Hampstead Upland District is characterized as having lithologies consisting of coarse-grained quartz schists (Loch Raven Schist) and fine-to medium-grained mafic schists (Piney Run, Pleasant Grove, and Prettyboy Formations), with lesser amounts of metagraywacke, boulder gneiss, meta-conglomerate, and isolated ultramafic bodies. The geologic structure is moderately to strongly deformed with all rocks foliated, and many sheared. Preservation of the original lithologic textures and compositions range from very poor to very good, and faults are common and often refolded. The landform description is rolling to hilly uplands interrupted by steep-walled gorges, where differential weathering of adjacent, contrasting lithologies produces distinctive ridges, hills, barrens and valleys. Streams may have short segments of narrow steep-sided valleys and are in a dendritic drainage pattern with angular imprint in places, especially associated with first- and second-order tributaries.

2.1.2 Climate

Based on data from the U.S. Climate Data Center from 1981 to 2010, the Bel Air area of Harford County, where much of the watershed is located, experiences moderate winters and warm to hot summers. The mean annual high temperature is 67.6° F and mean annual low temperature is 46.3° F, with an average temperature of 56.95° F. Temperatures in the summer months from June through September have average highs ranging from 81° to 89° F and average lows ranging from 63° to 68° F, with July typically being the hottest month. Temperatures in the winter months from December through February have average highs ranging from 44° to 47° F and average lows ranging from 26° to 30° F, with January typically being the coldest month (US Climate Data, 2017).

The average annual precipitation in the form of rainfall is 47.87 inches. The monthly precipitation is fairly-uniform throughout the year. The wettest months are May, July, and September, with average monthly rainfall amounts of 4.84, 4.72, and 4.65 inches, respectively. The driest months are February, October and November, with average monthly rainfall amounts of 3.03, 3.50, and 3.58 inches, respectively (US Climate Data, 2017). Thunderstorms producing flashy stream flows from high amounts of urban runoff during short periods of time tend to be most frequent in July and August, but these may vary widely from one area to another throughout the County and from season to season. Average annual snowfall was not provided on the U.S. Climate Data site, but according to the “Life in Harford County” webpage, the yearly snowfall for the County is 17.4 inches (Harford County, 2017).

2.1.3 Geology

According to the *Geologic Map of Harford County* (MGS, 1968), the watershed is underlain by five (5) distinct geologic formations with seven different designations, which includes formations consisting of bedded rock underlying soil and intrusive rock that appears to have crystallized from magma emplaced in the surrounding rock. The oldest geologic formation in the watershed, which according to the map was potentially from the Precambrian era (beginning of earth to 544 million years ago), is identified as the Wissahickon formation (pCwb and pCwl designations), a type of bedded rock formation. This formation begins in the northwest corner in Forest Hill, extends along the northern boundary, and continues southeastward towards Hickory and southward towards Rock Spring. Since issuance of the 1968 map, the Maryland Geological Survey (MGS) no longer uses the designation “Wissahickon formation” in Maryland, and it is now believed that the formations in this area are from the Upper Cambrian or Lower Ordovician period of the Paleozoic era (~ 505 million years ago). The pCwb designation is now known as the Sykesville formation, and the pCwl designation is known as the Loch Raven Schist formation (Crowley 1976).

Additionally, from the Paleozoic era (544 to 248 million years ago), but from an unknown period, are three (3) formations of intrusive rock known as the Baltimore Gabbro of Cloos and Hershey (1936) formation (Pzb and Pzbp), the Muscovite Quartz Monzonite Gneiss formation (Pzm), and the Port Deposit Gneiss formation (Pzpd) (MGS 1968). The Baltimore Gabbro formation designated as Pzb underlays most of the watershed area from Hickory and northern Bel Air to the north and extending to northern Fountain Green and downtown Bel Air to the south. Two smaller areas along Prospect Mill Road near MD 543 within this formation are designated as Pzbp. The Muscovite Quartz Monzonite Gneiss formation underlays a seam that separates the former Wissahickon formation types described above from the Baltimore Gabbro formation, running from just north of Red Pump road at MD 24 then along Bynum Road in a northeasterly direction to the Hickory area north of US Route 1. The Port Deposit Gneiss formation is found in the southeastern corner of the watershed in the Fountain Green area.

The most recent formation within the watershed is Alluvium (Qal designation) which is considered bedded rock from the Cenozoic era, Quaternary period, and Holocene epoch (8,000 years ago to present) (MGS, 1968). This formation is primarily located along the narrow stream valleys of the mainstem of Bynum Run beginning north of the Rock Spring area, and several smaller tributaries in the northern end of the watershed and continues southeastward to upstream of an existing mill dam area north of Moore’s Mill Road. The formation broadens below the mill dam south of Southampton Road and underlays the broader floodplain area where the mainstem of Bynum Run confluences with several tributaries from the north Fountain Green area along MD 543 and from the Shamrock area of Bel Air, continuing to the end of the watershed study area at MD 22.

Detailed descriptions of each of the geologic formations identified on the *Geologic Map of Harford County* (MGS, 1968) are provided below:

- Wissahickon Formation (pCwb and pCwl designations) is bedded rock from the Glenarm Series. The pCwb designation consists primarily of boulder gneiss, thick-bedded to massive biotite-muscovite-plagioclase-quartz metagraywacke, found locally with chlorite or garnet. The formation contains lenses of metamorphosed, conglomerate sandstone. Conglomeratic lenses, the largest of which are shown by a pattern of circles, contain angular to rounded fragments of vein quartz, metagraywacke, biotite schist, amphibolite, and quartz diorite in a weakly foliated, feldspathic, arenaceous matrix that in places resembles granite or granitic gneiss. The pCwl designation consists of lower pelitic schist, chiefly biotite-muscovite-plagioclase-quartz schist with accessory garnet, staurolite, and kyanite in appropriate metamorphic zones; sillimanite occurs locally. Thin beds of sugary quartzite and metagraywacke make up less than 10 percent of the section and the designation grades upward and laterally into the pCwb designation.
- Baltimore Gabbro of Cloos and Hershey (1936) (Pzb and Pzbp designations) is an intrusive rock. Pzb consists essentially of massive hypersthene gabbro in all stages of conversion to uralite gabbro, with norite and augite gabbro occuring in subordinate amounts. Pzbp consists of pyroxenite, mostly converted to light-green talc-amphibole and amphibole rock.
- Muscovite Quartz Monzonite Gneiss (Pzm designation) is an intrusive rock that consists of light-colored, well-foliated to nearly massive muscovite quartz monzonite gneiss; generally medium-grained and even-textured but contains local porphyritic and pegmatitic zones. Weathers to grayish-brown, micaceous, clayey, quartz-rich saprolite that is locally dug for sand.
- Port Deposit Gneiss (Pzpd designation) consists of a moderately to strongly deformed intrusive complex, chiefly composed of quartz diorite gneiss. Rock types include gneissic biotite-quartz, hornblende-biotite-quartz diorite, and biotite granodiorite, with minor amounts of quartz monzonite and hornblende-quartz diorite. Moderate protoclastic foliation grades into strong cataclastic shearing.
- Alluvium (Qal designation) consists of bedded rock that is chiefly micaceous silt and clayey sand and includes alluvium and colluvium in floodplain and valley fill deposits. Deposits typically reflect the bedrock composition in this portion of the County.

2.1.4 Soils

According to a custom soil survey report developed for the Upper Bynum Run Watershed through the NRCS's Web Soil Survey site (USDA-NRCS 2017), approximately 73% of the soils that underlay the watershed consist of silt loams on slopes ranging from 3-8%. The most dominant of these soil types are Neshaminy silt loam (NeB2), Montalto silt loam (MsB2), Aldino silt loam (AdB), Watchung silt loam (WaB), and Chester silt loam (CcB2). Hydric soil types that predominantly underlay swales, depressions, drainageways, flats, and floodplains or stream valleys make up approximately 17% of the soils that underlay the watershed and consist of Baile silt loam (BaA and BaB), Hatboro silt loam (Hb), Watchung silt loam (WaA and WaB), and Watchung very stony silt loam (WcB). An additional 22% of the watershed soil types that are not considered hydric, may have hydric inclusions from the Baile, Hatboro and Watchung soil series in low lying areas.

A table describing the acres, percentage of drainage area, and characteristics of each soil type identified in the watershed is provided below. A figure depicting the locations of each soil type is also included in Appendix A.

Table 1 – Soil Types within Upper Bynum Run Watershed

Map Unit Symbol	Map Unit Name	Total AC	Total %	Landform	Hydric Soil (Y or N)	Hydric Inclusion (Y or N)
AdB	Aldino silt loam, 3-8% slopes	650.6	11.9%	Hills	N	Y
AsB	Aldino very stony silt loam, 0-8% slopes	11.8	0.2%	Hills	N	Y
BaA	Baile silt loam, 0-3% slopes	50.5	0.9%	Swales, depressions, drainageways, hillslopes	Y	N
BaB	Baile silt loam, 3-8% slopes	12.1	0.2%	Swales, depressions, drainageways, hillslopes	Y	N
BrC2	Brandywine gravelly loam, 8-15% slopes, moderately eroded	8.9	0.2%	Hills	N	N
BrD3	Brandywine gravelly loam, 15-25% slopes, severely eroded	5.3	0.1%	Hills	N	N
CcB2	Chester silt loam, 3-8% slopes	503.7	9.2%	Hillslopes	N	N
CcC2	Chester silt loam, 8-15% slopes	46.4	0.8%	Hillslopes	N	N
CrE	Chrome channery silty clay loam, 15-45% slopes	9.7	0.2%	Ridges	N	N
Cu	Codorus silt loam	36.1	0.7%	Floodplains	N	Y
DcA	Delanco silt loam, 0-3% slopes	0.5	0.0%	Stream terraces	N	N
GcB2	Glenelg loam, 3-8% slopes	133.2	2.4%	Interfluves, hillslopes	N	N
GcC	Glenelg loam, 8-15% slopes	56.4	1.0%	Interfluves, hillslopes	N	N
GcC3	Glenelg loam, 8-15% slopes, severely eroded	5.0	0.1%	Hillslopes	N	N
GcD2	Glenelg loam, 15-25% slopes, moderately eroded	6.5	0.1%	Hillslopes	N	N
GgB2	Glenelg channery loam, 3-8% slopes	7.2	0.1%	Interfluves, hillslopes	N	N
GnA	Glenville silt loam, 0-3% slopes	54.0	1.0%	Swales, drainageways	N	Y
GnB	Glenville silt loam, 3-8% slopes	109.1	2.0%	Swales, drainageways	N	Y
Hb	Hatboro silt loam	242.1	4.4%	Floodplains	Y	N
KeB	Kelly silt loam, 3-8% slopes	306.6	5.6%	Hills	N	Y
KeC2	Kelly silt loam, 8-15% slopes, moderately eroded	43.0	0.8%	Hills	N	Y
KfD	Kelly very stony silt loam, 3-25% slopes	9.2	0.2%	Hills	N	Y
LeB2	Legore silt loam, 3-8% slopes, moderately eroded	72.3	1.3%	Dikes, interfluves, hillslopes	N	N
LeC2	Legore silt loam, 8-15% slopes, moderately eroded	110.7	2.0%	Dikes, hillslopes	N	N
LeD2	Legore silt loam, 15-25% slopes, moderately eroded	55.1	1.0%	Hills	N	N
LeE	Legore silt loam, 25-45% slopes	4.0	0.1%	Hills	N	N

Map Unit Symbol	Map Unit Name	Total AC	Total %	Landform	Hydric Soil (Y or N)	Hydric Inclusion (Y or N)
LfC	Legore very stony silt loam, 0-15% slopes	12.0	0.2%	Hills	N	N
LfD	Legore very stony silt loam, 15-25% slopes	3.7	0.1%	Hills	N	N
LgD3	Legore silty clay loam, 15-25% slopes, severely eroded	10.1	0.2%	Hills	N	N
MbB2	Manor loam, 3-8% slopes, moderately eroded	60.7	1.1%	Interfluves, ridges, hillslopes	N	N
MbC	Manor loam, 8-15% slopes	62.2	1.1%	Hills	N	N
MbD	Manor loam, 15-25% slopes	6.7	0.1%	Hillslopes	N	N
McB2	Manor channery loam, 3-8% slopes, moderately eroded	6.7	0.1%	Ridges, hillslopes	N	N
MsB2	Montalto silt loam, 3-8% slopes, moderately eroded	823.5	15.0%	Hillslopes	N	N
MsC2	Montalto silt loam, 8-15% slopes, moderately eroded	149.8	2.7%	Hillslopes	N	N
NeA	Neshaminy silt loam, 0-3% slopes	1.4	0.0%	Hillslopes	N	N
NeB2	Neshaminy silt loam, 3-8% slopes, moderately eroded	952.9	17.4%	Hillslopes	N	N
NeC2	Neshaminy silt loam, 8-15% slopes, moderately eroded	123.7	2.3%	Hillslopes	N	N
NsC	Neshaminy & Montalto very stony silt loams, 0-15% slopes	95.4	1.7%	Hills	N	N
NsD	Neshaminy & Montalto very stony silt loams, 15-25% slopes	4.0	0.1%	Hillslopes	N	N
W	Water	3.2	0.1%	Open Water	Y	N
WaA	Watchung silt loam, 0-3% slopes	20.4	0.4%	Swales, depressions, drainageways, flats	Y	N
WaB	Watchung silt loam, 3-8% slopes	566.6	10.3%	Swales, depressions, drainageways, flats	Y	N
WcB	Watchung very stony silt loam, 0-8% slopes	34.9	0.6%	Flats	Y	N
Totals for Watershed		**5,487.7**	**100.0%**		**7**	**8**

An analysis of the soil types in terms of their hydrologic grouping (A, B, C or D) is provided below in Section 2.7.2.

2.1.5 Land Use and Zoning Summary

According to the general Harford County Zoning/Land Use interactive map by the Department of Planning and Zoning, the predominant land uses within the upper portion of the watershed are “medium intensity” development in the Forest Hill and Bel Air North areas, and “light intensity” and “medium intensity” development in the MD 543 and Prospect Mill Road areas. The lower portion of the watershed is predominantly classified as “town” land use. There are several moderate sized areas of “industrial/employment” land use in the Forest Hill Industrial Park area and in the Hickory area near the MD 23 and U.S. Route 1 / Hickory Bypass corridor. Small areas of “high intensity” development are located in the Jarrettsville and U.S. Business Route 1 corridors connecting Forest Hill to Hickory, and at the MD 23 and MD 24 corridor leading into the “village” land use area in the center of Forest Hill. There are also three areas designated as “park” land use in the watershed, including Friends Park, the Ma & Pa Trailhead in Forest Hill, and Blakes Venture Park in Bel Air North.

The entire watershed is located within the County's Development Envelope and/or the Town of Bel Air limits, and most of the watershed is served by existing sanitary sewer service or is in a planned sewer service area. The predominant zoning classifications within the watershed, outside of the Town of Bel Air, are R1, R2, and R3 Urban Residential areas. Community and General Business Districts (B2 and B3) are concentrated in the MD 24/Rock Spring Road, U.S. Business Route 1, and MD 22 corridors. Commercial Industrial (CI) and General Industrial (GI) Districts are located along the northern edge of the watershed between MD 23, Jarrettsville Road, U.S. Business Route 1, and U.S. Route 1/Hickory Bypass. Small area of Rural Residential (RR) and Agricultural (AG) zoning are located along Prospect Mill Road and Village Business (VB) and Village Residential (VR) zoning is found in Forest Hill. Agricultural (AG) zoning is also found on The Vineyard property along Wysongs Branch. There is also a significant amount of land classified as State and County/Town Right-of-Way along the major roadways traversing the watershed.

Several small properties in the Hickory and Forest Hill/Bel Air North areas requested changes in zoning during the 2017 Comprehensive Zoning Review. These are not likely to result in significant changes in land use or imperviousness on a watershed scale, as much of the watershed is built out.

Table 2 below lists the mapped land uses with their total area in acres and associated percentage of the watershed.

Table 2 - Land Use Descriptions from GIS

GIS Land Use Description	Land Use Description for BayFAST Model	Land Use Area (Acres)	Land Use Percentage
Impervious Area	Impervious	1496.5	27.30%
Medium Density Residential	Regulated Pervious Developed	1195.7	21.80%
Deciduous Forest	Forest	1025	18.70%
Low Density Residential	Regulated Pervious Developed	331.8	6.00%
Cropland	Nutrient Management Lowtill	291.8	5.30%
High Density Residential	Regulated Pervious Developed	220.2	4.00%
Brush	Forest	151	2.80%
Commercial	Regulated Pervious Developed	153.9	2.80%
Pasture	Pasture	123.8	2.30%
Institutional	Regulated Pervious Developed	122.7	2.20%
Open Urban	Regulated Pervious Developed	120.9	2.20%
Industrial	Regulated Pervious Developed	106.5	1.90%
Highway Corridor	Forest	42.3	0.80%
Large Lot Subdivision (Ag)	Regulated Pervious Developed	45.1	0.80%
Water	Water	28.4	0.50%
Mixed Forest	Forest	14	0.30%
Agricultural Facilities	Regulated Pervious Developed	11.8	0.20%
Evergreen Forest	Forest	6.5	0.10%
	Total Watershed Area	**5487.9**	

The watershed has a wide variety of land uses as shown in the above table. These include commercial, residential, agricultural, institutional, open-space, and forest. Although these land uses vary throughout the watershed, there are areas that are dominated by a specific type of land use. For example, the City of Bel Air sits in the southwest corner of the watershed where land use is characterized as highly impervious and heavily developed. The northern and western portions of the watershed tend to be more open space agricultural and forested areas. The most common land use type throughout the entire watershed is medium density residential development.

To characterize the watershed using the BayFAST model the above land use types were consolidated to be consistent with land uses that are designated in the model. Table 3 below illustrates the land use categories included in BayFAST as well as a breakdown of the consolidated acreage and representative percentages of each category for the Upper Bynum Run Watershed.

Table 3 - Land Use Descriptions for BayFAST Use

Land Use for BayFAST Model	Land Use Area (Acres)	Land Use Percentage
Regulated Pervious Developed	2308.6	42.10%
Impervious	1496.5	27.30%
Forest	1238.8	22.60%
Nutrient Management Lowtill	291.8	5.30%
Pasture	123.8	2.30%
Water	28.4	0.50%
Total Watershed Area	**5487.9**	

2.2 EXISTING STREAM CONDITIONS

2.2.1 Maryland Designated Stream Use

Bynum Run and its tributaries are considered Use Class III – Nontidal Cold Waters, as designated under the Code of Maryland Regulations (COMAR) Section 26.08.02.08. Designated uses within Use III waters include the following:

- Growth and propagation of fish (including trout), other aquatic life and wildlife;
- Water contact sports;
- Leisure activities involving direct contact with surface water;
- Fishing;
- Agricultural water supply; and
- Industrial water supply (Environment, 2017).

To protect aquatic species, in-stream work may not be conducted during the period from October 1 through April 30, inclusive, during any year within Use III Waters. For stream restoration projects, this results in a relatively narrow construction window from May 1 to September 30, the hottest time of the year when more frequent flashy storm events occur, often shortening the construction window.

2.2.2 High Quality Waters (Tier II) Status

The stream segments within the Upper Bynum Run Watershed and the entire catchment area are not considered to be Tier II High Quality Waters of the State, and therefore are not required to meet stricter protections associated with

Federal antidegradation regulations (40 CFR131.12) (MDE 2016). Tier II high quality waters are those that have an existing water quality that is significantly better than the minimum requirements for the designated use class, as specified in the State's water quality standards. These streams and catchment areas have been designated as such based on biological community scores for benthic macroinvertebrates and fish, where the data collection and analysis strictly follow the Maryland Biological Stream Survey (MBSS) protocols developed by the Maryland Department of Natural Resources (DNR).

2.2.3 Maryland Biological Stream Survey (MBSS) Monitoring Data

According to the MD iMAP Stream Health 2016 interactive map (DNR 2016), the general watershed health rating for the entire Bynum Run watershed is considered "Poor". For the individual stream reach health within the watershed, the mapping indicates that the mainstem of Bynum Run from its headwaters in Forest Hill to where the stream leaves the study area at MD 22 in Bel Air is listed as being in "Fair" health. A major tributary identified as Unnamed Tributary 1 (UT-1) beginning in Hickory, east of U.S. Route 1, which flows through a Vineyard property to its confluence with the Bynum Run mainstem just north of Moore's Mill Road near U.S. Route 1 is listed as being in "Poor" health. Another major tributary identified as Unnamed Tributary 2 (UT-2) beginning near MD 543 and Prospect Mill Road and flowing along the west side of MD 543 to its confluence with the Bynum Run mainstem north of Moore's Mill Road near MD 22 is also listed as being in "Poor" health. Additional details on the sampling undertaken along these streams that were used to rate the health of specific stream segments is provided below.

The following provides a description of the locations for each of the MBSS sample locations identified within or just downstream of the study area:

- BYNU-117-R-2004-3/4 – Located on Bynum Run mainstem in the Spenceola Community in Forest Hill, approximately 400 feet downstream of Mardic Drive and north of the Ma & Pa Heritage Trail.
- BYNU-109-R-2004-11/12 – Located on Bynum Run mainstem along Candlelight Drive and behind Del Plaza in Bel Air, approximately 400 feet upstream of U.S. Route 1.
- HA-P-062-207-96 – Located on Bynum Run mainstem along north side of Moore's Mill Road between Pecan Ct. and Old Southampton Road, upstream of the historic Heighe House where Moores Mill stood on the site from c. 1745 until 1928.
- BYNU-207-R-2016 – Located on Bynum Run Mainstem along north side of Moore's Mill Road, likely in the same area as HA-P-062-207-96 above.
- BYNU-201-X-2006 – Located on Bynum Run Mainstem. Location of actual sample site not shown on DNR's Stream Health 2016 webpage, but it appears to be somewhere between the mainstem crossing of Moore's Mill Road and the crossing of Brierhill Drive, just below the study limits, based on catchment size.
- BYNU-112-R-2004-7/8 – Located on Unnamed Tributary 1 (UT-1) to Bynum Run along southeast side of U.S. Route 1 Hickory Bypass approximately 1,800 feet downstream of an SHA-owned stormwater pond at the corner of U.S. Route 1 and MD 543. The sample location was between Saddleback Way and Overlook Way, downstream of the confluence of a tributary to UT-1.

- BYNU-105-R-2004-10 – Located on Unnamed Tributary 2 (UT-2) to Bynum Run approximately 100 feet north of Valley Oak Way.

The following table 4 provides the catchment area to each of the above sample locations as well as the estimated land uses within the catchment area. Figure 3 provides a map of the approximate location for each sampling station, based on the MD iMap website.

Table 4 - MBSS Sample Locations and Catchment Area Land Use

	BYNU-117-R-2004-3/4	BYNU-109-R-2004-11/12	HA-P-062-207-96	BYNU-207-R-2016	BYNU-201-X-2006	BYNU-112-R-2004–7/8 (UT-1)	BYNU-105-R-2004-10 (UT-2)
Sample Year	2004	2004	1996	2016	2006	2004	2004
Catchment Area	552 AC	1,763 AC	2,747 AC	2,749.2 AC	4,763 AC	202 AC	105 AC
Urban Land Use	40%	46%	15.3%	69.2%	40%	30%	25%
Agricultural Land Use	46%	30%	56.5%	6.9%	33%	21%	35%
Forested Land Use	15%	23%	27.8%	23%	25%	47%	39%
Combined Index of Biotic Integrity (CBI)	2.33	3.00	3.17	2.67	3.00	2.50	2.50

Figure 3 - MBSS Sample Location Map

2.2.3.1 Benthic Macroinvertebrate Data

Benthic macroinvertebrate communities, including insects, snails and bivalves which inhabit the beds of streams for part of their life cycle, provide an indicator of stream health. Good water quality is indicated by high taxonomic diversity or species richness, an abundance of taxa that are sensitive to disturbance, and a lack of taxa that are tolerant of disturbance. The MBSS program has completed benthic macroinvertebrate sampling during the spring season at each of the sampling locations described above and has developed a Benthic Index of Biotic Integrity (BIBI) for each location. More detailed information on the benthic macroinvertebrates collected at each sampling site that were used to develop the BIBI can be found by following the hyperlinks for each station on the MD iMAP Stream Health 2016 interactive map. A summary and analysis of this data is provided in the table below.

Table 5 - MBSS Benthic Macroinvertebrate Data

	BYNU-117-R-2004-3/4	BYNU-109-R-2004-11/12	HA-P-062-207-96	BYNU-207-R-2016	BYNU-201-X-2006	BYNU-112-R-2004–7/8 (UT-1)	BYNU-105-R-2004-10 (UT-2)
Benthic IBI	1.33/5.0 Poor	1.33/5.0 Poor	3.00/5.0 Fair	2.00/5.0 Poor	1.33/5.0 Poor	1.00/5.0 Poor	3.67/5.0 Fair
Total # Genus/Family	26	13	12	29	15	15	30
Total Counted	93	163	99	115	112	150	131
Sensitive Taxa (% of Indiv.)	2 (2%)	2 (1%)	3 (7%)	2 (5%)	1 (3%)	1 (3%)	9 (24%)
Intermediate Sensitivity Taxa (% of Indiv.)	6 (11%)	2 (3%)	1 (4%)	4 (15%)	3 (8%)	3 (11%)	9 (43%)
Tolerant Taxa (% of Indiv.)	13 (76%)	8 (96%)	4 (84%)	16 (71%)	10 (89%)	4 (80%)	8 (28%)
Tolerance NI (% of Indiv.)	5 (11%)	1 (1%)	4 (5%)	7 (9%)	1 (1%)	2 (6%)	4 (4%)

2.2.3.2 Fish Data

Fish communities within a stream can also provide an indicator of stream health. Similar to benthic macroinvertebrates, good water quality is indicated by high taxonomic diversity or species richness, an abundance of taxa that are sensitive to disturbance, and a lack of taxa that are tolerant of disturbance. The MBSS program has completed fish surveys during the summer season at each of the sampling locations described above and has developed a Fish Index of Biotic Integrity (FIBI) for each location. More detailed information on the fish species and their tolerance levels collected at each sampling site that were used to develop the FIBI can be found by following the hyperlinks for each station on the MD iMAP Stream Health 2016 interactive map. A summary and analysis of this data is provided in the table below.

Table 6 - MBSS Fish Data

	BYNU-117-R-2004-3/4	BYNU-109-R-2004-11/12	HA-P-062-207-96	BYNU-207-R-2016	BYNU-201-X-2006	BYNU-112-R-2004–7/8 (UT-1)	BYNU-105-R-2004-10 (UT-2)
Fish IBI	3.33/5.0 Fair	4.67/5.0 Good	3.33/5.0 Fair	3.33/5.0 Fair	4.67/5.0 Good	4.00/5.0 Good	1.67/5.0 Poor
Total # Species	16	16	11	13	17	8	2
Total Counted	435	702	211	147	414	194	22
Sensitive Taxa (% of Indiv.)	0 (0%)	2 (7%)	1 (4%)	1 (14%)	2 (2%)	1 (13%)	0 (0%)
Intermediate Sensitivity Taxa (% of Indiv.)	5 (17%)	7 (48%)	5 (38%)	7 (24%)	9 (81%)	2 (19%)	0 (0%)
Tolerant Taxa (% of Indiv.)	5 (83%)	7 (45%)	5 (58%)	5 (63%)	6 (17%)	5 (69%)	2 (100%)

2.2.3.3 Physical Habitat Data

A wide variety of physical habitat measurements are conducted by the MBSS program concurrent with the spring benthic macroinvertebrate sampling and the summer fish surveys. Data gathered for several of these measurements at each station are provided by following the hyperlinks on the MD iMAP Steam Health interactive map, including data for five (5) key habitat assessment metrics that are rated on a scale of 0-20, as well as the percent of embeddedness of the riffles and the percent of the wetted area of the stream that is shaded. A summary of these data are provided in the table below.

Table 7 - MBSS Physical Habitat Data

	BYNU-117-R-2004-3/4	BYNU-109-R-2004-11/12	HA-P-062-207-96	BYNU-207-R-2016	BYNU-201-X-2006	BYNU-112-R-2004–7/8 (UT-1)	BYNU-105-R-2004-10 (UT-2)
Instream Habitat	14/20	17/20	8/20	14/20	16/20	14/20	12/20
Epifaunal Substrate	9/20	17/20	4/20	7/20	16/20	14/20	12/20
Velocity/Depth Diversity	11/20	14/20	6/20	6/20	13/20	9/20	7/20
Pool Quality (Extent)	15/20 (72 M)	14/20 (37 M)	16/20 (~75M)	14/20 (75 M)	14/20 (60 M)	9/20 (45 M)	8/20 (56 M)
Riffle Quality (Extent)	5/20 (3 M)	14/20 (50 M)	0/20 (0 M)	0/20 (0 M)	14/20 (45 M)	10/20 (30 M)	8/20 (19 M)
Shading	65%	90%	60%	45%	78%	95%	85%
Embeddedness	35%	15%	90%	50%	30%	20%	20%
KEY:	Optimal	Suboptimal	Marginal	Poor			

2.2.3.4 Chemical Water Quality Data

Selected chemical water quality variables are measured at each sampling location based on grab samples collected in the field by the MBSS program during the spring benthic macroinvertebrate monitoring efforts. The samples are sent to a lab for analysis and the data gathered is used to evaluate the state of acidification, degree of organic loading, and specific ions known to influence stream biota in the sample area. A representative summary of data for each sample station is provided in the table below.

Table 8 - MBSS Chemical Water Quality Data

	BYNU-117-R-2004-3/4	BYNU-109-R-2004-11/12	HA-P-062-207-96	BYNU-207-R-2016	BYNU-201-X-2006	BYNU-112-R-2004–7/8 (UT-1)	BYNU-105-R-2004-10 (UT-2)
Water Temperature	**16.1^0 C**	**17.1^0 C**	**21.7^0 C**	**NA**	**22.6^0 C**	**18.6^0 C**	**17.3^0 C**
Dissolved Oxygen (DO)	**10.3 mg/L**	**9.8 mg/L**	**8.9 mg/L**	**NA**	**8.7 mg/L**	**8.9 mg/L**	**7.0 mg/L**
pH (lab)	**6.83**	**7.28**	**8.3**	**8.73**	**8.3**	**7.21**	**7.6**
Conductivity	**194 µmho/cm**	**248 µmho/cm**	**203 µmho/cm**	**NA**	**300 µmho/cm**	**566 µmho/cm**	**221 µmho/cm**
Alkalinity (ANC)	**406.4 µeq/L**	**631.2 µeq/L**	**910.3 µeq/L**	**1051.8 µeq/L**	**1099 µeq/L**	**1158 µeq/L**	**1288 µeq/L**
Dissolved Organic Carbon (DOC)	**1.1 mg/L**	**3.0 mg/L**	**2.3 mg/L**	**1.2293 mg/L**	**1.8834 mg/L**	**5.9 mg/L**	**2.1 mg/L**

2.2.4 USGS Stream Gauge Data

The U.S. Geological Survey (USGS) has established a stream gage (#01581500) on the mainstem of Bynum Run along the right bank, 30 feet downstream from the bridge over MD 22 in the Bynum Run Park area in Bel Air. This gage is located immediately downstream from the Upper Bynum Run Watershed project limits and is 8.5 miles upstream from the confluence with the Bush River. The gage consists of a water-stage recorder and crest-stage gage. General information describing the location of the gage and the range of dates in which collected data is available in the table below:

Table 9 - USGS Stream Gauge Data

Drainage Area	8.52 mi^2	
Latitude, Longitude, Horizontal Datum	39^0 32' 29.3" N, 76^0 19' 48.4" W, NAD83	
Vertical Datum of Gage	250.08 feet above NAVD88	
Available Data*:	Begin Date:	End Date:
Current/Historical Observations	06-04-1999	Present
Daily Data, Discharge in cubic feet per second	06-01-1944	Present
Daily Statistics, Discharge in cubic feet per second	06-01-1944	10-15-2016
Monthly Statistics, Discharge in cubic feet per second	06-1944	10-2016
Annual Statistics, Discharge in cubic feet per second	1944	2017
Peak Streamflow	07-19-1945	02-24-2016
Field Measurements	06-23-1944	10-17-2017
Field/Lab Water Quality Samples	11-23-1965	09-23-2010
Water-Year Summary	2006	2016

*Dates provided above are based on information provided by the USGS Maryland Water Science Center at the following website: https://waterdata.usgs.gov/nwis/inventory/?site_no=01581500&agency_cd=USGS. Significant gaps in the availability of historical instantaneous data may exist due to instrument problems, environmental conditions or other factors that affect the ability to collect data.

Data from this stream gauge will be very beneficial in calibrating flow values and model results for any future stream restoration projects.

2.2.5 Natural and Living Resources

The Maryland DNR's MERLIN website identifies several types of natural and living resources within the watershed that should be considered for protection, including large contiguous forest stands, wetlands, and known sensitive species areas. As described above, approximately 22.6% of the watershed is covered in forest. Contiguous forest tracts that are considered suitable for supporting forest interior dwelling (FID) species are identified in several locations in the eastern and southern portions of the watershed. The largest tract begins in Hickory, is bounded by U.S. Business Route 1 to the north and west, MD 543 to the east, and Leeswoods Road to the south, and includes the riparian corridor along Wysongs Branch to its confluence with the mainstem. Two smaller tracts are located between Prospect Mill Road and MD 543 at the headwaters of several unnamed tributaries. Another large tract runs along the mainstem of Bynum Run beginning at U.S. Route 1 and continuing along the north side of Moore's Mill Road before crossing the road and extending along the floodplain to MD 22.

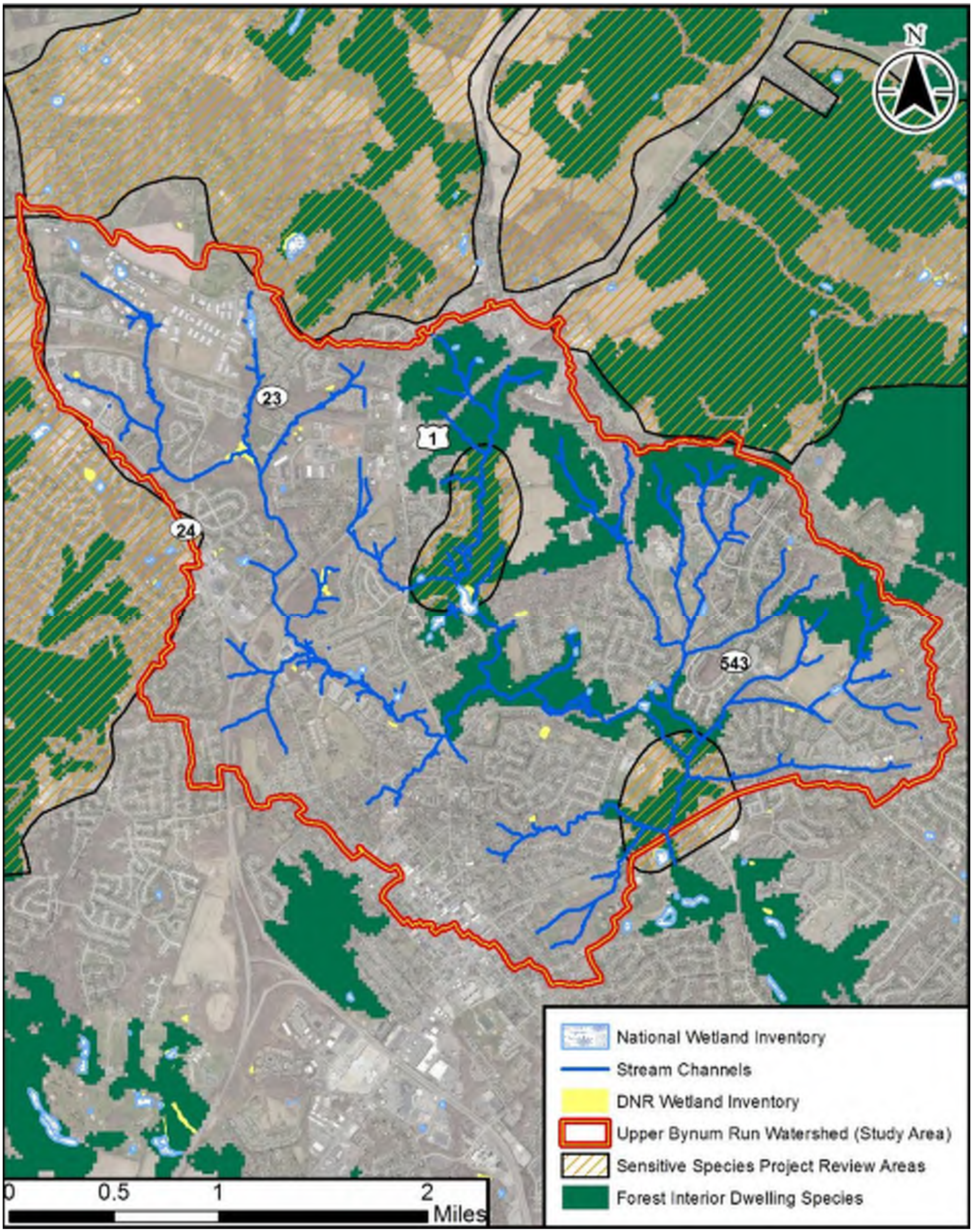
Numerous palustrine wetland systems are identified by the U.S. Fish and Wildlife Services (USFWS) on National Wetlands Inventory (NWI) mapping and by DNR throughout the watershed, with most of the systems located near the stream channels. These systems include freshwater forested, scrub-shrub, and emergent wetlands as well as over 25 freshwater ponds, some of which appear to be stormwater management facilities. The largest wetland complexes are in the Blakes Venture Park area, along Wysongs Branch near the Leeswoods community, along UT-2 near MD 543 and Southampton Road, along an unnamed tributary near the entrance to the Amyclae community, and in the broad floodplain valley of the mainstem between Moore's Mill Road and MD 22.

Several areas within and along the edge of the watershed are designated as Sensitive Species Project Review Areas. Federally-listed threatened or endangered species review areas are located along the western and northern boundaries of the watershed in the Forest Hill and Hickory areas. State-listed rare, threatened or endangered (RTE) species review areas are located along Wysongs Branch and in the location where numerous tributaries confluence with the mainstem of Bynum Run at the downstream end of the watershed, along Moore's Mill Road and MD 22.

DNR's MERLIN site has also identified two fish blockage locations along the mainstem of Bynum Run. The blockages are both located in Forest Hill, with the most downstream blockage at an instream dam west of Mardic Drive in the Spenceola community, and the upstream blockage at a box culvert beneath MD 23.

Figure 4 depicts the Natural and Living Resources described above within the watershed.

Figure 4 - Natural Resources Map



2.2.6 Cultural Resources

Several properties within the watershed are listed on the National Register of Historic Places, including: 1) St. Ignatius Church; 2) The Vineyard, which is located along Wysong's Branch; 3) the Heighe House, which is located along the north side of Moore's Mill Road where the original Moore's Mill was located; and 4) seven (7) historic buildings in downtown Bel Air. There are also numerous properties scattered throughout the watershed listed by the Maryland Inventory of Historic Properties, including most notably, the Forest Hill Historic District, the Heighe House Complex, and a significant number of properties clustered in downtown Bel Air (DNR 2017).

2.2.7 Other Mapped Information

Based on high resolution aerial imagery from 2011-2013, it does not appear that there are any significant overhead utility line corridors or gas pipeline corridors running through the watershed. As most of the watershed is served by public water and sewer, water mains typically are found along roadways, and sanitary sewer mains and interceptors typically are found along the stream valleys.

2.2.8 Stream Corridor Assessment (SCA) Survey Methodology

An initial windshield survey was conducted to confirm GIS hydrology drainage lines that were provided to Stantec by Harford County. This information was used to determine which streams would be surveyed and assessed in greater detail to aide in the selection of recommended stream restoration reaches. Surveys were conducted by looking at streams that crossed roadways from the vehicle or from the edge of the roadway. Streams were photographed and initially evaluated using the "Stream Health" data sheets developed by the Maryland Department of Natural Resources (DNR). A map indicating the locations of the windshield surveys is included in Appendix A.

During the windshield survey, it was discovered that some of the hydrology lines were not existing stream channel. In these instances, the hydrology lines were edited to remove data that was not associated with an existing stream from the GIS mapping and the areas were eliminated from further consideration for more detailed assessments. Examples of some of the features removed included roadside drainage swales, SWM ponds, and incorrect flow paths resulting from underground drainage systems.

The Stream Corridor Assessment (SCA) Survey methodology used to gather more detailed information on select streams within the watershed was developed by the Maryland DNR (DNR 2001). This survey is based on a stream walk approach and was selected for this watershed assessment because it allows for both a quick assessment of the general conditions of the stream and identifies restoration opportunities. The survey is based on identifying common environmental problems affecting the stream such as stream bank erosion or fish blockages. The SCA Survey includes data sheets to evaluate 10 common environmental problems which are completed when one or more of those specific problems is encountered along a stream reach. Data sheets were converted into a digital format and information was collected using mobile devices. Data sheets and all supporting documentation, including photographs, were spatially referenced and incorporated into the GIS mapping and database.

2.2.9 Reach Descriptions & Findings

For the purposes of this study, reach descriptions and findings have been summarized based on the watershed subareas. A total of 344 data points were collected using the SCA protocol throughout the Upper Bynum Run

Watershed. Subarea descriptions and findings are detailed below. Figure 5 - Watershed Subarea MapFigure 5 shows a watershed map with subareas included. The results of the SCA protocol and stream photos were compiled in a Geospatial database and are included as a digital attachment to this report.

Subarea 5 - Subarea 5 is the most upstream subarea in the watershed. The majority of streams in this subarea are first or second order with little or no base flow. The downstream point of interest for this subarea is the confluence of an unnamed tributary with Upper Bynum Run and a bridge crossing for the Ma and Pa Trail. Approximately 5.3 miles of stream channel were assessed in this subarea. Overall, the stream channels in this subarea are in good condition except for a few areas identified during the assessment. Three beaver dams were located at the downstream end of this subarea; two of which are located on Upper Bynum Run and the third is situated on the most downstream tributary. The presence of three dams is affecting the natural functions of the stream channels. All appear to obstruct flow, sediment transport, and fish passage. The dams are also creating backwater ponding which forces flow out of the existing stream channel. It is important to note that this backwater pool has created a new wetland habitat in this subarea. Beaver activity has also led to a lack of mature vegetation and canopy cover over the stream. This lack of cover is resulting in elevated temperatures and the growth of unwanted or invasive vegetation adjacent to the stream channel. Other issues recorded in this subarea include the presence of invasive common reed (*Phragmites australis*) along the stream channel around Industry Drive. Erosion was a common occurrence in this subarea with some of the largest problem areas located downstream of roadway culverts or stormwater discharge ponds.

Subarea 4 - Subarea 4 is the second most upstream subarea in the watershed, beginning downstream of Subarea 5. Streams in this subarea are primarily comprised of the main channel of Upper Bynum Run and two unnamed first or second order tributaries. The downstream point of interest for this subarea is a confluence of Upper Bynum Run and an unnamed tributary located approximately 400 feet upstream of the Harford County Detention Center. Approximately 1.7 miles of stream channel were assessed in this subarea. The largest unnamed tributary in this subarea, which is located southeast of the Bel Air Bypass and west of Pipercove Way, has very little baseflow and defined bed and bank within its upper reaches. Flow in the tributary traverses through a mature forest and includes some areas of severely eroded banks which occur around meander bends. A headcut is also forming on this tributary. The main stem of Upper Bynum Run in this subarea is in fair condition. There are areas of moderate erosion and stream downcutting around the roadway culverts at the Bel Air Bypass and access ramps.

Subarea 3 - The Subarea 3 downstream point of interest is Conowingo Road (Business Route 1) just north of Moores Mills Road and is bounded upstream by Subarea 4. The majority of stream miles in Subarea 3 are located along the main branch of Bynum Run which flows through a forested corridor beginning at the Harford County Detention Center and ending at Conowingo Road. There are two small unnamed tributaries and several small stream channels originating from SWM facilities. Approximately 4.6 miles of stream channel were assessed in this subarea. The main channel of Upper Bynum Run in this subarea is braided in several sections. The channel sections have several natural grade control features including bedrock which causes flow in multiple channels and limits downcutting of the existing stream channels. Overall the main section of Upper Bynum Run is in fair condition within this subarea. There are flooding issues associated with the tributaries located west of Rock Spring Road within the neighborhood along James Avenue. The two culvert crossings beneath James Avenue appear to be frequently blocked with debris and sediment which becomes problematic during high flow events. These tributaries also do not appear to be able to handle the flow from increased impervious surfaces due to recent residential development in the area. Additionally, a SWM facility outflow channel in a townhome/apartment neighborhood between Switchman Drive and Crocker Drive is severely incised and poses a risk to nearby infrastructure.

Subarea 2 – The Subarea 2 downstream point of interest is approximately 3,800 feet downstream of Subarea 3 along Upper Bynum Run, north of Moore's Mill Road and east of Conowingo Road. The downstream extent for this subarea is an existing historic mill dam across Upper Bynum Run, which is located approximately 2,300 feet upstream of the Southampton Road crossing. The main stream system within the subarea consists of a second order tributary north of the main stem of Upper Bynum Run known as Wysong Branch, which extends to the upstream portions of the subarea and flows through dense and mature forests bounded by very low to medium density residential development. Approximately 7.8 miles of stream channel were assessed in this subarea. Subarea 2 also includes a small section of the main branch of Upper Bynum Run. The main branch of Upper Bynum Run is largely impacted by an existing, degraded and out of use mill dam at the downstream end of the subarea. Wysong Branch appears to be in the best condition of all the streams and tributaries observed within the Upper Bynum Run watershed. Wysong Branch flows through mature forests and limited development is occurring within the vicinity of the stream channel. Several reference reaches were noted throughout the stream reach. An unnamed tributary flowing from west to east under the Bel Air bypass and Conowingo Road is in very poor condition and presents potential restoration opportunities.

Subarea 1 - Subarea 1 is the second largest and the most downstream subarea in the Upper Bynum Run watershed. The downstream extent for this subarea and the overall watershed is the East Churchville Road (MD 22) crossing. There are several large tributaries in this subarea that carry flow from subareas N1, N2, N3, and S1 to Upper Bynum Run. Approximately 7.4 miles of stream channel were evaluated in this subarea. The main channel of Upper Bynum Run is a braided system in fair condition at the upstream end of the subarea. The middle reaches of Upper Bynum Run in this subarea are also in fair condition with moderate bank erosion. The downstream sections of Upper Bynum Run were not assessed due to property owner access restrictions. The northern most sections of this subarea are developed, but open areas exist around the stream channels. A residential neighborhood is being developed within a former agricultural field in the northeastern portion of the subarea located north of Fountain Green Road and west of Amyclae Drive. Although this development will increase impervious surfaces within the subarea, modern SWM facilities should aid in protecting the stream channel from increased and concentrated flow rates. The unnamed tributaries in this subarea are overall in fair condition with mild bank erosion and downcutting. These stream impairments were more severe around roadway culverts and other concentrated flow areas. One section of stream within this subarea was identified for potential restoration opportunities and is located south of Sparta Court and MD 543 and north and west of Econ Drive.

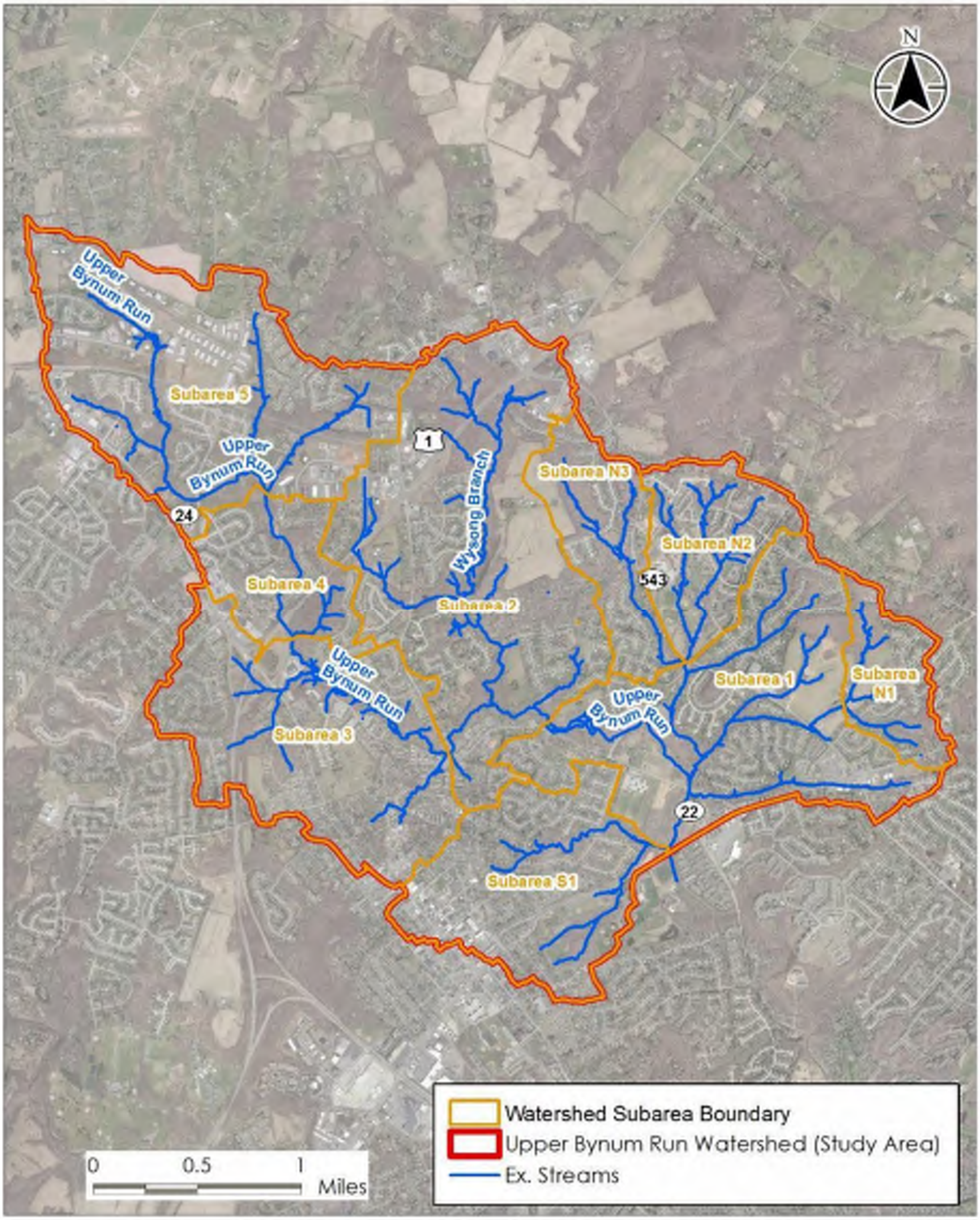
Subarea S1 - Subarea S1 is located in the southeastern portion of the watershed and is the most developed and urban subarea receiving flows from portions of the Town of Bel Air. The point of interest for this subarea is an unnamed tributary to Bynum Run located just upstream of the crossing with MD 22. All streams in this subarea are first and second order. This subarea includes a higher percentage of impervious surface as compared to the other subareas. Approximately 8.0 miles of stream channel were assessed in this subarea. Stream channels within the highly urbanized subarea are subjected to increased and concentrated flow rates from both overland flow and existing storm drain infrastructure. Stream channels in this subarea are exhibiting severe bank erosion and downcutting of the existing bed. Stream channels in this subarea are in poor condition and are a candidate for restoration opportunities.

Subarea N1 - Subarea N1 is the smallest and least developed of all study areas included in this watershed assessment. The point of interest is upstream of a private pond located adjacent to a private drive approximately 1,100 feet northwest of the intersection of Fountain Green Drive and Amyclae Drive. All stream channels in this subarea are first or second order and are bounded by very low residential development and forested areas. Approximately 5.2 miles of stream channel were evaluated in this subarea. Most of the stream channels have little to no baseflow. Due to property access constraints, stream assessments in this subarea were limited. Stream channels where assessments were completed in this subarea were overall in good condition.

Subarea N2 - Subarea N2 is a significantly developed subarea which includes C. Milton Wright High School, athletic fields and medium to high density residential development. The point of interest includes the confluence of two unnamed tributaries located approximately 200 feet southwest of the intersection of Southampton Road and MD 543. All stream channels in this subarea are first or second order, with most of the streams being ephemeral or lacking baseflow. Approximately 3.2 miles of stream channel were evaluated in this subarea. The development has resulted in increased and runoff leading to an increase in channelized flow and stream bank erosion. Bank erosion was observed in several stream channels in the subarea, most notably on the C. Milton Wright High School property. Unlike in other subareas where erosion was identified in minimal lengths along the channel banks, stream channels in this subarea had long sustained reaches with severe bank erosion. The stream channels in this subarea are in poor condition and are candidates for restoration opportunities.

Subarea N3 - Subarea N3 is located the farthest west of any of the tributaries north of Bynum Run. The point of interest for this subarea is the confluence of two unnamed tributaries located approximately 200 feet southwest of the intersection of Southampton Road and MD 543. All stream channels in this subarea are first or second order. Approximately 2.3 miles of stream channel were assessed in this subarea. Development in this subarea has been fairly recent and well managed by SWM facilities. Impairments to the stream channel were identified. However, they occur in small stretches near roadway crossings, or SWM facility outfalls. Overall the stream channels in this subarea are in fair condition. The stream channel in the downstream portions of this subarea could benefit from an improved overhead canopy.

Figure 5 - Watershed Subarea Map



2.3 EXISTING STORMWATER MANAGEMENT

2.3.1 Desktop Analysis

Stormwater BMPs were identified by desktop analysis using multiple GIS data sources from both Harford County and the Town of Bel Air. Some data sources included BMP details such as type, year built, drainage area. Other BMP sources lacked data, which required data calculation. Harford County also provided as-built plans for several BMPs where information was difficult to determine using the available desktop data. All BMPs were investigated through aerial photography using street view imagery. Drainage areas were delineated using current topography, drainage networks, as-built plans, and street view imagery.

2.3.2 Existing BMP Inventory and Computation of Watershed Pollutant Loads

The BMP inventory and drainage area delineation was completed exclusively by desktop analysis using GIS. A total of 190 BMPs were identified in the Watershed during this analysis. A map showing drainage areas and locations of all BMPs can be found in Appendix A. These BMPs were identified from county and local GIS data, aerial imagery, or as-built plans. All existing BMPs were identified and assigned a BMP type from the available options in the BayFAST program. The BMPs observed included all types and sizes from facilities on a single lot to SWM ponds designed to handle large subdivisions. Similarly, the BMPs observed were built at various times and based on different environmental regulations. Table 10 is a summary of all identified BMPs placed into the BayFAST categories and the total drainage areas associated with each type of facility.

Table 10 - Existing BMP types and Drainage Areas

BayFAST BMP Type	# of BMPs	Total Drainage Area to all BMPS (acres)
Bioretention/raingardens- underdrain	16	16.7
Dry Extended Detention Pond	83	1,284.0
Infiltration Practices w/ Sand, Veg no underdrain	19	50.3
Infiltration Practices w/o Sand, Veg no underdrain	5	7.2
Permeable Pavement with sand and underdrain	1	0.05
Stormwater Management by Era 1985 to 2002 MD	35	60.4
Stormwater Management by Era 2002 to 2010 MD	6	5.4
Vegetated Open Channel no underdrain	3	3.1
Vegetated Open Swales A/B Soils	2	2.4
Wet Pond and Wetland	20	387.3
Totals	**190**	**1,816.9**

BMPs serve many purposes that benefit overall stream and watershed health. Benefits of BMPs include retaining and limiting discharges of stormwater runoff from impervious areas and promoting infiltration to mimic natural processes prior to development. As indicated above, there are numerous types of BMPs located throughout the watershed, each with various treatment efficiencies. When analyzing overall BMP treatment, it is important to take into consideration when development occurred within the watershed. Depending on the timeframe, SWM may not have been required and the planning process should attempt to identify areas where BMPs can be installed.

In analyzing BMPs, it is important to understand the drainage area and associated impervious area that specifically flows to and is treated by an existing BMP. Table 11 includes a summary of sub-drainage areas within the overall Upper Bynum Run Watershed draining to BMPs and provides a percent of impervious surface drainage that is flowing to the existing facilities.

Note that it is impossible to determine if the BMPs were designed to treat 100% of the impervious runoff draining to them without reviewing and analyzing design calculations for each facility, which is outside of the level or effort for this project.

Table 11 - Subarea Descriptions with Land Use BMP Treatment

Subarea Name	Total Area (acres)	Total Impervious Area (acres)	Total Drainage Area to BMP (acres)	Total Impervious draining to existing BMP (acres)	Subarea Percentage Impervious Treated by BMPs (acres)
Subarea 1	903.57	208.81	207.62	80.77	38.68%
Subarea 2	1181.98	257.87	368.32	128.81	49.95%
Subarea 3	786.73	271.88	292.61	135.28	49.76%
Subarea 4	285.40	79.18	105.55	42.69	53.92%
Subarea 5	992.51	313.85	464.74	217.15	69.19%
Subarea N1	192.67	29.57	51.04	18.28	61.83%
Subarea N2	303.76	79.61	179.59	54.28	68.18%
Subarea N3	285.90	51.58	98.31	33.39	64.73%
Subarea S1	555.27	203.58	48.26	19.87	9.76%

The computation of all existing pollutant load calculations was completed done using an online program, BayFAST. BayFAST was developed with funding by the EPA. BayFAST calculates loading rates and removal rates for nitrogen, phosphorus, and sediment. BayFAST uses an established list of BMPs and land uses to perform these calculations. Although there is some source documentation available for BayFAST, the loading rates by land use are not publicly available but are generally assumed to be accurate and accepted for TMDL studies. To calculate the effects of the existing BMPs on the existing watershed two different scenarios were created in BayFAST. The first scenario was created using the land use areas from GIS and assuming no BMPs in place to establish a nutrient and sediment loading baseline for the watershed. Table 12 summaries this baseline loading for the watershed.

Table 12 - Watershed Pollutant Loads from BayFAST

BayFAST Land Use	Acres	Watershed Edge of Stream Loading assuming No BMPs		
		Nitrogen (lbs/yr)	Phosphorus (lbs/yr)	Sediment (lbs/yr)
Forest	1238.4	4,661.1	89.1	77,743.9
Agricultural Hightill	291.76	10,705.3	330.8	279,717.5
Pasture	123.84	572.2	81.6	7,770.9
Regulated Impervious Developed	1,442.10	25,514.3	2,317.7	1,182,298
Regulated Pervious Developed	2,278.17	30,539.3	718	277,347.8
Water	28.4	277.4	17.4	0

2.4 WATERSHED POLLUTANT LOAD ANALYSIS

2.4.1 Existing BMP Pollutant Removal Loading

To calculate the effects of the existing BMPs, a second BayFAST scenario was created to compare with the baseline scenario. The second scenario uses the same land use areas from the baseline but incorporates the existing BMPs into the model. Similar to assigning the existing BMPs a BMP type that matches the BayFAST model, the project team must also assign existing land use data to match the BayFAST land use data. The BMPs in BayFAST are all under the category of Urban BMPs. Therefore, all land use designations must be urban land types in the BayFAST model. All land uses in the BMP drainage areas have either been assigned as regulated pervious developed or regulated impervious developed. This results in limitations to the BayFAST model. For example, if a large stormwater pond has a drainage area that includes forested areas, agricultural areas and development, BayFAST must assume that the entire drainage area for that pond is urban pervious land. Table 13 provides a detailed breakdown of the BMP types and the associated land use values that were used as inputs into the BayFAST model. Table 14 summarizes the loading rates from the second scenario with existing BMPs and includes the reduction from the existing BMPs which is equal to the difference in loading from the first (baseline) and second scenarios. Note that table 14 includes nutrient load reductions from urban land use only.

Table 13 - Existing BMP Drainage Area Land Use for BayFAST

BayFAST BMP Type	Land Use Type	Acres
Bioretention/raingardens- underdrain	Regulated Impervious Developed	8.86
	Regulated Pervious Developed	7.86
Dry Extended Detention Pond	Regulated Impervious Developed	502.57
	Regulated Pervious Developed	781.42
Infiltration Practices w/ Sand, Veg no underdrain	Regulated Impervious Developed	31.96
	Regulated Pervious Developed	18.38
Infiltration Practices w/o Sand, Veg no underdrain	Regulated Impervious Developed	2.81
	Regulated Pervious Developed	4.40
Permeable Pavement with sand and underdrain	Regulated Impervious Developed	0.04
	Regulated Pervious Developed	0.00
Stormwater Management by Era 1985 to 2002 MD	Regulated Impervious Developed	34.15
	Regulated Pervious Developed	26.21
Stormwater Management by Era 2002 to 2010 MD	Regulated Impervious Developed	4.08
	Regulated Pervious Developed	1.33
Vegetated Open Channel no underdrain	Regulated Impervious Developed	0.69
	Regulated Pervious Developed	2.43
Vegetated Open Swales A/B Soils	Regulated Impervious Developed	1.75
	Regulated Pervious Developed	0.68
Wet Pond and Wetland	Regulated Impervious Developed	141.08
	Regulated Pervious Developed	246.21
Totals		**1,816.9**

Table 14 - Watershed Pollutant Loads with Existing BMPs for BayFAST

BayFAST Land Use	Acres	Watershed Edge of Stream Loading with Existing BMPs			Loading Rates Reduced from existing BMPs		
		Nitrogen (lbs/yr)	Phosphorus (lbs/yr)	Sediment (lbs/yr)	Nitrogen (lbs/yr)	Phosphorus (lbs/yr)	Sediment (lbs/yr)
Forest	1,238.4	4,661.1	89.1	77,743.9	0	0	0
Agricultural Hightill	291.76	10,705.3	330.8	279,717.5	0	0	0
Pasture	123.84	572.2	81.6	7,770.9	0	0	0
Regulated Impervious Developed	1,442.10	22,512.1	1,977.6	823,238.9	3,002.2	340.1	359,059.1
Regulated Pervious Developed	2,278.17	27,454.1	625.8	209,182	3,085.2	92.2	68,165.8
Water	28.4	277.4	17.4	0	0	0	0

2.4.2 Stream Outfall Channel Pollutant Loading Removal

The BayFAST program uses its built-in loading and reduction values to determine the loading rates delivered to the downstream end of the watershed. Table 15 below summarizes the loading rates delivered downstream from the edge of stream to the downstream end of the watershed and takes into consideration reduction rates associated with distance traveled in stream channels to the downstream location. The stream channels reduce nitrogen and phosphorus rates by natural processes. Generally, the sediment loading increases in the stream channel due to erosion and sediment transport processes that occur naturally in stream channels. The BayFAST model fails to account for increased nitrogen and phosphorus levels that may be attached to sediment eroded from stream banks.

Table 15 - Watershed Pollutant Loads from Stream Channels from BayFAST

BayFAST Land Use	Acres	Watershed Loading delivered downstream			Loading Rates reduced by stream channels		
		Nitrogen (lbs/yr)	Phosphorus (lbs/yr)	Sediment (lbs/yr)	Nitrogen (lbs/yr)	Phosphorus (lbs/yr)	Sediment (lbs/yr)
Forest	1,238.4	3,110.5	71.2	105,737.4	1,550.6	17.9	-27,993.5
Agricultural Hightill	291.76	7144	262.5	376,395.7	3,561.3	68.3	-96,678.2
Pasture	123.84	381.8	64.8	10,483	190.4	16.8	-2,712.1
Regulated Impervious Developed	1,442.10	15,022.9	1,569.4	1,125,002	7,489.2	408.2	-301,763.1
Regulated Pervious Developed	2,278.17	18,320.9	496.6	285,859.4	9,133.2	129.2	-76,677.4
Water	28.4	185.1	13.8	0	92.3	3.6	0

3.0 RESTORATION STRATEGIES

Stantec recommends the following watershed restoration strategies to meet the goals and objectives of the watershed management plan, based on the existing conditions findings described above. These strategies involve the implementation of three different types of restoration practices. The first practice involves constructing new SWM BMPs at selected sites where no current SWM facilities are in place. Several different types of facilities are proposed as new SWM BMPs. The second practice involves the construction of retrofits to existing SWM BMPs that are outdated or not functioning properly, which can be updated based on new and more efficient design guidelines and techniques. Several different types of existing BMPs were selected for retrofit using several different types of proposed retrofit techniques. The first and second restoration strategies focus primarily on treating sediment and pollutants from overland flow before the storm flows reach Upper Bynum Run and its tributaries. The third restoration strategy is the construction of stream restoration projects, which focuses primarily on reducing sediment and nutrient loads delivered downstream which are derived primarily from within the banks of the stream channel. The streambank erosion occurring in the restoration reaches recommended by Stantec are likely the result of excess or improperly managed stormwater flows reaching the stream channels that are not of sufficient size to handle the increased flows. For this strategy, Stantec has prepared conceptual stream restoration designs to address stream instability and streambank erosion along several main stem and tributary stream reaches where sediment and nutrient loading to downstream portions of the Bynum Run watershed and the Chesapeake Bay appears to be significant.

3.1 NEW STORMWATER MANAGEMENT

A total of 51 new SWM BMPs were identified by Stantec for potential construction in the Upper Bynum Run Watershed. The types of SWM facilities identified include: stormwater management ponds (23), bioretention facilities (20), bioswales (7), and a Regenerative Stormwater Conveyance system (RSC) (1). Potential BMP sites were selected during the desktop analysis efforts based on land ownership, existing development, and nearby stormwater infrastructure (storm drains, inlets, outfalls, etc.). Sites selected included small single lot commercial facilities, public properties, and existing large single-family developments without existing stormwater management. Drainage areas to potential BMPs were delineated for each of the identified sites. The drainage area impervious percentage and Hygrologic Soil Groups (HSG) were extracted in GIS to determine the required Water Quality Volume (WQv) for the facilities. Treatment at some sites was determined to be infeasible due to BMP sizing, existing utility conflicts, or other site constraints. Roughly 20 percent of the original 63 sites Stantec identified were not selected as final recommended BMPs due to constraints. BMPs were sized to treat the maximum WQv based on available open space on each site. For most sites, the concept design allows for treatment credit over 100% of the existing impervious area. Appendix D includes a map which depicts the final location and drainage areas for the recommended BMPs. This appendix also provides a full breakdown of the Proposed BMP sizing.

Table 16 provides an analysis of the drainage areas treated by the recommended BMPs collectively within each sub area. As indicated, BMPs are properly sized to treat WQv. The recommended BMPs can achieve treatment credit for over 100% of the existing impervious area drainage to each recommended BMP. Altogether, the proposed BMPs treat 9% of the total impervious area (1,495 acres) in the Upper Bynum Run Watershed.

Table 16 - Proposed BMP Treatment

Sub Area Name	# of Recommended BMPs	Total Drainage Area to BMP (Acres)	Drainage Area - Impervious to BMP (Acres)	WQV (FT3) (Required)	ESDv (FT3) (Required)	SWM Volume (FT3) (Provided)	% WQv Treated	Actual Impervious Area Treated by BMP (Acres)
1	9	72.31	25.68	97,006	155,210	148,175	153%	28.00
2	6	22.18	10.90	39,633	76,988	55,630	140%	12.00
3	5	79.74	29.16	109,753	194,686	132,409	121%	29.93
4	3	35.12	13.63	50,902	95,222	62,443	123%	12.86
5	7	27.74	15.39	55,309	110,028	63,844	115%	14.45
N1	0	-	-	-	-	-	-	-
N2	1	6.28	2.45	9,160	16,488	17,152	187%	2.99
N3	1	2.91	1.38	5,050	9,090	10,512	208%	1.76
S1	19	81.21	29.74	111,910	198,945	133,791	120%	29.22
Total	**51**	**327.49**	**128.34**	**478,722**	**856,657**	**623,955**	**130%**	**131.22**

Subarea 1 - For this subarea, 3 bioretention facilities and 6 new SWM ponds are recommended. This provides the 3rd largest area of impervious landcover treated when compared to other subareas within the watershed. Development in this subarea consists primarily of larger residential developments. Proposed SWM ponds in these developments are anticipated to treat larger drainage areas and limit runoff downstream of the development.

Subarea 2 – For this subarea, 3 bioretention facilities, 1 bioswale and 2 new SWM ponds are recommended. This is the largest subarea with most of the existing development treated by an existing SWM facility. The recommended BMPs are smaller than an average SWM facility in the watershed but are designed in a way to maximize the treatment of the impervious area that drains to the BMPs. A total of 12 acres of impervious area is treated by the proposed BMPs.

Subarea 3 – For this subarea, 2 bioretention facilities and 3 new SWM ponds are recommended. Subarea 3 treats the greatest amount of impervious surface compared to the other subareas. The proposed BMPs primarily treat residential development, but also treat smaller areas of commercial development.

Subarea 4 – For this subarea, 1 bioswale, 1 RSC, and 1 new SWM pond are recommended. The recommended facilities provide treatment of almost 13 acres of impervious landcover. The proposed BMPs treat 2 residential developments and a large commercial development.

Subarea 5 – For this subarea, 2 bioretention facilities, 1 bioswale, and 4 new SWM ponds are recommended. The BMPs recommended for this subarea treat mainly commercial development and some impervious development located on County-owned properties. The development in this portion of the watershed includes open space between commercial properties which allows the design to include smaller facilities rather than typical large SWM ponds that would treat much larger development areas.

Subarea N1 – For this subarea, no new SWM BMPs have been recommended due to its rural land use. A well forested area with tributaries to Upper Bynum Run that are in good condition reduced the need to include a BMP in Subarea N1. Minimal availability of public land also makes it difficult to find a practical location to place a BMP without having to gain permission from private land owners.

Subareas N2 and N3 – For these subareas, 1 new SWM pond has been recommended for each. These are smaller subwatersheds with more open space and forested areas than in other portions of the watershed. The development in this area is recent, with several existing BMP facilities in place. The 2 recommended facilities are proposed to treat residential developments and impervious area adjacent to those developments.

Subarea S1 – This subarea features the greatest concentration of impervious area, totaling 37% of the land cover. The Town of Bel Air contributes to this high concentration. For this subarea, a total of 19 BMPs are recommended, which is the most BMPs proposed within a sub area. The recommended facilities include 10 bioretention facilities, 4 bioswales and 5 new SWM ponds. The increased number of BMPs allows for an increased amount of impervious area to be treated.

3.2 RETROFIT EXISTING STORMWATER MANAGEMENT FACILITIES

Existing BMPs built before the year 2002 within the watershed were investigated for retrofit potential. A total of 95 BMPs were investigated in the field within the study area. Riser structures, embankments, inflow pipes, and stormwater treatment performance were considered when investigating existing BMPs. Facilities with minor maintenance needs were noted and information was stored in a GIS database for County review. Out of the 95 BMPs investigated a total of 49 were determined to be candidates for proposed retrofit. A map depicting the proposed BMP retrofits is included in Appendix E. Some older facilities investigated were found to have potential to be updated as newer Environmental Site Design (ESD) facilities. The proposed facilities are noted by their proposed retrofit BMP type. The BMP type corresponds to the CAST naming convention. A more detailed breakdown of what is being proposed for each BMP type can be found in the next paragraph. The proposed retrofit BMP types include: 5 bioretention facilities, 32 dry detention ponds, 8 wet ponds, and 4 standard stormwater treatment facilities to retrofit underground storage systems.

The 5 proposed bioretention facilities are being proposed in place of existing more conventional SWM ponds. The 32 dry retention ponds, and 8 wet ponds are being proposed to have forebays added, wet pools created/regraded, and outlet structure improvements. Outlet structure improvements include a combination of the following: Installing new riser structures, riser replacement, barrel replacement, and proprietary remote flow control structures. The 4 proposed standard stormwater treatment facilities are currently underground facilities but will be retrofitted as a bioretention or similar structure given the space onsite and the existing drainage infrastructure. Bioretention and forebay footprint sizes have been based off concept level calculations from Maryland SWM Manual. Table 17 provides a summary of the drainage area information associated with the 49 proposed retrofit BMP facilities.

Several design assumptions were made regarding the proposed retrofit BMPs. The first assumption was that the existing BMPs were operating at partial capacity, in such a way that they only treated half of the impervious land use draining to that facility. This assumption is based on best engineering judgement of the average performance of the selected BMPs under existing conditions for all proposed retrofit BMPs. Observed conditions affecting BMP performance included outdated or less-efficient design practices, failures of BMP facility infrastructure, and damaged outlet structures. The second assumption was that the proposed retrofit BMP can be sized to treat the total amount of impervious surface draining to the existing facility. The impervious area treated by each facility is 50% of the total amount in the drainage area based on the first assumption. The design of underground retrofit BMP facilities will require additional investigations to verify facility discharge points and associated constructability during subsequent design phases. These underground facilities have been given a lower priority than other above the surface facilities where constructability is easier to evaluate at the concept design stage.

Table 17 - Proposed BMP Retrofit Summary

Sub Area Name	# of Proposed BMPs	Total Drainage Area to BMP (Acres)	Drainage Area - Impervious to BMP (Acres)	Drainage Area – Pervious to BMP (Acres)	% of impervious Area Treated by BMP	Actual Impervious Area Treated by BMP (Acres)
1	11	143.46	53.92	89.54	50%	26.96
2	10	208.12	52.36	155.76	50%	26.18
3	6	130.27	64.91	65.36	50%	32.46
4	1	35.13	12.36	22.77	50%	6.18
5	15	248.01	120.03	127.98	50%	60.02
N1	0	-	-	-	-	-
N2	1	149.12	36.29	112.83	50%	18.15
N3	4	96.56	33.25	63.31	50%	16.63
S1	1	38.89	13.31	25.58	50%	6.66
Totals	**49**	**1,049.56**	**386.43**	**663.13**		**193.22**

Subarea 1 – This subarea includes 7 dry extended detention pond retrofits, 1 wet pond and 3 standard performance stormwater treatment facilities. Most of the treatment potential is from the retrofits of the existing ponds. These retrofits include facilities that treat impervious areas from residential developments. The retrofits of underground facilities treat smaller single lot commercial properties. This subarea treats the 3rd highest amount of impervious land cover of the subareas.

Subarea 2- This subarea includes 6 dry extended detention pond retrofits, 1 bioretention facility, 1 wet pond and 1 standard performance stormwater treatment facility. The proposed retrofits treat a mix of residential development, large commercial development, and single lot commercial properties. The proposed retrofits will treat just over 26 acres of impervious land area in the subarea.

Subarea 3- This subarea includes 1 bioretention facility, 4 dry extended detention pond retrofits and 1 wet pond. Most of the retrofit facilities treat impervious areas from large residential development, with a few smaller commercial properties also proposed for treatment. This subarea treats the second highest impervious area at over 32 acres.

Subarea 4 – This subarea includes 1 dry extended detention pond retrofit. The existing pond treats impervious drainage from a large residential development site, and over 6 acres of impervious area will be treated by the proposed retrofit.

Subarea 5 - This subarea includes 3 dry extended detention pond retrofits, 3 wet ponds, and 3 bioretention facilities. This subarea treats the largest amount of impervious area at just over 60 acres. The majority of the impervious drainage treated is from commercial and industrial development areas. There are a few SWM ponds that will be retrofitted to treat runoff from residential development properties.

Subarea N1 - This subarea does not contain any proposed BMP retrofits due to its rural land use and the lack of existing development. There are 4 existing BMPs in this subarea, which were recently built and in stable condition. A well forested area with tributaries to Bynum Run also reduces the need to include BMP retrofits in Subarea N1.

Subarea N2 - This subarea includes 1 dry extended detention pond retrofit. The existing facility has a riser structure in line with the stream and treats a very large drainage area. The retrofit structure will have to provide a bypass for the existing stream channel and provide treatment for the stormwater runoff. This retrofit can be completed in conjunction with the proposed upstream stream restoration project, as described in the next report section.

Subarea N3 - This subarea includes 4 dry extended detention pond retrofits. These SWM ponds treat stormwater runoff exclusively from residential development areas and associated adjacent impervious areas. This subarea is moderately developed and the retrofits treat the 3rd lowest amount of impervious drainage area of all subareas. The treatment credit for these retrofits includes nearly 17 acres.

Subarea S1 – This subarea includes 1 wet pond retrofit. This retrofit is outside of the highly developed area of downtown Bel Air. The retrofit will treat stormwater runoff from a large residential development area. A total of nearly 7 acres of treatment credit will result from this retrofit.

3.3 PROPOSED STREAM RESTORATION REACHES

Building upon the field walks conducted during the stream corridor assessment, Stantec identified 15 reaches totaling approximately 5.07 miles of stream channel in the Upper Bynum Run watershed for potential restoration opportunities. The Bank Assessment for Non-point Source Consequences of Sediment (BANCS) procedures, which incorporates a rapid analysis of Bank Erosion Hazard Index (BEHI) and Near Bank Stress (NBS), was conducted between March and May of 2018 on each identified reach in order to analyze and estimate current baseline streambank erosion rates. Restoration reach descriptions and results from the BANCS analysis are detailed in the following paragraphs beginning with the upstream portions of the watershed. Please refer to Appendix F for a more detailed breakdown of streambank erosion rates and representative photographs for each of the reaches described below.

Bynum Run at Newport Drive

The Bynum Run at Newport Drive (BRNP) reach is a perennial stream located in the Forest Hill area within Subarea 5 in the upper portion of the watershed. BRNP is bounded by Newport Drive to the north, the Ma & Pa Heritage Trail to the west, MD-23 to the south and a vacant lot zoned for industrial use to the east. The reach begins from an approximate 36” RCP beneath Newport Drive and flows in a southerly direction for approximately 520 linear feet (LF) before entering a 60” concreted-line CMP beneath MD-23. BRNP has an approximate drainage area of 0.38 mi^2 of which 49.3% is calculated as impervious using the StreamStats program. Approximately 340 LF of the reach is located on property owned by the Klein Family Development Corporation (Tax Map 40, Parcel 387) with the remaining 180 LF located on SHA right-of-way (ROW). The upstream portion of the restoration site consists of adjacent scrub-shrub wetlands primarily consisting of common reed (*Phragmites australis),* which is a noxious invasive plant species. The downstream portion of the reach is surrounded by a mid-successional forest. A severely eroded SWM detention pond (ID# 170) outfall channel contributes to the reach along the right bank approximately 150 LF downstream of the 36” RCP. BRNP has an approximate slope of 0.8% and sinuosity of 1.1 with an average bank height of two feet. Based on the BANCS Analysis conducted on BRNP, Stantec observed multiple outside meander bends having both high BEHI and NBS ratings and estimates a total annual streambank erosion rate for the reach of 5.5 ton/yr.

Bynum Run at MD-23

The Bynum Run at MD-23 (BR23) reach is a perennial stream located in the Forest Hill area within Subarea 5 in the upper portion of the watershed. BR23 is bounded by MD-23 to the north, the Ma & Pa Heritage Trail and Hart Heritage Assisted Living to the west, Wagner Way to the south and Mardic Drive to the east. The reach begins from an approximate 60” concreted lined CMP beneath MD-23 downstream of BRNP and flows in a southerly direction for approximately 2,130 LF before entering the 1903 Rockspring Road property (Tax Map 40, Parcel 123) which marks the end of the reach. BR23 has an approximate drainage area of 0.53 mi^2 of which 44.8% is calculated as impervious (StreamStats). BR23 flows through five parcels including the Spenceola Farms II Community open space (Tax Map 40, Parcel 411) (1,550 LF), Spenceola Farms II Townhome Village HOA open space (Tax Map 40, Parcel 411) (160 LF), the Forest Glen Community Association open space (Tax Map 40, Parcels 437 and 444) (420 LF), and S&G Realty Ventures LLC property (Tax Map 40, Parcel 51), which shares the downstream extent of the reach with Parcel 437. Both the right and left banks are buffered by a mid-successional forest with an open understory. The Ma & Pa Heritage Trail runs adjacent to BR23 along the right bank of the upstream portion of the reach before bisecting the stream at a pedestrian bridge crossing on Parcel 411. A stormwater management detention pond (ID# 193) outfall channel contributes to the reach along the right bank approximately 460 LF upstream of the pedestrian bridge crossing.

BR23 has an approximate slope of 0.7% and sinuosity of 1.3 with an average bank height of two feet. Based on the BANCS Analysis conducted on BR23, Stantec observed many areas having both high BEHI and NBS ratings especially on outside meander bends, resulting in an estimated annual streambank erosion rate of 35.0 ton/yr. The most severe erosion in BR23 is occurring immediately downstream of the pedestrian bridge crossing where the stream maneuvers through a tight meander which has created 8-10’ banks resulting in a very high rating for BEHI and extreme rating for NBS.

Bynum Run at Blake’s Venture Park

The Bynum Run at Blake’s Venture Park (BRBVP) reach is a perennial stream located in the Forest Hill area near the downstream extent of Subarea 5. BRBVP is bounded by Donald Circle to the north, Mardic Drive to the west, Streett Circle to the south, Melrose Lane to the east and is bisected by the Ma & Pa Heritage Trail. The reach begins from a series of three box culverts beneath Mardic Drive downstream of BR23 and flows in a northeasterly direction for approximately 1,525 LF before flowing beneath a pedestrian bridge for the Ma & Pa Heritage Trail. After the pedestrian bridge crossing, the reach flows in a southerly direction for an additional 945 LF where it comes to another pedestrian bridge trail crossing which marks the end of the reach. The majority of BRBVP (2,340 LF) is located on Harford County-owned property referred to as Blake’s Venture Park (Tax Map 40, Parcel 57) with the remaining 130

LF located on property owned by Spenceola Farms II Community Association (Tax Map 40, Parcel 411) at the upstream extent of the reach. BRBVP has an approximate drainage area of 1.42 mi^2 of which 42.8% is calculated as impervious. The reach begins in an early to mid-successional forest before entering a floodplain meadow with adjacent emergent wetlands. Beaver activity was observed throughout the reach including two dams which are actively creating backwatered areas, especially downstream of the pedestrian crossing. A SWM detention pond (ID# 186) outfalls into a backwater wetland along the left bank approximately 230' upstream of the pedestrian bridge crossing and an unnamed tributary contributes to BRBVP approximately 360' downstream of the crossing.

BRBVP has an approximate slope of 0.4% and sinuosity of 1.1 with an average bank height of 3.5 feet. Based on the BANCS Analysis conducted on BR23, Stantec observed outside meander bends having both high BEHI and NBS ratings and a majority of the channel is entrenched. The estimated annual streambank erosion rate is 31.2 ton/yr.

Unnamed Tributary at Melrose Lane

The Unnamed Tributary at Melrose Lane (UTML) reach is a perennial stream located in the Forest Hill area within Subarea 5 in the upper portion of the watershed. UTML is bounded by MD-23 to the north, Melrose Lane to the west, the Ma & Pa Heritage Trail to the south and Robin Circle to the east. The restoration reach begins from an approximate 36" RCP beneath MD-23 and flows in a southerly direction for approximately 1,900 linear feet (LF) before entering two 48" CMPs beneath Melrose Lane. After the road crossing, the reach flows in a southerly direction for an additional 320 LF where it contributes to Bynum Run (BRBVP) which marks the end of the reach. UTML has an approximate drainage area of 0.44 mi^2 of which 49.6% is calculated as impervious. The upstream portion of the reach flows through six parcels which includes Bynum Woods Townhouse Owners Association (Tax Map 40, Parcels 368 & 378), 1641 Robin Circle LLC (Tax Map 40, Parcel 382), the State of Maryland (Tax Map 40, Parcel 382), Bynum Run Business Center Association Inc. (Tax Map 40, Parcel 382), and Harford County (Tax Map 40, Parcel 57). The downstream portion of the reach is entirely on Harford County owned Blake's Venture Park property (Tax Map 40, Parcel 57).

The upstream portion of the restoration reach consists of a mid-successional forest with a moderately dense understory and adjacent forested wetlands. The downstream portion is backwatered by a beaver dam and flows through an open floodplain meadow associated with Bynum Run. A SWM detention pond (ID# 171) outfall channel contributes to the reach along the left bank approximately 630 LF upstream of the Melrose Lane crossing. UTML has an approximate slope of 0.5% upstream of the crossing and 0.6% downstream of the crossing. The approximate sinuosity of the reach is 1.2 with an average bank height of two feet. Based on the BANCS Analysis conducted on UTML, Stantec observed multiple outside meander bends having both high BEHI and NBS ratings and estimates an annual streambank erosion rate of 17.3 ton/yr.

Unnamed Tributary at Pipercove Way

The Unnamed Tributary at Pipercove Way (UTPW) reach is an intermittent stream located in the Bel Air area within the downstream portion of Subarea 4. UTPW is bounded by US-1/Bel Air Bypass to the north and west, Bynum Run to the south and Pipercove Way to the east. The restoration reach begins at the confluence of an outfall channel from a SWM pond (ID# 68) and flows in a southerly direction for approximately 1,040 linear feet (LF) before contributing to Bynum Run, which marks the end of the reach. UTPW has an approximate drainage area of 0.12 mi^2 of which 15.8% is calculated as impervious. The reach is entirely on Harford County owned land which includes Parcels 64 and 68 on Tax Maps 41 and 40, respectively.

UTPW meanders through a mature forest with an open understory and adjacent forested wetlands and has an approximate slope of 1.5%, sinuosity of 1.2 with and an average bank height of 1.5'. Based on the BANCS Analysis conducted on UTPW, Stantec observed multiple outside meander bends having both high BEHI and NBS ratings and estimates an annual streambank erosion rate of 11.2 ton/yr. The reach is actively downcutting as it makes its way towards Bynum Run and fallen trees were observed along many of the tight meander bends.

Bynum Run at Harford County Detention Center

The Bynum Run at Harford County Detention Center (BRHD) reach is a perennial stream located in the Bel Air area and is in both Subareas 4 and 3. BRHD is bounded by US-1/Bel Air Bypass to the north, an access ramp from MD 24 to the Bypass to the west, Harford County Detention Center to the south, and Pipercove Way to the east. The restoration reach begins from a series of two box culverts beneath the access ramp for US-1/Bel Air Bypass and flows in a southerly direction for approximately 730 LF before reaching the outfall of a SWM facility (ID# 92) which marks the end of the reach. BRHD is entirely located on Harford County owned property (Tax Map 40, Parcel 68) and has an approximate drainage area of 1.97 mi^2 of which 40.8% is calculated as impervious. The restoration reach has a gently sloping mature forest along its left bank and a steep roadway embankment along most of the right bank before giving way to maintained lawn adjacent to the Detention Center.

BRHD has an approximate slope of 1.0% and sinuosity of 1.1 with an average bank height of 3 feet. Based on the BANCS Analysis conducted on BR23, Stantec observed outside meander bends having both high BEHI and NBS ratings with an estimated annual streambank erosion rate of 13.3 ton/yr. The most severe erosion was observed on an outside meander bend along the right bank adjacent to the access ramp embankment where the bank was vertical and exposed up to 10' in height.

Unnamed Tributary at Bel Air Bypass

The Unnamed Tributary at Bel Air Bypass (UTBB) reach is a perennial stream located in the Bel Air area within the northwest portion of Subarea 2. UTBB is bounded by US-1/Bel Air Bypass to the north, the Kelly Glen residential neighborhood to the west, Hartley Way to the south and Conowingo Road to the east. The restoration reach begins from two approximate 60" RCPs beneath US-1/Bel Air Bypass and flows in a southeasterly direction for approximately 2,305 linear feet (LF) before entering into an elliptical concrete-lined CMP beneath Conowingo Road, which marks the end of the reach. The stream contributes to Wysong Branch downstream of Conowingo Road which is a direct tributary to Bynum Run. UTBB has an approximate drainage area of 0.2 mi^2 of which 11.6% is calculated as impervious (StreamStats). The majority of the reach is located on property owned by Kelly Green Homeowners Association (Tax Map 41, Parcels 61 & 686) except for 160 LF on the upstream extent which is on SHA ROW property.

UTBB flows through a mid-successional forest within the SHA-owned property in the upper extent of the reach before entering a dense hedgerow in an open meadow on Kelly Green HOA property. The stream is relatively stable in the hedgerow with isolated areas recording moderate BEHI and NBS ratings during the BANCS analysis. This portion of the reach has an approximate slope of 1.9% and sinuosity of 1.0 with an average bank height of one foot. After flowing through the meadow hedgerow, UTBB enters a mid-successional forest with steep slopes along the right bank and broad floodplain along the left bank which includes forested wetlands. Two unnamed tributaries contribute to UTBB along the left bank in the upstream portion of the forested area. Stantec observed the stream actively downcutting in this portion of the reach with many areas recording high BEHI and NBS ratings. This portion of the reach has an approximate slope of 1.9% and sinuosity of 1.2 with an average bank height of 2.3'. Based on the BANCS Analysis conducted on UTBB, Stantec estimates an annual streambank erosion rate of 17.6 ton/yr.

Unnamed Tributary at Switchman Drive

The Unnamed Tributary at Switchman Drive (UTSD) reach is an intermittent stream located in the town of Bel Air within Subarea 3. UTSD is bounded by Crocker Drive and Donzen Drive to the north, Switchman Drive to the south, Ma and Pa Road to the west, and Crocker Drive to the east. The restoration reach begins at an approximate 48" RCP stormwater outfall (ID# 15) beneath Switchman Drive and flows in an easterly direction for approximately 430 LF where it confluences with a similarly sized unnamed tributary at a 36" CMP at Crocker Drive marking the end of the restoration reach. UTSD has an approximate drainage area of 0.3 mi^2 of which 45.8% is calculated as impervious (StreamStats).

UTSD flows through a thin hedgerow of trees with dense shrubs surrounded by mowed and maintained lawn on Hickory Village HOA property. The upper portion of the reach is experiencing severe erosion along the left bank with exposed vertical banks approximately nine feet in height. The severe erosion in this portion of the reach can be attributed to the outfall directing flow during large storm events directly at the left bank. Approximately 310 LF downstream of the outfall, UTSD enters a 36" CMP for approximately 60 LF, the purpose of this CMP is unknown. UTSD has an approximate slope of 1.8% and sinuosity of 1.1 with an average bank height of 4.5'. Based on the BANCS Analysis conducted on UTSD, Stantec observed many areas along the restoration reach exhibiting high to very high BEHI and NBS ratings and estimates an annual streambank erosion rate of 11.1 ton/yr.

Bynum Run at Moores Mill Road

The Bynum Run at Moores Mill Road (BRMMR) reach is a perennial stream located in the Bel Air area and is in both Subareas 1 and 2. BRMMR is bounded by Henderson Road to the north, Conowingo Road to the west, Moores Mill Road to the south, and Old Southampton Road to the east. The restoration reach begins within a utility easement immediately downstream of 798 Moores Mill Road and flows in an easterly direction for approximately 1,090 LF before coming to an approximately 4' tall historic mill dam that is no longer in functional use. According to an 1878 Martenet Map of Harford County, the dam is approximately in the same location as the J &J Moore grist mill. BRMMR continues to flow east for an additional 350 LF downstream of the dam which marks the end of the restoration reach. The restoration reach flows through three parcels including properties owned by Farside Worldwide Properties (Tax Map 41, Parcel 94), Nancy Connor (Tax Map 41, Parcel 96), and Elizabeth Thornton (Tax Map 41, Parcel 97). The Thornton property is recognized on both the Maryland Inventory of Historic Properties and the National Register of Historic Places as "Heighe House" (National ID 90001568 / MIHP ID HA-1770). The mill dam is associated with the Heighe House property. BRMMR has an approximate drainage area of 4.99 mi^2 of which 34.6% is calculated as impervious (StreamStats).

The mill dam has created a slow flowing backwater feature in the upstream portion of BRMMR buffered by forested and emergent wetlands adjacent to both banks of the stream. A side channel has developed around the right side of the dam which directs flow towards an outfall channel associated with a SWM pond (ID# 144) in the Major's Choice residential neighborhood. The side channel is approximately 370 LF and has an active beaver dam just upstream of the outfall. Upstream of the mill dam has an approximate slope of 0.3% and sinuosity of 1.0 with an average bank height of 3 feet. Based on the BANCS Analysis conducted upstream of the mill dam, Stantec observed many areas recording moderate to high BEHI ratings; NBS ratings were generally low in this area due to the backwater nature caused by the mill dam feature. The downstream portion of the reach (below the dam) is buffered by a mature forest on both the right and left banks and has an approximate slope of 1.7% and sinuosity of 1.0 with an average bank height of two feet. Based on the BANCS Analysis conducted downstream of the dam, Stantec observed a relatively stable stream with low to moderate BEHI and NBS ratings. Stantec estimates that BRMMR has an annual streambank erosion rate of 18.4 ton/yr, most of which is being trapped by the mill dam. The mill dam appears to be in very poor condition and if it fails Stantec believes there will be a stockpile of sediment washed to downstream receiving waters.

Unnamed Tributary at Frogleap Way

The Unnamed Tributary at Frogleap Way (UTFW) reach is an intermittent stream located in the Bel Air area within Subarea N3. UTFW is bounded by Frogleap Way to the north, the Vineyard Oak residential neighborhood west, Leeswood Road to the south and North Fountain Green Road (MD 543) to the east. The restoration reach begins at an approximate 48” RCP beneath Frogleap Way and flows in a southerly direction for approximately 640 LF to 1110 Leeswood Road (Tax Map 41, Parcel 663) which marks the end of the restoration reach. Approximately 470 LF downstream of the RCP a 140 LF eroded outfall channel associated SWM pond ID# 179 contributes to UTFW. The USGS StreamStats site was unable to delineate both drainage area and percent impervious for UTFW. The entire reach is on Vineyard Oak Homeowners Association owned property.

UTFW meanders through a mid-successional forest with a moderately dense understory with adjacent forested wetlands and has an approximate slope of 2.2%, sinuosity of 1.2 with and an average bank height of 2.2’. Based on the BANCS Analysis conducted on UTFW, Stantec observed many areas along both the reach and outfall channel exhibiting high BEHI and NBS ratings and estimate an annual streambank erosion rate of 11.7 ton/yr.

Unnamed Tributary at MD-543

The Unnamed Tributary at MD-543 (UT543) reach is a perennial stream located in the Bel Air area within Subarea 1. UT543 is bounded by MD-543 to the north, Moores Mill Road to the south, the Amyclae Estates residential neighborhood to the east, and Chestnut Knoll Drive to the west. The restoration reach begins at an approximate 48” concrete-lined CMP beneath MD-543 and flows in a westerly direction for approximately 2,165 LF where it confluences with a similarly sized unnamed tributary. At the confluence, UT543 flows in a southerly direction for approximately 1,390 LF where it contributes to an unnamed tributary located on the 1112 Moores Mill Road property, which marks the end of the restoration reach. Two SWM pond outfall channels (ID# 166 and 167) contribute to UT543 along the left bank within the restoration reach. UT543 has an approximate drainage area of 0.69 mi^2 of which 23.0% is calculated as impervious (StreamStats). However, impervious area in this drainage area is anticipated to increase significantly due to a planned residential neighborhood being developed north of MD-543.

The upstream portion of UT543 (upstream of the confluence) meanders through a mid-successional strip of forest with a very dense understory on Amyclae Estates HOA and Southampton HOA owned property and has an approximate slope of 1.4% and sinuosity of 1.1 with an average bank height of 2.3’. The downstream portion of UT543 meanders through a wider mid-successional forest with adjacent forested wetlands on Amyclae Estates HOA and Southampton HOA owned property and has an approximate slope of 0.7% and sinuosity of 1.2 with an average bank height of three feet. Based on the BANCS Analysis conducted on UT543, Stantec observed many areas along the restoration reach exhibiting high BEHI and NBS ratings and estimate an annual streambank erosion rate of 50.2 ton/yr.

Unnamed Tributary at Rockfield Park

The Unnamed Tributary at Rockfield Park (UTRP) reach is a perennial stream located on Town of Bel Air and John Carroll High School owned property in the Town of Bel Air within Subarea S1. UTRP is bounded by East Churchville Road (MD-22) to the north, Linwood Avenue to the south, John Carroll High School to the east, and Giles Street to the west. The restoration reach begins in a forested area approximately 150 LF upstream from a 36" RCP outfall that directs runoff from Linwood Court into the stream. From the outfall, UTRP flows in a northeasterly direction through a steeply sloped mature forest with adjacent pedestrian trails for approximately 1,860 LF where it confluences with a similarly sized unnamed tributary. At the confluence UTRP continues to flow in a northeasterly direction through a broad floodplain area that includes emergent and scrub-shrub wetlands for approximately 830 LF where it enters a culvert beneath the John Carroll High School entrance road. On the downstream side of the culvert, UTRP continues through a mowed and maintained lawn area on the John Carroll High School property for approximately 280 LF where it comes to a double 24" RCP marking the end of the restoration reach. UTRP has an approximate drainage area of 0.26 mi^2 of which 30.9% is calculated as impervious (StreamStats).

The upstream portion of UTRP (upstream of the confluence) has an approximate slope of 2% and sinuosity of 1.4 with an average bank height of 2.8'. The downstream portion of UTRP has an approximate slope of 0.8% and sinuosity of 1 with an average bank height of 2.0'. Based on the BANCS Analysis conducted on UTRP, Stantec observed many areas along the restoration reach exhibiting very high to high BEHI and NBS ratings especially in the upstream areas and estimates an annual streambank erosion rate of 42.0 ton/yr.

Unnamed Tributary at MD-22

The Unnamed Tributary at MD-22 (UT22) reach is a perennial stream located on property owned by Leon Levitsky and St. Matthew Lutheran Church in the Bel Air area within Subarea S1. UT22 is downstream of UTRP and is bounded by Hitching Post Drive to the north and west and MD-22 to the south and east. The restoration reach begins on the Levitsky property approximately 55 LF downstream of a 60" RCP beneath MD-22 and flows in a northeasterly direction for approximately 1,225 LF where it contributes to restoration reach UTB which marks the end of the reach. A moderately sloped forest behind a residential neighborhood comprises the upland areas along the left bank and a gently sloped forest behind an active construction site comprises the upland areas along the right bank. UT22 has an approximate drainage area of 0.29 mi^2 of which 31.2% is calculated as impervious (StreamStats). UT22 has an approximate slope of 1.1% and sinuosity of 1.1 with an average bank height of 2.8'. Based on the BANCS Analysis conducted on UT22, Stantec observed many areas along the restoration reach exhibiting very high to high BEHI and NBS ratings and estimates an annual streambank erosion rate of 22.7 ton/yr.

Unnamed Tributary at Broadway

The Unnamed Tributary at Broadway (UTB) reach is located on properties owned by Harford County and St. Matthew Lutheran Church in the Bel Air area within Subarea S1. UT22 is the furthest downstream reach in the Upper Bynum Watershed and is bounded by Southampton Middle School to the north, Jackson Boulevard to the south, East Broadway to the west, and Bynum Run to the east. The restoration reach begins at an approximately 72" wide elliptical CMP beneath East Broadway and flows in an easterly direction for approximately 2,300 LF where it contributes to Bynum Run which marks the end of the reach. A stormwater outfall from Jackson Boulevard and UT22 contribute to UTB along the right bank and an unnamed tributary originating from the Southampton Middle School athletic field contributes to UTB along the right bank. Upland areas along the right bank are comprised of a forest with a dense understory and pedestrian trails behind Southampton Middle School on the upstream portion of the reach and a floodplain forest associated with Bynum Run on the bottom half of the reach. The upland areas along the right bank include a forest behind a residential neighborhood on the upstream portion of the reach and a maintained sanitary sewer easement along the downstream portion of the reach. UTB has an approximate drainage area of 0.76 mi^2 of which 38.0% is calculated as impervious (StreamStats).

UTB has an approximate slope of 1.0%, sinuosity of 1.3 with an average bank height of 3.6'. Based on the BANCS Analysis conducted on UTB, Stantec observed that the majority of this reach is severely incised exhibiting very high to high BEHI and NBS ratings and an estimated annual streambank erosion rate of 70.3 ton/yr.

3.4 NUTRIENT REDUCTION POTENTIAL

The Chesapeake Assessment Scenario Tool (CAST) online model was used to determine the loading rates on the proposed BMPs, retrofit BMPs and Stream Restoration reaches. Over the course of the watershed assessment, the BayFAST model, which was used for the existing conditions calculations, was combined into the CAST model. Therefore, BayFAST could not be used for the proposed project nutrient reduction calculations. Similar to the BayFAST modeling, multiple scenarios were created to determine the potential nutrient reduction. First, a base scenario with no BMPs was created in the CAST model. This first scenario sets the loading rates for nitrogen, phosphorus and sediment for the watershed. This base scenario used the year 2017 as a base for landcover, existing BMPs and wastewater loading rates. The CAST model does not allow for a user defined watershed boundary and is only available at the HUC 12 level for Bynum Run. Therefore, the model was set up for the entire HUC 12 Bynum Run Watershed, rather than just the Upper Bynum Run section of the watershed. The CAST model includes existing BMPs from the MDE database. The MDE database is not available to compare with the existing BMPs modeled previously in BayFAST. It is for this reason along with different watershed size that the existing BMPs from BayFAST were not incorporated into the CAST model.

The second scenario created in CAST is a copy of the base scenario with the 51 recommended, new SWM BMPs included in the watershed. This model calculates nutrient and sediment reductions to edge of stream loading and delivered downstream to edge of tidal waters. This scenario is only concerned with overland flow and contributions outside of existing stream channels so the edge of stream loading and reduction values were summarized. Another scenario was created by copying the base scenario and incorporating the 49 recommended, existing SWM BMP retrofits into the model. The model does not have a BMP type for retrofits. Therefore, CAST BMP types are assumed to be new BMPs with no existing treatment in place. To account for the existing BMP treatment, it was assumed that the existing BMPs treat half of the existing impervious land use with the BMP drainage area. This assumption is based on best engineering judgement of the average performance under existing conditions of all proposed retrofit BMPs. This allows the model to apply a reduction for the newer more efficient BMP facilities while still considering the benefits of the existing BMPs.

For both the proposed new SWM BMPs and the existing SWM BMP retrofit scenarios, the land uses treated by the BMPs were set to impervious and pervious developed MS4 lands. Loading rates remain unchanged for the rest of the watershed for the agricultural and natural land uses based off Proposed BMPs.

The final CAST scenario was developed by copying the base scenario and applying the proposed 26,650 feet of stream restoration to the scenario. The CAST model calculates the stream load as a ratio of the total edge of stream load from non-stream sources to the stream load source. For comparison, additional impairment calculations were developed based on the BANCS analysis for each of the proposed stream restoration reaches above. The BEHI and NBS values estimated along the stream banks was applied to Protocol 1 of the Maryland Expert Panel recommendations (Schueler & Stack, 2014) to determine sediment and nutrient load reduction potential based on the estimated annual streambank erosion rates. Protocols 2 and 3 from the expert panel paper were not used as they give minimal credit compared to protocol 1. Protocol 4 was not applicable in all situations and was therefore not used in pollutant reduction calculations as well. The estimated nutrient concentrations within the bank sediments and restoration reduction values based on a typical natural channel design stream restoration approach were taken from the Expert Panel paper and used to calculate the sediment and nutrient reductions for the proposed stream restoration reaches.

For the stream restoration scenarios, the results of the CAST model were compared against the results of the guidelines of the Maryland Expert Panel recommendations. The results of the CAST model were lower and outside of an acceptable range when compared with the results of the Expert Panel method (Schueler & Stack, 2014). Therefore, the loading reductions used in this report are based on field surveyed BANCs data and the Maryland Expert Panel to estimate stream bank erosion and load reductions.

To simplify the CAST scenarios the models were set up by combining all the similar BMP types into one entry. This simplifies the model but makes calculating the reduction from a specific project more difficult. To calculate the reduction for each BMP facility, the total reduction was multiplied as a percentage of the individual BMP drainage to the overall drainage area. The tables below summarize the CAST base model loading rates, reduction rates and post restoration loading rates for Nitrogen, Phosphorus, and Sediment.

Table 18 - Nitrogen Loading and Reduction Summary Table

Loading Source	CAST Base Model Loading (lbs/yr)	Reduction from Proposed BMP (lb/yr)	Reduction from Proposed BMP Retrofits (lbs/yr)	Proposed Stream Reductions from Expert Panel (lbs/yr)	Proposed Loading after Project Implementation (lbs/yr)	Percent Reduction
Agricultural	43,422.75	0	0	0	43,422.75	0.0%
Developed	26,689.83	384.78	853.83	0	25,451.22	4.6%
Natural	15,085.13	0	0	4,850	10,235.13	32.2%
Septic	7,301.01	0	0	0	7,301.01	0.0%
Wastewater	18.03	0	0	0	18.03	0.0%
Total Loads	**92,516.75**	**384.78**	**853.83**	**4,850**	**86,428.14**	**6.6%**

Table 19 - Phosphorus Loading and Reduction Summary Table

Loading Source	CAST Base Model Loading (lbs/yr)	Reduction from Proposed BMP (lb/yr)	Reduction from Proposed BMP retrofits (lbs/yr)	Proposed Stream Reductions from Expert Panel (lbs/yr)	Proposed Loading after Project implementation (lbs/yr)	Percent Reduction
Agricultural	1,393.62	0	0	0	1,393.62	0.0%
Developed	2,620.18	77.39	130.06	0	2,412.73	7.9%
Natural	2,177.1	0	0	2,234	-56.9	102.6%
Septic	0	0	0	0	0	0.0%
Wastewater	0.55	0	0	0	0.55	0.0%
Total Loads	**6,191.45**	**77.39**	**130.06**	**2,234**	**3,750**	**39.4%**

Table 20 - Sediment Loading and Reduction Summary Table

Loading Source	CAST Base Model Loading (lbs/yr)	Reduction from Proposed BMP (lb/yr)	Reduction from Proposed BMP retrofits (lbs/yr)	Proposed Stream Reductions from Expert Panel (lbs/yr)	Proposed Loading after Project implementation (lbs/yr)	Percent Reduction
Agricultural	1,416,110	0	0	0	1,416,110	0.0%
Developed	2,229,541	78,914	177,367	0	1,973,259	11.5%
Natural	8,894,950	0	0	770,067	8,124,884	8.7%
Septic	0	0	0	0	0	0.0%
Wastewater	234	0	0	0	234	0.0%
Total Loads	**12,540,835**	**78,914**	**177,367**	**770,067**	**11,514,487**	**8.2%**

3.5 COST ANALYSIS

Cost analyses for the proposed restoration approaches were based on various sources. The costs of the proposed SWM BMPs (new and retrofits), bioretention facilities, bioswales and stream restoration projects were calculated using costs from completed local projects within the State of Maryland. Several projects involving different facilities, different design approaches, and different municipalities or agencies were averaged together to calculate a construction cost based on a design measure. Several SWM pond projects were averaged together to estimate a cost of just over $3 per cubic feet of storage volume provided. Bioretention facilities were estimated to be $49.95 per square foot of surface area in the facility provided. Bioswales were estimated to be $218.63 per linear foot of the proposed facility.

A total of five active or completed stream restoration projects were averaged together resulting in a cost of $780.00 per linear foot of restoration for construction. This amount includes all construction costs including erosion and sediment control. Costs of design and permitting would be additional and typically run 20 percent of the construction costs. The projects, ranged from 700 to 5,500 feet of restoration. RSC practices were estimated to be the same cost per linear foot as stream restoration. The CAST model includes a cost breakdown on the basis of drainage area treated. Cost analysis using the values from CAST were deemed to underestimate costs on smaller SWM ponds. Because of this, the CAST model cost projections were not used in this assessment. Detailed cost breakdown for the proposed BMPs and proposed retrofits can be found in Appendix E.

Table 21 summarizes the cost analysis for the stream restoration reaches. Average values of existing nutrient and sediment loads per linear foot calculated from the Expert Panel recommendations were used to create a cost per pound removed. The results in this table can assist the County in the prioritization process by highlighting the most efficient stream restoration projects available. Table 22 summarizes the overall project costs based on the proposed project and facility type. A detailed breakdown of the cost/lb of pollutant for proposed new BMPs and retrofit BMPs can be found in appendix G.

Table 21 - Stream Restoration Cost Breakdown

Reach	Length (LF)	Cost/LF*	Project Cost	Cost/ lb of TSS Removed	Cost/lb of N Removed	Cost/lb of P Removed
Bynum Run @ Newport Drive	520	$ 780.00	$ 405,600	$ 36.60	$ 5,811.23	$ 12,618.66
Bynum Run @ MD-23	2,133	$ 780.00	$ 1,663,740	$ 23.76	$ 3,772.44	$ 8,191.59
Unnamed Tributary @ Melrose Lane	2,247	$ 780.00	$ 1,752,660	$ 50.57	$ 8,029.13	$ 17,434.69
Unnamed Tributary @ Switchman Drive	429	$ 780.00	$ 334,620	$ 15.04	$ 2,387.79	$ 5,184.92
Unnamed Tributary @ Pipercove Way	1,040	$ 780.00	$ 811,200	$ 38.65	$ 6,136.50	$ 13,324.96
Unnamed Tributary @ Broadway	2,298	$ 780.00	$ 1,792,440	$ 12.74	$ 2,023.06	$ 4,392.93
Unnamed Tributary @ Rockfield Park	2,453	$ 780.00	$ 1,913,340	$ 26.00	$ 4,127.67	$ 8,962.94
Unnamed Tributary @ Frogleap Way	780	$ 780.00	$ 608,400	$ 26.02	$ 4,131.64	$ 8,971.57
Unnamed Tributary @ Centreville Way	1,975	$ 780.00	$ 1,540,500	$ 22.53	$ 3,577.75	$ 7,768.84
Unnamed Tributary @ Bel Air Bypass	2,306	$ 780.00	$ 1,798,680	$ 51.16	$ 8,122.06	$ 17,636.48
Bynum Run @ Blake's Venture Park	2,469	$ 780.00	$ 1,925,820	$ 30.83	$ 4,894.51	$ 10,628.08
Unnamed Tributary @ MD 543	3,722	$ 780.00	$ 2,903,160	$ 29.47	$ 4,678.36	$ 10,158.73
Unnamed Tributary @ MD-22	1,223	$ 780.00	$ 953,940	$ 21.00	$ 3,334.66	$ 7,240.97
Bynum Run @ Moores Mill Road	2,331	$ 780.00	$ 1,818,180	$ 49.43	$ 7,848.29	$ 17,042.00
Bynum Run @ Harford Detention Center	727	$ 780.00	$ 567,060	$ 21.24	$ 3,372.90	$ 7,324.02
Total/Average:	**26,651**		**$ 20,789,340.00**	**$ 30.34**	**$ 4,816.53**	**$ 10,458.76**
***I**ncludes all construction costs including erosion and sediment control. Design and Permitting are not included.						

Table 22 - Overall Proposed BMP Cost Estimate

Proposed BMP	Total Cost
Bioretention	$ 1,415,949
Bioswale	$ 341,063
RSC	$ 351,000
Stormwater Management Pond	$ 1,674,654
Proposed BMP Total Cost	**$ 3,509,666**
Proposed Retrofits	
Bioretention	$ 719,118
Dry Extended Detention Ponds	$ 3,262,149
Standard Stormwater Treatment	$ 56,867
Wet Ponds	$ 1,236,508
Proposed Retrofits Total Cost	**$ 5,274,642**
Proposed Stream Restoration	**$ 20,789,340**
Total Project Costs	**$ 29,846,648**

4.0 FUNDING AND TECHNICAL ASSISTANCE

4.1 POTENTIAL FUNDING SOURCES

The overall cost of all proposed projects within the watershed is estimated at nearly $30 million. The proposed fiscal year 2019 capital budget for all of Harford County includes a total of $11.44 million for Stormwater Management Projects. The proposed six-year capital improvement program for stormwater management in Harford County remains relatively consistent at a yearly budget at approximately $11 million. Based on the County Budget for 2019, a little over half of that amount will come from County Bonds. State sources are the second largest contributor to the budget. The remaining budget is filled with federal, developer and other sources of funding for these projects, including short-term funding mechanisms such as grants, loans, and sale of bonds (Harford County, 2018). The County budget includes all the watershed projects within Harford County and is not specifically designated solely to projects within the Upper Bynum Run watershed. The schedule and yearly budget for these recommended projects are set up to stay within the County Budget as it exists now. Funding from outside the County or an expansion of the County budget for SWM projects could allow the proposed projects to be completed in a shorter timeframe.

Several innovative funding techniques may also be considered by the County to implement the recommended projects. A cost sharing approach with other municipalities, including the Town of Bel Air, or agencies outside the County, such as the Maryland Department of Transportation – State Highway Administration (MDOT-SHA), may be an option. This approach would most likely require a credit sharing system to be set up with the cost-sharing entity that is also seeking to obtain TMDL credits in this watershed.

Full delivery banking projects, which would involve the County working with a restoration or nutrient credit trading banking firm to purchase sediment, nutrient and impervious surface treatment credits from is a second option. The banking firm would be responsible for every aspect of the project including acquiring easements to a site, performing assessments, developing the design, obtaining permits, constructing, and monitoring the site for compliance with the permits to ensure estimated credits are available for purchase. Under this scenario, the County could pay the banking firm incrementally for the anticipated credits as significant milestones are met, with final payment based on the total credits purchased.

The County may also want to implement the projects using a design-build scenario, where a conceptual design by the County or their consultant is advertised for bidding by a design-build team. The design-build team would be responsible for taking the project from concept to final design, obtain the permits, construct the project, and provide as-built surveys.

A final funding scenario may include the County teaming with a private developer, corporation or stakeholder group to form a public-private partnership (P3) to implement projects. The advantages of the full delivery, design-build, and P3 scenarios to the County is that they can reduce time and costs of project implementation, as well as the oversight costs on the County, especially on stream restoration projects which typically require more capital costs and funding years than SWM projects, but yield greater load reduction credits per unit constructed.

4.2 TECHNICAL ASSISTANCE

The County employs a team of managers, engineers, and scientists to assist in running the Watershed Protection and Restoration program. These employees have extensive experience regarding the projects that are proposed in this watershed assessment. The County also relies on the private sector to provide design and consulting expertise to prepare watershed assessment recommendations, develop designs, acquire permits, assist in construction consultation, and to monitor and report on implemented projects. The County also hires qualified contractors to construct watershed restoration projects. Technical assistance required to implement recommended projects will be a considerable task and will involve a combination of County staff and private consultants and contractors to complete the restoration efforts.

5.0 IMPLEMENTATION SCHEDULE

An evaluation of the recommended projects was completed to develop a proposed implementation schedule. The projects with the highest cost/benefit ratio were given highest priority. Generally, this equates to awarding the highest priority to projects with the lowest cost per lb of credit achieved. This priority consideration was not the only approach used to develop the schedule Projects were also prioritized based on knowledge of County planning, stormwater management, and stream restoration projects being located adjacent to ongoing capital improvement projects. BMP and Stream Restoration projects adjacent to each other were also grouped together so they could be completed together to save design and construction costs for individual projects.

The projects were scheduled over a 10 yr period with the first projects getting underway in fiscal year 2019. It should be noted that several of these projects are not going to be able to be completed in a single fiscal year. The projects were also grouped in a way that the overall construction costs in each year were nearly equal. Another factor considered when prioritizing projects is the severity and correctability of the project. Streams or existing BMPs in poor condition were given priority over streams that may be able to sustain themselves for a few years. Similarly, existing BMPs with failing risers or embankment issues were given priority over BMPs in better condition. The schedule is set only for the year that the project will kick off, and not for the overall project completion which could take several years. Table 23 provides a summary of the number of projects, and costs associated with each year of the implementation schedule. A detailed breakdown of the priority ranking and the scheduled fiscal year estimates can be found in Appendix G.

Table 23 - Implementation Schedule Summary

Fiscal Year	Number of Proposed Projects	Proposed N Removal (lbs/yr)	Proposed P Removal (lbs/yr)	Proposed Sediment Removal (lbs/yr)	Total Cost of Proposed Projects
2020	12	564.02	200.93	1,969,225	$ 3,149,338
2021	3	521.77	240.29	82,843	$ 3,176,940
2022	6	1238.26	553.08	199,667	$ 3,011,788
2023	6	681.56	295.07	733,182	$ 3,243,462
2024	12	808.05	262.40	2,614,825	$ 3,188,246
2025	16	625.80	241.19	1,135,283	$ 2,998,721
2026	7	633.93	263.45	1,005,347	$ 3,153,271
2027	11	361.83	123.78	1,238,534	$ 2,856,927
2028	25	194.54	54.16	678,790	$ 2,421,472
2029	17	458.99	206.72	73,707	$ 2,646,484
Totals	**115**	**6,088.75**	**2,441.07**	**9,731,403**	**$ 29,846,648**

6.0 EDUCATION AND OUTREACH

Public outreach is an important part to watershed management. The public has direct and indirect impacts on various factors that affect watershed and stream health. Direct impacts may include volunteering for stream cleanups, disconnecting roof drains from the storm drain system, and maintaining existing SWM facilities. Indirect impacts are spreading knowledge to friends, watershed homeowners, and businesses to improve watershed stewardship. Harford County has already reached out through mailed letters to private landowners within the watershed as part of this study. Further outreach may include providing stakeholders within the watershed with a synopsis of the results and recommendations of this watershed plan. Harford County already provides valuable information about current and previously completed watershed assessments and plans on its website.

As part of this project, an online GIS based Story Map is being created. This Story Map can be used to educate the public on the watershed assessment project and steps being taken to improve watershed health. The Story Map can also be set up to gather public comments, suggestions, or problems observed in the watershed.

An additional way to promote outreach and education is through projects with a public outreach component. Projects along public trails, parks and schools are great places to place signage to teach people about improving watershed health. There are currently no stakeholder groups with direct watershed involvement for the Upper Bynum Run project area. Stakeholder groups that could be contacted to help improve watershed conditions may include the local Forest Hill and Bel Air community boards and recreation councils, the Ma and Pa Heritage Trail, Inc. non-profit organization, various Home Owner’s Associations (HOAs), Schools, Churches and Libraries.

7.0 MONITORING AND EVALUATION

7.1 MILESTONE AND EVALUATION CRITERIA FOR PROPOSED STRATEGIES

Milestones for this watershed can be defined by several sources. The TMDL report for the Bynum Run watershed can be used as an indicator on assessing sediment load milestones. The proposed projects in this report will create an approximate 8.2% reduction in overall sediment load reduction. The proposed watershed improvements achieve half of the sediment reduction required for the overall Bynum Run Watershed. The lower portions of the watershed should have sufficient project sites to meet the TMDL goals set forth by the EPA. The proposed implementation schedule can also be used as a base for the project milestones and evaluation of watershed restoration. The proposed projects follow a project start schedule for a given fiscal year. If all of the proposed projects are not started within the proposed fiscal year, progress of the watershed restoration may be delayed and overall targets and schedules will need to be reassessed.

7.2 WATER QUALITY MONITORING

Water Quality Monitoring will not be a direct action as part of this watershed plan. Watershed stakeholders, research organizations, or government agencies may have an interest in water quality monitoring to compare pre- and post-restoration conditions. Organizations such as these may be able to provide water quality monitoring for specific projects as part of this watershed assessment. There have been six (6) MBSS monitoring sites within the watershed in past years. The MBSS program may want to consider monitoring at these same stations again during future year monitoring efforts following implementation of projects to compare the results of those sampling efforts with previous sampling efforts to monitor progress and changes in overall stream health from the implemented projects. These MBSS sampling locations may be the most consistent and reliable source of water quality data within the watershed.

7.3 INSPECTIONS AND MAINTENANCE

Regular maintenance and inspections are required for any stormwater management or stream restoration project. Stormwater management facilities require maintenance to remove any debris or excess vegetation that may be clogging outlet or discharge features. SWM facilities should also be inspected regularly for possible failures in the riser structure, discharge pipes, embankments and inflow pipes. Stream restoration projects require more extensive inspections and monitoring. Restoration projects are monitored for changes in the design parameters as natural stream channel changes occur. Monitoring of stream cross sections and profiles should be completed following the construction of the project and periodically after the restoration for a period determined in permit requirements. As part of a stream restoration project, the proposed riprarian vegetation should also be monitored to make sure that it is establishing as designed. If issues are identified during the monitoring periods, maintenance or remediation may be needed to address items associated with the restored stream.

8.0 CONCLUSION

In conclusion, implementation of the proposed projects will result in a healthier Upper Bynum Run Watershed. The proposed new BMP and proposed retrofit BMPs treat a total of 324.4 impervious acres. This is 21.7% of the total 1,496.5 acres in the Upper Bynum Run watershed. Completing all proposed projects in this report would meet Harford County's NPDES MS4 permit requirements for impervious area treated in the upper Bynum Run watershed. The NPDES MS4 permit covers all of Harford County so additional work would still need to be completed outside of this watershed to satisfy permit requirements. The combination of the proposed new BMPs, retrofit BMPs and stream restoration projects achieve a reduction of 8.2% of the sediment load for the entire Bynum Run watershed. The proposed projects exceed the halfway point in achieving the local sediment TMDL. Further evaluation of the downstream portions of the Bynum Run watershed will most likely present projects with enough treatment credit to achieve the overall local sediment TMDL goals.

The proposed projects work in collaboration with each other. Proposed and retrofit BMP projects limit runoff peak discharges, runoff quantities, and reduce nutrients and sediments from entering stream channels. Stream restoration brings natural processes back to stream channels. These natural processes with well-connected and active floodplains reduce concentrated flows within stream channels, allow flood waters to infiltrate into riparian floodplains, and promote groundwater interactions. Implementation of all of the proposed projects over time can significantly limit nutrient and sediment runoff in the watershed to improve stream quality on the downstream portions of Bynum Run and the Chesapeake Bay.

9.0 REFERENCES

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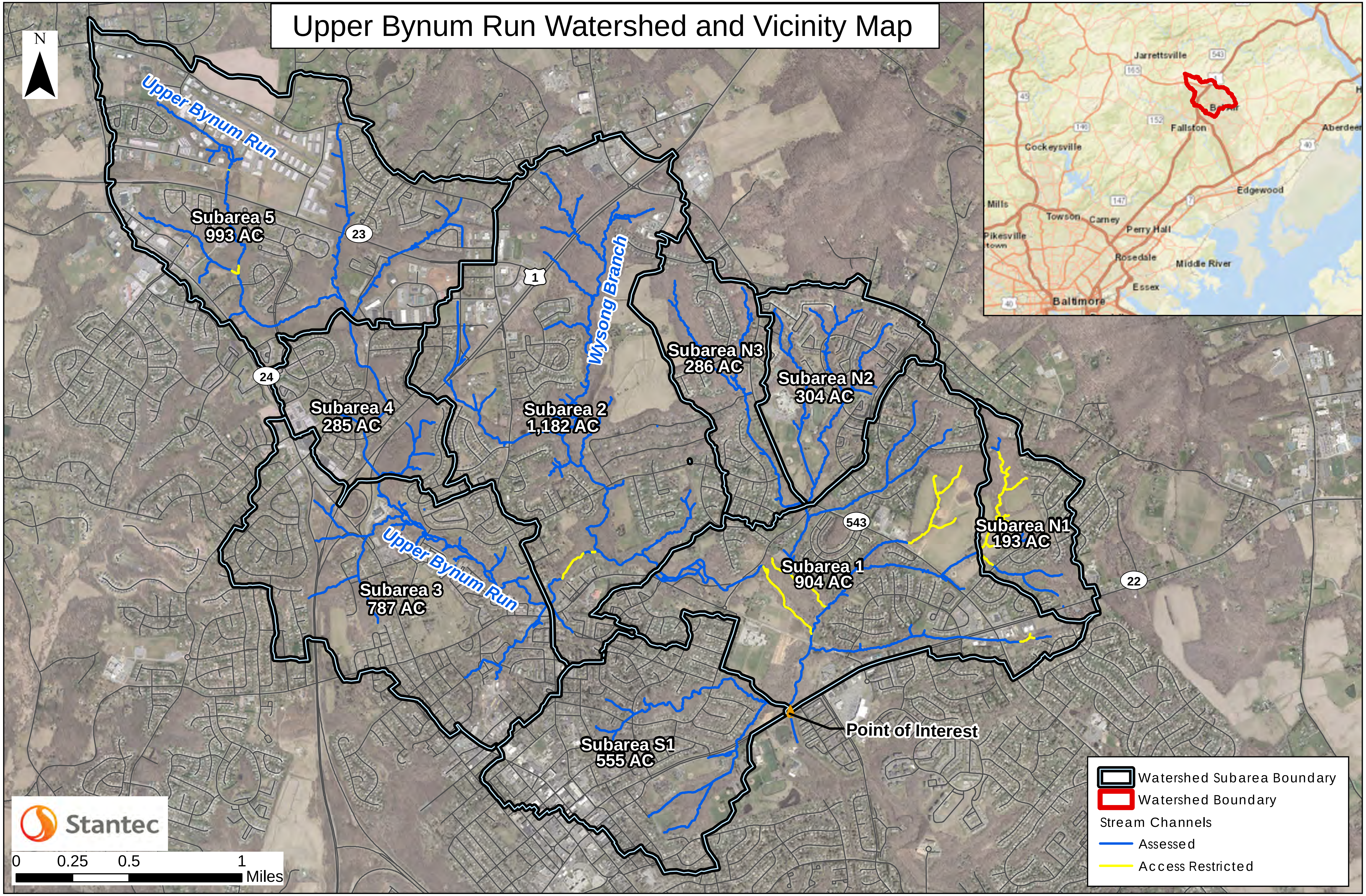
Appendix A

A.1 UPPER BYNUM RUN WATERSHED MAP

Map A.1


Upper Bynum Run Watershed and Vicinity Map
N
Upper Bynum Run
Subarea 5
993 AC
23
Wysong Branch
1
Subarea N3
286 AC
Subarea N2
304 AC
24
Subarea 4
285 AC
Subarea 2
1,182 AC
543
Subarea N1
193 AC
Upper Bynum Run
Subarea 1
904 AC
Subarea 3
787 AC
22
Point of Interest
Subarea S1
555 AC
Jarrettsville
Fallston
Aberdeen
Cockeysville
Edgewood
Mills
Towson
Carney
Perry Hall
Pikesville
Rosedale
Middle River
Essex
Baltimore
Watershed Subarea Boundary
Watershed Boundary
Stream Channels
Assessed
Access Restricted
Stantec
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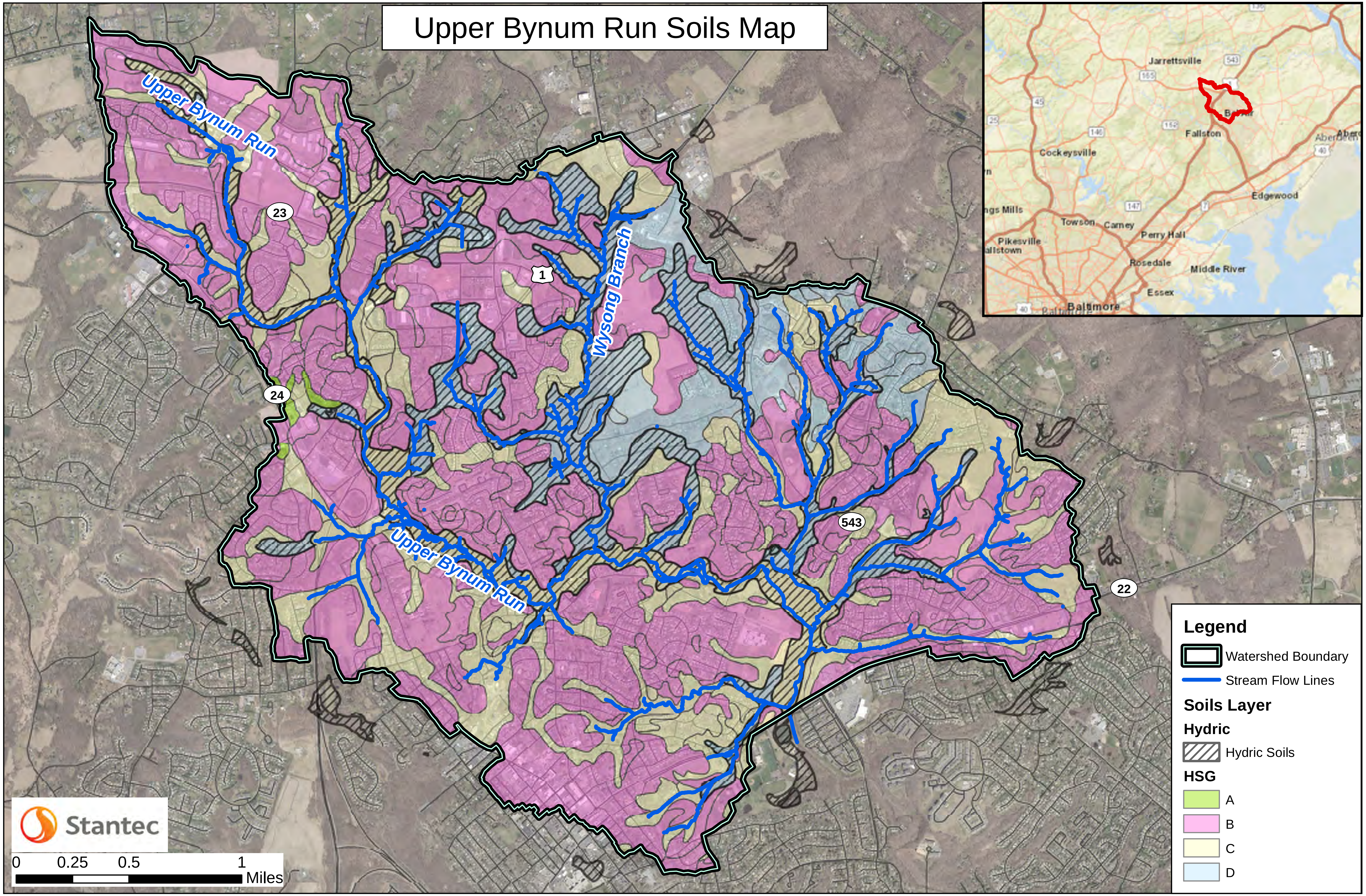
A.2 UPPER BYNUM RUN SOIL MAP

MAP A.2



Upper Bynum Run Soils Map
Upper Bynum Run
Wysong Branch
Upper Bynum Run
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Jarrettsville
Fallston
Cockeysville
Edgewood
Towson
Carney
Perry Hall
Pikesville
Rosedale
Middle River
Essex
Baltimore
Legend
Watershed Boundary
Stream Flow Lines
Soils Layer
Hydric
Hydric Soils
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C
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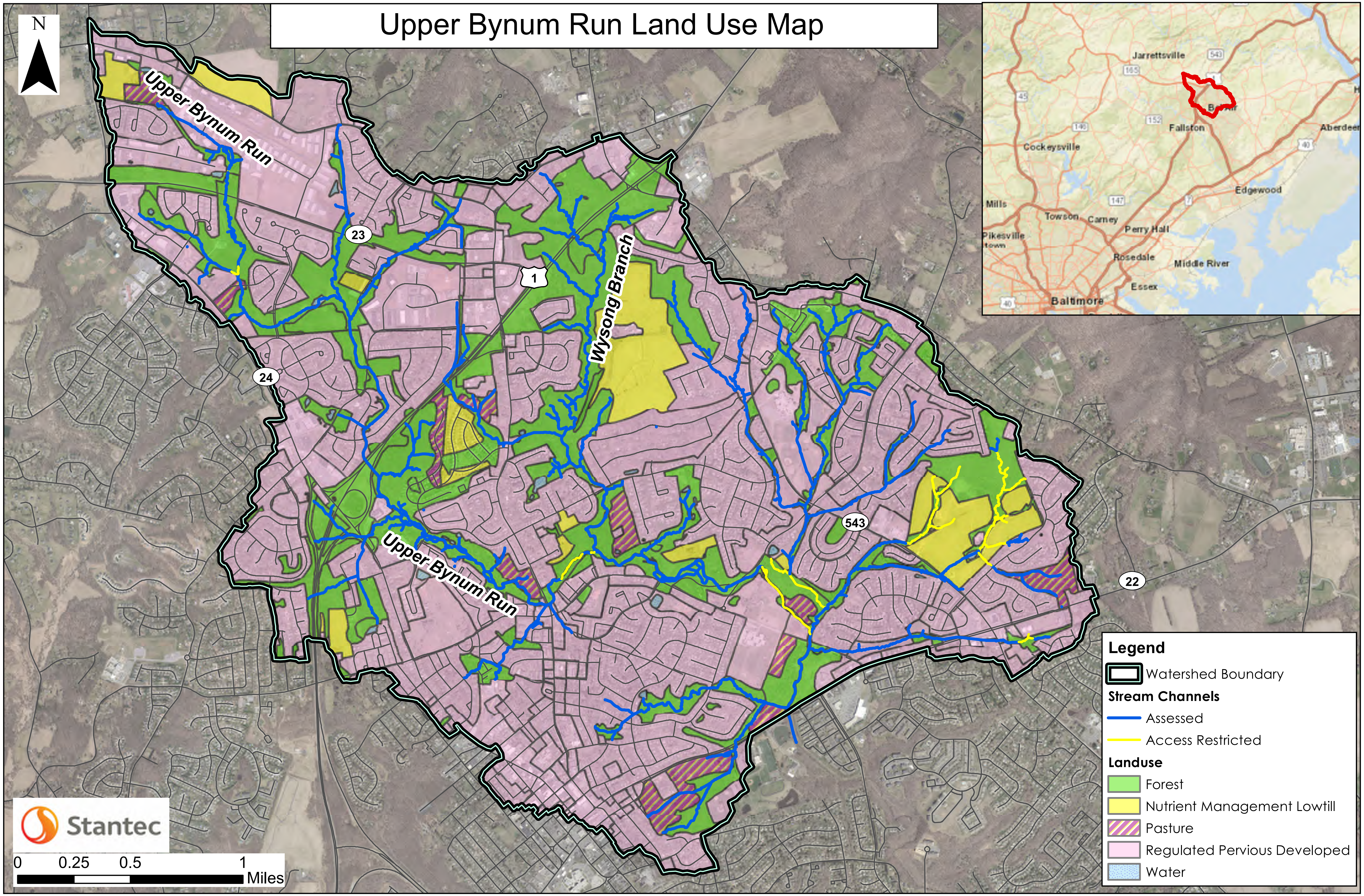
A.3 UPPER BYNUM RUN LAND USE MAP

MAP A.3



Upper Bynum Run Land Use Map
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Upper Bynum Run
Wysong Branch
Upper Bynum Run
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Jarrettsville
Fallston
Cockeysville
Aberdeen
Edgewood
Mills
Towson
Carney
Perry Hall
Pikesville
Rosedale
Middle River
Essex
Baltimore
Legend
Watershed Boundary
Stream Channels
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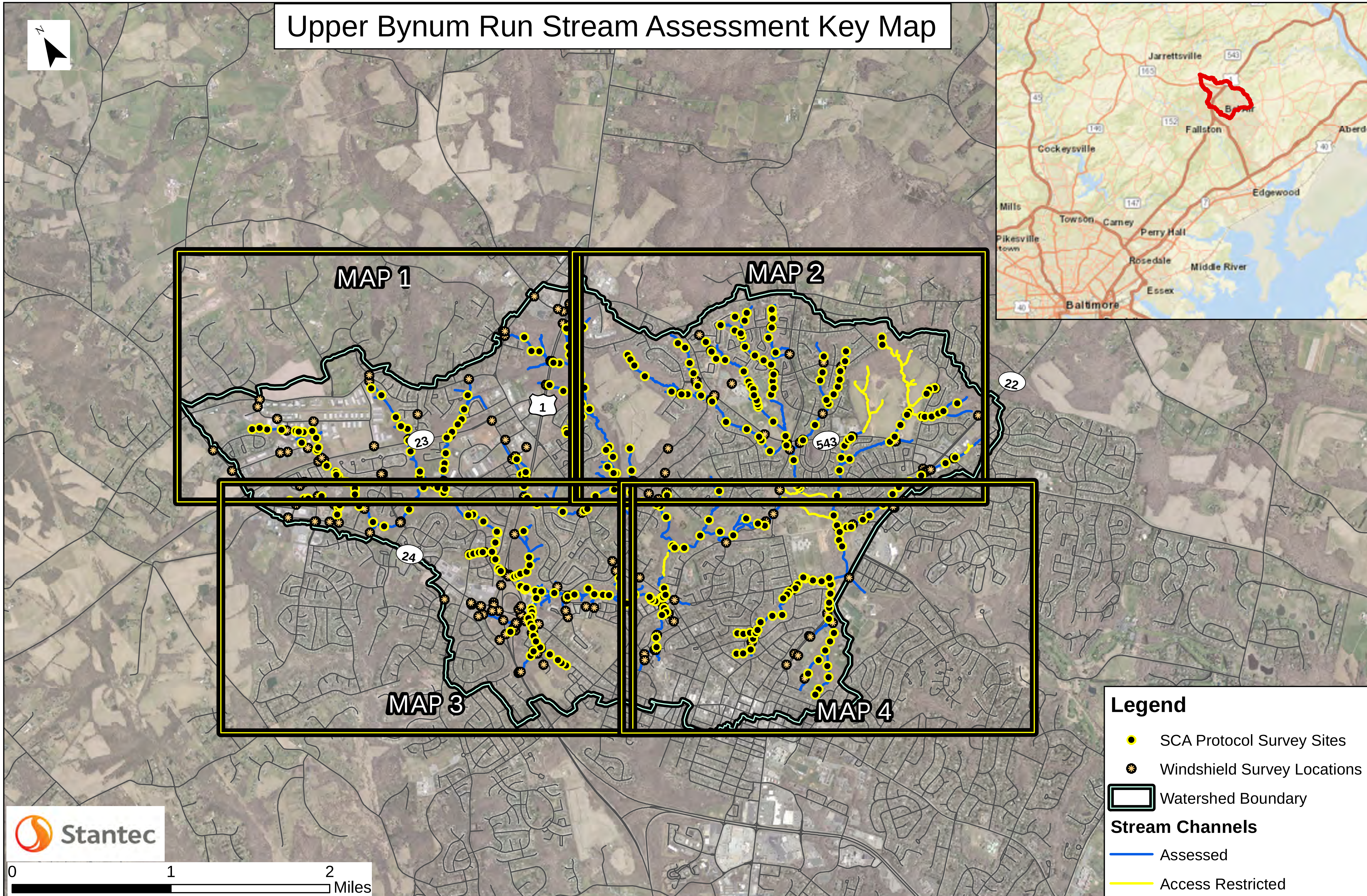
A.4 STREAM ASSESSMENT MAP

MAP A.4


Upper Bynum Run Stream Assessment Key Map
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MAP 2
MAP 3
MAP 4
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Jarrettsville
Fallston
Aberdeen
Cockeysville
Edgewood
Towson
Carney
Perry Hall
Pikesville
Rosedale
Middle River
Essex
Baltimore
Legend
SCA Protocol Survey Sites
Windshield Survey Locations
Watershed Boundary
Stream Channels
Assessed
Access Restricted
Stantec
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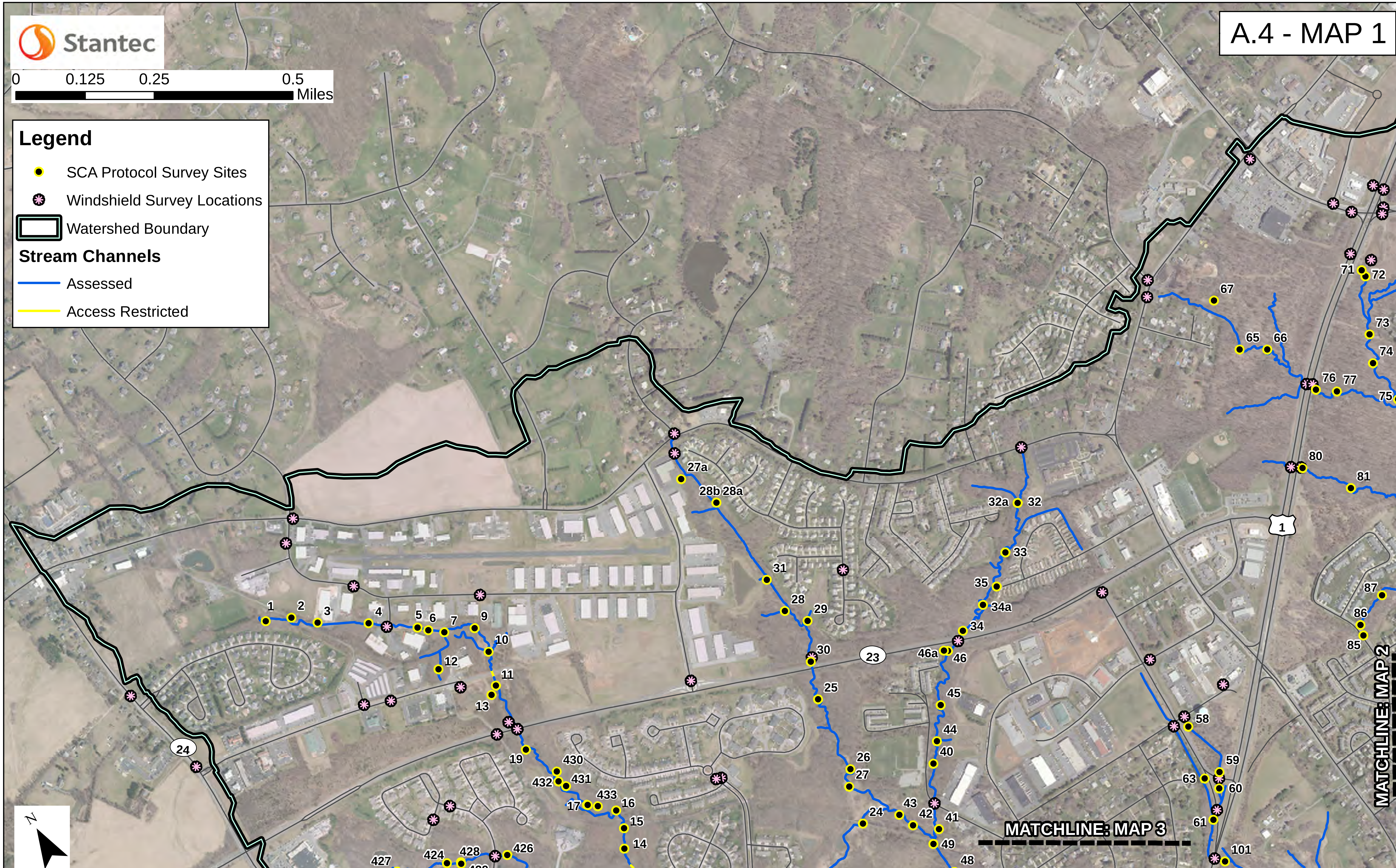
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A.4 - MAP 1
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SCA Protocol Survey Sites
Windshield Survey Locations
Watershed Boundary
Stream Channels
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MATCHLINE: MAP 2
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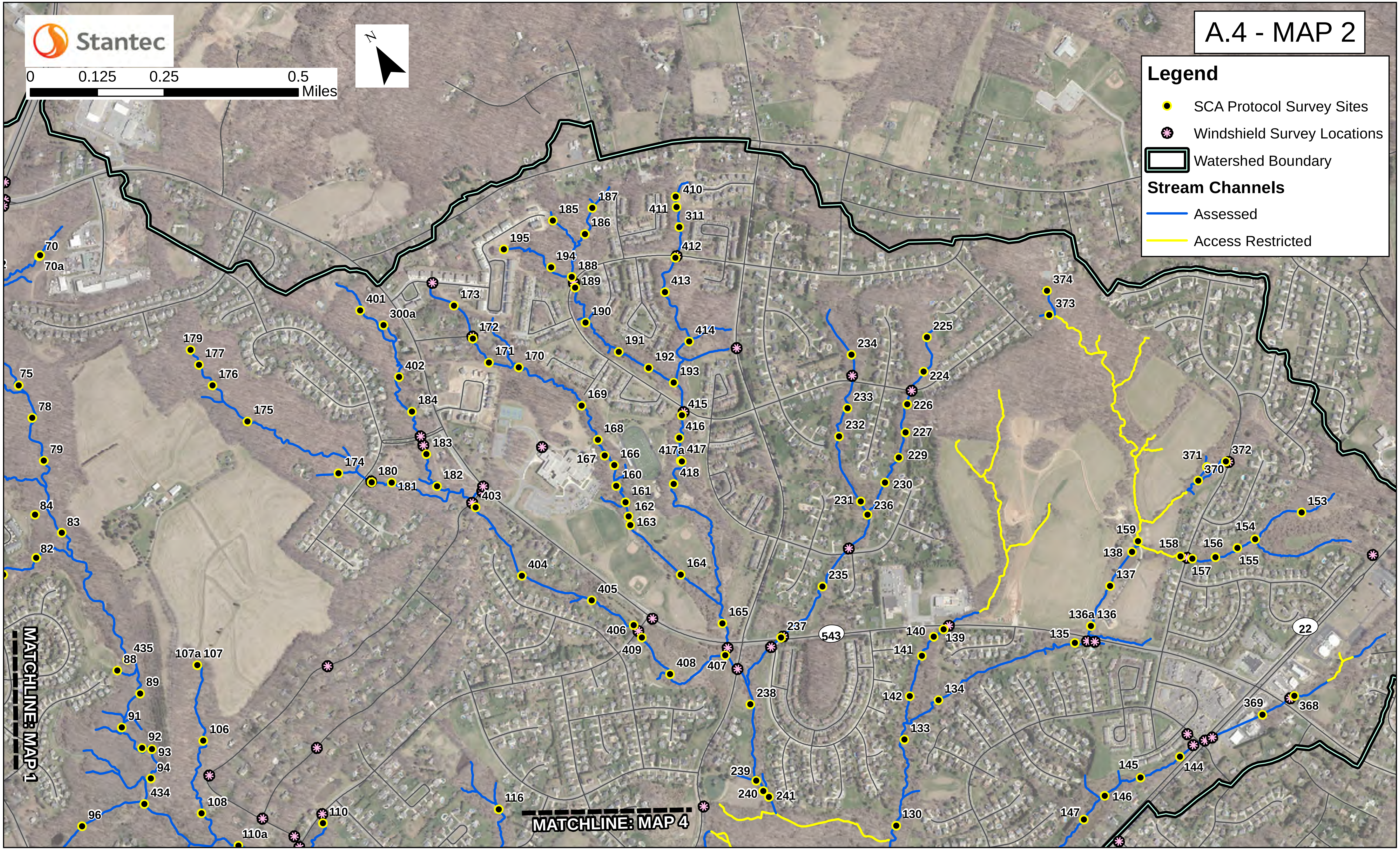
A.4 - MAP 2
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Watershed Boundary
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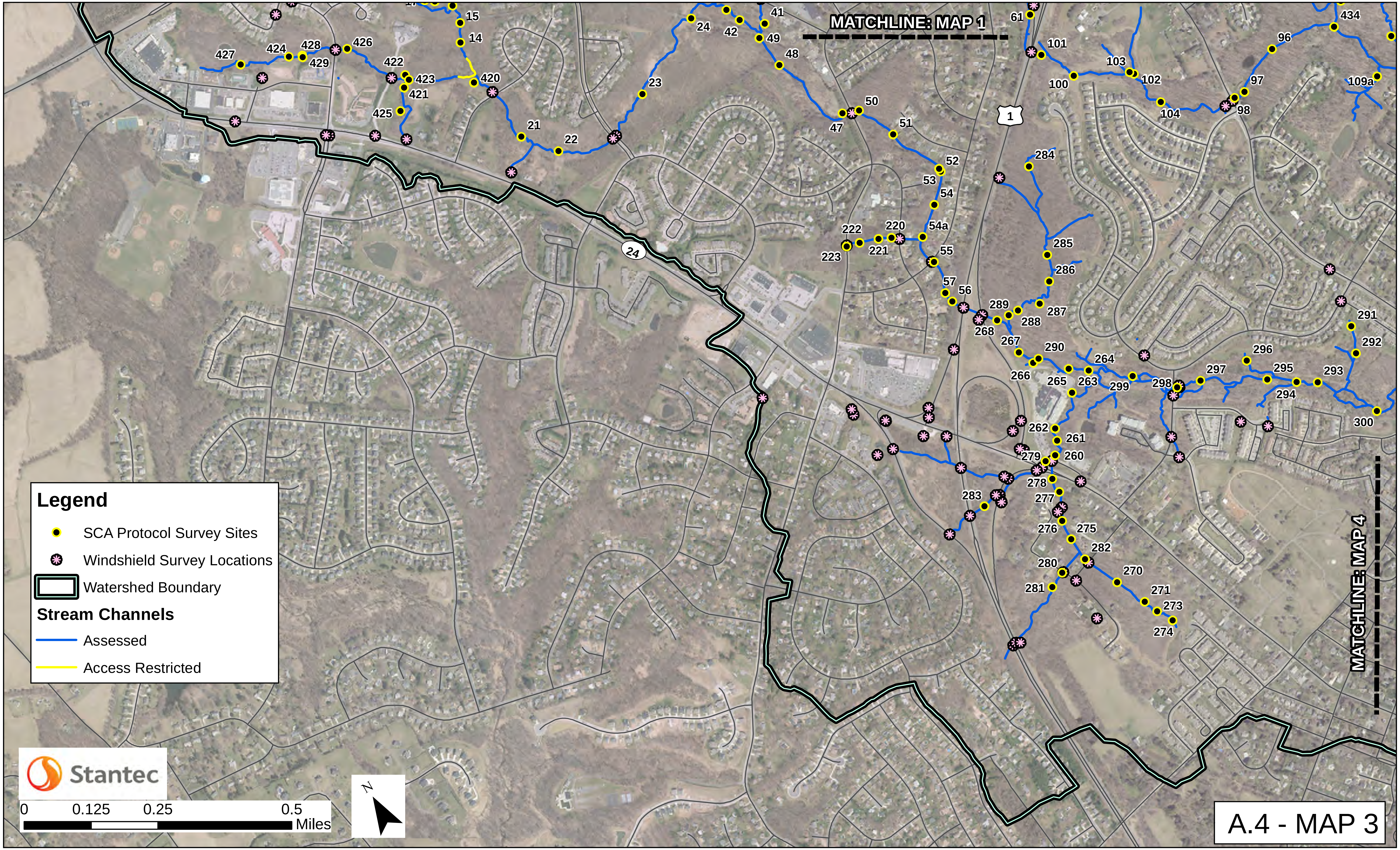

MATCHLINE: MAP 1
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SCA Protocol Survey Sites
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Watershed Boundary
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A.4 - MAP 3


A.4 - MAP 4
MATCHLINE: MAP 2
MATCHLINE: MAP 3
Legend
SCA Protocol Survey Sites
Windshield Survey Locations
Watershed Boundary
Stream Channels
Assessed
Access Restricted
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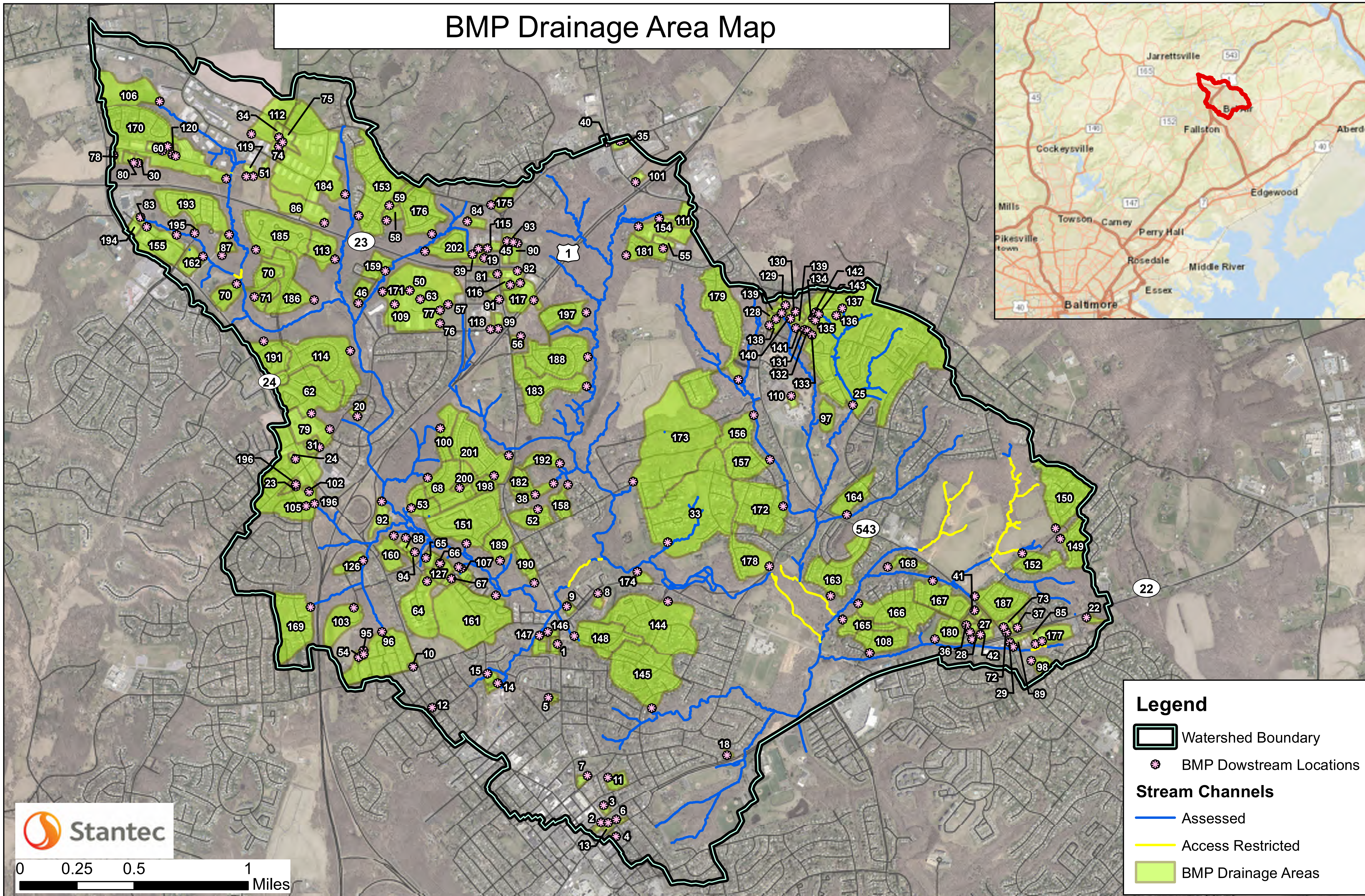
A.5 EXISTING BMP DRAINAGE AREA MAP

MAP A.5


BMP Drainage Area Map
Legend
Watershed Boundary
BMP Dowstream Locations
Stream Channels
Assessed
Access Restricted
BMP Drainage Areas
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Miles
Stantec
Jarrettsville
Fallston
Cockeysville
Aberdeen
Edgewood
Towson
Carney
Perry Hall
Pikesville
Rosedale
Middle River
Essex
Baltimore
Mills

Appendix B

B.1 EXISTING BMP SUMMARY TABLE

BMP Number*	Subarea	BMP Type for BayFAST	Drainage Area (ac)
1	Subarea 3	Bioretention/raingardens - underdrain	1.75
2	Subarea S1	Stormwater Management by Era 1985 to 2002 MD	1.03
3	Subarea S1	Stormwater Management by Era 1985 to 2002 MD	0.86
4	Subarea S1	Stormwater Management by Era 1985 to 2002 MD	0.45
5	Subarea 3	Stormwater Management by Era 1985 to 2002 MD	0.87
6	Subarea S1	Infiltration Practices w/o Sand, Veg no underdrain	0.57
7	Subarea S1	Stormwater Management by Era 1985 to 2002 MD	1.35
8	Subarea 2	Stormwater Management by Era 1985 to 2002 MD	1.53
9	Subarea 2	Infiltration Practices w/ Sand, Veg no underdrain	1.36
10	Subarea 3	Stormwater Management by Era 1985 to 2002 MD	0.53
11	Subarea S1	Infiltration Practices w/o Sand, Veg no underdrain	3.58
12	Subarea 3	Infiltration Practices w/ Sand, Veg no underdrain	0.43
13	Subarea S1	Stormwater Management by Era 1985 to 2002 MD	0.90
14	Subarea 3	Dry Extended Detention Pond	1.45
15	Subarea 3	Dry Extended Detention Pond	1.84
18	Subarea S1	Bioretention/raingardens - underdrain	0.63
19	Subarea 5	Stormwater Management by Era 1985 to 2002 MD	1.13
20	Subarea 4	Dry Extended Detention Pond	2.01
22	Subarea N1	Stormwater Management by Era 1985 to 2002 MD	1.59
23	Subarea 3	Dry Extended Detention Pond	1.54
24	Subarea 3	Stormwater Management by Era 1985 to 2002 MD	0.73
25	Subarea N2	Dry Extended Detention Pond	149.12
27	Subarea 1	Stormwater Management by Era 1985 to 2002 MD	1.95
28	Subarea 1	Stormwater Management by Era 1985 to 2002 MD	0.95
29	Subarea 1	Stormwater Management by Era 1985 to 2002 MD	1.33
30	Subarea 5	Dry Extended Detention Pond	1.01
31	Subarea 3	Dry Extended Detention Pond	2.89
33	Subarea 2	Dry Extended Detention Pond	73.95
34	Subarea 5	Dry Extended Detention Pond	1.37
35	Subarea 2	Stormwater Management by Era 1985 to 2002 MD	1.94
36	Subarea 1	Dry Extended Detention Pond	0.96
37	Subarea 1	Stormwater Management by Era 1985 to 2002 MD	1.93
38	Subarea 2	Dry Extended Detention Pond	2.32
39	Subarea 5	Stormwater Management by Era 1985 to 2002 MD	1.58
40	Subarea 2	Stormwater Management by Era 1985 to 2002 MD	0.38

BMP Number*	Subarea	BMP Type for BayFAST	Drainage Area (ac)
41	Subarea 1	Vegetated Open Channel no underdrain	0.93
42	Subarea 1	Stormwater Management by Era 1985 to 2002 MD	1.55
43	Subarea 1	Stormwater Management by Era 1985 to 2002 MD	0.82
45	Subarea 2	Stormwater Management by Era 1985 to 2002 MD	2.72
46	Subarea 5	Infiltration Practices w/ Sand, Veg no underdrain	3.77
47	Subarea 3	Stormwater Management by Era 1985 to 2002 MD	0.68
50	Subarea 5	Infiltration Practices w/ Sand, Veg no underdrain	0.78
51	Subarea 5	Infiltration Practices w/ Sand, Veg no underdrain	2.32
52	Subarea 2	Dry Extended Detention Pond	9.29
53	Subarea 3	Dry Extended Detention Pond	8.94
54	Subarea 3	Bioretention/raingardens - underdrain	0.68
55	Subarea 2	Infiltration Practices w/ Sand, Veg no underdrain	2.30
56	Subarea 2	Stormwater Management by Era 2002 to 2010 MD	2.09
57	Subarea 5	Infiltration Practices w/ Sand, Veg no underdrain	0.96
58	Subarea 5	Dry Extended Detention Pond	3.24
59	Subarea 5	Dry Extended Detention Pond	2.93
60	Subarea 5	Infiltration Practices w/ Sand, Veg no underdrain	1.83
62	Subarea 4	Wet Pond and Wetland	28.21
63	Subarea 5	Infiltration Practices w/ Sand, Veg no underdrain	1.74
64	Subarea 3	Dry Extended Detention Pond	20.07
65	Subarea 3	Dry Extended Detention Pond	2.35
66	Subarea 3	Stormwater Management by Era 1985 to 2002 MD	0.88
67	Subarea 3	Stormwater Management by Era 1985 to 2002 MD	1.16
68	Subarea 4	Dry Extended Detention Pond	17.98
69	Subarea 5	Stormwater Management by Era 1985 to 2002 MD	0.93
70	Subarea 5	Dry Extended Detention Pond	14.40
71	Subarea 5	Dry Extended Detention Pond	5.74
72	Subarea 1	Stormwater Management by Era 2002 to 2010 MD	0.68
73	Subarea 1	Stormwater Management by Era 1985 to 2002 MD	1.69
74	Subarea 5	Dry Extended Detention Pond	2.17
75	Subarea 5	Dry Extended Detention Pond	3.28
76	Subarea 5	Infiltration Practices w/o Sand, Veg no underdrain	1.86
77	Subarea 5	Stormwater Management by Era 1985 to 2002 MD	1.26
78	Subarea 5	Stormwater Management by Era 1985 to 2002 MD	0.95
79	Subarea 4	Infiltration Practices w/ Sand, Veg no underdrain	12.61
80	Subarea 5	Infiltration Practices w/ Sand, Veg no underdrain	1.51
81	Subarea 2	Vegetated Open Channel no underdrain	0.80
82	Subarea 2	Infiltration Practices w/ Sand, Veg no underdrain	1.19
83	Subarea 5	Infiltration Practices w/ Sand, Veg no underdrain	0.56

BMP Number*	Subarea	BMP Type for BayFAST	Drainage Area (ac)
84	Subarea 5	Stormwater Management by Era 1985 to 2002 MD	2.38
85	Subarea 1	Infiltration Practices w/ Sand, Veg no underdrain	1.02
86	Subarea 5	Dry Extended Detention Pond	13.61
87	Subarea 5	Dry Extended Detention Pond	3.44
88	Subarea 3	Dry Extended Detention Pond	1.65
89	Subarea 1	Infiltration Practices w/ Sand, Veg no underdrain	0.33
90	Subarea 2	Stormwater Management by Era 1985 to 2002 MD	2.36
91	Subarea 2	Infiltration Practices w/ Sand, Veg no underdrain	0.97
92	Subarea 3	Dry Extended Detention Pond	5.21
93	Subarea 2	Infiltration Practices w/o Sand, Veg no underdrain	0.59
94	Subarea 3	Infiltration Practices w/ Sand, Veg no underdrain	1.16
95	Subarea 3	Bioretention/raingardens - underdrain	0.33
96	Subarea 3	Wet Pond and Wetland	29.32
97	Subarea N2	Dry Extended Detention Pond	5.11
98	Subarea 1	Dry Extended Detention Pond	3.39
99	Subarea 2	Vegetated Open Channel no underdrain	1.39
100	Subarea 4	Wet Pond and Wetland	9.63
101	Subarea 2	Infiltration Practices w/ Sand, Veg no underdrain	1.29
102	Subarea 3	Bioretention/raingardens - underdrain	0.56
103	Subarea 3	Stormwater Management by Era 1985 to 2002 MD	12.85
105	Subarea 3	Bioretention/raingardens - underdrain	1.89
106	Subarea 5	Dry Extended Detention Pond	18.25
107	Subarea 3	Dry Extended Detention Pond	2.17
108	Subarea 1	Dry Extended Detention Pond	12.14
109	Subarea 5	Dry Extended Detention Pond	2.88
110	Subarea N2	Stormwater Management by Era 1985 to 2002 MD	1.42
111	Subarea 2	Stormwater Management by Era 1985 to 2002 MD	6.02
112	Subarea 5	Wet Pond and Wetland	14.62
113	Subarea 5	Wet Pond and Wetland	10.28
114	Subarea 4	Dry Extended Detention Pond	35.13
115	Subarea 5	Vegetated Open Swale A/B Soils	1.89
116	Subarea 2	Stormwater Management by Era 1985 to 2002 MD	1.32
117	Subarea 2	Dry Extended Detention Pond	10.06
118	Subarea 2	Stormwater Management by Era 1985 to 2002 MD	0.75
119	Subarea 5	Stormwater Management by Era 2002 to 2010 MD	1.45
120	Subarea 5	Vegetated Open Swale A/B Soils	0.78
121	Subarea 5	Stormwater Management by Era 2002 to 2010 MD	0.34
122	Subarea 5	Stormwater Management by Era 2002 to 2010 MD	0.50
123	Subarea 3	Stormwater Management by Era 2002 to 2010 MD	0.35

BMP Number*	Subarea	BMP Type for BayFAST	Drainage Area (ac)
125	Subarea 2	Permeable Pavement with sand and Underdrain	2.36
126	Subarea 3	Wet Pond and Wetland	4.58
127	Subarea 3	Dry Extended Detention Pond	5.54
128	Subarea N2	Wet Pond and Wetland	1.04
129	Subarea N2	Bioretention/raingardens - underdrain	1.21
130	Subarea N2	Bioretention/raingardens - underdrain	1.07
131	Subarea N2	Bioretention/raingardens - underdrain	0.45
132	Subarea N2	Bioretention/raingardens - underdrain	0.87
133	Subarea N2	Bioretention/raingardens - underdrain	0.58
134	Subarea N2	Bioretention/raingardens - underdrain	1.17
135	Subarea N2	Bioretention/raingardens - underdrain	0.69
136	Subarea N2	Bioretention/raingardens - underdrain	1.96
137	Subarea N2	Bioretention/raingardens - underdrain	1.05
138	Subarea N3	Bioretention/raingardens - underdrain	1.81
139	Subarea N2	Wet Pond and Wetland	1.65
140	Subarea N2	Wet Pond and Wetland	1.43
141	Subarea N2	Wet Pond and Wetland	1.25
142	Subarea N2	Wet Pond and Wetland	3.51
143	Subarea N2	Wet Pond and Wetland	6.32
144	Subarea 1	Wet Pond and Wetland	45.95
145	Subarea S1	Wet Pond and Wetland	38.89
146	Subarea 3	Dry Extended Detention Pond	1.27
147	Subarea 3	Dry Extended Detention Pond	2.80
148	Subarea 2	Dry Extended Detention Pond	17.80
149	Subarea N1	Dry Extended Detention Pond	12.15
150	Subarea N1	Dry Extended Detention Pond	27.80
151	Subarea 3	Dry Extended Detention Pond	32.27
152	Subarea N1	Dry Extended Detention Pond	9.73
153	Subarea 5	Dry Extended Detention Pond	34.24
154	Subarea 2	Dry Extended Detention Pond	16.68
155	Subarea 5	Dry Extended Detention Pond	16.32
156	Subarea N3	Dry Extended Detention Pond	10.77
157	Subarea N3	Dry Extended Detention Pond	15.13
158	Subarea 2	Dry Extended Detention Pond	5.37
159	Subarea 5	Dry Extended Detention Pond	6.42
160	Subarea 3	Dry Extended Detention Pond	7.85
161	Subarea 3	Dry Extended Detention Pond	43.50
162	Subarea 5	Dry Extended Detention Pond	5.55
163	Subarea 1	Dry Extended Detention Pond	22.27

BMP Number*	Subarea	BMP Type for BayFAST	Drainage Area (ac)
164	Subarea 1	Dry Extended Detention Pond	10.76
165	Subarea 1	Dry Extended Detention Pond	8.63
166	Subarea 1	Dry Extended Detention Pond	23.83
167	Subarea 1	Dry Extended Detention Pond	16.43
168	Subarea 1	Dry Extended Detention Pond	3.83
169	Subarea 3	Dry Extended Detention Pond	26.15
170	Subarea 5	Dry Extended Detention Pond	53.14
171	Subarea 5	Dry Extended Detention Pond	49.06
172	Subarea N3	Dry Extended Detention Pond	28.07
173	Subarea 2	Wet Pond and Wetland	75.85
174	Subarea 2	Dry Extended Detention Pond	2.03
175	Subarea 5	Dry Extended Detention Pond	4.20
176	Subarea 5	Dry Extended Detention Pond	19.22
177	Subarea 1	Dry Extended Detention Pond	6.44
178	Subarea 1	Dry Extended Detention Pond	15.87
179	Subarea N3	Dry Extended Detention Pond	42.53
180	Subarea 1	Dry Extended Detention Pond	7.29
181	Subarea 2	Dry Extended Detention Pond	9.27
182	Subarea 2	Wet Pond and Wetland	9.95
183	Subarea 2	Dry Extended Detention Pond	23.98
184	Subarea 5	Dry Extended Detention Pond	55.67
185	Subarea 5	Dry Extended Detention Pond	27.20
186	Subarea 5	Dry Extended Detention Pond	19.36
187	Subarea 1	Dry Extended Detention Pond	16.64
188	Subarea 2	Dry Extended Detention Pond	26.65
189	Subarea 3	Dry Extended Detention Pond	10.32
190	Subarea 3	Dry Extended Detention Pond	6.00
191	Subarea 5	Dry Extended Detention Pond	12.78
192	Subarea 2	Dry Extended Detention Pond	4.96
193	Subarea 5	Wet Pond and Wetland	23.04
194	Subarea 5	Dry Extended Detention Pond	2.15
195	Subarea 5	Infiltration Practices w/o Sand, Veg no underdrain	0.61
196	Subarea 3	Wet Pond and Wetland	50.00
197	Subarea 2	Infiltration Practices w/ Sand, Veg no underdrain	11.94
198	Subarea 2	Dry Extended Detention Pond	4.85
200	Subarea 2	Wet Pond and Wetland	4.80
201	Subarea 2	Wet Pond and Wetland	27.11
202	Subarea 5	Dry Extended Detention Pond	11.07
*BMP IDs are not sequentially numbered			

Appendix C

C.1 STREAM ASSESSMENT PROTOCOL SUMMARY TABLES

Erosion Site Summary Table													
Site ID	Subarea	Erosion Type	Erosion Cause	Erosion Length (ft)	Erosion Avg. Height (ft)	Left Bank Land Use	Right Bank Land Use	Threat to Infrastructure	Threat Description	Severity (1=Severe, 5=Minor)	Correctability (1=Best, 5=Worst)	Access (1=Best, 5=Worst)	Erosion Comments
1	1	Downcutting	Land Use Change	200	1.5	Shrubs & Small Trees	Shrubs & Small Trees	no		4	1	1	
5	1	Headcutting	Outfall	50	4	Paved	Forest	no		2	1	1	Head cut area.
5	1	Headcutting	Outfall	50	3	Paved	Forest	no		2	1	1	Main channel head cutting into wider channel from storm water outfall.
7	1	Downcutting	Land Use Change	1000	4	Shrubs & Small Trees	Shrubs & Small Trees	no	Down cutting and widening channel.	2	3	3	
7	1	Unknown	Other	0	0	Other	Other	no					
7	1	Unknown	Other	0	0	Other	Other	no					
14	1	Widening	Land Use Change	200	4	Forest	Forest	no		2	2	1	Eroded bank.
15	1	Widening	Other	200	3	Multiflora Rose	Multiflora Rose	no		1	1	1	
17	1	Widening	Land Use Change	50	3	Shrubs & Small Trees	Shrubs & Small Trees			1	1	1	Erosion cut on outside bend.
17b	1	Widening	Land Use Change	200	2.5	Forest	Forest	no		3	3	3	
22	1	Widening	Land Use Change	300	2	Shrubs & Small Trees	Shrubs & Small Trees	no		2	2	3	Right overbank could have more vegetation and overhead canopy lots of grassy area. Eroded banks with very small channel flowing in just upstream of the point
23	1	Widening	Land Use Change	300	2.5	Forest	Shrubs & Small Trees	no		2	2	3	Right bank fairly open with some large trees. Stream has downcut from historic floodplain
25	1	Downcutting	Bend	200	1	Forest	Shrubs & Small Trees	no		5	1	2	Woody debris jam and erosion
26	1	Downcutting	Land Use Change	300	1.5	Shrubs & Small Trees	Shrubs & Small Trees	no		4	2	3	Left overbank has open area after short distance of shrubs
28	1	Downcutting	Outfall	200	0.5	Shrubs & Small Trees		no		5	1	1	Small tributary on right bank of main stream
28a	1	Downcutting	Bend	300	4	Shrubs & Small Trees	Shrubs & Small Trees	no		3	3	3	Channel much more sinuous than appears on mapping. Actively down cutting
28b	1	Downcutting	Bend	300	4	Shrubs & Small Trees	Shrubs & Small Trees	no		3	3	3	Channel much more sinuous that appears on mapping. Actively down cutting
33	1	Downcutting	Land Use Change	300	1	Shrubs & Small Trees	Shrubs & Small Trees	no		5	2	2	Eroded channel section debris jam upstream
40	1	Downcutting	Land Use Change	300	2	Shrubs & Small Trees	Forest	no		4	2	1	
42	1	Downcutting	Outfall	200	2	Shrubs & Small Trees	Shrubs & Small Trees	no		4	2	1	Erosion is worse towards confluence. Active headcutting from tributary with man made rock dam across the stream (Trib is flow around beaver dam)
46	1	Downcutting	Land Use Change	300	2	Forest	Shrubs & Small Trees	no		4	2	1	
51	4	Downcutting	Road Crossing	200	4	Shrubs & Small Trees	Shrubs & Small Trees	no		3	4	1	Downstream end of confined flow below roadway crossing
54	4	Downcutting	Land Use Change	300	2	Lawn	Shrubs & Small Trees	no		4	2	3	Left bank erosion 3-4 ft on average right bank erosion 0-1 ft on average

Erosion Site Summary Table													
Site ID	Subarea	Erosion Type	Erosion Cause	Erosion Length (ft)	Erosion Avg. Height (ft)	Left Bank Land Use	Right Bank Land Use	Threat to Infrastructure	Threat Description	Severity (1=Severe, 5=Minor)	Correctability (1=Best, 5=Worst)	Access (1=Best, 5=Worst)	Erosion Comments
57	4	Widening	Road Crossing	200	3	Shrubs & Small Trees	Lawn	no		4	1	2	"Bank stabilization by individual property owners at several places along this reach on right overbank.
58	2	Downcutting	Outfall	200	2	Shrubs & Small Trees	Shrubs & Small Trees	no		3	2	1	Channel downstream of roadway culvert very incised and eroded
59	2	Downcutting	Road Crossing	300	2	Shrubs & Small Trees	Shrubs & Small Trees	no		3	2	1	Upstream of oval shaped culvert. Stream downcutting to level of culvert
60	2		Road Crossing	200	2	Shrubs & Small Trees	Shrubs & Small Trees	no		3	2	1	Between 2 highway culvert channel downcutting to culvert inverts.
61	2	Downcutting	Road Crossing	150	2	Shrubs & Small Trees	Shrubs & Small Trees	no		3	3	1	Downstream of culvert crossing under on ramp
65	2	Downcutting	Land Use Change	200	2	Forest	Shrubs & Small Trees	no		4	2	2	Home made dam. Behind houses
66	2	Downcutting	Land Use Change	200	2	Forest	Forest	no		3	3	3	Small stream has a lot of erosion for the size of the stream.
70a	2	Downcutting	Land Use Change	200	2.5	Forest	Forest	no		3	3	2	
72	2	Downcutting	Outfall	100	4	Shrubs & Small Trees	Forest	no		2	4	2	
74	2	Downcutting	Bend	50	5	Forest	Forest	no		2	4	3	Isolated erosion on outside meander
75	2	Headcutting	Bend	40	4	Forest	Forest	no		2	4	4	
81	2	Downcutting	Land Use Change	1000	0.5	Forest	Forest	no		4	2	2	
82	2	Downcutting	Land Use Change	500	2.5	Forest	Shrubs & Small Trees	no		2	2	2	
91	2	Downcutting	Bend	70	4	Forest	Forest	no		3	3	4	
93	2	Downcutting	Bend	60	3.5	Forest	Forest	no		3	3	4	
94	2	Headcutting	Bend	60	3.5	Forest	Forest	no		3	3	2	
96	2	Widening	Land Use Change	200	5	Forest	Forest	no		2	4	4	
97	2	Widening	Land Use Change	600	7	Lawn	Shrubs & Small Trees	yes	House and driveway	1	5	1	
101	2	Downcutting	Outfall	300	1	Forest	Shrubs & Small Trees	no		4	2	2	Downstream end of culvert with plunge pool erosion of stream just downstream
102	2	Downcutting	Land Use Change	200	2	Shrubs & Small Trees	Shrubs & Small Trees	no		3	3	2	Left overbank is reforestation area. Downcutting Channel
104	2	Downcutting	Land Use Change	200	3	Forest	Shrubs & Small Trees	no		2	3	2	Downcutting
106	2	Downcutting	Land Use Change	300	2.5	Forest	Forest	no		4	2	2	Erosion site with downed tree debris jam
107	2	Downcutting	Land Use Change	300	0.5	Forest	Forest	no		5	5	3	Start of channelized flow
107a	2	Downcutting	Land Use Change	300	0.5	Forest	Forest	no		5	5	3	Start of channelized flow
108	2	Downcutting	Land Use Change	300	2	Lawn	Forest	yes	Private fence	3	3	2	Erosion right against private fence

Erosion Site Summary Table													
Site ID	Subarea	Erosion Type	Erosion Cause	Erosion Length (ft)	Erosion Avg. Height (ft)	Left Bank Land Use	Right Bank Land Use	Threat to Infrastructure	Threat Description	Severity (1=Severe, 5=Minor)	Correctability (1=Best, 5=Worst)	Access (1=Best, 5=Worst)	Erosion Comments
110	2	Downcutting	Below Channelization	200	0.5	Forest	Forest	no		5	1	2	Downstream of culvert crossing
110a	2	Downcutting	Land Use Change	300	2	Forest	Forest	no		3	3	3	
113	2	Downcutting	Land Use Change	300	2	Forest	Forest	no		3	3	3	Erosion
114	2	Downcutting	Land Use Change	300	2	Forest	Forest	no		3	2	3	Just above confluence before no access property.
115	2	Headcutting	Land Use Change	300	2.5	Forest	Forest			3	3	3	Just upstream of confluence stream has headcutting down to level of stream below.
116	2	Downcutting	Land Use Change	300	3	Shrubs & Small Trees	Shrubs & Small Trees	no		3	3	2	Possible old sw pond has breached embankment. Newer bio retention entering stream from left bank
117	2	Headcutting	Land Use Change	300	2	Forest	Forest	no		3	3	3	Just upstream of culvert crossing and pond outfall
118	2	Widening	Land Use Change	0	2	Shrubs & Small Trees	Shrubs & Small Trees	no		4	3	3	Needs additional canopy cover. Large backwater pool
119	2	Downcutting	Land Use Change	300	2	Other	Lawn	no		3	3	3	Erosion site with bamboo on left bank man made dam removed downstream
124	1	Downcutting	Road Crossing	300	3	Shrubs & Small Trees	Forest	no		3	3	1	Downstream of roadway crossing
130	1	Widening	Land Use Change	400	3.5	Forest	Shrubs & Small Trees	no		3	3	1	
131	1	Downcutting	Land Use Change	400	4	Forest	Shrubs & Small Trees	no		2	4	3	
133	1	Downcutting	Land Use Change	300	3	Shrubs & Small Trees	Shrubs & Small Trees	no		3	3	1	
134	1	Downcutting	Land Use Change	600	4	Shrubs & Small Trees	Lawn	no		3	3	1	
139	1	Downcutting	Land Use Change	100	3	Shrubs & Small Trees	Paved	yes	Eroding towards paved lot	3	3	1	
141	1	Downcutting	Land Use Change	300	3	Shrubs & Small Trees	Shrubs & Small Trees	no		3	3	2	
144	1	Downcutting	Land Use Change	150	3.5	Shrubs & Small Trees	Shrubs & Small Trees	no		3	3	1	
146	1	Downcutting	Land Use Change	400	3	Shrubs & Small Trees	Shrubs & Small Trees	no		3	3	3	
148	1	Widening	Land Use Change	500	3	Shrubs & Small Trees	Shrubs & Small Trees	no		3	3	2	
155	N1	Downcutting	Land Use Change	200	3	Shrubs & Small Trees	Shrubs & Small Trees	no		3	3	2	
157	N1	Downcutting	Land Use Change	200	4.5	Lawn	Shrubs & Small Trees	no		3	3	1	
159	N1	Downcutting		200	3	Shrubs & Small Trees	Shrubs & Small Trees	no		2	2	1	
160	N2	Downcutting		150	3.5	Shrubs & Small Trees	Shrubs & Small Trees	no		3	3	1	

Erosion Site Summary Table													
Site ID	Subarea	Erosion Type	Erosion Cause	Erosion Length (ft)	Erosion Avg. Height (ft)	Left Bank Land Use	Right Bank Land Use	Threat to Infrastructure	Threat Description	Severity (1=Severe, 5=Minor)	Correctability (1=Best, 5=Worst)	Access (1=Best, 5=Worst)	Erosion Comments
163	N2	Downcutting	Land Use Change	300	3.5	Shrubs & Small Trees	Shrubs & Small Trees	yes	Paved pedestrian crossing being undermined	3	3	1	
164	N2	Downcutting	Land Use Change	300	3	Shrubs & Small Trees	Shrubs & Small Trees	no		3	3	1	
165	N2	Downcutting	Land Use Change	150	3	Shrubs & Small Trees	Shrubs & Small Trees	no		3	3	2	Two 60" concrete culverts beneath Fountain Green Road
166	N2	Downcutting	Land Use Change	200	2.5	Forest	Forest	no		2	2	1	
169	N2	Downcutting	Land Use Change	300	2.5	Forest	Forest	no		3	3	1	
170	N2	Downcutting	Land Use Change	200	3.5	Forest	Forest	no		4	4	2	
173	N2	Downcutting	Land Use Change	150	3.5	Lawn	Forest	no		3	3	1	
175	N3	Downcutting	Land Use Change	50	3.5	Forest	Forest	no		2	2	3	
176	N3	Downcutting	Bend	70	4.5	Forest	Forest			3	3	3	
177	N3	Downcutting	Bend	70	5	Forest	Forest	no		3	3	3	
182	N3	Widening	Land Use Change	100	3	Forest	Forest	no		3	3	2	
183	N3	Downcutting	Land Use Change	200	0	Forest	Forest	no		4	4	2	
184	N3	Downcutting	Land Use Change	200	3.5	Shrubs & Small Trees	Forest	no		3	3	2	
186	N2	Downcutting	Land Use Change	200	4	Forest	Forest	no		3	3	4	
187	N2	Downcutting	Land Use Change	150	3	Forest	Forest	no		3	3	2	Eroded ephemeral channel
189	N2	Downcutting	Land Use Change	200	4	Forest	Shrubs & Small Trees	no		3	3	1	
190	N2	Downcutting	Land Use Change	150	4	Forest	Forest	no		3	3	2	
192	N2	Downcutting	Bend	150	5	Shrubs & Small Trees	Forest	no		2	4	1	
193	N2	Widening	Land Use Change	150	4	Shrubs & Small Trees	Shrubs & Small Trees	no		3	3	1	
194	N2	Widening	Land Use Change	200	3.5	Forest	Forest	no		3	3	1	
195	N2	Downcutting	Bend	100	6	Forest	Forest	no		2	4	3	
221	4	Downcutting	Land Use Change	150	3.5	Forest	Forest	no		3	3	2	
222	4	Downcutting		70	4	Forest	Forest	no		3	3	3	
227	1	Widening	Land Use Change	70	2	Forest	Forest	no		4	2	2	
229	1	Downcutting	Land Use Change	100	3	Shrubs & Small Trees	Lawn			3	3	1	
230	1	Downcutting	Land Use Change	70	3	Lawn	Shrubs & Small Trees	no		3	3	2	

Erosion Site Summary Table													
Site ID	Subarea	Erosion Type	Erosion Cause	Erosion Length (ft)	Erosion Avg. Height (ft)	Left Bank Land Use	Right Bank Land Use	Threat to Infrastructure	Threat Description	Severity (1=Severe, 5=Minor)	Correctability (1=Best, 5=Worst)	Access (1=Best, 5=Worst)	Erosion Comments
231	1	Downcutting	Land Use Change	75	2.5	Shrubs & Small Trees	Shrubs & Small Trees	no		3	3	2	
232	1	Widening	Land Use Change	75	3.5	Shrubs & Small Trees	Shrubs & Small Trees			3	3	2	
233	1	Downcutting	Land Use Change	100	2.5	Forest	Forest	no		2	2	1	
234	1	Downcutting	Land Use Change	100	2	Forest	Forest	no		4	2	1	
235	1	Downcutting	Land Use Change	150	3.5	Lawn	Lawn	no		3	3	1	
236	1	Widening	Land Use Change	100	3.5	Lawn	Lawn	no		4	4	1	
238	1	Downcutting	Land Use Change	200	3.5	Shrubs & Small Trees	Shrubs & Small Trees			3	3	2	
240	1	Widening	Land Use Change	100	4	Shrubs & Small Trees	Lawn	no		3	3	1	
241	1	Widening	Land Use Change	100	0	Shrubs & Small Trees	Shrubs & Small Trees	no		3	3	2	
242	S1	Downcutting	Land Use Change	150	3	Lawn	Lawn	no		3	2	1	
243	S1	Downcutting	Land Use Change	300	3	Shrubs & Small Trees	Shrubs & Small Trees	no		3	3	3	
244	S1	Downcutting	Land Use Change	200	4	Forest	Forest	no		4	3	3	
245	S1	Downcutting	Land Use Change	200	5	Forest	Forest	no		2	4	3	
246	S1	Downcutting	Bend	150	6	Forest	Forest	no		2	4	4	
247	S1	Widening	Land Use Change	100	4.5	Forest	Forest	no		2	4	2	
249	S1	Downcutting	Land Use Change	200	2.5	Shrubs & Small Trees	Shrubs & Small Trees	no		3	3	1	
251	S1	Widening	Land Use Change	75	3.5	Forest	Forest	no		3	3	1	
261	3	Widening	Land Use Change	80	3	Shrubs & Small Trees	Shrubs & Small Trees	no		3	3	2	
264a	3	Widening	Land Use Change	50	2	Lawn	Lawn	no		3	3	1	Two channels are eroded before coming to rip rap confluence
267	3	Downcutting	Bend	150	10	Forest	Shrubs & Small Trees	no		1	5	1	
268	4	Widening	Land Use Change	75	3.5	Forest	Shrubs & Small Trees	no		3	3	1	Near upstream extent of prison property
271	3	Widening	Land Use Change	75	4.5	Forest	Forest	no		3	3	2	
274	3	Downcutting	Land Use Change	150	4.5	Forest	Forest	no		3	3	3	
278	3	Widening	Bend	75	3.5	Shrubs & Small Trees	Shrubs & Small Trees	no		3	2	1	

Erosion Site Summary Table													
Site ID	Subarea	Erosion Type	Erosion Cause	Erosion Length (ft)	Erosion Avg. Height (ft)	Left Bank Land Use	Right Bank Land Use	Threat to Infrastructure	Threat Description	Severity (1=Severe, 5=Minor)	Correctability (1=Best, 5=Worst)	Access (1=Best, 5=Worst)	Erosion Comments
282	3	Downcutting	Land Use Change	50	2.5	Forest	Forest	no		2	2	3	
283	3	Widening	Land Use Change	70	2.5	Forest	Forest	no		2	2	3	
285	4	Headcutting	Below Channelization	150	2.5	Forest	Forest	no		2	2	3	
288	4	Downcutting	Land Use Change	150	2.5	Forest	Forest	no		2	2	3	
289	4	Downcutting	Land Use Change	200	3.5	Forest	Forest	no		4	4	2	
290	3	Downcutting	Land Use Change	250	4	Forest	Forest			2	4	3	
293	3	Widening	Land Use Change	200	2.5	Shrubs & Small Trees	Shrubs & Small Trees	no		2	2	2	
295	3	Widening	Land Use Change	150	3.5	Forest	Forest	no		3	3	3	
299	3	Widening	Land Use Change	60	3	Forest	Forest			3	3	3	
300	3	Widening	Other	50	4	Shrubs & Small Trees	Shrubs & Small Trees	no		4	2	3	Backwater channel,standing water
300a	N3	Downcutting	Road Crossing	200	3	Shrubs & Small Trees	Shrubs & Small Trees	no		3	3	2	Downstream of highway culvert
301	3	Downcutting	Land Use Change	150	4	Shrubs & Small Trees	Shrubs & Small Trees			3	3	2	Near island in stream channel
302	3	Widening	Land Use Change	100	0	Shrubs & Small Trees	Shrubs & Small Trees	no		4	4	3	
304	3	Downcutting	Land Use Change	80	4	Forest	Shrubs & Small Trees	no		3	3	3	Beaver activity in area
306	2	Downcutting	Land Use Change	200	4.5	Shrubs & Small Trees	Shrubs & Small Trees	no		2	4	3	
312	S1	Widening	Land Use Change	100	4.5	Shrubs & Small Trees	Forest	no		3	3	2	
315	S1	Widening	Land Use Change	70	2.5	Shrubs & Small Trees	Shrubs & Small Trees	no		2	2	1	
317	S1	Widening	Land Use Change	50	6	Lawn	Shrubs & Small Trees	yes	Property fenceline eroding into channel	2	4	2	
318	S1	Downcutting	Land Use Change	200	4	Shrubs & Small Trees	Shrubs & Small Trees	no		2	3	2	Confluence with intermittent channel
321	S1	Widening	Land Use Change	200	3	Forest	Forest	no		3	3	2	At confluence with pond outfall
322	S1	Widening	Bend	250	4.5	Forest	Forest			2	4	3	
323	S1	Widening	Bend	150	6	Forest	Forest	no		3	3	3	
326	S1	Widening	Land Use Change	150	3.5	Shrubs & Small Trees	Forest			3	3	2	
327	S1			100	0	Shrubs & Small Trees	Shrubs & Small Trees	no		3	3	2	After Broadway road crossing

Erosion Site Summary Table													
Site ID	Subarea	Erosion Type	Erosion Cause	Erosion Length (ft)	Erosion Avg. Height (ft)	Left Bank Land Use	Right Bank Land Use	Threat to Infrastructure	Threat Description	Severity (1=Severe, 5=Minor)	Correctability (1=Best, 5=Worst)	Access (1=Best, 5=Worst)	Erosion Comments
328	S1	Downcutting	Land Use Change	150	0	Shrubs & Small Trees	Shrubs & Small Trees	no		3	2		
329	S1	Downcutting	Land Use Change	250	4	Shrubs & Small Trees	Lawn			2	4	2	
330	S1	Downcutting	Land Use Change	250	8	Shrubs & Small Trees	Lawn	no		1	5	1	
332	S1	Widening	Land Use Change	200	7	Shrubs & Small Trees	Shrubs & Small Trees	no		1	5	1	
333	1	Widening	Land Use Change	100	5.5	Multiflora Rose	Multiflora Rose	no		3	3	2	
334	1	Downcutting	Land Use Change	200	8	Multiflora Rose	Multiflora Rose	no		2	4	2	
335	1	Downcutting	Land Use Change	200	7	Multiflora Rose	Pasture	no		2	4	3	
336	S1	Downcutting	Land Use Change	50	3.5	Shrubs & Small Trees	Pasture			3	3	2	
337	S1	Downcutting	Land Use Change	150	3.5	Shrubs & Small Trees	Shrubs & Small Trees	no		3	3	2	
339	S1	Downcutting	Land Use Change	100	3.5	Shrubs & Small Trees	Shrubs & Small Trees	no		3	3	2	
360	3	Widening	Land Use Change	250	4	Shrubs & Small Trees	Shrubs & Small Trees	yes	Parking lot being undermined	2	4	1	
361	3	Widening	Land Use Change	150	3	Paved	Shrubs & Small Trees	yes	Parking lot	2	4	1	
368	1	Downcutting	Land Use Change	100	1	Lawn	Shrubs & Small Trees	no		2	2	2	
369	1	Widening	Land Use Change	100	3	Shrubs & Small Trees	Shrubs & Small Trees	no		3	3	1	
370	N1	Downcutting	Land Use Change	200	2	Forest	Forest	no		3	3	1	
371	N1	Downcutting	Land Use Change	150	2.5	Forest	Crop Field	no		3	3	2	
374	N1	Widening	Land Use Change	40	2.5	Forest	Forest	no		2	2	2	Right below confluence. Stream is intermittent and not flowing.
401	N3	Downcutting	Below Channelization	200	2	Lawn	Forest	no		3	3	3	
402	N3	Downcutting	Land Use Change	200	3	Forest	Forest	no		3	3	3	
403	N3	Downcutting	Road Crossing	200	1	Shrubs & Small Trees	Shrubs & Small Trees	no		4	2	2	Downstream of roadway crossing
404	N3	Widening	Bend	300	3	Shrubs & Small Trees	Lawn	yes	Small storage shed	3	3	2	
405	N3	Downcutting	Land Use Change	500	2	Shrubs & Small Trees	Shrubs & Small Trees	no		4	2	2	
409	N3	Downcutting	Road Crossing	200	2	Shrubs & Small Trees	Shrubs & Small Trees	no		3	2	1	Downstream of culvert some erosion but overal stream is in good shape going farther downstream

Erosion Site Summary Table													
Site ID	**Subarea**	**Erosion Type**	**Erosion Cause**	**Erosion Length (ft)**	**Erosion Avg. Height (ft)**	**Left Bank Land Use**	**Right Bank Land Use**	**Threat to Infrastructure**	**Threat Description**	**Severity (1=Severe, 5=Minor)**	**Correctability (1=Best, 5=Worst)**	**Access (1=Best, 5=Worst)**	**Erosion Comments**
411	N2	Downcutting	Land Use Change	300	2.5	Shrubs & Small Trees	Forest	no		3	3	2	
412	N2	Downcutting	Below Channelization	300	3	Forest	Forest			2	4	3	Rip rap channel above and below culvert. Severe erosion downstream of riprap channel below culvert
414	N2	Downcutting	Below Channelization	300	3	Forest	Forest	no		2	2	3	Below channelization for protection of sewer line
415	N2	Downcutting	Road Crossing	300	2	Shrubs & Small Trees	Shrubs & Small Trees			3	3	1	Downstream of roadway crossing. Erosion site
418	N2	Downcutting	Land Use Change	200	2	Shrubs & Small Trees	Shrubs & Small Trees			3	3	3	Open section of stream limited canopy. Downcutting channel
424	1	Widening	Other	100	4	Shrubs & Small Trees	Shrubs & Small Trees			2	2	3	
430	1	Widening	Other	50	3	Shrubs & Small Trees	Shrubs & Small Trees	no		2	2	1	Eroded bank and deep pool.
431	1	Widening	Other	100	3	Shrubs & Small Trees	Shrubs & Small Trees	no		1	1	1	Erosion cut on outside bend.
432	1	Widening	Other	50	3	Shrubs & Small Trees	Shrubs & Small Trees	no		1	1	1	Erosion cut along outside bend.
433	1	Widening	Bend	50	5	Shrubs & Small Trees	Shrubs & Small Trees	no		1	1	1	
435	2	Downcutting	Bend	50	3	Forest	Forest	no		3	3	2	

Channel Alterations Summary Table													
Site ID	**Subarea**	**Alteration Type**	**Bottom Width (ft)**	**Length (ft)**	**Perennial flow**	**Sediment Deposition**	**Road Crossing**	**Distance above Road (ft)**	**Distance Below Road (ft)**	**Severity (1=Severe, 5=Minor)**	**Correctability (1=Best, 5=Worst)**	**Access (1=Best, 5=Worst)**	**Comments**
32	1	RipRap	12	20	yes	no	No	0	0	5	1	1	Riprap placed at confluence of 2 small streams.
32a	1	RipRap	12	20	yes	no	No	0	0	5	1	1	Riprap placed at confluence of 2 small streams.
52	4	Other	120	200	yes	no	No	0	0	5	1	3	Large rock wall built to arm our left bank area. Possible j hook built into channel
54a	4	Other	72	50	yes	no	No	0	0	5	1	1	Bank stabilized with large rock on right bank below pipe outfall. Construction project possible sewer replacement on left overbank.
55	4	Concrete	144	70	yes	no	Below	0	50	1	2	2	Concrete side wall just downstream of 4 large circular culverts at roadway crossing.
63	2	Other	12	200	no	no	No	0	0	1	1	1	Roadside swale
412	N2	RipRap	48	150	yes	no	Both	100	50	2	4	2	Rip rap channel above and below culvert. Severe erosion downstream of riprap channel below culvert
414	N2	RipRap	36	40	yes	no	No	0	0	3	3	3	Below channelization for protection of sewer line

Exposed Pipe Summary Table													
Site ID	Subarea	Pipe Channel	Pipe Type	Pipe Diameter (in)	Pipe Length (ft)	Pipe Purpose	Discharge	Color	Odor	Severity (1=Severe, 5=Minor)	Correctability (1=Best, 5=Worst)	Access (1=Best, 5=Worst)	Comments
21	1	Other	Concrete	36	20	Stormwater	no			4	2	3	Old concrete culverts from abandoned stream crossing still in stream
47	4	Above	SmoothMetal	12	30	Sewage	no			1	5	1	Exposed sewer line upstream of roadway bridge
156	N1	Above	SmoothMetal	12	6	Unknown	no	Other	None	5	1	1	
303	3	Other		0	0								
336	S1	Bottom	SmoothMetal	12	12	Unknown	no	Other	Other	2	2	2	
360	3	Along	Plastic	63	0	Unknown			Other	5	1	1	

Fish Barrier Summary Table										
SITE_ID	Subarea	Blockage	Type	Barrier Reason	Drop (in)	Depth (in)	Severity (1=Severe, 5=Minor)	Correctability (1=Best, 5=Worst)	Access (1=Best, 5=Worst)	Comments
24	5	Total	BeaverDam	TooHigh	16	24	2	4	1	Beaver dam must downstream of walking path. Water backed several hundred feet upstream of here.
25	1	Partial	DebrisDam	TooHigh	3	5	1	1	2	Woody debris jam and erosion
40	1	Total	DebrisDam	TooHigh	6	3	3	1	1	
41	1	Total	BeaverDam	TooHigh	24	8	3	3	2	Beaver dam
42	1	Partial	Dam	TooHigh	4	4	4	1	1	Active headcutting from tributary with man made rock dam across the stream (Trib is flow around beaver dam)
43	1	Total	BeaverDam	TooHigh	24	8	3	3	2	Beaver dam creating flow channel over the bank
65	2	Total	Dam	TooHigh	1	1	4	2	2	Home made dam. Behind houses
78	2	Partial	DebrisDam	TooShallow	0	1	3	3	3	
87	2	Total	Dam	TooHigh	30	0	2	3	1	
91	2	Partial	DebrisDam	TooHigh	12	0	4	2	3	
92	2	Total	DebrisDam	TooHigh	12	0	2	4	4	
100	2	Partial	DebrisDam	TooHigh	6	0	4	2	2	
123	2	Total	Dam	TooHigh	36	0	1	5	2	Large dam across stream. Visible signs of failure.
133	1	Partial	DebrisDam	TooShallow	0	3	4	1		
142	1	Partial	DebrisDam	TooHigh	5	0	4	1	1	
149	1	Partial	DebrisDam	TooShallow	0	1	2	1	1	
161	N2	Partial	DebrisDam	TooHigh	12	0	4	2	1	
162	N2	Total	DebrisDam	TooHigh	12	0	4	2	1	
167	N2	Partial	Other	TooHigh	12	0	4	2	2	
181	N3	Total	DebrisDam	TooHigh	12	0	3	3	3	
186	N2	Total	DebrisDam	TooHigh	24	0	3	4	4	
191	N2	Partial	DebrisDam	TooHigh	0	0	4	1	2	
223	4	Total	NaturalFalls	TooHigh	12	2	4	2	1	
225	1	Total	DebrisDam	TooHigh	36	0	3	2	2	
226	1	Total	DebrisDam	TooHigh	30	0	2	2	2	
231	1	Partial		TooHigh	12	0	4	2	1	
235	1	Partial	DebrisDam	TooHigh	12	0	4	2	1	
236	1	Total	DebrisDam	TooHigh	8	0	3	2	1	
250	S1	Partial	DebrisDam	TooHigh	0	0	4	1	1	
265	3	Partial	DebrisDam	TooHigh	36	0	3	3	1	
273	3	Partial	DebrisDam	TooHigh	6	0	4	1	2	
277	3	Total	DebrisDam	TooHigh	12	0	3	1	1	
286	4	Total	DebrisDam	TooHigh	10	0	4	1	3	
289	4	Total	DebrisDam	TooHigh	20	0	3	2	3	
294	3	Total	Dam	TooHigh	10	0	4	2	2	Gabion stream crossing
297	3	Partial	DebrisDam	TooHigh	0	0	3	3	3	

Fish Barrier Summary Table										
SITE_ID	Subarea	Blockage	Type	Barrier Reason	Drop (in)	Depth (in)	Severity (1=Severe, 5=Minor)	Correctability (1=Best, 5=Worst)	Access (1=Best, 5=Worst)	Comments
314	S1	Partial	DebrisDam	TooHigh	0	0	4	1	1	
324	S1	Partial	DebrisDam		0	0	3	2	2	
325	S1	Total	DebrisDam	TooHigh	36	0	2	2	2	
408	N3	Partial	PipeCrossing	TooHigh	4	0	4	2	3	Old curvert in stream possibly makeshift crossing. Causing large dam upstream
413	N2	Total	DebrisDam	TooHigh	6	0	3	3	3	Debris jam mostly leaves and organic matter
417	N2	Partial	DebrisDam	TooShallow	0	0.5	3	3	3	Debris jam
417a	N2	Partial	DebrisDam	TooShallow	0	0.5	3	3	3	Debris jam

Inadequate Buffer Summary Table																	
Site ID	Subarea	Buffer Inadequate Bank	Unshaded	Left Buffer Width (ft)	Right Buffer Width (ft)	Left Length (ft)	Right Length (ft)	Left Bank Land Use	Right Bank Land Use	Recently Established	Livestock Present	Livestock Type	Severity (1=Severe, 5=Minor)	Correctability (1=Best, 5=Worst)	Access (1=Best, 5=Worst)	Wetland Potential	Comments
27	1	Both	Both	70	70	200	300	Other	Other	no	no		4	2	3	1	Open area thick with grasses
406	N3	Both	Both	0	0	200	300	Lawn	Lawn	no	no		4	2	1	3	
418	N2	Left	Niether	10	10	100	30	Shrubs & Small Trees	Shrubs & Small Trees	no	no		3	2	3	1	Open section of stream limited canopy. Downcutting channel

In or Near Stream Construction Land Use										
SITE_ID	**Subarea**	**Construction Type**	**Sediment Control**	**Excess Sediment**	**Construction Length (ft)**	**Construction Company**	**Location**	**Contact Needed**	**Severity (1=Severe, 5=Minor)**	**Comments**
50	4	Utility	Adequate	no	150	N/a	Left overbank		4	Sewer replacement project downstream of road bridge
54a	4	Utility	Adequate	no	150	N/a	Left bank		5	Bank stabilized with large rock on right bank below pipe outfall. Construction project possible sewer replacement on left overbank.

Pipe Outfall Summary Table													
Site ID	Subarea	Outfall Type	Pipe Type	Location	Diameter (ft)	Channel Width (ft)	Discharge	Discharge Color	Discharge Odor	Severity (1=Severe, 5=Minor)	Correctability (1=Best, 5=Worst)	Access (1=Best, 5=Worst)	Comments
2	1	Stormwater	CorrugatedMetal	Head_Stream	24	0	no			5	1	1	Culvert.
4	1	Stormwater	CorrugatedMetal	Left_Bank	20	3	yes	Clear	None	1	1	1	Storm water outfall.
9	1	Stormwater	Plastic	Left_Bank	4	3	yes	Clear	None	5	1	1	Small drainage pipe into channel.
16	1	Stormwater	Other	Right_Bank	0	0	yes	Clear	None	5	1	1	Unknown outfall channel.
27a	1	Stormwater	ConcretePipe	Right_Bank	30	3	no			5	1	1	Silt fence immediately downstream of culvert
29	1	Stormwater	ConcretePipe	Left_Bank	36	2	yes	Clear	None	4	2	2	Eroded channel from stormwater pond
31	1	Stormwater	ConcretePipe	Right_Bank	24	3	yes	Clear	None	5	1	1	Stormwater pond discharge pipe. All riprap downstream has eroded.
34a	1	Stormwater	CorrugatedMetal	Left_Bank	18	1	no			5	1	1	Stormwater pond discharge pipe
44	1	Stormwater	CorrugatedMetal	Left_Bank	30	4	yes	Clear	None	5	1	2	Stormwater pond discharge pond. Gabian baskets in front of pipe to disappaite flow.
45	1	Stormwater	CorrugatedMetal	Right_Bank	30	6	yes	Clear	None	5	1	1	Discharge pipe leading directly to stream erosion occurring both upstream and downstream of pipe
53	4	Stormwater	ConcretePipe	Left_Bank	24	10	no			3	4	4	Outfall with concrete headwall being eroded underneath of it
54a	4	Stormwater	ConcretePipe	Right_Bank	36	12	yes	Clear	None	5	1	2	Bank stabilized with large rock on right bank below pipe outfall. Construction project possible sewer replacement on left overbank.
61	2	Stormwater	ConcretePipe	Head_Stream	36	4	no			3	3	1	Downstream of culvert crossing under on ramp
71	2	Stormwater	ConcretePipe	Head_Stream	48	4	yes	Clear	None	3	3	2	
76	2	Stormwater	ConcreteChannel	Head_Stream	24	4	yes	Clear	None	5	1	1	
80	2	Stormwater	ConcretePipe	Head_Stream	24	2	yes	M_Brown	None	5	1	1	
84	2	Stormwater	ConcretePipe	Head_Stream	24	2	yes	Y_Brown	None	4	2	1	
85	2	Stormwater	ConcretePipe	Other	24	0	no	Other	Other			1	
86	2	Stormwater	ConcretePipe	Head_Stream	60	3	yes	Clear	None	5	1	1	
88	2	Stormwater	ConcretePipe	Head_Stream	36	3	yes	Clear	None	5	1	1	
98	2	Stormwater	CorrugatedMetal	Head_Stream	60	6	yes	Clear	None	2	4	1	
111	2	Stormwater	ConcretePipe	Head_Stream	48	12	yes	Clear	None	2	2	1	Upstream culvert crossing. Stream downcut to level of the culvert
112	2	Stormwater	ConcretePipe	Left_Bank	30	3	yes	Clear	None	2	4	1	Large pool below culvert with stream channel from left bank feeding into it
116	2	Stormwater	Plastic	Left_Bank	8	2	no			2	2	2	Possible old sw pond has breached embankment. Newer bio retention entering stream from left bank
120	1	Stormwater	ConcretePipe	Left_Bank	36	4	no			5	1	1	Just upstream of bridge crossing stream is in very good shape

Pipe Outfall Summary Table													
Site ID	Subarea	Outfall Type	Pipe Type	Location	Diameter (ft)	Channel Width (ft)	Discharge	Discharge Color	Discharge Odor	Severity (1=Severe, 5=Minor)	Correctability (1=Best, 5=Worst)	Access (1=Best, 5=Worst)	Comments
135	1	Stormwater	CorrugatedMetal	Head_Stream	48	3	yes	Clear	None	5	1	1	
136	1	Stormwater	CorrugatedMetal	Head_Stream	48	3	yes	Clear	None	5	1	1	
136a	1	Stormwater	CorrugatedMetal	Head_Stream	48	3	yes	Clear	None	5	1	1	
138	1	Stormwater	ConcretePipe	Head_Stream	36	20	yes	Clear	None	4	2	1	SWM pond
140	1	Stormwater	ConcretePipe	Head_Stream	36	4	yes	Clear	None	5	1	1	
145	1	Stormwater	ConcretePipe	Head_Stream	36	3	yes	Clear	Oily	4	2	1	
150	1	Stormwater	CorrugatedMetal	Other	36	0	no	Other	Other			1	
151	1	Stormwater	CorrugatedMetal	Head_Stream	60	3	yes	Clear	None	5	1	1	
152	1	Stormwater	Other	Head_Stream	96	4	yes	Clear	None			1	
158	N1	Stormwater	ConcretePipe	Head_Stream	60	2	yes	Clear	None	5	1	1	
160	N2	Stormwater	ConcretePipe	Head_Stream	36	4	no	Other	Other	4	2	1	
163	N2	Stormwater	CorrugatedMetal	Head_Stream	36	3	yes	Clear	None	2	4	1	
172	N2	Stormwater	ConcretePipe	Head_Stream	48	2	no	Other	Other			1	
174	N3	Other	CorrugatedMetal	Head_Stream	60	4	yes	Clear	None			1	
188	N2	Other	CorrugatedMetal	Other	48	3	yes	Clear	None	5	1	1	
220	4	Stormwater	ConcretePipe	Head_Stream	36	3	yes	Clear	None	5	1	1	
224	1	Stormwater	CorrugatedMetal	Head_Stream	24	2	yes	Clear	None	5	1	1	
237	1	Other	CorrugatedMetal	Other	24	3	yes	Clear	None	3	2	1	
239	1	Stormwater	ConcretePipe	Head_Stream	48	3	yes	Clear	None	5	1	1	
247	S1	Stormwater	ConcretePipe	Head_Stream	36	10			None	4	2	2	
263a	3	Stormwater	CorrugatedMetal		60	1	yes	Clear	None	4	2	1	
264a	3	Stormwater	Plastic	Left_Bank	24	0	no	Other	Other				
266	3	Stormwater	ConcretePipe	Head_Stream	36	0	no	Other	Other			1	
270	3	Other	ConcretePipe	Other	36	3	yes	Clear	None	3	3	1	
275	3	Other	ConcretePipe	Other	36	6.5	no	Clear	None	3	3	1	
280	3	Other	CorrugatedMetal	Head_Stream	24	3.5	yes	M_Brown	None	4	2	1	
281	3	Other	CorrugatedMetal	Other	24	3	no	Other	Other	2	3	1	
284	4	Stormwater	ConcretePipe	Head_Stream	36	3	yes	Clear	None			1	
291	3	Stormwater	ConcretePipe	Head_Stream	36	1.5	no	Other	None			1	
296	3	Stormwater	ConcretePipe	Head_Stream	48	3.5	yes	Clear	None	2	4	2	Blown out outfall, rip rap washed away
310	S1	Stormwater	CorrugatedMetal	Head_Stream	24	3	yes	Clear	None	3	3	1	
313	S1	Stormwater	CorrugatedMetal	Head_Stream	48	7	yes	Clear	None	5	1	1	
316	S1	Stormwater	SmoothMetalPipe	Right_Bank	24	5	yes	Clear	None	5	1	2	
319	S1	Stormwater	ConcretePipe	Right_Bank	24	11	no	Other	Other				
320	S1	Stormwater	ConcretePipe	Head_Stream	48	11	yes	Clear	Chlorine	4	2	1	
322	S1	Stormwater	ConcretePipe	Head_Stream	36	2.5	no	Other	Other				
340	S1	Stormwater	ConcretePipe	Right_Bank	24	0		Other	Other				
358	3	Stormwater	CorrugatedMetal	Left_Bank	24	4.5	no	Other	Other	4	2	1	
362	3	Stormwater	ConcretePipe	Head_Stream	36	1.5	no	Other	None	5	1	1	
372	N1	Stormwater	ConcretePipe	Head_Stream	36	1	no	Other	None	5	1	1	

Pipe Outfall Summary Table													
Site ID	**Subarea**	**Outfall Type**	**Pipe Type**	**Location**	**Diameter (ft)**	**Channel Width (ft)**	**Discharge**	**Discharge Color**	**Discharge Odor**	**Severity (1=Severe, 5=Minor)**	**Correctability (1=Best, 5=Worst)**	**Access (1=Best, 5=Worst)**	**Comments**
410	N2	Stormwater	CorrugatedMetal	Left_Bank	18	2	no			2	2	1	Stormwater pond outlet. One more stormwater pond upstream
428	1	Stormwater	CorrugatedMetal	Right_Bank	24	4	yes	Clear	None	5	1	1	

Representative Reach Summary Table

Site ID	Subarea	Macro Invertebrate Subrata	Embeddedness	Shelter for Fish	Channel Alterations	Sediment Deposition	Velocity and Depth	Channel Flow	Bank Vegetation	Bank Condition	Riparian Vegetation	Riffle Width (in)	Run Width (in)	Pool Width (in)	Riffle Depth (in)	Run Depth (in)	Pool Depth (in)	Bottom Type	Comments
35	1	Suboptimal	Suboptimal	Suboptimal	Suboptimal	Suboptimal	Suboptimal	Suboptimal	Suboptimal	Marginal	Suboptimal	36	30	36	2	0	4	Gravel	Representative site upstream of stormwater pond
48	4	Optimal	Optimal	Optimal	Optimal	Suboptimal	Optimal	Optimal	Optimal	Suboptimal	Suboptimal	144	0	200	6	0	8	Cobble	Reach in good condition
70	2	Optimal	Optimal	Optimal	Suboptimal	Optimal	Suboptimal	Suboptimal	Optimal	Optimal	Optimal	48	0	72	1	0	8	Cobble	
73	2	Optimal	Optimal	Suboptimal	Suboptimal	Suboptimal	Suboptimal	Optimal	Optimal	Optimal	Optimal	48	0	60	3	0	8	Cobble	
77	2	Optimal	Suboptimal	Suboptimal	Suboptimal	Optimal	Suboptimal	Suboptimal	Optimal	Optimal	Optimal	36	0	48	2	0	6	Cobble	
89	2	Optimal	Optimal	Optimal	Suboptimal	Suboptimal	Optimal	Optimal	Optimal	Suboptimal	Optimal	48	0	84	2	0	6	Cobble	
248	S1	Suboptimal	Suboptimal	Suboptimal	Optimal	Optimal	Suboptimal	Suboptimal	Optimal	Optimal	Optimal	48	0	60	2	0	6	Cobble	
264	3	Optimal	Optimal	Optimal	Suboptimal	Optimal	Optimal	Optimal	Optimal	Suboptimal	Optimal	72	0	120	3	0	11	Cobble	

Trash Dumping Summary Table											
Site Area	**Subarea**	**Type**	**Amount**	**Other measure**	**Trash Confined**	**Volunteer Cleanup**	**Land Ownership**	**Severity (1=Severe, 5=Minor)**	**Correctability (1=Best, 5=Worst)**	**Access (1=Best, 5=Worst)**	**Comments**
11	5	Other	1	0	SingleSite	yes	Private	4	1	1	Seafood dumped along creek.

Unusual Condition or Comment Summary Table								
Site ID	Subarea	Type	Description	Cause	Severity (1=Severe, 5=Minor)	Correctability (1=Best, 5=Worst)	Access (1=Best, 5=Worst)	Comments
2	1	Comment	Blown out riprap below culvert. Culvert through stream concentrated flow		1	1	1	Culvert.
3	1	UnusualCondition	Stream goes into a 12" CMP pipe under parking lot of Mid Atlantic Label.		1	1	1	
3	1							
3	1							
6	1	Comment	Fragmites dense along channel.		4	2	2	Dense fragmites.
10	1	Comment	Looks like area has been previously restored. Placed riprap and evidence of fabric.		1	1	1	
12	1	UnusualCondition	Dense fragmites.		2	1	1	
13	1	UnusualCondition	Large burrow hole in the side of stormwater pond.		3	2	1	Burrowing hole in pond berm.
17a	1	UnusualCondition	Debris jam		1	1	1	
19	1	Comment	Large eroded pool below culvert. 48" CMP.		1	1	1	
30	1	Comment	Upstream end of roadway culvert crossing approx. 54" circular CMP pipe with concrete on bottom					
34	1	UnusualCondition	Blocked roadway culvert		1	1	2	Upstream of roadway culvert partially blocked
46a	4	UnusualCondition	Ponding below roadway culvert		2	2	2	Ponding below roadway culvert
49	4	Comment						Head of riffle. Natural grade control causing large pool to form upstream
56	2	Comment			1	1	1	Upstreaend of highway culverts bamboo on right bank
67	2	Comment	Stormwater pond					Old stormwater
79	2	UnusualCondition	Channel has many braids, lots of wetland spring feed channels, many downed trees in channel.		3		4	
83	2	UnusualCondition	Braided channels, floodplain spread wide. Eroded banks along steep slopes to the left.		2	2	2	
103	2	UnusualCondition	Trib coming into downcut stream		3	3	2	Tribe coming into downcut stream
109	2	Comment	See site comment		4	2	3	Braided channel from overland flow in right overbank. Headcutting to level of main stream
109a	1	Comment	See site comment		4	2	3	Braided channel from overland flow in right overbank. Headcutting to level of main stream
121	1	UnusualCondition	See site notes		4	2	2	Concrete placed across stream possible old bridge or utility protection
122	1	UnusualCondition	See site notes		5	5	3	Bedrock feature across stream holds the grade and forces flow out of stream into right overbank to form braided channel downstream
137	1	UnusualCondition	Washed out concrete culvert		2	2	1	
147	N2	UnusualCondition	Old road bridge crossing		2	2	3	
171	N2	UnusualCondition	Riprap outfall into stream				1	
190	3	UnusualCondition	Plastic pipe in stream					

Unusual Condition or Comment Summary Table								
Site ID	Subarea	Type	Description	Cause	Severity (1=Severe, 5=Minor)	Correctability (1=Best, 5=Worst)	Access (1=Best, 5=Worst)	Comments
260	3	UnusualCondition	Cement banks					
262	3	UnusualCondition	Bank protection					
263	3	UnusualCondition	Rock bank protection					
276	3	Comment	Pedestrian bridge					
279	3	Comment	Bio retention pond outfall					
292	3	Comment	Pond with and island					
298	3	Comment	Sewer manhole in stream					
303	N2	Comment	Protected sewer crossing					
311	S1	Comment	Stream bank protection boulders		1	1	1	
331	N3	Comment	Homeless camp with trip wires					Homeless camp
407	N2	Comment	Confluence		5	1	2	Confluence of tribe stream in pretty good shape
416	1	Comment	See site comment		4	3	3	Concrete pad crossing the stream. Possible sewer line crossing
420	1	Comment	Deep pool and eroded bank.					
421	1	Comment	Debris jam.					
422	1	Comment	Spring fed tributary					
423	1	Comment						
425	1	UnusualCondition	Debris jam		1	1	1	
426	1							
427	1	Comment						
429	5	UnusualCondition	Debris jam		1	1	1	

C.2 STREAM PHOTOGRAPHS

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Photo 1 - Beaver dam at stream assessment Point 43 at downstream end of sub area 5

Photo 2 - Bank stabilization behind residential homes at stream assessment Point 52

Photo 3- Backwater pool at stream assessment Point 118 created by downstream Mill Dam

Photo 4 - Mill dam in poor condition blocking flow at stream assessment Point 123

Photo 5 - Upper Bynum Run main-stem in healthy condition at stream assessment Point 20

Photo 6 - Unnamed tributary in fair condition in subarea N1 at stream assessment Point 155

Photo 7 - Eroded channel section in subarea N2, at stream assessment Point 170

Photo 8 - Eroded stream bank at stream assessment Point 175 in subarea N3

Photo 9 - Stream assessment Point 181 shows debris in the stream channel

Photo 10 - Unnamed tributary in poor condition at stream assessment Point 244 in subarea S1

Photo 11 - Stream assessment Point 264 - Upper Bynum Run channel in stable condition

Photo 12 - Severe stream bank erosion observed at stream assessment Point 267 in subarea 3

Photo 13 - Downcutting channel for further investigation in subarea 4 at stream assessment Point 285

Photo 14 - Stream assessment Point 271 in subarea 3 - moderate bank erosion

Photo 15 - Severe bank erosion at outside meander bend in subarea S1 at stream assessment Point 330

Photo 16 - Eroded tributary in subarea 3 at stream assessment Point 360

Photo 17 - Stream channel at assessment Point 370 in subarea S1 - moderate erosion

Photo 18 - Undercutting of banks on outside of meander bend at assessment Point 413 in subarea N2

Photo 19 - Downstream of culvert crossing at assessment Point 426 in subarea 5

Photo 20 - Erosion observed on stream meander in subarea 5 at assessment Point 431

C.3 STREAM CORRIDOR ASSESSMENT SURVEY FORMS

CHANNEL ALTERATION CA

Map: _______________ **Team:** _______ **Site:** _________

Date: ____/____/____ **Photo:** _______ **Survey:** _______
MM DD YY

Type: **Co**ncrete, **Ga**bion, **R**ip-**r**ap, **E**arth **C**hannel, **O**ther: ________________

Bottom Width: _______________ in **Length:** _______________ ft.

Does channel have perennial flow? **Y**es **N**o

Is sediment deposition occurring in the channel? **Y**es **N**o

Is vegetation growing in the channel? **Y**es **N**o

Is it part of a road crossing? **No** **Ab**ove **Be**low **Bo**th

Channelized length above road crossing _______________ ft.

Channelized length below road crossing _______________ ft.

Severity	Severe	**1**	**2**	**3**	**4**	**5**	Minor	Unknown (**-1**)
Correctability	Best	**1**	**2**	**3**	**4**	**5**	Worst	Unknown (**-1**)
Access	Best	**1**	**2**	**3**	**4**	**5**	Worst	Unknown (**-1**)

CHANNEL ALTERATION CA

Map: _______________ **Team:** _______ **Site:** _________

Date: ____/____/____ **Photo:** _______ **Survey:** _______
MM DD YY

Type: **Co**ncrete, **Ga**bion, **R**ip-**r**ap, **E**arth **C**hannel, **O**ther: ________________

Bottom Width: _______________ in **Length:** _______________ ft.

Does channel have perennial flow? **Y**es **N**o

Is sediment deposition occurring in the channel? **Y**es **N**o

Is vegetation growing in the channel? **Y**es **N**o

Is it part of a road crossing? **No** **Ab**ove **Be**low **Bo**th

Channelized length above road crossing _______________ ft.

Channelized length below road crossing _______________ ft.

Severity	Severe	**1**	**2**	**3**	**4**	**5**	Minor	Unknown (**-1**)
Correctability	Best	**1**	**2**	**3**	**4**	**5**	Worst	Unknown (**-1**)
Access	Best	**1**	**2**	**3**	**4**	**5**	Worst	Unknown (**-1**)

EROSION SITE

ES

Map: _______________ **Team:** _______ **Site:** _________

Date: ____/____/____ **Photo:** _______ **Survey:** _______
MM DD YY

Type: **D**owncutting **W**idening **H**eadcutting **U**nknown

Cause: **Be**nd at steep slope, **P**ipe **O**utfall, Below **Ch**annelization, Below **R**oad **C**rossing, **Li**vestock, **L**and **U**se **C**hange Upstream, **O**ther: ___________________________

Length: ______________________ ft. **Average exposed bank height:** _______________________ ft.

Present Land Use Left Side (looking downstream): **Cr**op field, **Pa**sture, **La**wn, **Pav**ed, **Sh**rubs & Small Trees, **Fo**rest, **M**ultiflora **R**ose, **O**ther ___________________________

Present Land Use Right Side (looking downstream): **Cr**op field, **Pa**sture, **La**wn, **Pav**ed, **Sh**rubs & Small Trees, **Fo**rest, **M**ultiflora **R**ose, **O**ther ___________________________

Threat to Infrastructure?: **Y**es **N**o **Describe**: ____

Severity	Severe	**1**	**2**	**3**	**4**	**5**	Minor	Unknown (**–1**)
Correctability	Best	**1**	**2**	**3**	**4**	**5**	Worst	Unknown (**–1**)
Access	Best	**1**	**2**	**3**	**4**	**5**	Worst	Unknown (**–1**)

EROSION SITE

ES

Map: _______________ **Team:** _______ **Site:** _________

Date: ____/____/____ **Photo:** _______ **Survey:** _______
MM DD YY

Type: **D**owncutting **W**idening **H**eadcutting **U**nknown

Cause: **Be**nd at steep slope, **P**ipe **O**utfall, Below **Ch**annelization, Below **R**oad **C**rossing, **Li**vestock, **L**and **U**se **C**hange Upstream, **O**ther: ___________________________

Length: ______________________ ft. **Average exposed bank height:** _______________________ ft.

Present Land Use Left Side (looking downstream): **Cr**op field, **Pa**sture, **La**wn, **Pav**ed, **Sh**rubs & Small Trees, **Fo**rest, **M**ultiflora **R**ose, **O**ther ___________________________

Present Land Use Right Side (looking downstream): **Cr**op field, **Pa**sture, **La**wn, **Pav**ed, **Sh**rubs & Small Trees, **Fo**rest, **M**ultiflora **R**ose, **O**ther ___________________________

Threat to Infrastructure?: **Y**es **N**o **Describe**: ____

Severity	Severe	**1**	**2**	**3**	**4**	**5**	Minor	Unknown (**–1**)
Correctability	Best	**1**	**2**	**3**	**4**	**5**	Worst	Unknown (**–1**)
Access	Best	**1**	**2**	**3**	**4**	**5**	Worst	Unknown (**–1**)

EXPOSED PIPE EP

Map: ______________ **Team:** ______ **Site:** _________

Date: ____/____/____ **Photo:** ______ **Survey:** ______
MM DD YY

Pipe is: Exposed across bottom of stream, Exposed along stream bank, Exposed manhole, Above stream, Other: ______________________________

Type of Pipe: Concrete, Smooth Metal, Corrugated Metal, Plastic, Terra Cotta, Other: ____________________

Pipe Diameter: _____________ in. **Length exposed:** ______________ ft.

Purpose of Pipe: Sewage, Water Supply, Stormwater, Unknown, Other: ________________________

Evidence of Discharge?: **Y**es **N**o

Color: Clear, medium brown, dark brown, green brown, yellow brown, green, other: ________________

Odor: Sewage, oily, musky, fishy, rotten eggs, chlorine, none, other: ________________

Severity	Severe	**1**	**2**	**3**	**4**	**5**	Minor	Unknown (**–1**)
Correctability	Best	**1**	**2**	**3**	**4**	**5**	Worst	Unknown (**–1**)
Access	Best	**1**	**2**	**3**	**4**	**5**	Worst	Unknown (**–1**)

EXPOSED PIPE EP

Map: ______________ **Team:** ______ **Site:** _________

Date: ____/____/____ **Photo:** ______ **Survey:** ______
MM DD YY

Pipe is: Exposed across bottom of stream, Exposed along stream bank, Exposed manhole, Above stream, Other: ______________________________

Type of Pipe: Concrete, Smooth Metal, Corrugated Metal, Plastic, Terra Cotta, Other: ____________________

Pipe Diameter: _____________ in. **Length exposed:** ______________ ft.

Purpose of Pipe: Sewage, Water Supply, Stormwater, Unknown, Other: ________________________

Evidence of Discharge?: **Y**es **N**o

Color: Clear, medium brown, dark brown, green brown, yellow brown, green, other: ________________

Odor: Sewage, oily, musky, fishy, rotten eggs, chlorine, none, other: ________________

Severity	Severe	**1**	**2**	**3**	**4**	**5**	Minor	Unknown (**–1**)
Correctability	Best	**1**	**2**	**3**	**4**	**5**	Worst	Unknown (**–1**)
Access	Best	**1**	**2**	**3**	**4**	**5**	Worst	Unknown (**–1**)

PIPE OUTFALL PO

Map: _______________ **Team:** _______ **Site:** _________

Date: ____/____/____ **Photo:** _______ **Survey:** _______
MM DD YY

Type of Outfall: Stormwater, Sewage Overflow, Industrial, Pumping Station, Agricultural, Other: ___________________________

Type of Pipe: Earth Channel, Concrete Channel, Concrete Pipe, Smooth Metal Pipe, Corrugated Metal, Plastic, Other: ___________________________

Location (facing downstream): left bank, right bank, head of stream, Other ___________________

Pipe Diameter: ______________ in. **Channel width:** ______________ ft.

Evidence of Discharge?: **Y**es **N**o

Color: Clear, medium brown, dark brown, green brown, yellow brown, green, other: ______________

Odor: Sewage, oily, musky, fishy, rotten eggs, chlorine, none, other: ______________

Severity	Severe	**1**	**2**	**3**	**4**	**5**	Minor	Unknown (**–1**)
Correctability	Best	**1**	**2**	**3**	**4**	**5**	Worst	Unknown (**–1**)
Access	Best	**1**	**2**	**3**	**4**	**5**	Worst	Unknown (**–1**)

PIPE OUTFALL PO

Map: _______________ **Team:** _______ **Site:** _________

Date: ____/____/____ **Photo:** _______ **Survey:** _______
MM DD YY

Type of Outfall: Stormwater, Sewage Overflow, Industrial, Pumping Station, Agricultural, Other: ___________________________

Type of Pipe: Earth Channel, Concrete Channel, Concrete Pipe, Smooth Metal Pipe, Corrugated Metal, Plastic, Other: ___________________________

Location (facing downstream): left bank, right bank, head of stream, Other ___________________

Pipe Diameter: ______________ in. **Channel width:** ______________ ft.

Evidence of Discharge?: **Y**es **N**o

Color: Clear, medium brown, dark brown, green brown, yellow brown, green, other: ______________

Odor: Sewage, oily, musky, fishy, rotten eggs, chlorine, none, other: ______________

Severity	Severe	**1**	**2**	**3**	**4**	**5**	Minor	Unknown (**–1**)
Correctability	Best	**1**	**2**	**3**	**4**	**5**	Worst	Unknown (**–1**)
Access	Best	**1**	**2**	**3**	**4**	**5**	Worst	Unknown (**–1**)

FISH BARRIER

FB

Map: ______________ **Team:** _______ **Site:** _________

Date: ____/____/____ **Photo:** _______ **Survey:** _______
MM DD YY

Fish Blockage: **To**tal, **Pa**rtial, **Te**mporary, **Un**known

Type of Barrier: **Da**m, **R**oad **C**rossing, **P**ipe **C**rossing, **N**atural **F**alls, **B**eaver **D**am, **Ch**annelized, Instream **Po**nd, **D**ebris **D**am, **Ot**her: ________________________

Blockage because: Too **hi**gh Too **sh**allow Too **fa**st

Water drop: _________________ inches (if too high)

Water depth: _________________ inches (if too shallow)

Severity	Severe	**1**	**2**	**3**	**4**	**5**	Minor	Unknown (**–1**)
Correctability	Best	**1**	**2**	**3**	**4**	**5**	Worst	Unknown (**–1**)
Access	Best	**1**	**2**	**3**	**4**	**5**	Worst	Unknown (**–1**)

FISH BARRIER

FB

Map: ______________ **Team:** _______ **Site:** _________

Date: ____/____/____ **Photo:** _______ **Survey:** _______
MM DD YY

Fish Blockage: **To**tal, **Pa**rtial, **Te**mporary, **Un**known

Type of Barrier: **Da**m, **R**oad **C**rossing, **P**ipe **C**rossing, **N**atural **F**alls, **B**eaver **D**am, **Ch**annelized, Instream **Po**nd, **D**ebris **D**am, **Ot**her: ________________________

Blockage because: Too **hi**gh Too **sh**allow Too **fa**st

Water drop: _________________ inches (if too high)

Water depth: _________________ inches (if too shallow)

Severity	Severe	**1**	**2**	**3**	**4**	**5**	Minor	Unknown (**–1**)
Correctability	Best	**1**	**2**	**3**	**4**	**5**	Worst	Unknown (**–1**)
Access	Best	**1**	**2**	**3**	**4**	**5**	Worst	Unknown (**–1**)

INADEQUATE BUFFER IB

Map: _______________ **Team:** _______ **Site:** __________

Date: ____/____/____ **Photo:** _______ **Survey:** _______
MM DD YY

Buffer inadequate on: **L**eft **R**ight **B**oth (looking downstream)

Is stream unshaded? **L**eft **R**ight **B**oth (looking downstream) **N**either

Buffer width left: ________ ft. **Buffer width right:** ________ ft.

Length left: _____________ ft. **Length right:** _____________ ft.

Present land use left side: **Cr**op field, **Pa**sture, **La**wn, **P**a**v**ed, **Sh**rubs & Small Trees, **Fo**rest, **M**ultiflora **R**ose, **O**ther ______________________

Present land use right side: **Cr**op field, **Pa**sture, **La**wn, **P**a**v**ed, **Sh**rubs & Small Trees, **Fo**rest, **M**ultiflora **R**ose, **O**ther ______________________

Has a buffer recently been established: **Y**es **N**o

Are Livestock present: **Y**es **N**o **Type:** **C**attle, **H**orses, **P**igs, **O**ther: ______________________

Severity	Severe	**1**	**2**	**3**	**4**	**5**	Minor	Unknown (**–1**)
Correctability	Best	**1**	**2**	**3**	**4**	**5**	Worst	Unknown (**–1**)
Access	Best	**1**	**2**	**3**	**4**	**5**	Worst	Unknown (**–1**)
Wetland Potential	Best	**1**	**2**	**3**	**4**	**5**	Worst	Unknown (**–1**)

(Good wetland potential = low slope, low bank height)

INADEQUATE BUFFER IB

Map: _______________ **Team:** _______ **Site:** __________

Date: ____/____/____ **Photo:** _______ **Survey:** _______
MM DD YY

Buffer inadequate on: **L**eft **R**ight **B**oth (looking downstream)

Is stream unshaded? **L**eft **R**ight **B**oth (looking downstream) **N**either

Buffer width left: ________ ft. **Buffer width right:** ________ ft.

Length left: _____________ ft. **Length right:** _____________ ft.

Present land use left side: **Cr**op field, **Pa**sture, **La**wn, **P**a**v**ed, **Sh**rubs & Small Trees, **Fo**rest, **M**ultiflora **R**ose, **O**ther ______________________

Present land use right side: **Cr**op field, **Pa**sture, **La**wn, **P**a**v**ed, **Sh**rubs & Small Trees, **Fo**rest, **M**ultiflora **R**ose, **O**ther ______________________

Has a buffer recently been established: **Y**es **N**o

Are Livestock present: **Y**es **N**o **Type:** **C**attle, **H**orses, **P**igs, **O**ther: ______________________

Severity	Severe	**1**	**2**	**3**	**4**	**5**	Minor	Unknown (**–1**)
Correctability	Best	**1**	**2**	**3**	**4**	**5**	Worst	Unknown (**–1**)
Access	Best	**1**	**2**	**3**	**4**	**5**	Worst	Unknown (**–1**)
Wetland Potential	Best	**1**	**2**	**3**	**4**	**5**	Worst	Unknown (**–1**)

(Good wetland potential = low slope, low bank height)

IN OR NEAR STREAM CONSTRUCTION IC

Map: _______________ **Team:** _______ **Site:** _________

Date: ____/____/____ **Photo:** _______ **Survey:** _______
MM DD YY

Type of activity: **Ro**ad, **R**oad **C**rossing, **U**tility, **Lo**gging, **B**ank **S**tabilization, **Re**sidential Development, **In**dustrial Development, **O**ther: _______________________

Sediment Control: **A**dequate **I**nadequate **U**nknown

If inadequate, why? ____

Is stream bottom below site laden with excess sediment? **Y**es **N**o

Length of stream affected: _________________________ ft.

Company doing construction: _____________________________________

Location: ____

Severity Severe **1** **2** **3** **4** **5** Minor Unknown (**-1**)

Contact office as soon as possible: (   )

IN OR NEAR STREAM CONSTRUCTION IC

Map: _______________ **Team:** _______ **Site:** _________

Date: ____/____/____ **Photo:** _______ **Survey:** _______
MM DD YY

Type of activity: **Ro**ad, **R**oad **C**rossing, **U**tility, **Lo**gging, **B**ank **S**tabilization, **Re**sidential Development, **In**dustrial Development, **O**ther: _______________________

Sediment Control: **A**dequate **I**nadequate **U**nknown

If inadequate, why? ____

Is stream bottom below site laden with excess sediment? **Y**es **N**o

Length of stream affected: _________________________ ft.

Company doing construction: _____________________________________

Location: ____

Severity Severe **1** **2** **3** **4** **5** Minor Unknown (**-1**)

Contact office as soon as possible: (   )

TRASH DUMPING TD

Map: _______________ **Team:** _______ **Site:** _________

Date: ____/____/____ **Photo:** _______ **Survey:** _______
MM DD YY

Type of trash: **Re**sidential, **In**dustrial, **Y**ard **W**aste, Flotables, **Ti**res, **Co**nstruction,
Other: ______________________________

Amount of trash: _______________________ pick-up truck loads

Other measure: _______________________

Is trash confined to? **S**ingle site, **L**arge Area

Possible cleanup site for volunteers? **Y**es **N**o

Land Ownership: **Pu**blic **Pr**ivate **Un**known

If public, name: __________________________________

Severity	Severe	**1**	**2**	**3**	**4**	**5**	Minor	Unknown (**-1**)
Correctability	Best	**1**	**2**	**3**	**4**	**5**	Worst	Unknown (**-1**)
Access	Best	**1**	**2**	**3**	**4**	**5**	Worst	Unknown (**-1**)

TRASH DUMPING TD

Map: _______________ **Team:** _______ **Site:** _________

Date: ____/____/____ **Photo:** _______ **Survey:** _______
MM DD YY

Type of trash: **Re**sidential, **In**dustrial, **Y**ard **W**aste, Flotables, **Ti**res, **Co**nstruction,
Other: ______________________________

Amount of trash: _______________________ pick-up truck loads

Other measure: _______________________

Is trash confined to? **S**ingle site, **L**arge Area

Possible cleanup site for volunteers? **Y**es **N**o

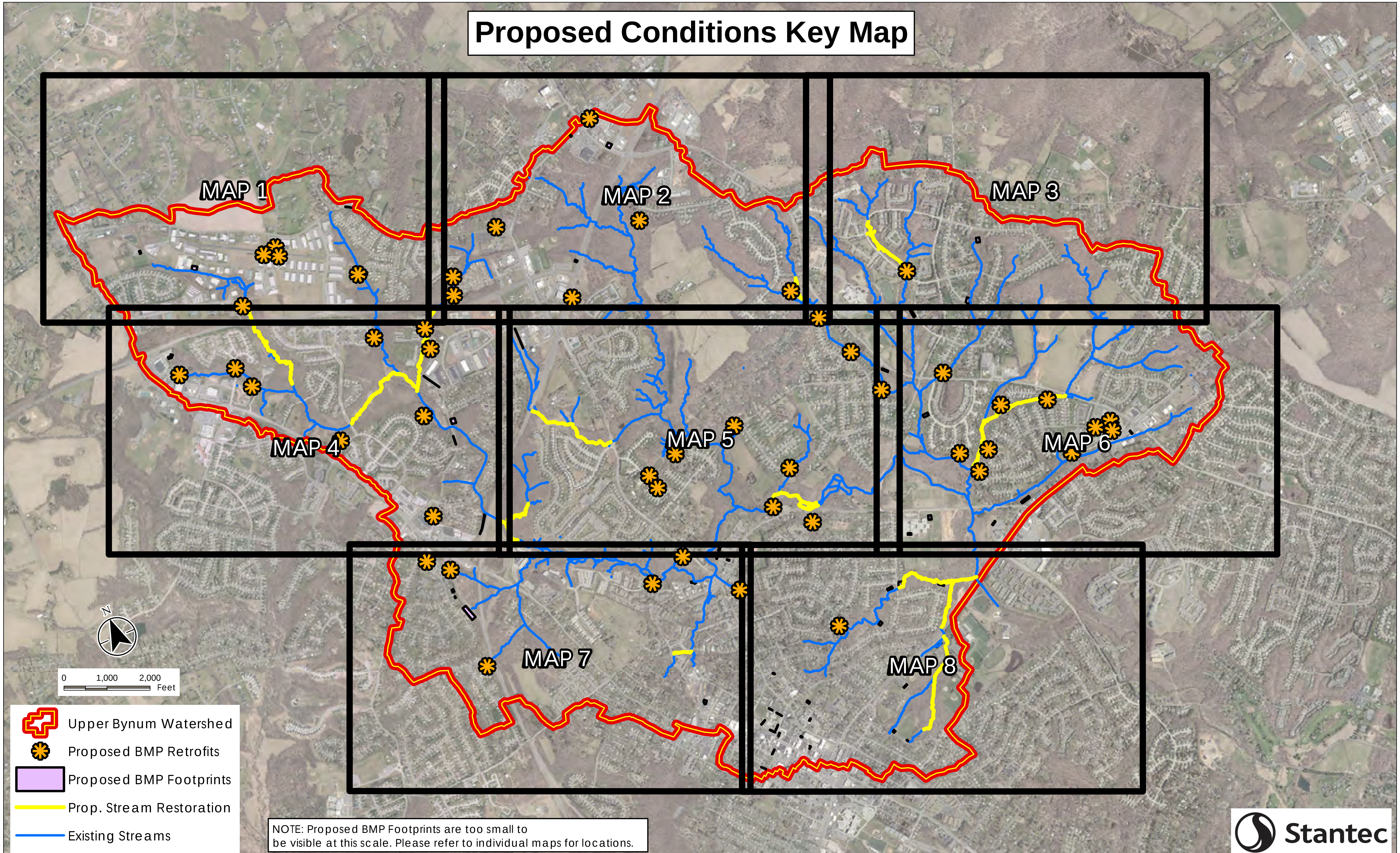
Land Ownership: **Pu**blic **Pr**ivate **Un**known

If public, name: __________________________________

Severity	Severe	**1**	**2**	**3**	**4**	**5**	Minor	Unknown (**-1**)
Correctability	Best	**1**	**2**	**3**	**4**	**5**	Worst	Unknown (**-1**)
Access	Best	**1**	**2**	**3**	**4**	**5**	Worst	Unknown (**-1**)

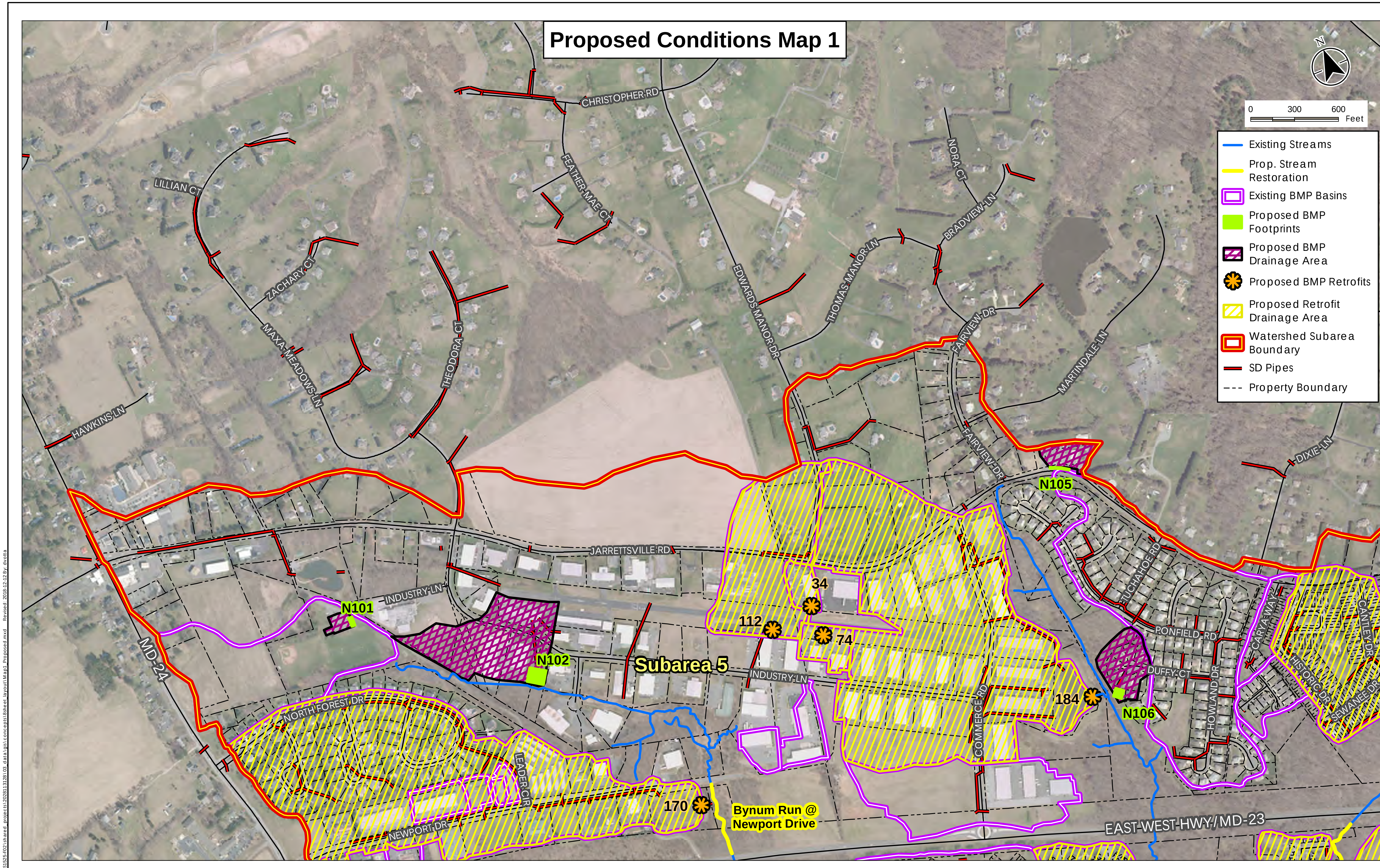
Appendix D

D.1 PROPOSED DESIGN MAPPING



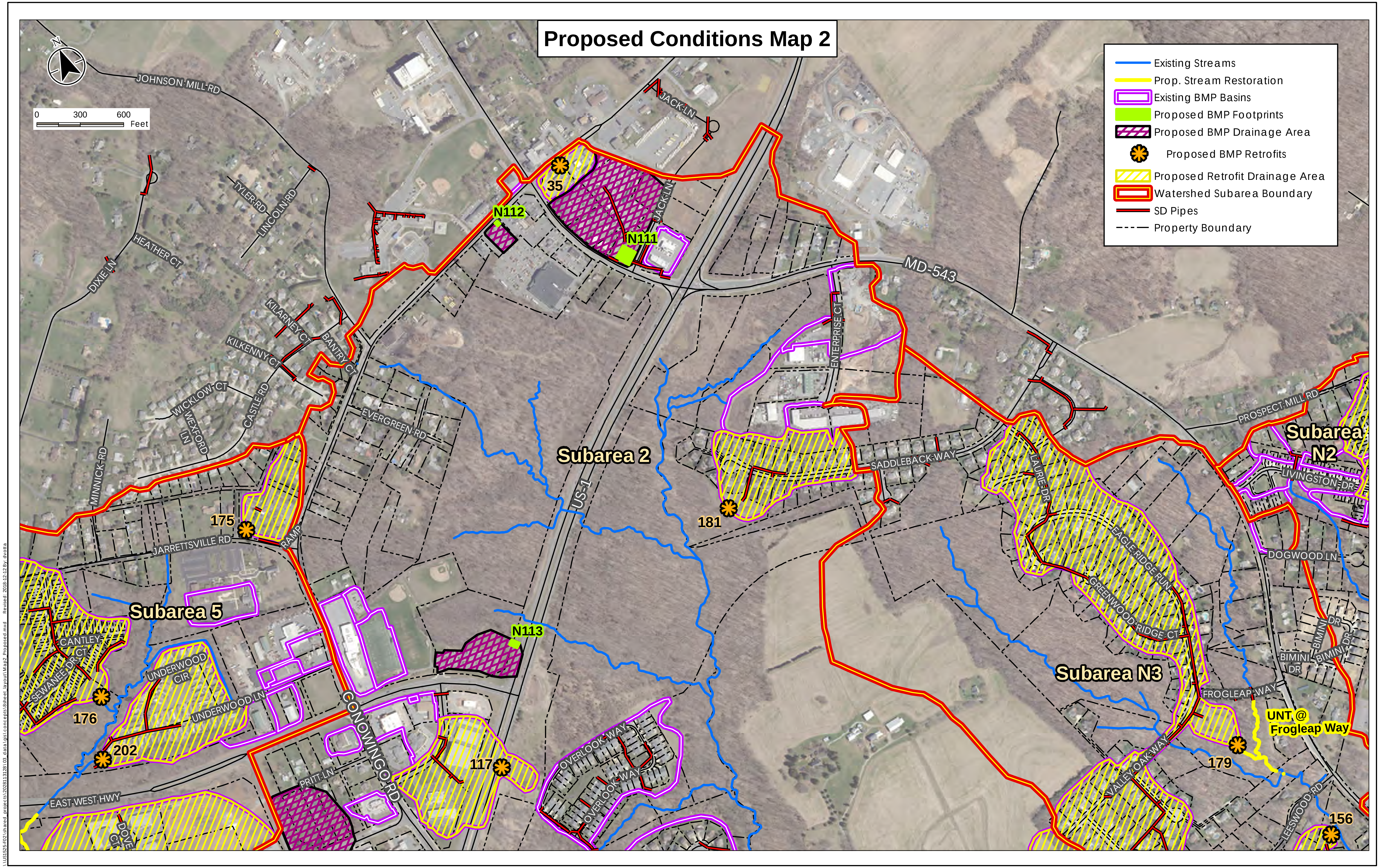
\\US1525-F02\shared_projects\202813128\03_data\gis\concepts\8sheet_layout\Key_Map_Proposed_Facilities_12122018.mxd Revised: 2018-12-12 By: dvotta

KEY MAP

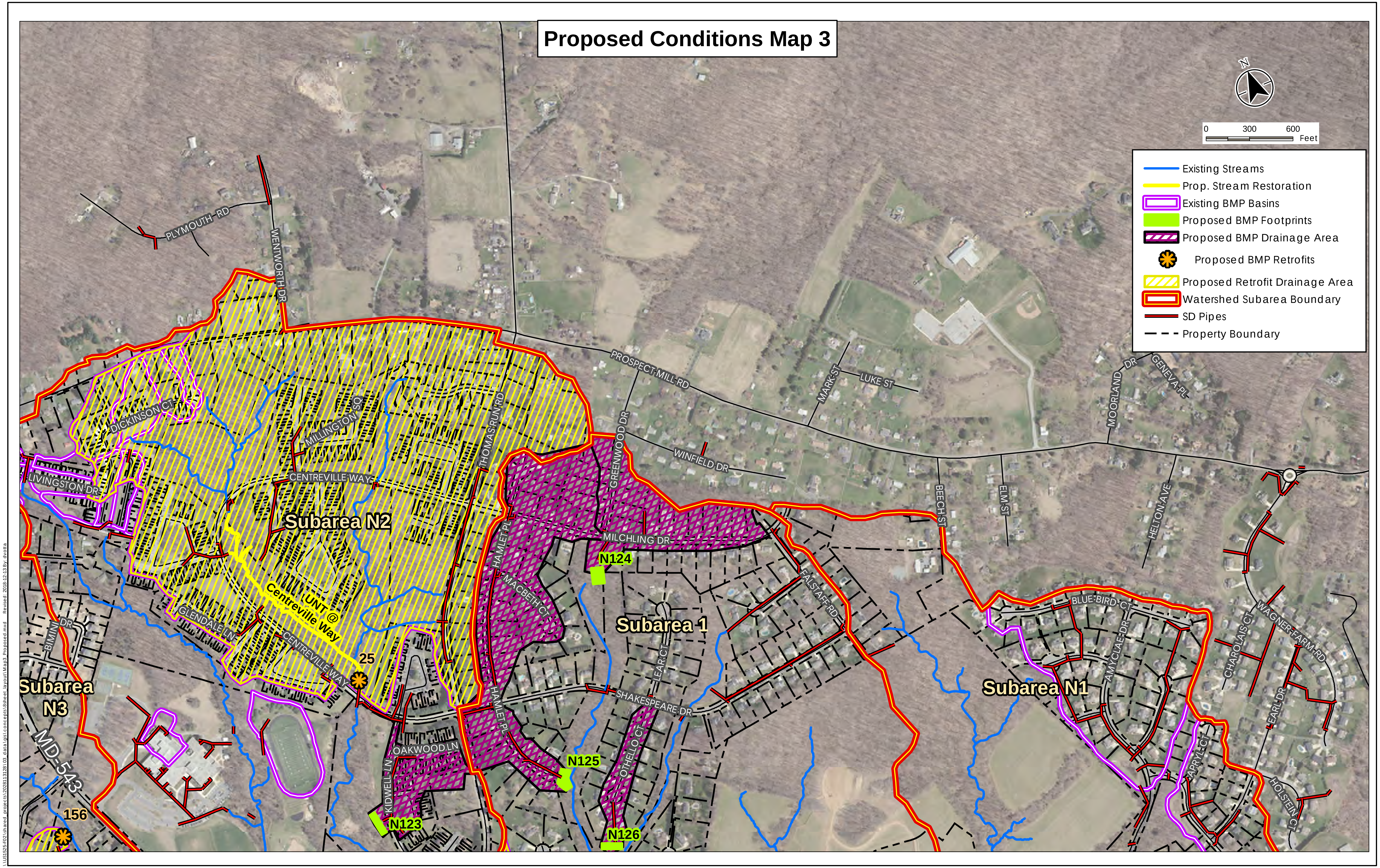


Proposed Conditions Map 1
0 300 600 Feet
N
Existing Streams
Prop. Stream Restoration
Existing BMP Basins
Proposed BMP Footprints
Proposed BMP Drainage Area
Proposed BMP Retrofits
Proposed Retrofit Drainage Area
Watershed Subarea Boundary
SD Pipes
Property Boundary
CHRISTOPHER RD
LILLIAN CT
FEATHER-MAE CT
EDWARDS MANOR DR
NORA CT
BRADVIEW LN
THOMAS MANOR LN
ZACHARY CT
MAXA MEADOWS LN
THEODORA CT
FAIRVIEW DR
MARTINDALE LN
HAWKINS LN
DIXIE LN
JARRETTSVILLE RD
INDUSTRY LN
N101
N102
N105
N106
34
112
74
184
170
Subarea 5
MD-24
NORTH FOREST DR
LEADER CIR
NEWPORT DR
COMMERCE RD
TUCHAHOE RD
PONFIELD RD
DUFFY CT
HOWLAND DR
CARYA WAY
HISTORIC DR
CANTLEY DR
SEWANEE DR
Bynum Run @ Newport Drive
EAST-WEST HWY / MD-23

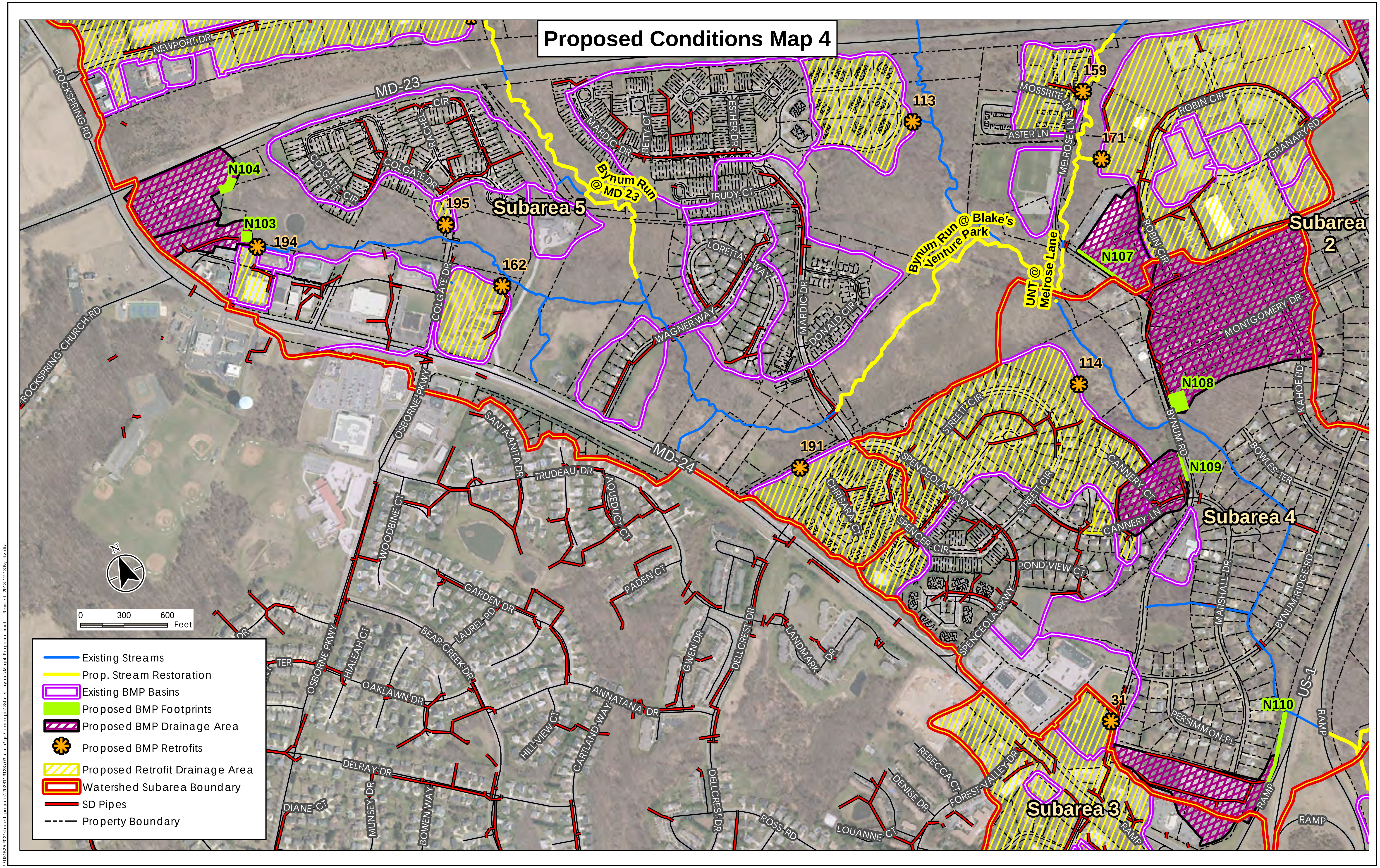
MAP 1


Proposed Conditions Map 2
Existing Streams
Prop. Stream Restoration
Existing BMP Basins
Proposed BMP Footprints
Proposed BMP Drainage Area
Proposed BMP Retrofits
Proposed Retrofit Drainage Area
Watershed Subarea Boundary
SD Pipes
Property Boundary
N
0 300 600
Feet
Subarea 2
Subarea 5
Subarea N3
Subarea N2
UNT @ Frogleap Way
N112
N111
N113
35
175
181
176
202
117
179
156
JOHNSON MILL RD
JACK LN
MD-543
US-1
PROSPECT MILL RD
LIVINGSTON DR
DOGWOOD LN
BIMINI DR
FROGLEAP WAY
VALLEY OAK WAY
LEESWOOD RD
EAGLE RIDGE RUN
GREENWOOD RIDGE CT
LAURIE DR
SADDLEBACK WAY
ENTERPRISE CT
OVERLOOK WAY
CONOWINGO RD
PRITT LN
EAST WEST HWY
UNDERWOOD LN
UNDERWOOD CIR
CANTLEY CT
SEWANEE DR
DOVE CT
JARRETTSVILLE RD
RAMP
EVERGREEN RD
MINNICK RD
WICKLOW CT
WEXFORD LN
CASTLE RD
KILKENNY CT
KILARNEY CT
BANTRY CT
DIXIE LN
HEATHER CT
TYLER RD
LINCOLN RD

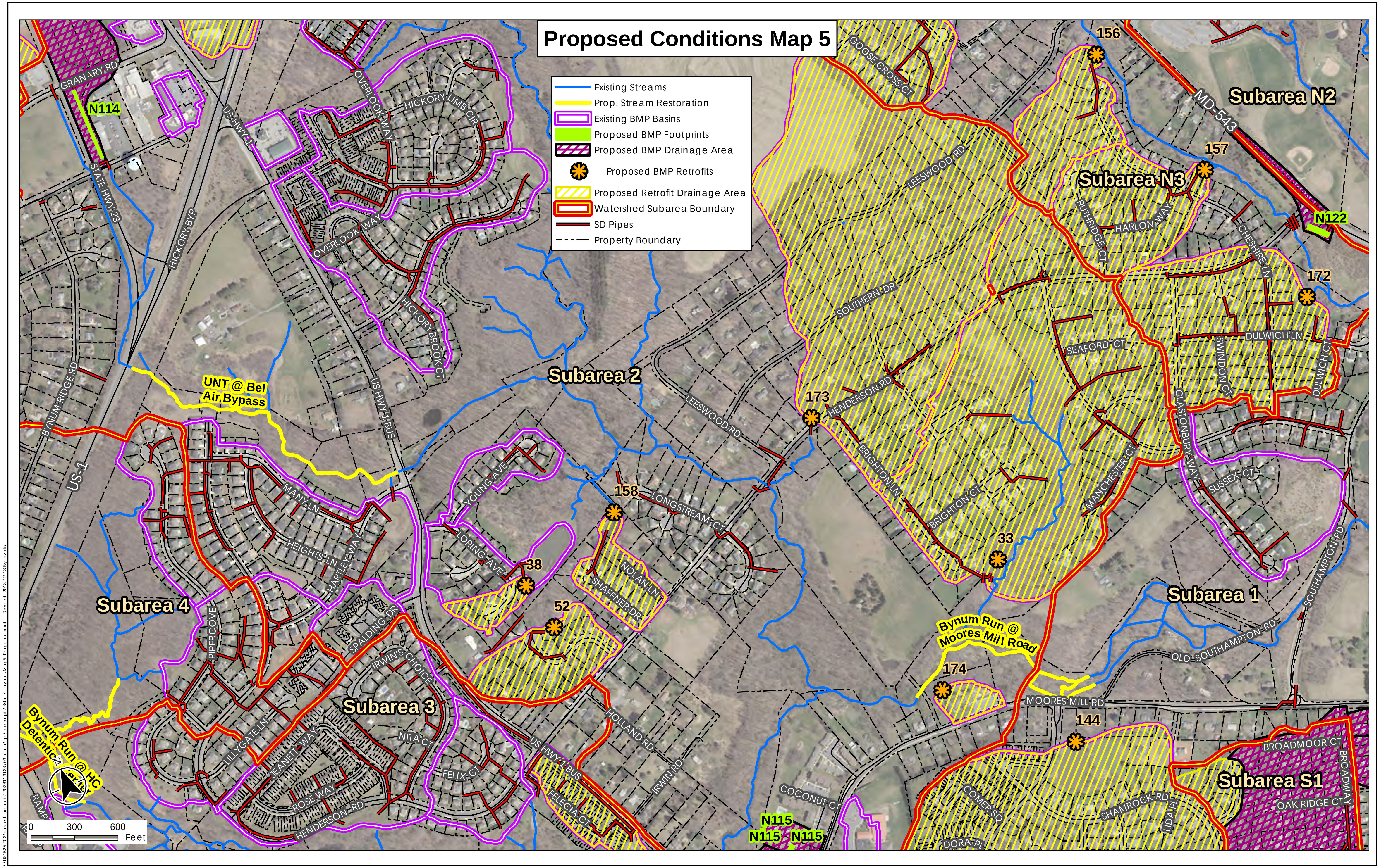
MAP 2

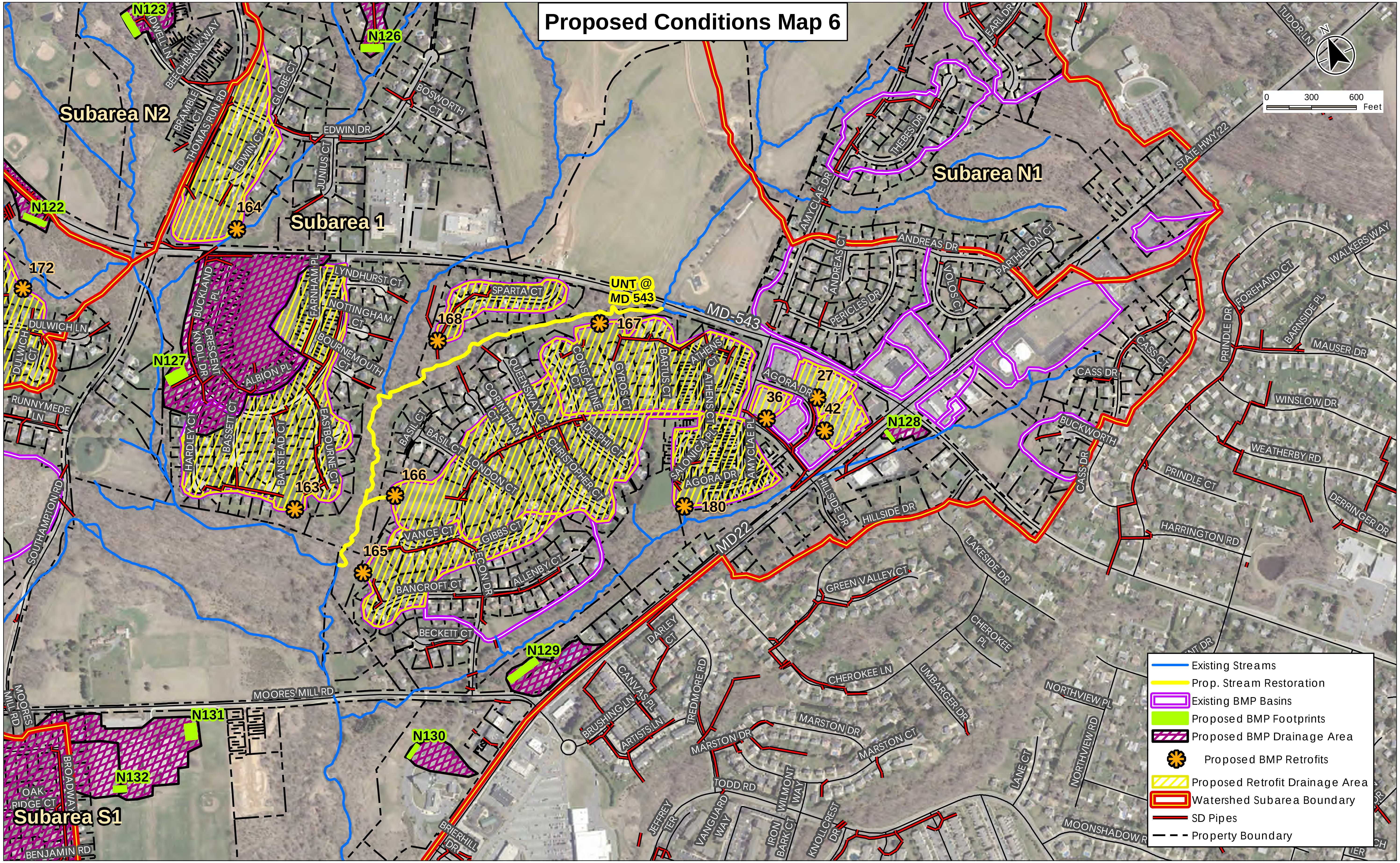

Proposed Conditions Map 3
0 300 600 Feet
Existing Streams
Prop. Stream Restoration
Existing BMP Basins
Proposed BMP Footprints
Proposed BMP Drainage Area
Proposed BMP Retrofits
Proposed Retrofit Drainage Area
Watershed Subarea Boundary
SD Pipes
Property Boundary
Subarea N2
Subarea 1
Subarea N1
Subarea N3
UNT @ Centreville Way
25
156
N123
N124
N125
N126
MD-543
PLYMOUTH RD
WENTWORTH DR
PROSPECT MILL RD
DICKINSON CT
MILLINGTON SQ
THOMAS RUN RD
CENTREVILLE WAY
LIVINGSTON DR
GLENDALE LN
BIMINI DR
GREENWOOD DR
WINFIELD DR
MILCHLING DR
HAMLET PL
MACBETH CT
LEAR CT
SHAKESPEARE DR
OTHELLO CT
OAKWOOD LN
KIDWELL LN
FALSTAFF RD
MARK ST
LUKE ST
BEECH ST
ELM ST
HELTON AVE
MOORLAND DR
GENEVA PL
BLUE BIRD CT
AMYCLAE DR
CHAROLAIS CT
WAGNER FARM RD
EARL DR
APRYL CT
HOLSTEIN CT

MAP 3

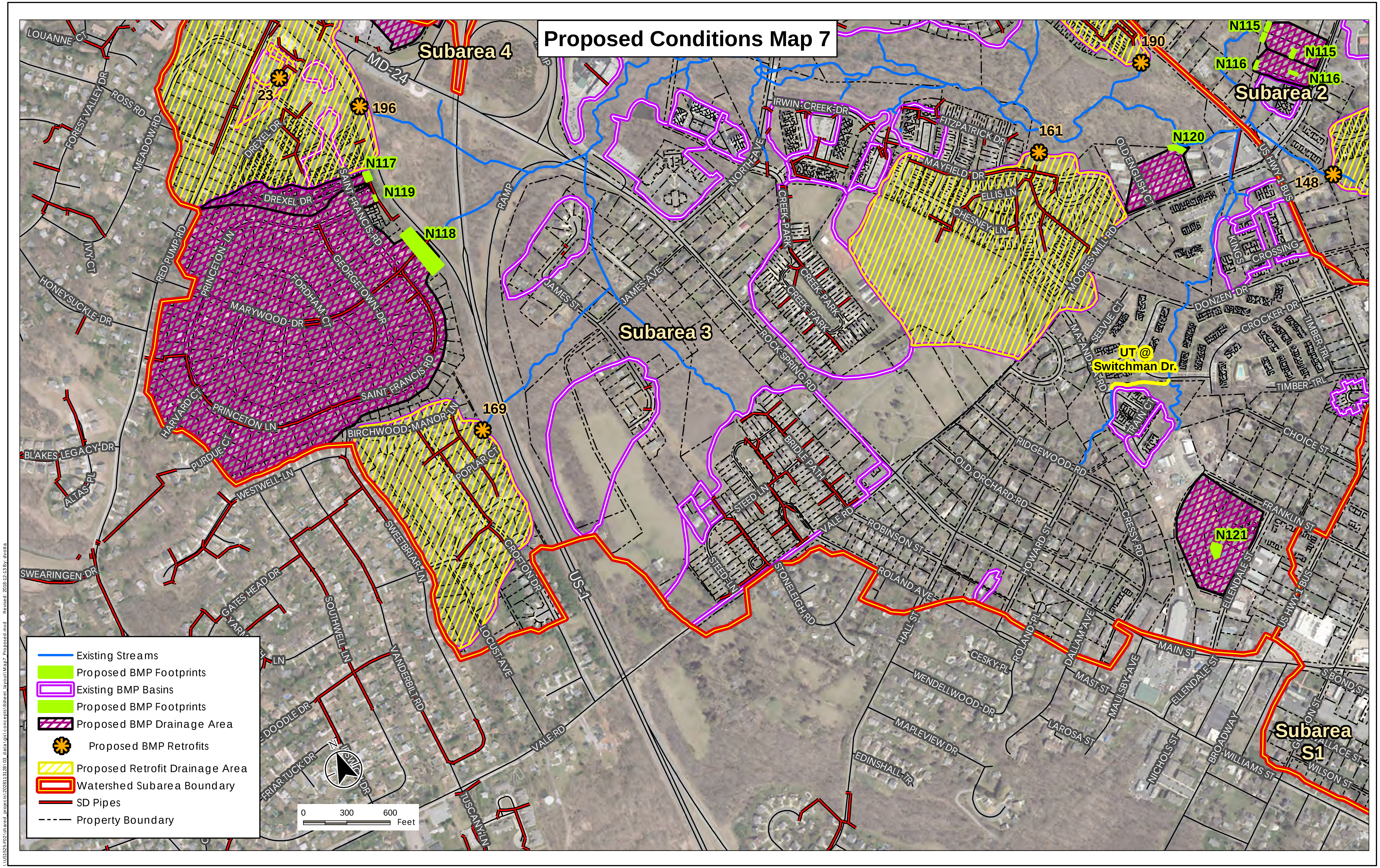

Proposed Conditions Map 4
Subarea 5
Subarea 2
Subarea 4
Subarea 3
Bynum Run @ MD 23
Bynum Run @ Blake's Venture Park
UNT @ Melrose Lane
N103
N104
N107
N108
N109
N110
113
114
159
162
171
191
194
195
31
MD-23
MD-24
US-1
ROCKSPRING RD
ROCKSPRING CHURCH RD
NEWPORT DR
COLGATE DR
COLGATE CIR
RACHEL CIR
MARDIC DR
BETTY CT
ESTHER DR
TRUDY CT
LORETTA WAY
WAGNER WAY
DONALD CIR
MOSSRITE LN
ASTER LN
MELROSE LN
ROBIN CIR
GRANARY RD
MONTGOMERY DR
KAHOE RD
BYNUM RD
BOWLES TER
STREETT CIR
SPENCEOLA PKWY
CHRISARA CT
SPENCER CIR
CANNERY CT
CANNERY LN
POND VIEW CT
MARSHALL DR
BYNUM RIDGE RD
PERSIMMON PL
RAMP
OSBORNE PKWY
SANTA ANITA DR
TRUDEAU DR
AQUEDUCT CT
WOODBINE CT
PADEN CT
GARDEN DR
LAUREL RD
BEAR CREEK DR
HIALEAH CT
OAKLAWN DR
GWEN DR
DELLCREST DR
LANDMARK DR
ANNATANA DR
HILL VIEW CT
CARTLAND WAY
DELRAY DR
DIANE CT
MUNSEY DR
BOWEN WAY
REBECCA CT
DENISE DR
FOREST VALLEY DR
ROSS RD
LOUANNE CT
N
0 300 600 Feet
Existing Streams
Prop. Stream Restoration
Existing BMP Basins
Proposed BMP Footprints
Proposed BMP Drainage Area
Proposed BMP Retrofits
Proposed Retrofit Drainage Area
Watershed Subarea Boundary
SD Pipes
Property Boundary

MAP 4

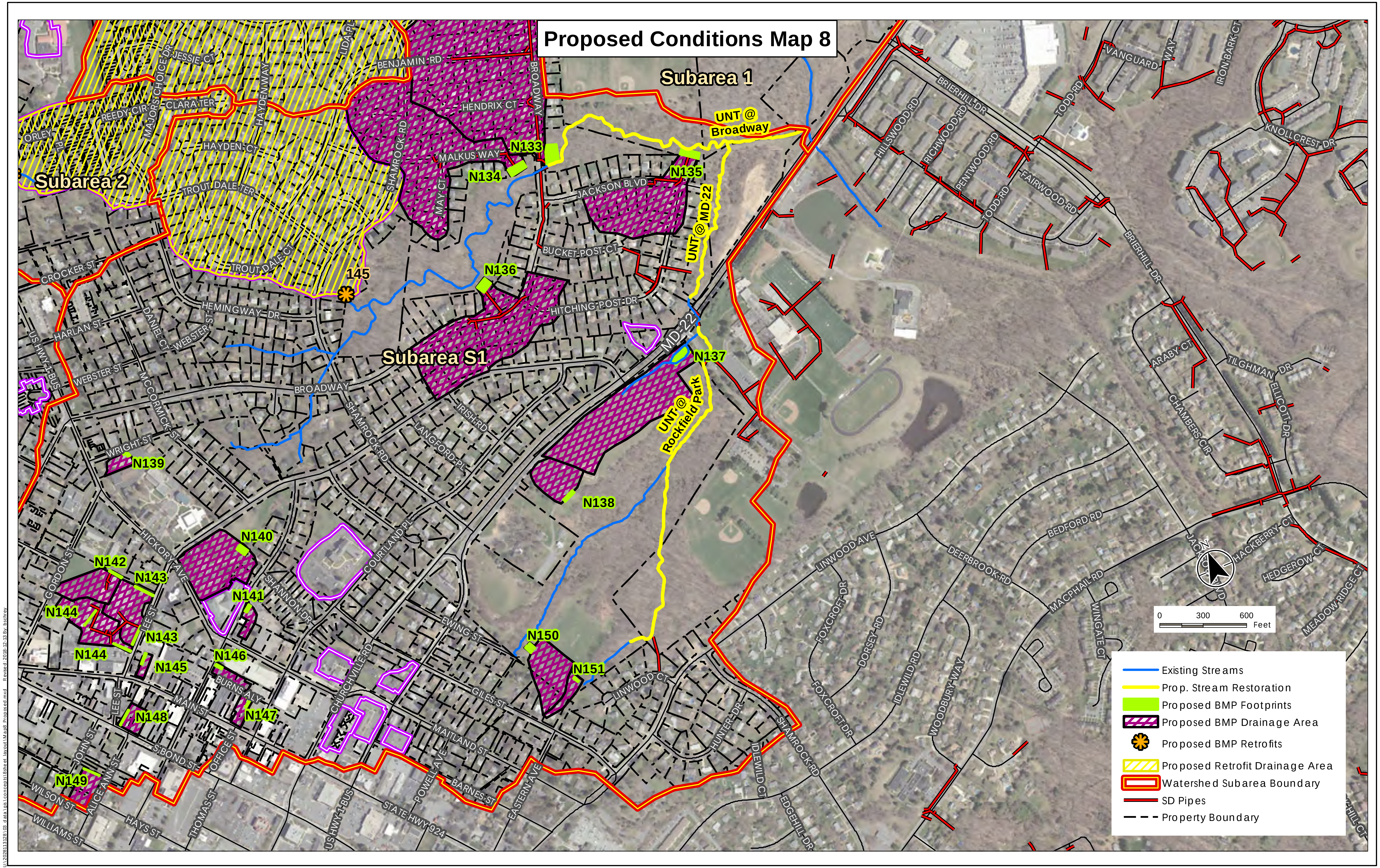

Proposed Conditions Map 5
Existing Streams
Prop. Stream Restoration
Existing BMP Basins
Proposed BMP Footprints
Proposed BMP Drainage Area
Proposed BMP Retrofits
Proposed Retrofit Drainage Area
Watershed Subarea Boundary
SD Pipes
Property Boundary
Subarea N2
Subarea N3
Subarea 2
Subarea 1
Subarea 4
Subarea 3
Subarea S1
UNT @ Bel Air Bypass
Bynum Run @ Moores Mill Road
Bynum Run @ HC Detention Pond
N114
N122
N115
156
157
172
173
158
38
52
33
174
144
GRANARY RD
STATE HWY 23
HICKORY BYP
US HWY 1
US-1
BYNUM RIDGE RD
OVERLOOK WAY
HICKORY LIMB CIR
HICKORY BROOK CT
US HWY 1 BUS
GOOSE CROSS CT
LEESWOOD RD
SOUTHERN DR
HENDERSON RD
BRIGHTON LN
BRIGHTON CT
MANCHESTER CT
SEAFORD CT
RUTHRIDGE CT
HARLON WAY
CHESHIRE LN
DULWICH LN
SWINDON CT
DULWICH CT
GLASTONBURY WAY
SUSSEX CT
SOUTHAMPTON RD
MD-543
YOUNG AVE
LORING AVE
LONGSTREAM CT
NOLAN LN
SHAFFNER DR
MANY LN
HEIGHTS LN
HARTLEY WAY
PIPERCOVE
SPALDING DR
IRWIN'S CHOICE
NITA CT
FELIX CT
LILLYGATE LN
ROSE WAY
HENDERSON RD
FELECIA CT
HOLLAND RD
IRWIN RD
COCONUT CT
OLD SOUTHAMPTON RD
MOORES MILL RD
COMER SQ
SHAMROCK RD
DORA PL
BROADMOOR CT
OAK RIDGE CT
BROADWAY
0 300 600 Feet



Proposed Conditions Map 6
Subarea N2
Subarea N1
Subarea 1
Subarea S1
N123
N126
N122
N127
N128
N129
N130
N131
N132
172
164
168
167
166
165
163
180
36
27
42
UNT @ MD 543
MD-543
MD22
STATE HWY 22
EDWIN DR
ANDREAS DR
MOORES MILL RD
HILLSIDE DR
HARRINGTON RD
WEATHERBY RD
WINSLOW DR
MARSTON DR
CHEROKEE LN
0 300 600 Feet
Existing Streams
Prop. Stream Restoration
Existing BMP Basins
Proposed BMP Footprints
Proposed BMP Drainage Area
Proposed BMP Retrofits
Proposed Retrofit Drainage Area
Watershed Subarea Boundary
SD Pipes
Property Boundary


Proposed Conditions Map 7
Subarea 4
Subarea 3
Subarea 2
Subarea S1
23
196
161
190
148
169
N115
N116
N117
N118
N119
N120
N121
UT @ Switchman Dr.
MD-24
US-1
RAMP
LOUANNE CT
FOREST VALLEY DR
ROSS RD
MEADOW RD
DREXEL DR
SAINT FRANCIS RD
PRINCETON LN
GEORGETOWN DR
FORDHAM CT
MARYWOOD DR
HARVARD CT
PURDUE CT
BIRCHWOOD MANOR LN
POPLAR CT
CROFTON DR
SWEETBRIAR LN
WESTWELL LN
HONEYSUCKLE DR
RED PUMP RD
IVY CT
BLAKES LEGACY DR
ALTAS PL
SWEARINGEN DR
GATES HEAD DR
SOUTHWELL LN
VANDERBILT RD
LOCUST AVE
VALE RD
FRIAR TUCK DR
TUSCANY LN
JAMES ST
JAMES AVE
NORTH AVE
IRWIN CREEK DR
FITZPATRICK DR
MAYFIELD DR
ELLIS LN
CHESNEY LN
CREEK PARK
ROCK SPRING RD
BRIDLE PATH
STEED LN
ROBINSON ST
ROLAND AVE
STONELEIGH RD
HALL ST
OLD ORCHARD RD
RIDGEWOOD RD
HOWARD ST
CRESSY RD
MOORES MILL RD
OLD ENGLISH CT
US HWY 1 BUS
KINGS CROSSING
DONZEN DR
CROCKER DR
TIMBER TRL
CHOICE ST
FRANKLIN ST
ELLENDALE ST
MAIN ST
S BOND ST
WENDELLWOOD DR
MAPLEVIEW DR
LAROSA ST
EDINSHALL TR
CESKY PL
MAST ST
MAULSBY AVE
DALLAM AVE
NICHOLS ST
BROADWAY
WILLIAMS ST
WILSON ST
WALLACE ST
Existing Streams
Proposed BMP Footprints
Existing BMP Basins
Proposed BMP Footprints
Proposed BMP Drainage Area
Proposed BMP Retrofits
Proposed Retrofit Drainage Area
Watershed Subarea Boundary
SD Pipes
Property Boundary
0 300 600 Feet

MAP 7


Proposed Conditions Map 8
Subarea 1
Subarea 2
Subarea S1
UNT @ Broadway
UNT @ MD 22
UNT @ Rockfield Park
MD-22
N133
N134
N135
N136
N137
N138
N139
N140
N141
N142
N143
N144
N145
N146
N147
N148
N149
N150
N151
145
0 300 600 Feet
Existing Streams
Prop. Stream Restoration
Proposed BMP Footprints
Proposed BMP Drainage Area
Proposed BMP Retrofits
Proposed Retrofit Drainage Area
Watershed Subarea Boundary
SD Pipes
Property Boundary

MAP 8

Appendix E

E.1 PROPOSED BMP DESIGN SUMMARY

Proposed BMP Summary Table

BMP #	Subwatershed Number	BMP Type	Total Drainage Area (Arces)	Drainage Area - Impervious (Acres)	WQ_v (FT^3) (Required)	ESD_v (FT^3) (Required)	SWM Volume (FT^3) (Provided)	% WQv Treated	Cost	Actual Impervious Area Treated (Acres)	N Removal (lbs/year)	P Removal (lbs/years)	Sediment Removal (lbs/year)
N101	5	bioretention	0.44	0.35	1222.42	2689.3	2760.00	226%	$ 68,925.00	0.46	0.51	0.10	105.39
N102	5	Stormwater Management Pond	9.31	3.69	13759.14	24568.7	20564.00	149%	$ 65,599.16	4.15	10.94	2.20	2243.86
N103	5	Stormwater Management Pond	2.54	1.69	5973.71	12671.9	9792.00	164%	$ 31,236.48	1.96	2.98	0.60	611.32
N104	5	Stormwater Management Pond	6.50	4.31	15263.72	32354.3	13952.00	91%	$ 44,506.88	3.94	7.63	1.54	1565.79
N105	5	bioretention	1.36	0.97	3403.25	7487.2	4212.00	124%	$ 35,841.00	1.02	1.60	0.32	327.23
N106	5	Stormwater Management Pond	2.83	0.85	3300.45	5280.7	5904.00	179%	$ 18,833.76	1.02	3.33	0.67	682.73
N107	5	bioswale	4.77	3.53	12386.05	24976.3	6660.00	54%	$ 98,383.50	1.90	5.60	1.13	1148.58
N108	4	Stormwater Management Pond	23.60	6.17	24441.51	39106.4	42912.00	176%	$ 136,889.28	7.34	27.73	5.58	5686.44
N109	4	bioswale	4.06	1.38	5246.49	9443.7	2960.00	56%	$ 43,726.00	0.78	4.77	0.96	978.68
N110	4	RSC	7.46	6.08	21214.41	46671.7	16570.58	78%	$ 351,000.00	4.75	8.77	1.76	1797.79
N111	2	Stormwater Management Pond	8.30	5.56	19682.31	40814.2	31552.00	160%	$ 100,650.88	6.40	9.75	1.96	2000.14
N112	2	bioretention	0.58	0.39	1385.04	3047.1	1425.00	103%	$ 35,841.00	0.39	0.68	0.14	139.05
N113	2	Stormwater Management Pond	2.93	1.11	4168.68	7503.6	5952.00	143%	$ 18,986.88	1.23	3.44	0.69	706.48
N114	2	bioswale	6.89	1.70	6793.69	10416.9	8950.00	132%	$ 109,315.00	1.83	8.09	1.63	1659.68
N115	2	bioretention	2.00	1.26	4484.66	8969.3	4455.00	99%	$ 206,775.00	1.25	2.35	0.47	482.04
N116	2	bioretention	1.48	0.87	3118.37	6236.7	3296.25	106%	$ 82,710.00	0.88	1.74	0.35	356.47
N117	3	bioretention	3.31	1.42	5241.29	9434.3	4368.75	83%	$ 110,280.00	1.18	3.89	0.78	798.75
N118	3	Stormwater Management Pond	65.89	21.65	82705.77	142910.5	107108.00	130%	$ 341,674.52	23.25	77.42	15.57	15877.17
N119	3	bioretention	0.44	0.20	730.89	1315.6	908.25	124%	$ 22,056.00	0.21	0.52	0.10	106.03
N120	3	Stormwater Management Pond	2.94	1.56	5621.01	10117.8	7112.00	127%	$ 22,687.28	1.66	3.46	0.70	708.92
N121	3	Stormwater Management Pond	7.15	4.33	15454.00	30908.0	12912.00	84%	$ 41,189.28	3.62	8.41	1.69	1723.88
N122	N3	Stormwater Management Pond	2.91	1.38	5049.89	9089.8	10512.00	208%	$ 33,533.28	1.76	3.41	0.69	700.30
N123	N2	Stormwater Management Pond	6.28	2.45	9160.11	16488.2	17152.00	187%	$ 54,714.88	2.99	7.38	1.49	1514.30
N124	1	Stormwater Management Pond	11.90	2.98	11892.49	14272.7	27232.00	229%	$ 86,870.08	3.94	13.98	2.81	2866.80
N125	1	Stormwater Management Pond	24.90	7.43	28802.63	39716.5	28572.00	99%	$ 91,144.68	7.37	29.26	5.88	6000.04
N126	1	Stormwater Management Pond	3.68	1.35	5087.29	9127.1	12426.00	244%	$ 39,638.94	1.84	4.33	0.87	887.17
N127	1	Stormwater Management Pond	18.14	6.34	24019.88	42045.4	23232.00	97%	$ 74,110.08	6.14	21.31	4.29	4370.41
N128	1	bioretention	0.74	0.52	1818.10	3713.4	2029.75	112%	$ 36,760.00	0.53	0.87	0.17	178.42
N129	1	Stormwater Management Pond	2.36	1.27	4576.55	8237.8	23872.00	522%	$ 76,151.68	1.78	2.77	0.56	568.94
N130	1	bioretention	1.59	0.89	3203.20	6406.4	3284.10	103%	$ 91,900.00	0.90	1.87	0.38	383.68
N131	1	Stormwater Management Pond	6.28	3.40	12247.60	22045.7	22500.00	184%	$ 71,775.00	4.11	7.38	1.48	1513.42
N132	1	bioretention	2.72	1.49	5358.20	9644.8	5026.88	94%	$ 128,660.00	1.40	3.20	0.64	656.38
N133	S1	Stormwater Management Pond	27.62	9.68	36629.23	65397.7	30312.00	83%	$ 96,695.28	8.01	32.45	6.53	6655.66
N134	S1	Stormwater Management Pond	12.64	4.33	16456.86	29288.1	21528.00	131%	$ 68,674.32	4.67	14.86	2.99	3046.63
N135	S1	Stormwater Management Pond	6.26	1.82	7085.78	11337.3	13792.00	195%	$ 43,996.48	2.25	7.36	1.48	1508.82
N136	S1	Stormwater Management Pond	9.81	3.14	12030.27	19279.1	17568.00	146%	$ 56,041.92	3.50	11.53	2.32	2364.00
N137	S1	Stormwater Management Pond	7.63	3.04	11313.57	20140.7	18512.00	164%	$ 59,053.28	3.52	8.96	1.80	1837.92
N138	S1	bioretention	1.67	0.72	2649.65	4769.4	4860.00	183%	$ 82,710.00	0.87	1.96	0.40	402.86
N139	S1	bioretention	0.42	0.26	911.39	1822.8	1335.75	147%	$ 38,827.75	0.29	0.49	0.10	100.71
N140	S1	bioretention	3.65	1.03	4040.08	6464.1	5101.50	126%	$ 128,660.00	1.10	4.29	0.86	879.94
N141	S1	bioretention	0.40	0.27	945.24	2079.5	1840.88	195%	$ 45,490.50	0.33	0.47	0.09	96.45
N142	S1	bioretention	1.59	0.95	3376.24	6752.5	1922.25	57%	$ 45,950.00	0.54	1.86	0.37	382.37

BMP #	Subwatershed Number	BMP Type	Total Drainage Area (Arces)	Drainage Area - Impervious (Acres)	WQ_v (FT^3) (Required)	ESD_v (FT^3) (Required)	SWM Volume (FT^3) (Provided)	% WQv Treated	Cost	Actual Impervious Area Treated (Acres)	N Removal (lbs/year)	P Removal (lbs/years)	Sediment Removal (lbs/year)
N143	S1	bioretention	1.91	0.93	3370.10	6066.2	4200.75	125%	$ 102,928.00	0.98	2.24	0.45	459.35
N144	S1	bioswale	2.24	1.28	4575.20	9150.4	2730.00	60%	$ 28,421.90	0.76	2.63	0.53	540.01
N145	S1	bioswale	0.23	0.13	474.18	948.4	936.00	197%	$ 17,490.40	0.16	0.27	0.05	55.89
N146	S1	bioretention	0.45	0.29	1034.42	2068.8	1137.00	110%	$ 27,570.00	0.30	0.53	0.11	107.98
N147	S1	bioswale	0.41	0.28	974.26	2143.4	936.00	96%	$ 17,490.40	0.26	0.48	0.10	98.03
N148	S1	bioswale	0.62	0.54	1861.53	4467.7	1980.00	106%	$ 26,235.60	0.54	0.73	0.15	148.88
N149	S1	bioretention	0.87	0.37	1365.39	2457.7	1446.75	106%	$ 33,084.00	0.37	1.02	0.21	210.19
N150	S1	bioretention	2.26	0.51	2083.91	2992.7	2743.50	132%	$ 68,925.00	0.55	2.66	0.53	545.04
N151	S1	bioretention	0.53	0.19	732.32	1318.2	908.25	124%	$ 22,056.00	0.21	0.62	0.13	127.84

*Sites N115, N116, N143, N144, N150 have multiple facilities proposed on site.

**Bioswale's with drainage areas over 1.0 acres will need drainage diversion or need to be split into mulitple facilites.

E.2 PROPOSED RETROFIT DESIGN SUMMARY

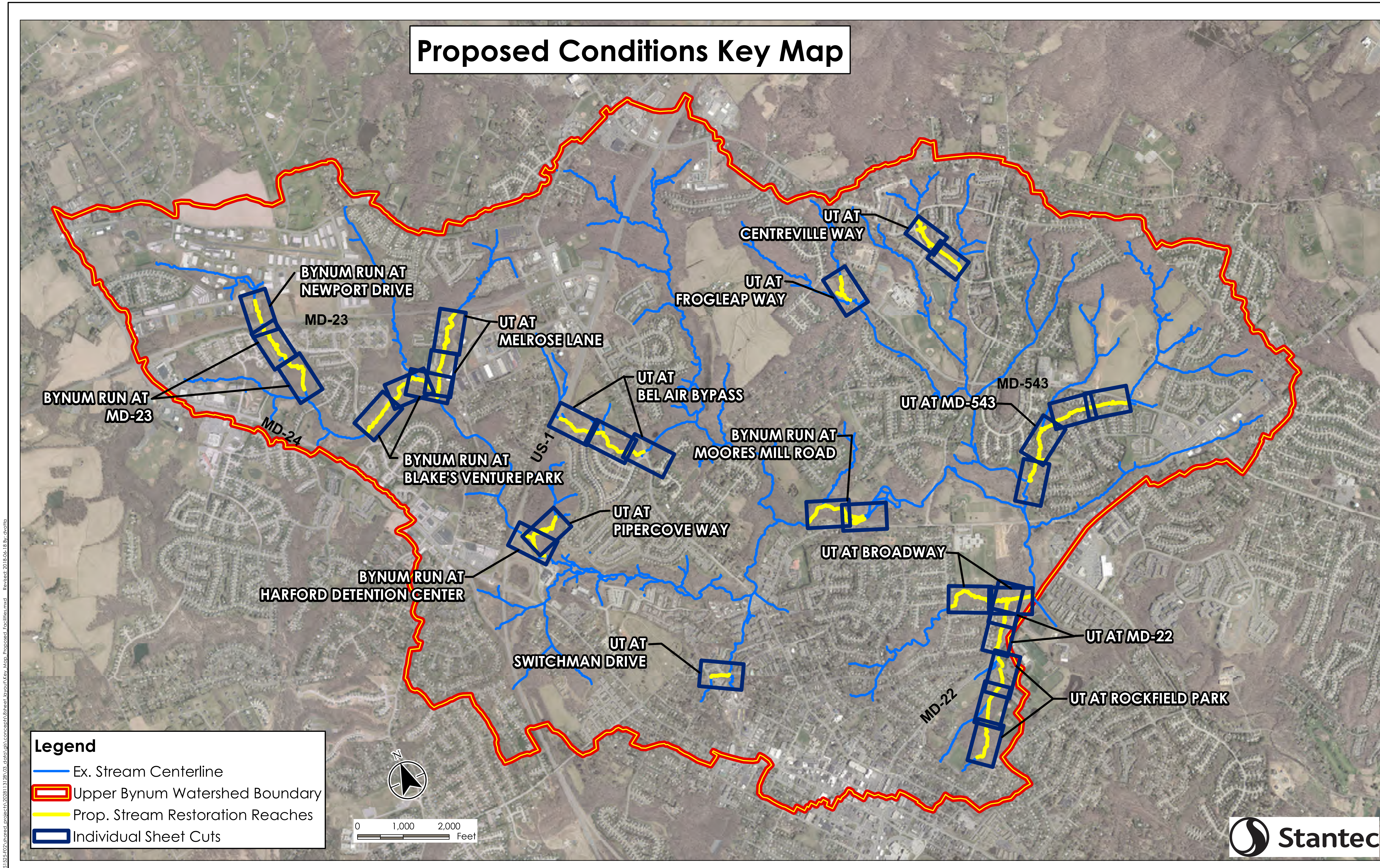
Proposed Retrofit Summary Table												
BMP ID	BMP Practice	Subwatershed #	Total Drainage Area (AC)	Total Impervious (AC)	% Impervious	Pervious (AC)	Impervious Acres Treated (AC)*	Cost ($)	N Removal (lbs/year)	P Removal (lbs/years)	Sediment Removal (lbs/year)
23	Bioretention	3	1.54	0.68	44.56	0.85	0.34	$60,654.00	1.250	0.190	259.583
25	Dry Extended Detention Ponds	N2	149.12	36.29	24.34	112.83	18.15	$464,591.46	121.314	18.479	25200.750
27	Stormwater Performance Standard-Stormwater Treatme	1	1.95	1.58	80.74	0.38	0.79	$17,310.09	1.588	0.242	329.903
31	Dry Extended Detention Ponds	3	2.89	1.99	69.05	0.89	1.00	$22,449.57	2.349	0.358	487.912
33	Dry Extended Detention Ponds	2	74.17	14.74	19.88	59.42	7.37	$196,588.30	60.335	9.191	12533.485
34	Bioretention	5	1.37	0.91	66.62	0.46	0.46	$82,710.00	1.115	0.170	231.624
35	Stormwater Performance Standard-Stormwater Treatme	2	1.94	1.80	92.54	0.15	0.90	$17,244.69	1.582	0.241	328.656
36	Stormwater Performance Standard-Stormwater Treatme	1	0.96	0.54	55.99	0.42	0.27	$8,553.27	0.785	0.120	163.012
38	Wet Pond and Wetland	2	2.32	0.78	33.73	1.54	0.39	$9,519.05	1.891	0.288	392.855
42	Stormwater Performance Standard-Stormwater Treatme	1	1.55	1.44	93.09	0.11	0.72	$13,759.17	1.262	0.192	262.228
52	Bioretention	2	9.29	2.86	30.78	6.43	1.43	$434,227.50	7.561	1.152	1570.585
74	Dry Extended Detention Ponds	5	2.17	1.56	72.15	0.60	0.78	$17,547.36	1.763	0.269	366.163
112	Wet Pond and Wetland	5	14.32	3.28	22.93	11.04	1.64	$42,520.48	11.651	1.775	2420.180
113	Wet Pond and Wetland	5	10.28	4.94	48.05	5.34	2.47	$57,442.46	8.365	1.274	1737.733
114	Dry Extended Detention Ponds	4	35.13	12.36	35.19	22.77	6.18	$149,149.36	28.575	4.353	5935.900
117	Dry Extended Detention Ponds	2	10.06	5.96	59.19	4.11	2.98	$67,909.30	8.187	1.247	1700.772
144	Wet Pond and Wetland	1	45.95	15.78	34.34	30.17	7.89	$191,048.31	37.380	5.694	7764.893
145	Wet Pond and Wetland	S1	38.89	13.31	34.24	25.57	6.66	$161,270.78	31.635	4.819	6571.541
148	Dry Extended Detention Ponds	2	17.80	7.59	42.62	10.21	3.79	$89,368.75	14.480	2.206	3007.977
156	Dry Extended Detention Ponds	N3	10.77	2.32	21.51	8.46	1.16	$30,386.41	8.765	1.335	1820.805
157	Dry Extended Detention Ponds	N3	15.13	5.28	34.89	9.85	2.64	$63,775.07	12.309	1.875	2556.892
158	Dry Extended Detention Ponds	2	5.37	1.93	35.88	3.44	0.96	$23,185.43	4.367	0.665	907.230
159	Dry Extended Detention Ponds	5	6.42	2.47	38.50	3.95	1.24	$29,468.71	5.222	0.795	1084.710
161	Dry Extended Detention Ponds	3	43.50	27.82	63.95	15.68	13.91	$315,116.79	35.388	5.390	7351.147
162	Dry Extended Detention Ponds	5	5.55	2.18	39.30	3.37	1.09	$25,935.01	4.513	0.687	937.498
163	Dry Extended Detention Ponds	1	22.27	9.55	42.89	12.72	4.78	$112,452.56	18.119	2.760	3763.911
164	Dry Extended Detention Ponds	1	10.76	2.53	23.52	8.23	1.27	$32,607.22	8.754	1.333	1818.534
165	Dry Extended Detention Ponds	1	8.63	3.38	39.19	5.24	1.69	$40,224.36	7.017	1.069	1457.618
166	Dry Extended Detention Ponds	1	23.83	7.49	31.43	16.34	3.75	$91,863.90	19.389	2.953	4027.624
167	Dry Extended Detention Ponds	1	16.43	6.36	38.68	10.08	3.18	$75,765.25	13.369	2.036	2777.161
168	Dry Extended Detention Ponds	1	3.83	1.71	44.58	2.12	0.85	$19,995.48	3.113	0.474	646.706
169	Dry Extended Detention Ponds	3	26.15	8.27	31.64	17.88	4.14	$101,366.38	21.274	3.241	4419.338
170	Dry Extended Detention Ponds	5	53.14	25.81	48.56	27.33	12.90	$299,714.85	43.230	6.585	8980.146
171	Dry Extended Detention Ponds	5	49.06	29.56	60.26	19.50	14.78	$336,515.89	39.912	6.080	8290.922
172	Dry Extended Detention Ponds	N3	28.07	10.38	36.98	17.69	5.19	$124,439.09	22.839	3.479	4744.353
173	Wet Pond and Wetland	2	75.85	13.27	17.49	62.59	6.63	$182,170.55	61.708	9.400	12818.660
174	Dry Extended Detention Ponds	2	2.03	0.72	35.50	1.31	0.36	$8,702.55	1.655	0.252	343.739
175	Dry Extended Detention Ponds	5	4.20	1.62	38.62	2.58	0.81	$19,325.90	3.415	0.520	709.321
176	Dry Extended Detention Ponds	5	19.22	8.84	45.99	10.38	4.42	$103,271.72	15.638	2.382	3248.466
179	Dry Extended Detention Ponds	N3	42.58	15.27	35.87	27.31	7.64	$183,842.63	34.639	5.276	7195.677
180	Dry Extended Detention Ponds	1	7.29	3.56	48.85	3.73	1.78	$41,345.47	5.932	0.904	1232.352

BMP ID	BMP Practice	Subwatershed #	Total Drainage Area (AC)	Total Impervious (AC)	% Impervious	Pervious (AC)	Impervious Acres Treated (AC)*	Cost ($)	N Removal (lbs/year)	P Removal (lbs/years)	Sediment Removal (lbs/year)
181	Dry Extended Detention Ponds	2	9.27	2.71	29.27	6.56	1.36	$33,649.09	7.541	1.149	1566.546
184	Wet Pond and Wetland	5	55.67	27.91	50.14	27.76	13.95	$323,090.80	45.285	6.898	9407.201
190	Dry Extended Detention Ponds	3	6.00	3.07	51.14	2.93	1.54	$35,482.20	4.885	0.744	1014.795
191	Dry Extended Detention Ponds	5	12.78	4.99	39.01	7.80	2.49	$59,365.09	10.399	1.584	2160.206
194	Bioretention	5	2.15	1.86	86.54	0.29	0.93	$121,308.00	1.752	0.267	363.963
195	Bioretention	5	0.61	0.21	35.42	0.39	0.11	$20,218.00	0.493	0.075	102.409
196	Wet Pond and Wetland	3	50.19	23.07	45.96	27.13	11.53	$269,445.16	40.832	6.220	8481.972
202	Dry Extended Detention Ponds	5	11.07	3.87	34.95	7.20	1.94	$46,747.61	9.009	1.372	1871.349

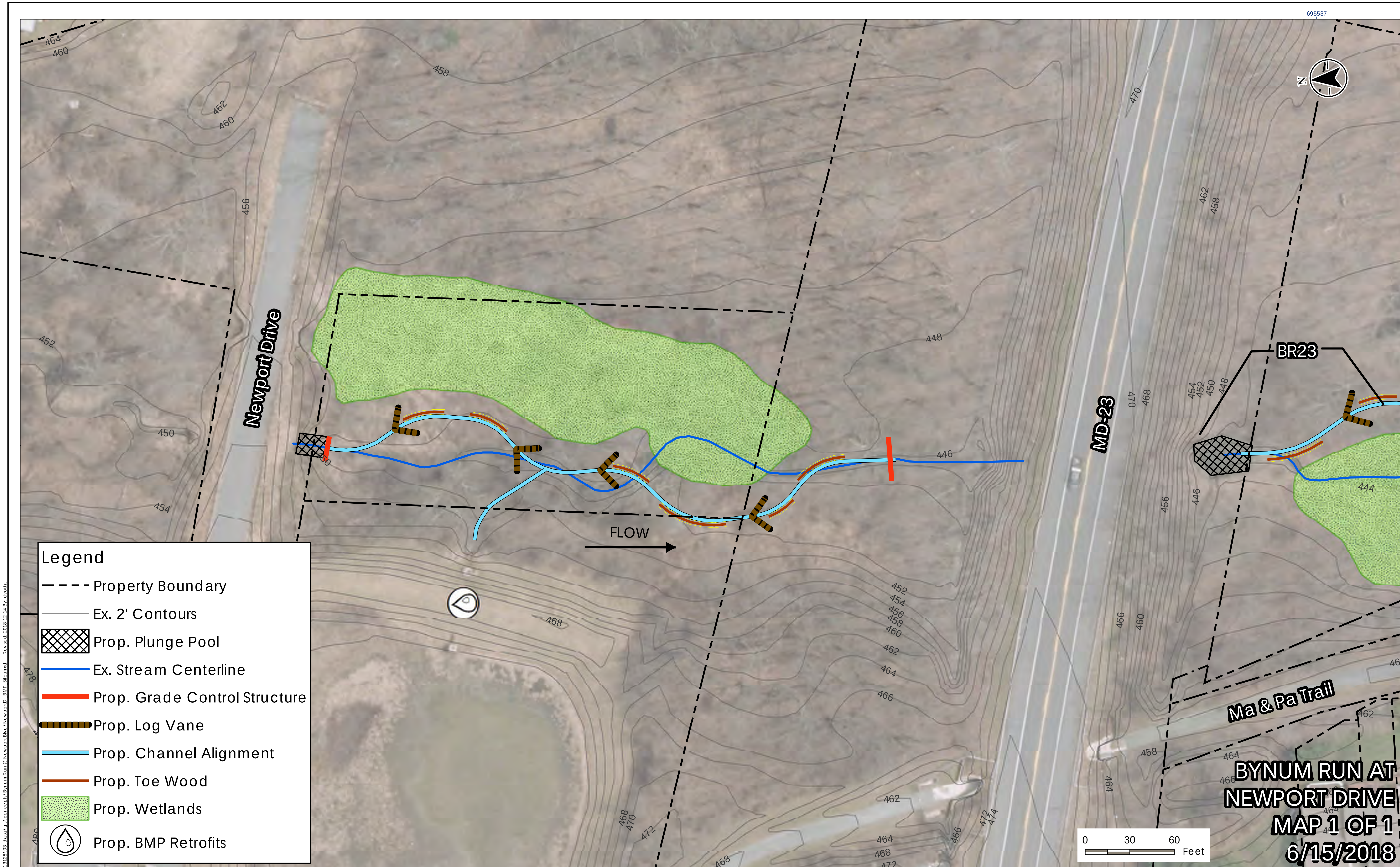
*Assume Existing BMP treats impervious at 50% efficiency and new retrofit will treat 100% of impervious not being treated by existing BMP

Appendix F

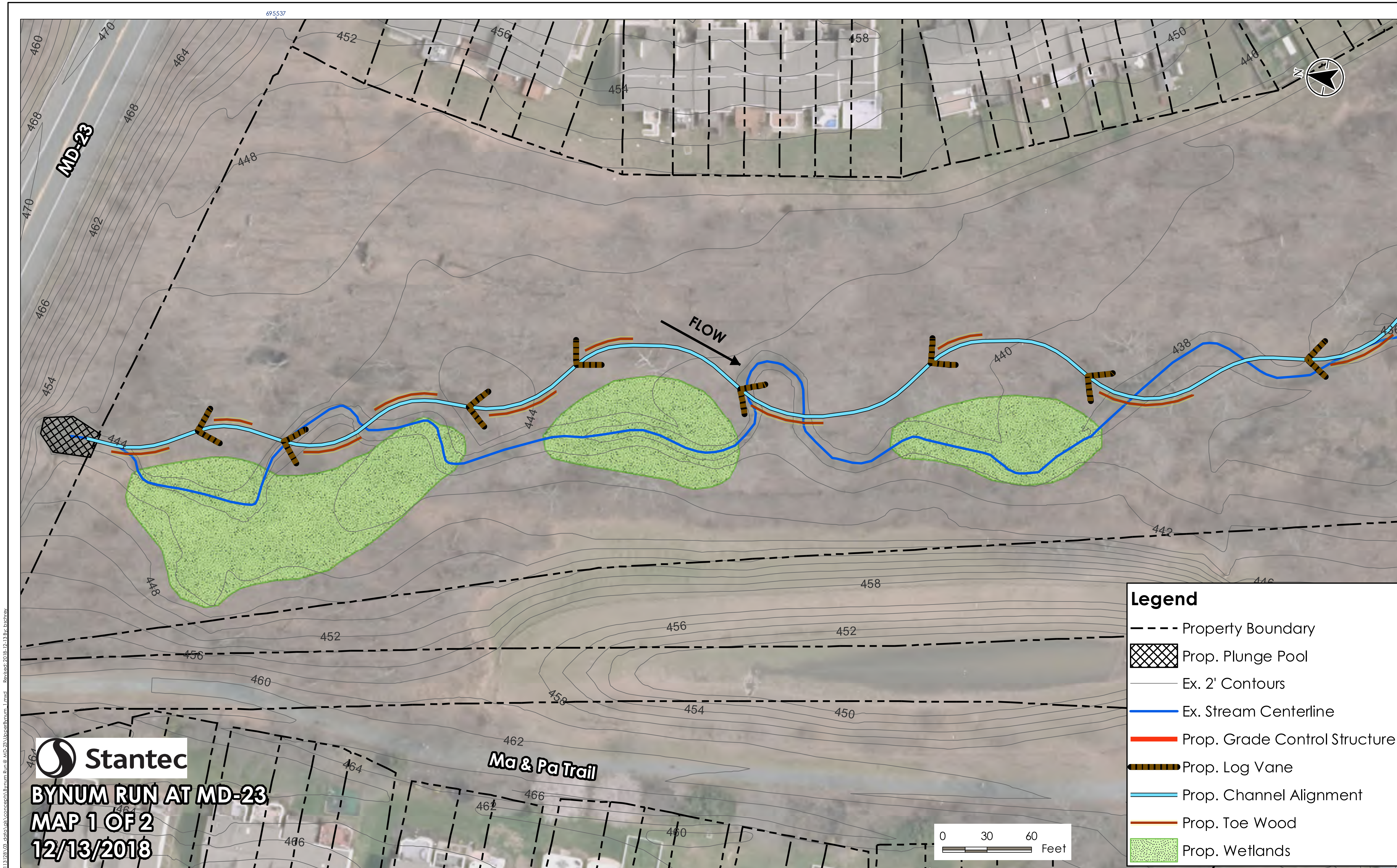
F.1 PROPOSED STREAM DESIGN FIGURES


Proposed Conditions Key Map
BYNUM RUN AT NEWPORT DRIVE
MD-23
UT AT MELROSE LANE
BYNUM RUN AT MD-23
MD-24
BYNUM RUN AT BLAKE'S VENTURE PARK
US-1
UT AT BEL AIR BYPASS
UT AT CENTREVILLE WAY
UT AT FROGLEAP WAY
BYNUM RUN AT MOORES MILL ROAD
MD-543
UT AT MD-543
UT AT PIPERCOVE WAY
BYNUM RUN AT HARFORD DETENTION CENTER
UT AT BROADWAY
UT AT MD-22
UT AT SWITCHMAN DRIVE
UT AT ROCKFIELD PARK
MD-22
Legend
Ex. Stream Centerline
Upper Bynum Watershed Boundary
Prop. Stream Restoration Reaches
Individual Sheet Cuts
N
0
1,000
2,000
Feet
Stantec

KEY MAP



Newport Drive
MD-23
Ma & Pa Trail
BR23
FLOW
Legend
Property Boundary
Ex. 2' Contours
Prop. Plunge Pool
Ex. Stream Centerline
Prop. Grade Control Structure
Prop. Log Vane
Prop. Channel Alignment
Prop. Toe Wood
Prop. Wetlands
Prop. BMP Retrofits
0 30 60 Feet
BYNUM RUN AT
NEWPORT DRIVE
MAP 1 OF 1
6/15/2018



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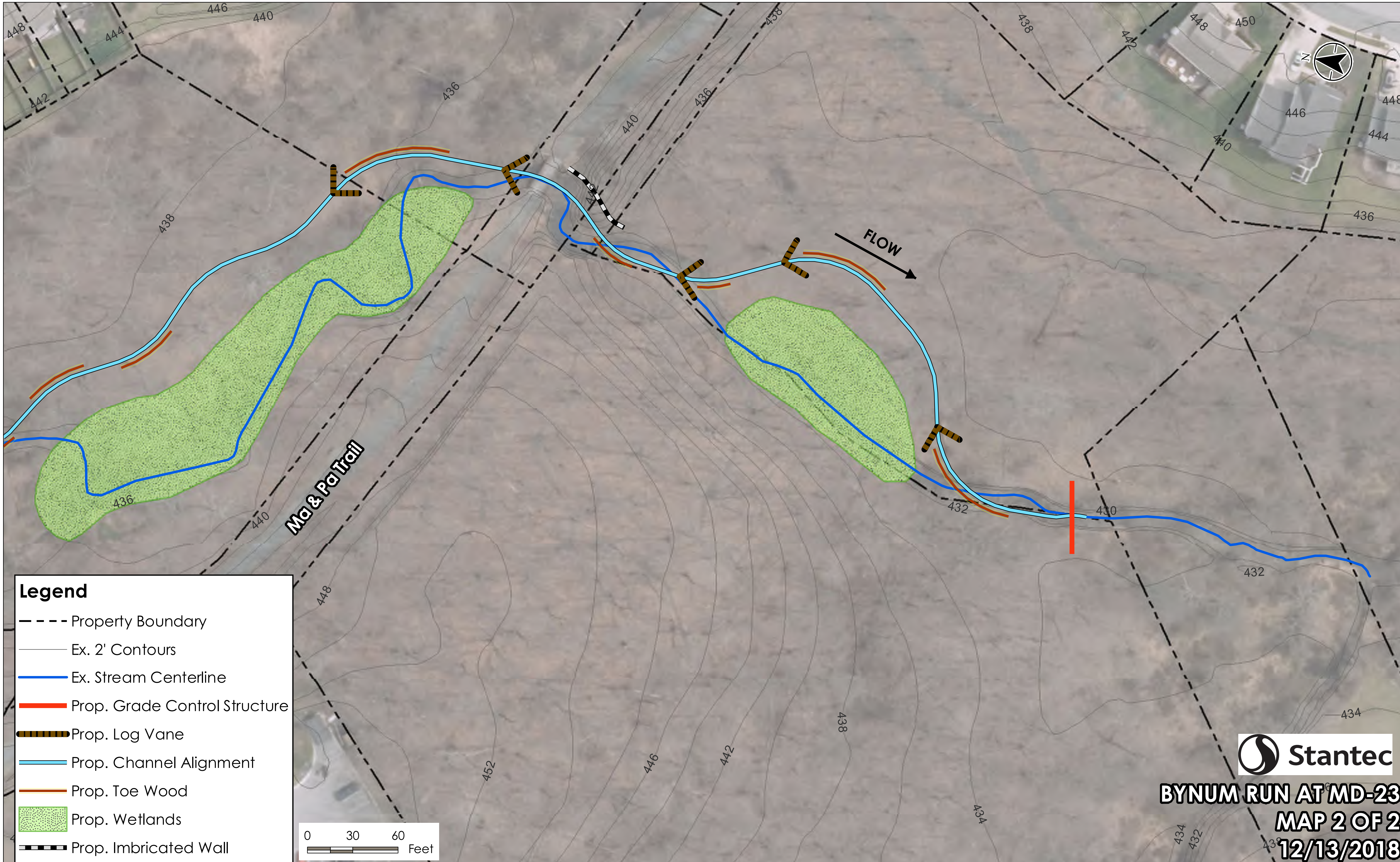
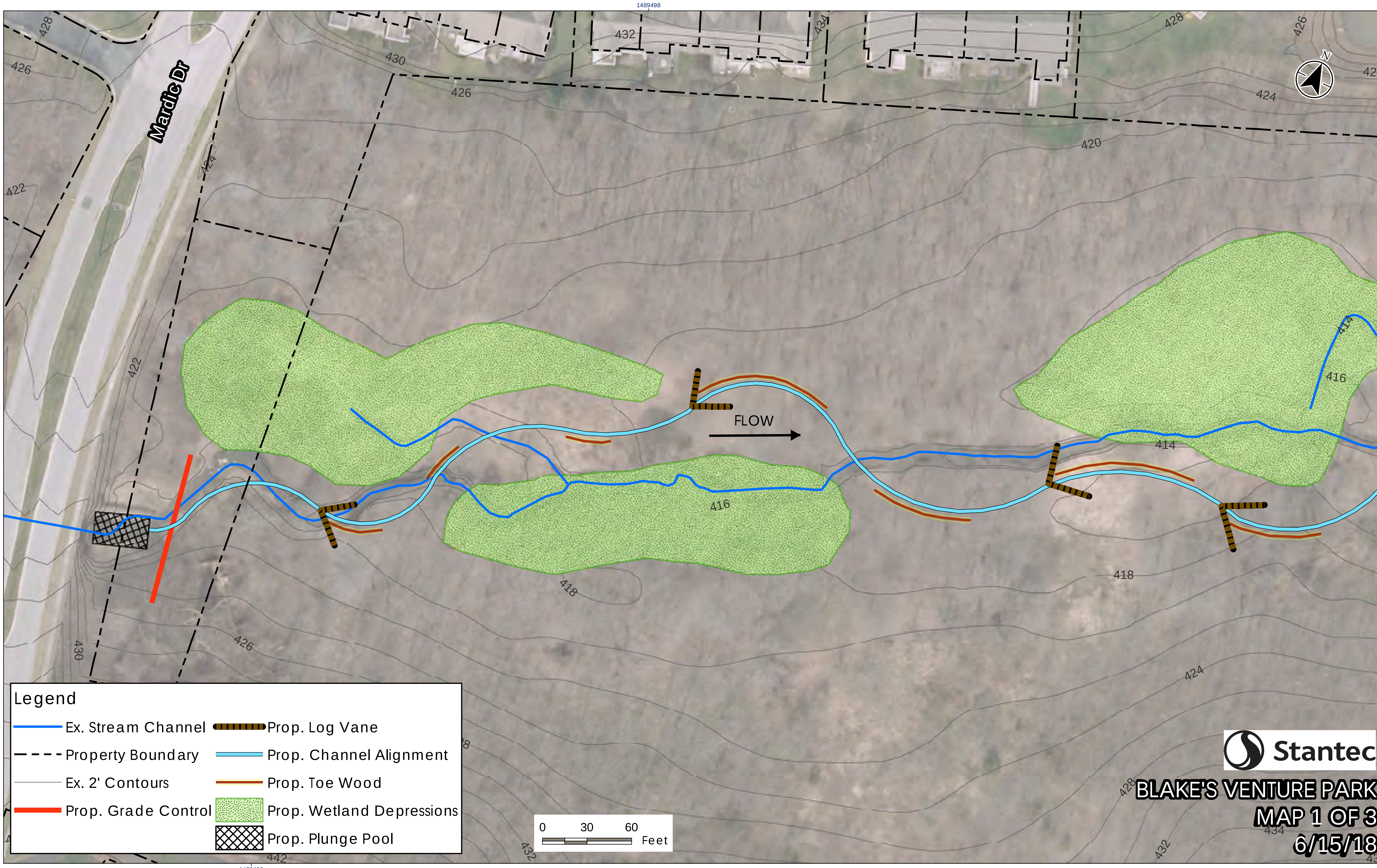

Legend
Property Boundary
Ex. 2' Contours
Ex. Stream Centerline
Prop. Grade Control Structure
Prop. Log Vane
Prop. Channel Alignment
Prop. Toe Wood
Prop. Wetlands
Prop. Imbricated Wall
0 30 60 Feet
Ma & Pa Trail
FLOW
N
Stantec
BYNUM RUN AT MD-23
MAP 2 OF 2
12/13/2018



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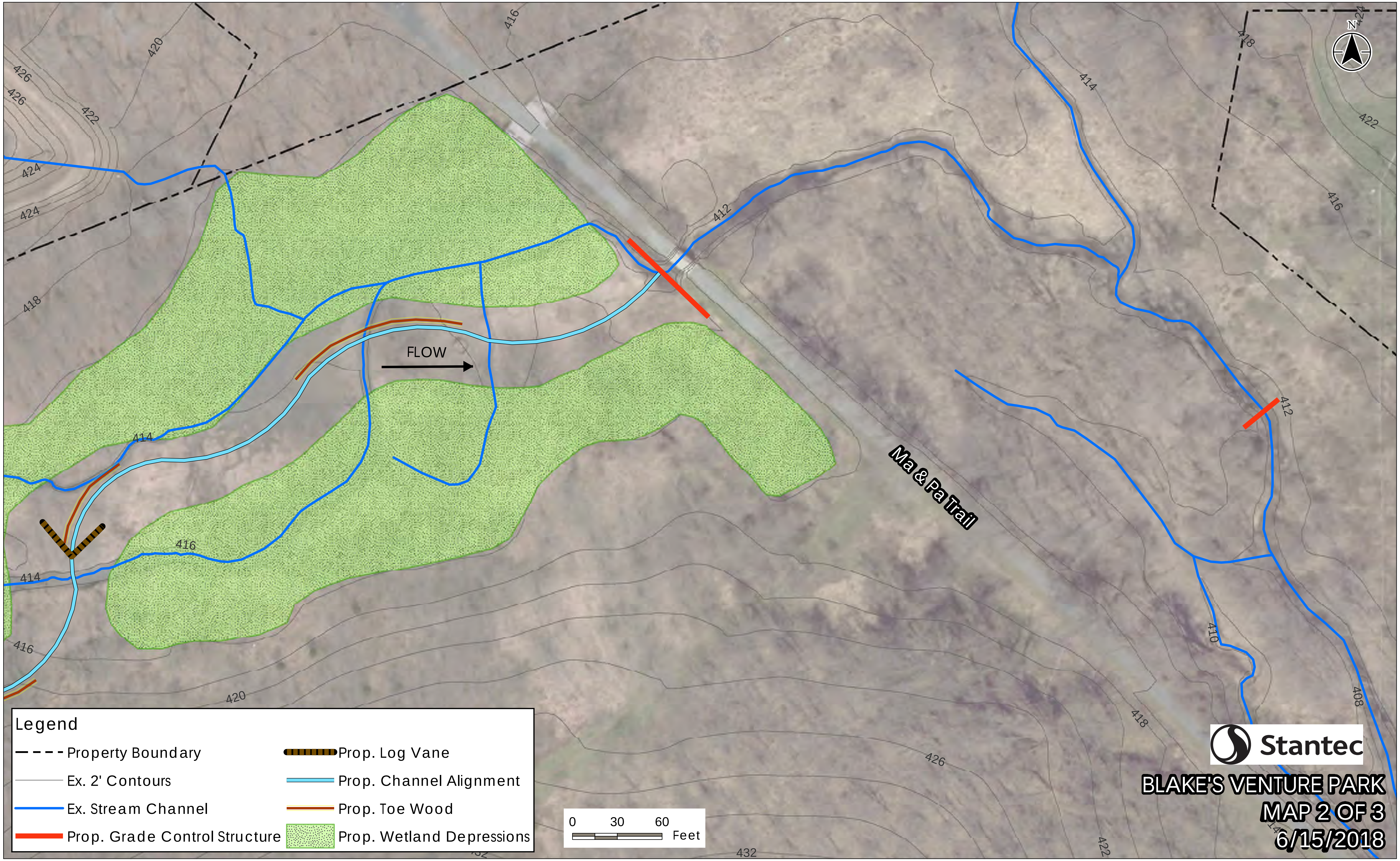
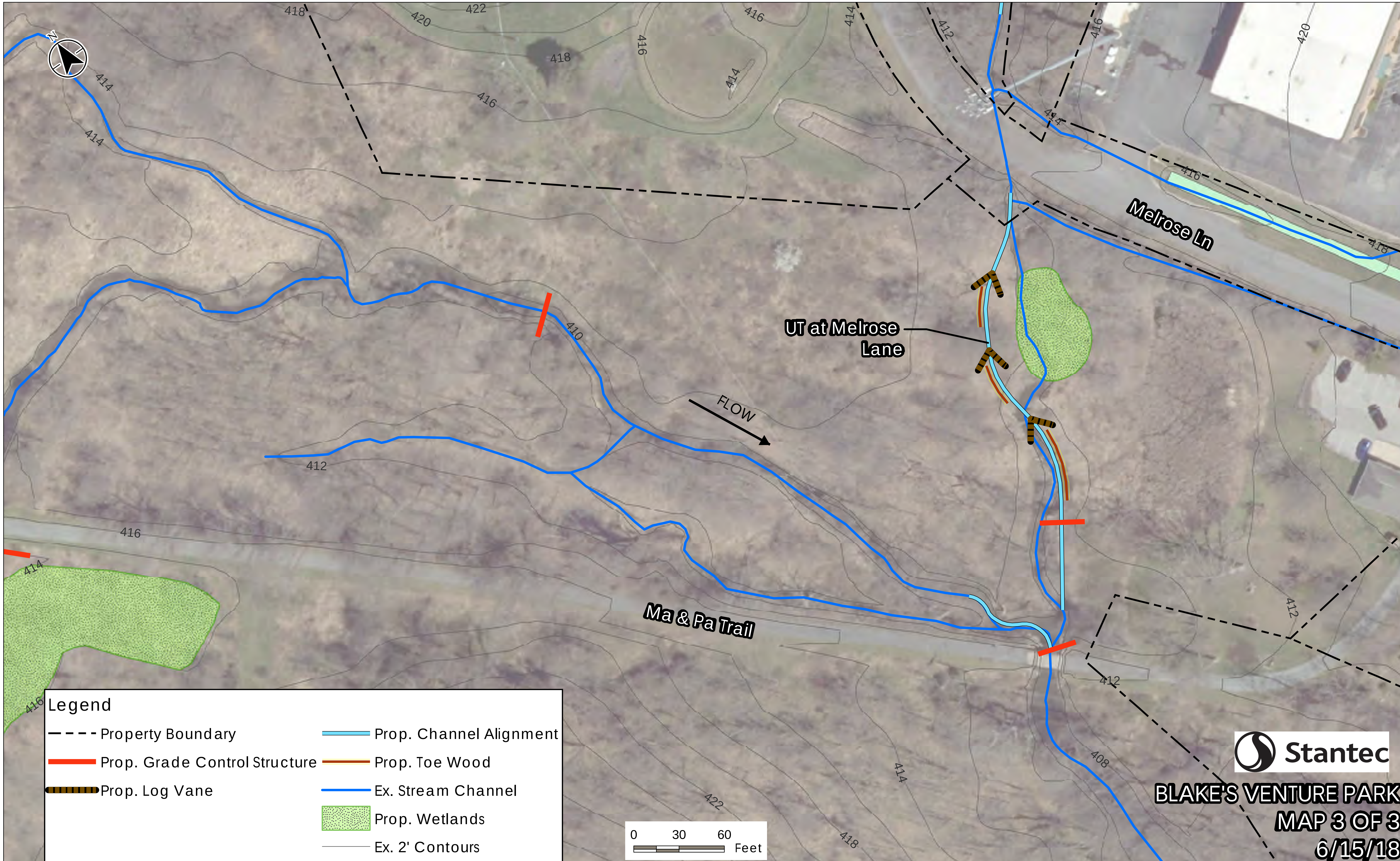
\\US1525-F02\shared_projects\202811312\8\03_data\gis\concepts\Bynum Run @ Blake's Venture\BlakesVenturePark_1.mxd Revised: 2018-06-15 By: dvotta


FLOW
Ma & Pa Trail
Legend
Property Boundary
Ex. 2' Contours
Ex. Stream Channel
Prop. Grade Control Structure
Prop. Log Vane
Prop. Channel Alignment
Prop. Toe Wood
Prop. Wetland Depressions
0 30 60
Feet
Stantec
BLAKE'S VENTURE PARK
MAP 2 OF 3
6/15/2018



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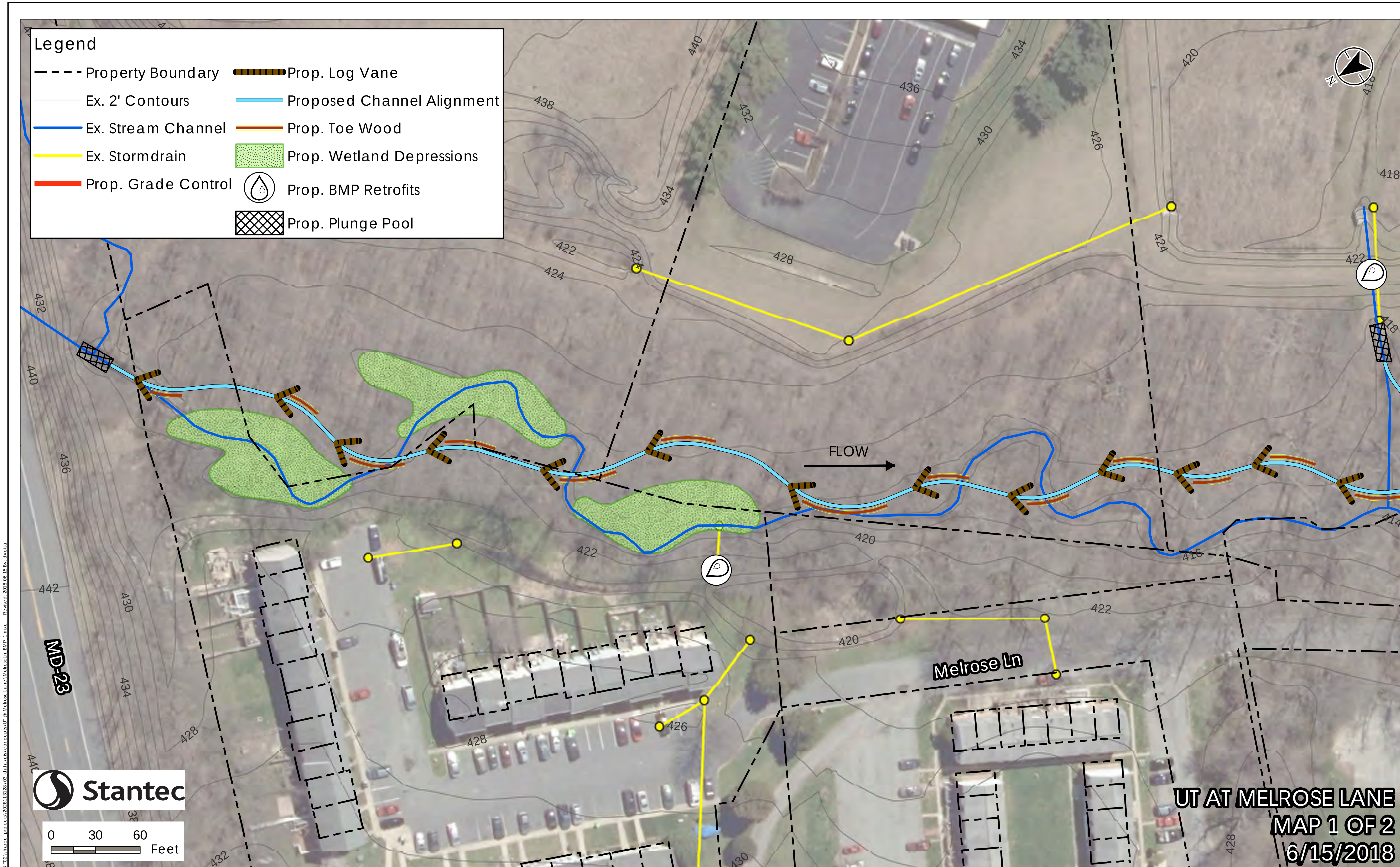
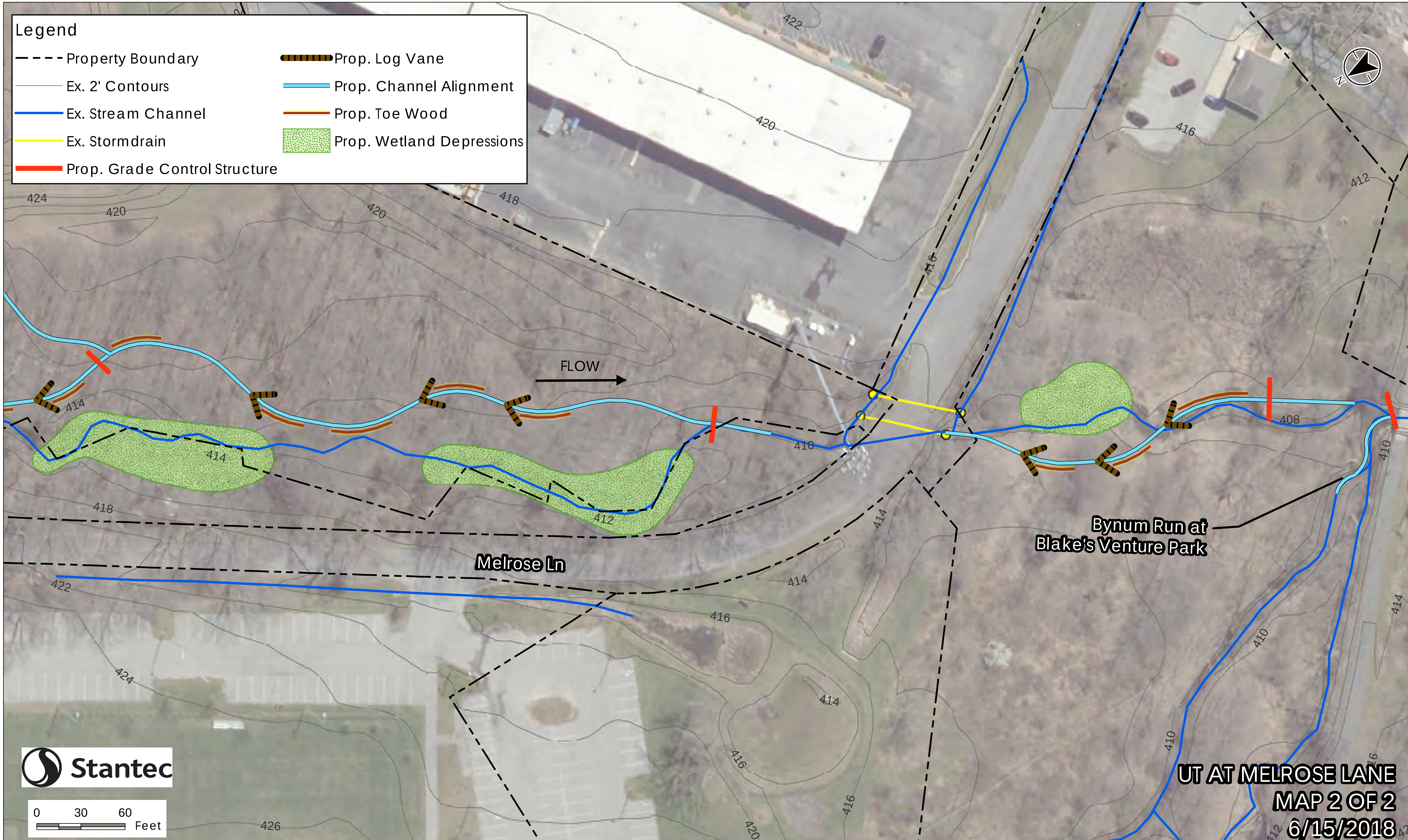
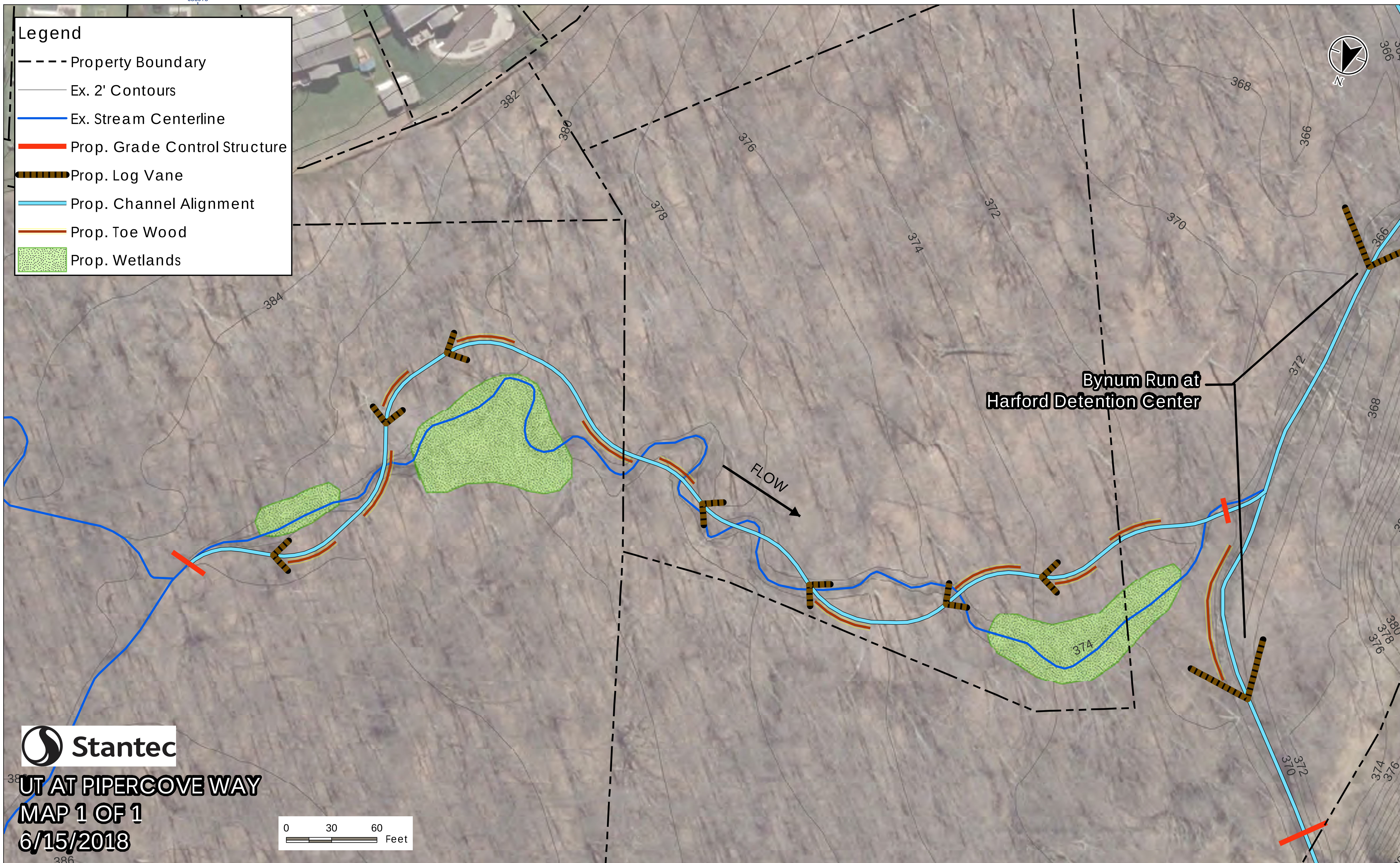
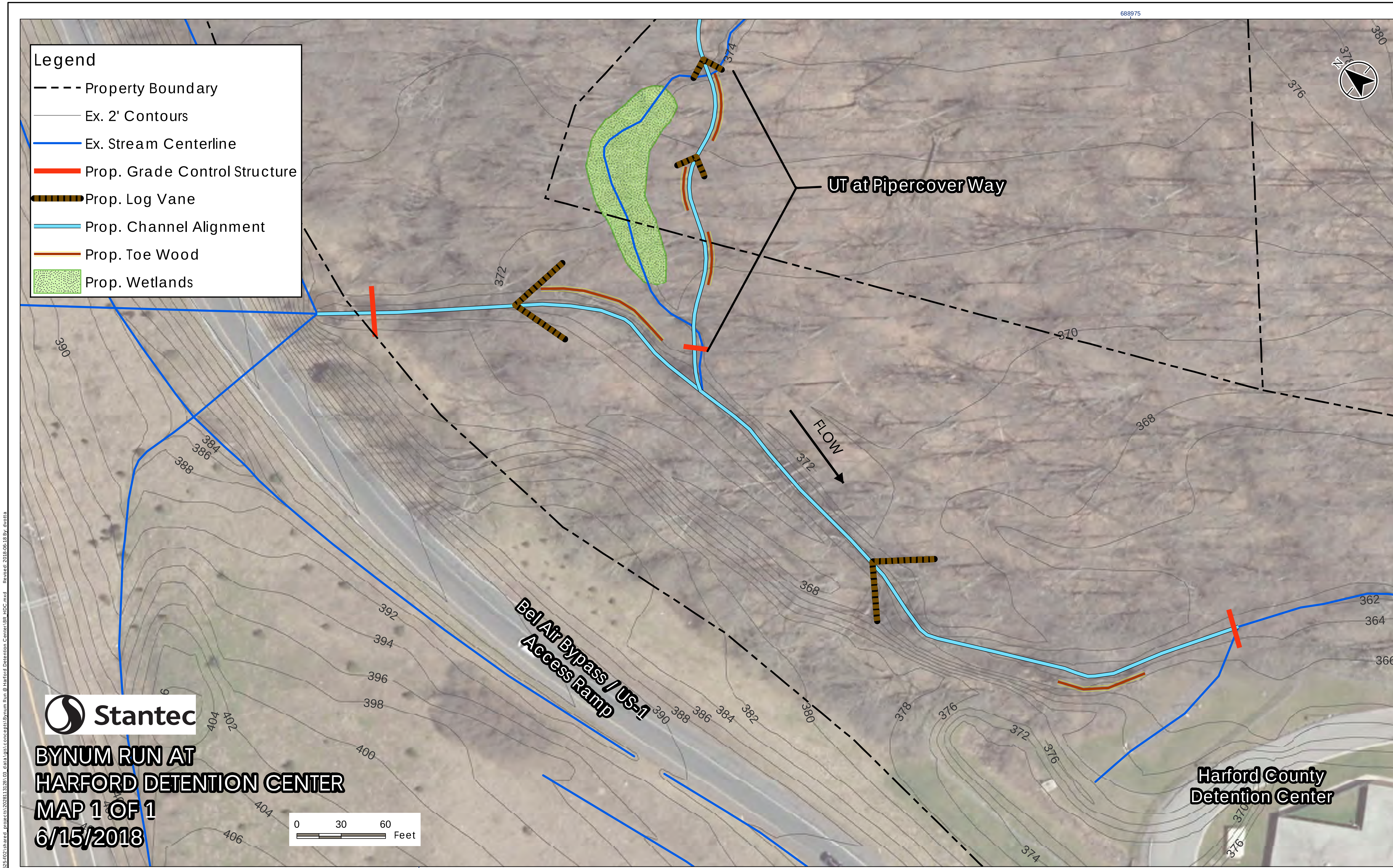

Legend
Property Boundary
Ex. 2' Contours
Ex. Stream Channel
Ex. Stormdrain
Prop. Grade Control
Prop. Log Vane
Proposed Channel Alignment
Prop. Toe Wood
Prop. Wetland Depressions
Prop. BMP Retrofits
Prop. Plunge Pool
FLOW
Melrose Ln
MD-23
Stantec
0 30 60
Feet
UT AT MELROSE LANE
MAP 1 OF 2
6/15/2018



Legend
Property Boundary
Ex. 2' Contours
Ex. Stream Channel
Ex. Stormdrain
Prop. Grade Control Structure
Prop. Log Vane
Prop. Channel Alignment
Prop. Toe Wood
Prop. Wetland Depressions
FLOW
Melrose Ln
Bynum Run at Blake's Venture Park
Stantec
0 30 60 Feet
UT AT MELROSE LANE
MAP 2 OF 2
6/15/2018


Legend
Property Boundary
Ex. 2' Contours
Ex. Stream Centerline
Prop. Grade Control Structure
Prop. Log Vane
Prop. Channel Alignment
Prop. Toe Wood
Prop. Wetlands
FLOW
Bynum Run at
Harford Detention Center
Stantec
UT AT PIPERCOVE WAY
MAP 1 OF 1
6/15/2018
0 30 60
Feet
N



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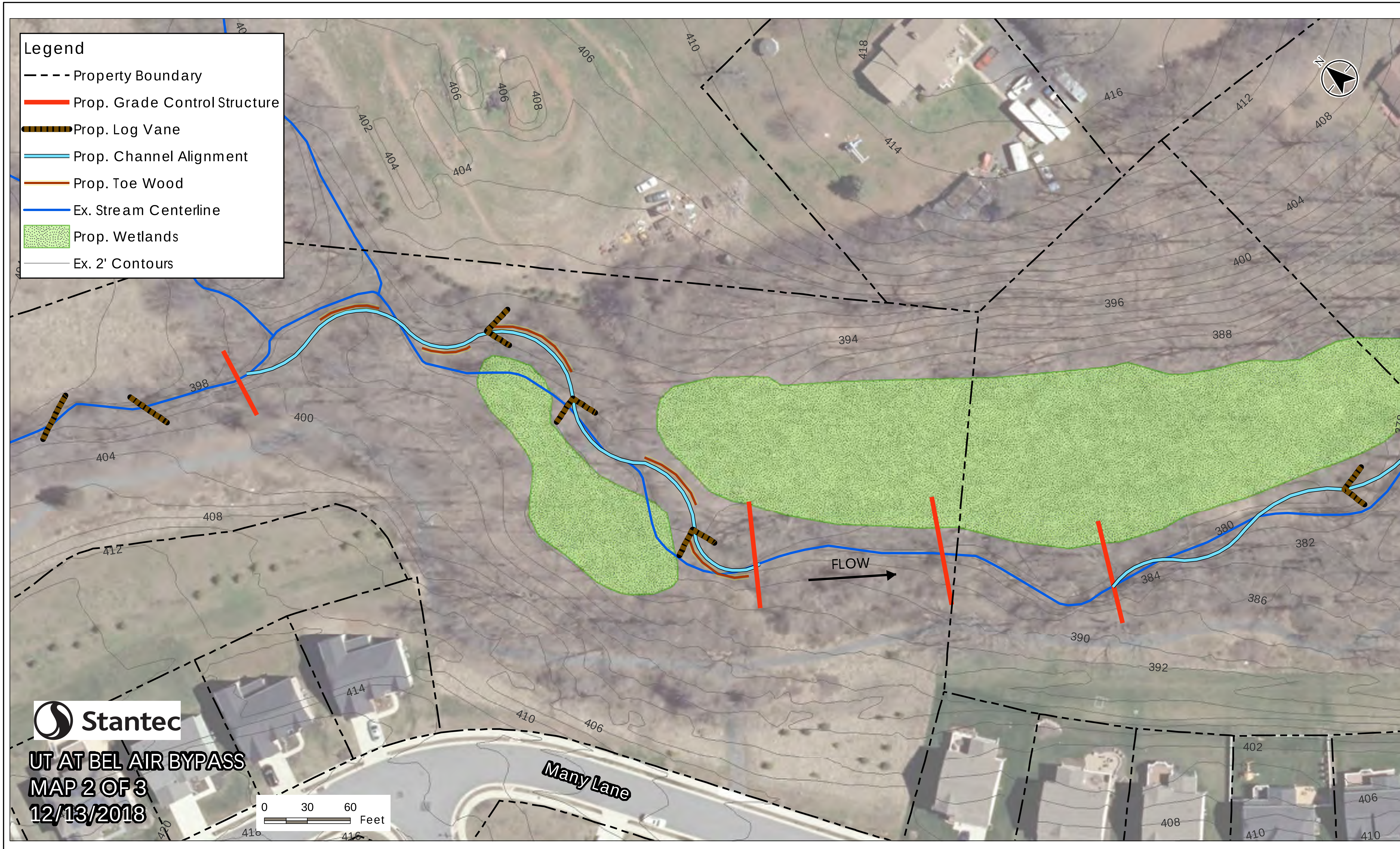

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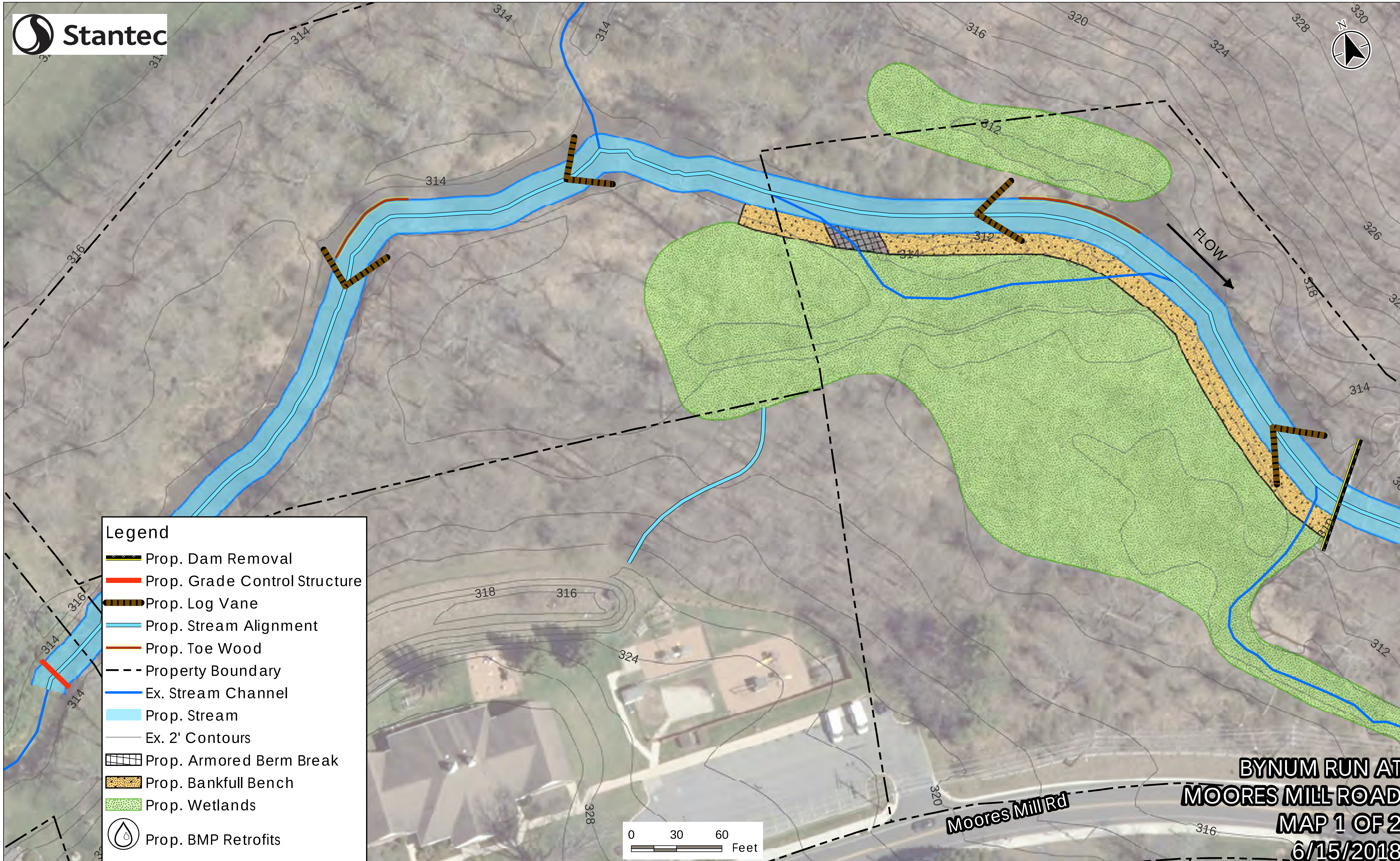

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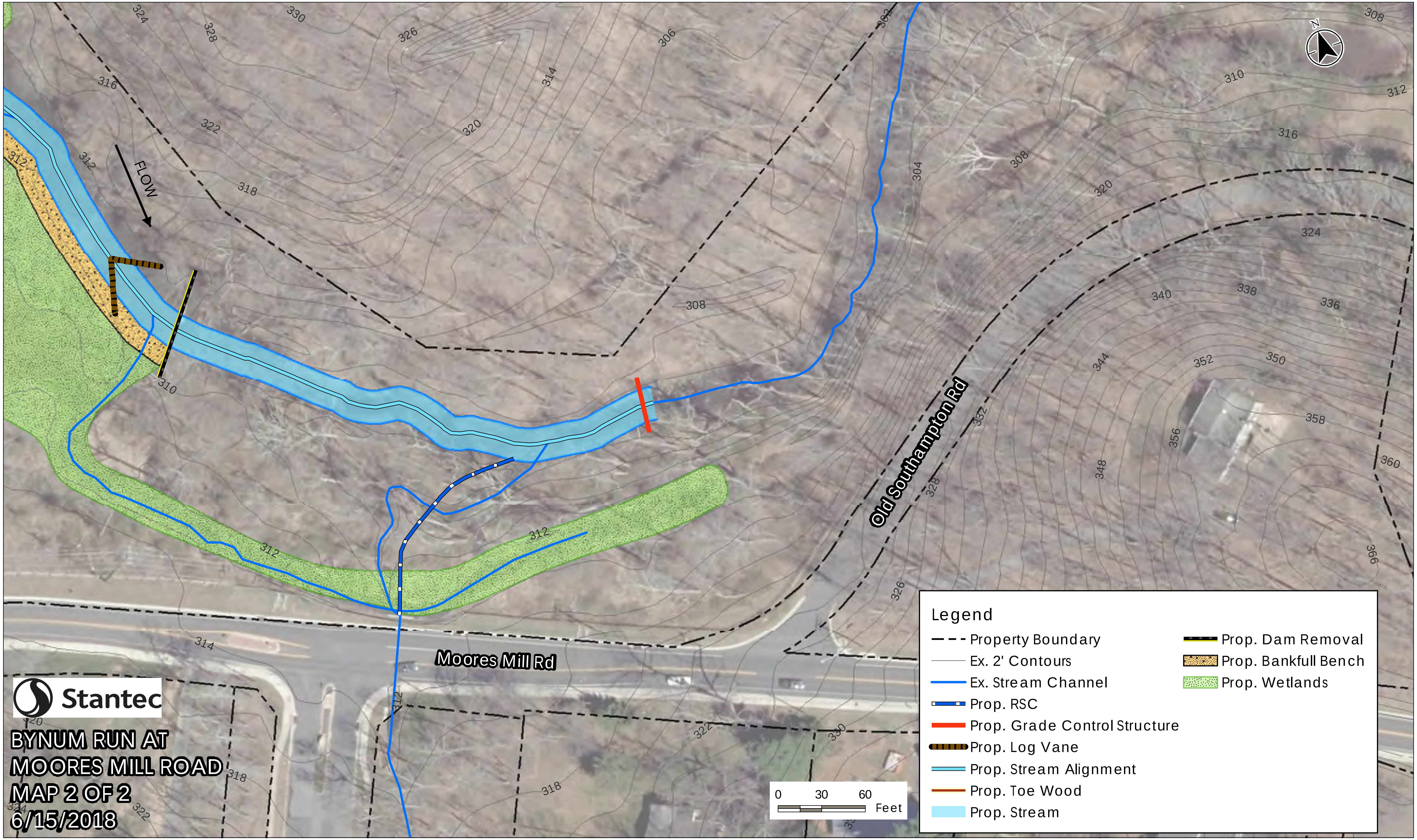

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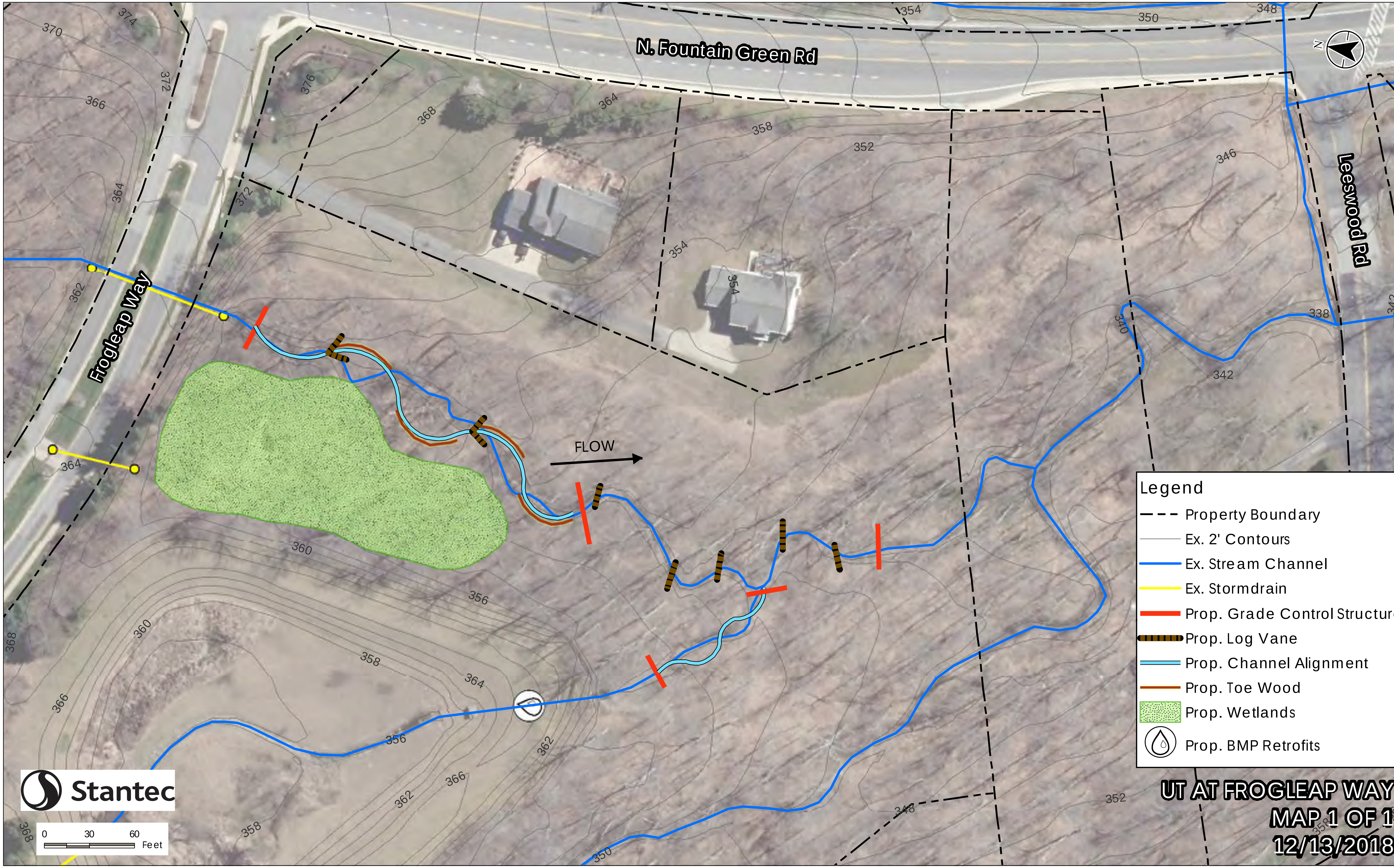

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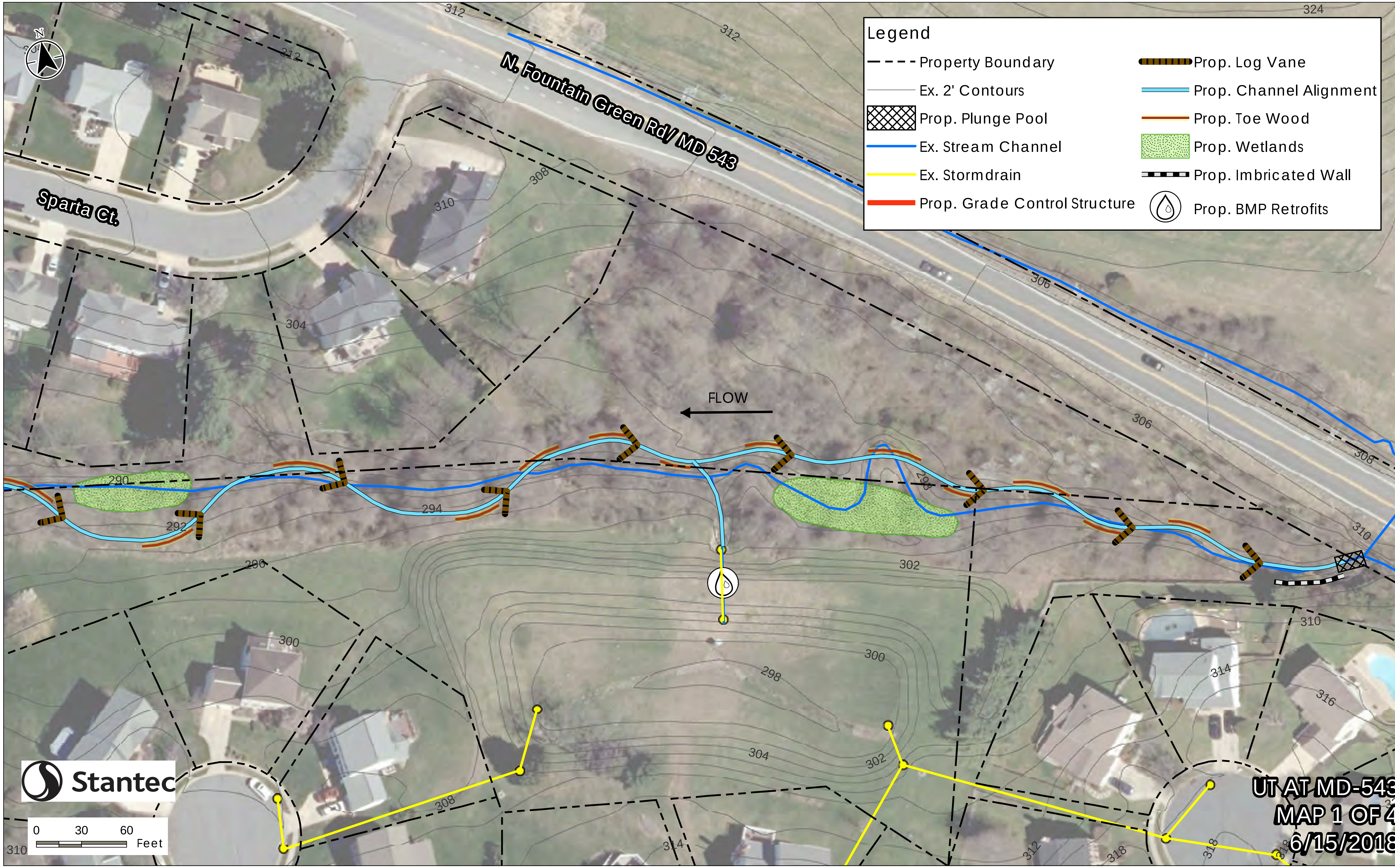
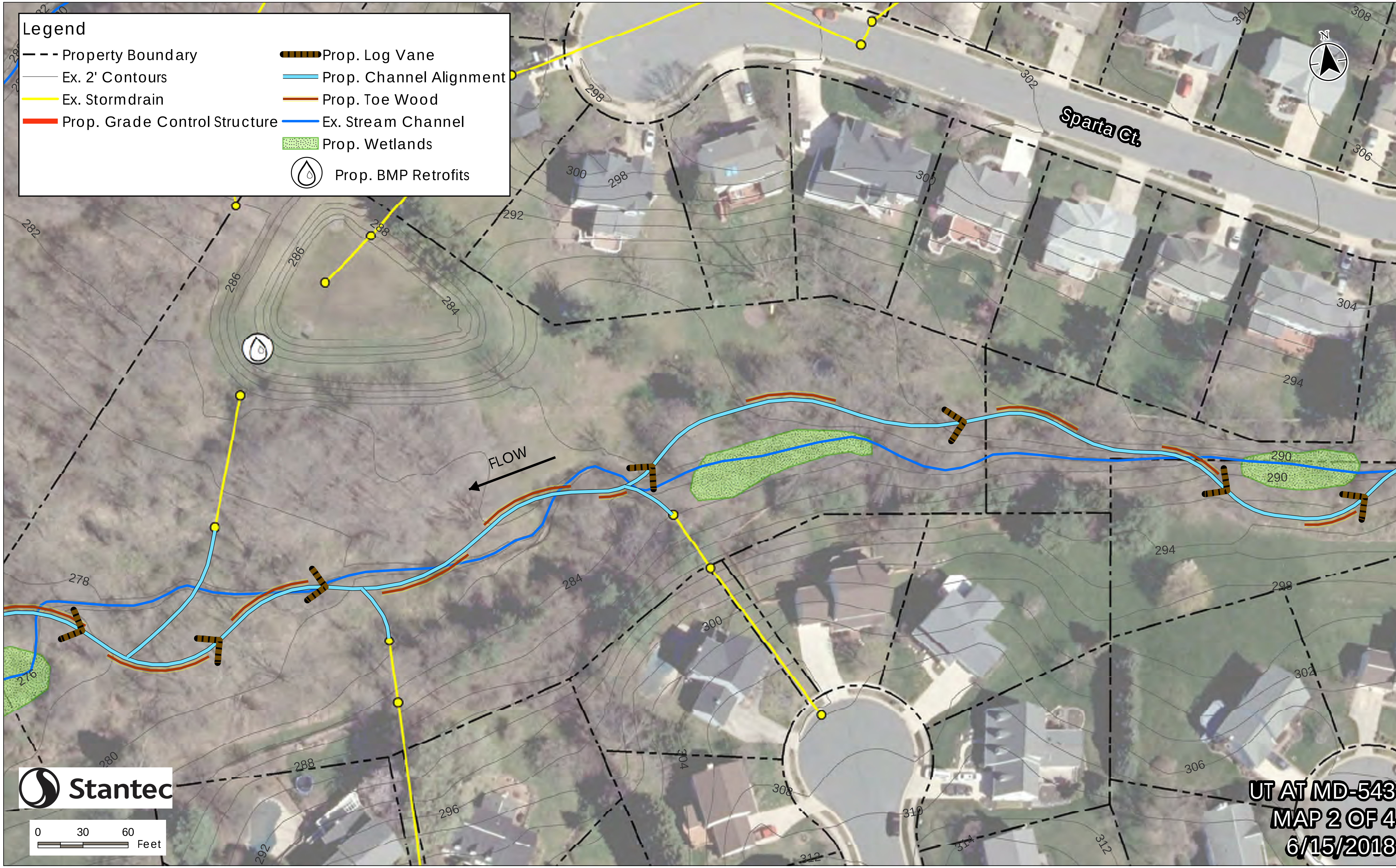

Legend
Property Boundary
Ex. 2' Contours
Prop. Plunge Pool
Ex. Stream Channel
Ex. Stormdrain
Prop. Grade Control Structure
Prop. Log Vane
Prop. Channel Alignment
Prop. Toe Wood
Prop. Wetlands
Prop. Imbricated Wall
Prop. BMP Retrofits
N. Fountain Green Rd/ MD 543
Sparta Ct.
FLOW
N
Stantec
0 30 60 Feet
UT AT MD-543
MAP 1 OF 4
6/15/2018



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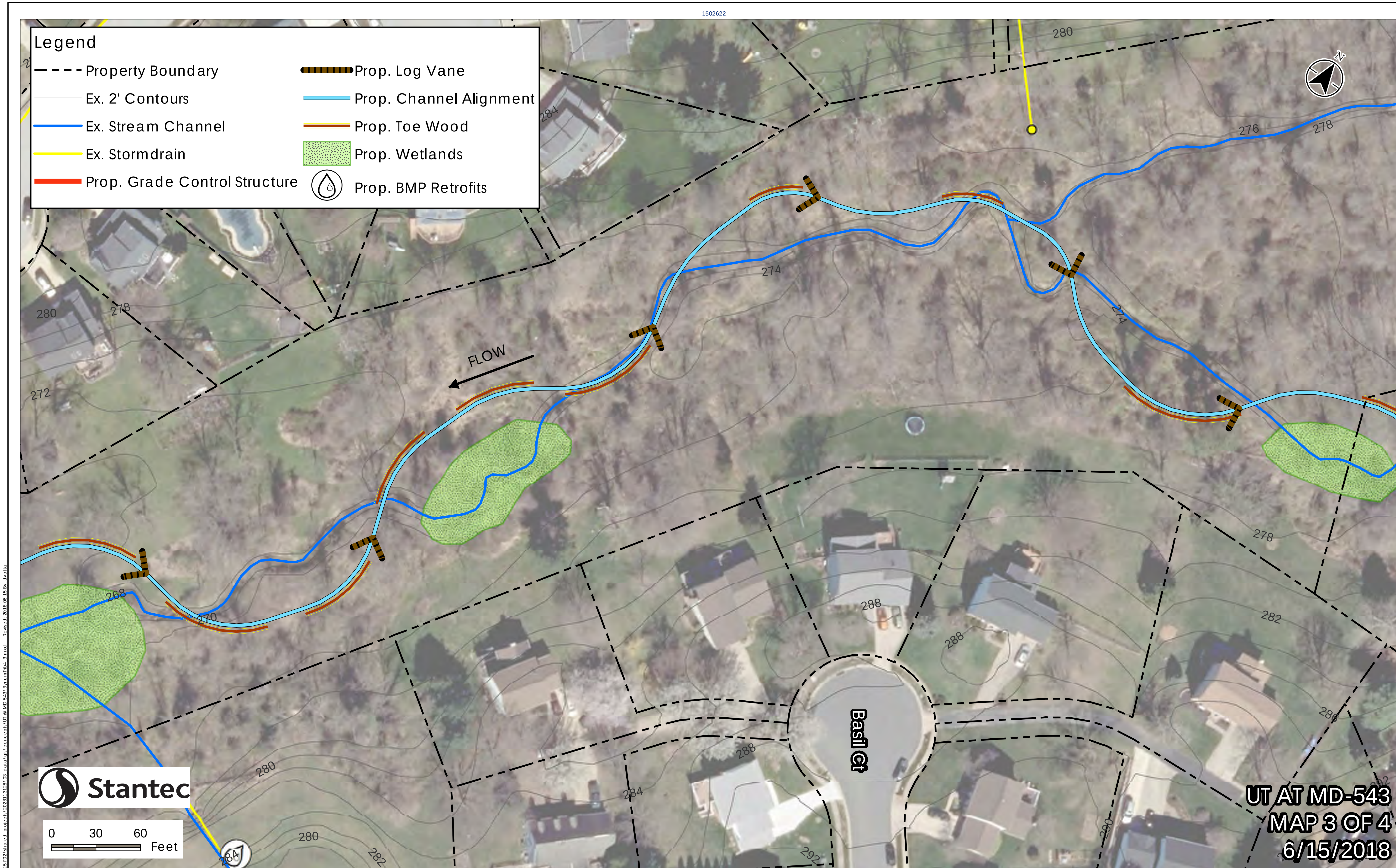

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Legend
Property Boundary
Ex. 2' Contours
Ex. Stream Channel
Ex. Stormdrain
Prop. Grade Control Structure
Prop. Log Vane
Prop. Channel Alignment
Prop. Toe Wood
Prop. Wetlands
Proposed BMP Retrofits
FLOW
Stantec
0 30 60 Feet
UT AT 543
MAP 4 OF 4
6/15/2018

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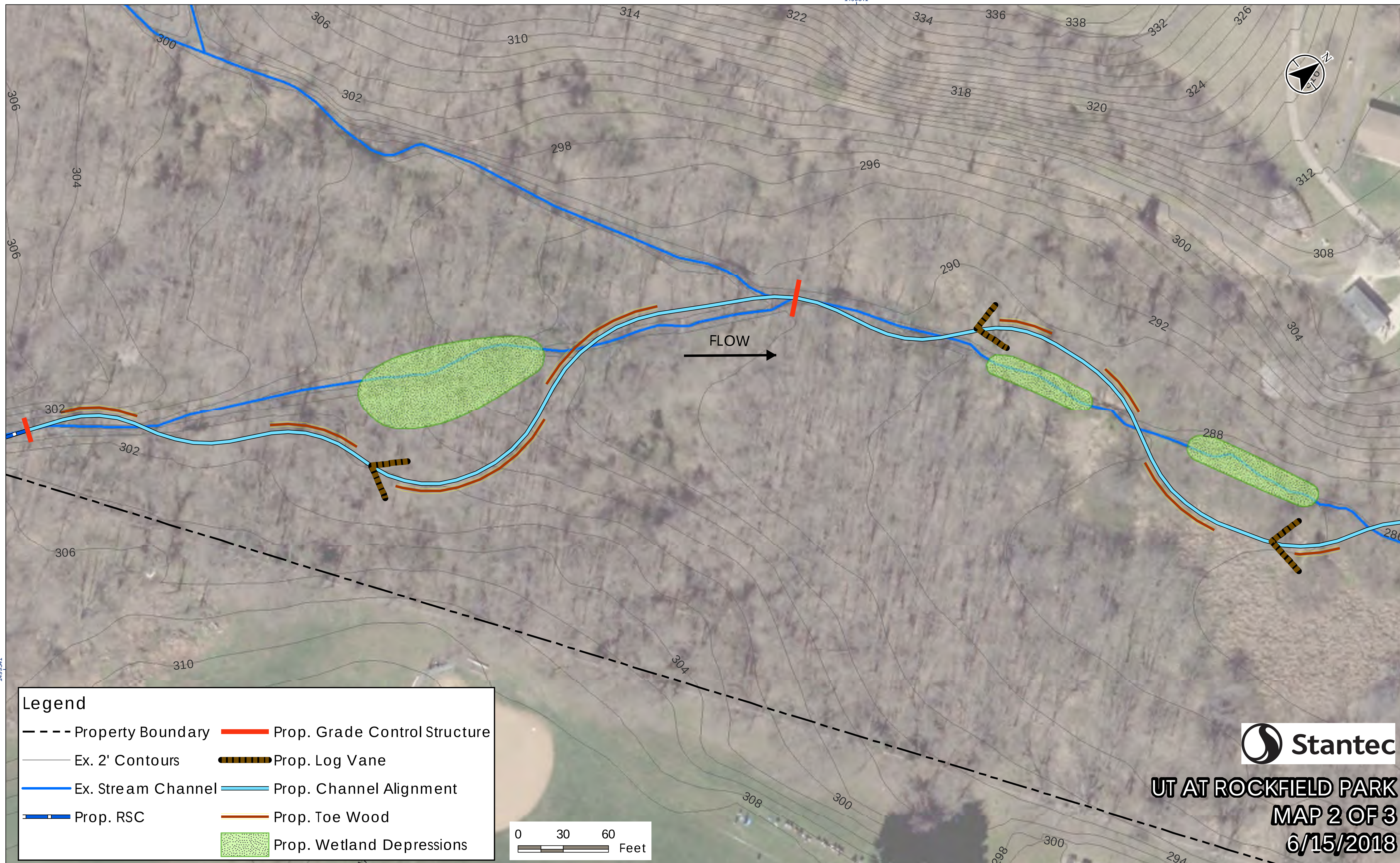
FLOW
Legend
Property Boundary
Ex. 2' Contours
Ex. Stream Channel
Prop. RSC
Prop. Grade Control Structure
Prop. Log Vane
Prop. Channel Alignment
Prop. Toe Wood
Prop. Wetland Depressions
0 30 60
Feet
Stantec
UT AT ROCKFIELD PARK
MAP 2 OF 3
6/15/2018

U:\202811312\8\03_data\gis\concepts\UT @ Rockfield Park\Rockfield_3.mxd Revised: 2018-12-13 By: bschrey

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\\US1525-F02\shared_projects\202813128\03_data\gis\concepts\UT @ MD-22\JacksonBlvd_1.mxd Revised: 2018-06-15 By: dvotta

Hitching Post Dr
Jackson Blvd
UT at Broadway
FLOW
Legend
Property Boundary
Ex. 2' Contours
Ex. Stream Channel
Ex. Stormdrain
Prop. Grade Control Structure
Prop. Log Vane
Prop. Channel Alignment
Prop. Toe Wood
Prop. Wetlands
Prop. BMP Footprint
Stantec
0 30 60 Feet
UT AT MD-22
MAP 2 OF 2
6/15/2018

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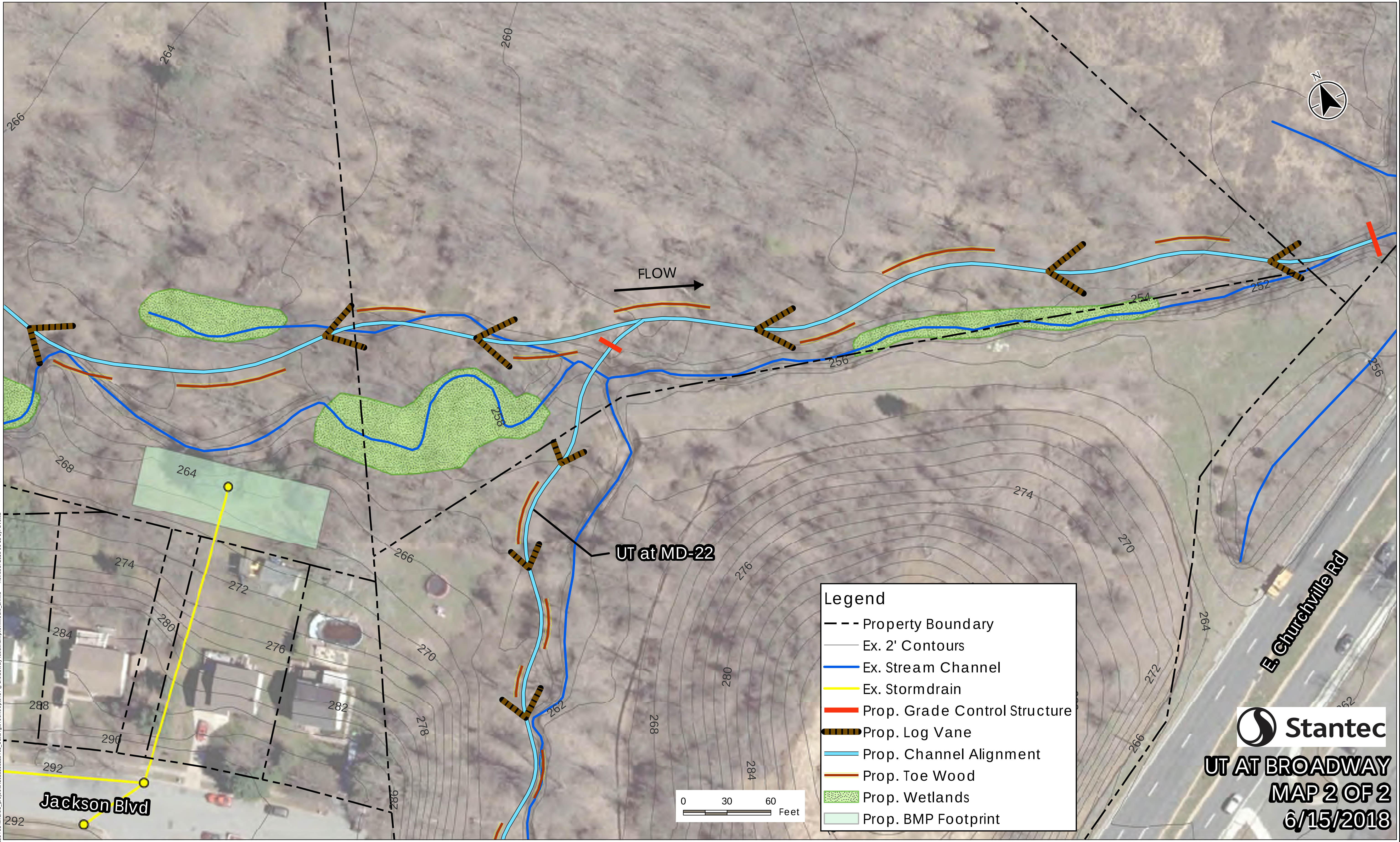

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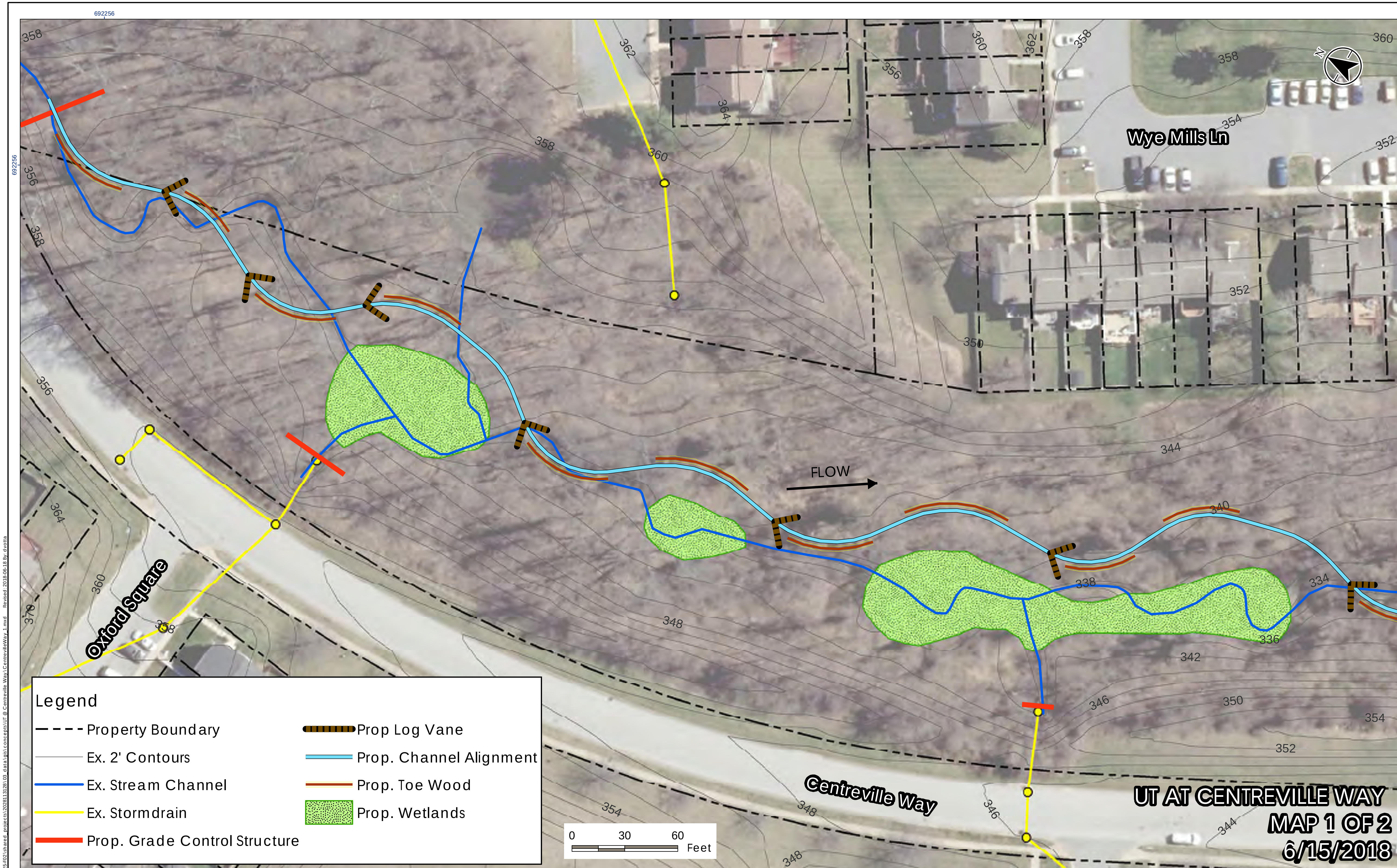

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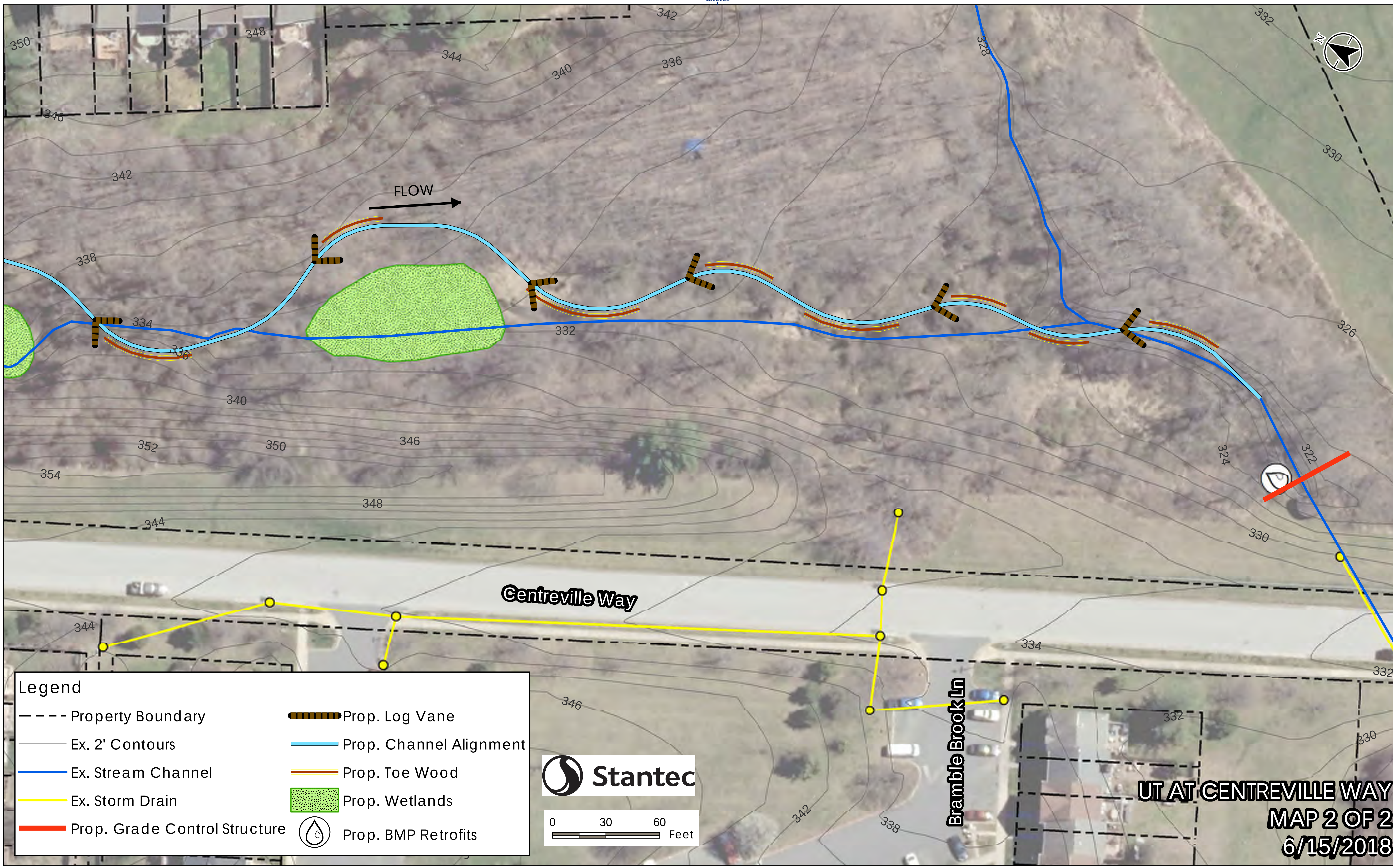
FLOW
Centreville Way
Bramble Brook Ln
Legend
Property Boundary
Ex. 2' Contours
Ex. Stream Channel
Ex. Storm Drain
Prop. Grade Control Structure
Prop. Log Vane
Prop. Channel Alignment
Prop. Toe Wood
Prop. Wetlands
Prop. BMP Retrofits
Stantec
0 30 60 Feet
UT AT CENTREVILLE WAY
MAP 2 OF 2
6/15/2018

F.2 PROPOSED STREAM PHOTOGRAPHS

Bynum Run at Newport Drive


Photo 1: Outside bend with an undercut bank in wooded area upstream of culvert.


Photo 2: Undercut bank downstream of a bend in a wooded area.


Photo 3: Outside bend with a steep undercut bank.

Bynum Run at MD-23

Photo 4: Scoured plunge pool at culvert outfall.

Photo 5: Tall bank indicating signs of failure.


Photo 6: Incised stream channel along a straightaway.


Photo 7: Outside bend tall vertical bank showing active signs of erosion.

Bynum Run at Blake's Venture Park

Photo 8: Excessive aggradation located at the downstream side of a road crossing.

Photo 9: Incised channel cut off from its forested floodplain.


Photo 10: Incised channel with actively eroding banks on bends and straightaways.


Photo 11: Previous beaver dam site. Headcut beginning to develop before bend.

Bynum Run at Moores Mill Road

Photo 12: Looking upstream at inactive low head dam.

Photo 13: Low head dam from right bank showing a slight lean and aggradation upstream.

Photo 14: Backwater pool with heavy aggradation caused from low head dam downstream.

Bynum Run at Harford Detention Center

Photo 15: Outside bend actively eroding.

Photo 16: Steep bank showing signs of active erosion.

Photo 17: Steep stratified bank displaying erosion at riffle section.

Photo 18: Steep eroding streambank exposing previous erosion protection attempts.

UNT at Melrose Lane

Photo 19: Incised channel with fine sediment deposition on streambed.

Photo 20: Incised channel with fine sediment deposition on streambed.

Photo 21: Stratified outside bend bank erosion.

Photo 22: Outside bend erosion encroaching on neighboring property.

UNT at Switchman Drive

Photo 23: Deeply incised channel with eroding bank toe.

Photo 24: Deeply incised channel with slightly vegetated banks.

Photo 25: Deeply incised channel.

Photo 26: Outside bank erosion exposing roof drain and encroaching on neighboring property.

UNT at Broadway

Photo 27: Steep outside bend erosion undercutting existing vegetation.

Photo 28: High, exposed, eroding bank.


Photo 29: Very high and steep outside bend.

UNT at Rockfield Park

Photo 30: High exposed eroding bank.

Photo 31: Hillside toe erosion.


Photo 32: Outside bank erosion with pointbar aggradation.

UNT at Frogleap Way

Photo 33: Undercut bank in forested area.

Photo 34: Outside bend bank erosion along torturous meanders.


Photo 35: Deeply incised channel with exposed banks.


Photo 36: Steep inside bank indicating heavily incised channel.

UNT at Centreville Way


Photo 37: Deeply incised channel with vegetated banks.


Photo 38: Outside bank erosion with exposed tree roots.


Photo 39: Exposed outside bank showing signs of severe erosion.


Photo 40: Exposed outside bank displaying signs of severe erosion.

UNT at Bel Air Bypass

Photo 41: High exposed bank displaying signs of erosion.

Photo 42: Incised channel with undercut bank.

Photo 43: Transverse bar creating an undercut bank.

Photo 44: Incised and widened channel cut off from its forested floodplain.

UNT at MD 543

Photo 45: Slightly vegetated outside bend displaying moderate erosion.

Photo 46: Steep bank downstream of bend showing signs of erosion.

UNT at MD 22

Photo 47: Unvegetated outside bank displaying erosion with a displaced pipe partially exposed.

Photo 48: Both inside and outside stream banks showing signs of erosion at downstream bend.

UNT at Pipercove Way

Photo 49: Outside bend displaying erosion.

Appendix G

G.1 PRIORITIZATION FOR IMPLEMENTATION SCHEDULE

Proposed Prioritization Summary Table

Proposed Project ID	BMP Practice	Subwatershed Number	Total Stream Restoration Length (ft)	Total Drainage Area (AC)	Total Impervious (AC)	Impervious Acres Treated (AC)*	Cost ($)	N Removal (lbs/year)	P Removal (lbs/years)	Sediment Removal (lbs/year)	Cost per lbs of Nitrogen Removal ($/lbs/yr)	Cost per lbs of Phosphorus Removal ($/lbs/yr)	Cost per lbs of Sediment Removal ($/lbs/yr)	Cost Per Pound of N Ranking	Cost per Pound of P Ranking	Cost per Pound of Sed Ranking	Average Cost per Pound Ranking	Fiscal Year Project Start
Unnamed Trbutary @ Switchman Drive	Stream Restoration	3	429	N/A	N/A	N/A	$ 334,620	140.138	64.537	22,250	$2,387.79	$5,184.92	$15.04	2	2	4	2.7	2020
173	Wet Pond and Wetland	2	N/A	75.85	13.27	6.63	$ 182,171	61.708	9.400	12,819	$2,952.14	$19,380.48	$14.21	3	19	2	8.0	2020
33	Dry Extended Detention Ponds	2	N/A	74.17	14.74	7.37	$ 196,588	60.335	9.191	12,533	$3,258.27	$21,390.20	$15.69	6	20	6	10.7	2020
156	Dry Extended Detention Ponds	N3	N/A	10.77	2.32	1.16	$ 30,386	8.765	1.335	1,821	$3,466.71	$22,758.57	$16.69	9	22	7	12.7	2020
112	Wet Pond and Wetland	5	N/A	14.32	3.28	1.64	$ 42,520	11.651	1.775	2,420	$3,649.66	$23,959.60	$17.57	12	24	9	15.0	2020
164	Dry Extended Detention Ponds	1	N/A	10.76	2.53	1.27	$ 32,607	8.754	1.333	1,819	$3,724.72	$24,452.39	$17.93	13	27	10	16.7	2020
181	Dry Extended Detention Ponds	2	N/A	9.27	2.71	1.36	$ 33,649	7.541	1.149	1,567	$4,462.02	$29,292.69	$21.48	19	33	14	22.0	2020
169	Dry Extended Detention Ponds	3	N/A	26.15	8.27	4.14	$ 101,366	21.274	3.241	4,419	$4,764.73	$31,279.93	$22.94	23	38	19	26.7	2020
174	Dry Extended Detention Ponds	2	N/A	2.03	0.72	0.36	$ 8,703	1.655	0.252	344	$5,259.20	$34,526.08	$25.32	34	47	30	37.0	2020
Bynum Run @ Moores Mill Road	Stream Restoration	1/2	2,331	N/A	N/A	N/A	$ 1,818,180	231.666	106.688	36,782	$7,848.29	$17,042.00	$49.43	65	15	74	51.3	2020
74	Dry Extended Detention Ponds	5	N/A	2.17	1.56	0.78	$ 17,547	1.763	0.269	366	$9,954.95	$65,353.21	$47.92	76	79	73	76.0	2020
N110	RSC	4	N/A	7.46	6.08	4.75	$ 351,000	8.766	1.76	1,798	$40,041.75	$199,086.01	$195.24	96	96	96	96.0	2020
Bynum Run @ Harford Detention Center	Stream Restoration	3/4	727	N/A	N/A	N/A	$ 567,060	168.122	77.425	26,693	$3,372.90	$7,324.02	$21.24	8	4	13	8.3	2021
Unnamed Tributary @ Pipercove Way	Stream Restoration	4	1,040	N/A	N/A	N/A	$ 811,200	132.193	60.878	20,988	$6,136.50	$13,324.96	$38.65	50	12	64	42.0	2021
Unnamed Tributary @ Bel Air Bypass	Stream Restoration	2	2,306	N/A	N/A	N/A	$ 1,798,680	221.456	101.986	35,161	$8,122.06	$17,636.48	$51.16	67	18	78	54.3	2021
Unnamed Tributary @ Broadway	Stream Restoration	S1	2,298	N/A	N/A	N/A	$ 1,792,440	886.005	408.029	140,673	$2,023.06	$4,392.93	$12.74	1	1	1	1.0	2022
N133	Stormwater Management Pond	S1	N/A	27.62	9.68	8.01	$ 96,695	32.452	6.527	6,656	$2,979.60	$14,814.46	$14.53	4	13	3	6.7	2022
Unnamed Tributary @ MD-22	Stream Restoration	S1	1,223	N/A	N/A	N/A	$ 953,940	286.068	131.742	45,420	$3,334.66	$7,240.97	$21.00	7	3	12	7.3	2022
N134	Stormwater Management Pond	S1	N/A	12.64	4.33	4.67	$ 68,674	14.855	2.988	3,047	$4,622.95	$22,985.11	$22.54	20	23	17	20.0	2022
N136	Stormwater Management Pond	S1	N/A	9.81	3.14	3.50	$ 56,042	11.527	2.318	2,364	$4,861.94	$24,173.39	$23.71	24	25	20	23.0	2022
N135	Stormwater Management Pond	S1	N/A	6.26	1.82	2.25	$ 43,996	7.357	1.480	1,509	$5,980.30	$29,733.83	$29.16	48	34	45	42.3	2022
166	Dry Extended Detention Ponds	1	N/A	23.83	7.49	3.75	$ 91,864	19.389	2.953	4,028	$4,738.03	$31,104.63	$22.81	22	37	18	25.7	2023
Unnamed Triburtay @ MD 543	Stream Restoration	1	3,722	N/A	N/A	N/A	$ 2,903,160	620.550	285.780	98,526	$4,678.36	$10,158.73	$29.47	21	9	47	25.7	2023
167	Dry Extended Detention Ponds	1	N/A	16.43	6.36	3.18	$ 75,765	13.369	2.036	2,777	$5,667.22	$37,204.72	$27.28	42	54	39	45.0	2023
165	Dry Extended Detention Ponds	1	N/A	8.63	3.38	1.69	$ 40,224	7.017	1.069	1,458	$5,732.54	$37,633.49	$27.60	44	56	42	47.3	2023
163	Dry Extended Detention Ponds	1	N/A	22.27	9.55	4.78	$ 112,453	18.119	2.760	3,764	$6,206.28	$40,743.57	$29.88	52	59	49	53.3	2023
168	Dry Extended Detention Ponds	1	N/A	3.83	1.71	0.85	$ 19,995	3.113	0.474	647	$6,422.83	$42,165.20	$30.92	54	60	52	55.3	2023
N125	Stormwater Management Pond	1	N/A	24.90	7.43	7.37	$ 91,145	29.256	5.884	6,000	$3,115.45	$15,489.91	$15.19	5	14	5	8.0	2024
Unnamed Tributary @ Centreville Way	Stream Restoration	N2	1,975	N/A	N/A	N/A	$ 1,540,500	430.578	198.292	68,364	$3,577.75	$7,768.84	$22.53	11	5	16	10.7	2024
N127	Stormwater Management Pond	1	N/A	18.14	6.34	6.14	$ 74,110	21.310	4.286	4,370	$3,477.76	$17,291.26	$16.96	10	16	8	11.3	2024
N118	Stormwater Management Pond	3	N/A	65.89	21.65	23.25	$ 341,675	77.416	15.570	15,877	$4,413.50	$21,943.76	$21.52	18	21	15	18.0	2024
25	Dry Extended Detention Ponds	N2	N/A	149.12	36.29	18.15	$ 464,591	121.314	18.479	25,201	$3,829.65	$25,141.25	$18.44	15	29	11	18.3	2024
38	Wet Pond and Wetland	2	N/A	2.32	0.78	0.39	$ 9,519	1.891	0.288	393	$5,033.41	$33,043.78	$24.23	28	41	24	31.0	2024
145	Wet Pond and Wetland	S1	N/A	38.89	13.31	6.66	$ 161,271	31.635	4.819	6,572	$5,097.88	$33,467.06	$24.54	29	42	25	32.0	2024
144	Wet Pond and Wetland	1	N/A	45.95	15.78	7.89	$ 191,048	37.380	5.694	7,765	$5,111.04	$33,553.42	$24.60	30	43	26	33.0	2024
157	Dry Extended Detention Ponds	N3	N/A	15.13	5.28	2.64	$ 63,775	12.309	1.875	2,557	$5,181.32	$34,014.78	$24.94	31	44	27	34.0	2024
202	Dry Extended Detention Ponds	5	N/A	11.07	3.87	1.94	$ 46,748	9.009	1.372	1,871	$5,189.27	$34,066.99	$24.98	32	45	28	35.0	2024
114	Dry Extended Detention Ponds	4	N/A	35.13	12.36	6.18	$ 149,149	28.575	4.353	5,936	$5,219.59	$34,266.04	$25.13	33	46	29	36.0	2024
N123	Stormwater Management Pond	N2	N/A	6.28	2.45	2.99	$ 54,715	7.384	1.485	1,514	$7,410.33	$36,843.88	$36.13	64	51	62	59.0	2024
Unnamed Tributary @ Rockfield Park	Stream Restoration	S1	2,453	N/A	N/A	N/A	$ 1,913,340	463.540	213.472	73,597	$4,127.67	$8,962.94	$26.00	16	7	33	18.7	2025
N121	Stormwater Management Pond	3	N/A	7.15	4.33	3.62	$ 41,189	8.406	1.691	1,724	$4,900.27	$24,363.95	$23.89	26	26	22	24.7	2025
N108	Stormwater Management Pond	4	N/A	23.60	6.17	7.34	$ 136,889	27.727	5.577	5,686	$4,937.11	$24,547.12	$24.07	27	28	23	26.0	2025

Proposed Project ID	BMP Practice	Subwatershed Number	Total Stream Restoration Length (ft)	Total Drainage Area (AC)	Total Impervious (AC)	Impervious Acres Treated (AC)*	Cost ($)	N Removal (lbs/year)	P Removal (lbs/years)	Sediment Removal (lbs/year)	Cost per lbs of Nitrogen Removal ($/lbs/yr)	Cost per lbs of Phosphorus Removal ($/lbs/yr)	Cost per lbs of Sediment Removal ($/lbs/yr)	Cost Per Pound of N Ranking	Cost per Pound of P Ranking	Cost per Pound of Sed Ranking	Average Cost per Pound Ranking	Fiscal Year Project Start
N113	Stormwater Management Pond	2	N/A	2.93	1.11	1.23	$ 18,987	3.445	0.693	706	$5,511.83	$27,404.59	$26.88	38	30	36	34.7	2025
158	Dry Extended Detention Ponds	2	N/A	5.37	1.93	0.96	$ 23,185	4.367	0.665	907	$5,308.83	$34,851.92	$25.56	36	49	32	39.0	2025
172	Dry Extended Detention Ponds	N3	N/A	28.07	10.38	5.19	$ 124,439	22.839	3.479	4,744	$5,448.55	$35,769.18	$26.23	37	50	35	40.7	2025
N104	Stormwater Management Pond	5	N/A	6.50	4.31	3.94	$ 44,507	7.635	1.536	1,566	$5,829.58	$28,984.46	$28.42	47	32	44	41.0	2025
175	Dry Extended Detention Ponds	5	N/A	4.20	1.62	0.81	$ 19,326	3.415	0.520	709	$5,659.76	$37,155.74	$27.25	41	53	38	44.0	2025
191	Dry Extended Detention Ponds	5	N/A	12.78	4.99	2.49	$ 59,365	10.399	1.584	2,160	$5,708.70	$37,477.02	$27.48	43	55	40	46.0	2025
162	Dry Extended Detention Ponds	5	N/A	5.55	2.18	1.09	$ 25,935	4.513	0.687	937	$5,746.69	$37,726.38	$27.66	45	57	43	48.3	2025
N137	Stormwater Management Pond	S1	N/A	7.63	3.04	3.52	$ 59,053	8.962	1.802	1,838	$6,589.62	$32,763.32	$32.13	56	40	56	50.7	2025
148	Dry Extended Detention Ponds	2	N/A	17.80	7.59	3.79	$ 89,369	14.480	2.206	3,008	$6,171.81	$40,517.28	$29.71	51	58	48	52.3	2025
196	Wet Pond and Wetland	3	N/A	50.19	23.07	11.53	$ 269,445	40.832	6.220	8,482	$6,598.95	$43,321.41	$31.77	57	61	53	57.0	2025
N150	bioretention	S1	N/A	2.26	0.51	0.55	$ 68,925	2.658	0.535	545	$25,935.43	$128,949.93	$126.46	88	88	88	88.0	2025
N151	bioretention	S1	N/A	0.53	0.19	0.21	$ 22,056	0.623	0.125	128	$35,384.70	$175,931.34	$172.53	93	93	93	93.0	2025
N138	bioretention	S1	N/A	1.67	0.72	0.87	$ 82,710	1.964	0.395	403	$42,106.88	$209,353.71	$205.31	99	98	99	98.7	2025
Unnamed Tributary @ Frogleap Way	Stream Restoration	N3	780	N/A	N/A	N/A	$ 608,400	147.254	67.814	23,380	$4,131.64	$8,971.57	$26.02	17	8	34	19.7	2026
Bynum Run @ Blake's Venture Park	Stream Restoration	5	2,469	N/A	N/A	N/A	$ 1,925,820	393.465	181.201	62,471	$4,894.51	$10,628.08	$30.83	25	10	51	28.7	2026
N106	Stormwater Management Pond	5	N/A	2.83	0.85	1.02	$ 18,834	3.329	0.670	683	$5,657.61	$28,129.42	$27.59	40	31	41	37.3	2026
179	Dry Extended Detention Ponds	N3	N/A	42.58	15.27	7.64	$ 183,843	34.639	5.276	7,196	$5,307.33	$34,842.05	$25.55	35	48	31	38.0	2026
113	Wet Pond and Wetland	5	N/A	10.28	4.94	2.47	$ 57,442	8.365	1.274	1,738	$6,866.75	$45,079.49	$33.06	59	63	57	59.7	2026
184	Wet Pond and Wetland	5	N/A	55.67	27.91	13.95	$ 323,091	45.285	6.898	9,407	$7,134.53	$46,837.45	$34.35	62	68	60	63.3	2026
N105	bioretention	5	N/A	1.36	0.97	1.02	$ 35,841	1.596	0.321	327	$22,462.93	$111,684.77	$109.53	86	86	86	86.0	2026
159	Dry Extended Detention Ponds	5	N/A	6.42	2.47	1.24	$ 29,469	5.222	0.795	1,085	$5,643.51	$37,049.02	$27.17	39	52	37	42.7	2027
N102	Stormwater Management Pond	5	N/A	9.31	3.69	4.15	$ 65,599	10.941	2.201	2,244	$5,995.80	$29,810.88	$29.24	49	35	46	43.3	2027
N124	Stormwater Management Pond	1	N/A	11.90	2.98	3.94	$ 86,870	13.978	2.811	2,867	$6,214.66	$30,899.04	$30.30	53	36	50	46.3	2027
N120	Stormwater Management Pond	3	N/A	2.94	1.56	1.66	$ 22,687	3.457	0.695	709	$6,563.36	$32,632.78	$32.00	55	39	55	49.7	2027
Unnamed Tributary @ Melrose Lane	Stream Restoration	5	2,247	N/A	N/A	N/A	$ 1,752,660	218.288	100.527	34,658	$8,029.13	$17,434.69	$50.57	66	17	76	53.0	2027
176	Dry Extended Detention Ponds	5	N/A	19.22	8.84	4.42	$ 103,272	15.638	2.382	3,248	$6,603.96	$43,354.30	$31.79	58	62	54	58.0	2027
180	Dry Extended Detention Ponds	1	N/A	7.29	3.56	1.78	$ 41,345	5.932	0.904	1,232	$6,969.39	$45,753.28	$33.55	61	67	59	62.3	2027
190	Dry Extended Detention Ponds	3	N/A	6.00	3.07	1.54	$ 35,482	4.885	0.744	1,015	$7,263.29	$47,682.73	$34.96	63	69	61	64.3	2027
117	Dry Extended Detention Ponds	2	N/A	10.06	5.96	2.98	$ 67,909	8.187	1.247	1,701	$8,294.39	$54,451.79	$39.93	68	75	65	69.3	2027
171	Dry Extended Detention Ponds	5	N/A	49.06	29.56	14.78	$ 336,516	39.912	6.080	8,291	$8,431.49	$55,351.81	$40.59	69	76	66	70.3	2027
161	Dry Extended Detention Ponds	3	N/A	43.50	27.82	13.91	$ 315,117	35.388	5.390	7,351	$8,904.67	$58,458.21	$42.87	70	77	67	71.3	2027
Bynum Run @ Newport Drive	Stream Restoration	5	520	N/A	N/A	N/A	$ 405,600	69.796	32.143	11,082	$5,811.23	$12,618.66	$36.60	46	11	63	40.0	2028
170	Dry Extended Detention Ponds	5	N/A	53.14	25.81	12.90	$ 299,715	43.230	6.585	8,980	$6,933.08	$45,514.94	$33.38	60	64	58	60.7	2028
N109	bioswale	4	N/A	4.06	1.38	0.78	$ 43,726	4.772	0.960	979	$9,163.09	$45,558.51	$44.68	71	65	68	68.0	2028
N126	Stormwater Management Pond	1	N/A	3.68	1.35	1.84	$ 39,639	4.326	0.870	887	$9,163.44	$45,560.24	$44.68	72	66	69	69.0	2028
N131	Stormwater Management Pond	1	N/A	6.28	3.40	4.11	$ 71,775	7.379	1.484	1,513	$9,726.54	$48,359.98	$47.43	74	70	71	71.7	2028
N122	Stormwater Management Pond	N3	N/A	2.91	1.38	1.76	$ 33,533	3.415	0.687	700	$9,820.55	$48,827.40	$47.88	75	71	72	72.7	2028
31	Dry Extended Detention Ponds	3	N/A	2.89	1.99	1.00	$ 22,450	2.349	0.358	488	$9,558.02	$62,747.39	$46.01	73	78	70	73.7	2028
N111	Stormwater Management Pond	2	N/A	8.30	5.56	6.40	$ 100,651	9.752	1.961	2,000	$10,320.53	$51,313.26	$50.32	77	72	75	74.7	2028
N103	Stormwater Management Pond	5	N/A	2.54	1.69	1.96	$ 31,236	2.981	0.600	611	$10,479.47	$52,103.52	$51.10	78	73	77	76.0	2028
N144	bioswale	S1	N/A	2.24	1.28	0.76	$ 28,422	2.633	0.530	540	$10,794.38	$53,669.24	$52.63	79	74	83	78.7	2028
36	Stormwater Performance Standard-Stormwater Treatment	1	N/A	0.96	0.54	0.27	$ 8,553	0.785	0.120	163	$10,899.71	$71,555.44	$52.47	80	81	79	80.0	2028
27	Stormwater Performance Standard-Stormwater Treatment	1	N/A	1.95	1.58	0.79	$ 17,310	1.588	0.242	330	$10,899.71	$71,555.44	$52.47	81	82	80	81.0	2028
35	Stormwater Performance Standard-Stormwater Treatment	2	N/A	1.94	1.80	0.90	$ 17,245	1.582	0.241	329	$10,899.71	$71,555.44	$52.47	82	83	81	82.0	2028
N114	bioswale	2	N/A	6.89	1.70	1.83	$ 109,315	8.092	1.628	1,660	$13,508.28	$67,162.62	$65.87	84	80	84	82.7	2028

Proposed Project ID	BMP Practice	Subwatershed Number	Total Stream Restoration Length (ft)	Total Drainage Area (AC)	Total Impervious (AC)	Impervious Acres Treated (AC)*	Cost ($)	N Removal (lbs/year)	P Removal (lbs/years)	Sediment Removal (lbs/year)	Cost per lbs of Nitrogen Removal ($/lbs/yr)	Cost per lbs of Phosphorus Removal ($/lbs/yr)	Cost per lbs of Sediment Removal ($/lbs/yr)	Cost Per Pound of N Ranking	Cost per Pound of P Ranking	Cost per Pound of Sed Ranking	Average Cost per Pound Ranking	Fiscal Year Project Start
42	Stormwater Performance Standard-Stormwater Treatment	1	N/A	1.55	1.44	0.72	$ 13,759	1.262	0.192	262	$10,899.71	$71,555.44	$52.47	83	84	82	83.0	2028
N107	bioswale	5	N/A	4.77	3.53	1.90	$ 98,384	5.600	1.126	1,149	$17,567.31	$87,343.94	$85.66	85	85	85	85.0	2028
N142	bioretention	S1	N/A	1.59	0.95	0.54	$ 45,950	1.864	0.375	382	$24,646.01	$122,539.01	$120.17	87	87	87	87.0	2028
N129	Stormwater Management Pond	1	N/A	2.36	1.27	1.78	$ 76,152	2.774	0.558	569	$27,450.82	$136,484.40	$133.85	89	89	89	89.0	2028
N117	bioretention	3	N/A	3.31	1.42	1.18	$ 110,280	3.895	0.783	799	$28,315.97	$140,785.86	$138.07	90	90	90	90.0	2028
N140	bioretention	S1	N/A	3.65	1.03	1.10	$ 128,660	4.291	0.863	880	$29,986.96	$149,093.99	$146.21	91	91	91	91.0	2028
195	Bioretention	5	N/A	0.61	0.21	0.11	$ 20,218	0.493	0.075	102	$41,010.93	$269,232.37	$197.42	98	106	98	100.7	2028
23	Bioretention	3	N/A	1.54	0.68	0.34	$ 60,654	1.250	0.190	260	$48,538.35	$318,649.08	$233.66	104	107	104	105.0	2028
52	Bioretention	2	N/A	9.29	2.86	1.43	$ 434,228	7.561	1.152	1,571	$57,432.46	$377,037.96	$276.48	108	109	108	108.3	2028
194	Bioretention	5	N/A	2.15	1.86	0.93	$ 121,308	1.752	0.267	364	$69,236.30	$454,528.94	$333.30	110	112	110	110.7	2028
34	Bioretention	5	N/A	1.37	0.91	0.46	$ 82,710	1.115	0.170	232	$74,178.24	$486,972.23	$357.09	111	114	111	112.0	2028
Bynum Run @ MD-23	Stream Restoration	5	2,133	N/A	N/A	N/A	$ 1,663,740	441.024	203.103	70,022	$3,772.44	$8,191.59	$23.76	14	6	21	13.7	2029
N149	bioretention	S1	N/A	0.87	0.37	0.37	$ 33,084	1.025	0.206	210	$32,280.67	$160,498.22	$157.40	92	92	92	92.0	2029
N148	bioswale	S1	N/A	0.62	0.54	0.54	$ 26,236	0.726	0.146	149	$36,141.77	$179,695.43	$176.22	94	94	94	94.0	2029
N147	bioswale	S1	N/A	0.41	0.28	0.26	$ 17,490	0.478	0.096	98	$36,591.06	$181,929.29	$178.41	95	95	95	95.0	2029
N132	bioretention	1	N/A	2.72	1.49	1.40	$ 128,660	3.200	0.644	656	$40,200.28	$199,874.18	$196.01	97	97	97	97.0	2029
N128	bioretention	1	N/A	0.74	0.52	0.53	$ 36,760	0.870	0.175	178	$42,255.18	$210,091.08	$206.03	100	99	100	99.7	2029
N119	bioretention	3	N/A	0.44	0.20	0.21	$ 22,056	0.517	0.104	106	$42,661.56	$212,111.59	$208.01	101	100	101	100.7	2029
N143	bioretention	S1	N/A	1.91	0.93	0.98	$ 102,928	2.240	0.450	459	$45,954.96	$228,486.25	$224.07	102	101	102	101.7	2029
N116	bioretention	2	N/A	1.48	0.87	0.88	$ 82,710	1.738	0.350	356	$47,586.37	$236,597.55	$232.03	103	102	103	102.7	2029
N130	bioretention	1	N/A	1.59	0.89	0.90	$ 91,900	1.871	0.376	384	$49,123.38	$244,239.48	$239.52	105	103	105	104.3	2029
N146	bioretention	S1	N/A	0.45	0.29	0.30	$ 27,570	0.527	0.106	108	$52,364.47	$260,354.06	$255.32	106	104	106	105.3	2029
N112	bioretention	2	N/A	0.58	0.39	0.39	$ 35,841	0.678	0.136	139	$52,864.21	$262,838.73	$257.76	107	105	107	106.3	2029
N145	bioswale	S1	N/A	0.23	0.13	0.16	$ 17,490	0.273	0.055	56	$64,184.20	$319,121.30	$312.96	109	108	109	108.7	2029
N139	bioretention	S1	N/A	0.42	0.26	0.29	$ 38,828	0.491	0.099	101	$79,071.30	$393,139.36	$385.54	112	110	112	111.3	2029
N115	bioretention	2	N/A	2.00	1.26	1.25	$ 206,775	2.350	0.473	482	$87,975.19	$437,409.17	$428.96	113	111	113	112.3	2029
N141	bioretention	S1	N/A	0.40	0.27	0.33	$ 45,491	0.470	0.095	96	$96,729.28	$480,934.15	$471.64	114	113	114	113.7	2029
N101	bioretention	5	N/A	0.44	0.35	0.46	$ 68,925	0.514	0.103	105	$134,125.50	$666,866.64	$653.98	115	115	115	115.0	2029