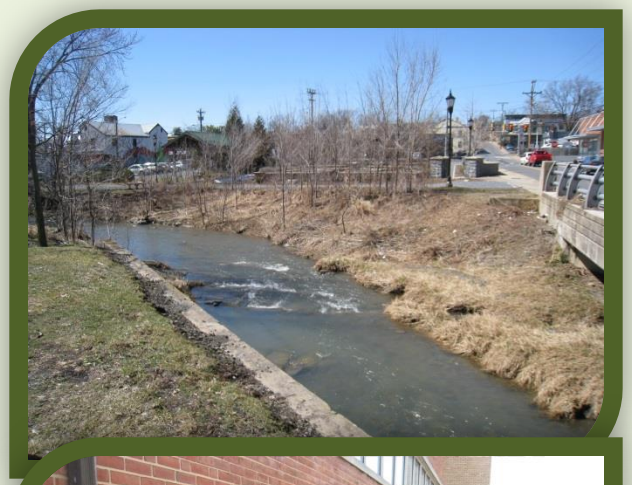


Stormwater Retrofit Opportunities on Public Land in Harrisonburg

September 2013
FINAL

PREPARED FOR:
City of Harrisonburg, VA

PREPARED BY:

CENTER FOR WATERSHED PROTECTION

8390 Main Street, 2nd Floor
Ellicott City, MD 21043
www.cwp.org

ACKNOWLEDGEMENTS

The project team from the Center for Watershed Protection (CWP) would like to acknowledge the significant contributions from Thanh Dang (Harrisonburg), Abe Kaufman and Dale Chestnut (JMU), David Nichols (Bridgewater), and Erin Yancey (Central Shenandoah Planning District Commission). Each provided coordination, guidance, and insight that allowed this project to be successful.

This study received additional support from the following:

Rick Altizer (Harrisonburg)
Ray Bailey (Harrisonburg)
Danny DeLong (Harrisonburg)
Tanya Denckla-Cobb (UVA Institute for Environmental Negotiation)
Jeremy Harold (Harrisonburg)
Tom Hartman (Harrisonburg)
CJ Mitchem (CSPDC)
Megan O'Gorek (Shenandoah SWCD)
Jerry Prey (Harrisonburg)
Natalie Raffol (UVA Institute for Environmental Negotiation)
Dan Rublee (Harrisonburg)
Wes Runion (Harrisonburg)
Tara Sieber (VADEQ)
John Ware (Bridgewater)
Tara Willging (VADEQ)

The CWP project team consisted of the following individuals:

Joe Battiata
David Hirschman
Lisa Fraley-McNeal
Chris Swann
Laurel Woodworth

We are grateful to the Central Shenandoah Planning District Commission for securing a Local Government Technical Assistance grant from the National Fish and Wildlife Foundation (NFWF) to fund this project, Grant # 0600.12.038466.

NFWF Disclaimer: The views and conclusions contained in this document are those of the authors and should not be interpreted as representing the opinions or policies of the U.S. Government or the National Fish and Wildlife Foundation. Mention of trade names of commercial products does not constitute their endorsement by the U.S. Government or the National Fish and Wildlife Foundation.

Table of Contents

ACKNOWLEDGEMENTS **2**
SECTION 1. PROJECT BACKGROUND **5**
1.1 Purpose 5
SECTION 2. RETROFIT INVENTORY PROTOCOLS **7**
2.1 Site Selection 7
2.2 Field Methodology 7
2.3 Retrofit Types 9
SECTION 3. EVALUATION & RANKING **13**
3.1 Evaluation Method 13
3.2 Ranking Process 13
Step 1: Selecting Screening Factors 13
Step 2: Scoring Each Candidate Practice Based on the Screening Factors 16
Step 3: Ranking the Projects 20
SECTION 4. STUDY RESULTS **22**
4.1 Summary of Projects 22
4.2 Trends in the Three Communities 24
SECTION 5. RECOMMENDATIONS **26**
5.1 Further Considerations 26
Expanding the Search for Retrofit Options 26
Investigating the Full Range of Practices 26
Stormwater Design Considerations for Karst 26
Keeping in Touch With DEQ About MS4 Reporting 27
5.2 Options for Achieving Required Load Reductions 27
REFERENCES **33**
APPENDIX A: FIELD FORMS **A-1**
APPENDIX B: HARRISONBURG RETROFIT CONCEPTS RANKING TABLE **B-1**
APPENDIX C: REGENERATIVE STORMWATER CONVEYANCE SYSTEMS **C-1**
APPENDIX D: RETROFIT MAPS, SUMMARIES, AND FIELD FORMS **D-1**

List of Figures

Figure 1. Field crews searching for potential stormwater retrofits. 8

List of Tables

Table 1. Examples of Stormwater Retrofit Practices 10
Table 2. Screening Factors Used for Retrofit Scoring 15
Table 3. Description of Retrofit Spreadsheet Inputs 17
Table 4. Documentation of Calculations in the Spreadsheet 18
Table 5. Unit Construction Costs and RR/ST Designation for Various Retrofit Practices 20

Table 6. All Projects Identified in Harrisonburg 22
Table 7. Summary of 10 Top-Ranked Retrofit Sites for Harrisonburg 23
Table 8. Cost-Effectiveness of New Retrofits vs. Conversions/Enhancements 25
Table 9. Percent of Load Reductions & Costs for "Heroic" Projects Compared to All Retrofits From This Study For Each Jurisdiction 25
Table 10. Harrisonburg MS4 Required Load Reductions 28
Table 11. Harrisonburg: Implementation of Retrofits Compared to Required Load Reductions 29
Table 12. Overview of Possible MS4 Load Reduction Scenarios for Harrisonburg 30
Table 13. City of Harrisonburg + JMU Combined MS4 Required Load Reductions 32
Table 14. City of Harrisonburg + JMU: Implementation of Retrofits Compared to Combined Required Load Reductions 32

SECTION 1. PROJECT BACKGROUND

1.1 Purpose

The intent of this project was to conduct a stormwater retrofit inventory for three neighboring communities in Virginia's Shenandoah Valley: the City of Harrisonburg, James Madison University, and the Town of Bridgewater. This study will help each of these communities determine the level to which stormwater retrofits on public properties can reduce urban nutrients and sediment. This report is tailored specifically to the study findings for Harrisonburg. In addition to serving as an inventory of potential retrofits, the report also quantifies costs of retrofit construction and pollutant removal, and suggests several scenarios for incorporating retrofits into the Small Municipal Separate Storm Sewer System (MS4) program and TMDL Action Plans.

"Stormwater retrofitting" refers to the practice of installing stormwater management features in places where development has already occurred. In some cases, existing developed land has no stormwater treatment to begin with. In others, older facilities, such as detention ponds, can be upgraded to enhance pollutant removal. A stormwater retrofit study provides an opportunity to look at the developed landscape, analyze how it changed as properties were developed, and imagine how it can be modified to better manage the flow of water that runs off it and to local streams.

This is not just an academic exercise. Runoff from existing developed properties is a major source of pollutants and increased storm flow that leads to the erosion of stream banks and degradation of waterways. Beyond these purposes, stormwater retrofits also foster innovation and create excitement in a community and are often used for educational purposes. People become excited about taking simple actions to promote clean water and to "green up" school campuses, parks, and other public buildings. Often, a few stormwater retrofits on public land can shift the way that stormwater is managed across the entire community, with developers and even homeowners adapting ideas to their own uses.

Controlling urban runoff is also the goal of evolving regulatory programs, such as the EPA-driven Chesapeake Bay Total Maximum Daily Load (TMDL) effort to reduce non-point sources of pollution to the Bay. In an effort to achieve the goals of the Bay TMDL, Virginia's Small MS4General Permit calls for regulated jurisdictions to achieve 5% of the total phosphorous, nitrogen, and sediment load reductions outlined as part of Virginia's Watershed Implementation Plans (WIP) within the current MS4 permit cycle (2013 – 2018). The remaining pollutant reductions must be achieved in subsequent permit cycles.

In March 2013, field teams consisting of CWP staff and Harrisonburg/JMU/Bridgewater staff fanned out across nearly 100 publically-owned sites (51 in Harrisonburg, 35 at JMU, and 13 in Bridgewater,). The teams investigated how to use the landscape to reduce, capture, and filter runoff that otherwise flows directly to nearby streams. This report describes the field investigation process and the analysis that followed and presents a prioritized list of stormwater retrofit concepts for Harrisonburg to consider constructing in the near term and as part of long-range planning.

This retrofit assessment was made possible through a grant from the National Fish and Wildlife Foundation's Chesapeake Bay Local Government Assistance Program. The grant proposal was secured by the Central Shenandoah Planning District Commission on behalf of the City of Harrisonburg, Town of Bridgewater, and James Madison University. This grant secured technical assistance from the Center for Watershed Protection to work on retrofit investigations with each of these jurisdictions. As MS4s, Harrisonburg, JMU, and Bridgewater have benefitted from working together through this project as they have been able to communicate more frequently about stormwater program issues and retrofitting strategies.

SECTION 2. RETROFIT INVENTORY PROTOCOLS

2.1 Site Selection

Each partner first developed a list of potential public property retrofit sites in their jurisdiction to assess in the field. Based on available mapping layers and stormwater BMP data, CWP staff then identified additional retrofit sites. This screening was based on public ownership and/or presence of existing detention or extended detention basins that may benefit from retrofitting.

In Harrisonburg, additional sites identified by CWP included all schools, a majority of city-owned land, and detention basins identified as public from the City's BMP data. City-owned land with limited opportunities for retrofitting (i.e., parking garages and sites with limited space) were excluded. Each list of field sites was finalized in consultation with each partner and a unique ID was assigned to each site. A total of 48 sites in Harrisonburg were pre-identified for field inspection. At James Madison University, additional sites identified by CWP included detention and extended detention basins that may benefit from retrofitting. A total of 35 sites at JMU were pre-selected to visit during field work. Finally, the retrofit sites suggested by Bridgewater staff included all town and public properties and no additional sites were identified by CWP. A total of 13 sites were selected for field inspection in Bridgewater.

2.2 Field Methodology

Using geographic information systems (GIS) data provided by each partner, CWP staff created field maps with recent aerial images, roads, topography, stormwater infrastructure, utilities, and streams. (Note: Maps for Bridgewater only contained aerial imagery and road locations.) These maps were used to identify the specific drainage areas of each potential retrofit and to make note of details, such as the direction of flow and discharge points for runoff.

Fieldwork was conducted from March 19-21, 2013. Many people were involved in conducting the retrofit field assessments. The following is a list of participants:

- *Bridgewater:* David Nichols and John Ware
- *James Madison University:* Dale Chestnut and Abe Kaufman
- *Harrisonburg:* Rick Altizer, Ray Bailey, Thanh Dang, Danny DeLong, Jeremy Harold, Tom Hartman, Jerry Prey, Wes Runion
- *Central Shenandoah Planning District Commission:* CJ Mitchem
- *Virginia Department of Environmental Quality:* Tara Sieber and Tara Willging
- *Shenandoah Soil and Water Conservation District:* Megan O'Gorek
- *Institute for Environmental Negotiation (UVA):* Tanya Denckla-Cobb, Natalie Raffol
- *Center for Watershed Protection:* Joe Battiata, Lisa Fraley-McNeal, David Hirschman, Chris Swann, Laurel Woodworth

Each of five field teams was led by a CWP staff person experienced with retrofitting. The latest Retrofit Reconnaissance Investigation (RRI) form was used (see **Appendix A**), and

methods outlined in CWP's *Urban Stormwater Retrofit Practices* were used as guidance (CWP, 2007). Using the RRI form, the teams evaluated the stormwater retrofit potential of each candidate site by analyzing existing drainage patterns, drainage areas, impervious cover, available space, and site constraints (e.g., conflicts with existing utilities and land uses, site access, and potential impacts to natural areas). Unless there were obvious site constraints and/or evidence that a particular stormwater retrofit would offer few or no watershed benefits, a stormwater retrofit concept was developed for each candidate project site, including a sketch plan when appropriate. Occasionally, other issues such as stream bank erosion, stormwater outfall pipe erosion, pollution hotspots, and impacted buffers were found in the field. The field crews noted these problems and potential solutions on different types of forms, also found in **Appendix A**.

Figure 1. *Field crews searching for potential stormwater retrofits.*

More detail on conducting the Retrofit Reconnaissance Inventory can be obtained directly from the guidance manual, Urban Stormwater Retrofit Practices (CWP, 2007). This publication contains extensive information on identifying and evaluating potential retrofit locations within a subwatershed as well as profile sheets on individual retrofit designs and guidance on construction, maintenance, and costs.

After field work was completed, CWP staff reviewed all field forms for completeness and compiled the data for each retrofit concept into a combined spreadsheet. This allowed evaluation of each retrofit to determine the nutrient and runoff reduction capabilities, planning-level cost, and cost efficiency. This spreadsheet also served as a platform for scoring and ranking each retrofit concept. See **Section 3** for more information about this evaluation process. Completed field forms for each site can be found in **Appendix D**, along with photos and maps of the project locations.

2.3 Retrofit Types

A wide variety of stormwater management retrofit options were considered while inventorying these public properties. This project followed the conventions in *Recommendations of the Expert Panel to Define Removal Rates for Urban Stormwater Retrofit Projects* (Schueler and Lane, 2012) by assigning retrofits to one of three categories:

New Retrofits: Retrofit projects that create storage to reduce nutrients from existing developed land that is not currently receiving any stormwater treatment.

BMP Conversions: Retrofits of older, existing stormwater ponds to employ more effective treatment mechanism(s), such as converting a dry pond to a constructed wetland.

BMP Enhancements: Retrofits that utilize the existing treatment mechanism in an existing BMP, but improve removal by increasing storage volume or hydraulic residence time.

The report includes a fourth category, BMP Restoration, which includes major maintenance upgrades to existing BMPs that have failed or lost their original treatment capacity. This category was not included in the study, since all projects involving an existing BMP aimed to maximize pollutant removal by including a conversion or enhancement of the existing practice. Some of the projects do include restoring treatment capacity, but that was factored into the conversion or enhancement concept design.

The project also had a category for Other Practices. These include practices such as pollution prevention, landscape maintenance, tree planting and reforestation, and outfall stabilization. **Table 1** shows examples and descriptions of the types of stormwater practices that were considered as options for retrofitting the subject properties.

Table 1. Examples of Stormwater Retrofit Practices			
New Retrofits	**Bioretention or Bioswale**		Landscaped practice that uses plants, mulch, and soil to treat runoff. Most have underdrain pipes to ensure water only ponds temporarily. Common in parking lot islands and edges and as part of commercial site plans.
	Rain Garden		Similar to bioretention/bioswale, but generally smaller and less expensive. Designed to treat runoff from rooftops, driveways, and yard areas. To keep design and construction simple, underdrains and gravel are not generally used.
	Wet Swale		Linear wetland cells that intercept shallow groundwater to maintain a wetland plant community. Saturated soils support wetland vegetation, which provides an ideal environment for gravitational settling, biological uptake, and microbial activity.
	Dry Swale		Also similar to bioretention/bioswale. Main difference is that the dry swale has a longitudinal slope to fit site conditions and may be narrower than typical bioretention. Sometimes check dams are used to slow water down and create temporary ponding cells.
	Filter Strip		Vegetated surfaces that are designed to treat sheet flow from adjacent surfaces. Filter strips function by slowing runoff velocities and filtering out sediment and other pollutants, and by providing some infiltration into underlying soils.
	Filtering Practice		Stormwater filters capture, temporarily store, and treat stormwater runoff by passing it through an engineered filter media, collecting it in an underdrain and then returning it back to the storm drain system. The filter consists of two chambers; the first is devoted to settling, and the second serves as a filter bed (with sand or an organic filtering media).

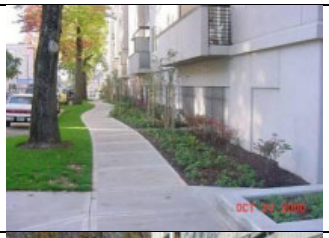
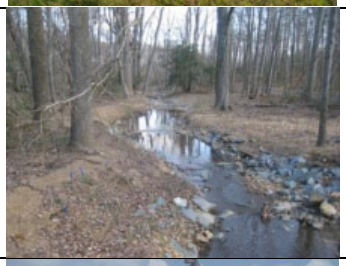
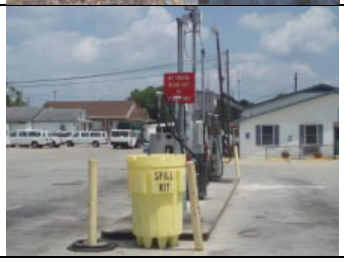
Table 1. Examples of Stormwater Retrofit Practices			
	Infiltration		Infiltration practices use temporary surface or underground storage to allow incoming stormwater runoff to infiltrate into underlying soils. These practices are suitable for use in areas where *measured* soil permeability rates exceed 1/2 inch per hour.
	Constructed Wetland		Constructed wetlands are shallow depressions that receive stormwater inputs for treatment. Wetlands are typically less than one foot deep (although they have deeper pools at the forebay and micropool) and possess variable microtopography to promote dense and diverse wetland cover.
	***Regenerative Stormwater Conveyance** **See App. C for longer description* **(Photo by: Keith Underwood)**		Linear open channel systems used at stormwater outfalls that convey and treat stormwater runoff in a stable manner. A series of shallow pools, an underlying sand bed, and native vegetation provide stability, even during large storm events. These designs are currently being used for wooded ravine outfalls in Anne Arundel County, MD.
	Impervious Disconnection		Disconnecting rooftop or other impervious surfaces so that runoff goes through vegetated areas instead of directly to storm sewer, driveway, parking lot, etc. Can be "simple" disconnection to grass (as shown in photo), or disconnection to rain garden, rain barrel, or soil-amended area.
	Stormwater Planter		Stormwater planters (also known as vegetative box filters or foundation planters) take advantage of limited space available for stormwater treatment by placing a soil filter in a container, often along buildings at the bottom of roof downspouts.
	Rainwater Harvesting		Collection of rooftop water in tank or cistern for later use for outdoor or indoor applications, including irrigation, washing, cooling systems, toilet flushing, laundry, etc. Cisterns can be above-ground or underground.

Table 1. Examples of Stormwater Retrofit Practices			
	Permeable Pavement		Pavement made from permeable materials, such as interlocking paver blocks, permeable concrete, and permeable asphalt. Storage for runoff is provided below pavement surface in a stone or gravel layer, and water either infiltrates into the ground or drains out slowly through underdrain pipes.
BMP Conversion/Enhancement			Existing stormwater ponds are either converted into a different BMP that employs more effective treatment mechanisms, or enhanced by increasing treatment volume and/or increasing hydraulic retention time. Most pond retrofits involve the conversion of older ponds into a constructed wetland or wet pond.
Other Practices	**Re-Vegetation / Tree-planting**		Vegetating turf areas with trees and shrubs to restore water retention capacity and provide other services, such as shade and habitat. In some cases, soil amendments are needed prior to re-vegetation. Deep tilling, or "sub-soiling," of soil prior to planting can also greatly improve infiltration.
	Outfall Protection		Adding stone, rip-rap, plunge pools, check dams, or vegetated conveyance channels to pipe outfalls that are eroding and causing damage to receiving streams.
	Stream Restoration		Repairing stream bank erosion and/or reconnecting stream flow to the floodplain.
	Pollution Prevention		Variety of management practices for spill response, materials storage, landscape maintenance, dumpster management, disposal of wash water and wastewater, vehicle maintenance, and employee training to keep pollutants out of stormwater runoff and waterways.

SECTION 3. EVALUATION & RANKING

3.1 Evaluation Method

Evaluation of the candidate retrofit projects involved:

1. Selecting "Screening Factors" that provide objective and subjective assessment of the relative value of candidate retrofit practices.
2. Scoring each candidate practice based on the Screening Factors.
3. Ranking the practices based on their respective scores.

This section will summarize the methodologies and computations involved in the scoring and ranking process. First, however, it is important to note several key objectives and caveats for this process:

- Since the overall intent of the project was to identify and evaluate retrofits in the context of numerical targets in the MS4 permits and Watershed Implementation Plans (WIPs), the scoring process, to the extent possible, used methods developed by the Chesapeake Bay Program to assign pollutant removal efficiencies to various BMPs. Of particular importance are the methods in *Recommendations of the Expert Panel to Define Removal Rates for Urban Stormwater Retrofit Projects* (Schueler and Lane, 2012). A potential significant caveat is that the state of Virginia (DEQ) has yet to define exactly the methods that MS4s are to use to report BMP pollutant removals (aside from inputting BMP implementation data into the VAST tool) and what role the Expert Panel methods will play in the Virginia system. As of the writing of this report, DEQ has assembled a Stakeholder Advisory Group to address this and other issues associated with the TMDL Action Plans. As such, the Expert Panel methods, as interpreted by the CWP project team, are the most up-to-date process for assigning retrofit pollutant removal rates.
- As noted, the Expert Panel report required some interpretation by the project team in order to apply the methods to specific projects. It was beyond the scope of the Expert Panel to envision every retrofit scenario, so the project team had to "fill in the blanks" in some cases. This section of the report documents the methods and computation procedures used to do this.

3.2 Ranking Process

The following sections provide detailed descriptions of each of the 3 steps outlined above.

Step 1: Selecting Screening Factors

Screening factors are metrics that define the overall value of a retrofit project. Since "overall value" is relative, the selection of screening factors involves careful vetting and analysis of the outcomes that are most important to a particular local program. Screening factors can fall into two general categories:

1. Calculated/Objective: Some screening factors are based on calculations derived from retrofit concepts. Calculation inputs can include drainage area and associated land cover to the retrofit site, potential storage volume provided by the retrofit (as measured in the field), and pollutant removal rates assigned to particular BMPs.
2. Subjective: Some screening factors are subjective and qualitative, but reflect important values for the program. Examples can include: value for education and outreach, public visibility, level of maintenance required, community acceptance, etc.

Generally, four to eight screening factors are selected. Often, the various factors are assigned "weights" so that each project can be scored on a 100-point scale.

In order to select screening factors for this project, a joint meeting was held with project representatives from Bridgewater, Harrisonburg, and JMU on April 25, 2013. At this meeting, potential screening factors were presented and discussed. There was a good deal of agreement among project participants, with only slight differences in the weighting of the various factors.

Table 2 portrays the screening factors selected for Harrisonburg and how each factor is assigned a maximum score to produce a maximum possible overall score of 100 points. The first two factors – Cost Effectiveness and Total Phosphorus removal – are calculated and reflect the importance of pollutant removal and cost for the management of MS4 programs. As such, these two factors are weighted the heaviest ("primary" factors), with each having a maximum score of 35. The remaining three factors – Maintenance Burden, Utility and Site Constraints, and Aesthetics/Safety – are subjective, and can be considered "secondary" factors with maximum scores in the 5 to 15 point range.

Table 2. Screening Factors Used for Retrofit Scoring		
Screening Factor	**Description**	**Scoring**
Pounds of Total Phosphorus (TP) Removed – TP used as indicator for other pollutants	Screening factor that combines influence of total drainage area treated and pollutant removal efficiency of proposed retrofit.	Each retrofit scored as % of best TP removal x 35 Maximum Score = **35**
Cost Effectiveness ($ per pound of TP removed)	Cost of construction per pound of total phosphorus removed by the retrofit	Each retrofit scored as % of best cost effectiveness x 35 Maximum Score = **35**
Maintenance Burden (Long-term)	Low maintenance retrofits rely on vegetation and passive treatment mechanisms (e.g., most stream restoration projects). It should be understood that ALL practices may have initial "high level" maintenance period to get plants established, control invasives, etc. As such, this metric measures long-term maintenance requirements. Retrofits with High maintenance burden may require removing debris after most storm events or have risk of heavy sediment loading, for example.	Low maintenance burden = **15**
		Medium maintenance burden = **7.5**
		High maintenance burden = **0**
Potential Utility or Site Constraints	Presence and significance of utility conflicts or other site constraints, such as limited space, required grading, or property issues	No apparent constraints = **10**
		Access somewhat constrained or utilities present but relatively easy to move (e.g., electric or phone lines) = **5**
		Poor access, major grading required, or major utilities must be moved (e.g., sewer) = **0**
Aesthetics and Safety	Since these projects are on public land, this factor considers issues such as standing water in close proximity to foot traffic, steep drop-offs or slopes, etc. The factor also considers projects that can enhance aesthetics by adding landscaping.	Practice adds landscaping and/or would enhance aesthetics at the site = **5**
		Practice neither detracts from aesthetic/safety nor adds much in the way of value = **2.5**
		Practice would pose an aesthetic or safety issue based on the practice type and location= **0**
		Total Maximum Score = 100

Step 2: Scoring Each Candidate Practice Based on the Screening Factors

Scoring each individual retrofit concept was accomplished by using a unique spreadsheet for each jurisdiction. The spreadsheet includes input cells populated by measurements taken in the field (e.g., potential practice surface area) and/or derived from GIS (e.g., drainage area, impervious cover). The spreadsheet uses these data to perform certain computations that relate to the screening factors discussed above. **Appendix B** contains a table of the significant fields from the completed spreadsheets.

The three tables that follow provide documentation for the calculations and scoring method:

- **Table 3** lists and describes the inputs to the spreadsheet. The table details inputs for all retrofit projects, plus additional inputs for BMP conversion and enhancement projects.
- **Table 4** documents the calculations performed by the spreadsheet and how these are used to assign scores for the selected screening factors.
- **Table 5** shows unit cost data used to score the cost-effectiveness screening factor, as well as whether the practice is categorized in the Expert Panel report as Runoff Reduction (RR) or Stormwater Treatment (ST).

Table 3. Description of Retrofit Spreadsheet Inputs	
ALL PRACTICES – GENERAL INPUT DATA	
CWP Lead Staff Person	Chris Swann (CPS), David Hirschman (DJH), Joe Battiata (JGB), Laurel Woodworth (LW), Lisa Fraley-McNeal (LFM).
Unique Site ID	Site identifier that starts with B (Bridgewater), H (Harrisonburg), J (JMU). For example, H8. Multiple retrofit projects on a single site are labeled H8-A, H8-B, etc.
Site Description	Site name and/or location within a larger site.
Drainage Area	Drainage area to the retrofit, in acres.
Impervious Cover	Impervious cover within the drainage area, in acres.
Proposed Practice	Generally practices from Table 2 in Expert Panel report (Schueler and Lane, 2012). Based on the report, practices are categorized as either "Runoff Reduction" (RR) or "Stormwater Treatment" (ST). JMU also had a stream restoration project, so this practice was added to the list of practice types.
Retrofit Practice Dimensions	Available surface footprint and depth to install the retrofit practice. Depending on the practice and site, this may include length, width, ponding depth, filter media depth (e.g., for bioretention), gravel depth (e.g., for underdrains). Depth can be constrained by the elevation of existing storm sewer inlets, topography, etc.
CONVERSIONS & ENHANCEMENTS – ADDITIONAL INPUT DATA	
Existing Practice	Choices include Dry Detention Pond (originally designed only for peak rate control) or Extended Detention (ED) Pond (designed for both peak rate control and water quality treatment).
Pre-Retrofit Performance Discount & Issue	Based on existing conditions, some ponds exhibit performance issues, such as short-circuiting or by-passing of the treatment area, storage filled with sediment, clogging, or the practice being undersized. Depending on the severity of the problem, a performance discount of 0, 0.25, 0.5, 0.75, or 1.0 can be assigned to existing ponds, with 0 being no performance issue and 1 being total practice failure. A column is also assigned to document the particular performance issue. Enhancement projects can also assign a Post-Retrofit Performance Discount (for example, even after the retrofit, the practice is undersized). The reason this Post-Retrofit discounts apply only to enhancements is that enhancement projects do not use the performance curves in the Expert Panel report, and thus treatment volume is not used to scale pollutant removal performance.

Table 4. Documentation of Calculations in the Spreadsheet

*NOTE: Items in bold are CALCULATED SCREENING FACTORS used in the scoring and ranking process (see **Table 2**)*

<table>
<tr><td>Target Water Quality Volume (WQ_V)</td><td>This represents the “target” storage volume for a retrofit, based on treating runoff from 1” of rainfall (standard for new development and redevelopment in Virginia stormwater regulations). While retrofits do not have the same regulatory obligation as new and redevelopment, establishing a target based on the regulatory standard can be an important screening factor.

Target WQV = 1” x Rv x DA x 3630

Where:
Target WQV = Target water quality volume (cubic feet)
Rv = Composite runoff coefficient in the drainage area = (% Impervious x 0.95) x (% Turf x 0.22)
DA = Drainage area (acres)
3630 = Conversion factor</td></tr>
<tr><td>Total Volume Provided By Retrofit Practice</td><td>Often retrofits cannot meet the full target water quality volume storage due to site constraints. This metric measures the actual storage volume potentially provided by the practice based on practice dimensions and storage layers, as measured in the field.

Total Volume = Surface Ponding + Soil Media Storage + Underdrain Gravel Storage

Assumptions:
Soil media porosity = 0.25
Gravel porosity = 0.40, as per VA Bioretention specification (No. 9)
Side slopes = 3:1

NOTE: The spreadsheet also calculates the “% of the Target WQ_V” stored in the practice, using the first two calculations</td></tr>
<tr><td>Drainage Area Pollutant Loads for TP, TN, TSS</td><td>These are the pollutant loads generated by the land covers in the drainage area <u>without any retrofit or existing practice.</u> Loading rates for TP, TN, and TSS were derived from 2009 Edge-Of-Stream rates from Phase 5.3.2 of the Chesapeake Bay Model for the Potomac River Basin.

Pollutant Load = (Urban Impervious x LR) + (Urban Pervious x LR)

LR = Loading Rate (lbs/acre per yr) from table below
<table>
<tr><th></th><th>TP</th><th>TN</th><th>TSS</th></tr>
<tr><td>Regulated Urban Impervious</td><td>1.62</td><td>16.86</td><td>1,171.32</td></tr>
<tr><td>Regulated Urban Pervious</td><td>0.41</td><td>10.07</td><td>175.8</td></tr>
</table></td></tr>
<tr><td>Runoff Depth Captured Per Impervious Acre</td><td>This value is the “X-axis” input to the Performance Curves in the Expert Panel report (see Appendix B of the Expert Panel report).

Retrofit Storage in acre-inches/Impervious acres in drainage area</td></tr>
<tr><td>Pollutant Removal for New Retrofits (lbs per year)</td><td>This computation replicates the performance curves in the Expert Panel report. The curves generate a % removal for TP, TN, and TSS and then applies the % removal to the pollutant load generated by the drainage area. There are curves for Runoff Reduction (RR) and Stormwater Treatment (ST) practices. RR practices treat stormwater through some treatment mechanism, such as filtering or settling, but also reduce the overall volume of runoff exiting the practice. ST practices accomplish just the former. Table 5 includes which practices are categorized as RR or ST, respectively.</td></tr>
</table>

<table>
<tr><td></td><td>An example of a performance curve equation is shown below for RR practice TP removal:

TP Removal % = 0.0304x⁵+0.2619x⁴+0.9161x³-1.6837x²+1.7072x-0.0091

There was one stream restoration project at JMU (Arboretum, J35). Pollutant removals for this project were based on the interim rates in the Stream Restoration Expert Panel report (Schueler and Stack, 2013) and a restoration length of 700 linear feet.[1] The provisional rates in lbs/ft/year are: TP = 0.068; TN = 0.20; TSS = 310 (NOTE: for TSS, the actual rate is closer to 55 lbs/ft/year since a delivery factor of around 0.175 is applied). It is important to note that actual rates for the project will be based on one of the three protocols in the Expert Panel report, so may vary considerably from the interim projections.</td></tr>
<tr><td>Pollutant Removal for Conversions & Enhancements (lbs per year)</td><td>For Conversions & Enhancements, there is an extra step to calculate the “Credited Pollutant Removal.” This is the removal accomplished by the retrofit minus the removal assigned to the existing practice (with relevant performance discounts). Existing practice removal rates are derived from Table A-5 in the Retrofits Expert Panel report (approved CBP rates). It is important to note that, based on the Expert Panel report, post-retrofit rates for Conversions (e.g., converting a dry pond to a constructed wetland) DO use the performance curves, but post-retrofit rates for Enhancements still use Table A-5 rates.[2]

<u>Conversion</u> Credited Pollutant Removal =
Conversion Removal from Performance Curves – Existing Practice Removal from Table A-5

<u>Enhancement</u> Credited Pollutant Removal = Enhancement Removal from Table A-5 – Existing practice removal x Difference between pre- and post-retrofit performance discounts.

Table A-5 (undiscounted) rates are listed in the table below (lbs/acre per yr):

<table>
<tr><th></th><th>TP</th><th>TN</th><th>TSS</th></tr>
<tr><td>Dry Detention Pond</td><td>10</td><td>5</td><td>10</td></tr>
<tr><td>Dry ED Pond</td><td>20</td><td>20</td><td>60</td></tr>
</table>
</td></tr>
<tr><td>Retrofit Cost</td><td>These are planning-level cost for the retrofit type, using unit construction costs ($/per cubic foot treated) from available studies. With the caveat that cost data are notoriously variable, the project team used the most up-to-date cost data from the Bay Watershed and elsewhere. The unit costs were derived from a variety sources, including JRA (2013), King & Hagan (2011), CWP (2007), and, where available, actual construction bids for retrofit projects (see, for example, CWP, 2011). These represent reasonable planning-level costs, but these data can be modified using local cost data. Also, it is important to note that these costs are construction costs and NOT BMP life-cycle costs. This is because construction costs are easier to ascertain and have less “scatter,” so represent a more reliable metric to compare projects. Life-cycle costs include project planning and permitting, administration, long-term inspection and maintenance, and other costs. Information on life-cycle BMP costs is available from WVDEP (2012), King & Hagan (2011), and WERF (2009), among other sources.

Cost = Cubic Foot Treated x Unit Construction Cost from Table 5</td></tr>
<tr><td>Cost-Effectiveness ($/lb of TP removed per year)</td><td>TP was used for this calculation since it is the keystone pollutant for the Virginia regulations.

Cost Effectiveness in $ = Retrofit Cost/lbs of TP Removed by Retrofit</td></tr>
</table>

[1] A proposal by Ecosystem Services, LLC (May 1, 2013) notes that there is approximately 1,400 linear feet of stream channel in this reach. A conservative estimate was made that the stream restoration protocols would apply to half of this reach length.
[2] This is because Enhancements, in theory, do not change the type of the existing practice, and so they are still considered an ED pond (even though the enhancement may add wetland cells, increase the flow path, etc.). Based on the Expert Panel report, dry and ED ponds should not use the performance curves. As such, with the method used in this project, the only net removal for Enhancements is assigning a performance discount to the existing practice and removing the discount, in part or in full, for the Enhancement retrofit.

Table 5. Unit Construction Costs and RR/ST Designation for Various Retrofit Practices

Retrofit Practice	RR or ST	Construction Cost/CF treated
Bioretention	RR	$24.46
Constructed Wetlands	ST	$12.37
Dry Swale	RR	$20.00
Filtering Practice	ST	$11.60
Green Roof	RR	$170.00
Infiltration	RR	$12.68
Permeable Pavers	RR	$63.15
Wet Ponds	ST	$12.37
Wet Swale	ST	$12.37
Rain Tank	RR	$15.00
Stormwater Planter	RR	$38.05
Regenerative Stormwater Conveyance*	RR	$45.00
Filter Strip	RR	$6.00
Stream Restoration	--	$12.47
Conversion & Enhancements	--	$3.59

**See Appendix C for detailed description of this practice.*

Step 3: Ranking the Projects

As a final step, the spreadsheet ranks the candidate retrofit projects within each jurisdiction from highest to lowest score, with the top-scoring project ranked #1. This ranking should not be taken at face value with regard to the final prioritizations of projects, as professional judgment is still required to identify which projects are most important for Harrisonburg to implement. For instance, projects that score high may have hidden "project killers" that reduce their feasibility. These may include overall cost, willingness of the landowner or manager, conflicts with other capital projects, community acceptance, loss of parking spaces, and other factors. Alternately, relatively low-ranking projects can be elevated by local stormwater managers because they can be implemented quickly, linked with other capital projects, and/or be implemented by an eager property manager or department director.

In order to vet the rankings produced by the spreadsheets, another meeting was held with the MS4 project representatives on July 3, 2013. At this meeting, the project team reviewed the mechanics of the scoring and ranking spreadsheets, presented the high-ranking projects,

and requested that the MS4 representatives review and potentially amend the rankings. Practices with No Score or Rank: It is important to note that some concepts developed during the field inventory were not given a score due to the nature of the practice. These include the following concept types:

- Bank Erosion Repair
- Impacted Buffer Repair
- Landscape Maintenance / Re-forestation
- Outfall Stabilization
- Pollution Prevention
- Filter Strip

These cannot be scored alongside the other practices because they do not create a storage volume and/or they represent changes in maintenance procedures or operations. However, these practices are listed in the overall retrofit inventory and should be equally considered for implementation.

As part of the broader MS4 program planning, some of these practices (e.g., buffer restoration, re-forestation) can be programmed in the VAST tool to compare pollutant removal benefits (see suggested scenarios in Section 5).

SECTION 4. STUDY RESULTS

4.1 Summary of Projects

Table 6 lists all of the 44 projects identified in Harrisonburg, with the rank of each practice, as applicable. To see detailed parameters and values for each project, see **Appendix B**. For summaries and photos of each site, see **Appendix D**. One should be aware that the scores are provided for comparative purposes. For instance, a project with a score in the 40s or 30s may seem like a "throw-away," but can actually be a sensible and achievable project.

Table 6. All Projects Identified in Harrisonburg

Site ID	Site Description	Proposed Practice	Rank
H200 alternate	Heritage Oaks Golf Course	Regenerative Stormwater Conveyance*	outlier[1]
H42	Median on Route 33 Market Street	Regenerative Stormwater Conveyance*	1
H11	Ralph Sampson Park	Enhancement	2
H47	Linda Lane Extended	Enhancement	3
H10-D	Ralph Sampson Park @ b'ball courts	Bioretention	4
H29-A	Keister Elementary School	Bioretention	5
H22-A	Westover Park Entrance	Bioretention	7
H-10A	Lucy Simms Basin	Enhancement	6
H4	Harrisonburg Electric Commission operations	Bioretention	8
H10-C	Lucy Simms Building	Rain Tank	9
H27	Harrisonburg High School	Bioretention	10
H37	Harrisonburg Public works yard	Wet Swale	11
H31	Purcell Park	Bioretention	13
H29-B	Keister Elementary School	Bioretention	12
H38-C	Harrisonburg Recycling Center	Bioretention	15
H201	Fire Station #3	Bioretention	14
H38-A	Harrisonburg Water & Sewer dept	Bioretention	16
H50	Old South High St	Bioretention	17
H45-A	Spotswood Elementary School	Bioretention	20
H19-B	Department of Community Development	Bioretention	19
H21	W. Market Street Basin No. 1	Enhancement	18
H200	Heritage Oaks Golf Course	Bioretention	21
H8-A	Waterman Elementary School	Bioretention	24
H10-B	Lucy Simms Parking Lot	Bioretention	23
H8-C	Waterman Elementary School	Dry Swale	22
H30	Unused Parcel between Rt 11 and Railroad	Bioretention	25
H38-B	Harrisonburg Public Works storage yard	Bioretention	26
H28 - Option 3	Maryland Ave Fire Station (truck washing activities)	Bioretention	27
H22-B	Westover Park Parking Lot	Bioretention	28

H9	Rockingham County Admin Bldg.	Bioretention	29
H8-B	Waterman Elementary School	Bioretention	30
H19-A	Department of Community Development	Bioretention	31
H16	Massanutten Regional Library	Stormwater Planter	32
H28 - Option 1	Maryland Ave Fire Station Driveway (truck washing activities)	Bioretention	33
H13-PP	City of Harrisonburg Hose Company #4	Pollution Prevention	N/A
H14-ER	Harrison Plaza	Bank Erosion	N/A
H14-IB	Harrison Plaza	Impacted Buffer	N/A
H15-A	County Court House	Landscape Maintenance	N/A
H15-B	County Court House	Landscape Maintenance	N/A
H28 - Option 2	Maryland Ave Fire Station (truck washing activities)	Filter Strip	N/A
H37-PP	Harrisonburg Public Works	Pollution Prevention	N/A
H40	Stone Spring Elementary School	Landscape Maintenance	N/A
H41-OT	A Dream Come True Playground	Outfall Stabilization	N/A
H45-B	Spotswood Elementary School	Landscape Maintenance	N/A
**See Appendix C for more detailed description of this type of practice.*			

Based on a natural break in the retrofit scores, the 10 highest-scoring practices were considered as the "Top-Ranked" category. **Table 7** summarizes the top-ranked projects for Harrisonburg**.**

Table 7. Summary of 10 Top-Ranked Retrofit Sites for Harrisonburg

Site	DA (ac.)	%WQ_V[1]	TP (lbs/yr)	TN (lbs/yr)	TSS (lbs/yr)	Construction Cost	$/lb TP reduced per yr
H200-Alt: Heritage Oaks G.C. RSC	100.00	5%	16.26	308.44	2,493	$220,320	$13,552
H42: Market St. Median	88.50	7%	12.22	123.44	9,574	$740,070	$60,545
H11: Ralph Sampson Park BMP	0.64	11%	0.18	2.02	436	$775	$4,234
H47: Linda Lane Extended	10.25	99%	0.86	12.81	1,483	$63,503	$73,472
H10-D: Ralph Sampson Park Courts	4.09	33%	1.50	25.57	439	$35,701	$23,776
H29: Keister E.S.	0.60	38%	0.38	3.58	331	$17,330	$45,174
H10-A: Lucy Simms Basin	20.16	19%	0.76	12.1	1,158	$21,540	$28,344
H22-A: Westover Park Entrance	3.00	56%	1.30	20.88	467	$48,478	$37,392
H4: H'burg Electric Commission	2.60	21%	0.94	9.63	743	$34,259	$36,493
H10-C: Lucy Simms Bldg.	1.39	100%	1.48	13.47	1,289	$67,920	$46,035
TOTALS	**231.23**		**35.88**	**531.94**	**18,415**	**$1,249,896**	**$34,835**[2]

*[1] This refers to the percent of the Target Water Quality Volume (WQ_V) captured by the practice, as described in **Table 4**. Since these are retrofit projects, they do not have a regulatory obligation to meet 100% of the WQ_V, but it is a good metric by which to compare projects.*

[2] This value is not a Total, per se, but the total cost for the 10 projects divided by the total TP removal.

4.2 Trends in the Three Communities

The following observations are general trends noted for all three jurisdictions.

What Are The Most Cost-Effective Practices?

Based on the scoring metric of cost per pound of Total Phosphorus reduced (cost-effectiveness), BMP conversions and enhancements are generally more cost-effective. **Table 8** shows the values for this metric for all three jurisdictions included in the project. Within each jurisdiction, conversions/enhancements are more cost-effective than new retrofits. For all three jurisdictions, the average cost-effectiveness for new retrofits is $56,279, compared to $23,647 for conversions/enhancements. As **Table 8** also illustrates, there is a wide range of cost-effectiveness values for both new and conversion/enhancement projects, and project-specific factors (e.g., drainage area, type of project) will dictate this.

Of equal importance, conversions/enhancements, while more cost-effective on average, are limited in number because they rely on a pre-existing practice, while new retrofits can be located across the broader landscape. The three jurisdictions had a total of 64 candidate new retrofit projects on public land, but only 9 conversions/enhancements.

What this means in practical terms is that an MS4 should seek first to convert and/or enhance existing BMPs, but will likely need to blend this with the most cost-effective new retrofits in order to meet load reduction targets. These data also suggest that MS4s would be well-served to seek conversion/enhancement projects for existing practices on private land. While the administrative issues would be more difficult for private land projects (e.g., securing easements, working with landowners), the overall cost-effectiveness may be worth the effort.

What Are "Heroic" Retrofit Projects?

For each jurisdiction, there appears to be one or two "heroic" retrofit projects that have large drainage areas, are cost-effectiveness, and achieve disproportionately high load reductions. The influence of these heroic projects can be quite pronounced, as illustrated in **Table 9**. Compared to the load reductions achieved by ALL of the candidate retrofit projects for a given jurisdiction, the one or two heroic projects are generally responsible for half or more of the reductions, and this value can exceed 75% (in the case of Bridgewater). These projects are clearly the heavy-hitters, and of course are the top-ranked projects for each jurisdiction.

The conundrum for an MS4 is that these projects also tend to be the more expensive projects, with estimated price tags for construction being in the hundreds of thousands of dollars (compared in many cases to tens of thousands for lower ranked projects). However, viewed another way, the heroic projects are relative bargains, because they cost proportionately less per pound of pollutant reduced. With this in mind, an MS4 may want to prioritize the heroic projects, but also realize that implementation, including raising the necessary capital, may take several years to accomplish. Also, it will be critical to scrutinize these projects thoroughly, as there may be reasons to not elevate them so highly. Feasibility,

construction issues, property rights, and political support must all be analyzed in a feasibility or concept design stage to truly analyze whether the projects can deliver what is promised.

Table 8. Cost-Effectiveness of New Retrofits vs. Conversions/Enhancements -- $/Pound of TP Removed

	Bridgewater	Harrisonburg	JMU
New Retrofits			
Number in Sample	9	31	24
Range of Values	$24,100 -- $120,046	$13,552 -- $210,949	$22,227 -- $105,657
Average	$51,511	$60,757	$56,568
Conversions/Enhancements			
Number in Sample	1	4	4
Range of Values	$7,723	$4,234 -- $94,553	$9,797 -- $14,164
Average	$7,723	$51,167	$12,052

Table 9. Percent of Load Reductions & Costs for "Heroic" Projects Compared to ALL Retrofits From This Study For Each Jurisdiction

	TP	TN	TSS	Construction Cost ($)
Bridgewater – Project B2-A, Oakdale Park	77%	78%	73%	40%
Harrisonburg – Projects H200-Alt (Heritage Oaks G.C. RSC) & H42 (Market St. Median)	54%	62%	36%	42%
JMU – Project J35, Arboretum Stream Restoration	50%	25%	57%	23%

SECTION 5. RECOMMENDATIONS

5.1 Further Considerations

For Harrisonburg, implementation of the retrofits identified in this study must be done strategically and with full vetting of other available BMPs and strategies to achieve target pollutant load reductions. As Harrisonburg embarks on its first MS4 Permit Cycle with the TMDL Action Plan and load reduction requirements, it will be important to keep the following topics in mind.

Expanding the Search for Retrofit Options

This study only addressed retrofits on selected public land parcels within the City. Obviously, the acreage covered is only a small percentage of land within the jurisdiction. Accordingly, and as is evidenced by the data presented in this section, public land retrofits will be only part of the overall pollutant load reduction puzzle for Harrisonburg. In future years, an expanded retrofit assessment could also cover rights-of-way, private parcels with significant impervious cover, private basins and ponds, and other promising scenarios.

Investigating the Full Range of Practices

Stormwater retrofits are only one of the BMP strategies available to MS4s to achieve pollutant load reductions. As of this report, the Chesapeake Bay Program Expert Panels have approved procedures and performance values for implementing new state performance standards, retrofits, stream restoration, and urban nutrient management (see: http://chesapeakestormwater.net/bay-stormwater/baywide-stormwater-policy/urban-stormwater-workgroup/). Several other Expert Panels are in progress or pending: illicit discharge detection and elimination (IDDE), street sweeping, enhanced erosion control, and floating wetlands. As these protocols become accepted by the Bay Program, it will be helpful for MS4s to analyze which practices will be most suitable and cost-effective for their jurisdiction.

Stormwater Design Considerations for Karst

Harrisonburg and other Shenandoah Valley jurisdictions must address stormwater design issues associated with karst. Karst tends to be a very site-specific feature, and it is difficult to establish at the concept stage how it may affect a particular stormwater practice with regard to design details and associated costs. It is important to note that the pollutant removal performance values and costs presented in this report are based on Bay-wide data and procedures (and sometimes national data with regard to unit costs). As such, the performance values and unit costs do not anticipate the use of impermeable liners, more involved geotechnical work at the design stage, or other karst-specific issues. CWP does believe that karst is an important design consideration, but should not result in across-the-board or automatic BMP design modifications that increase cost.

The most recent Bay-wide guidance on stormwater design in karst is Technical Bulletin #1 from the Chesapeake Stormwater Network, and can be found here (CSN, 2009):

http://chesapeakestormwater.net/2012/03/technical-bulletin-no-1-stormwater-design-guidelines-for-karst-terrain/. It should also be noted that the Virginia BMP Specifications on the Clearinghouse website (http://vwrrc.vt.edu/swc/NonProprietaryBMPs.html) contain short sections about design adaptations for karst.

Keeping in Touch With DEQ About MS4 Reporting

This study used the Bay Program-approved protocols, with some technical interpretations by CWP staff, to assign pollutant removal performance values to candidate retrofit (and some stream restoration) projects. A major caveat is that Virginia DEQ must still weigh in on how MS4s should report BMPs and their corresponding performance values. As of the writing of this report, DEQ has convened an MS4 Stakeholder Group to address issues with the TMDL Action Plan. Harrisonburg staff may need to revisit the numbers presented in this section after DEQ issues its guidance.

5.2 Options for Achieving Required Load Reductions

The remainder of this section consists of several tables that present and analyze retrofit data for Harrisonburg. The tables are as follows:

- **Table 10** presents assumed load reduction requirements for Harrisonburg for Total Phosphorus (TP), Total Nitrogen (TN), and Total Suspended Solids (TSS). The numbers are relevant to the "TMDL Action Plan" required in the Virginia Small MS4 General Permit and Virginia's Phase II Watershed Implementation Plan (WIP). For Harrisonburg, these numbers likely overestimate the load reductions actually required since they reflect total acreage for "regulated urban impervious" and "regulated urban pervious" land cover within the whole City. The numbers can be refined once Harrisonburg delineates actual land area within the MS4 boundaries.
- **Table 11** shows how potential load reductions from the candidate retrofit projects in this study compare to those needed in the MS4 Permit and WIP. The table breaks out total loads from all of the candidate retrofit projects, as well as the 10 top-ranked projects (see **Table 7**). The table also shows the percentage of the reduction achieved through retrofits for the 1st (current) permit cycle, as well as the 2nd cycle and the total required reductions through 3 cycles.

  It should be noted that the current general permit only contains requirements to achieve 5% of the reductions, but also states that future permit cycles will be in accordance with the WIP.

  As such, the projections for future permits are based on the percent reductions noted in the WIP. As can be seen from this table, retrofits on public land in Harrisonburg will be only part of the overall MS4 pollution reduction strategy. Implementing the top ten projects within 5 years would achieve 28% (for TSS), 48% (for TP), and 97% (for TN) of the reductions required in the 1st permit term.
- **Table 12** outlines several possible TMDL Action Plan scenarios for Harrisonburg based on the retrofit data. These scenarios assume different retrofit implementation levels and timelines, and assume that retrofits will be implemented along with other

MS4 strategies. A couple of the scenarios involve cooperating with JMU on selected projects or even entering into a joint permit with JMU. Some of the scenarios also envision limited purchase of nutrient credits through the Chesapeake Bay Nutrient Credit Exchange, although this program is still being fleshed out at the state level. It should be noted that these scenarios are hypothetical, and of course the actual strategy must be vetted through a local process. However, the proposed scenarios may help the City with understanding its choices as it continues to implement the MS4 program.

- Since one of the scenarios in **Table 12** involves a joint permit with JMU, **Table 13** and **Table 14** show data on what the required load reductions would presumably be under such a permit and how well different retrofit implementation strategies would achieve the target reductions.

Table 10. Harrisonburg MS4 Required Load Reductions

	Required Load Reductions[1]		
	TP (lbs/yr)	**TN (lbs/yr)**	**TSS (lbs/yr)**
1st Permit Cycle (ending 2018) – Achieve 5% of total reduction[2]	75	550	64,733
2nd Permit Cycle (ending 2023) – Achieve additional 35% of total reduction	524	3,851	453,133
Total Reduction Required (in up to three permit cycles)	1,498	11,003	1,294,667

[1] Load reductions derived from DCR spreadsheet that is based on Phase 5.3.2 Watershed Model. The reductions are a % reduction from Edge-of-Stream baseline loads from July 1, 2009. Loads are calculated based on the acreage of "regulated urban impervious" and "regulated urban pervious" acres within the MS4, with specific loading rates for Potomac and Shenandoah River Basin, as documented in Phase 5.3.2 of the Chesapeake Bay Model. All load figures were rounded to the nearest whole number.

[2] The Virginia Small MS4 General Permit became effective on July 1, 2013. Section 1(C) – Special Conditions for the Chesapeake Bay TMDL – stipulates that MS4s achieve 5% of their required reductions in the 1st 5-year permit cycle, and also states that future permit cycle reductions will be in accordance with Virginia's Phase 1 and 2 Watershed Implementation Plans. The permit also requires MS4s to offset increased loads from some new development projects (initiated after July 1, 2009) as well as grandfathered projects (initiated after July 1, 2014). This table shows only numbers for reductions from existing sources. Reductions in the other two categories are expected to be low compared to values for existing sources.

Table 11. Harrisonburg: Implementation of Retrofits Compared to Required Load Reductions				
	TP (lbs/yr)	**TN (lbs/yr)**	**TSS (lbs/yr)**	**Construction Cost**
Implement All Retrofits[1]	**53**	**694**	**33,675**	**$2,312,618**
	% of Permit Cycle's Required Reduction			
All Retrofits % 1st Permit Cycle	71%	126%	52%	
All Retrofits % 2nd Permit Cycle (inclusive)[2]	9%	16%	7%	
All Retrofits % Total Reduction	4%	6%	3%	
Implement Only 10 Top-Ranked Retrofits	**36**	**532**	**18,415**	**$1,249,896**
	% of Permit Cycle's Required Reduction			
Top-Ranked % 1st Permit Cycle	48%	97%	28%	
Top-Ranked % 2nd Permit Cycle (inclusive)	6%	12%	4%	
Top-Ranked % Total Reduction	2%	5%	1%	

*[1] The total load reductions and costs for implementing All Retrofits assumed that: (1) for H28, option 3 is used and Options 1 and 2 are excluded from the summing of load reductions and costs, and (2) for H200, the Alternative regenerative stormwater conveyance project is used, and the smaller parking lot bioretention project is excluded (see **Appendix B**). The reason for this is that these projects are nested, and it is likely that only one of the options for each site would be implemented.*

[2] "Inclusive" means the % reduction achieved compared to required reductions for the 1st plus 2nd permit cycles, based on the WIPs. This amounts to a total reduction of 40% (5% for the 1st permit cycle + an additional 35% for the 2nd).

Table 12. Overview of Possible MS4 Load Reduction Scenarios for Harrisonburg

Permit Cycle Activities & Actions	Notes
Scenario 1: Partner With JMU on Arboretum Project[1] + Retrofits + Trading	
<u>1st Permit Cycle (2018):</u> • The drainage area for the JMU Arboretum Project is within the City, and the project yields high pollutant reductions and is cost-efficient. If both MS4s were willing partners, Harrisonburg could cost-share and negotiate the % of reduction received. • In addition, Harrisonburg may want to implement several of their smaller high-ranking retrofit projects (e.g., H4, H11, H22-A, H47). • Begin design work for some larger retrofits to be constructed during the 2nd cycle (e.g., H42, H200-Alt) • Take a hard look at other BMPs that may be more cost-effective than retrofits for the needed pollutant reductions: stream restoration, urban nutrient management, street sweeping, IDDE, etc. For instance, the City could conduct a stream restoration inventory that identifies and prioritizes candidate projects. • Purchase certified nutrient credits to make up any deficits for the 1st cycle, if any. **<u>2nd Permit Cycle (2023):</u>** 1. Expand the retrofit inventory to include public rights-of-way, highly-impervious private land, and especially existing stormwater basins and ponds. 2. Construct one or more of the larger high-ranking retrofits, as noted above. 3. Continue to implement other urban BMPs. **<u>Out-Year Permits:</u>** Re-evaluate other potential retrofits along with other Bay Program & Virginia credited practices: street sweeping, urban nutrient management, stream restoration, etc. to pick most cost-effective mix of practices.	• The JMU Arboretum Project generates surplus TSS reductions through the 2nd permit cycle, based on the projections in this study. On the other hand, JMU may fall short for TN reduction. A partnership with Harrisonburg may allow JMU to use its advantage to reduce TSS and Harrisonburg to use its advantage to reduce TN through BMPs such as urban nutrient management or street sweeping. • Nutrient trading regulations are still in process at DEQ, so the rules of the game and cost are still uncertain. However, the MS4 General Permit does authorize the use of trading.
[1] The "Arboretum Project" refers to a candidate retrofit project identified at JMU as part of this study. The project (J35) involves removing an existing pond and restoring the reach of stream between Neff Avenue and the main Arboretum Pond.	
Scenario 2: Retrofit "Campuses" + Other BMPs + Trading	
<u>1st Permit Cycle (2018):</u> • Harrisonburg could "cluster" retrofits at certain sites so that they could better serve as demonstration sites. Potential sites include Lucy Simms/Ralph Sampson Park (H10 sites, H11), Westover Park (H22 sites), Waterman Elementary School (H8 sites), and/or Keister Elementary (H29 sites). The strategy would be to use retrofits strategically, but rely on other BMPs (e.g., stream restoration) for a larger share of load reductions. • Conduct an inventory of available stream restoration projects; rank and prioritize similar to the retrofit study.	• As noted, the retrofit campus idea has merit to concentrate retrofit efforts and serve educational and outreach functions. However, it would not lead to high percentages of needed reductions. For instance, the 4 projects as Lucy Simms/Ralph Sampson Park together would yield 5% of needed reductions for TP and TSS and 9% for TN for the 1st cycle. • Stream restoration is suggested for several reasons: (1) retrofit-derived TSS reductions seem to lag slightly behind TP/TN for Harrisonburg, (2) as evidenced by the JMU Arboretum project, stream restoration can

• Conduct an inventory of available retrofits of existing (private) basins and ponds, rights-of-way, some private land. • Also, based on emerging guidance, quantify the cost-effectiveness of urban nutrient management, street sweeping, and other Bay Program and VA credited practices. • Purchase certified nutrient credits to make up any deficits for the 1st cycle. **2nd Permit Cycle (2023):** • Construct strategic stream restoration projects. • Construct some of the larger high-ranking retrofits. • Implement other BMPs. • Possibly trading as needed. **Out-Year Permits:** See Scenario 1.	generate high levels of TSS reduction based on the interim rate, and (3) TSS is not available for trading as are TP/TN.
Scenario 3: Joint Permit With JMU (see Table 13)	
1st Permit Cycle (2018): • Negotiate joint permit with JMU and DEQ. • Implement Arboretum Project and the best high-ranking retrofits from JMU & Harrisonburg. • Jointly conduct an inventory of possible stream restoration projects and other available BMPs. **2nd Permit Cycle (2023):** • Implement the most cost-effective stream restoration, retrofit, or other BMP projects. **Out-Year Permits:** Same as Scenarios 1 and 2.	• Overall, the most cost-effective retrofits are at JMU – between the Arboretum and several basin conversions (J26, J28, J33). The average cost per pound of TP for the 3 JMU basin conversions is $12,022/lb, while the average for the top 10 Harrisonburg retrofits is nearly $37,000/lb. Therefore, it is likely that the basin conversions would be the first projects to be implemented through a joint permit.

Table 13. City of Harrisonburg + JMU Combined MS4 Required Load Reductions

	Required Load Reductions[1]		
	TP (lbs/yr)	**TN (lbs/yr)**	**TSS (lbs/yr)**
1st Permit Cycle (ending 2018) – Achieve 5% of total reduction[2]	78	578	67,568
2nd Permit Cycle (ending 2023) – Achieve additional 35% of total reduction	548	4,050	472,981
Total Reduction Required (in up to three permit cycles)	1,566	11,572	1,351,376

[1] Load reductions derived from DCR spreadsheet that is based on Phase 5.3.2 Watershed Model. The reductions are a % reduction from Edge-of-Stream baseline loads from July 1, 2009. Loads are calculated based on the acreage of "regulated urban impervious" and "regulated urban pervious" acres within the MS4, with specific loading rates for Potomac and Shenandoah River Basin, as documented in Phase 5.3.2 of the Chesapeake Bay Model. All load figures were rounded to the nearest whole number.

[2] The Virginia Small MS4 General Permit became effective on July 1, 2013. Section 1(C) – Special Conditions for the Chesapeake Bay TMDL – stipulates that MS4s achieve 5% of their required reductions in the 1st 5-year permit cycle, and also states that future permit cycle reductions will be in accordance with Virginia's Phase 1 and 2 Watershed Implementation Plans. The permit also requires MS4s to offset increased loads from some new development projects (initiated after July 1, 2009) as well as grandfathered projects (initiated after July 1, 2014). This table shows only numbers for reductions from existing sources. Reductions in the other two categories are expected to be low compared to values for existing sources.

Table 14. City of Harrisonburg + JMU: Implementation of Retrofits Compared to Combined Required Load Reductions

	TP (lbs/yr)	**TN (lbs/yr)**	**TSS (lbs/yr)**	**Construction Cost**
Implement All Retrofits	**148**	**1251**	**101,191**	**$4,175,545**
	% of Permit Cycle's Required Reduction			
All Retrofits % 1st Permit Cycle	189%	216%	150%	
All Retrofits % 2nd Permit Cycle (inclusive)[1]	24%	27%	19%	
All Retrofits % Total Reduction	9%	11%	7%	
Implement Only Combined 15 Top-Ranked Retrofits	**111**	**905**	**69,505**	**$2,226,649**
	% of Permit Cycle's Required Reduction			
Top-Ranked % 1st Permit Cycle	142%	156%	103%	
Top-Ranked % 2nd Permit Cycle (inclusive)	18%	20%	13%	
Top-Ranked % Total Reduction	7%	8%	5%	
Implement Arboretum Project Only	**48**	**140**	**38,500**	**$420,000**
	% of Permit Cycle's Required Reduction			
Arboretum % 1st Permit Cycle	61%	24%	57%	
Arboretum % 2nd Permit Cycle (inclusive)	8%	3%	7%	
Arboretum % Total Reduction	3%	1%	3%	

[1] "Inclusive" means the % reduction achieved compared to required reductions for the 1st plus 2nd permit cycles, based on the WIPs. This amounts to a total reduction of 40% (5% for the 1st permit cycle + an additional 35% for the 2nd).

REFERENCES

Anne Arundel County, Maryland. 2012. *Regenerative Step Pool Storm Conveyance (SPSC), Design Guidelines.* Revision 5: December 2012.

Center for Watershed Protection (CWP). 2007. *Urban Stormwater Retrofit Practices Version 1.0. Manual 3 in the Urban Subwatershed Restoration Manual Series*. CWP. Ellicott City, MD.

Center for Watershed Protection (CWP). 2011. *In-Lieu Fee Proposal for On-Site Stormwater Management*. Unpublished draft. Prepared for the Delaware Department of Natural Resources and Environmental Control Division of Soil and Water conservation. CWP. Ellicott City, MD.

Chesapeake Stormwater Network (CSN). 2009. *Technical Bulletin No. 1: Stormwater Design Guidelines for Karst Terrain in the Chesapeake Bay Watershed.* Version 2.0. Developed by Karst Working Group. CSN. Ellicott City, MD.

James River Association (JRA). 2013. *Cost-Effectiveness Study of Urban Stormwater BMPs in the James River Basin.* JRA. Richmond, VA.

King, D., and P. Hagan. 2011. *Costs of Stormwater Management Practices in Maryland Counties*. Prepared for Maryland Department of the Environment by the University of Maryland Center for Environmental Services. Technical Report Series No. TS-626-11 of the University of Maryland Center for Environmental Science.

Novotney, M. and R. Winer. 2008. *Municipal Pollution Prevention/Good Housekeeping Practices Manual - Version 1.0.* Manual 9 in the *Urban Subwatershed Restoration Manual Series*. Center for Watershed Protection. Ellicott City, MD.

Schueler, T. and C. Lane. 2012. *Recommendations of the Expert Panel to Define Removal Rates for Urban Stormwater Retrofit Projects.* Chesapeake Stormwater Network. Ellicott City, MD.

Schueler, T. and B. Stack. 2013. *Final Recommendations of the Expert Panel to Define Removal Rates for Individual Stream Restoration Projects*. Chesapeake Stormwater Network and Center for Watershed Protection. Ellicott City, MD.

Water Environment Research Foundation (WERF). 2009. *BMP and LID Whole Life Cost Models: Version 2.0.* Alexandria, VA. Available at: http://www.werf.org/i/a/Ka/Search/ResearchProfile.aspx?ReportId=SW2R08

West Virginia Department of Environmental Protection (WVDEP). 2012. *Guidance for Developing an Off-Site Stormwater Compliance Program in West Virginia.*

Wright, T., C. Swann, K. Cappiella, T. Schueler. 2005. *Unified Subwatershed and Site Reconnaissance: A User's Manual-Version 2.0.* Manual 11 in the *Urban Subwatershed Restoration Manual Series*. Center for Watershed Protection. Ellicott City, MD.

APPENDIX A: FIELD FORMS

This appendix includes the field forms used during the stormwater retrofit study:

- Retrofit Reconnaissance Inventory form
- Hotspot Site Investigation form
- Severe Bank Erosion form
- Stormwater Outfall form
- Impacted Buffer form

WATERSHED:	SUBWATERSHED:	UNIQUE SITE ID:	
DATE:	ASSESSED BY:	CAMERA ID:	PICTURES:
GPS ID:	LMK ID:	LAT:	LONG:

SITE DESCRIPTION

Name:_____
Address:_____

Ownership: ☐ Public ☐ Private ☐ Unknown
If Public, Government Jurisdiction: ☐ Local ☐ State ☐ DOT ☐ Other:_____

Corresponding USSR/USA Field Sheet? ☐ Yes ☐ No If yes, Unique Site ID:_____

Proposed Retrofit Location:

Storage
- ☐ Existing Pond
- ☐ Above Roadway Culvert
- ☐ Below Outfall
- ☐ In Conveyance System
- ☐ In Road ROW
- ☐ Near Large Parking Lot
- ☐ Other:_____

On-Site
- ☐ Hotspot Operation
- ☐ Individual Rooftop
- ☐ Small Parking Lot
- ☐ Small Impervious Area
- ☐ Individual Street
- ☐ Landscape / Hardscape
- ☐ Underground
- ☐ Other:_____

DRAINAGE AREA TO PROPOSED RETROFIT

Drainage Area ≈ _____
Imperviousness ≈ _____%
Impervious Area ≈ _____

Notes:

Drainage Area Land Use:
- ☐ Residential
  - ☐ SFH (< 1 ac lots)
  - ☐ SFH (> 1 ac lots)
  - ☐ Townhouses
  - ☐ Multi-Family
- ☐ Commercial
- ☐ Institutional
- ☐ Industrial
- ☐ Transport-Related
- ☐ Park
- ☐ Undeveloped
- ☐ Other:_____

EXISTING STORMWATER MANAGEMENT

Existing Stormwater Practice: ☐ Yes ☐ No ☐ Possible
If Yes, Describe:

Describe Existing Site Conditions, Including Existing Site Drainage and Conveyance:
Existing Street Width (if applicable):_____

Existing Head Available:	**Note where points are measured from: (i.e. street elevation to catch basin invert, manhole rim to catch basin invert, other)**

PROPOSED RETROFIT

Purpose of Retrofit:
☐ Water Quality ☐ Recharge ☐ Channel Protection ☐ Flood Control
☐ Demonstration / Education ☐ Repair ☐ Other:_____

Retrofit Volume Computations - Target Storage:

Retrofit Volume Computations - Available Storage:

Proposed Treatment Option:
☐ Extended Detention ☐ Wet Pond ☐ Created Wetland ☐ Bioretention
☐ Filtering Practice ☐ Infiltration ☐ Swale ☐ Other:_____

Describe Elements of Proposed Retrofit, Including Surface Area, Maximum Depth of Treatment, and Conveyance:

Available Width:	
Available Length:	
Available Area:	
Ponding Depth:	
Soil Depth:	

SITE CONSTRAINTS

Adjacent Land Use:
☐ Residential ☐ Commercial ☐ Institutional
☐ Industrial ☐ Transport-Related ☐ Park
☐ Undeveloped ☐ Other:_____
Possible Conflicts Due to Adjacent Land Use? ☐ Yes ☐ No
If Yes, Describe:

Access:
☐ No Constraints
Constrained due to
☐ Slope ☐ Space
☐ Utilities ☐ Tree Impacts
☐ Structures ☐ Property
Ownership
☐ Other:_____

Conflicts with Existing Utilities:

	Yes	Possible/ Modifiable	No	Unknown
Sewer:	☐	☐	☐	☐
Water:	☐	☐	☐	☐
Gas:	☐	☐	☐	☐
Electric to Streetlights:	☐	☐	☐	☐
Other:	☐	☐	☐	☐

_____
_____

Potential Permitting Factors:

Dam Safety Permits Necessary	☐ Probable	☐ Not Probable
Impacts to Wetlands	☐ Probable	☐ Not Probable
Impacts to a Stream	☐ Probable	☐ Not Probable
Floodplain Fill	☐ Probable	☐ Not Probable
Impacts to Forests	☐ Probable	☐ Not Probable
Impacts to Specimen Trees	☐ Probable	☐ Not Probable

How many?_____
Approx. DBH_____

Other factors:_____
_____
_____

Soils:
Soil auger test holes: ☐ Yes ☐ No
Evidence of poor infiltration (clays, fines): ☐ Yes ☐ No
Evidence of shallow bedrock: ☐ Yes ☐ No
Evidence of high water table (gleying, saturation): ☐ Yes ☐ No

SKETCH

DESIGN OR DELIVERY NOTES

FOLLOW-UP NEEDED TO COMPLETE FIELD CONCEPT

- ☐ Confirm property ownership
- ☐ Confirm drainage area
- ☐ Confirm drainage area impervious cover
- ☐ Confirm volume computations
- ☐ Complete concept sketch
- ☐ Obtain existing stormwater practice as-builts
- ☐ Obtain site as-builts
- ☐ Obtain detailed topography
- ☐ Obtain utility mapping
- ☐ Confirm storm drain invert elevations
- ☐ Confirm soil types
- ☐ Other:_____

INITIAL FEASIBILITY AND CONSTRUCTION CONSIDERATIONS

SITE CANDIDATE FOR FURTHER INVESTIGATION:	☐ YES	☐ NO	☐ MAYBE
IS SITE CANDIDATE FOR EARLY ACTION PROJECT(S):	☐ YES	☐ NO	☐ MAYBE
IF NO, SITE CANDIDATE FOR OTHER RESTORATION PROJECT(S):	☐ YES	☐ NO	☐ MAYBE

IF YES, TYPE(S):_____

Hotspot Site Investigation **HSI**

WATERSHED:	**SUBWATERSHED:**	**UNIQUE SITE ID:**
DATE: ___/___/_____	**ASSESSED BY:** / **CAMERA ID:**	**PIC#:**
MAP GRID:	**LAT** ___°_____'_____" **LONG** ___°_____'____"	**LMK #**

A. SITE DATA AND BASIC CLASSIFICATION

Name and Address: _____

_____

_____

SIC code (if available): _____

NPDES Status: ☐ Regulated ☐ Unregulated ☐ Unknown

Category: ☐ Commercial ☐ Industrial ☐ Institutional ☐ Municipal ☐ Transport-Related

Miscellaneous ☐ Golf Course ☐ Marina ☐ Animal Facility

Basic Description of Operation:

_____

	INDEX*
B. VEHICLE OPERATIONS ☐ **N/A** *(Skip to part C)*	**Observed Pollution Source?** ☐
B1. Types of vehicles: ☐ Fleet vehicles ☐ School buses ☐ Other: _____	
B2. Approximate number of vehicles: _____	
B3. Vehicle activities *(circle all that apply)*: **Maintained Repaired Recycled Fueled Washed Stored**	○
B4. Are vehicles stored and/or repaired outside? ☐ Y ☐ N ☐ Can't Tell Are these vehicles lacking runoff diversion methods? ☐ Y ☐ N ☐ Can't Tell	○
B5. Is there evidence of spills/leakage from vehicles? ☐ Y ☐ N ☐ Can't Tell	○
B6. Are uncovered outdoor fueling areas present? ☐ Y ☐ N ☐ Can't Tell	○
B7. Are fueling areas directly connected to storm drains? ☐ Y ☐ N ☐ Can't Tell	○
B8. Are vehicles washed outdoors? ☐ Y ☐ N ☐ Can't Tell Does the area where vehicles are washed discharge to the storm drain? ☐ Y ☐ N ☐ Can't Tell	○
C. OUTDOOR MATERIALS ☐ **N/A** *(Skip to part D)*	**Observed Pollution Source?** ☐
C1. Are loading/unloading operations present? ☐ Y ☐ N ☐ Can't Tell If yes, are they uncovered *and* draining towards a storm drain inlet? ☐ Y ☐ N ☐ Can't Tell	○
C2. Are materials stored outside? ☐ Y ☐ N ☐ Can't Tell If yes, are they ☐ Liquid ☐ Solid Description: _____ Where are they stored? ☐ grass/dirt area ☐ concrete/asphalt ☐ bermed area	○
C3. Is the storage area directly or indirectly connected to storm drain (circle one)? ☐ Y ☐ N ☐ Can't Tell	○
C4. Is staining or discoloration around the area visible? ☐ Y ☐ N ☐ Can't Tell	○
C5. Does outdoor storage area lack a cover? ☐ Y ☐ N ☐ Can't Tell	○
C6. Are liquid materials stored *without* secondary containment? ☐ Y ☐ N ☐ Can't Tell	○
C7. Are storage containers missing labels or in poor condition (rusting)? ☐ Y ☐ N ☐ Can't Tell	○
D. WASTE MANAGEMENT ☐ **N/A** *(Skip to part E)*	**Observed Pollution Source?** ☐
D1. Type of waste *(check all that apply)*: ☐ Garbage ☐ Construction materials ☐ Hazardous materials **any of these**	○
D2. Dumpster condition (*check all that apply)*: ☐ No cover/Lid is open ☐ Damaged/poor condition ☐ Leaking or evidence of leakage (stains on ground) ☐ Overflowing **any of these**	○
D3. Is the dumpster located near a storm drain inlet? ☐ Y ☐ N ☐ Can't Tell If yes, are runoff diversion methods (berms, curbs) lacking? ☐ Y ☐ N ☐ Can't Tell **if both are yes**	○
E. PHYSICAL PLANT ☐ **N/A** *(Skip to part F)*	**Observed Pollution Source?** ☐
E1. Building: Approximate age: _____ yrs. Condition of surfaces: ☐ Clean ☐ Stained ☐ Dirty ☐ Damaged	○
Evidence that maintenance results in discharge to storm drains (staining/discoloration)? ☐ Y ☐ N ☐ Don't know	○

*Index: ○ denotes potential pollution source; ☐ denotes confirmed polluter (evidence was seen)

E2. Parking Lot: Approximate age _____ yrs. Condition: ☐ Clean ☐ Stained ☐ Dirty ☐ Breaking up Surface material ☐ Paved/Concrete ☐ Gravel ☐ Permeable ☐ Don't know	○
E3. Do downspouts discharge to impervious surface? ☐ Y ☐ N ☐ Don't know ☐ None visible Are downspouts directly connected to storm drains? ☐ Y ☐ N ☐ Don't know	○
E4. Evidence of poor cleaning practices for construction activities (stains leading to storm drain)? ☐ Y ☐ N ☐ Can't Tell	○
E5. Evidence of poor cleaning practices for washing activities (observed washwater dumping, stains leading to storm drain)? ☐ Y ☐ N ☐ Can't Tell	○
F. TURF/LANDSCAPING AREAS ☐ **N/A** *(skip to part G)*	**Observed Pollution Source?**
F1. % of site with: Forest canopy ____% Turf grass _____ % Landscaping ____% **Bare Soil 20 %**	○
F2. Rate the turf management status: ☐ High ☐ Medium ☐ Low **40% medium to high**	○
F3. Evidence of permanent irrigation or "non-target" irrigation ☐ Y ☐ N ☐ Can't Tell	○
F4. Do landscaped areas drain to the storm drain system? ☐ Y ☐ N ☐ Can't Tell	○
F5. Do landscape plants accumulate organic matter (leaves, grass clippings) on adjacent impervious surface? ☐ Y ☐ N ☐ Can't Tell	○
G. STORM WATER INFRASTRUCTURE ☐ **N/A** *(skip to part H)*	**Observed Pollution Source?**
G1. Are storm water treatment practices present? ☐ Y ☐ N ☐ Unknown If yes, please describe: _____	○
G2. Are private storm drains located at the facility? ☐ Y ☐ N ☐ Unknown **> 25 %** Is trash, sediment and/or organic material present in gutters leading to storm drains? *(circle appropriate)*	○

H. INITIAL HOTSPOT STATUS - INDEX RESULTS

☐ Not a hotspot (fewer than 5 circles and no boxes checked) ☐ Potential hotspot (5 to 10 circles but no boxes checked)
☐ Confirmed hotspot (10 to 15 circles and/or 1 box checked) ☐ Severe hotspot (>15 circles and/or 2 or more boxes checked)

Follow-up Action:

Immediate (1 week)
- ☐ Refer for immediate enforcement
- ☐ Test for illicit discharge
- ☐ Check to see if hotspot is an NPDES non-filer

Mid-term (2-3 months)
- ☐ Schedule a review of storm water pollution prevention plan
- ☐ Suggest follow-up on-site inspection

Long-term (1 year)
- ☐ Onsite non-residential retrofit
- ☐ Suggest pollution prevention training for employees
- ☐ Other:_____

Identified Opportunities:

General
- ☐ Include in future education effort (add specifics to Notes)
- ☐ Stencil or mark storm drain inlets
- ☐ Signage opportunities (buffer, wetland, bacteria, etc.)
- ☐ Other:_____

Rooftop
- ☐ Evaluate feasibility of cistern or water reuse (roof area:____sf)
- ☐ Downspout disconnection (#: _____)

Loading Areas
- ☐ Sweep loading areas
- ☐ Cover loading docks or redesign drainage (area: _____sf)

Fueling Islands
- ☐ Cover fueling islands (covered area: _____sf)
- ☐ Install dry spill response kits (#: _____)

Landscaping / turf
- ☐ Turf conversion to landscaping / Bayscaping (area: _____sf)
- ☐ Pervious area restoration (turf area: _____sf)
- ☐ Tree planting (# or area: _____)
- ☐ Reduce maintenance (mowing, herbicides, fertilizers)

Vehicle repairs
- ☐ Plumb indoor shop drains to sanitary
- ☐ Store fluids/batteries inside or under cover

Outdoor materials
- ☐ Provide cover or secondary containment (area: _____sf)
- ☐ Place materials on pallets

Dumpster management
- ☐ Cover or add/repair lids (#: _____)
- ☐ Move dumpsters away from storm drains or streams

Parking lots
- ☐ Find and fix fluid leaks
- ☐ Trash and litter pick-up, sweeping
- ☐ Identify retrofit projects
- ☐ Reduce salt application

Stormwater Infrastructure
- ☐ Clean out storm drain inlets
- ☐ Perform maintenance inspection

Notes:

Severe Bank Erosion **ER**

WATERSHED/SUBSHED:		**DATE:** ___/_____/___	**ASSESSED BY:**
SURVEY REACH:	**TIME:**___:____AM/PM	**PHOTO ID** (CAMERA-PIC #):	/#
SITE ID: (*Condition-#*) **ER-**_____	*START* **LAT** ___°___'___" **LONG** ___°___'___" **LMK** _____ *END* **LAT** ___°___'___" **LONG** ___°___'___" **LMK** _____	**GPS:** (*Unit ID*)	

PROCESS: ☐ Currently unknown

☐ Downcutting ☐ Widening ☐ Headcutting ☐ Aggrading ☐ Sed. deposition

☐ Bed scour ☐ Bank failure ☐ Bank scour ☐ Slope failure ☐ Channelized

BANK OF CONCERN: ☐ LT ☐ RT ☐ Both *(looking downstream)*

LOCATION: ☐ Meander bend ☐ Straight section ☐ Steep slope/valley wall ☐ Other:

DIMENSIONS:

Length *(if no GPS)*	LT_____ft	and/or RT_____ft	Bottom width _____ft
Bank Ht	LT_____ft	and/or RT_____ft	Top width _____ft
Bank Angle	LT_____°	and/or RT_____°	Wetted Width _____ft

LAND OWNERSHIP: ☐ Private ☐ Public ☐ Unknown

LAND COVER: ☐ Forest ☐ Field/Ag ☐ Developed:

PERCENT OF BANK VEGETATED:

☐ <10% ☐ 10-25% ☐ 25-50% ☐ 50-75% ☐ >75%

BANK COMPOSITION:

☐ 100% sand ☐ Mix sand, gravel, cobble ☐ 100% clay ☐ Other:_____

DESCRIPTION OF BANK TOE:

☐ Loose/unstable ☐ Mixed (some rocks/veg., loose) ☐ Appears stable (rocks/veg.)

POTENTIAL RESTORATION CANDIDATE: ☐ Grade control ☐ Bank stabilization ☐ No ☐ Other:

THREAT TO PROPERTY/INFRASTRUCTURE: ☐ No ☐ Yes (Describe):

EXISTING RIPARIAN WIDTH: ☐ ≤25 ft ☐ 25 - 50 ft ☐ 50-75ft ☐ 75-100ft ☐ >100ft

EROSION SEVERITY(*circle#*) Channelized= ☐ 1	Active downcutting; tall banks on both sides of the stream eroding at a fast rate; erosion contributing significant amount of sediment to stream; obvious threat to property or infrastructure.	Pat downcutting evident, active stream widening, banks actively eroding at a moderate rate; no threat to property or infrastructure	Grade and width stable; isolated areas of bank failure/erosion; likely caused by a pipe outfall, local scour, impaired riparian vegetation or adjacent use.
	5 4	3 2	1
ACCESS:	Good access: Open area in public ownership, sufficient room to stockpile materials, easy stream channel access for heavy equipment using existing roads or trails.	Fair access: Forested or developed area adjacent to stream. Access requires tree removal or impact to landscaped areas. Stockpile areas small or distant from stream.	Difficult access. Must cross wetland, steep slope or other sensitive areas to access stream. Minimal stockpile areas available and/or located a great distance from stream section. Specialized heavy equipment required.
	5 4	3 2	1

NOTES/CROSS SECTION SKETCH:

REPORTED TO AUTHORITIES ☐ YES ☐ NO

Storm Water Outfalls **OT**

WATERSHED/SUBSHED:		**DATE:** ___/_____/___	**ASSESSED BY:**
SURVEY REACH ID:	**TIME:**___:____AM/PM	**PHOTO ID:** (*Camera-Pic #*)	/#
SITE ID (*Condition-#*): **OT-**_____	**LAT** ___°_____'_____" **LONG** ___°_____'_____"	**LMK**_____	**GPS:** (*Unit ID*)

BANK: ☐LT ☐RT ☐ Head

FLOW: ☐ None ☐ Trickle ☐ Moderate ☐ Substantial ☐ Other:

TYPE:
☐ Closed pipe
☐ Open channel

MATERIAL:
☐ Concrete ☐ Metal ☐ PVC/Plastic ☐ Brick ☐ Other:
☐ Concrete ☐ Earthen ☐ Other:

SHAPE: ☐ Single ☐ Circular ☐ Double ☐ Elliptical ☐ Triple ☐ Other:
☐ Trapezoid ☐ Parabolic ☐ Other:

DIMENSIONS:
Diameter:_____(in)
Depth: _____(in)
Width (Top):_____(in)
" (Bottom):_____(in)

NOT APPLICABLE

SUBMERGED: ☐ No ☐ Partially ☐ Fully

CONDITION: ☐ None ☐ Chip/Cracked ☐ Peeling Paint ☐ Corrosion ☐ Other:

ODOR: ☐ No ☐ Gas ☐ Sewage ☐ Rancid/Sour ☐ Sulfide ☐ Other:

DEPOSITS/STAINS: ☐ None ☐ Oily ☐ Flow Line ☐ Paint ☐ Other:

VEGGIE DENSITY: ☐ None ☐ Normal ☐ Inhibited ☐ Excessive ☐ Other:

PIPE BENTHIC GROWTH: ☐ None ☐ Brown ☐ Orange ☐ Green ☐ Other:

POOL QUALITY: ☐ No pool ☐ Good ☐ Odors ☐ Colors ☐ Oils ☐ Suds ☐ Algae ☐ Floatables ☐ Other:

FOR FLOWING ONLY		
	COLOR:	☐ Clear ☐ Brown ☐ Grey ☐ Yellow ☐ Green ☐ Orange ☐ Red ☐ Other:
	TURBIDITY:	☐ None ☐ Slight Cloudiness ☐ Cloudy ☐ Opaque
	FLOATABLES:	☐ None ☐ Sewage (toilet paper, etc.) ☐ Petroleum (oil sheen) ☐ Other:
OTHER CONCERNS:		☐ Excess Trash (paper/plastic bags) ☐ Dumping (bulk) ☐ Excessive Sedimentation ☐ Needs Regular Maintenance ☐ Bank Erosion ☐ Other:

POTENTIAL RESTORATION CANDIDATE ☐ Discharge investigation ☐ Stream daylighting ☐ Local stream repair/outfall stabilization ☐ no ☐ Storm water retrofit ☐ Other:

If yes for daylighting:

Length of vegetative cover from outfall: _____ft Type of existing vegetation:_____ Slope: _____°

If yes for stormwater:

Is stormwater currently controlled? ☐ Yes ☐ No ☐ Not investigated

Land Use description:_____

Area available:

OUTFALL SEVERITY: *(circle #)*	Heavy discharge with a distinct color and/or a strong smell. The amount of discharge is significant compared to the amount of normal flow in receiving stream; discharge appears to be having a significant impact downstream.		Small discharge; flow mostly clear and odorless. If the discharge has a color and/or odor, the amount of discharge is very small compared to the stream's base flow and any impact appears to be minor / localized.		Outfall does not have dry weather discharge; staining; or appearance of causing any erosion problems.
	5	4	3	2	1

SKETCH/NOTES:

REPORTED TO AUTHORITIES: ☐ YES ☐ NO

Impacted Buffer **IB**

WATERSHED/SUBSHED:		**DATE:** ___/____/___	**ASSESSED BY:**
SURVEY REACH:	**TIME:**___:____AM/PM	**PHOTO ID:** (*Camera-Pic #*) /#	
SITE ID: (*Condition-#*) **IB-_____**	*START* **LAT** ___° ___' ___" **LONG** ___° ___' ___" **LMK** _____		**GPS:** (*Unit ID*)
	END **LAT** ___° ___' ___" **LONG** ___° ___' ___" **LMK** _____		

IMPACTED BANK: ☐ LT ☐ RT ☐ Both

REASON INADEQUATE: ☐ Lack of vegetation ☐ Too narrow ☐ Widespread invasive plants ☐ Recently planted ☐ Other:

LAND USE:	Private	Institutional	Golf Course	Park	Other Public
(Facing downstream) LT Bank	☐	☐	☐	☐	☐ :
RT Bank	☐	☐	☐	☐	☐ :

DOMINANT LAND COVER:	Paved	Bare ground	Turf/lawn	Tall grass	Shrub/scrub	Trees	Other
LT Bank	☐	☐	☐	☐	☐	☐	☐:
RT Bank	☐	☐	☐	☐	☐	☐	☐:

INVASIVE PLANTS: ☐ None ☐ Rare ☐ Partial coverage ☐ Extensive coverage ☐ unknown

STREAM SHADE PROVIDED? ☐ None ☐ Partial ☐ Full

WETLANDS PRESENT? ☐ No ☐ Yes ☐ Unknown

POTENTIAL RESTORATION CANDIDATE ☐Active reforestation ☐Greenway design ☐ Natural regeneration ☐ Invasives removal ☐ no ☐ Other:

RESTORABLE AREA

	LT BANK	RT
Length (ft):	_____	_____
Width (ft):	_____	_____

REFORESTATION POTENTIAL: (*Circle #*)

Impacted area on public land where the riparian area does not appear to be used for any specific purpose; plenty of area available for planting	Impacted area on either public or private land that is presently used for a specific purpose; available area for planting adequate	Impacted area on private land where road; building encroachment or other feature significantly limits available area for planting
5 4	3 2	1

POTENTIAL CONFLICTS WITH REFORESTATION ☐ Widespread invasive plants ☐ Potential contamination ☐ Lack of sun ☐ Poor/unsafe access to site ☐ Existing impervious cover ☐ Severe animal impacts (deer, beaver) ☐ Other:

NOTES:

APPENDIX B: HARRISONBURG RETROFIT CONCEPTS RANKING TABLE

Site ID	Site Description	Proposed Practice	Drainage Area (acre)	Impervious Cover (acre)	Target WQv (cf)	Available Practice Width (ft)	Available Practice Length (ft)	% Water Quality Volume[1]	TP Removal (lb/yr)	TN Removal (lb/yr)	TSS Removal (lb/yr)	Cost $	Cost Effectiveness ($/lb TP removed)	Scoring						Rank
														Cost Effectiveness	Phosphorus Removal	Maintenance Burden	Potential Utility or Site Constraints	Aesthetics / Safety	Total Score	
H42	Median on Route 33 Market Street	Regenerative Stormwater Conveyance	88.50	57.4	222,780.36	20	1,000	11	17.55	179.9	13,751	$1,076,220	$61,309	14	35	15	10	2.5	76	1
H11	Ralph Sampson Park	Enhancement	0.64	0.54	1,942.05	3	72	11	0.18	2.02	436.47	$775	$4,234	35	7	7.5	10	2.5	62	2
H47	Linda Lane Extended	Enhancement	10.25	3.67	17,910.78	113	113	99	0.86	12.81	1,483.18	$63,503	$73,472	2	35	7.5	10	5	60	3
H10-D	Ralph Sampson Park @ b'ball courts	Bioretention	4.09	0.45	4,458.73	25	45	33	1.50	25.57	439.10	$35,701	$23,776	35	3	7.5	5	5	55	4
H29-A	Keister Elementary School	Bioretention	0.60	0.53	1,883.61	10	70	38	0.38	3.58	330.73	$17,330	$45,174	18	1	15	10	5	49	5
H-10A	Lucy Simms Basin	Enhancement	20.16	5.73	31,283.70	-	-	19	0.76	12.10	1,157.85	$21,540	$28,344	5	31	7.5	5	0	49	6
H22-A	Westover Park Entrance	Bioretention	3.00	0.44	3,561.76	20	75	56	1.30	20.88	467.39	$48,478	$37,392	22	3	7.5	10	5	47	7
H4	Harrisonburg Electric Commission operations	Bioretention	2.60	1.74	6,687.19	30	30	21	0.94	9.63	743.34	$34,259	$36,493	23	2	7.5	10	5	47	8
H10-C	Lucy Simms Building	Rain Tank	1.39	1.29	4,528.43	-	-	100	1.48	13.47	1,289.48	$67,920	$46,035	18	3	15	5	2.5	44	9
H37	Harrisonburg Public works yard	Wet Swale	1.02	0.88	3,146.48	25	100	98	0.81	5.62	820.08	$38,089	$47,254	18	2	7.5	10	5	42	10
H27	Harrisonburg High School	Bioretention	2.12	2.12	7,310.82	25	100	57	1.88	16.79	1,677.07	$102,671	$54,546	15	4	7.5	10	5	42	11
H29-B	Keister Elementary School	Bioretention	0.17	0.17	586.25	15	35	102	0.19	1.70	169.81	$14,563	$76,421	11	0	15	10	5	41	12
H31	Purcell Park	Bioretention	1.94	1.35	5,126.65	25	50	27	0.86	8.75	692.66	$33,573	$38,880	21	2	7.5	5	5	41	13
H201	Fire Station #3	Bioretention	0.45	0.28	1,101.34	9	34	25	0.18	1.89	138.24	$6,620	$36,980	23	0	7.5	5	5	40	14
H38-A	Harrisonburg Water & Sewer dept	Bioretention	0.75	0.68	2,400.88	30	30	58	0.63	5.84	549.11	$34,259	$54,176	15	1	7.5	10	5	39	15
H38-C	Harrisonburg Recycling Center	Bioretention	1.60	1.36	4,881.62	30	70	73	1.44	13.60	1,230.55	$87,687	$60,779	14	3	7.5	10	5	39	16
H21	W. Market Street Basin No. 1	Enhancement	1.10	1.10	3,793.35	55	150	247	0.36	3.71	889.10	$33,699	$94,553	2	14	7.5	10	5	38	17
H19-B	Department of Community Development	Bioretention	0.28	0.22	806.59	12	50	28	0.14	1.31	112.84	$5,468	$40,388	21	0	7.5	5	5	38	18

Site ID	Site Description	Proposed Practice	Drainage Area (acre)	Impervious Cover (acre)	Target WQv (cf)	Available Practice Width (ft)	Available Practice Length (ft)	% Water Quality Volume[1]	TP Removal (lb/yr)	TN Removal (lb/yr)	TSS Removal (lb/yr)	Cost $	Cost Effectiveness ($/lb TP removed)	Scoring						Rank
														Cost Effectiveness	Phosphorus Removal	Maintenance Burden	Potential Utility or Site Constraints	Aesthetics / Safety	Total Score	
H50	Old South High St	Bioretention	1.59	0.91	3,681.18	32	70	88	1.22	13.19	913.48	$79,301	$65,059	13	2	7.5	10	5	38	19
H45-A	Spotswood Elementary School	Bioretention	1.14	0.83	3,109.82	42	48	81	0.97	9.68	792.50	$61,703	$63,386	13	2	7.5	10	5	38	20
H8-C	Waterman Elementary School	Dry Swale	0.21	0.21	724.19	8	96	100	0.23	2.09	209.05	$14,535	$61,959	13	0	7.5	10	5	36	21
H200	Heritage Oaks Golf Course	Bioretention	1.08	0.89	3,220.90	40	55	100	1.06	10.10	897.62	$78,874	$74,292	11	2	7.5	10	5	36	22
H30	Unused Parcel between Rt 11 and Railroad	Bioretention	1.32	0.55	2,511.60	15	70	50	0.71	8.60	467.88	$30,809	$43,322	19	1	7.5	5	2.5	36	23
H10-B	Lucy Simms Parking Lot	Bioretention	1.35	1.27	4,443.48	29	53	54	1.12	10.22	983.61	$59,129	$52,719	16	2	7.5	5	5	36	24
H38-B	Harrisonburg Public Works storage yard	Bioretention	0.70	0.63	2,228.46	15	100	96	0.72	6.65	624.19	$52,496	$72,896	11	1	7.5	10	5	35	25
H8-A	Waterman Elementary School	Bioretention	2.18	1.87	6,696.26	49	50	50	1.63	15.37	1,396.23	$81,533	$49,933	17	3	7.5	5	2.5	35	26
H28 - Option 3	Maryland Ave Fire Station (truck washing activities)	Bioretention	0.83	0.83	2,862.26	35	80	145	1.01	8.97	898.56	$101,185	$100,389	8	2	7.5	10	5	33	27
H22-B	Westover Park Parking Lot	Bioretention	0.94	0.94	3,241.59	45	50	103	1.06	9.40	941.79	$81,368	$76,992	11	2	7.5	5	5	30	28
H9	Rockingham County Admin Bldg.	Bioretention	0.87	0.87	3,000.20	38	70	102	0.98	8.69	870.87	$75,070	$76,817	11	2	7.5	5	5	30	29
H8-B	Waterman Elementary School	Bioretention	0.49	0.43	1,530.77	25	51	100	0.50	4.67	431.75	$37,506	$74,773	11	1	7.5	5	5	30	30
H19-A	Department of Community Development	Bioretention	0.54	0.45	1,623.70	35	68	69	0.47	4.44	396.70	$27,277	$58,314	14	1	7.5	0	5	28	31
H16	Massanutten Regional Library	Stormwater Planter	0.10	0.10	344.85	3	24	32	0.06	0.54	54.34	$4,178	$68,509	12	0	7.5	0	5	25	32
H28 - Option 1	Maryland Ave Fire Station Driveway (truck washing activities)	Bioretention	0.23	0.23	793.16	30	80	344	0.32	2.71	263.36	$66,810	$210,949	4	1	7.5	0	5	17	33
H200-Alt	Heritage Oaks GC	Outfall Stabilization	100.00	5.00	93,109.50	15	30	5	16.26	308.4	2,493.49	$220,320	$13,552	35	32	15	10	5	97	Outlier[2]
H15-A	County Court House	Landscape Maintenance	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
H15-B	County Court House	Landscape Maintenance	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Site ID	Site Description	Proposed Practice	Drainage Area (acre)	Impervious Cover (acre)	Target WQv (cf)	Available Practice Width (ft)	Available Practice Length (ft)	% Water Quality Volume[1]	TP Removal (lb/yr)	TN Removal (lb/yr)	TSS Removal (lb/yr)	Cost $	Cost Effectiveness ($/lb TP removed)	Scoring						Rank
														Cost Effectiveness	Phosphorus Removal	Maintenance Burden	Potential Utility or Site Constraints	Aesthetics / Safety	Total Score	
H45-B	Spotswood Elementary School	Tree Planting/Re-forestation	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
H13-PP	City of Harrisonburg Hose Company #4	Pollution Prevention	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
H14-IB	Harrison Plaza	Impacted Buffer	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
H14-ER	Harrison Plaza	Bank Erosion	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
H28 Option 2	Maryland Ave Firestation	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
H41-OT	A Dream Come True Playground	Outfall Stabilization	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
H37-PP1	Harrisonburg Public Works	Pollution Prevention	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
H40	Stone Spring Elementary School	Landscape Maintenance	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

[1] This refers to the percent of the Water Quality Volume (WQV) captured by the practice. For this application, the WQV is defined as the runoff generated by 1" of rainfall in the drainage area, which is the Virginia standard in the Runoff Reduction Method (see **Section X** for the associated computation). Since these are retrofit projects, they do not have a regulatory obligation to meet 100% of the WQV, but it is a good metric by which to compare projects.

[2] The Heritage Oaks RSC project was considered an outlier in terms of scoring, since it scored much higher than the other projects and thus skewed the scoring curve for other projects. The scores reported for the other projects are thus calculated without the Heritage Oaks project.

APPENDIX C: REGENERATIVE STORMWATER CONVEYANCE SYSTEMS

The following is a description by the firm, Biohabitats, Inc., of Regenerative Stormwater Conveyance systems (also sometimes call "step-pool conveyance" systems).

More Resources:

To see a newly constructed example of this type of practice, click on the link below to view a two-minute video by the Center for Watershed Protection, entitled, "Froelich Park Regenerative Step Pool Storm Conveyance Demo Project":

https://www.youtube.com/watch?v=PmmDJ3XG3SQ

Anne Arundel County, MD developed the first design specifications for this practice. Their Regenerative Step Pool Conveyance Systems Design Guidelines can be found at:

http://www.aacounty.org/DPW/Watershed/StepPoolStormConveyance.cfm#.UkCBd3-EWS8

Regenerative Stormwater Conveyance: A New Tool to Effectively Mitigate Failed Stormwater Outfalls

Introduction

Regenerative stormwater conveyance (RSC) combines stormwater management with wetland and stream restoration. Applicable in new development, retrofit, and restoration scenarios, RSC uses carbon-rich, sand-bedded channels, wide parabolic grade control weirs, and shallow pools to collect and convey stormwater runoff (Figure 1). The practice can convey within a site, to other stormwater treatment practices in a treatment train, or from outfalls into receiving streams. This approach aligns with philosophies such as low impact development and green infrastructure.

Status Quo

Drainage infrastructure, whether it be simply conveyance based or intended for other stormwater management criteria (e.g., detention, channel protection), typically results in the concentration of flows at discrete outfall points. The result seen throughout urbanizing watersheds is impaired habitat, excessive erosion and transport of sediment and nutrients to downstream sinks (e.g., ponds, lakes, estuaries, etc.), and compromised infrastructure.

Basic Building Blocks

RSC systems are open-channel, sand seepage filtering systems that utilize a series of shallow aquatic pools, riffle weir grade controls, native vegetation, and underlying sand channel to treat and safely attenuate and convey storm flow, and convert stormwater to groundwater through infiltration and below ground seepage (Figure 2). RSC systems combine features and treatment benefits of swales, infiltration, filtering, and wetland practices.

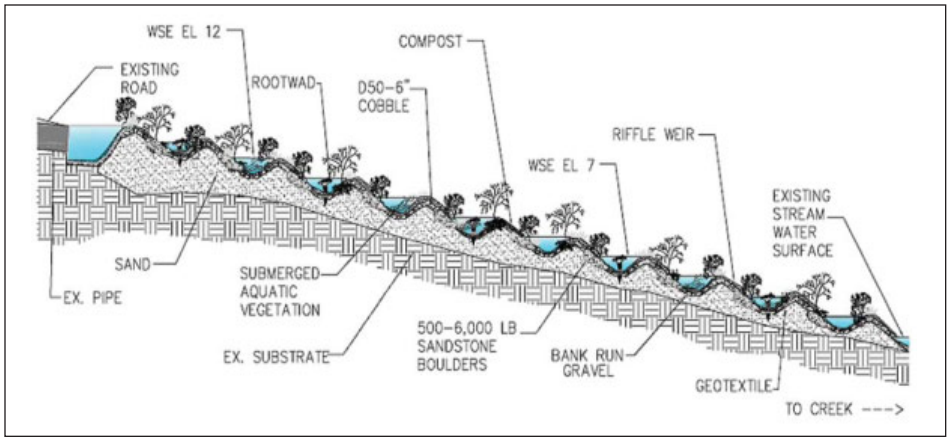
Establishing the sand seepage hydrology associated with an RSC system requires the creation of a series of well vegetated stilling pools, sand seepage beds replete with above and below ground biomass, and associated flow paths through low areas dominated by native wetland plants. The physical effect of the pools and their many plant stems is to reduce water velocity and facilitate removal of suspended particles and their associated nutrients and contaminants.

Keith Underwood

Keith Underwood

Figure 1. Examples of regenerative stormwater conveyance systems.

The cobble weirs set the surface water elevations and establish the hydraulic head necessary to drive the sand seepage system and support the plants. The sand seepage bed, with its 20%-by-volume green mulch, supports microbes, fungi, macroinvertebrates, and processes which remove nutrients and contaminants as they pass through the sand bed while maintaining porosity. The many roots present in the sand take up nutrients and provide sites for microbial attachment, contaminant adsorption, and long-term sequestration in the peat forming layer resulting from annual root formation of the fibric root mat.



Biohabitats, Inc. and Keith Underwood

Figure 2. Example conceptual profile from a regenerative stormwater conveyance project.

While RSC systems provide added structural stability via stone and sand to eroded outfalls and receiving streams, the vegetative material along the channel and in the bottoms of pools provides an important contribution to project sustainability by tying the system together and increasing the porosity of the pools. Once established, these systems are designed to restore the ecology of forest floor systems and be mostly self-maintaining.

Stormwater Management Benefits

The systems combine features and treatment benefits of swales, infiltration, filtering, and wetland practices. They are designed to convey flows associated with events up to and including the extreme floods (i.e., 100-year storm) in a non-erosive manner, which results in reduced channel erosion impacts commonly associated with stormwater practice outfalls and receiving waters. Due to the ability to safely convey larger flows, these systems do not require flow splitters to divert smaller events to them for treatment. As part of the conveyance system, they also reduce the need for storm drain infrastructure. Finally, these RSC systems have the added benefit of providing dynamic and diverse ecosystems for a range of plants, animals, amphibians, and insects. These ecosystems enhance pollutant uptake and assimilation and provide a natural and native aesthetic to sites.

Application

RSC systems are unique in that they can be located on the front or tail end of a treatment system and still provide water quality and groundwater recharge benefits. They have been most commonly applied as a system at the downstream end of a stormwater treatment practice, such as a pond or wetland. Where located on the front end of a treatment train, they provide water quality, groundwater infiltration, and channel protection treatment while also providing non-erosive flow conveyance that delivers flows to a supplemental stormwater treatment practice. RSC systems have multiple applications including within linear systems such as roads, highways, and conveyance from pipe outfalls to receiving waters.

Conclusion

RSC is a holistic approach to stormwater management whereby the natural regeneration of stream and wetland ecosystems is the driving performance standard, rather than the presumption that detention of a designated storm event will be of benefit to the downstream water bodies. Installation of these systems has multiple benefits including, less area of disturbance, lower costs, and opportunities for stakeholder stewardship and participation. The last of these benefits has been shown to be invaluable in terms of raising community awareness and helping to foster the important and often overlooked connection between humans and nature.

Acknowledgements

Much of the work to develop the regenerative stormwater conveyance approach has been led by Keith Underwood, of Underwood & Associates, in collaboration with Biohabitats, Inc.

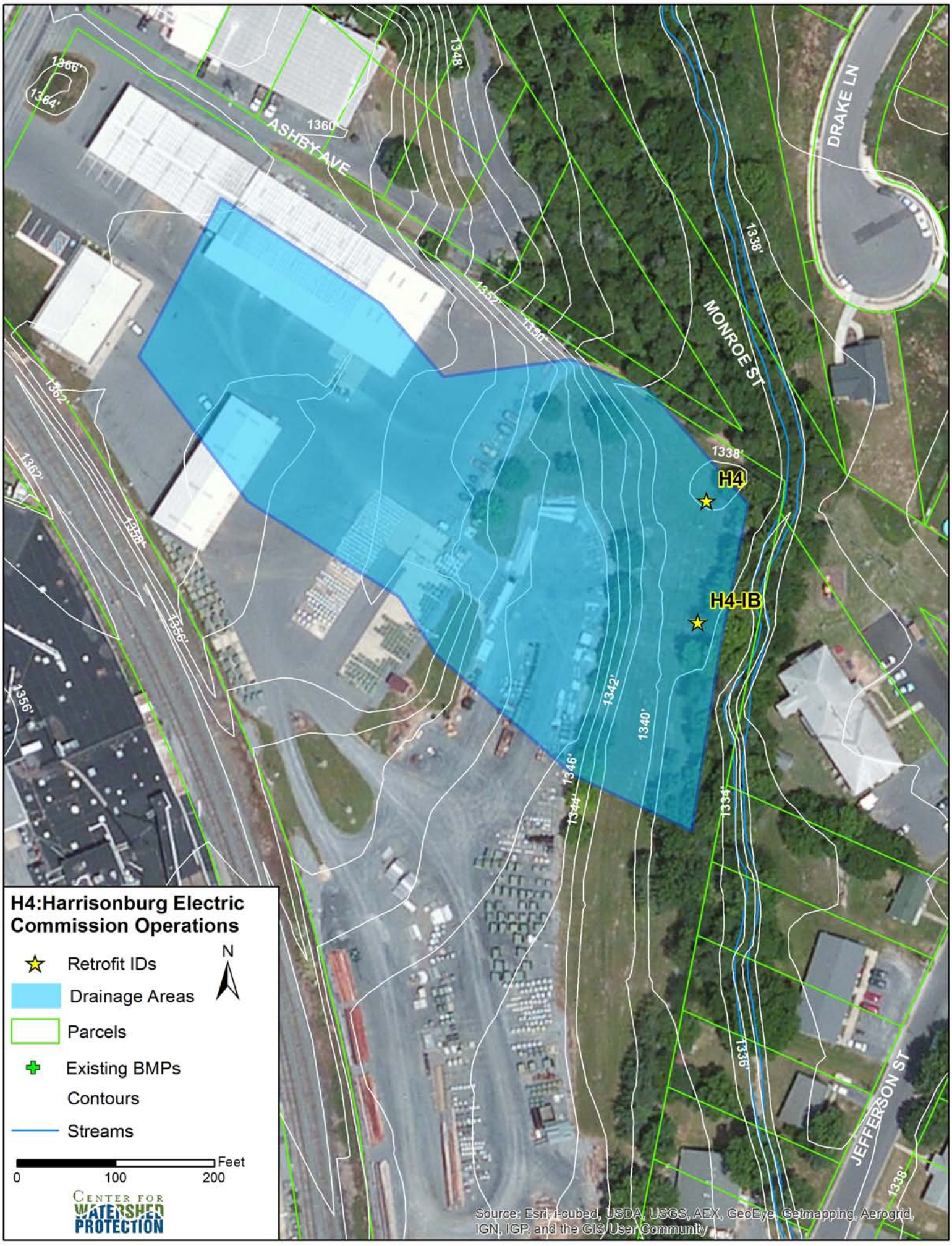
Biohabitats
GREAT LAKES BIOREGION
Incorporated
2026 Murray Hill Road, Room 107
Cleveland, Ohio 44106
tel 216.921.4430 / fax 216.751.2087
www.biohabitats.com

Biohabitats
OHIO RIVER BIOREGION
Incorporated
120 Webster Street, Suite 326
Louisville, Kentucky 40206
tel 502.561.9300 / fax 502.561.9301
www.biohabitats.com

APPENDIX D: RETROFIT MAPS, SUMMARIES, AND FIELD FORMS

This appendix includes the maps, summaries, and field forms for the retrofit concepts.

H4: Harrisonburg Electric Commission Operations


H4:Harrisonburg Electric Commission Operations
Retrofit IDs
Drainage Areas
Parcels
Existing BMPs
Contours
Streams
N
Feet
0
100
200
Center for Watershed Protection
H4
H4-IB
ASHBY AVE
MONROE ST
DRAKE LN
JEFFERSON ST
1366'
1364'
1360'
1348'
1352'
1350'
1338'
1362'
1358'
1356'
1342'
1340'
1346'
1344'
1334'
1336'
Source: Esri, i-cubed, USDA, USGS, AEX, GeoEye, Getmapping, Aerogrid, IGN, IGP, and the GIS User Community

H4: Harrisonburg Electric Commission Operations

Score: 48

Rank: 8

Investigators: Rick Altizer, Chris Swann

Figure 2: *Aerial view (Source: Google Maps)*

Figure 1: *Bioretention area*

Description: This site is approximately 2.6 acres and is the location for storage and operations for the Harrisonburg Electric Commission (Figure 1). It consists of buildings, asphalt parking lots, and gravel parking and storage areas. A large area near the edge of the property is currently maintained in a mowed grass state with some trees. This area is in the 100-year floodplain of Blacks Run.

Proposed Retrofit: The concept is to treat the runoff from the impervious area through a combination of projects. The first is through enhancing the tree cover on the site. Trees can be replanted in the floodplain area along the fence line, assuming that this area will not be used in future expansion. Tree planting would help enhance the stream buffer and provide filtering for the runoff.

The second project would be developing a 30’ x 30’ bioretention system to be located at the base of the grassy slope (Figure 2). The practice would discharge into the stream buffer after treatment. There is also an opportunity to provide pretreatment by placing a swale with some checkdams along the side fence of the property prior to runoff entering the larger bioretention system at the base of the hill.

Impacted Buffer

IB

WATERSHED/SUBSHED: HARRISONBURG	**DATE:** 2/20/14	**ASSESSED BY:** EDS/DA
SURVEY REACH:	**TIME:** ___:___ AM/PM	**PHOTO ID:** (*Camera-Pic #*) /#
SITE ID: (*Condition-#*) IB-H4-IB-1	*START* **LAT** ___° ___' ___" **LONG** ___° ___' ___" **LMK** ___	**GPS:** (*Unit ID*)
	END **LAT** ___° ___' ___" **LONG** ___° ___' ___" **LMK** ___	

IMPACTED BANK: ☐ LT ☒ RT ☐ Both

REASON INADEQUATE: ☐ Lack of vegetation ☒ Too narrow ☐ Widespread invasive plants ☐ Recently planted ☐ Other:

LAND USE: (*Facing downstream*)	Private	Institutional	Golf Course	Park	Other Public
LT Bank	☐	☐	☐	☐	☐ :
RT Bank	☐	☒	☐	☐	☐ :

DOMINANT LAND COVER:	Paved	Bare ground	Turf/lawn	Tall grass	Shrub/scrub	Trees	Other
LT Bank	☐	☐	☐	☐	☐	☐	☐:
RT Bank	☐	☐	☐	☒	☐	☐	☐:

INVASIVE PLANTS: ☒ None ☐ Rare ☐ Partial coverage ☐ Extensive coverage ☐ unknown

STREAM SHADE PROVIDED? ☒ None ☐ Partial ☐ Full

WETLANDS PRESENT? ☐ No ☐ Yes ☐ Unknown

POTENTIAL RESTORATION CANDIDATE ☒ Active reforestation ☐ Greenway design ☐ Natural regeneration ☐ Invasives removal ☐ no ☐ Other:

RESTORABLE AREA

	LT BANK	RT
Length (ft):	0	300
Width (ft):	0	40

REFORESTATION POTENTIAL: (*Circle #*)

Impacted area on public land where the riparian area does not appear to be used for any specific purpose; plenty of area available for planting		Impacted area on either public or private land that is presently used for a specific purpose; available area for planting adequate		Impacted area on private land where road; building encroachment or other feature significantly limits available area for planting
(5)	4	3	2	1

POTENTIAL CONFLICTS WITH REFORESTATION ☐ Widespread invasive plants ☐ Potential contamination ☐ Lack of sun ☐ Poor/unsafe access to site ☐ Existing impervious cover ☐ Severe animal impacts (deer, beaver) ☐ Other:

NOTES:

PLANTING INSIDE FENCE ON HARRISONBURG ELECTRIC COMMISSION SITE

AREA IS FLOODPLAIN

NO CONFLICTS WITH CURRENT USE

Impacted Buffer

IB

WATERSHED/SUBSHED:		DATE: ___/___/___	ASSESSED BY:
SURVEY REACH:	TIME: ___:___ AM/PM	PHOTO ID: (*Camera-Pic #*)	/#
SITE ID: (*Condition-#*) IB-_____	*START* LAT ___° ___' ___" LONG ___° ___' ___" LMK _____		GPS: (*Unit ID*)
	END LAT ___° ___' ___" LONG ___° ___' ___" LMK _____		

IMPACTED BANK: ☐ LT ☐ RT ☐ Both

REASON INADEQUATE: ☐ Lack of vegetation ☐ Too narrow ☐ Widespread invasive plants ☐ Recently planted ☐ Other:

LAND USE:	Private	Institutional	Golf Course	Park	Other Public
(*Facing downstream*) LT Bank	☐	☐	☐	☐	☐ :
RT Bank	☐	☐	☐	☐	☐ :

DOMINANT LAND COVER:	Paved	Bare ground	Turf/lawn	Tall grass	Shrub/scrub	Trees	Other
LT Bank	☐	☐	☐	☐	☐	☐	☐:
RT Bank	☐	☐	☐	☐	☐	☐	☐:

INVASIVE PLANTS: ☐ None ☐ Rare ☐ Partial coverage ☐ Extensive coverage ☐ unknown

STREAM SHADE PROVIDED? ☐ None ☐ Partial ☐ Full

WETLANDS PRESENT? ☐ No ☐ Yes ☐ Unknown

POTENTIAL RESTORATION CANDIDATE ☐ Active reforestation ☐ Greenway design ☐ Natural regeneration ☐ Invasives removal ☐ no ☐ Other:

RESTORABLE AREA

	LT BANK	RT
Length (ft):	_____	_____
Width (ft):	_____	_____

REFORESTATION POTENTIAL: (*Circle #*)

Impacted area on public land where the riparian area does not appear to be used for any specific purpose; plenty of area available for planting		Impacted area on either public or private land that is presently used for a specific purpose; available area for planting adequate		Impacted area on private land where road; building encroachment or other feature significantly limits available area for planting
5	4	3	2	1

POTENTIAL CONFLICTS WITH REFORESTATION ☐ Widespread invasive plants ☐ Potential contamination ☐ Lack of sun ☐ Poor/unsafe access to site ☐ Existing impervious cover ☐ Severe animal impacts (deer, beaver) ☐ Other:

NOTES:

RRI

WATERSHED: HARRISONBURG	SUBWATERSHED: HARRISONBURG	UNIQUE SITE ID: #4	
DATE: 3/20/13	ASSESSED BY: CPS RA	CAMERA ID: OLYMPUS BLUE DOT	PICTURES: S1-S4
GPS ID:	LMK ID:	LAT:	LONG:

SITE DESCRIPTION

Name: HARRISONBURG ELECTRIC COMMISSION OPERATIONS
Address: SULLIVAN TRACT 86BN LIBERTY STREET

Ownership: ☒ Public ☐ Private ☐ Unknown
If Public, Government Jurisdiction: ☒ Local ☐ State ☐ DOT ☐ Other:

Corresponding USSR/USA Field Sheet? ☐ Yes ☒ No If yes, Unique Site ID:

Proposed Retrofit Location:

Storage
- ☐ Existing Pond
- ☐ Below Outfall
- ☐ In Road ROW
- ☐ Other:
- ☐ Above Roadway Culvert
- ☐ In Conveyance System
- ☐ Near Large Parking Lot

On-Site
- ☐ Hotspot Operation
- ☐ Small Parking Lot
- ☐ Individual Street
- ☐ Underground
- ☐ Individual Rooftop
- ☐ Small Impervious Area
- ☐ Landscape / Hardscape
- ☒ Other: ALONG STREAM

DRAINAGE AREA TO PROPOSED RETROFIT

Drainage Area ≈ 2.6
Imperviousness ≈ .70 %
Impervious Area ≈ 1.94

Notes:

Drainage Area Land Use:
- ☐ Residential
  - ☐ SFH (< 1 ac lots)
  - ☐ SFH (> 1 ac lots)
  - ☐ Townhouses
  - ☐ Multi-Family
- ☐ Commercial
- ☒ Institutional
- ☐ Industrial
- ☐ Transport-Related
- ☐ Park
- ☐ Undeveloped
- ☐ Other:

EXISTING STORMWATER MANAGEMENT

Existing Stormwater Practice: ☐ Yes ☒ No ☐ Possible
If Yes, Describe:

Describe Existing Site Conditions, Including Existing Site Drainage and Conveyance:
Existing Street Width (if applicable):

LARGE PARKING LOT AND STORAGE BLDGS
SHEET FLOW TO GRASSY AREA

Existing Head Available:

N/A

Note where points are measured from: (i.e. street elevation to catch basin invert, manhole rim to catch basin invert, other)

PROPOSED RETROFIT

Purpose of Retrofit:
☑ Water Quality ☐ Recharge ☐ Channel Protection ☐ Flood Control
☐ Demonstration / Education ☐ Repair ☐ Other:_____

Retrofit Volume Computations - Target Storage:

Retrofit Volume Computations - Available Storage:

Proposed Retrofit Practice: (Runoff Reduction)
☐ Disconnection ☑ Bioretention ☐ Bio Swale
☐ Expanded Tree Pit ☐ Infiltration ☐ Green Roof
☐ Permeable Pavement ☐ Rainwater Harvesting

Proposed Retrofit Practice: (Stormwater Treatment)
☐ Constructed Wetland ☐ Wet Swale ☐ Wet Pond
☐ Filtering Practice ☐ Proprietary:_____
☐ Other: _____

Retrofit Category (as defined by Chesapeake Bay Program):
☑ New BMP ☐ BMP Enhancement ☐ BMP Restoration ☐ BMP Conversion ☐ Not CBP-approved

Describe Elements of Proposed Retrofit, Including Surface Area, Maximum Depth of Treatment, and Conveyance:

1. RIPARIAN REPLANTING ALONG FENCE AREA - SEE 1B FORM
2. BIORETENTION AREA
3. GRASS SWALE

Available Width:	30	9
Available Length:	30	70
Available Area:		
Ponding Depth:		
Soil Depth:		

SITE CONSTRAINTS

Adjacent Land Use:
☑ Residential ☐ Commercial ☑ Institutional
☐ Industrial ☐ Transport-Related ☐ Park
☐ Undeveloped ☐ Other:_____
Possible Conflicts Due to Adjacent Land Use? ☐ Yes ☑ No
If Yes, Describe:

Access:
☑ No Constraints
Constrained due to
☐ Slope ☐ Space
☐ Utilities ☐ Tree Impacts
☐ Structures ☐ Property
Ownership
☐ Other:_____

Conflicts with Existing Utilities:

	Yes	Possible/ Modifiable	No	Unknown
Sewer:	☐	☐	☑	☐
Water:	☐	☐	☑	☐
Gas:	☐	☐	☐	☐
Electric to Streetlights:	☐	☐	☑	☐
Other:	☐	☐	☑	☐

_____

Potential Permitting Factors:

Dam Safety Permits Necessary	☐ Probable	☑ Not Probable
Impacts to Wetlands	☐ Probable	☑ Not Probable
Impacts to a Stream	☐ Probable	☑ Not Probable
Floodplain Fill	☐ Probable	☑ Not Probable
Impacts to Forests	☐ Probable	☑ Not Probable
Impacts to Specimen Trees	☐ Probable	☑ Not Probable

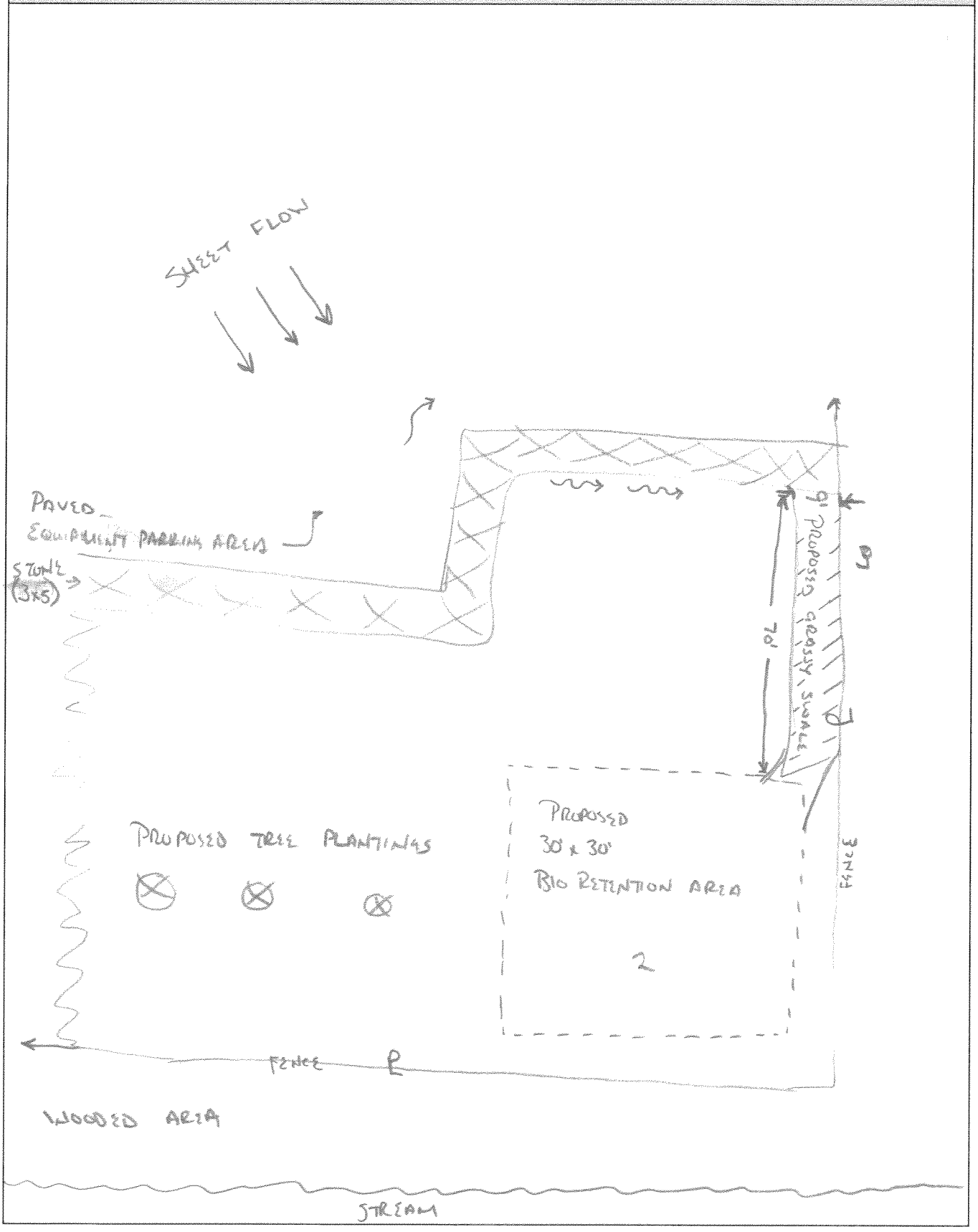
How many?_____
Approx. DBH_____

Other factors:_____
_____

Soils:

Soil auger test holes:	☐ Yes	☑ No
Evidence of poor infiltration (clays, fines):	☐ Yes	☑ No
Evidence of shallow bedrock:	☐ Yes	☑ No
Evidence of high water table (gleying, saturation):	☐ Yes	☑ No

SKETCH


SHEET FLOW
PAVED EQUIPMENT PARKING AREA
STONE (3x5)
9' PROPOSED GRASSY SWALE
70'
PROPOSED 30 x 30' BIO RETENTION AREA
2
PROPOSED TREE PLANTINGS
FENCE
WOODED AREA
STREAM

DESIGN OR DELIVERY NOTES

FOLLOW-UP NEEDED TO COMPLETE FIELD CONCEPT

- ☐ Confirm property ownership
- ☐ Confirm drainage area
- ☐ Confirm drainage area impervious cover
- ☐ Confirm volume computations
- ☑ Complete concept sketch
- ☐ Obtain existing stormwater practice as-builts
- ☐ Obtain site as-builts
- ☐ Obtain detailed topography
- ☐ Obtain utility mapping
- ☐ Confirm storm drain invert elevations
- ☑ Confirm soil types
- ☐ Other:_____

INITIAL FEASIBILITY AND CONSTRUCTION CONSIDERATIONS

SITE CANDIDATE FOR FURTHER INVESTIGATION:	☑ YES	☐ NO	☐ MAYBE
IS SITE CANDIDATE FOR EARLY ACTION PROJECT(S):	☐ YES	☑ NO	☐ MAYBE
IF NO, SITE CANDIDATE FOR OTHER RESTORATION PROJECT(S):	☐ YES	☑ NO	☐ MAYBE

IF YES, TYPE(S):_____

Impacted Buffer

IB

WATERSHED/SUBSHED: HARRISONBURG		**DATE:** 2/20/15	**ASSESSED BY:** CPS/RA
SURVEY REACH:	**TIME:** ___:___ AM/PM	**PHOTO ID:** (*Camera-Pic #*)	/#
SITE ID: (*Condition-#*) IB-H4-IB-1	*START* **LAT** ___° ___' ___" **LONG** ___° ___' ___" **LMK** ___		**GPS:** (*Unit ID*)
	END **LAT** ___° ___' ___" **LONG** ___° ___' ___" **LMK** ___		

IMPACTED BANK: ☐ LT ☒ RT ☐ Both

REASON INADEQUATE: ☐ Lack of vegetation ☒ Too narrow ☐ Widespread invasive plants ☐ Recently planted ☐ Other:

LAND USE: (*Facing downstream*)	Private	Institutional	Golf Course	Park	Other Public
LT Bank	☐	☐	☐	☐	☐:
RT Bank	☐	☒	☐	☐	☐:

DOMINANT LAND COVER:	Paved	Bare ground	Turf/lawn	Tall grass	Shrub/scrub	Trees	Other
LT Bank	☐	☐	☐	☐	☐	☐	☐:
RT Bank	☐	☐	☐	☒	☐	☐	☐:

INVASIVE PLANTS: ☒ None ☐ Rare ☐ Partial coverage ☐ Extensive coverage ☐ unknown

STREAM SHADE PROVIDED? ☒ None ☐ Partial ☐ Full

WETLANDS PRESENT? ☐ No ☐ Yes ☐ Unknown

POTENTIAL RESTORATION CANDIDATE ☒ Active reforestation ☐ Greenway design ☐ Natural regeneration ☐ Invasives removal ☐ no ☐ Other:

RESTORABLE AREA

	LT BANK	RT
Length (ft):	0	300
Width (ft):	0	40

REFORESTATION POTENTIAL: (*Circle #*)

5	4	3	2	1
Impacted area on public land where the riparian area does not appear to be used for any specific purpose; plenty of area available for planting		Impacted area on either public or private land that is presently used for a specific purpose; available area for planting adequate		Impacted area on private land where road; building encroachment or other feature significantly limits available area for planting

POTENTIAL CONFLICTS WITH REFORESTATION ☐ Widespread invasive plants ☐ Potential contamination ☐ Lack of sun ☐ Poor/unsafe access to site ☐ Existing impervious cover ☐ Severe animal impacts (deer, beaver) ☐ Other:

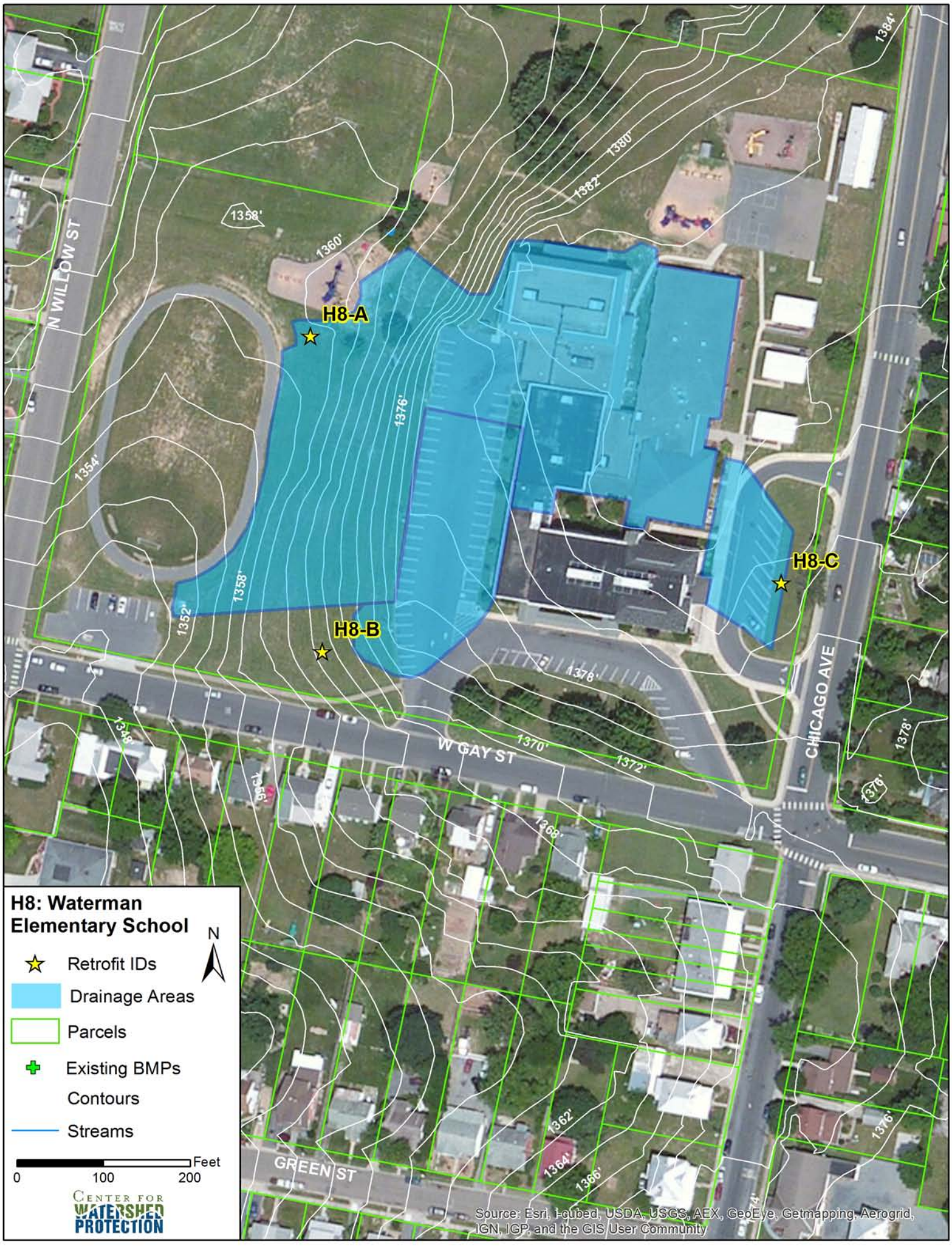
NOTES:

PLANTING INSIDE FENCE ON HARRISONBURG ELECTRIC COMMISSION SITE

AREA IS FLOODPLAIN

NO CONFLICTS WITH CURRENT USE

H8: Waterman Elementary School


H8-A
H8-B
H8-C
N WILLOW ST
W GAY ST
CHICAGO AVE
GREEN ST
1384'
1380'
1382'
1358'
1360'
1376'
1354'
1358'
1352'
1378'
1370'
1372'
1348'
1368'
1362'
1364'
1366'
1374'
H8: Waterman Elementary School
N
Retrofit IDs
Drainage Areas
Parcels
Existing BMPs
Contours
Streams
Feet
0
100
200
Center for Watershed Protection
Source: Esri, i-cubed, USDA, USGS, AEX, GeoEye, Getmapping, Aerogrid, IGN, IGP, and the GIS User Community

H8-A: Waterman Elementary School Parking & Building

Score: 36

Rank: 24

Investigators: David Hirschman, CJ Mitchem, Danny DeLong

Figure 1: *Area near the playground where existing runoff pools. Note the standing water.*

Description: The western end of the parking lot and about half of the school building drain down to the track and adjacent playground through two pipes that outlet on the slope as well as some sheet flow. There is an existing ditch along the track that drains to an inlet in the small parking area along W. Gay St. At the time of the site visit (had recently snowed), there was standing water sitting right next to the playground.

Proposed Retrofit: The retrofit involves installing a bioretention area adjacent to the playground combined with a bioswale in the existing ditch line along the track. An underdrain could outlet to daylight or be tied into the existing inlet at the W. Gay St. parking area. Ponding depths should be kept shallow (6” or less) because of the setting near a playground and track.

H8-B: Waterman Elementary School Parking (2)

Score: 30

Rank: 30

Investigators: David Hirschman, CJ Mitchem, Danny DeLong

Figure 1: *Slope below parking lot.*

Description: About ¾ of the parking lot (at the eastern end) has a curb and runoff goes directly to the street.

Proposed Retrofit: A curb cut and swale could be created just above the sidewalk to direct runoff down the slope. Along the slope, there is slight "plateau" that could be used for a bioretention area. Some grading or terracing would be needed to create the bioretention. An underdrain could tie into the existing inlet on the W. Gay St. side.

H8-C: Waterman Elementary School Parking (3)

Score: 37
Rank: 22
Investigators: David Hirschman, CJ Mitchem, Danny DeLong

Figure 1: *Parking and adjacent grass area on the Chicago Ave. side.*

Description: A couple of roof drains and a small parking area sheet flow to a grassy area along Chicago Avenue.

Proposed Retrofit: This would be a fairly simple retrofit, since there is already sheet flow. A bioswale could be constructed in the grassy area, likely closer to the edge of parking. This could also be as simple as adding soil amendments and some plantings. Underdrains may be difficult, as it is uncertain where they would outlet. Given the very public location, ponding depth should be kept shallow at approximately 6”.

WATERSHED:	SUBWATERSHED:	UNIQUE SITE ID: H-8A
DATE: 03/19/13	ASSESSED BY: DJH, CEM DJD	CAMERA ID: PICTURES: 1-7
GPS ID:	LMK ID:	LAT: LONG:

SITE DESCRIPTION

Name: Waterman E.S.
Address:

Ownership: ☒ Public ☐ Private ☐ Unknown
If Public, Government Jurisdiction: ☐ Local ☐ State ☐ DOT ☐ Other:

Corresponding USSR/USA Field Sheet? ☐ Yes ☐ No If yes, Unique Site ID:

Proposed Retrofit Location:

Storage
- ☐ Existing Pond
- ☐ Below Outfall
- ☐ In Road ROW
- ☐ Other:
- ☐ Above Roadway Culvert
- ☐ In Conveyance System
- ☐ Near Large Parking Lot

On-Site
- ☐ Hotspot Operation
- ☐ Small Parking Lot
- ☐ Individual Street
- ☐ Underground
- ☒ Individual Rooftop
- ☐ Small Impervious Area
- ☐ Landscape / Hardscape
- ☐ Other:

DRAINAGE AREA TO PROPOSED RETROFIT

Drainage Area ≈ 2.18
Imperviousness ≈ %
Impervious Area ≈ 1.87

Notes:

Drainage Area Land Use:
- ☐ Residential
  - ☐ SFH (< 1 ac lots)
  - ☐ SFH (> 1 ac lots)
  - ☐ Townhouses
  - ☐ Multi-Family
- ☐ Commercial
- ☒ Institutional
- ☐ Industrial
- ☐ Transport-Related
- ☐ Park
- ☐ Undeveloped
- ☐ Other:

EXISTING STORMWATER MANAGEMENT

Existing Stormwater Practice: ☐ Yes ☒ No ☐ Possible
If Yes, Describe:

Describe Existing Site Conditions, Including Existing Site Drainage and Conveyance:
Existing Street Width (if applicable):
Roof drains all connected to drainage system. Outfall on steep bank leading down to track. Some erosion, drainage. Drainage ditch next to track.

Existing Head Available:
4-5'

Note where points are measured from: (i.e. street elevation to catch basin invert, manhole rim to catch basin invert, other)
playground to downstream ditch along track

PROPOSED RETROFIT

Purpose of Retrofit:
☒ Water Quality ☐ Recharge ☐ Channel Protection ☐ Flood Control
☐ Demonstration / Education ☐ Repair ☒ Other: fix drainage issue

Retrofit Volume Computations - Target Storage:

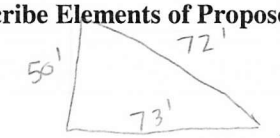
Retrofit Volume Computations - Available Storage:

Proposed Retrofit Practice: (Runoff Reduction)
☐ Disconnection ☒ Bioretention ☒ Bio Swale
☐ Expanded Tree Pit ☐ Infiltration ☐ Green Roof
☐ Permeable Pavement ☐ Rainwater Harvesting

Proposed Retrofit Practice: (Stormwater Treatment)
☐ Constructed Wetland ☐ Wet Swale ☐ Wet Pond
☐ Filtering Practice ☐ Proprietary:_____
☐ Other: _____

Retrofit Category (as defined by Chesapeake Bay Program):
☒ New BMP ☐ BMP Enhancement ☐ BMP Restoration ☐ BMP Conversion ☐ Not CBP-approved

Describe Elements of Proposed Retrofit, Including Surface Area, Maximum Depth of Treatment, and Conveyance:



+ 240 l.f. of ex. ditch along track

triangle 1825 + ditch 600
TOT = 2425

Available Width:	
Available Length:	
Available Area:	
Ponding Depth:	6"
Soil Depth:	2-3' depending on getting u.d. to daylight

SITE CONSTRAINTS

Adjacent Land Use:
☐ Residential ☐ Commercial ☒ Institutional
☐ Industrial ☐ Transport-Related ☐ Park
☐ Undeveloped ☐ Other:_____
Possible Conflicts Due to Adjacent Land Use? ☒ Yes ☐ No
If Yes, Describe:
immediately adjacent to playground

Access:
☒ No Constraints
Constrained due to
☐ Slope ☐ Space
☐ Utilities ☐ Tree Impacts
☐ Structures ☐ Property
Ownership
☐ Other:_____

Conflicts with Existing Utilities:

	Yes	Possible/ Modifiable	No	Unknown
Sewer:	☐	☐	☒	☐
Water:	☐	☐	☒	☐
Gas:	☐	☐	☒	☐
Electric to Streetlights:	☐	☒	☐	☐
Other:	☐	☐	☐	☐

Potential Permitting Factors:

Dam Safety Permits Necessary	☐ Probable	☒ Not Probable
Impacts to Wetlands	☐ Probable	☒ Not Probable
Impacts to a Stream	☐ Probable	☒ Not Probable
Floodplain Fill	☐ Probable	☒ Not Probable
Impacts to Forests	☐ Probable	☒ Not Probable
Impacts to Specimen Trees	☐ Probable	☒ Not Probable

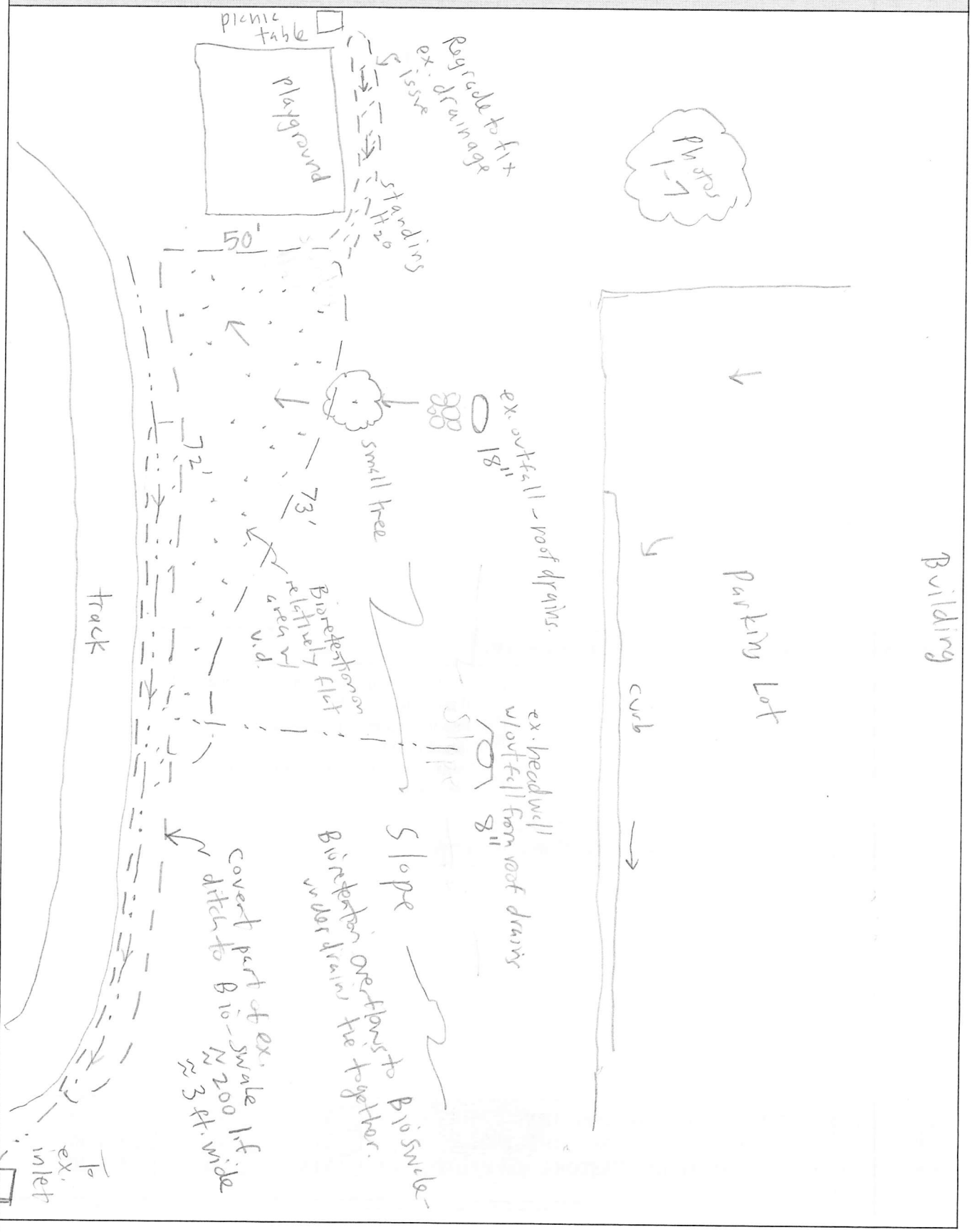
How many?_____
Approx. DBH_____

Other factors: small tree may have to be removed

Soils:

Soil auger test holes:	☐ Yes	☒ No
Evidence of poor infiltration (clays, fines):	☒ Yes	☐ No sitting water around playground
Evidence of shallow bedrock:	☐ Yes	☒ No
Evidence of high water table (gleying, saturation):	☐ Yes	☒ No

SKETCH



Unique Site ID: H 8A

DESIGN OR DELIVERY NOTES

- Better topo to figure out underdrain
- Work w/ school on playground/ standing water

FOLLOW-UP NEEDED TO COMPLETE FIELD CONCEPT

- ☐ Confirm property ownership
- ☒ Confirm drainage area
- ☒ Confirm drainage area impervious cover
- ☒ Confirm volume computations
- ☒ Complete concept sketch
- ☐ Obtain existing stormwater practice as-builts
- ☐ Obtain site as-builts
- ☒ Obtain detailed topography
- ☒ Obtain utility mapping
- ☐ Confirm storm drain invert elevations
- ☒ Confirm soil types
- ☐ Other:_____

INITIAL FEASIBILITY AND CONSTRUCTION CONSIDERATIONS

SITE CANDIDATE FOR FURTHER INVESTIGATION:	☒ YES	☐ NO	☐ MAYBE
IS SITE CANDIDATE FOR EARLY ACTION PROJECT(S):	☐ YES	☐ NO	☐ MAYBE
IF NO, SITE CANDIDATE FOR OTHER RESTORATION PROJECT(S):	☐ YES	☐ NO	☐ MAYBE

IF YES, TYPE(S):_____

RRI

WATERSHED:	SUBWATERSHED:	UNIQUE SITE ID: H8-B
DATE: 03/19/13	ASSESSED BY: DJH, CJM, JDD	CAMERA ID: PICTURES: 8-11
GPS ID:	LMK ID:	LAT: LONG:

SITE DESCRIPTION

Name: Waterman E.S.
Address:

Ownership: ☒ Public ☐ Private ☐ Unknown
If Public, Government Jurisdiction: ☐ Local ☐ State ☐ DOT ☐ Other:

Corresponding USSR/USA Field Sheet? ☐ Yes ☐ No If yes, Unique Site ID:

Proposed Retrofit Location:

Storage
- ☐ Existing Pond
- ☐ Below Outfall
- ☐ In Road ROW
- ☐ Other:
- ☐ Above Roadway Culvert
- ☐ In Conveyance System
- ☐ Near Large Parking Lot

On-Site
- ☐ Hotspot Operation
- ☒ Small Parking Lot
- ☐ Individual Street
- ☐ Underground
- ☐ Individual Rooftop
- ☐ Small Impervious Area
- ☐ Landscape / Hardscape
- ☐ Other:

DRAINAGE AREA TO PROPOSED RETROFIT

Drainage Area ≈ 0.49
Imperviousness ≈ %
Impervious Area ≈ 0.43

Notes:

Drainage Area Land Use:
- ☐ Residential
  - ☐ SFH (< 1 ac lots)
  - ☐ SFH (> 1 ac lots)
  - ☐ Townhouses
  - ☐ Multi-Family
- ☐ Commercial
- ☒ Institutional
- ☐ Industrial
- ☐ Transport-Related
- ☐ Park
- ☐ Undeveloped
- ☐ Other:

EXISTING STORMWATER MANAGEMENT

Existing Stormwater Practice: ☐ Yes ☒ No ☐ Possible
If Yes, Describe:

Describe Existing Site Conditions, Including Existing Site Drainage and Conveyance:
Existing Street Width (if applicable):

Parking lot w/ curb - all water currently goes to street

Existing Head Available:

Lots
Pretty good slope

Note where points are measured from: (i.e. street elevation to catch basin invert, manhole rim to catch basin invert, other)

Park

PROPOSED RETROFIT

Purpose of Retrofit:
☒ Water Quality ☐ Recharge ☐ Channel Protection ☐ Flood Control
☐ Demonstration / Education ☐ Repair ☐ Other:_____

Retrofit Volume Computations - Target Storage:

Retrofit Volume Computations - Available Storage:

Proposed Retrofit Practice: (Runoff Reduction)
☐ Disconnection ☒ Bioretention ☐ Bio Swale
☐ Expanded Tree Pit ☐ Infiltration ☐ Green Roof
☐ Permeable Pavement ☐ Rainwater Harvesting

Proposed Retrofit Practice: (Stormwater Treatment)
☐ Constructed Wetland ☐ Wet Swale ☐ Wet Pond
☐ Filtering Practice ☐ Proprietary:_____
☐ Other: _____

Retrofit Category (as defined by Chesapeake Bay Program):
☒ New BMP ☐ BMP Enhancement ☐ BMP Restoration ☐ BMP Conversion ☐ Not CBP-approved

Describe Elements of Proposed Retrofit, Including Surface Area, Maximum Depth of Treatment, and Conveyance:

Area is small plateau along slope - would have to be terraced, but could get it in.

Available Width:	47
Available Length:	70
Available Area:	
Ponding Depth:	6"
Soil Depth:	3'

SITE CONSTRAINTS

Adjacent Land Use:
☐ Residential ☐ Commercial ☒ Institutional
☐ Industrial ☐ Transport-Related ☐ Park
☐ Undeveloped ☐ Other:_____
Possible Conflicts Due to Adjacent Land Use? ☐ Yes ☐ No
If Yes, Describe:

Access:
☐ No Constraints
Constrained due to
☒ Slope some ☐ Space
☐ Utilities ☐ Tree Impacts
☐ Structures ☐ Property
Ownership
☐ Other:_____

Conflicts with Existing Utilities:

SS along sidewalk

	Yes	Possible/ Modifiable	No	Unknown
Sewer:	☒	☐	☐	☐
Water:	☐	☐	☐	☒
Gas:	☐	☐	☐	☒
Electric to Streetlights:	☐	☐	☒	☐
Other:	☐	☐	☐	☐

Potential Permitting Factors:

Dam Safety Permits Necessary	☐ Probable	☒ Not Probable
Impacts to Wetlands	☐ Probable	☒ Not Probable
Impacts to a Stream	☐ Probable	☒ Not Probable
Floodplain Fill	☐ Probable	☒ Not Probable
Impacts to Forests	☐ Probable	☒ Not Probable
Impacts to Specimen Trees	☐ Probable	☒ Not Probable

How many?_____
Approx. DBH_____

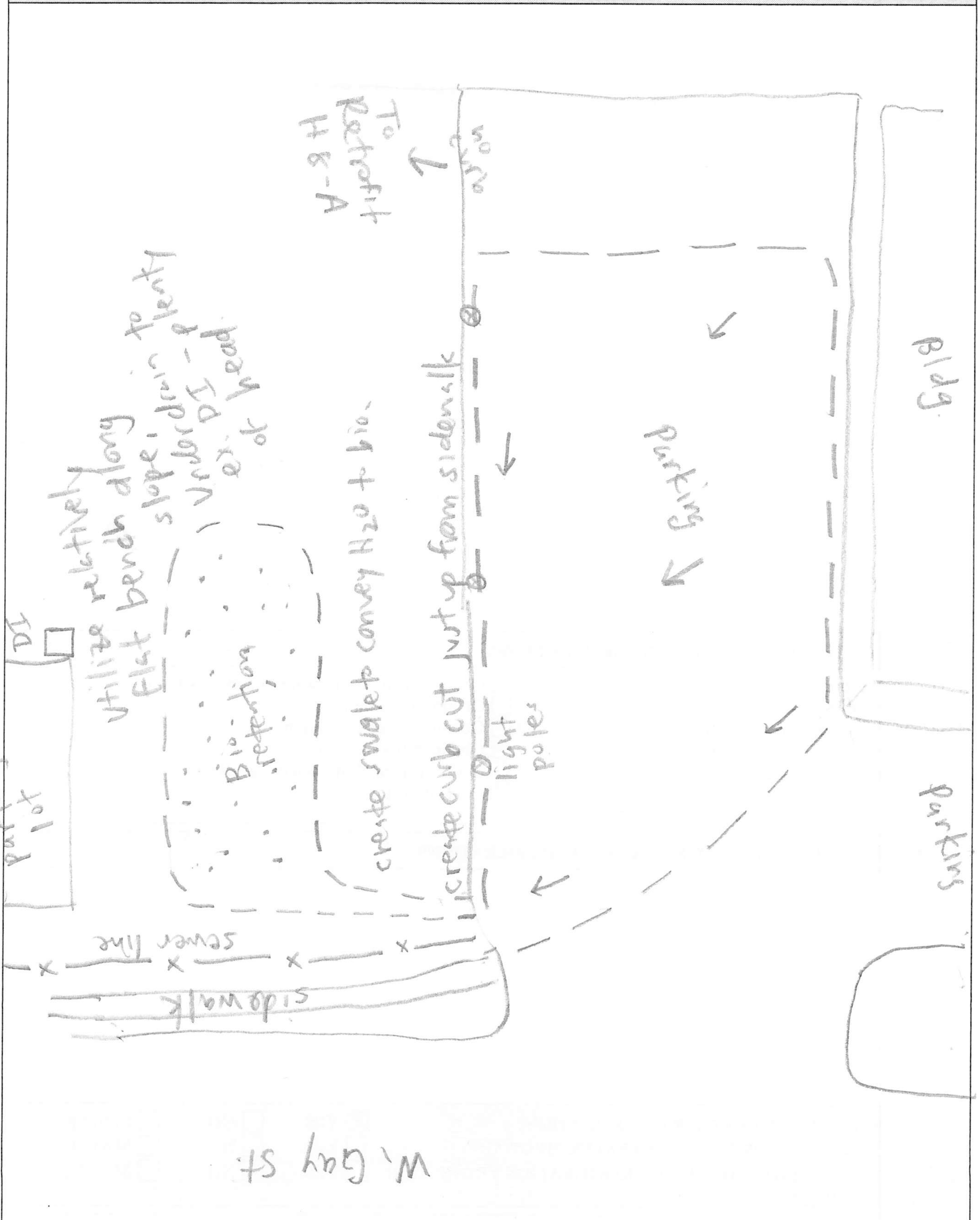
Other factors:_____

Soils:

Soil auger test holes:	☒ Yes	☐ No
Evidence of poor infiltration (clays, fines):	☐ Yes	☒ No
Evidence of shallow bedrock:	☐ Yes	☒ No
Evidence of high water table (gleying, saturation):	☐ Yes	☒ No

clay

SKETCH


To Retrofit H8-A
Bldg.
Parking
Parking
utilize relatively flat bench along slope; underdrain to ex. DI - plenty of head
create swale to convey H2O to bio.
create curb cut just up from sidewalk
Bio-retention
light poles
DI
small parking lot
sewer line
sidewalk
W. Gay St

DESIGN OR DELIVERY NOTES

- Confer w/ School.
Not a heavily-used area.

FOLLOW-UP NEEDED TO COMPLETE FIELD CONCEPT

- ☐ Confirm property ownership
- ☒ Confirm drainage area
- ☒ Confirm drainage area impervious cover 100% IC
- ☒ Confirm volume computations
- ☒ Complete concept sketch
- ☐ Obtain existing stormwater practice as-builts
- ☐ Obtain site as-builts
- ☒ Obtain detailed topography
- ☒ Obtain utility mapping
- ☐ Confirm storm drain invert elevations
- ☒ Confirm soil types
- ☐ Other:_____

INITIAL FEASIBILITY AND CONSTRUCTION CONSIDERATIONS

SITE CANDIDATE FOR FURTHER INVESTIGATION:	☒ YES	☐ NO	☐ MAYBE
IS SITE CANDIDATE FOR EARLY ACTION PROJECT(S):	☐ YES	☐ NO	☐ MAYBE
IF NO, SITE CANDIDATE FOR OTHER RESTORATION PROJECT(S):	☐ YES	☐ NO	☐ MAYBE

IF YES, TYPE(S):_____

WATERSHED:	SUBWATERSHED:	UNIQUE SITE ID: H-8C	
DATE: 3/19/13	ASSESSED BY: DSD, DTH, CJM	CAMERA ID:	PICTURES: 12 - 14
GPS ID:	LMK ID:	LAT:	LONG:

SITE DESCRIPTION

Name: Waterman Elementary School
Address: _____

Ownership: ☒ Public ☐ Private ☐ Unknown
If Public, Government Jurisdiction: ☐ Local ☐ State ☐ DOT ☐ Other: _____

Corresponding USSR/USA Field Sheet? ☐ Yes ☐ No If yes, Unique Site ID: _____

Proposed Retrofit Location:

Storage
- ☐ Existing Pond
- ☐ Below Outfall
- ☐ In Road ROW
- ☐ Other: _____
- ☐ Above Roadway Culvert
- ☐ In Conveyance System
- ☐ Near Large Parking Lot

On-Site
- ☐ Hotspot Operation
- ☒ Small Parking Lot
- ☐ Individual Street
- ☐ Underground
- ☒ Individual Rooftop
- ☐ Small Impervious Area
- ☐ Landscape / Hardscape
- ☐ Other: _____

DRAINAGE AREA TO PROPOSED RETROFIT

Drainage Area ≈ 0.21
Imperviousness ≈ _____ %
Impervious Area ≈ 0.21

Notes:

Drainage Area Land Use:
- ☐ Residential
  - ☐ SFH (< 1 ac lots)
  - ☐ SFH (> 1 ac lots)
  - ☐ Townhouses
  - ☐ Multi-Family
- ☐ Commercial
- ☒ Institutional
- ☐ Industrial
- ☐ Transport-Related
- ☐ Park
- ☐ Undeveloped
- ☐ Other: _____

EXISTING STORMWATER MANAGEMENT

Existing Stormwater Practice: ☐ Yes ☒ No ☐ Possible
If Yes, Describe:

Describe Existing Site Conditions, Including Existing Site Drainage and Conveyance:
Existing Street Width (if applicable): _____

Roof drains outfalling to small parking lot which the sheetflows to grass area

Existing Head Available:

Good slope on lot

Note where points are measured from: (i.e. street elevation to catch basin invert, manhole rim to catch basin invert, other)

PROPOSED RETROFIT

Purpose of Retrofit:
☒ Water Quality ☐ Recharge ☐ Channel Protection ☐ Flood Control
☐ Demonstration / Education ☐ Repair ☐ Other:_____

Retrofit Volume Computations - Target Storage:

Retrofit Volume Computations - Available Storage:

Proposed Retrofit Practice: (Runoff Reduction)
☐ Disconnection ☐ Bioretention ☒ Bio Swale
☐ Expanded Tree Pit ☐ Infiltration ☐ Green Roof
☐ Permeable Pavement ☐ Rainwater Harvesting

Proposed Retrofit Practice: (Stormwater Treatment)
☐ Constructed Wetland ☐ Wet Swale ☐ Wet Pond
☐ Filtering Practice ☐ Proprietary:_____
☐ Other: _____

Retrofit Category (as defined by Chesapeake Bay Program):
☒ New BMP ☐ BMP Enhancement ☐ BMP Restoration ☐ BMP Conversion ☐ Not CBP-approved

Describe Elements of Proposed Retrofit, Including Surface Area, Maximum Depth of Treatment, and Conveyance:

Available Width:	28'
Available Length:	100'
Available Area:	
Ponding Depth:	6"
Soil Depth:	2'-3'

SITE CONSTRAINTS

Adjacent Land Use:
☐ Residential ☐ Commercial ☒ Institutional
☐ Industrial ☐ Transport-Related ☐ Park
☐ Undeveloped ☐ Other:_____
Possible Conflicts Due to Adjacent Land Use? ☐ Yes ☐ No
If Yes, Describe:

Access:
☒ No Constraints
Constrained due to
☐ Slope ☐ Space
☐ Utilities ☐ Tree Impacts
☐ Structures ☐ Property
Ownership
☐ Other:_____

Conflicts with Existing Utilities:

	Yes	Possible/ Modifiable	No	Unknown
Sewer:	☐	☐	☒	☐
Water:	☐	☐	☒	☐
Gas:	☐	☐	☒	☐
Electric to Streetlights:	☐	☐	☒	☐
Other:	☐	☐	☐	☐

_____

Potential Permitting Factors:

Dam Safety Permits Necessary	☐ Probable	☒ Not Probable
Impacts to Wetlands	☐ Probable	☒ Not Probable
Impacts to a Stream	☐ Probable	☒ Not Probable
Floodplain Fill	☐ Probable	☒ Not Probable
Impacts to Forests	☐ Probable	☒ Not Probable
Impacts to Specimen Trees	☐ Probable	☒ Not Probable

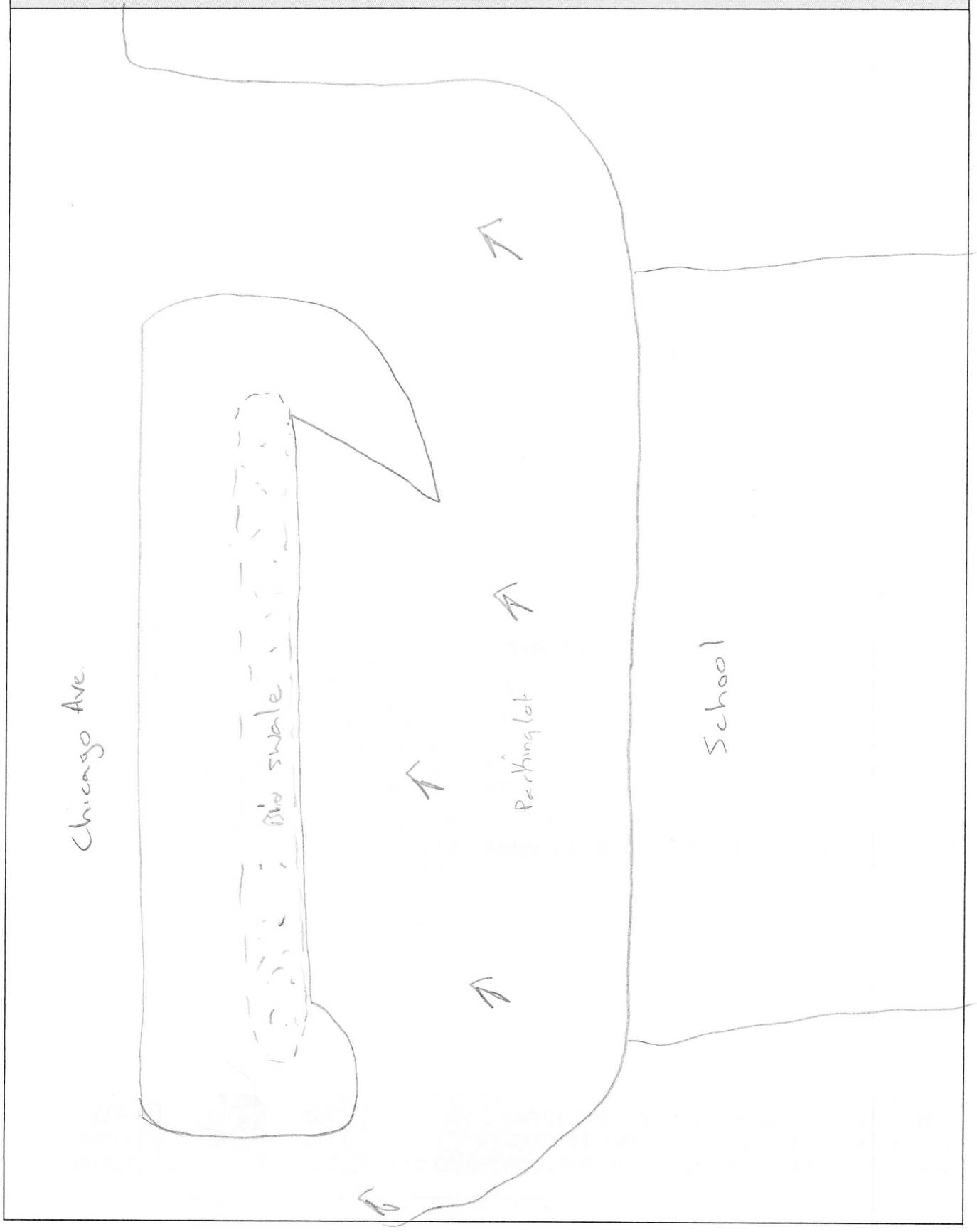
How many?_____
Approx. DBH_____

Other factors:_____
_____

Soils:

Soil auger test holes:	☒ Yes	☐ No Clay
Evidence of poor infiltration (clays, fines):	☐ Yes	☒ No
Evidence of shallow bedrock:	☐ Yes	☒ No
Evidence of high water table (gleying, saturation):	☐ Yes	☒ No

SKETCH



DESIGN OR DELIVERY NOTES

- Confer w/ school
Not a heavily used area

FOLLOW-UP NEEDED TO COMPLETE FIELD CONCEPT

- ☐ Confirm property ownership
- ☒ Confirm drainage area
- ☒ Confirm drainage area impervious cover
- ☒ Confirm volume computations
- ☒ Complete concept sketch
- ☐ Obtain existing stormwater practice as-builts
- ☐ Obtain site as-builts
- ☒ Obtain detailed topography
- ☐ Obtain utility mapping
- ☐ Confirm storm drain invert elevations
- ☐ Confirm soil types
- ☐ Other:_____

INITIAL FEASIBILITY AND CONSTRUCTION CONSIDERATIONS

SITE CANDIDATE FOR FURTHER INVESTIGATION:	☐ YES	☐ NO	☐ MAYBE
IS SITE CANDIDATE FOR EARLY ACTION PROJECT(S):	☐ YES	☐ NO	☐ MAYBE
IF NO, SITE CANDIDATE FOR OTHER RESTORATION PROJECT(S):	☐ YES	☐ NO	☐ MAYBE

IF YES, TYPE(S):_____

H9: Rockingham County Admin Building


1334'
1334'
1330'
1332'
N MAIN ST
1332'
1330'
H9
N MASON ST
N MASON ST
E GAY ST
1330'
3.15 Manufactured BMP Systems
1332'
1334'
1336'
H9: Rockingham County Admin Building
N
Retrofit IDs
Drainage Areas
Parcels
Existing BMPs
Contours
Streams
Feet
0
55
110
CENTER FOR WATERSHED PROTECTION
Source: Esri, i-cubed, USDA, USGS, AEX, GeoEye, Getmapping, Aerogrid, IGN, IGP, and the GIS User Community

H9: Rockingham County Administration Building

Score: 31

Rank: 29

Investigators: David Hirschman, CJ Mitchem, Danny DeLong

Figure 1: *Existing parking island that could be expanded and modified for bioretention*

Description: This is a very large parking lot with 2 existing drain inlets. There are several narrow vegetated islands in the parking lot.

Proposed Retrofit: The best retrofit potential is one of the islands situated so that it could collect runoff from northern section of the parking lot. Converting this into a larger bioretention would require taking out parking stalls furthest from the building. Six to nine parking stalls would be needed to expand the island to an adequate size. The top soil layer of the island would have to be lowered from curb-height to about 6" below the asphalt, and an underdrain could be tied into one of the existing inlets, although this would have to be a shallow system, since the inlet is only 2.5' deep.

Retrofit Reconnaissance Investigation **RRI**
Updated: 3/13/2013

WATERSHED:	SUBWATERSHED:	UNIQUE SITE ID: #9	
DATE: 2/19/2013	ASSESSED BY: DJH, DJL CEM	CAMERA ID:	PICTURES: 15-19
GPS ID:	LMK ID:	LAT:	LONG:

SITE DESCRIPTION

Name: Rockingham Co. Admin. Bldg.
Address: Int. of Mason St. & Gay St.

Ownership: ☒ Public ☐ Private ☐ Unknown
If Public, Government Jurisdiction: ☒ Local ☐ State ☐ DOT ☐ Other:

Corresponding USSR/USA Field Sheet? ☐ Yes ☐ No If yes, Unique Site ID:

Proposed Retrofit Location:

Storage
☐ Existing Pond ☐ Above Roadway Culvert
☐ Below Outfall ☐ In Conveyance System
☐ In Road ROW ☐ Near Large Parking Lot
☐ Other:

On-Site
☐ Hotspot Operation ☐ Individual Rooftop
☐ Small Parking Lot ☐ Small Impervious Area
☐ Individual Street ☐ Landscape / Hardscape
☐ Underground ☒ Other: large parking lot

DRAINAGE AREA TO PROPOSED RETROFIT

Drainage Area ≈
Imperviousness ≈ %
Impervious Area ≈

Notes:

Drainage Area Land Use:
☐ Residential
☐ SFH (< 1 ac lots)
☐ SFH (> 1 ac lots)
☐ Townhouses
☐ Multi-Family
☐ Commercial
☒ Institutional
☐ Industrial
☐ Transport-Related
☐ Park
☐ Undeveloped
☐ Other:

EXISTING STORMWATER MANAGEMENT

Existing Stormwater Practice: ☐ Yes ☒ No ☐ Possible
If Yes, Describe:

No structures at site. There is a DI. downgradient of site.

Describe Existing Site Conditions, Including Existing Site Drainage and Conveyance:
Existing Street Width (if applicable):

Large parking lot with 2 DI.s. Sheet flow concentrates @ proposed BMP location, which was selected to impact minimal, low quality parking spaces. Size may be adjusted to minimize spaces impact.

Existing Head Available: ≈ 3'

≈ 0.8' of fall to from island to DI
+ 2.5' to INV of DI
TOT = ≈ 3.3'

Note where points are measured from: (i.e. street elevation to catch basin invert, manhole rim to catch basin invert, other)

Proposed BMP site to DI

3.3
1.5
1.8

6" = Ponding
12" = gravel

PROPOSED RETROFIT

Purpose of Retrofit:
☒ Water Quality ☐ Recharge ☐ Channel Protection ☐ Flood Control
☐ Demonstration / Education ☐ Repair ☐ Other:_____

Retrofit Volume Computations - Target Storage:

Retrofit Volume Computations - Available Storage:

Proposed Retrofit Practice: (Runoff Reduction)
☐ Disconnection ☒ Bioretention ☐ Bio Swale
☐ Expanded Tree Pit ☐ Infiltration ☐ Green Roof
☐ Permeable Pavement ☐ Rainwater Harvesting

Proposed Retrofit Practice: (Stormwater Treatment)
☐ Constructed Wetland ☐ Wet Swale ☐ Wet Pond
☒ Filtering Practice ☐ Proprietary:_____
☐ Other: _____

Retrofit Category (as defined by Chesapeake Bay Program):
☒ New BMP ☐ BMP Enhancement ☐ BMP Restoration ☐ BMP Conversion ☐ Not CBP-approved

Describe Elements of Proposed Retrofit, Including Surface Area, Maximum Depth of Treatment, and Conveyance:
Propose bio retention with underdrain in parking lot. Underdrain to daylight in existing DI structure. As proposed, biofilter would impact 9 parking spaces located away from building

Available Width:	38'
Available Length:	86'
Available Area:	3268
Ponding Depth:	
Soil Depth:	

SITE CONSTRAINTS

Adjacent Land Use:
☐ Residential ☐ Commercial ☒ Institutional
☐ Industrial ☐ Transport-Related ☐ Park
☐ Undeveloped ☐ Other:_____
Possible Conflicts Due to Adjacent Land Use? ☒ Yes ☐ No
If Yes, Describe: County offices parking lot - consider

Access:
☐ No Constraints
Constrained due to
☐ Slope ☐ Space
☒ Utilities ☐ Tree Impacts
☐ Structures ☐ Property
Ownership
☐ Other: Aquemart

Conflicts with Existing Utilities:

	Yes	Possible/ Modifiable	No	Unknown
Sewer:	☐	☐	☒	☐
Water:	☐	☐	☒	☐
Gas:	☐	☐	☒	☐
Electric to Streetlights:	☒	☐	☐	☐
Other:	☐	☐	☐	☐

Potential Permitting Factors:

Dam Safety Permits Necessary	☐ Probable	☒ Not Probable
Impacts to Wetlands	☐ Probable	☒ Not Probable
Impacts to a Stream	☐ Probable	☒ Not Probable
Floodplain Fill	☐ Probable	☒ Not Probable
Impacts to Forests	☐ Probable	☒ Not Probable
Impacts to Specimen Trees	☐ Probable	☒ Not Probable

How many?_____
Approx. DBH_____

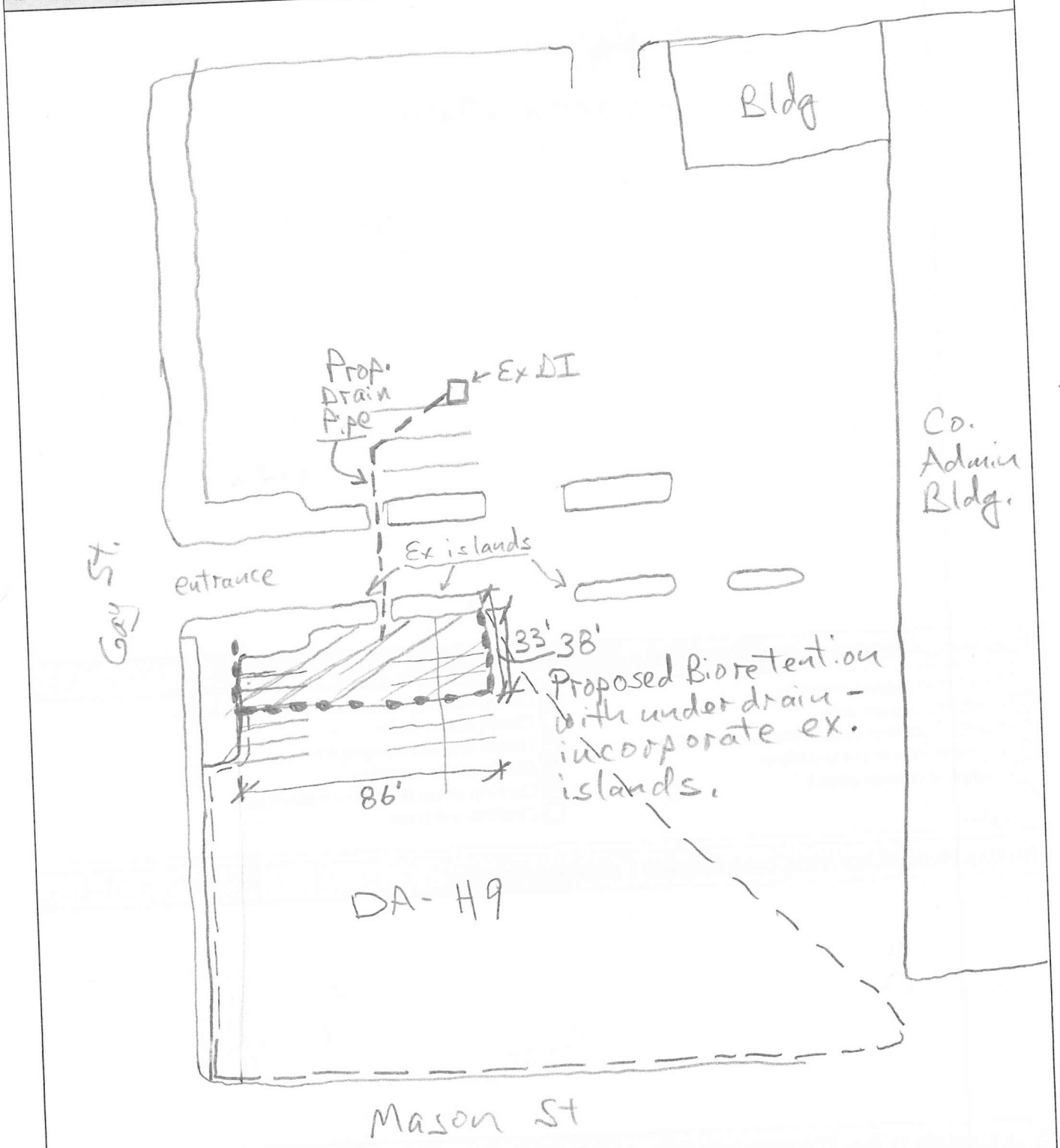
Other factors:_____

Soils:

Soil auger test holes:	☐ Yes	☒ No
Evidence of poor infiltration (clays, fines):	☐ Yes	☒ No
Evidence of shallow bedrock:	☐ Yes	☒ No
Evidence of high water table (gleying, saturation):	☐ Yes	☒ No

Parking Lot - paved

SKETCH



Unique Site ID: H9

DESIGN OR DELIVERY NOTES

Confirm DA.
Work w/ County staff

FOLLOW-UP NEEDED TO COMPLETE FIELD CONCEPT

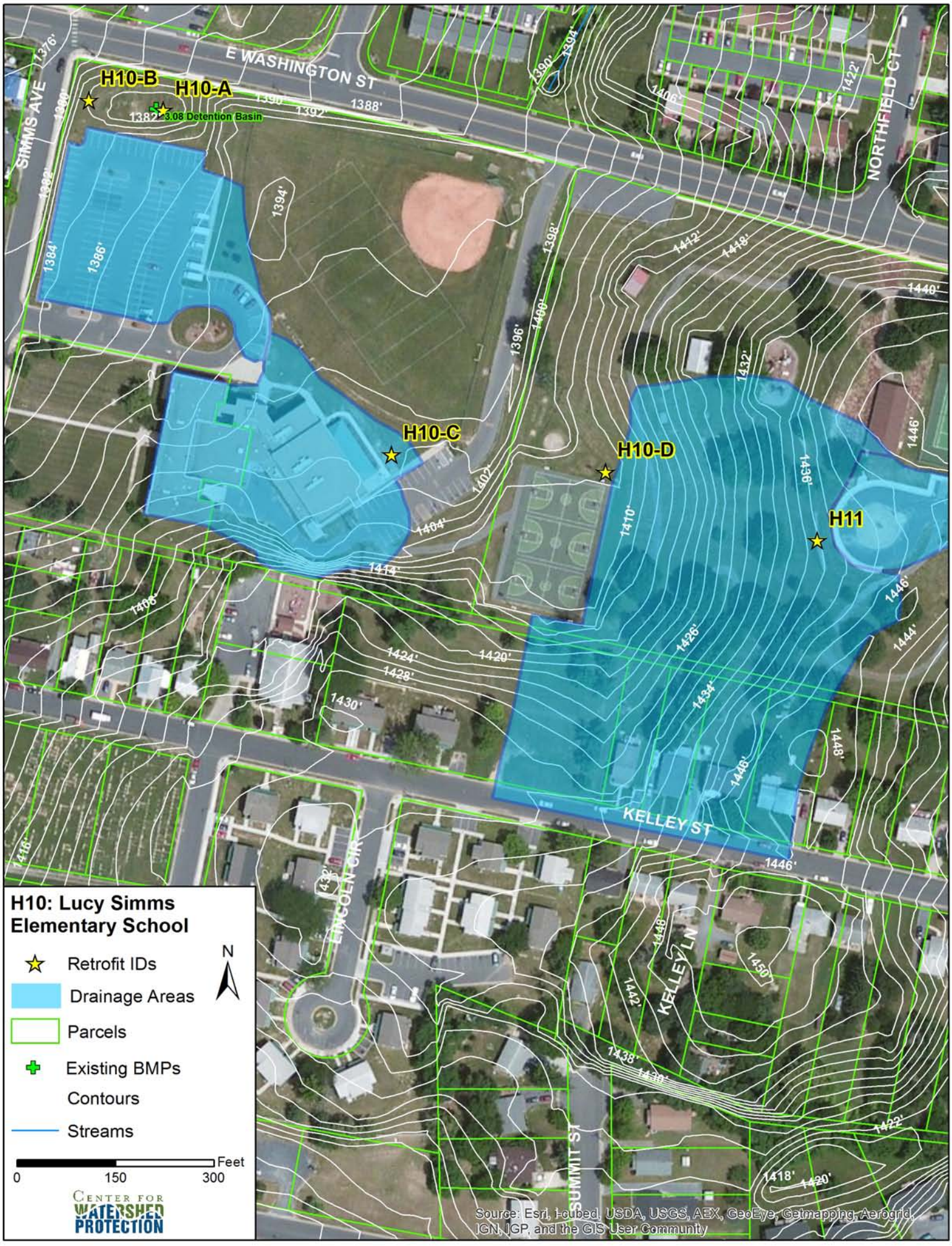
- ☐ Confirm property ownership
- ☒ Confirm drainage area
- ☐ Confirm drainage area impervious cover
- ☒ Confirm volume computations
- ☒ Complete concept sketch
- ☐ Obtain existing stormwater practice as-builts
- ☐ Obtain site as-builts
- ☒ Obtain detailed topography
- ☒ Obtain utility mapping
- ☒ Confirm storm drain invert elevations
- ☐ Confirm soil types
- ☐ Other:_____

INITIAL FEASIBILITY AND CONSTRUCTION CONSIDERATIONS

SITE CANDIDATE FOR FURTHER INVESTIGATION:	☒ YES	☐ NO	☐ MAYBE
IS SITE CANDIDATE FOR EARLY ACTION PROJECT(S):	☐ YES	☐ NO	☐ MAYBE
IF NO, SITE CANDIDATE FOR OTHER RESTORATION PROJECT(S):	☐ YES	☐ NO	☐ MAYBE

IF YES, TYPE(S):_____

H10: Lucy Simms Elementary School


H10-B
H10-A
3.08 Detention Basin
H10-C
H10-D
H11
E WASHINGTON ST
SIMMS AVE
NORTHFIELD CT
KELLEY ST
LINCOLN CIR
KELLEY LN
SUMMIT ST
H10: Lucy Simms Elementary School
Retrofit IDs
Drainage Areas
Parcels
Existing BMPs
Contours
Streams
N
Feet
0
150
300
CENTER FOR WATERSHED PROTECTION
Source: Esri, i-cubed, USDA, USGS, AEX, GeoEye, Getmapping, Aerogrid, IGN, IGP, and the GIS User Community

H10-A: Lucy Simms School Basin

Score: 49

Rank: 6

Investigators: David Hirschman, Tom Hartman

Figure 1: *Existing basin in front of Lucy Simms Center*

Description: The existing basin has about 1' of sediment built up in the bottom, and this is blocking one of the outlets. In addition, outlet protection at the inlets has deteriorated and the trash rack appears to be gone.

Proposed Retrofit: This would be a basin restoration project, to include removing the accumulated sediment, repairing the low-flow orifice and trash rack, and adding outlet protection to the two pipes. It may also be possible to add some water quality enhancement to the basin, such as lengthening the flow path or adding wetland cells. However, the available basin floor area is quite limited for these enhancements.

H10-B: Lucy Simms School Parking Lot

Score: 36
Rank: 23
Investigators: David Hirschman, Tom Hartman

Figure 1: *Looking from the parking lot inlet to the adjacent grassy area*

Description: The large parking lot in front of Lucy Simms Community Center has one inlet in the northwest corner. The inlet goes directly to the basin, discussed with H10-A. There is a grassy area north of the parking lot inlet along Simms Ave (Figure 1).

Proposed Retrofit: The grassy area could be used for a bioretention area that would function as a sort of pre-treatment (or additional water quality treatment) before stormwater goes to the existing basin. This would be a good practice since the basin seems undersized for its substantial drainage area. This concept would treat only the parking lot, but that would be the most important part of the drainage area for water quality purposes.

Water could be diverted to the bioretention area by using curb cuts on either side of the existing inlet, or possibly a paired inlet (shallow upgradient inlet that goes directly to bioretention). Once the bioretention filled up, water could spill over a weir into the existing basin.

H10-C: Lucy Simms School Building

Score: 45

Rank: 9

Investigators: David Hirschman, Tom Hartman, Lisa Fraley McNeal

Figure 1: *Drainage structures surround the Lucy Simms building, and there is an adjacent ballfield*

Description: The Lucy Simms building is ringed by storm inlets that eventually go to the existing basin (H10-A). There is a baseball field in front of the community center. It is unknown whether this field is currently being irrigated.

Proposed Retrofit: One of the existing inlets at the northeast corner of the building would be a good place to install a rainwater harvesting system. This one inlet appears to collect water from much of the existing storm drain system collecting roof runoff. Collected water could be used to irrigate the field, and possibly for other uses inside or outside the building. An underground cistern system would likely be the most appropriate configuration, but other underground or above-ground configurations could be explored.

H10-D: Ralph Sampson Park Basketball Court

Score: 57

Rank: 4

Investigators: David Hirschman, Tom Hartman

Figure 1: *Existing inlet adjacent to basketball courts*

Description: Ralph Sampson Park consists largely of maintained turf with stone dust trails. Some of the trails and grass areas show evidence of rill erosion, due to the slopes and amount of runoff conveying through the area. There is an existing inlet adjacent to the basketball courts at the part of the park closest to Lucy Simms (low part of the park) – see Figure 1. There is also a shallow swale adjacent to the basketball court.

Proposed Retrofit: The existing inlet can be raised and a bioretention area constructed around the inlet in a triangle shape. Some grading would be necessary to create a flat bioretention surface. This would be a relatively shallow system, since the invert of the existing drain would constrain the depth of the underdrain.

RRI

WATERSHED:	SUBWATERSHED:	UNIQUE SITE ID: H10 A	
DATE: 3/19/13	ASSESSED BY: DSH/TAH	CAMERA ID:	PICTURES: 31-33
GPS ID:	LMK ID:	LAT:	LONG:

SITE DESCRIPTION

Name: Lucy Sims School
Address:

Ownership: ☒ Public ☐ Private ☐ Unknown
If Public, Government Jurisdiction: ☒ Local ☐ State ☐ DOT ☐ Other:

Corresponding USSR/USA Field Sheet? ☐ Yes ☐ No If yes, Unique Site ID:

Proposed Retrofit Location:

Storage
- ☒ Existing Pond
- ☐ Below Outfall
- ☐ In Road ROW
- ☐ Other:
- ☐ Above Roadway Culvert
- ☐ In Conveyance System
- ☐ Near Large Parking Lot

On-Site
- ☐ Hotspot Operation
- ☐ Small Parking Lot
- ☐ Individual Street
- ☐ Underground
- ☐ Individual Rooftop
- ☐ Small Impervious Area
- ☐ Landscape / Hardscape
- ☐ Other:

DRAINAGE AREA TO PROPOSED RETROFIT

Drainage Area ≈ 20.16 From file comps
Imperviousness ≈ ____ %
Impervious Area ≈ 5.73 From file comps

Notes:

Drainage Area Land Use:
- ☐ Residential
  - ☐ SFH (< 1 ac lots)
  - ☐ SFH (> 1 ac lots)
  - ☐ Townhouses
  - ☐ Multi-Family
- ☐ Commercial
- ☐ Institutional
- ☐ Industrial
- ☐ Transport-Related
- ☐ Park
- ☐ Undeveloped
- ☒ Other: SCHOOL

EXISTING STORMWATER MANAGEMENT

Existing Stormwater Practice: ☒ Yes ☐ No ☐ Possible
If Yes, Describe:

EXISTING EXTENDED DETENTION FACILITY

Describe Existing Site Conditions, Including Existing Site Drainage and Conveyance:
Existing Street Width (if applicable):

- EXISTING ED APPEARS TO HAVE APPROX 1' of SEDIMENT BUILT UP IN THE BOTTOM.
- EXISTING OP AT EACH PIPE IS LOW
- TRASH RACK APPEARS TO BE SHIFTED OFF.

Existing Head Available:	Note where points are measured from: (i.e. street elevation to catch basin invert, manhole rim to catch basin invert, other)

PROPOSED RETROFIT

Purpose of Retrofit:
☐ Water Quality ☐ Recharge ☐ Channel Protection ☐ Flood Control
☐ Demonstration / Education ☒ Repair ☐ Other:_____

Retrofit Volume Computations - Target Storage:

Retrofit Volume Computations - Available Storage:

Proposed Retrofit Practice: (Runoff Reduction)
☐ Disconnection ☐ Bioretention ☐ Bio Swale
☐ Expanded Tree Pit ☐ Infiltration ☐ Green Roof
☐ Permeable Pavement ☐ Rainwater Harvesting

Proposed Retrofit Practice: (Stormwater Treatment)
☐ Constructed Wetland ☐ Wet Swale ☐ Wet Pond
☐ Filtering Practice ☐ Proprietary:_____
☒ Other: REPAIR ED

Retrofit Category (as defined by Chesapeake Bay Program):
☐ New BMP ☐ BMP Enhancement ☒ BMP Restoration ☐ BMP Conversion ☐ Not CBP-approved

Describe Elements of Proposed Retrofit, Including Surface Area, Maximum Depth of Treatment, and Conveyance:

Available Width:	27'
Available Length:	97'
Available Area:	~3000 SF
Ponding Depth:	N/A
Soil Depth:	

SITE CONSTRAINTS

Adjacent Land Use:
☐ Residential ☐ Commercial ☐ Institutional
☐ Industrial ☐ Transport-Related ☒ Park
☐ Undeveloped ☒ Other: SCHOOL
Possible Conflicts Due to Adjacent Land Use? ☐ Yes ☒ No
If Yes, Describe:

Access:
☒ No Constraints
Constrained due to
☐ Slope ☐ Space
☐ Utilities ☐ Tree Impacts
☐ Structures ☐ Property
Ownership
☐ Other:_____

Conflicts with Existing Utilities:

	Yes	Possible/ Modifiable	No	Unknown
Sewer:	☐	☐	☒	☐
Water:	☐	☐	☒	☐
Gas:	☐	☐	☒	☐
Electric to Streetlights:	☐	☒	☐	☐
Other:	☐	☐	☐	☐

_____

Potential Permitting Factors:

Dam Safety Permits Necessary	☐ Probable	☒ Not Probable
Impacts to Wetlands	☐ Probable	☒ Not Probable
Impacts to a Stream	☐ Probable	☒ Not Probable
Floodplain Fill	☐ Probable	☒ Not Probable
Impacts to Forests	☐ Probable	☒ Not Probable
Impacts to Specimen Trees	☐ Probable	☒ Not Probable

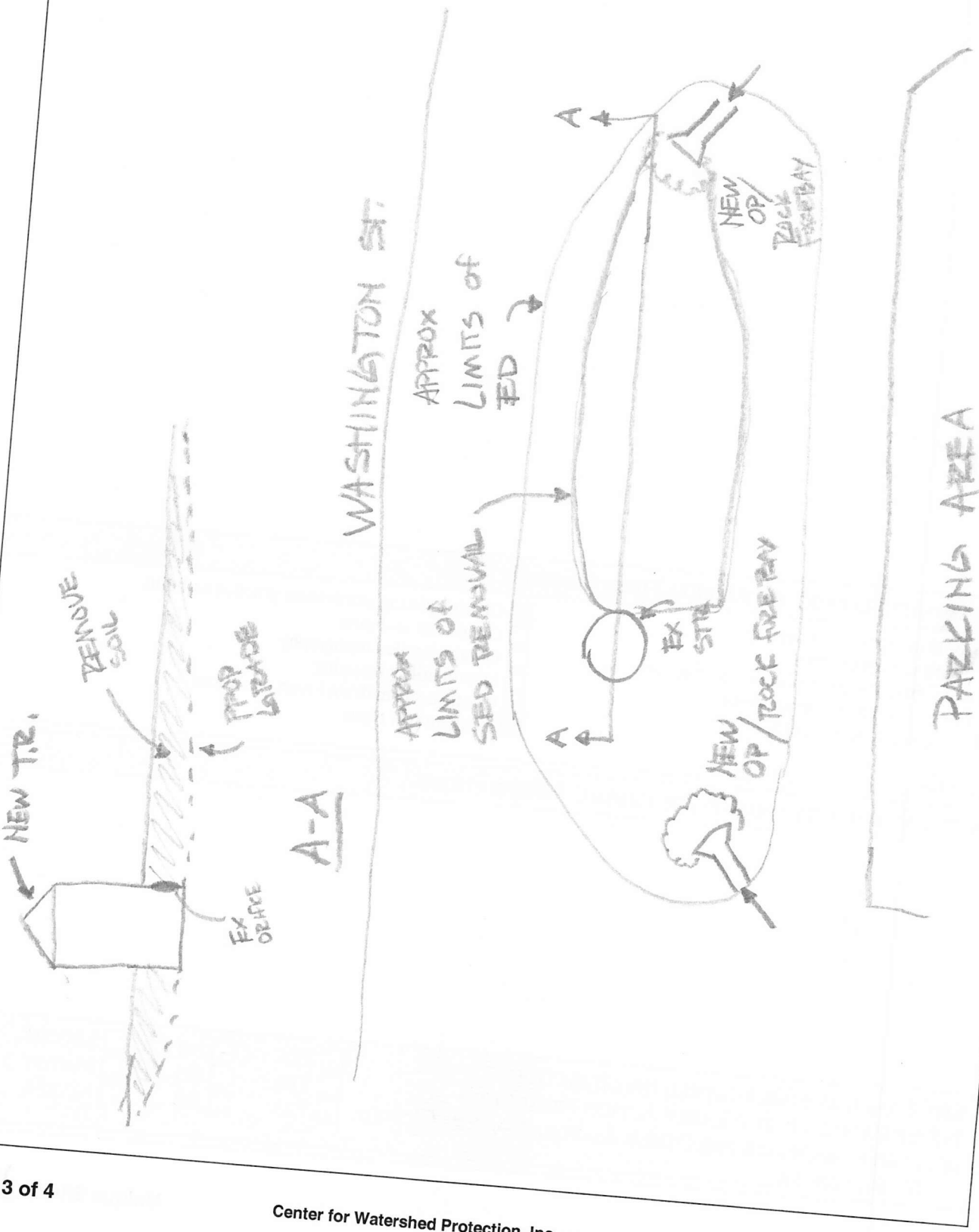
How many?_____
Approx. DBH_____

Other factors:_____

Soils:

Soil auger test holes:	☐ Yes	☒ No
Evidence of poor infiltration (clays, fines):	☐ Yes	☒ No
Evidence of shallow bedrock:	☐ Yes	☒ No
Evidence of high water table (gleying, saturation):	☐ Yes	☒ No

SKETCH



Unique Site ID: H10A

DESIGN OR DELIVERY NOTES

FOLLOW-UP NEEDED TO COMPLETE FIELD CONCEPT

- ☐ Confirm property ownership
- ☐ Confirm drainage area
- ☐ Confirm drainage area impervious cover
- ☒ Confirm volume computations
- ☒ Complete concept sketch
- ☒ Obtain existing stormwater practice as-builts
- ☐ Obtain site as-builts
- ☐ Obtain detailed topography
- ☐ Obtain utility mapping
- ☒ Confirm storm drain invert elevations
- ☒ Confirm soil types
- ☐ Other:_____

INITIAL FEASIBILITY AND CONSTRUCTION CONSIDERATIONS

SITE CANDIDATE FOR FURTHER INVESTIGATION:	☐ YES	☐ NO	☐ MAYBE
IS SITE CANDIDATE FOR EARLY ACTION PROJECT(S):	☐ YES	☐ NO	☐ MAYBE
IF NO, SITE CANDIDATE FOR OTHER RESTORATION PROJECT(S):	☐ YES	☐ NO	☐ MAYBE

IF YES, TYPE(S):_____

RRI

WATERSHED:	SUBWATERSHED:	UNIQUE SITE ID: H10_B

DATE: 03/19/13	ASSESSED BY:	CAMERA ID:	PICTURES: 34-36
GPS ID:	LMK ID:	LAT:	LONG:

SITE DESCRIPTION

Name: Lucy Simms Community Ctr.
Address:

Ownership: ☒ Public ☐ Private ☐ Unknown
If Public, Government Jurisdiction: ☐ Local ☐ State ☐ DOT ☐ Other:

Corresponding USSR/USA Field Sheet? ☐ Yes ☐ No If yes, Unique Site ID:

Proposed Retrofit Location:

Storage
- ☐ Existing Pond
- ☐ Below Outfall
- ☐ In Road ROW
- ☐ Other:
- ☐ Above Roadway Culvert
- ☐ In Conveyance System
- ☐ Near Large Parking Lot

On-Site
- ☐ Hotspot Operation
- ☒ Small Parking Lot
- ☐ Individual Street
- ☐ Underground
- ☐ Individual Rooftop
- ☐ Small Impervious Area
- ☐ Landscape / Hardscape
- ☐ Other:

DRAINAGE AREA TO PROPOSED RETROFIT

Drainage Area ≈ 1.35
Imperviousness ≈ %
Impervious Area ≈ 1.27

Notes:

Drainage Area Land Use:
- ☒ Residential
  - ☒ SFH (< 1 ac lots)
  - ☐ SFH (> 1 ac lots)
  - ☐ Townhouses
  - ☐ Multi-Family
- ☒ Commercial
- ☐ Institutional
- ☐ Industrial
- ☐ Transport-Related
- ☒ Park
- ☐ Undeveloped
- ☐ Other:

EXISTING STORMWATER MANAGEMENT

Existing Stormwater Practice: ☐ Yes ☒ No ☐ Possible
If Yes, Describe:

Describe Existing Site Conditions, Including Existing Site Drainage and Conveyance:
Existing Street Width (if applicable):

Large parking lot currently drains to 1 inlet in corner.

Existing Head Available:	Note where points are measured from: (i.e. street elevation to catch basin invert, manhole rim to catch basin invert, other)
≈5' from ex. ground to invert of adjacent dry pond	

PROPOSED RETROFIT

Purpose of Retrofit:
☒ Water Quality ☐ Recharge ☐ Channel Protection ☐ Flood Control
☒ Demonstration / Education ☐ Repair ☐ Other:_____

Retrofit Volume Computations - Target Storage:

Retrofit Volume Computations - Available Storage:

Proposed Retrofit Practice: (Runoff Reduction)
☐ Disconnection ☒ Bioretention ☐ Bio Swale
☐ Expanded Tree Pit ☐ Infiltration ☐ Green Roof
☐ Permeable Pavement ☐ Rainwater Harvesting

Proposed Retrofit Practice: (Stormwater Treatment)
☐ Constructed Wetland ☐ Wet Swale ☐ Wet Pond
☐ Filtering Practice ☐ Proprietary:_____
☐ Other: _____

Retrofit Category (as defined by Chesapeake Bay Program):
☒ New BMP ☐ BMP Enhancement ☐ BMP Restoration ☐ BMP Conversion ☐ Not CBP-approved

Describe Elements of Proposed Retrofit, Including Surface Area, Maximum Depth of Treatment, and Conveyance:

Put in curb cuts around existing inlet to divert runoff to bio, which would then "spill over" to ex. dry pond. In this way, bio would serve as additional treatment

Available Width:	
Available Length:	
Available Area:	
Ponding Depth:	
Soil Depth:	

SITE CONSTRAINTS

Adjacent Land Use:
☒ Residential ☒ Commercial ☐ Institutional
☐ Industrial ☐ Transport-Related ☒ Park
☐ Undeveloped ☐ Other:_____
Possible Conflicts Due to Adjacent Land Use? ☐ Yes ☒ No
If Yes, Describe:

Access:
☒ No Constraints
Constrained due to
☐ Slope ☐ Space
☐ Utilities ☐ Tree Impacts
☐ Structures ☐ Property
Ownership
☐ Other:_____

Conflicts with Existing Utilities:

	Yes	Possible/ Modifiable	No	Unknown
Sewer:	☐	☐	☒	☐
Water:	☐	☐	☒	☐
Gas:	☐	☐	☒	☐
Electric to Streetlights:	☒	☐	☐	☐
Other:	☐	☐	☐	☐

_____

Potential Permitting Factors:

Dam Safety Permits Necessary	☐ Probable	☒ Not Probable
Impacts to Wetlands	☐ Probable	☒ Not Probable
Impacts to a Stream	☐ Probable	☒ Not Probable
Floodplain Fill	☐ Probable	☒ Not Probable
Impacts to Forests	☐ Probable	☒ Not Probable
Impacts to Specimen Trees	☐ Probable	☒ Not Probable

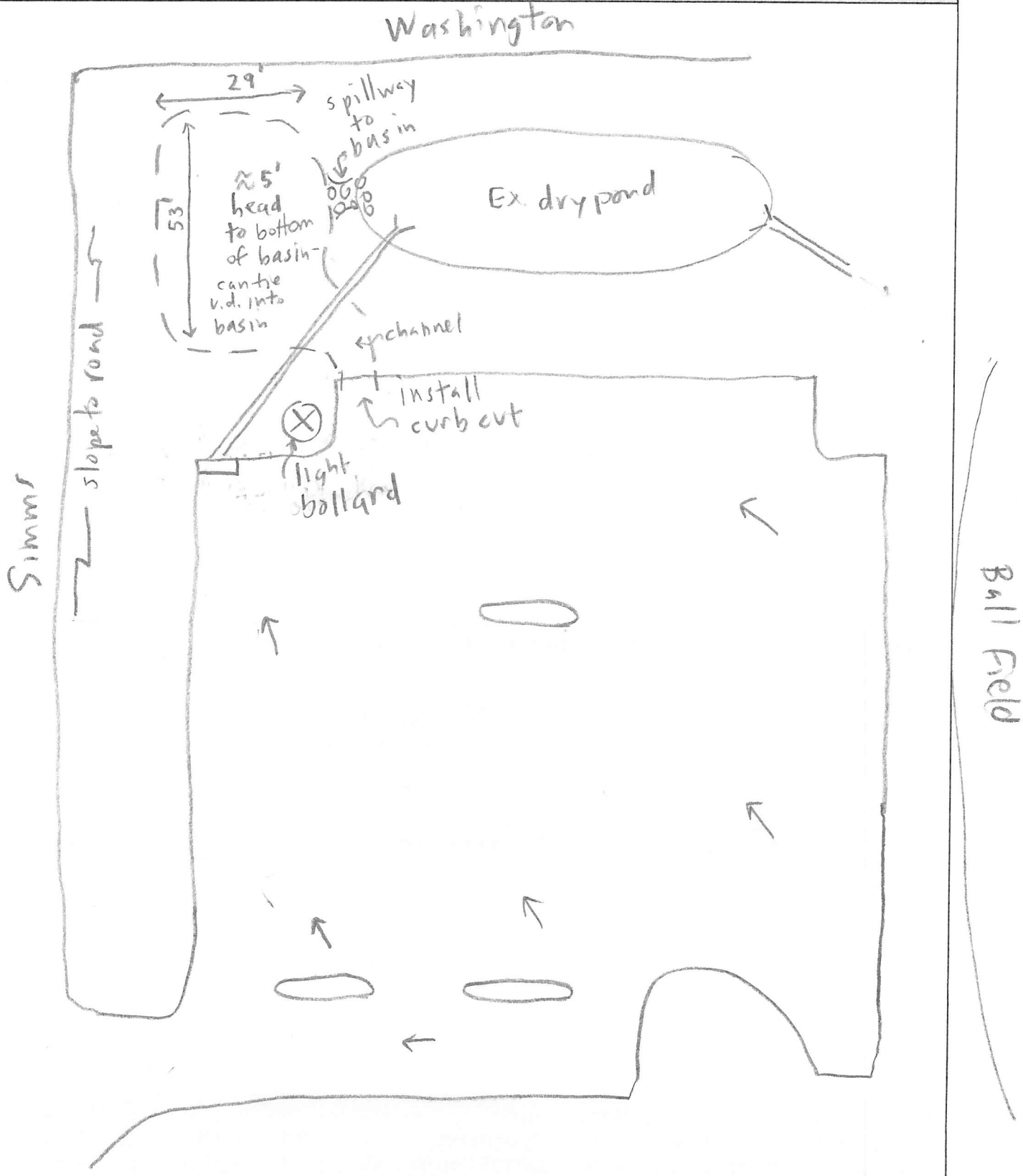
How many?_____
Approx. DBH_____

Other factors:_____
_____

Soils:

Soil auger test holes:	☐ Yes	☒ No
Evidence of poor infiltration (clays, fines):	☒ Yes	☐ No
Evidence of shallow bedrock:	☐ Yes	☒ No
Evidence of high water table (gleying, saturation):	☐ Yes	☒ No

SKETCH


Washington
29'
spillway to basin
≈5' head to bottom of basin - can tie u.d. into basin
53'
Ex. drypond
slope to road
Simms
ex channel
install curb cut
light bollard
Ball Field

DESIGN OR DELIVERY NOTES

FOLLOW-UP NEEDED TO COMPLETE FIELD CONCEPT

- ☐ Confirm property ownership
- ☒ Confirm drainage area
- ☒ Confirm drainage area impervious cover
- ☒ Confirm volume computations
- ☐ Complete concept sketch
- ☐ Obtain existing stormwater practice as-builts
- ☐ Obtain site as-builts
- ☒ Obtain detailed topography
- ☐ Obtain utility mapping
- ☐ Confirm storm drain invert elevations
- ☐ Confirm soil types
- ☐ Other:_____

INITIAL FEASIBILITY AND CONSTRUCTION CONSIDERATIONS

SITE CANDIDATE FOR FURTHER INVESTIGATION:	☒ YES	☐ NO	☐ MAYBE
IS SITE CANDIDATE FOR EARLY ACTION PROJECT(S):	☐ YES	☐ NO	☐ MAYBE
IF NO, SITE CANDIDATE FOR OTHER RESTORATION PROJECT(S):	☐ YES	☐ NO	☐ MAYBE

IF YES, TYPE(S):_____

RRI

WATERSHED:	SUBWATERSHED:	UNIQUE SITE ID: H10-C
DATE: 3/19/13	ASSESSED BY: LFM DJH Tom	CAMERA ID: Lisa's Pic only Mem	PICTURES: 2607
GPS ID:	LMK ID:	LAT:	LONG:

SITE DESCRIPTION

Name: Lucy Simms
Address:

Ownership: ☒ Public ☐ Private ☐ Unknown
If Public, Government Jurisdiction: ☐ Local ☐ State ☐ DOT ☐ Other:

Corresponding USSR/USA Field Sheet? ☐ Yes ☒ No If yes, Unique Site ID:

Proposed Retrofit Location:

Storage
- ☐ Existing Pond
- ☐ Below Outfall
- ☐ In Road ROW
- ☐ Other:
- ☐ Above Roadway Culvert
- ☐ In Conveyance System
- ☐ Near Large Parking Lot

On-Site
- ☐ Hotspot Operation
- ☒ Small Parking Lot
- ☐ Individual Street
- ☐ Underground
- ☒ Individual Rooftop
- ☐ Small Impervious Area
- ☐ Landscape / Hardscape
- ☒ Other:

DRAINAGE AREA TO PROPOSED RETROFIT

Drainage Area ≈ 1.39
Imperviousness ≈ %
Impervious Area ≈ 1.29

Notes:

Drainage Area Land Use:
- ☐ Residential
  - ☐ SFH (< 1 ac lots)
  - ☐ SFH (> 1 ac lots)
  - ☐ Townhouses
  - ☐ Multi-Family
- ☐ Commercial
- ☐ Institutional
- ☐ Industrial
- ☐ Transport-Related
- ☐ Park
- ☐ Undeveloped
- ☒ Other: School

EXISTING STORMWATER MANAGEMENT

Existing Stormwater Practice: ☐ Yes ☒ No ☐ Possible
If Yes, Describe:

Describe Existing Site Conditions, Including Existing Site Drainage and Conveyance:
Existing Street Width (if applicable):

School rooftop and parking lot drainage to stormdrain network around school. Space available between school and adjacent football fields.

Existing Head Available:	Note where points are measured from: (i.e. street elevation to catch basin invert, manhole rim to catch basin invert, other)

PROPOSED RETROFIT

Purpose of Retrofit:
☐ Water Quality ☐ Recharge ☐ Channel Protection ☐ Flood Control
☒ Demonstration / Education ☐ Repair ☒ Other: Rainwater Harvesting

Retrofit Volume Computations - Target Storage:

Retrofit Volume Computations - Available Storage:

Proposed Retrofit Practice: (Runoff Reduction)
☐ Disconnection ☐ Bioretention ☐ Bio Swale
☐ Expanded Tree Pit ☐ Infiltration ☐ Green Roof
☐ Permeable Pavement ☒ Rainwater Harvesting

Proposed Retrofit Practice: (Stormwater Treatment)
☐ Constructed Wetland ☐ Wet Swale ☐ Wet Pond
☐ Filtering Practice ☐ Proprietary:_____
☐ Other: _____

Retrofit Category (as defined by Chesapeake Bay Program):
☒ New BMP ☐ BMP Enhancement ☐ BMP Restoration ☐ BMP Conversion ☐ Not CBP-approved

Describe Elements of Proposed Retrofit, Including Surface Area, Maximum Depth of Treatment, and Conveyance:
Vault underground that would receive water from two adjacent stormdrain inlets. The water would be used to irrigate the adjacent football field

Available Width:	
Available Length:	
Available Area:	
Ponding Depth:	
Soil Depth:	

SITE CONSTRAINTS

Adjacent Land Use:
☐ Residential ☐ Commercial ☐ Institutional
☐ Industrial ☐ Transport-Related ☐ Park
☐ Undeveloped ☒ Other: School

Possible Conflicts Due to Adjacent Land Use? ☐ Yes ☐ No
If Yes, Describe:

Access:
☐ No Constraints
Constrained due to
☐ Slope ☐ Space
☐ Utilities ☐ Tree Impacts
☐ Structures ☐ Property
Ownership
☐ Other:_____

Conflicts with Existing Utilities:

	Yes	Possible/ Modifiable	No	Unknown
Sewer:	☐	☐	☐	☐
Water:	☐	☒	☐	☐
Gas:	☐	☐	☐	☐
Electric to Streetlights:	☐	☐	☐	☐
Other:	☐	☒	☐	☐

Underground utilities

Potential Permitting Factors:

Dam Safety Permits Necessary	☐ Probable	☒ Not Probable
Impacts to Wetlands	☐ Probable	☒ Not Probable
Impacts to a Stream	☐ Probable	☒ Not Probable
Floodplain Fill	☐ Probable	☒ Not Probable
Impacts to Forests	☐ Probable	☒ Not Probable
Impacts to Specimen Trees	☐ Probable	☒ Not Probable

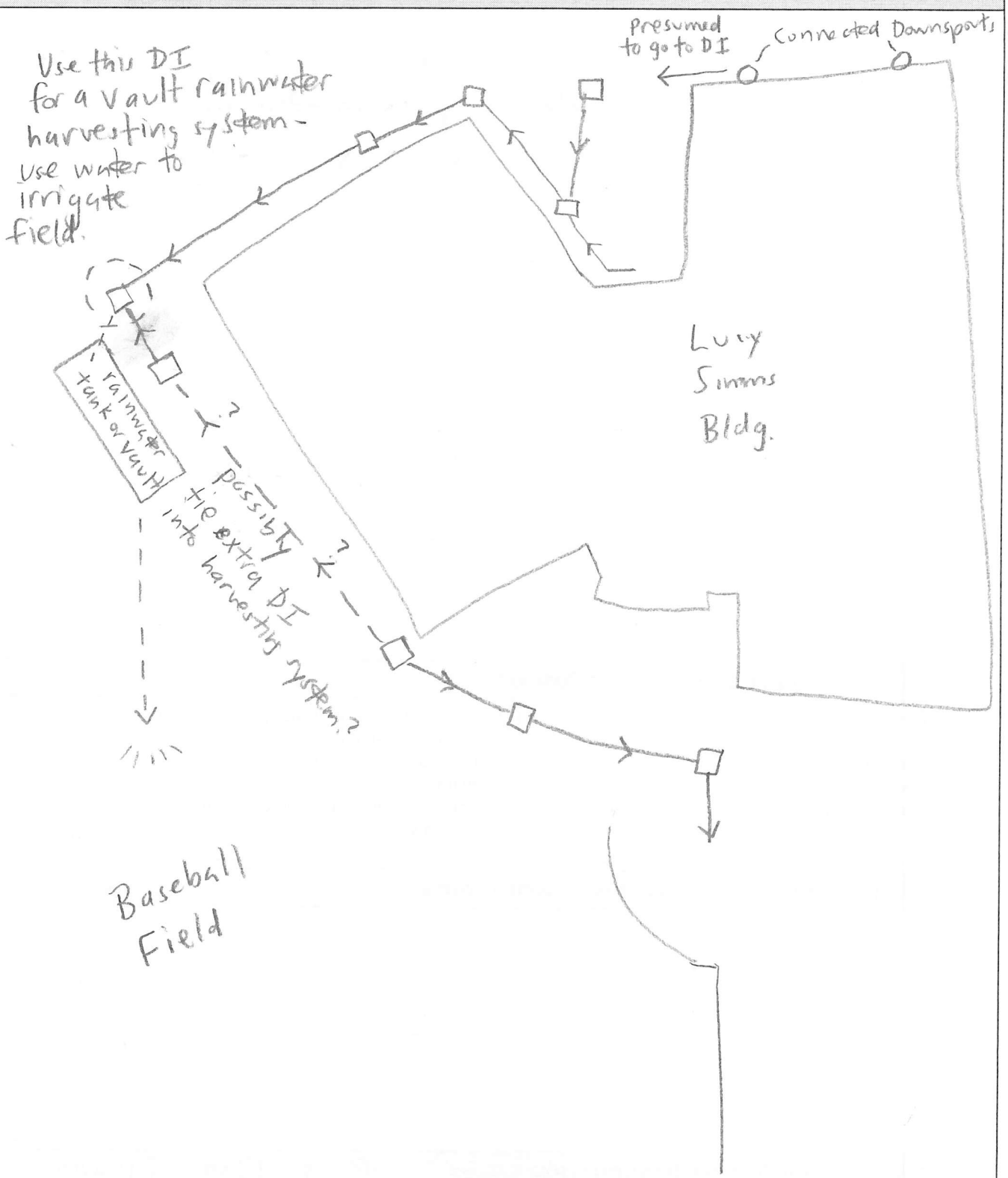
How many?_____
Approx. DBH_____

Other factors:_____

Soils:

Soil auger test holes:	☐ Yes	☒ No
Evidence of poor infiltration (clays, fines):	☐ Yes	☒ No
Evidence of shallow bedrock:	☐ Yes	☒ No
Evidence of high water table (gleying, saturation):	☐ Yes	☒ No

SKETCH


Use this DI for a vault rainwater harvesting system - use water to irrigate field.
Presumed to go to DI
Connected Downspouts
Lucy Simms Bldg.
rainwater tank or vault
possibly tie extra DI into harvesting system?
Baseball Field

DESIGN OR DELIVERY NOTES

- Check w/ Parks Dept about irrigation needs at field or in park in general.
- Think about grant funding for system

FOLLOW-UP NEEDED TO COMPLETE FIELD CONCEPT

- ☐ Confirm property ownership
- ☒ Confirm drainage area
- ☐ Confirm drainage area impervious cover
- ☒ Confirm volume computations
- ☐ Complete concept sketch
- ☐ Obtain existing stormwater practice as-builts
- ☐ Obtain site as-builts
- ☐ Obtain detailed topography
- ☒ Obtain utility mapping
- ☐ Confirm storm drain invert elevations
- ☐ Confirm soil types
- ☐ Other:_____

INITIAL FEASIBILITY AND CONSTRUCTION CONSIDERATIONS

SITE CANDIDATE FOR FURTHER INVESTIGATION:	☒ YES	☐ NO	☐ MAYBE
IS SITE CANDIDATE FOR EARLY ACTION PROJECT(S):	☐ YES	☐ NO	☐ MAYBE
IF NO, SITE CANDIDATE FOR OTHER RESTORATION PROJECT(S):	☐ YES	☐ NO	☐ MAYBE

IF YES, TYPE(S):_____

WATERSHED:	SUBWATERSHED:	UNIQUE SITE ID: H 10 D	
DATE: 3/19/13	ASSESSED BY: DSH/TAH	CAMERA ID:	PICTURES: 27-30
GPS ID:	LMK ID:	LAT:	LONG:

SITE DESCRIPTION

Name: RALPH SAMPSON PARK
Address: _____

Ownership: ☒ Public ☐ Private ☐ Unknown
If Public, Government Jurisdiction: ☒ Local ☐ State ☐ DOT ☐ Other: _____

Corresponding USSR/USA Field Sheet? ☐ Yes ☒ No If yes, Unique Site ID: _____

Proposed Retrofit Location:

Storage
- ☐ Existing Pond
- ☐ Below Outfall
- ☐ In Road ROW
- ☐ Other: _____
- ☐ Above Roadway Culvert
- ☐ In Conveyance System
- ☐ Near Large Parking Lot

On-Site
- ☐ Hotspot Operation
- ☐ Small Parking Lot
- ☐ Individual Street
- ☐ Underground
- ☐ Individual Rooftop
- ☐ Small Impervious Area
- ☐ Landscape / Hardscape
- ☒ Other: PARK

DRAINAGE AREA TO PROPOSED RETROFIT

Drainage Area ≈ _____
Imperviousness ≈ _____ %
Impervious Area ≈ _____

Notes:

Drainage Area Land Use:
- ☐ Residential
  - ☐ SFH (< 1 ac lots)
  - ☐ SFH (> 1 ac lots)
  - ☐ Townhouses
  - ☐ Multi-Family
- ☐ Commercial
- ☐ Institutional
- ☐ Industrial
- ☐ Transport-Related
- ☒ Park
- ☐ Undeveloped
- ☐ Other: _____

EXISTING STORMWATER MANAGEMENT

Existing Stormwater Practice: ☐ Yes ☒ No ☐ Possible
If Yes, Describe:

Describe Existing Site Conditions, Including Existing Site Drainage and Conveyance:
Existing Street Width (if applicable): _____

- EXISTING PARK AREA W/ MAINTAINED GRASS AREAS, AND STONE TRAILS.
- STONE TRAILS SHOW SIGNS OF REEL EROSION DUE TO +10% GRADES
- WIDE SHALLOW DITCH CONVEYS WATER TO INLET.

Existing Head Available:

LOTS ABOVE SITE. @ SITE 3.3 from PROP SWL TO DI INVERT

Note where points are measured from: (i.e. street elevation to catch basin invert, manhole rim to catch basin invert, other)

PROPOSED RETROFIT

Purpose of Retrofit:
☒ Water Quality ☐ Recharge ☐ Channel Protection ☐ Flood Control
☐ Demonstration / Education ☐ Repair ☐ Other:_____

Retrofit Volume Computations - Target Storage:

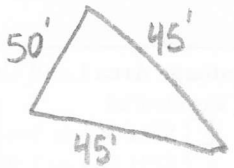
Retrofit Volume Computations - Available Storage:

Proposed Retrofit Practice: (Runoff Reduction)
☐ Disconnection ☒ Bioretention ☐ Bio Swale
☐ Expanded Tree Pit ☐ Infiltration ☐ Green Roof
☐ Permeable Pavement ☐ Rainwater Harvesting

Proposed Retrofit Practice: (Stormwater Treatment)
☐ Constructed Wetland ☐ Wet Swale ☐ Wet Pond
☐ Filtering Practice ☐ Proprietary:_____
☐ Other: _____

Retrofit Category (as defined by Chesapeake Bay Program):
☒ New BMP ☐ BMP Enhancement ☐ BMP Restoration ☐ BMP Conversion ☐ Not CBP-approved

Describe Elements of Proposed Retrofit, Including Surface Area, Maximum Depth of Treatment, and Conveyance:



6.5'
5.4'
4.0'

2.31' (INVERT)
+ raise +/- 2.0'
Tot Head ≈ 4.3'

Available Width:	
Available Length:	
Available Area:	
Ponding Depth:	
Soil Depth:	

SITE CONSTRAINTS

Adjacent Land Use:
☒ Residential ☐ Commercial ☐ Institutional
☐ Industrial ☐ Transport-Related ☒ Park
☐ Undeveloped ☐ Other:_____
Possible Conflicts Due to Adjacent Land Use? ☐ Yes ☒ No
If Yes, Describe:

Access:
☒ No Constraints
Constrained due to
☐ Slope ☐ Space
☐ Utilities ☐ Tree Impacts
☐ Structures ☐ Property
Ownership
☐ Other:_____

Conflicts with Existing Utilities:

	Yes	Possible/ Modifiable	No	Unknown
Sewer:	☐	☐	☒	☐
Water:	☐	☐	☒	☐
Gas:	☐	☐	☒	☐
Electric to Streetlights:	☐	☒	☐	☐
Other:	☐	☐	☐	☐

_____

Potential Permitting Factors:

Dam Safety Permits Necessary	☐ Probable	☒ Not Probable
Impacts to Wetlands	☐ Probable	☒ Not Probable
Impacts to a Stream	☐ Probable	☒ Not Probable
Floodplain Fill	☐ Probable	☒ Not Probable
Impacts to Forests	☐ Probable	☒ Not Probable
Impacts to Specimen Trees	☐ Probable	☒ Not Probable

How many?_____
Approx. DBH_____

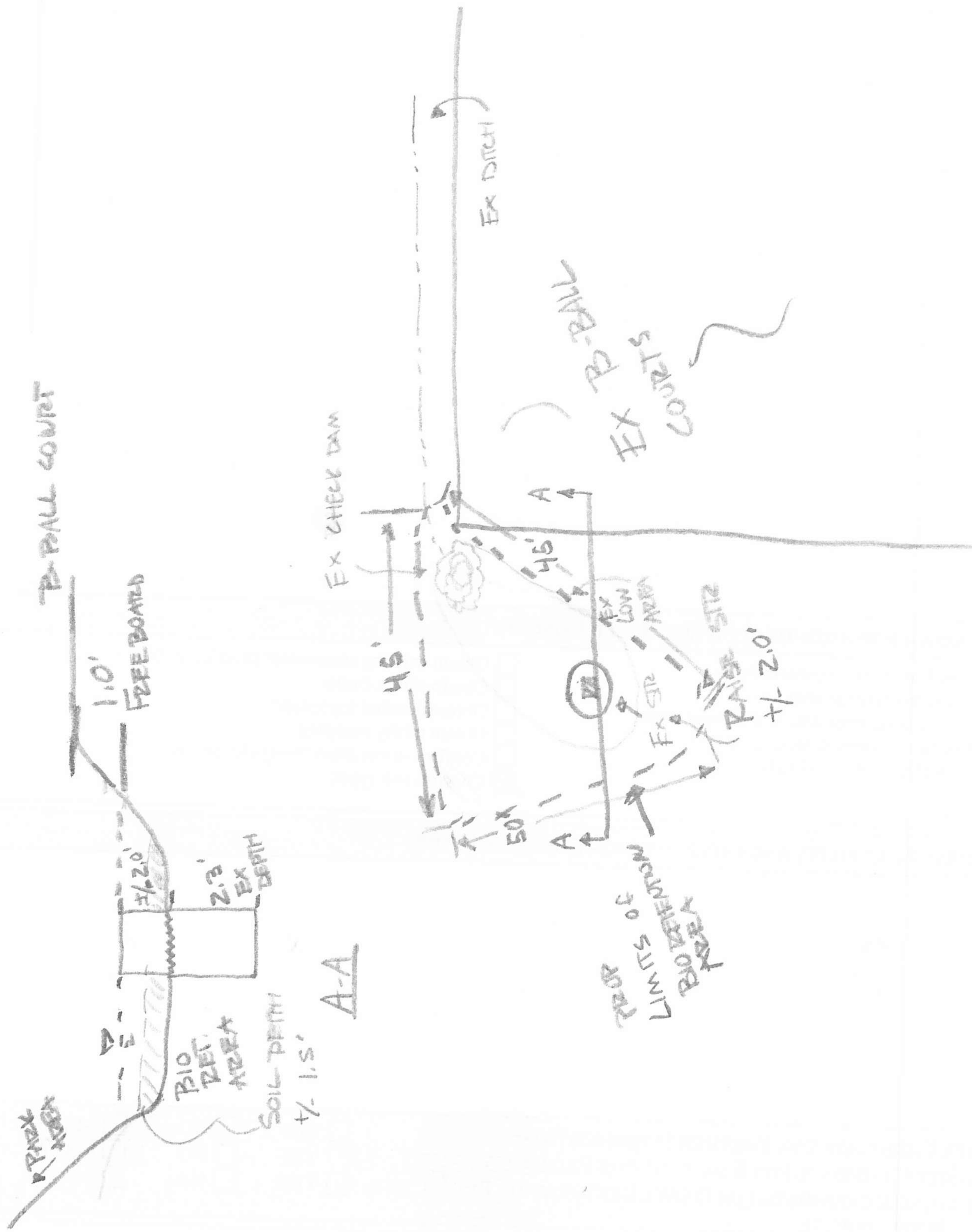
Other factors:_____
_____

Soils:

Soil auger test holes:	☒ Yes	☐ No
Evidence of poor infiltration (clays, fines):	☐ Yes	☒ No
Evidence of shallow bedrock:	☐ Yes	☒ No
Evidence of high water table (gleying, saturation):	☐ Yes	☒ No

CLAY W/ PIECES OF GRAVEL

SKETCH


EX DITCH
EX B-BALL COURTS
EX CHECK DAM
45'
45'
50'
A
A
EX LOW AREA
EX STR
RAISE STR
+/- 2.0'
PROP LIMITS OF BIO RETENTION AREA
B-BALL COURT
1.0' FREE BOARD
+/- 2.0'
2.3' EX DEPTH
BIO RET. AREA
SOIL DEPTH +/- 1.5'
PARK AREA
A-A

DESIGN OR DELIVERY NOTES

FOLLOW-UP NEEDED TO COMPLETE FIELD CONCEPT

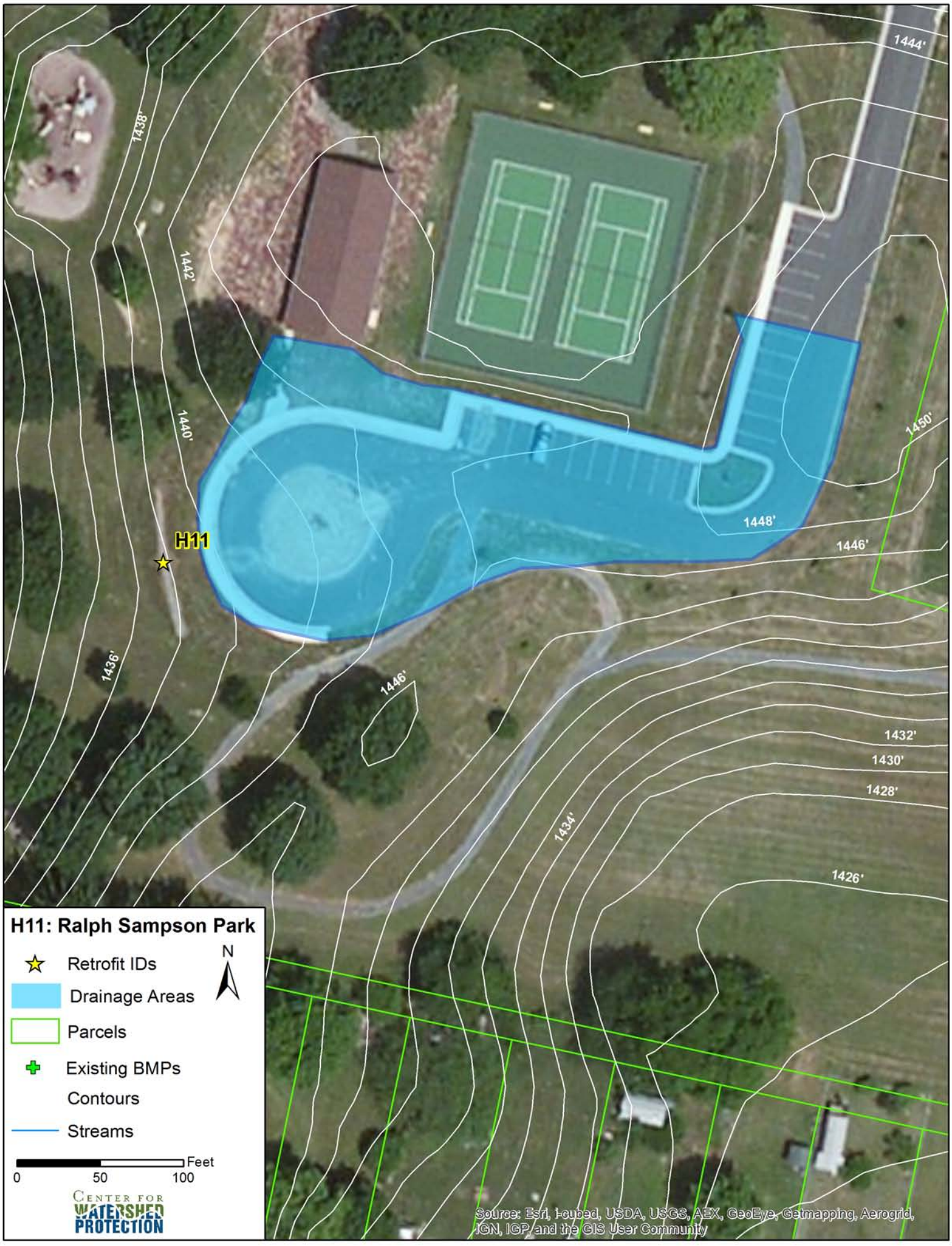
- [ ] Confirm property ownership
- [x] Confirm drainage area
- [x] Confirm drainage area impervious cover
- [x] Confirm volume computations
- [x] Complete concept sketch
- [ ] Obtain existing stormwater practice as-builts
- [ ] Obtain site as-builts
- [ ] Obtain detailed topography
- [ ] Obtain utility mapping
- [ ] Confirm storm drain invert elevations
- [x] Confirm soil types
- [ ] Other:_____

INITIAL FEASIBILITY AND CONSTRUCTION CONSIDERATIONS

SITE CANDIDATE FOR FURTHER INVESTIGATION:	☐ YES	☐ NO	☐ MAYBE
IS SITE CANDIDATE FOR EARLY ACTION PROJECT(S):	☐ YES	☐ NO	☐ MAYBE
IF NO, SITE CANDIDATE FOR OTHER RESTORATION PROJECT(S):	☐ YES	☐ NO	☐ MAYBE

IF YES, TYPE(S):_____

H11: Ralph Sampson Park


H11
1444'
1438'
1442'
1440'
1450'
1448'
1446'
1436'
1446'
1432'
1430'
1428'
1434'
1426'
H11: Ralph Sampson Park
Retrofit IDs
Drainage Areas
Parcels
Existing BMPs
Contours
Streams
N
Feet
0
50
100
Center for Watershed Protection
Source: Esri, i-cubed, USDA, USGS, AEX, GeoEye, Getmapping, Aerogrid, IGN, IGP, and the GIS User Community

H11: Ralph Sampson Park Existing BMP

Score: 62

Rank: 2

Investigators: David Hirschman, Tom Hartman

Figure 1: *Existing level spreader below parking & travelway*

Description: The existing level spreader on the slope serves the uphill travelway and parking. An 8" pipe comes from an inlet in the circular travelway and discharges to the middle of the level spreader. Most of the flow seems to be going directly downhill, as the level spreader is on a slope, thus the treatment mechanism is being by-passed.

Proposed Retrofit: This is a fairly simple enhancement to ensure that the BMP functions correctly and does not by-pass. The stone can be replaced and a T-junction added to the outlet to evenly distribute the flow. A downhill berm can be added to ensure that water is held within the BMP. Alternately, the level spreader could be converted to a long, skinny bioswale.

WATERSHED:	SUBWATERSHED:	UNIQUE SITE ID: H-11	
DATE: 03/19/13	ASSESSED BY: DJH TAH	CAMERA ID:	PICTURES: 24-26
GPS ID:	LMK ID:	LAT:	LONG:

SITE DESCRIPTION

Name: Ralph Sampson Park
Address: _____

Ownership: ☒ Public ☐ Private ☐ Unknown
If Public, Government Jurisdiction: ☐ Local ☐ State ☐ DOT ☐ Other: _____

Corresponding USSR/USA Field Sheet? ☐ Yes ☐ No If yes, Unique Site ID: _____

Proposed Retrofit Location:

Storage
- ☐ Existing Pond
- ☐ Below Outfall
- ☐ In Road ROW
- ☐ Other: _____
- ☐ Above Roadway Culvert
- ☐ In Conveyance System
- ☐ Near Large Parking Lot

On-Site
- ☐ Hotspot Operation
- ☒ Small Parking Lot
- ☐ Individual Street
- ☐ Underground
- ☐ Individual Rooftop
- ☐ Small Impervious Area
- ☐ Landscape / Hardscape
- ☐ Other: _____

DRAINAGE AREA TO PROPOSED RETROFIT

Drainage Area ≈ _____
Imperviousness ≈ _____ %
Impervious Area ≈ _____

Notes:

Drainage Area Land Use:
- ☐ Residential
  - ☐ SFH (< 1 ac lots)
  - ☐ SFH (> 1 ac lots)
  - ☐ Townhouses
  - ☐ Multi-Family
- ☐ Commercial
- ☐ Institutional
- ☐ Industrial
- ☐ Transport-Related
- ☒ Park
- ☐ Undeveloped
- ☐ Other: _____

EXISTING STORMWATER MANAGEMENT

Existing Stormwater Practice: ☒ Yes ☐ No ☐ Possible
If Yes, Describe:
Level spreader - seems to be by-passing. Most of it doesn't seem to be accessed

Describe Existing Site Conditions, Including Existing Site Drainage and Conveyance:
Existing Street Width (if applicable): _____
Relatively new park - to DI to level spreader

Existing Head Available:
Lots!

Note where points are measured from: (i.e. street elevation to catch basin invert, manhole rim to catch basin invert, other)

PROPOSED RETROFIT

Purpose of Retrofit:
☒ Water Quality ☐ Recharge ☒ Channel Protection ☐ Flood Control
☐ Demonstration / Education ☐ Repair ☐ Other:_____

Retrofit Volume Computations - Target Storage:

Retrofit Volume Computations - Available Storage:

Proposed Retrofit Practice: (Runoff Reduction)
☐ Disconnection ☐ Bioretention ☐ Bio Swale
☐ Expanded Tree Pit ☐ Infiltration ☐ Green Roof
☐ Permeable Pavement ☐ Rainwater Harvesting

Proposed Retrofit Practice: (Stormwater Treatment)
☐ Constructed Wetland ☐ Wet Swale ☐ Wet Pond
☐ Filtering Practice ☐ Proprietary:_____
☒ Other: Level spreader

Retrofit Category (as defined by Chesapeake Bay Program):
☐ New BMP ☒ BMP Enhancement ☐ BMP Restoration ☐ BMP Conversion ☐ Not CBP-approved

Describe Elements of Proposed Retrofit, Including Surface Area, Maximum Depth of Treatment, and Conveyance:

Repair/enhance ex. level spreader. Use T w/ perforated pipe & berm on downslope side

Available Width:	3'
Available Length:	72'
Available Area:	
Ponding Depth:	N/A
Soil Depth:	

SITE CONSTRAINTS

Adjacent Land Use:
☐ Residential ☐ Commercial ☐ Institutional
☐ Industrial ☐ Transport-Related ☒ Park
☐ Undeveloped ☐ Other:_____
Possible Conflicts Due to Adjacent Land Use? ☐ Yes ☒ No
If Yes, Describe:

Access:
☒ No Constraints
Constrained due to
☐ Slope ☐ Space
☐ Utilities ☐ Tree Impacts
☐ Structures ☐ Property
Ownership
☐ Other:_____

Conflicts with Existing Utilities:

	Yes	Possible/ Modifiable	No	Unknown
Sewer:	☐	☐	☒	☐
Water:	☐	☐	☒	☐
Gas:	☐	☐	☒	☐
Electric to Streetlights:	☐	☐	☒	☐
Other:	☐	☐	☐	☐

Potential Permitting Factors:

Dam Safety Permits Necessary	☐ Probable	☒ Not Probable
Impacts to Wetlands	☐ Probable	☒ Not Probable
Impacts to a Stream	☐ Probable	☒ Not Probable
Floodplain Fill	☐ Probable	☒ Not Probable
Impacts to Forests	☐ Probable	☒ Not Probable
Impacts to Specimen Trees	☐ Probable	☒ Not Probable

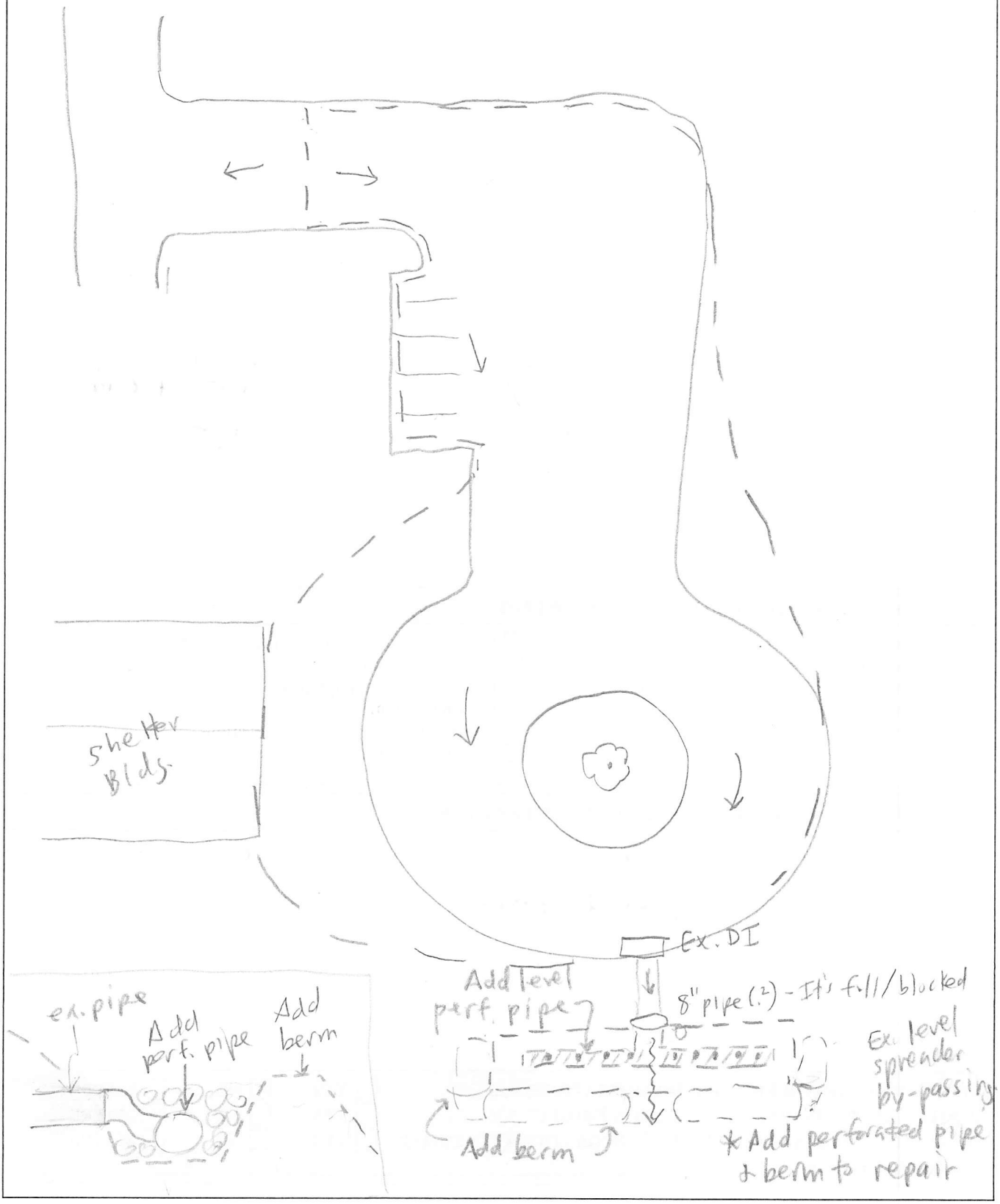
How many?_____
Approx. DBH_____

Other factors:_____

Soils:

Soil auger test holes:	☐ Yes	☐ No
Evidence of poor infiltration (clays, fines):	☐ Yes	☐ No
Evidence of shallow bedrock:	☐ Yes	☐ No
Evidence of high water table (gleying, saturation):	☐ Yes	☐ No

SKETCH


shelter Bldg.
Ex. DI
Add level perf. pipe
8" pipe (2) - It's full/blocked
Ex. level spreader by-passing
Add berm
*Add perforated pipe + berm to repair
ex. pipe
Add perf. pipe
Add berm

DESIGN OR DELIVERY NOTES

- Check plans

FOLLOW-UP NEEDED TO COMPLETE FIELD CONCEPT

- ☐ Confirm property ownership
- ☐ Confirm drainage area
- ☒ Confirm drainage area impervious cover
- ☒ Confirm volume computations
- ☒ Complete concept sketch
- ☒ Obtain existing stormwater practice as-builts
- ☐ Obtain site as-builts
- ☐ Obtain detailed topography
- ☐ Obtain utility mapping
- ☐ Confirm storm drain invert elevations
- ☐ Confirm soil types
- ☐ Other:_____

INITIAL FEASIBILITY AND CONSTRUCTION CONSIDERATIONS

Basically, this makes an ex. BMP more functional

SITE CANDIDATE FOR FURTHER INVESTIGATION:	☐ YES	☐ NO	☐ MAYBE
IS SITE CANDIDATE FOR EARLY ACTION PROJECT(S):	☐ YES	☐ NO	☐ MAYBE
IF NO, SITE CANDIDATE FOR OTHER RESTORATION PROJECT(S):	☐ YES	☐ NO	☐ MAYBE

IF YES, TYPE(S):_____

H13: City of Harrisonburg

Hose Company #4


1338'
1340'
1342'
1344'
1346'
1348'
1350'
1352'
1354'
1356'
1358'
H13-PP
E ROCK ST
COMMUNITY ST
COMMUNITY ST
BROAD ST
H13: City of Harrisonburg Hose Company #4
Retrofit IDs
Drainage Areas
Parcels
Existing BMPs
Contours
Streams
N
Feet
0
50
100
CENTER FOR WATERSHED PROTECTION
Source: Esri, i-cubed, USDA, USGS, AEX, GeoEye, Getmapping, Aerogrid, IGN, IGP, and the GIS User Community

H13-PP: City of Harrisonburg Hose Company #4

Score: N/A

Rank: N/A

Investigators: Megan O'Gorek, Laurel Woodworth

Figure 1: *Stains on asphalt from wash water*

Figure 2: *Fresh oil stain leaking to street*

Description: As suggested by stains on the asphalt, it appears that fire trucks are washed outside of the station where wash water flows untreated into the street, then the storm drain system, and eventually into a local stream (Figure 1). There reportedly is a wash bay inside the station where trucks can be washed and where water enters the sanitary sewer system for treatment. Fresh oil was also found on the asphalt in front of the station (Figure 2), which also would have been washed off into the storm drain during the next rain storm.

Proposed Solutions: All washing should be done in the indoor wash bay to avoid wash water runoff into the street and storm drain. Keep and maintain trucks indoors to avoid outdoor oil leaks. When leaks do occur outside, put down absorbent material to soak up liquid and then sweep up and discard in trash.

Hotspot Site Investigation **HSI**

WATERSHED:	~~SUBWATERSHED:~~	UNIQUE SITE ID: H-13-PP
DATE: 3/19/13	ASSESSED BY: MD, LW / CAMERA ID:	PIC#: 3150-3152
MAP GRID:	LAT ___°___'___" LONG ___°___'___"	LMK #

A. SITE DATA AND BASIC CLASSIFICATION

Name and Address: City of Ithaca Fire Co. #4

Category: ☐ Commercial ☐ Industrial ☐ Institutional ☒ Municipal ☐ Transport-Related
Miscellaneous: ☐ Golf Course ☐ Marina ☐ Animal Facility

SIC code (if available): _____

NPDES Status: ☐ Regulated ☒ Unregulated ☐ Unknown

Basic Description of Operation: fire dept.

	INDEX*
B. VEHICLE OPERATIONS ☐ **N/A** *(Skip to part C)*	**Observed Pollution Source?** ☐
B1. Types of vehicles: ☒ Fleet vehicles ☐ School buses ☒ Other: fire trucks, cars	
B2. Approximate number of vehicles: _____	
B3. Vehicle activities *(circle all that apply)*: **Maintained Repaired Recycled Fueled Washed Stored**	○
B4. Are vehicles stored and/or repaired outside? ☒ Y ☐ N ☐ Can't Tell Are these vehicles lacking runoff diversion methods? ☒ Y ☐ N ☐ Can't Tell	○
B5. Is there evidence of spills/leakage from vehicles? ☒ Y ☐ N ☐ Can't Tell	○
B6. Are uncovered outdoor fueling areas present? ☐ Y ☒ N ☐ Can't Tell	○
B7. Are fueling areas directly connected to storm drains? ☐ Y ☒ N ☐ Can't Tell	○
B8. Are vehicles washed outdoors? ☒ Y ☐ N ☐ Can't Tell street → storm drain 1 wash bay inside but not used due to fire truck storage s the area where vehicles are washed discharge to the storm drain? ☒ Y ☐ N ☐ Can't Tell	○
C. OUTDOOR MATERIALS ☐ **N/A** *(Skip to part D)*	**Observed Pollution Source?** ☐
C1. Are loading/unloading operations present? ☐ Y ☐ N ☐ Can't Tell If yes, are they uncovered *and* draining towards a storm drain inlet? ☐ Y ☐ N ☐ Can't Tell	○
C2. Are materials stored outside? ☐ Y ☐ N ☐ Can't Tell If yes, are they ☐ Liquid ☐ Solid Description: _____ Where are they stored? ☐ grass/dirt area ☐ concrete/asphalt ☐ bermed area	○
C3. Is the storage area directly or indirectly connected to storm drain (circle one)? ☐ Y ☐ N ☐ Can't Tell	○
C4. Is staining or discoloration around the area visible? ☐ Y ☐ N ☐ Can't Tell	○
C5. Does outdoor storage area lack a cover? ☐ Y ☐ N ☐ Can't Tell	○
C6. Are liquid materials stored *without* secondary containment? ☐ Y ☐ N ☐ Can't Tell	○
C7. Are storage containers missing labels or in poor condition (rusting)? ☐ Y ☐ N ☐ Can't Tell	○
D. WASTE MANAGEMENT ☐ **N/A** *(Skip to part E)*	**Observed Pollution Source?** ☐
D1. Type of waste *(check all that apply)*: ☐ Garbage ☐ Construction materials ☐ Hazardous materials **any of these**	○
D2. Dumpster condition *(check all that apply)*: ☐ No cover/Lid is open ☐ Damaged/poor condition ☐ Leaking or evidence of leakage (stains on ground) ☐ Overflowing **any of these**	○
D3. Is the dumpster located near a storm drain inlet? ☐ Y ☐ N ☐ Can't Tell If yes, are runoff diversion methods (berms, curbs) lacking? ☐ Y ☐ N ☐ Can't Tell **if both are yes**	○
E. PHYSICAL PLANT ☐ **N/A** *(Skip to part F)*	**Observed Pollution Source?** ☐
E1. Building: Approximate age: _____ yrs. Condition of surfaces: ☐ Clean ☐ Stained ☐ Dirty ☐ Damaged	○
idence that maintenance results in discharge to storm drains (staining/discoloration)? ☐ Y ☐ N ☐ Don't know	○

*Index: ○ denotes potential pollution source; ☐ denotes confirmed polluter (evidence was seen)

E2. Parking Lot: Approximate age _____ yrs. Condition: ☐ Clean ☐ Stained ☐ Dirty ☐ Breaking up
Surface material ☐ Paved/Concrete ☐ Gravel ☐ Permeable ☐ Don't know ○

E3. Do downspouts discharge to impervious surface? ☐ Y ☐ N ☐ Don't know ☐ None visible
Are downspouts directly connected to storm drains? ☐ Y ☐ N ☐ Don't know ○

E4. Evidence of poor cleaning practices for construction activities (stains leading to storm drain)? ☐ Y ☐ N ☐ Can't Tell ○

E5. Evidence of poor cleaning practices for washing activities (observed washwater dumping, stains leading to storm drain)? ☐ Y ☐ N ☐ Can't Tell ○

F. TURF/LANDSCAPING AREAS ☐ **N/A** *(skip to part G)* **Observed Pollution Source?** ☐

F1. % of site with: Forest canopy ____% Turf grass _____ % Landscaping ____% **Bare Soil 20 %** ○

F2. Rate the turf management status: ☐ High ☐ Medium ☐ Low **40% medium to high** ○

F3. Evidence of permanent irrigation or "non-target" irrigation ☐ Y ☐ N ☐ Can't Tell ○

F4. Do landscaped areas drain to the storm drain system? ☐ Y ☐ N ☐ Can't Tell ○

F5. Do landscape plants accumulate organic matter (leaves, grass clippings) on adjacent impervious surface? ☐ Y ☐ N ☐ Can't Tell ○

G. STORM WATER INFRASTRUCTURE ☐ **N/A** *(skip to part H)* **Observed Pollution Source?** ☐

G1. Are storm water treatment practices present? ☐ Y ☐ N ☐ Unknown If yes, please describe: _____ ○

G2. Are private storm drains located at the facility? ☐ Y ☐ N ☐ Unknown **> 25 %** ○
Is trash, sediment and/or organic material present in gutters leading to storm drains? *(circle appropriate)*

H. INITIAL HOTSPOT STATUS - INDEX RESULTS

☐ Not a hotspot (fewer than 5 circles and no boxes checked) ☐ Potential hotspot (5 to 10 circles but no boxes checked)
☐ Confirmed hotspot (10 to 15 circles and/or 1 box checked) ☐ Severe hotspot (>15 circles and/or 2 or more boxes checked)

Follow-up Action:

Immediate (1 week)
- ☐ Refer for immediate enforcement
- ☐ Test for illicit discharge
- ☐ Check to see if hotspot is an NPDES non-filer

Mid-term (2-3 months)
- ☐ Schedule a review of storm water pollution prevention plan
- ☒ Suggest follow-up on-site inspection

Long-term (1 year)
- ☐ Onsite non-residential retrofit
- ☐ Suggest pollution prevention training for employees
- ☐ Other:_____

Identified Opportunities:

General
- ☐ Include in future education effort (add specifics to Notes)
- ☐ Stencil or mark storm drain inlets
- ☐ Signage opportunities (buffer, wetland, bacteria, etc.)
- ☐ Other:_____

Rooftop
- ☐ Evaluate feasibility of cistern or water reuse (roof area:____sf)
- ☐ Downspout disconnection (#: _____)

Loading Areas
- ☐ Sweep loading areas
- ☐ Cover loading docks or redesign drainage (area: _____sf)

Fueling Islands
- ☐ Cover fueling islands (covered area: _____sf)
- ☒ Install dry spill response kits (#: _____)

Landscaping / turf
- ☐ Turf conversion to landscaping / Bayscaping (area: _____sf)
- ☐ Pervious area restoration (turf area: _____sf)
- ☐ Tree planting (# or area: _____)
- ☐ Reduce maintenance (mowing, herbicides, fertilizers)

Vehicle repairs
- ☐ Plumb indoor shop drains to sanitary
- ☒ Store fluids/batteries inside or under cover

Outdoor materials
- ☐ Provide cover or secondary containment (area: _____sf)
- ☐ Place materials on pallets

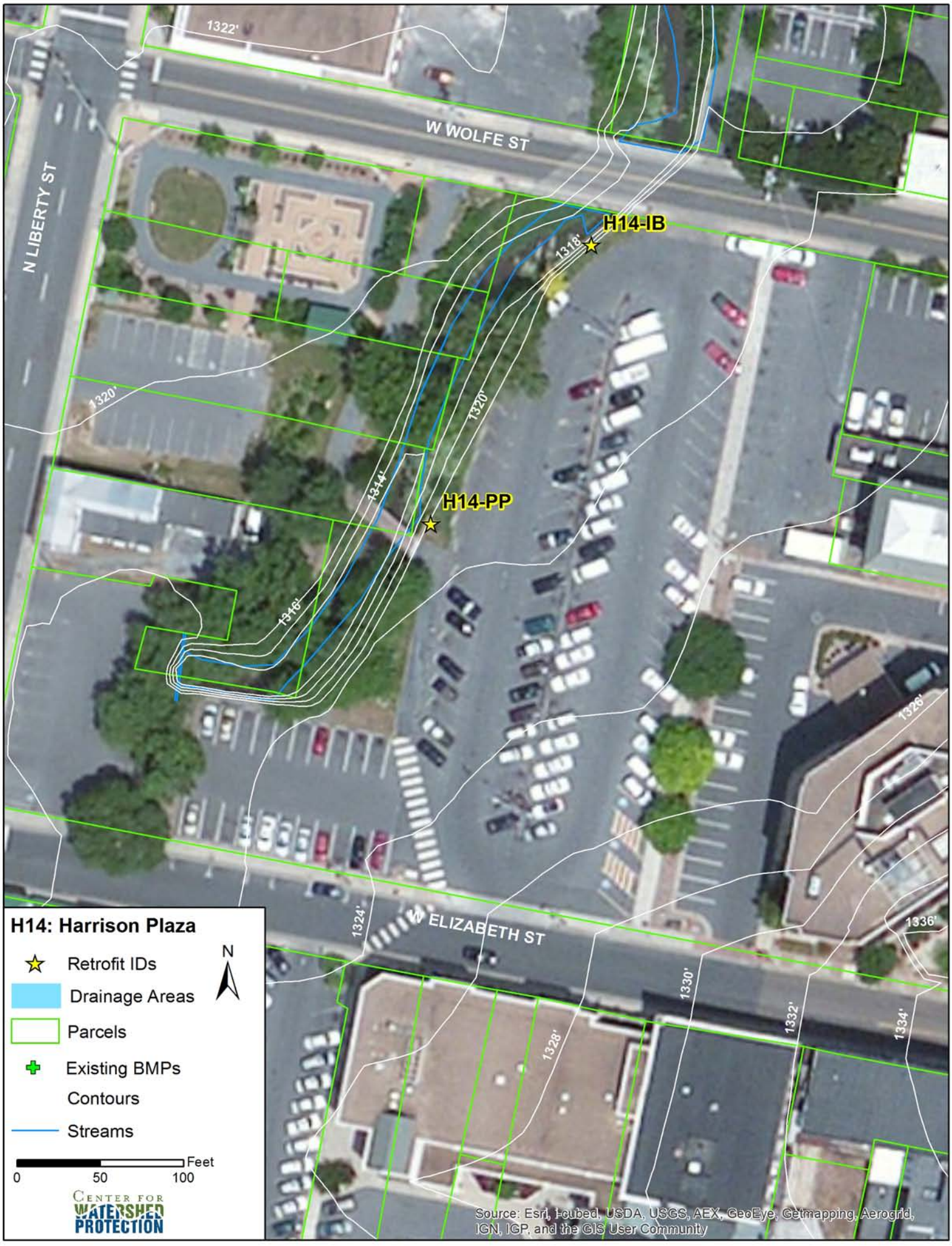
Dumpster management
- ☐ Cover or add/repair lids (#: _____)
- ☐ Move dumpsters away from storm drains or streams

Parking lots
- ☒ Find and fix fluid leaks → Wash trucks indoors
- ☐ Trash and litter pick-up, sweeping
- ☐ Identify retrofit projects
- ☐ Reduce salt application

Stormwater Infrastructure
- ☐ Clean out storm drain inlets
- ☐ Perform maintenance inspection

Notes:

H14: Harrison Plaza


W WOLFE ST
N LIBERTY ST
W ELIZABETH ST
H14-IB
H14-PP
1322'
1320'
1318'
1316'
1314'
1324'
1326'
1328'
1330'
1332'
1334'
1336'
H14: Harrison Plaza
Retrofit IDs
Drainage Areas
Parcels
Existing BMPs
Contours
Streams
N
Feet
0
50
100
Center for Watershed Protection
Source: Esri, i-cubed, USDA, USGS, AEX, GeoEye, Getmapping, Aerogrid, IGN, IGP, and the GIS User Community

H14-ER: Harrison Plaza, Erosion

Score: N/A

Rank: N/A

Investigators: Megan O'Gorek, Laurel Woodworth

Figure 1: *Erosion in front of foot bridge*

Figure 2: *Close-up of erosion along bridge abutment*

Description: Stormwater from the Harrison Plaza parking lot behind the Harrisonburg Police Administration building runs off directly into the adjacent stream. Runoff from approximately half of the lot becomes concentrated in one spot along the stream bank, right next to the abutment at the foot of the bridge (Figure 1). This concentrated stormwater runoff has caused the bank to start eroding (Figure 2). Further erosion could undermine the concrete bridge abutment.

Proposed Solutions: A number of solutions may help dissipate the parking lot runoff and reduce erosion along the stream bank. Where runoff approaches the stream bank (near telephone pole), excavate a small plunge pool to catch the runoff, with a rip-rap spillway down to the stream. Since the erosion is happening so close to the bridge, an alternative is to build a swale along the edge of the parking lot to carry the runoff further away from the bridge, with a level rip-rap spillway for the water to drop down to the stream.

H14-IB: Harrison Plaza, Buffer

Score: N/A
Rank: N/A
Investigators: Megan O'Gorek, Laurel Woodworth

Figure 1: *Left bank of stream, no buffer*

Description: A section of the left bank just downstream of the W. Wolfe Street bridge is lacking a vegetated buffer. Runoff from a portion of the parking lot behind the Police Administration building drains across this area and into the stream. The edge of the bank at the top of the concrete retaining wall is beginning to erode (Figure 1)

Proposed Solutions: Re-vegetate this area with shrubs and tall grasses, or simply reduce mowing frequency. The taller vegetation will not only help hold the soil in place, but also help reduce pollution in the stormwater. The edge of the buffer above the retaining wall may also need to be secured with erosion control matting.

Be aware that there may be underground utility lines in this area.

H-14 IB Harrison Plaza

Impacted Buffer **IB**

WATERSHED/SUBSHED:	**DATE:** 3 / 19 / 13	**ASSESSED BY:**
SURVEY REACH:	**TIME:** ____ : ____ AM/PM	**PHOTO ID:** (*Camera-Pic #*) 3142 /# 3144

IB ID: (*Condition-#*) IB-_____

START **LAT** ____ ° ____ ' ____ " **LONG** ____ ° ____ ' ____ " **LMK** _____

END **LAT** ____ ° ____ ' ____ " **LONG** ____ ° ____ ' ____ " **LMK** _____

GPS: (*Unit ID*)

IMPACTED BANK: ☐ LT ☐ RT ☐ Both

REASON INADEQUATE: ☒ Lack of vegetation ☐ Too narrow ☐ Widespread invasive plants ☐ Recently planted ☒ Other: Some erosion/some weeds/invasive

LAND USE:	Private	Institutional	Golf Course	Park	Other Public
(*Facing downstream*) LT Bank	☐	☐	☐	☒ Liberty Park	☐ :
RT Bank	☐	☐	☐	☐	☒ : Harrison Plaza parking lot

DOMINANT LAND COVER:	Paved	Bare ground	Turf/lawn	Tall grass	Shrub/scrub	Trees	Other
LT Bank	☒	☒	☒	☐	☒	☒	☐ :
RT Bank	☐	☐	☒	☒	☒	☒	☐ :

INVASIVE PLANTS: ☐ None ☐ Rare ☒ Partial coverage ☐ Extensive coverage ☐ unknown

STREAM SHADE PROVIDED? ☐ None ☒ Partial ☐ Full

WETLANDS PRESENT? ☐ No ☐ Yes ☐ Unknown

POTENTIAL RESTORATION CANDIDATE ☐ Active reforestation ☒ Greenway design ☐ Natural regeneration ☐ Invasives removal ☐ no ☐ Other: Stabilization/revegetation

RESTORABLE AREA

	LT BANK	RT
Length (ft):	_____	_____
Width (ft):	_____	_____

REFORESTATION POTENTIAL: (*Circle #*)

Impacted area on public land where the riparian area does not appear to be used for any specific purpose; plenty of area available for planting	Impacted area on either public or private land that is presently used for a specific purpose; available area for planting adequate	Impacted area on private land where road; building encroachment or other feature significantly limits available area for planting
5 4	3 2	1

POTENTIAL CONFLICTS WITH REFORESTATION ☐ Widespread invasive plants ☐ Potential contamination ☐ Lack of sun ☐ Poor/unsafe access to site ☐ Existing impervious cover ☐ Severe animal impacts (deer, beaver) ☐ Other:

NOTES:

* Some utilities along top of LT Bank

H14-ER Harrison Plaza

Severe Bank Erosion **ER**

WATERSHED/SUBSHED:		DATE: 3/19/13	ASSESSED BY: LW
SURVEY REACH: Between W. Wolfe + W. Flizabeth St.	TIME: ___:___ AM/PM	PHOTO ID (CAMERA-PIC #): 3145 /# 3149	
SITE ID: (*Condition-#*) ER-_____	*START* LAT ___° ___' ___" LONG ___° ___' ___" LMK _____		GPS: (*Unit ID*)
	END LAT ___° ___' ___" LONG ___° ___' ___" LMK _____		

PROCESS: ☐ Currently unknown

☐ Downcutting ☐ Widening ☐ Headcutting ☐ Aggrading ☐ Sed. deposition

☐ Bed scour ☐ Bank failure ☐ Bank scour ☐ Slope failure ☐ Channelized

BANK OF CONCERN: ☑ LT ☐ RT ☐ Both (*looking downstream*)

LOCATION: ☐ Meander bend ☐ Straight section ☑ Steep slope/valley wall ☐ Other:

DIMENSIONS:

Length (*if no GPS*)	LT_____ft and/or RT_____ft	Bottom width	_____ft
Bank Ht	LT_____ft and/or RT_____ft	Top width	_____ft
Bank Angle	LT_____° and/or RT_____°	Wetted Width	_____ft

LAND OWNERSHIP: ☐ Private ☑ Public ☐ Unknown

LAND COVER: ☐ Forest ☐ Field/Ag ☑ Developed:

POTENTIAL RESTORATION CANDIDATE: ☐ No ☐ Grade control ☑ Bank stabilization ☐ Other:

THREAT TO PROPERTY/INFRASTRUCTURE: ☐ No ☑ Yes (Describe): Slight threat to bridge abutment

EXISTING RIPARIAN WIDTH: ☐ ≤25 ft ☐ 25 - 50 ft ☐ 50-75ft ☐ 75-100ft ☐ >100ft

EROSION SEVERITY(*circle#*) Channelized= ☐ 1	Active downcutting; tall banks on both sides of the stream eroding at a fast rate; erosion contributing significant amount of sediment to stream; obvious threat to property or infrastructure.	Pat downcutting evident, active stream widening, banks actively eroding at a moderate rate; no threat to property or infrastructure		Grade and width stable; isolated areas of bank failure/erosion; likely caused by a pipe outfall, local scour, impaired riparian vegetation or adjacent use.
	5	4	3	2 1
ACCESS:	**Good access:** Open area in public ownership, sufficient room to stockpile materials, easy stream channel access for heavy equipment using existing roads or trails.	**Fair access**: Forested or developed area adjacent to stream. Access requires tree removal or impact to landscaped areas. Stockpile areas small or distant from stream.		**Difficult access.** Must cross wetland, steep slope or other sensitive areas to access stream. Minimal stockpile areas available and/or located a great distance from stream section. Specialized heavy equipment required.
	5	4	3	2 1

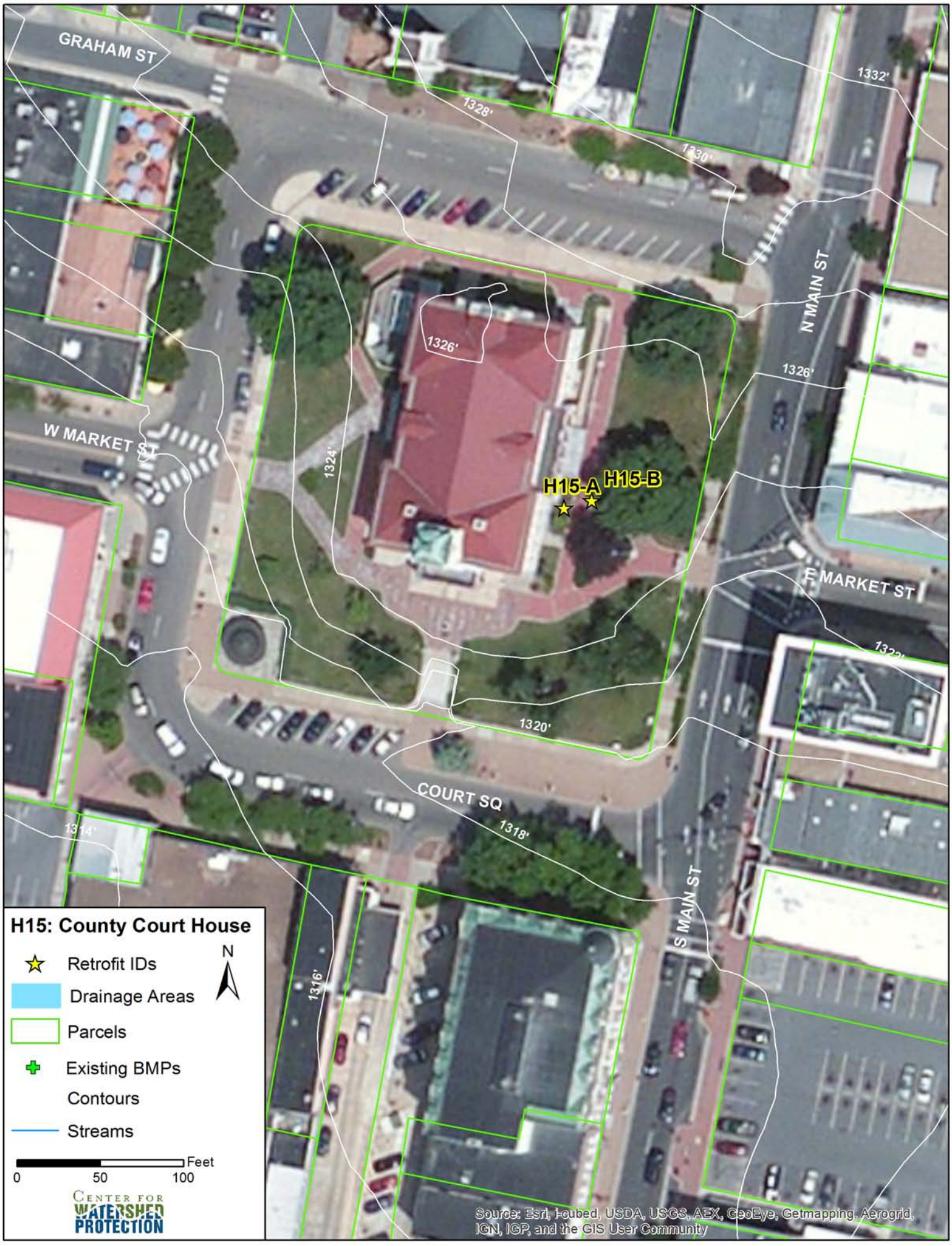
NOTES/CROSS SECTION SKETCH:

- Slight erosion of bank caused by parking lot runoff, not from stream flow.

- Stabilize "outfall" spot with rip-rap or other material to dissipate runoff velocity

REPORTED TO AUTHORITIES ☐ YES ☐ NO

H15: County Court House


GRAHAM ST
W MARKET ST
N MAIN ST
E MARKET ST
COURT SQ
S MAIN ST
1332'
1328'
1330'
1326'
1326'
1324'
1322'
1320'
1318'
1316'
1314'
H15-A
H15-B
H15: County Court House
Retrofit IDs
Drainage Areas
Parcels
Existing BMPs
Contours
Streams
N
Feet
0
50
100
CENTER FOR WATERSHED PROTECTION
Source: Esri, i-cubed, USDA, USGS, AEX, GeoEye, Getmapping, Aerogrid, IGN, IGP, and the GIS User Community

H15: County Courthouse

Score: N/A

Rank: N/A

Investigators: Ray Bailey, Megan O'Gorek, Laurel Woodworth

Figure 1: *Planter bed & downspout in background*

Figure 2: *Water ponded on walkway and grass*

Figure 3: *Roof downspout*

Description: A roof downspout is located on the East side of the courthouse building (Figure 3), just to the left of the steps/porch. Flow from this downspout travels across the brick walkway and ponds in the grass and on part of the walkway (Figure 2). This likely causes an ice problem in winter, which may be a safety issue.

Proposed Solutions: Just to the left of the downspout is a planter bed with its surface elevation flush with the level of the brick walkway (Figure 1). This area could potentially be used to capture and absorb runoff coming out of the downspout. The planter bed could be dug down several inches to give more depth for ponding and the downspout opening would need to be diverted to the left toward the planter bed rather than toward the walkway.

Another potential solution is to replace some of the brick walkway with permeable pavers underlain by a thick gravel or sand bed. This would allow water to seep in rather than pond on the surface.

RRI

WATERSHED:	SUBWATERSHED:	UNIQUE SITE ID: H15	
DATE: 3/19/13	ASSESSED BY: LW	CAMERA ID: cville	PICTURES: 3132-3138
GPS ID:	LMK ID:	LAT:	LONG: (3139-3141)

SITE DESCRIPTION

Name: County Courthouse
Address:

Ownership: ☒ Public ☐ Private ☐ Unknown
If Public, Government Jurisdiction: ☐ Local ☐ State ☐ DOT ☒ Other: County

Corresponding USSR/USA Field Sheet? ☐ Yes ☒ No If yes, Unique Site ID:

Proposed Retrofit Location:

Storage
- ☐ Existing Pond
- ☐ Below Outfall
- ☐ In Road ROW
- ☒ Other: Existing planting bed
- ☐ Above Roadway Culvert
- ☐ In Conveyance System
- ☐ Near Large Parking Lot

On-Site
- ☐ Hotspot Operation
- ☐ Small Parking Lot
- ☐ Individual Street
- ☐ Underground
- ☒ Individual Rooftop
- ☒ Small Impervious Area
- ☐ Landscape / Hardscape
- ☐ Other:

DRAINAGE AREA TO PROPOSED RETROFIT

Drainage Area ≈
Imperviousness ≈ %
Impervious Area ≈

Notes: See Map and GIS

Drainage Area Land Use:
- ☐ Residential
  - ☐ SFH (< 1 ac lots)
  - ☐ SFH (> 1 ac lots)
  - ☐ Townhouses
  - ☐ Multi-Family
- ☐ Commercial
- ☒ Institutional
- ☐ Industrial
- ☐ Transport-Related
- ☐ Park
- ☐ Undeveloped
- ☐ Other:

EXISTING STORMWATER MANAGEMENT

Existing Stormwater Practice: ☐ Yes ☒ No ☐ Possible
If Yes, Describe:

Describe Existing Site Conditions, Including Existing Site Drainage and Conveyance:
Existing Street Width (if applicable):

- Open downspout on East side of building
- Flow from downspout is causing ponding in grass; also likely causes ice problems on the brick walkway in winter

Existing Head Available:	Note where points are measured from: (i.e. street elevation to catch basin invert, manhole rim to catch basin invert, other)

PROPOSED RETROFIT

Purpose of Retrofit:
☒ Water Quality ☐ Recharge ☐ Channel Protection ☐ Flood Control
☒ Demonstration / Education ☐ Repair ☒ Other: Safety - prevent ice in winter

Retrofit Volume Computations - Target Storage:

Retrofit Volume Computations - Available Storage:

Proposed Retrofit Practice: (Runoff Reduction)
☐ Disconnection ☐ Bioretention ☐ Bio Swale
☒ Expanded Tree Pit ☐ Infiltration ☐ Green Roof
☒ Permeable Pavement ☐ Rainwater Harvesting

Proposed Retrofit Practice: (Stormwater Treatment)
☐ Constructed Wetland ☐ Wet Swale ☐ Wet Pond
☐ Filtering Practice ☐ Proprietary:_____
☐ Other: _____

Retrofit Category (as defined by Chesapeake Bay Program):
☐ New BMP ☐ BMP Enhancement ☐ BMP Restoration ☐ BMP Conversion ☐ Not CBP-approved

Describe Elements of Proposed Retrofit, Including Surface Area, Maximum Depth of Treatment, and Conveyance:

(1) retrofit existing planting bed to absorb downspout flow
(2) propose gravel or SAND bed below pavers to provide some storage

Available Width:	6
Available Length:	20.5
Available Area:	
Ponding Depth:	
Soil Depth:	

SITE CONSTRAINTS

Adjacent Land Use:
☐ Residential ☐ Commercial ☐ Institutional
☐ Industrial ☐ Transport-Related ☐ Park
☐ Undeveloped ☐ Other:_____
Possible Conflicts Due to Adjacent Land Use? ☐ Yes ☒ No
If Yes, Describe:

Access:
☐ No Constraints
Constrained due to
☐ Slope ☐ Space
☐ Utilities ☐ Tree Impacts
☐ Structures ☐ Property
Ownership
☒ Other: County?

Conflicts with Existing Utilities:

	Yes	Possible/ Modifiable	No	Unknown
Sewer:	☐	☐	☐	☒
Water:	☐	☐	☐	☒
Gas:	☐	☐	☐	☒
Electric to Streetlights:	☐	☐	☐	☐
Other:	☐	☐	☐	☐

_____

Potential Permitting Factors:

Dam Safety Permits Necessary	☐ Probable	☒ Not Probable
Impacts to Wetlands	☐ Probable	☒ Not Probable
Impacts to a Stream	☐ Probable	☒ Not Probable
Floodplain Fill	☐ Probable	☒ Not Probable
Impacts to Forests	☐ Probable	☒ Not Probable
Impacts to Specimen Trees	☐ Probable	☒ Not Probable

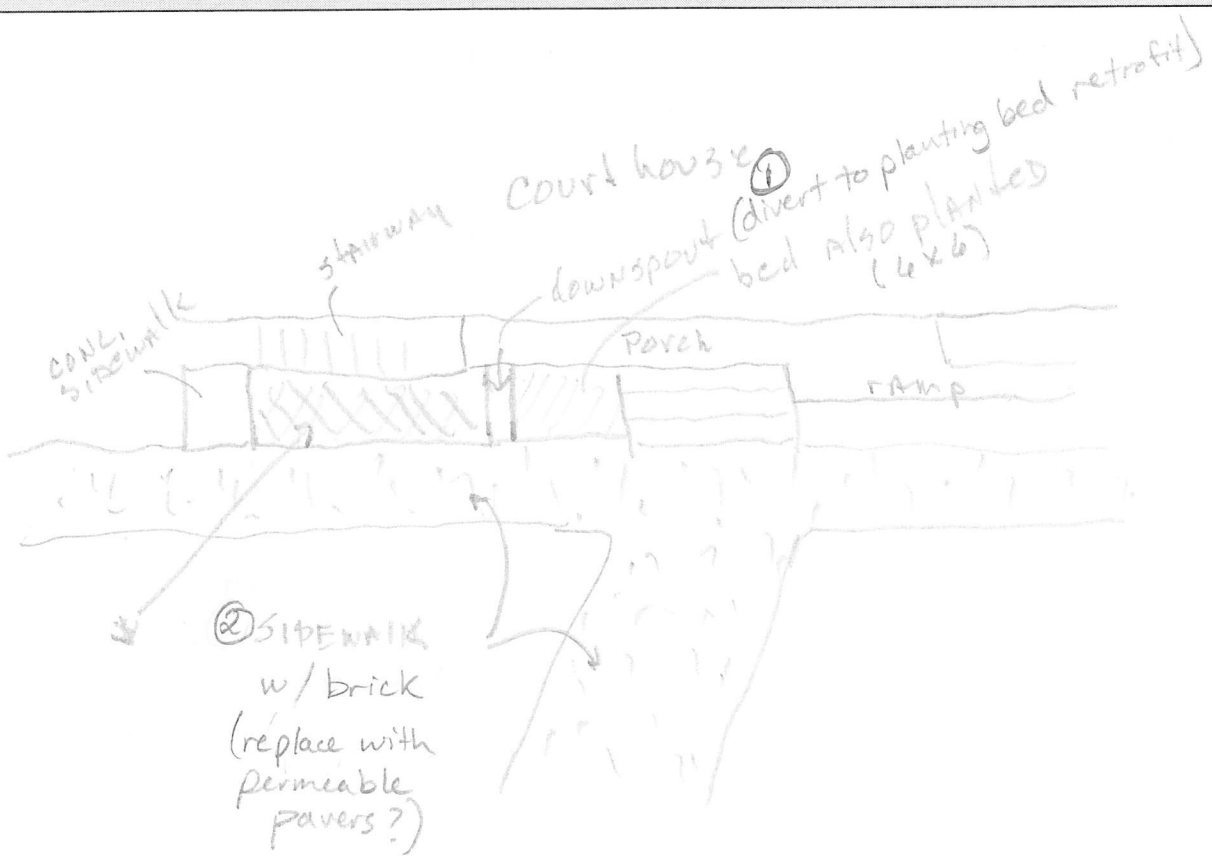
How many?_____
Approx. DBH_____

Other factors:_____
_____

Soils:

Soil auger test holes:	☐ Yes	☒ No
Evidence of poor infiltration (clays, fines):	☐ Yes	☐ No
Evidence of shallow bedrock:	☐ Yes	☐ No
Evidence of high water table (gleying, saturation):	☐ Yes	☐ No

SKETCH


stairway
Court house
① (divert to planting bed retrofit)
downspout
bed also planted (4x6)
CONC. SIDEWALK
Porch
ramp
② SIDEWALK w/ brick (replace with permeable pavers?)

DESIGN OR DELIVERY NOTES

- No storm drain network available to which to connect an underdrain
  - ↳ ensure that overflow from planter bed has a safe place to go (not towards the building
  - ↳ OR install storm drain on site

FOLLOW-UP NEEDED TO COMPLETE FIELD CONCEPT

- ☒ Confirm property ownership
- ☐ Confirm drainage area
- ☐ Confirm drainage area impervious cover
- ☐ Confirm volume computations
- ☐ Complete concept sketch
- ☐ Obtain existing stormwater practice as-builts
- ☒ Obtain site as-builts
- ☐ Obtain detailed topography
- ☒ Obtain utility mapping
- ☐ Confirm storm drain invert elevations
- ☐ Confirm soil types
- ☐ Other:_____

INITIAL FEASIBILITY AND CONSTRUCTION CONSIDERATIONS

SITE CANDIDATE FOR FURTHER INVESTIGATION:	☐ YES	☐ NO	☐ MAYBE
IS SITE CANDIDATE FOR EARLY ACTION PROJECT(S):	☐ YES	☐ NO	☐ MAYBE
IF NO, SITE CANDIDATE FOR OTHER RESTORATION PROJECT(S):	☐ YES	☐ NO	☐ MAYBE

IF YES, TYPE(S):_____

H16: Massanutten Regional Library


E WATER ST
NEWMAN AVE
1322'
1324'
1326'
1336'
H16
1316'
S MAIN ST
1332'
1334'
1330'
S FEDERAL ST
E BRUCE ST
1328'
1330'
H16: Massanutten Regional Library
Retrofit IDs
Drainage Areas
Parcels
Existing BMPs
Contours
Streams
N
Feet
0
50
100
CENTER FOR WATERSHED PROTECTION
Source: Esri, i-cubed, USDA, USGS, AEX, GeoEye, Getmapping, Aerogrid, IGN, IGP, and the GIS User Community

H16: Massanutten Regional Library

Score: 25

Rank: 32

Investigators: Ray Bailey, Megan O'Gorek, Laurel Woodworth

Figure 1: *Downspout next to planter bed*

Figure 2: *Existing planter bed*

Description: A 3'-wide and 24'-long planter bed is located along the outside wall of the library, along Newman Avenue. A roof downspout is located right next to it, but is connected to an underground storm drain pipe. This downspout appears to collect approximately 0.10 acres of roof runoff.

Proposed Retrofit: Convert the existing planter bed into a stormwater planter to capture runoff from the downspout. This would consist of making the planter bed structure taller to allow enough depth for more soil (bioretention soil mix), a gravel sump, and an underdrain/overflow pipe. This extra depth should also allow for about 6 inches of surface ponding depth. There may also be an option to make the bed wider, as space allows next to the sidewalk, to increase water capacity. An impermeable liner should also be installed against the walls to keep the water from seeping through.

The downspout should then be diverted into the planter bed. The underdrain pipe in the planter bed should be connected to the underground storm drain pipe that the downspout is currently connected to.

RRI

WATERSHED:	SUBWATERSHED:	UNIQUE SITE ID: H-16

DATE: 3/19/13	ASSESSED BY: LW	CAMERA ID: cville	PICTURES: 3128-3131
GPS ID:	LMK ID:	LAT:	LONG:

SITE DESCRIPTION

Name: Massanutten Regional Library
Address: _____

Ownership: ☒ Public ☐ Private ☐ Unknown
If Public, Government Jurisdiction: ☒ Local ☐ State ☐ DOT ☐ Other: _____

Corresponding USSR/USA Field Sheet? ☐ Yes ☒ No If yes, Unique Site ID: _____

Proposed Retrofit Location:

Storage
- ☐ Existing Pond
- ☐ Below Outfall
- ☐ In Road ROW
- ☐ Other: _____
- ☐ Above Roadway Culvert
- ☐ In Conveyance System
- ☐ Near Large Parking Lot

On-Site
- ☐ Hotspot Operation
- ☐ Small Parking Lot
- ☐ Individual Street
- ☐ Underground
- ☐ Individual Rooftop
- ☐ Small Impervious Area
- ☒ Landscape / Hardscape
- ☐ Other: _____

DRAINAGE AREA TO PROPOSED RETROFIT

Drainage Area ≈ 0.10 acres
Imperviousness ≈ 100 %
Impervious Area ≈ 0.10

Notes: See map and GIS

Drainage Area Land Use:
- ☐ Residential
  - ☐ SFH (< 1 ac lots)
  - ☐ SFH (> 1 ac lots)
  - ☐ Townhouses
  - ☐ Multi-Family
- ☐ Commercial
- ☒ Institutional
- ☐ Industrial
- ☐ Transport-Related
- ☐ Park
- ☐ Undeveloped
- ☐ Other: _____

EXISTING STORMWATER MANAGEMENT

Existing Stormwater Practice: ☐ Yes ☒ No ☐ Possible
If Yes, Describe:

Describe Existing Site Conditions, Including Existing Site Drainage and Conveyance:
Existing Street Width (if applicable): _____

roof drains tied into storm drain system

Existing Head Available:

unknown

Note where points are measured from: (i.e. street elevation to catch basin invert, manhole rim to catch basin invert, other)

PROPOSED RETROFIT

Purpose of Retrofit:
☒ Water Quality ☐ Recharge ☐ Channel Protection ☐ Flood Control
☒ Demonstration / Education ☐ Repair ☐ Other:_____

Retrofit Volume Computations - Target Storage:

Retrofit Volume Computations - Available Storage:

Proposed Retrofit Practice: (Runoff Reduction)
☐ Disconnection ☐ Bioretention ☐ Bio Swale
☒ Expanded Tree Pit ☐ Infiltration ☐ Green Roof
☐ Permeable Pavement ☐ Rainwater Harvesting

existing planter bed

Proposed Retrofit Practice: (Stormwater Treatment)
☐ Constructed Wetland ☐ Wet Swale ☐ Wet Pond
☐ Filtering Practice ☐ Proprietary:_____
☐ Other: _____

Retrofit Category (as defined by Chesapeake Bay Program):
☒ New BMP ☐ BMP Enhancement ☐ BMP Restoration ☐ BMP Conversion ☐ Not CBP-approved

Describe Elements of Proposed Retrofit, Including Surface Area, Maximum Depth of Treatment, and Conveyance:

- retrofit existing planter bed to stormwater planter → make taller to allow enough soil depth
- tie in existing storm drain to planter
- impermeable liner against building

Available Width:	3'
Available Length:	24'
Available Area:	
Ponding Depth:	6"
Soil Depth:	12"

→ must increase depth to 30", plus 12" for gravel + underdrain!

SITE CONSTRAINTS

Adjacent Land Use:
☐ Residential ☒ Commercial ☐ Institutional
☐ Industrial ☐ Transport-Related ☐ Park
☐ Undeveloped ☐ Other:_____
Possible Conflicts Due to Adjacent Land Use? ☐ Yes ☐ No
If Yes, Describe:

Access:
☒ No Constraints
Constrained due to
☐ Slope ☐ Space
☐ Utilities ☐ Tree Impacts
☐ Structures ☐ Property
Ownership
☐ Other:_____

Conflicts with Existing Utilities:

	Yes	Possible/ Modifiable	No	Unknown
Sewer:	☐	☐	☒	☐
Water:	☐	☐	☒	☐
Gas:	☐	☐	☒	☐
Electric to Streetlights:	☐	☐	☒	☐
Other:	☐	☐	☐	☐

_____

Potential Permitting Factors:

Dam Safety Permits Necessary	☐ Probable	☒ Not Probable
Impacts to Wetlands	☐ Probable	☒ Not Probable
Impacts to a Stream	☐ Probable	☒ Not Probable
Floodplain Fill	☐ Probable	☒ Not Probable
Impacts to Forests	☐ Probable	☐ Not Probable
Impacts to Specimen Trees	☐ Probable	☒ Not Probable

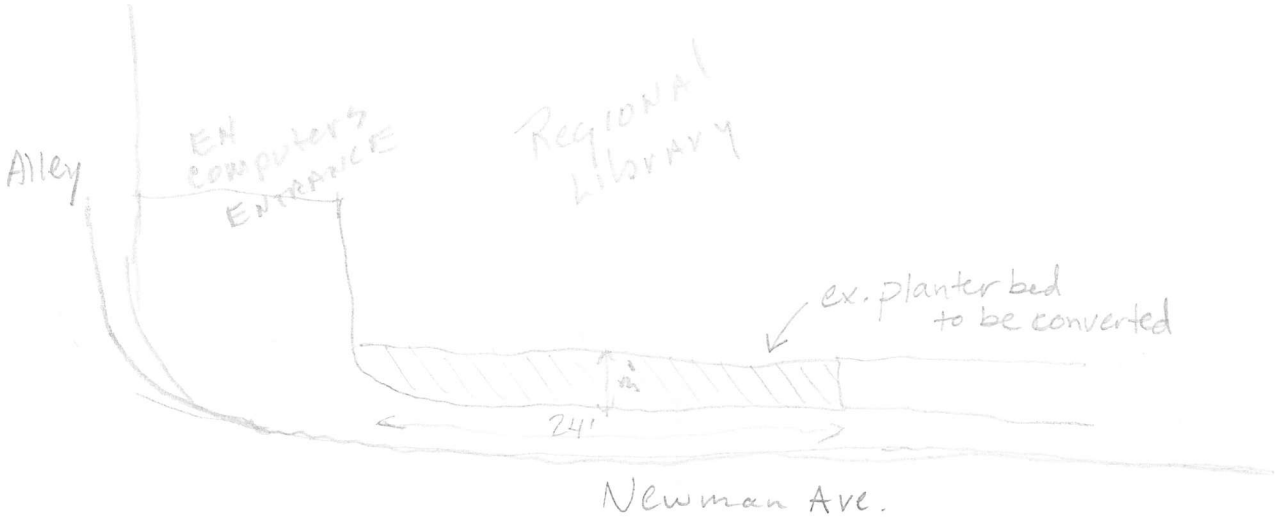
How many?_____
Approx. DBH_____

Other factors:_____
_____

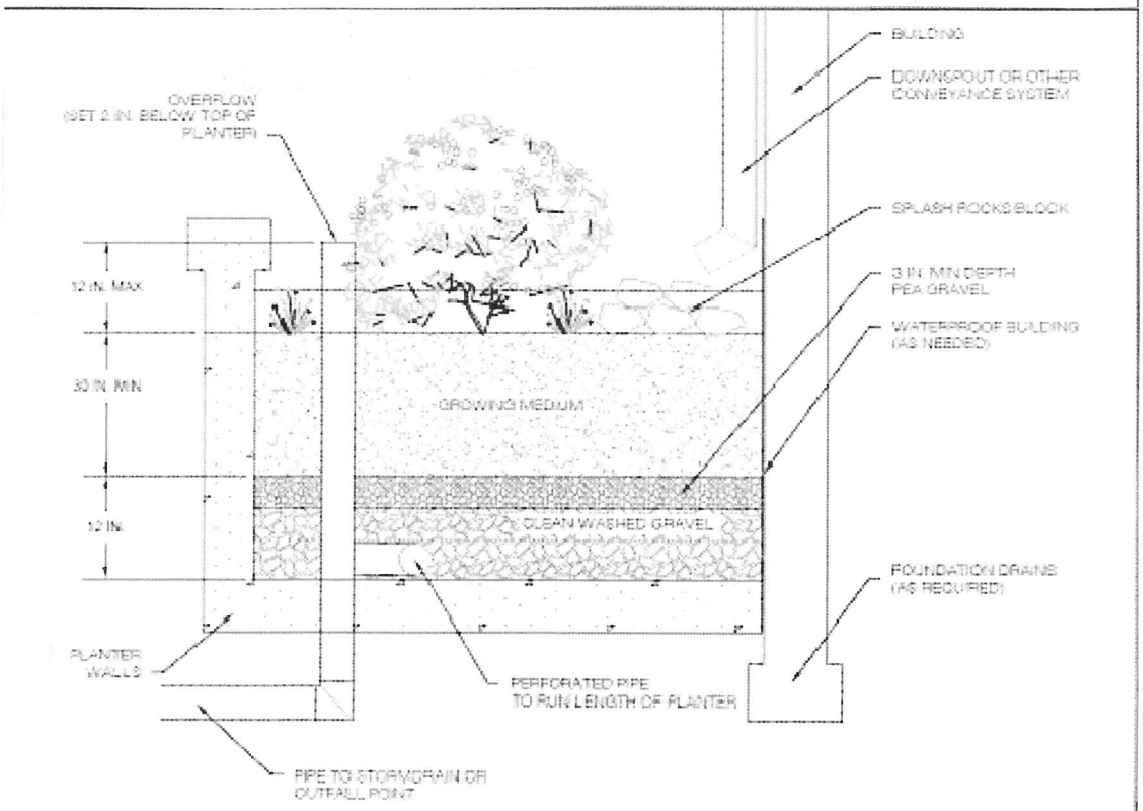
Soils:

Soil auger test holes:	☐ Yes	☒ No
Evidence of poor infiltration (clays, fines):	☐ Yes	☐ No
Evidence of shallow bedrock:	☐ Yes	☐ No
Evidence of high water table (gleying, saturation):	☐ Yes	☐ No

SKETCH



From Bioretention Design Spec. (VA DCR) → Stormwater Planter Cross-section:



TYPICAL URBAN BIORETENTION BASIN (Figure 9-A.4)

NTS

DESIGN OR DELIVERY NOTES

need to look at site plans - old section of public library (Newman av.) to determine drainage area

- Ensure library wall has proper protection from water damage

- Requires significant re-construction of planter bed in order to tie in underdrain to existing storm drain and to make planter box taller (for more soil + gravel depth).

FOLLOW-UP NEEDED TO COMPLETE FIELD CONCEPT

- ☐ Confirm property ownership
- ☐ Confirm drainage area
- ☐ Confirm drainage area impervious cover
- ☐ Confirm volume computations
- ☐ Complete concept sketch
- ☐ Obtain existing stormwater practice as-builts
- ☐ Obtain site as-builts
- ☐ Obtain detailed topography
- ☐ Obtain utility mapping
- ☐ Confirm storm drain invert elevations
- ☐ Confirm soil types
- ☐ Other:_____

INITIAL FEASIBILITY AND CONSTRUCTION CONSIDERATIONS

SITE CANDIDATE FOR FURTHER INVESTIGATION:	☐ YES	☐ NO	☐ MAYBE
IS SITE CANDIDATE FOR EARLY ACTION PROJECT(S):	☐ YES	☐ NO	☐ MAYBE
IF NO, SITE CANDIDATE FOR OTHER RESTORATION PROJECT(S):	☐ YES	☐ NO	☐ MAYBE

IF YES, TYPE(S):_____

H19: Department of Community Development


H19-A
H19-B
WARREN ST
CAMPBELL ST
S MAIN ST
1310'
1312'
1314'
1316'
1318'
1320'
1322'
1324'
1326'
1328'
1330'
1332'
1334'
1336'
1338'
H19: Department of Community Development
Retrofit IDs
Drainage Areas
Parcels
Existing BMPs
Contours
Streams
N
Feet
0
50
100
CENTER FOR WATERSHED PROTECTION
Source: Esri, i-cubed, USDA, USGS, AEX, GeoEye, Getmapping, Aerogrid, IGN, IGP, and the GIS User Community

H19-A: Department of Community Development, NE Side

Score: 28

Rank: 31

Investigators: Ray Bailey, Megan O'Gorek, Laurel Woodworth

Figure 1: *Small landscape area, N. side of building*

Figure 2: *Roof drain outlet on left & eroded area*

Description: A triangle-shaped grass landscape area is located on the northeast side of the Department of Community Development office building (Figure 1). Runoff from the roof and parts of the parking lot is directed to this area via a green PVC pipe (Figure 2). Unfortunately, flow of water coming out of that pipe is causing a rill of erosion to form and is eventually flowing into a corner of the parking lot (near white trucks shown in background of Figure 2)

Proposed Retrofit: A stormwater retrofit of this grass area could repair existing and prevent further erosion and could reduce runoff volume from the site. The proposed retrofit involves excavating out the existing soil and replacing it with a bioretention feature that would collect, pond, and treat the runoff with plants and soil. Flow from the downspout should be re-directed to spread out across the bioretention surface so as to no create an eroded channel. Since there are no existing underground storm drains in the vicinity, there is no structure to tie in a perforated underdrain pipe. Since the bioretention practice cannot have an underdrain, it should be constructed to only pond 2 – 3" of water, which can soak in after several hours.

H19-B: Department of Community Development, NW Side

Score: 38

Rank: 19

Investigators: Ray Bailey, Megan O'Gorek, Laurel Woodworth

Figure 1: *Bioswale can be located to left of asphalt*

Figure 2: *Drainage area looking down Warren St.*

Description: A 0.28-acre drainage area comprised of a section of Warren Street and the parking lot behind the Community Development building (Figure 2) drains to a large grass area across from the farmers' market pavilion. This area is used for staging tents and booths during festivals and farmers' markets, and is sometimes used for overflow parking. In recent years the grass area has become very muddy, hindering its use.

Proposed Retrofit: A stormwater retrofit to capture and treat runoff from this drainage area could both improve water quality and reduce the amount of water getting into the field. The proposed retrofit concept converts a 12' x 50' section of grass at the edge of the back parking lot into a bioswale (Figure 1). A very shallow storm drain pipe (approximately 1-ft deep) was installed in the vicinity to carry runoff from the roof down to Liberty Street where it enters a larger storm drain pipe. This pipe is not deep enough to tie in a regular underdrain pipe. Therefore, the bioswale can be built either without an underdrain or with an underdrain that has an "upturned elbow" joint to connect into the existing shallow storm drain pipe. If no underdrain is installed, it is recommended that the ponding depth be kept shallow t (e.g., 3") to avoid water standing for many days.

RRI

WATERSHED:	SUBWATERSHED:	UNIQUE SITE ID: H19-A	
DATE: 3/19/13	ASSESSED BY: LW	CAMERA ID: cville	PICTURES: 3122 - 3126
GPS ID:	LMK ID:	LAT:	LONG:

SITE DESCRIPTION

Name: Department of Community Development
Address:

Ownership: ☑ Public ☐ Private ☐ Unknown
If Public, Government Jurisdiction: ☑ Local ☐ State ☐ DOT ☐ Other:

Corresponding USSR/USA Field Sheet? ☐ Yes ☑ No If yes, Unique Site ID:

Proposed Retrofit Location:

Storage
- ☐ Existing Pond
- ☐ Below Outfall
- ☐ In Road ROW
- ☐ Other:
- ☐ Above Roadway Culvert
- ☐ In Conveyance System
- ☐ Near Large Parking Lot

On-Site
- ☐ Hotspot Operation
- ☐ Small Parking Lot
- ☐ Individual Street
- ☐ Underground
- ☐ Individual Rooftop
- ☐ Small Impervious Area
- ☑ Landscape / Hardscape
- ☐ Other:

DRAINAGE AREA TO PROPOSED RETROFIT

Drainage Area ≈ 0.54 acres
Imperviousness ≈ 83 %
Impervious Area ≈ 0.45 acres

Notes: Check GIS

Drainage Area Land Use:
- ☐ Residential
  - ☐ SFH (< 1 ac lots)
  - ☐ SFH (> 1 ac lots)
  - ☐ Townhouses
  - ☐ Multi-Family
- ☐ Commercial
- ☑ Institutional
- ☐ Industrial
- ☐ Transport-Related
- ☐ Park
- ☐ Undeveloped
- ☐ Other:

EXISTING STORMWATER MANAGEMENT

Existing Stormwater Practice: ☐ Yes ☑ No ☐ Possible
If Yes, Describe:

Describe Existing Site Conditions, Including Existing Site Drainage and Conveyance:
Existing Street Width (if applicable): N/A

- Roof drains and pieces of parking lot drain to small grassy area on north side of building
- Erosion rill already started → retrofit would improve situation

Existing Head Available:	Note where points are measured from: (i.e. street elevation to catch basin invert, manhole rim to catch basin invert, other)

PROPOSED RETROFIT

Purpose of Retrofit:
☑ Water Quality ☐ Recharge ☐ Channel Protection ☐ Flood Control
☑ Demonstration / Education ☐ Repair ☑ Other: erosion

Retrofit Volume Computations - Target Storage:

Retrofit Volume Computations - Available Storage:

Proposed Retrofit Practice: (Runoff Reduction)
☐ Disconnection ☑ Bioretention ☐ Bio Swale
☐ Expanded Tree Pit ☐ Infiltration ☐ Green Roof
☐ Permeable Pavement ☐ Rainwater Harvesting

Proposed Retrofit Practice: (Stormwater Treatment)
☐ Constructed Wetland ☐ Wet Swale ☐ Wet Pond
☐ Filtering Practice ☐ Proprietary:_____
☐ Other: _____

Retrofit Category (as defined by Chesapeake Bay Program):
☑ New BMP ☐ BMP Enhancement ☐ BMP Restoration ☐ BMP Conversion ☐ Not CBP-approved

Describe Elements of Proposed Retrofit, Including Surface Area, Maximum Depth of Treatment, and Conveyance:

- Use grassy area for bioretention to collect + pond roof drain and parking lot runoff
- Keep ponding shallow as there is no SW infrastructure to which an underdrain can be connected.

Available Width:	35'
Available Length:	68'
Available Area:	
Ponding Depth:	2-3"
Soil Depth:	

SITE CONSTRAINTS

Adjacent Land Use:
☐ Residential ☐ Commercial ☐ Institutional
☐ Industrial ☐ Transport-Related ☐ Park
☐ Undeveloped ☐ Other:_____
Possible Conflicts Due to Adjacent Land Use? ☐ Yes ☑ No
If Yes, Describe:

Access:
☑ No Constraints
Constrained due to
☐ Slope ☐ Space
☐ Utilities ☐ Tree Impacts
☐ Structures ☐ Property
Ownership
☐ Other:_____

Conflicts with Existing Utilities:

	Yes	Possible/ Modifiable	No	Unknown
Sewer:	☐	☐	☑	☐
Water:	☐	☐	☑	☐
Gas:	☐	☐	☑	☐
Electric to Streetlights:	☐	☑	☐	☐
Other:	☐	☐	☐	☐

_____

Potential Permitting Factors:

Dam Safety Permits Necessary	☐ Probable	☑ Not Probable
Impacts to Wetlands	☐ Probable	☑ Not Probable
Impacts to a Stream	☐ Probable	☑ Not Probable
Floodplain Fill	☐ Probable	☑ Not Probable
Impacts to Forests	☐ Probable	☑ Not Probable
Impacts to Specimen Trees	☐ Probable	☑ Not Probable

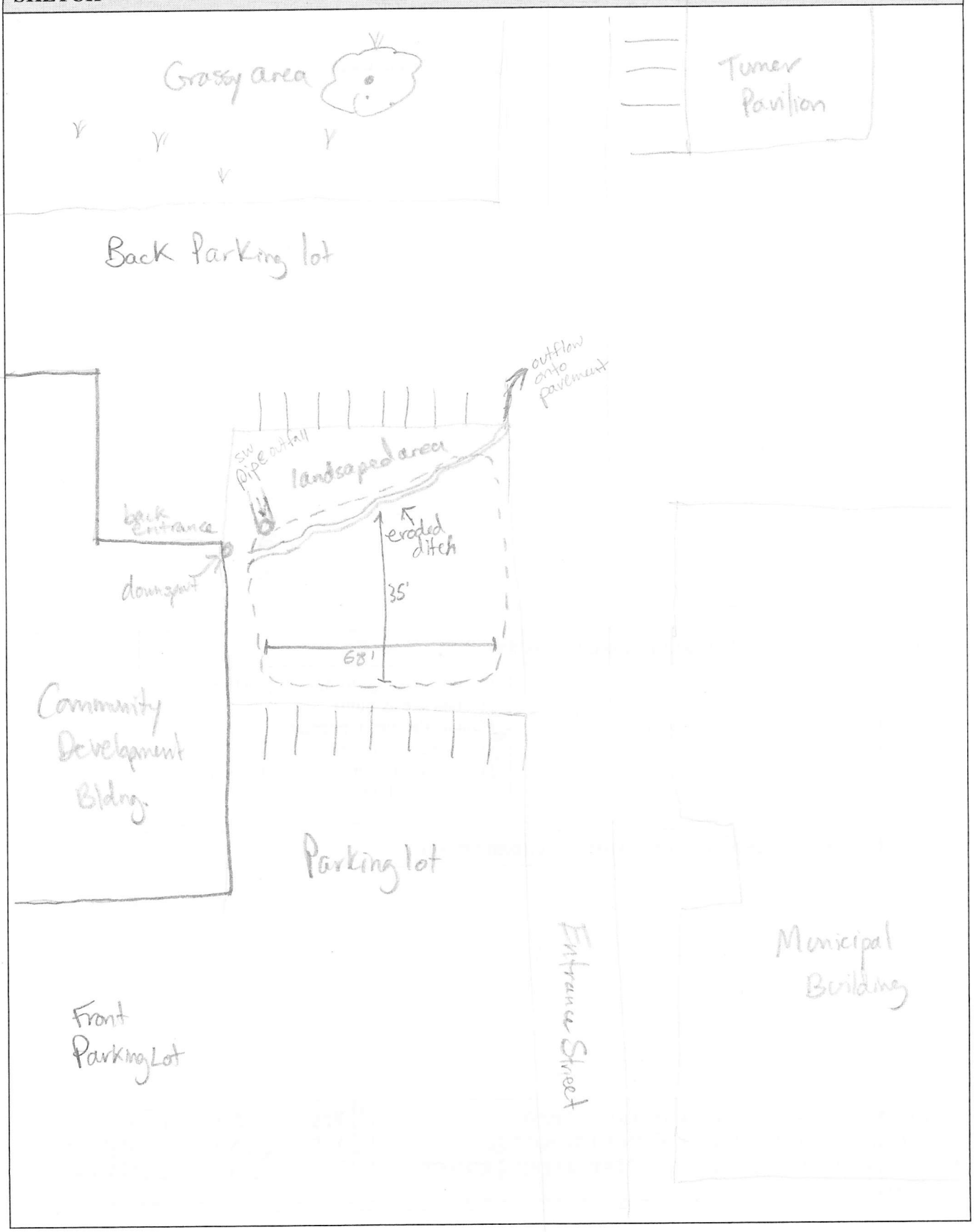
How many?_____
Approx. DBH_____

Other factors:_____
_____

Soils:

Soil auger test holes:	☐ Yes	☑ No
Evidence of poor infiltration (clays, fines):	☐ Yes	☐ No
Evidence of shallow bedrock:	☐ Yes	☐ No
Evidence of high water table (gleying, saturation):	☐ Yes	☐ No

SKETCH


Grassy area
Turner Pavilion
Back Parking lot
outflow onto pavement
SW pipe outfall
landscaped area
back entrance
eroded ditch
downspout
35'
68'
Community Development Bldg.
Parking lot
Front Parking Lot
Entrance Street
Municipal Building

DESIGN OR DELIVERY NOTES

- No storm drains available for underdrain pipe
- Consider adding very shallow underdrain to drain bioretention area → would require building up the ponding area

FOLLOW-UP NEEDED TO COMPLETE FIELD CONCEPT

- ☐ Confirm property ownership
- ☐ Confirm drainage area
- ☐ Confirm drainage area impervious cover
- ☐ Confirm volume computations
- ☐ Complete concept sketch
- ☐ Obtain existing stormwater practice as-builts
- ☐ Obtain site as-builts
- ☐ Obtain detailed topography
- ☑ Obtain utility mapping
- ☐ Confirm storm drain invert elevations
- ☐ Confirm soil types
- ☐ Other:_____

INITIAL FEASIBILITY AND CONSTRUCTION CONSIDERATIONS

☆ High probability that Comm. Development Building will be expanded and will take up area of proposed retrofit.

SITE CANDIDATE FOR FURTHER INVESTIGATION:	☑ YES	☐ NO	☐ MAYBE
IS SITE CANDIDATE FOR EARLY ACTION PROJECT(S):	☐ YES	☐ NO	☐ MAYBE
IF NO, SITE CANDIDATE FOR OTHER RESTORATION PROJECT(S):	☐ YES	☐ NO	☐ MAYBE

IF YES, TYPE(S):_____

RRI

WATERSHED:	SUBWATERSHED:	UNIQUE SITE ID: HR-B

DATE: 3/19/13	ASSESSED BY: LW	CAMERA ID: cville	PICTURES: 3110-3121
GPS ID:	LMK ID:	LAT:	LONG:

SITE DESCRIPTION

Name: Department of Community Development
Address:

Ownership: ☑ Public ☐ Private ☐ Unknown
If Public, Government Jurisdiction: ☑ Local ☐ State ☐ DOT ☐ Other:

Corresponding USSR/USA Field Sheet? ☐ Yes ☑ No If yes, Unique Site ID:

Proposed Retrofit Location:

Storage
- ☐ Existing Pond
- ☐ Below Outfall
- ☐ In Road ROW
- ☐ Other:
- ☐ Above Roadway Culvert
- ☐ In Conveyance System
- ☐ Near Large Parking Lot

On-Site
- ☐ Hotspot Operation
- ☐ Small Parking Lot
- ☐ Individual Street
- ☐ Underground
- ☐ Individual Rooftop
- ☑ Small Impervious Area
- ☐ Landscape / Hardscape
- ☐ Other:

DRAINAGE AREA TO PROPOSED RETROFIT

Drainage Area ≈ 0.28 acres
Imperviousness ≈ 79 %
Impervious Area ≈ 0.22

Notes: See map and GIS

Drainage Area Land Use:
- ☐ Residential
  - ☐ SFH (< 1 ac lots)
  - ☐ SFH (> 1 ac lots)
  - ☐ Townhouses
  - ☐ Multi-Family
- ☐ Commercial
- ☑ Institutional
- ☐ Industrial
- ☐ Transport-Related
- ☐ Park
- ☐ Undeveloped
- ☐ Other:

EXISTING STORMWATER MANAGEMENT

Existing Stormwater Practice: ☐ Yes ☑ No ☐ Possible
If Yes, Describe:

Newly installed storm drain carries rooftop runoff away from site, but back parking lot and entrance drive still drain to grass area behind building (making it muddy)

Describe Existing Site Conditions, Including Existing Site Drainage and Conveyance:
Existing Street Width (if applicable):

Existing Head Available:	Note where points are measured from: (i.e. street elevation to catch basin invert, manhole rim to catch basin invert, other)
< 1 ft.	Depth of new storm pipe, below surface

PROPOSED RETROFIT

Purpose of Retrofit:
☑ Water Quality ☐ Recharge ☐ Channel Protection ☐ Flood Control
☑ Demonstration / Education ☐ Repair ☑ Other: reduce muddiness in grass

Retrofit Volume Computations - Target Storage:

Retrofit Volume Computations - Available Storage:

Proposed Retrofit Practice: (Runoff Reduction)
☐ Disconnection ☐ Bioretention ☑ Bio Swale
☐ Expanded Tree Pit ☐ Infiltration ☐ Green Roof
☐ Permeable Pavement ☐ Rainwater Harvesting

Proposed Retrofit Practice: (Stormwater Treatment)
☐ Constructed Wetland ☐ Wet Swale ☐ Wet Pond
☐ Filtering Practice ☐ Proprietary:_____
☐ Other: _____

Retrofit Category (as defined by Chesapeake Bay Program):
☑ New BMP ☐ BMP Enhancement ☐ BMP Restoration ☐ BMP Conversion ☐ Not CBP-approved

Describe Elements of Proposed Retrofit, Including Surface Area, Maximum Depth of Treatment, and Conveyance:

- Install linear bioretention (bioswale) along edge of parking lot behind building - along grass area

Available Width:	10-15'
Available Length:	50'
Available Area:	
Ponding Depth:	2-3"
Soil Depth:	

- Nearby storm drain not deep enough for an underdrain, so keep ponding shallow and use existing storm drain for overflow structure.

SITE CONSTRAINTS

Adjacent Land Use:
☐ Residential ☐ Commercial ☑ Institutional
☐ Industrial ☐ Transport-Related ☐ Park
☐ Undeveloped ☑ Other: Used for farmers market + events

Possible Conflicts Due to Adjacent Land Use? ☐ Yes ☐ No
If Yes, Describe: Bioswale shouldn't take up too much room away from parking

Access:
☑ No Constraints
Constrained due to
☐ Slope ☐ Space
☐ Utilities ☐ Tree Impacts
☐ Structures ☐ Property
Ownership
☐ Other:_____

Conflicts with Existing Utilities:

	Yes	Possible/ Modifiable	No	Unknown
Sewer:	☐	☐	☑	☐
Water:	☐	☐	☑	☐
Gas:	☐	☐	☐	☑
Electric to Streetlights:	☐	☐	☑	☐
Other:	☐	☐	☐	☐

_____

Potential Permitting Factors:

Dam Safety Permits Necessary	☐ Probable	☑ Not Probable
Impacts to Wetlands	☐ Probable	☑ Not Probable
Impacts to a Stream	☐ Probable	☑ Not Probable
Floodplain Fill	☐ Probable	☑ Not Probable
Impacts to Forests	☐ Probable	☐ Not Probable
Impacts to Specimen Trees	☐ Probable	☐ Not Probable

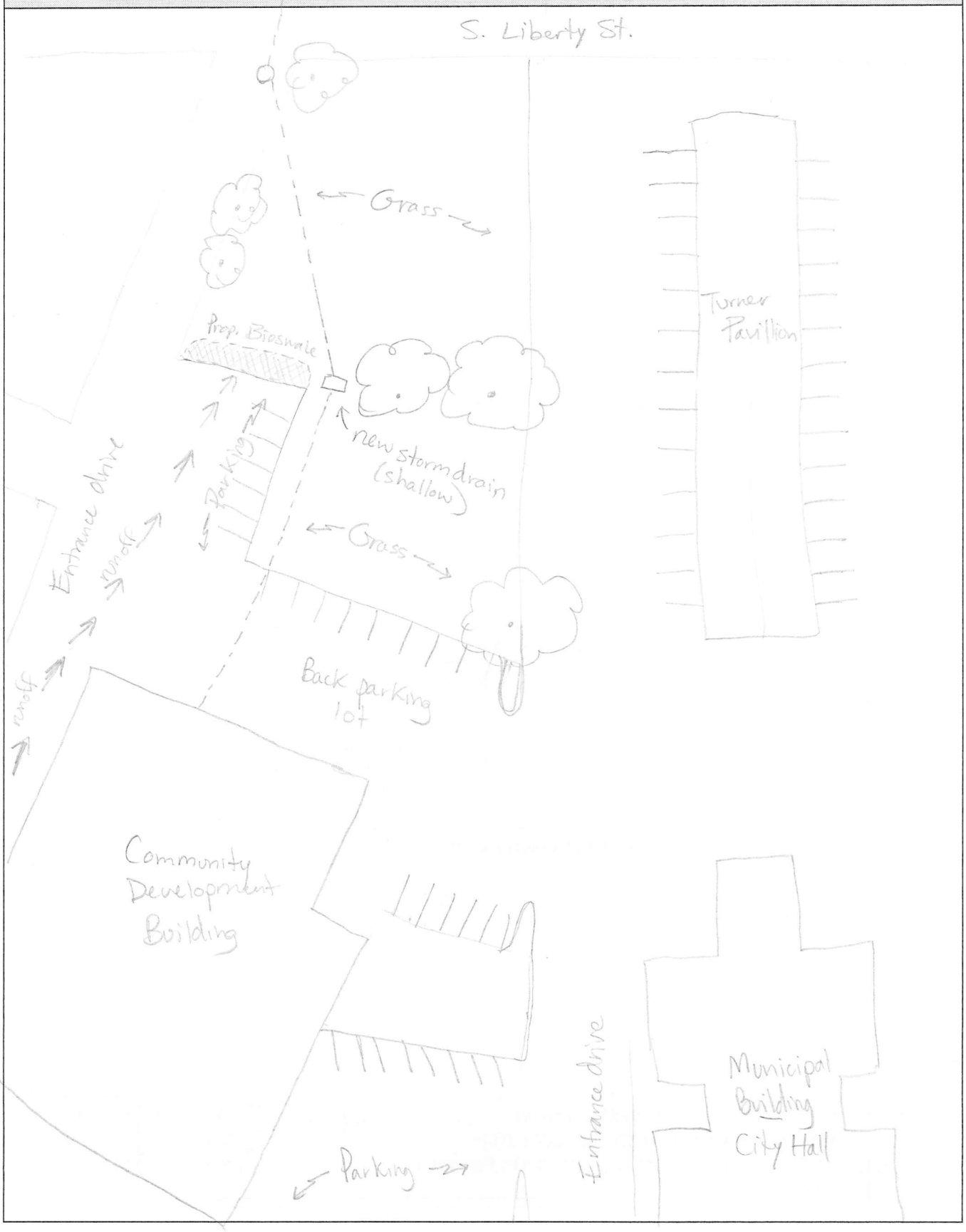
How many?_____
Approx. DBH_____

Other factors:_____
_____

Soils:

Soil auger test holes:	☐ Yes	☑ No
Evidence of poor infiltration (clays, fines):	☐ Yes	☐ No
Evidence of shallow bedrock:	☐ Yes	☐ No
Evidence of high water table (gleying, saturation):	☐ Yes	☐ No

SKETCH


S. Liberty St.
Grass
Prop. Bioswale
new storm drain (shallow)
Entrance drive
runoff
Parking
Grass
Turner Pavilion
Back parking lot
runoff
Community Development Building
Parking
Entrance drive
Municipal Building City Hall

DESIGN OR DELIVERY NOTES

- This will only work if City allows bioswale without an underdrain. Without an underdrain, ponding should be kept shallow

- Overflow structure can be tied into new storm drain pipe (<1ft. deep)

- This retrofit should keep runoff off the grass area, which is known to get muddy.

FOLLOW-UP NEEDED TO COMPLETE FIELD CONCEPT

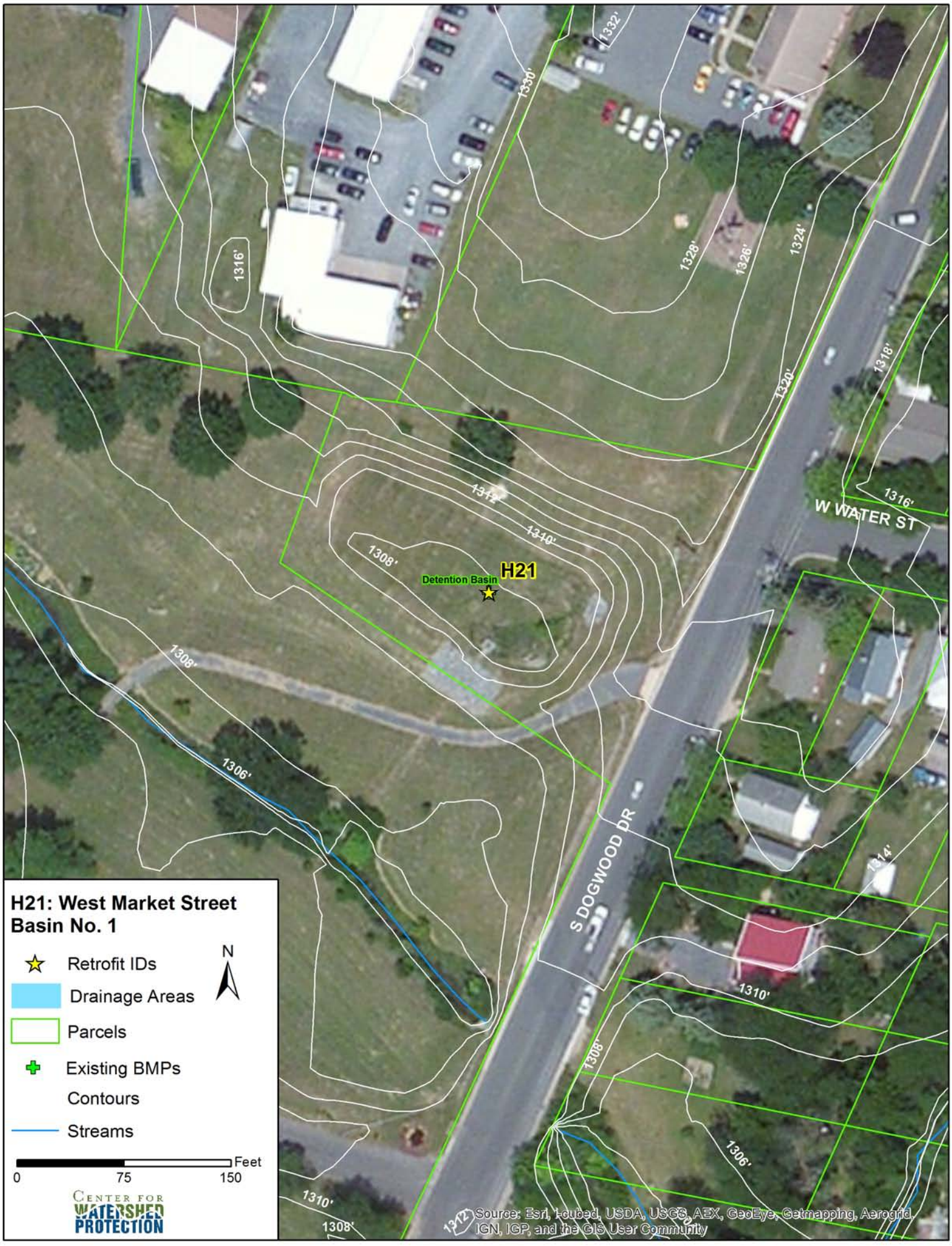
- ☐ Confirm property ownership
- ☐ Confirm drainage area
- ☐ Confirm drainage area impervious cover
- ☐ Confirm volume computations
- ☐ Complete concept sketch
- ☐ Obtain existing stormwater practice as-builts
- ☐ Obtain site as-builts
- ☐ Obtain detailed topography
- ☐ Obtain utility mapping
- ☑ Confirm storm drain invert elevations
- ☐ Confirm soil types
- ☐ Other:_____

INITIAL FEASIBILITY AND CONSTRUCTION CONSIDERATIONS

SITE CANDIDATE FOR FURTHER INVESTIGATION:	☐ YES	☐ NO	☐ MAYBE
IS SITE CANDIDATE FOR EARLY ACTION PROJECT(S):	☐ YES	☐ NO	☐ MAYBE
IF NO, SITE CANDIDATE FOR OTHER RESTORATION PROJECT(S):	☐ YES	☐ NO	☐ MAYBE

IF YES, TYPE(S):_____

H21: West Market Street Basin No. 1


H21
Detention Basin
W WATER ST
S DOGWOOD DR
1332'
1330'
1328'
1326'
1324'
1322'
1320'
1318'
1316'
1314'
1312'
1310'
1308'
1306'
H21: West Market Street Basin No. 1
Retrofit IDs
Drainage Areas
Parcels
Existing BMPs
Contours
Streams
N
Feet
0
75
150
CENTER FOR WATERSHED PROTECTION
Source: Esri, i-cubed, USDA, USGS, AEX, GeoEye, Getmapping, Aerogrid, IGN, IGP, and the GIS User Community

H21: West Market Street Basin No. 1

Score: 38
Rank: 18
Investigators: Joe Battiata

Figure 1: *Principal Spillway. 2-year rectangular orifice showing (one each side); WQ orifice is buried 15" below rectangular orifice.*

Figure 2: *Inflow from diversion manhole in South Dogwood Street (basin silted in to top of pipe).*

Description: The West Market Street (Route 33) widening project includes several stormwater management Extended Detention (ED) basins. This basin (Basin No. 1) is located near the entrance to Westover Park on South Dogwood Street and serves the added impervious cover of the West Market Street. A diversion manhole in South Dogwood Street diverts the design water quality flow rate from the drainage system to the basin. The basin consists of a primary riser structure with a low flow (water quality) orifice, a 2-year (or 1-year extended detention) channel protection orifice, and a rip rap overflow spillway (Figure 1). A significant volume of temporary storage (approximately 15" in depth across most of the basin) has been filled with sediment.

Proposed Retrofit: This "conversion" includes the removal of the sediment, and the conversion of the ED volume to a wetland pool (Figure 2). Alternatively, if the storage is needed to maintain the channel protection volume, then the conversion would include a combination of sediment removal and excavation in order to establish an adequate wetland pool. A survey may be beneficial to determine the exact storage volumes needed beyond what may already be available after sediment is removed. It may also be worth assessing whether the basin meets the new stormwater requirements. Minor modifications to the riser structure may be required.

WATERSHED:	SUBWATERSHED:	UNIQUE SITE ID: H21	
DATE: 3/20/13	ASSESSED BY: JGB	CAMERA ID:	PICTURES:
GPS ID:	LMK ID:	LAT:	LONG:

SITE DESCRIPTION

Name: WEST MARKET STREET BASIN No. 1 ENHANCEMENT
Address: _____

Ownership: ☒ Public ☐ Private ☐ Unknown
If Public, Government Jurisdiction: ☐ Local ☐ State ☒ DOT ☐ Other: _____

Corresponding USSR/USA Field Sheet? ☐ Yes ☐ No If yes, Unique Site ID: _____

Proposed Retrofit Location:

Storage
- ☒ Existing Pond
- ☐ Below Outfall
- ☐ In Road ROW
- ☐ Other: _____
- ☐ Above Roadway Culvert
- ☐ In Conveyance System
- ☐ Near Large Parking Lot

On-Site
- ☐ Hotspot Operation
- ☐ Small Parking Lot
- ☐ Individual Street
- ☐ Underground
- ☐ Individual Rooftop
- ☐ Small Impervious Area
- ☐ Landscape / Hardscape
- ☐ Other: _____

DRAINAGE AREA TO PROPOSED RETROFIT

Drainage Area ≈ _____
Imperviousness ≈ _____ %
Impervious Area ≈ 1.10 AC

Notes: LARGE DA - MANHOLE DIVERSION STRUCTURE DIVERTS APPROX. 1.10 AC OF NEW IMP TO BASIN (COMPS NOT AVAILABLE TO VERIFY)

Drainage Area Land Use:
- ☐ Residential
  - ☐ SFH (< 1 ac lots)
  - ☐ SFH (> 1 ac lots)
  - ☐ Townhouses
  - ☐ Multi-Family
- ☐ Commercial
- ☐ Institutional
- ☐ Industrial
- ☐ Transport-Related
- ☐ Park
- ☐ Undeveloped
- ☐ Other: _____

EXISTING STORMWATER MANAGEMENT

Existing Stormwater Practice: ☒ Yes ☐ No ☐ Possible

If Yes, Describe:
- EXISTING POND W/ DIVERSION STRUCTURE IN S. DOGWOOD DR. TO DIVERT WQ FLOW INTO POND. INFLOW SHORT CIRCUITS TO OUTLET.
- SIGNIFICANT SEDIMENT ACCUMULATION

POND IS EXT. DETENTION BASIN

Describe Existing Site Conditions, Including Existing Site Drainage and Conveyance:
Existing Street Width (if applicable): _____

POND IN A PARK SETTING ADJACENT TO S. DOGWOOD DR.

Existing Head Available:	Note where points are measured from: (i.e. street elevation to catch basin invert, manhole rim to catch basin invert, other)

PROPOSED RETROFIT

Purpose of Retrofit:
☒ Water Quality ☐ Recharge ☐ Channel Protection ☐ Flood Control
☐ Demonstration / Education ☐ Repair ☐ Other:_____

Retrofit Volume Computations - Target Storage:

Retrofit Volume Computations - Available Storage:

Proposed Retrofit Practice: (Runoff Reduction)
☐ Disconnection ☐ Bioretention ☐ Bio Swale
☐ Expanded Tree Pit ☐ Infiltration ☐ Green Roof
☐ Permeable Pavement ☐ Rainwater Harvesting

Proposed Retrofit Practice: (Stormwater Treatment)
☒ Constructed Wetland ☐ Wet Swale ☐ Wet Pond
☐ Filtering Practice ☐ Proprietary:_____
☐ Other: EXT DETENTION

Retrofit Category (as defined by Chesapeake Bay Program):
☐ New BMP ☐ BMP Enhancement ☐ BMP Restoration ☒ BMP Conversion ☐ Not CBP-approved

Describe Elements of Proposed Retrofit, Including Surface Area, Maximum Depth of Treatment, and Conveyance:
① EXCAVATE ACCUMULATED SEDIMENT
② INSTALL BAFFLE TO ELIMINATE SHORT CIRCUIT.
③ VERIFY STORAGE VOLUME & MODIFY RISER TO ADD
— SHALLOW MARSH, OR
— ED VOLUME
— BOTH

Available Width:	
Available Length:	
Available Area:	
Ponding Depth:	
Soil Depth:	

SITE CONSTRAINTS

Adjacent Land Use:
☐ Residential ☐ Commercial ☐ Institutional
☐ Industrial ☐ Transport-Related ☒ Park
☐ Undeveloped ☐ Other: ROADWAY

Possible Conflicts Due to Adjacent Land Use? ☐ Yes ☒ No
If Yes, Describe:

Access:
☒ No Constraints
Constrained due to
☐ Slope ☐ Space
☐ Utilities ☐ Tree Impacts
☐ Structures ☐ Property
Ownership
☐ Other:_____

Conflicts with Existing Utilities:

	Yes	Possible/ Modifiable	No	Unknown
Sewer:	☐	☐	☒	☐
Water:	☐	☐	☒	☐
Gas:	☐	☐	☒	☐
Electric to Streetlights:	☐	☐	☒	☐
Other:	☐	☐	☒	☐

Potential Permitting Factors:

Dam Safety Permits Necessary	☐ Probable	☒ Not Probable
Impacts to Wetlands	☐ Probable	☒ Not Probable
Impacts to a Stream	☐ Probable	☒ Not Probable
Floodplain Fill	☐ Probable	☒ Not Probable
Impacts to Forests	☐ Probable	☒ Not Probable
Impacts to Specimen Trees	☐ Probable	☒ Not Probable

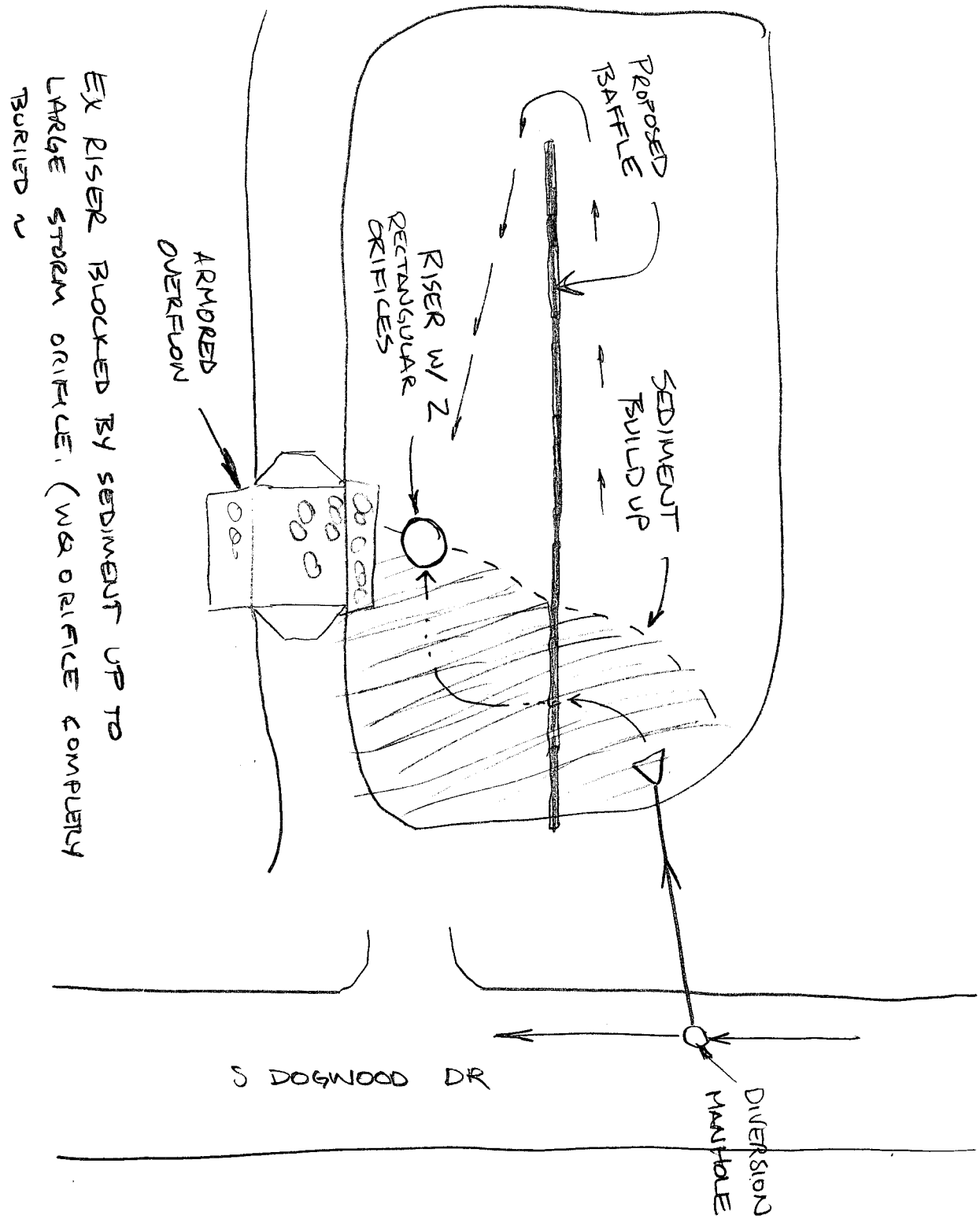
How many?_____
Approx. DBH_____

Other factors:_____

Soils:

Soil auger test holes:	☐ Yes	☒ No
Evidence of poor infiltration (clays, fines):	☒ Yes	☐ No
Evidence of shallow bedrock:	☐ Yes	☒ No
Evidence of high water table (gleying, saturation):	☐ Yes	☒ No

SKETCH


PROPOSED BAFFLE
RISER W/ 2 RECTANGULAR ORIFICES
ARMORED OVERFLOW
SEDIMENT BUILD UP
EX RISER BLOCKED BY SEDIMENT UP TO LARGE STORM ORIFICE. (WQ ORIFICE COMPLETELY BURIED ~
S DOGWOOD DR
DIVERSION MANHOLE

DESIGN OR DELIVERY NOTES

NEED DESIGN INFO:

- DA MAP
- RISER DESIGN
- STORAGE VOLUME CALCS
- SEDIMENT VOLUME REMOVAL APPROX

PROPOSED

FOLLOW-UP NEEDED TO COMPLETE FIELD CONCEPT

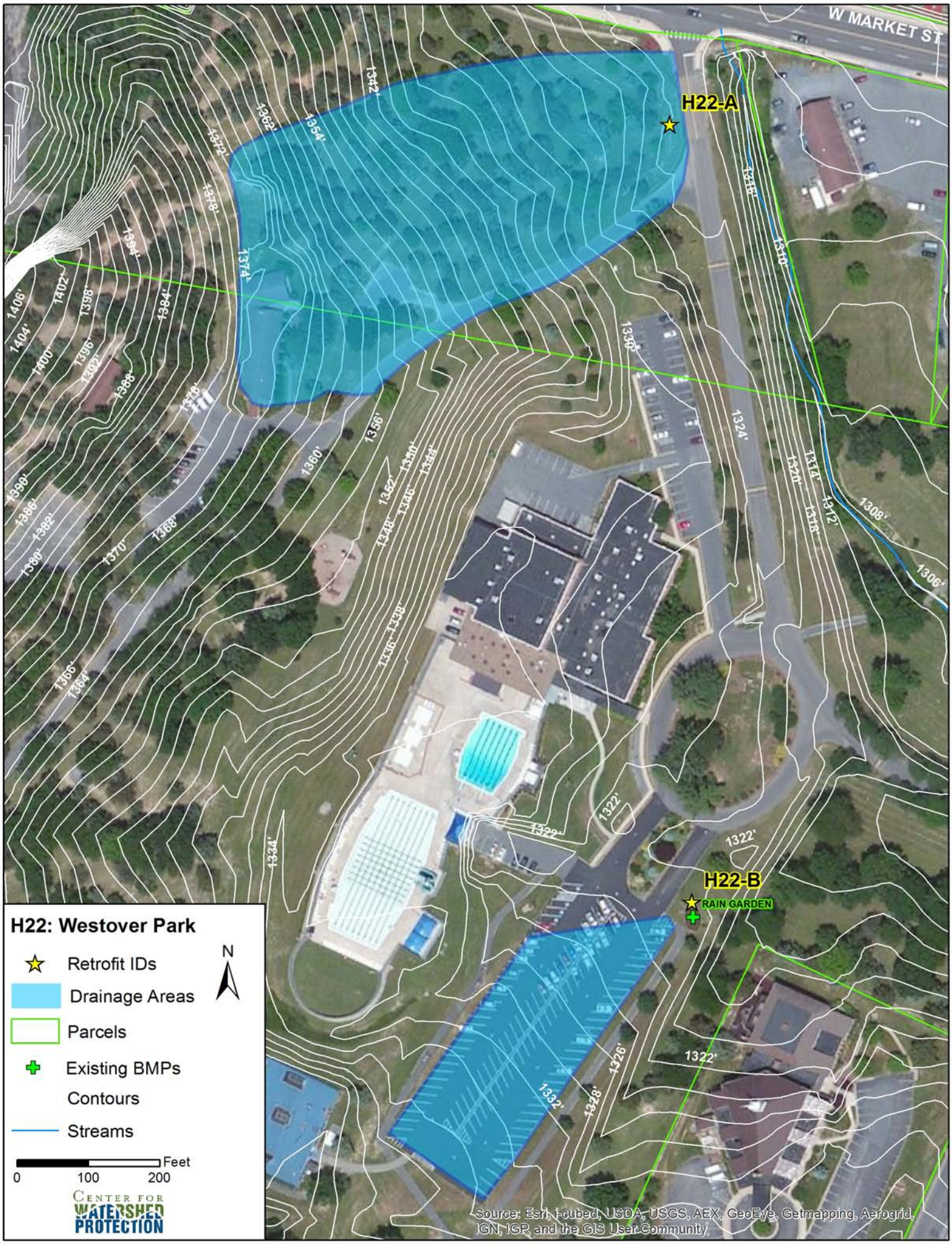
- ☐ Confirm property ownership
- ☒ Confirm drainage area
- ☒ Confirm drainage area impervious cover
- ☒ Confirm volume computations
- ☐ Complete concept sketch
- ☒ Obtain existing stormwater practice as-builts
- ☐ Obtain site as-builts
- ☐ Obtain detailed topography
- ☐ Obtain utility mapping
- ☐ Confirm storm drain invert elevations
- ☐ Confirm soil types
- ☐ Other: _____

INITIAL FEASIBILITY AND CONSTRUCTION CONSIDERATIONS

SITE CANDIDATE FOR FURTHER INVESTIGATION:	☐ YES	☐ NO	☐ MAYBE
IS SITE CANDIDATE FOR EARLY ACTION PROJECT(S):	☐ YES	☐ NO	☐ MAYBE
IF NO, SITE CANDIDATE FOR OTHER RESTORATION PROJECT(S):	☐ YES	☐ NO	☐ MAYBE

IF YES, TYPE(S): _____

H22: Westover Park


W MARKET ST
H22-A
H22-B
RAIN GARDEN
H22: Westover Park
Retrofit IDs
Drainage Areas
Parcels
Existing BMPs
Contours
Streams
N
Feet
0
100
200
CENTER FOR WATERSHED PROTECTION
Source: Esri, i-cubed, USDA, USGS, AEX, GeoEye, Getmapping, Aerogrid, IGN, IGP, and the GIS User Community

H22-A: Westover Park Entrance

Score: 48

Rank: 7

Investigators: Wes Runion, Jeremy Harold, Lisa Fraley-McNeal

Figure 1: *Stream bank erosion*

Figure 2: *Proposed bioretention location*

Description: Approximately 3 acres of roadway, building, and vegetated hill-slope drain down a side road at the park entrance, across the main park entrance road, and into the adjacent stream. The runoff is causing erosion along the stream bank where it enters the stream near the culvert at W. Market St. (Figure 1).

Proposed Retrofit: To capture this runoff, a 20’ by 75’ bioretention is proposed along the grass area to the west side of the park entrance road (Figure 2). The underdrain would tie into the existing inlet at the intersection of the park entrance road and W. Market St. To direct water into the practice, an asphalt berm would need to be constructed across the side road at the park entrance. A few trees need to be avoided at the proposed location. High visibility at the park entrance makes this bioretention a good candidate for a demonstration project.

H22-B: Westover Park Parking Lot

Score: 31

Rank: 28

Investigators: Thanh Dang, David Hirschman

Figure 1: *Flat, grassy area adjacent to large parking lot. Note the existing rain garden where the investigators are standing.*

Description: The nearly 1-acre parking lot drains to the northeast corner. A small, existing rain garden has been installed here. There is a flat area here, and the ground slopes down to the east beyond the flat area (Figure 1).

Proposed Retrofit: The existing rain garden is an excellent feature, but could be expanded to treat more runoff from the parking lot. The rain garden can stop at the drip line of the existing tree or go beyond the drip line if the tree is not considered important and/or can be replaced. The underdrain can outlet down the slope, although the existing sewer line must be avoided. One area of concern is that a soil auger test in the area encountered an impenetrable barrier about 6" below the ground surface. This should be investigated further, as it may limit the feasibility of a bioretention practice in this spot.

Retrofit Reconnaissance Investigation **RRI**
Updated: 3/13/2013

WATERSHED:	SUBWATERSHED:	UNIQUE SITE ID: H22-A	
DATE: 20 March 2013	ASSESSED BY: Lisa Jessup Wes	CAMERA ID:	PICTURES: 28-35
GPS ID:	LMK ID:	LAT:	LONG:

SITE DESCRIPTION

Name: West over Park Entrance
Address: _____

Ownership: ☐ Public ☐ Private ☐ Unknown
If Public, Government Jurisdiction: ☒ Local ☐ State ☐ DOT ☐ Other: _____

Corresponding USSR/USA Field Sheet? ☐ Yes ☐ No If yes, Unique Site ID: _____

Proposed Retrofit Location:

Storage
- ☐ Existing Pond
- ☐ Below Outfall
- ☐ In Road ROW
- ☐ Other: _____
- ☐ Above Roadway Culvert
- ☐ In Conveyance System
- ☐ Near Large Parking Lot

On-Site
- ☐ Hotspot Operation
- ☐ Small Parking Lot
- ☐ Individual Street
- ☐ Underground
- ☐ Individual Rooftop
- ☐ Small Impervious Area
- ☐ Landscape / Hardscape
- ☒ Other: Park drainage

DRAINAGE AREA TO PROPOSED RETROFIT

Drainage Area ≈ 3 acres
Imperviousness ≈ 14.7 %
Impervious Area ≈ 0.44 acres

Notes:

Drainage Area Land Use:
- ☐ Residential
  - ☐ SFH (< 1 ac lots)
  - ☐ SFH (> 1 ac lots)
  - ☐ Townhouses
  - ☐ Multi-Family
- ☐ Commercial
- ☐ Institutional
- ☐ Industrial
- ☐ Transport-Related
- ☒ Park
- ☐ Undeveloped
- ☐ Other: _____

EXISTING STORMWATER MANAGEMENT

Existing Stormwater Practice: ☐ Yes ☒ No ☐ Possible
If Yes, Describe:

Describe Existing Site Conditions, Including Existing Site Drainage and Conveyance:
Existing Street Width (if applicable): _____

Park location with street & hillside drainage, causing severe erosion on stream bank.

Existing Head Available:

4' measured from manhole rim to catch basin invert

Note where points are measured from: (i.e. street elevation to catch basin invert, manhole rim to catch basin invert, other)

PROPOSED RETROFIT

Purpose of Retrofit:
☒ Water Quality ☐ Recharge ☒ Channel Protection ☐ Flood Control
☒ Demonstration / Education ☐ Repair ☐ Other:_____

Retrofit Volume Computations - Target Storage:
3562 ft³

Retrofit Volume Computations - Available Storage:
1982 ft³

Proposed Retrofit Practice: (Runoff Reduction)
☐ Disconnection ☒ Bioretention ☐ Bio Swale
☐ Expanded Tree Pit ☐ Infiltration ☐ Green Roof
☐ Permeable Pavement ☐ Rainwater Harvesting

Proposed Retrofit Practice: (Stormwater Treatment)
☐ Constructed Wetland ☐ Wet Swale ☐ Wet Pond
☐ Filtering Practice ☐ Proprietary:_____
☐ Other: _____

Retrofit Category (as defined by Chesapeake Bay Program):
☒ New BMP ☐ BMP Enhancement ☐ BMP Restoration ☐ BMP Conversion ☐ Not CBP-approved

Describe Elements of Proposed Retrofit, Including Surface Area, Maximum Depth of Treatment, and Conveyance:
Create a bioretention area to capture stormwater runoff from road + hillside.

Available Width:	20'
Available Length:	75' or greater
Available Area:	1500 ft²
Ponding Depth:	1'
Soil Depth:	30"

4' invert - T.C into existing stormdrain at intersection of West Market (Rt 33) and westover Dr.

SITE CONSTRAINTS

Adjacent Land Use:
☐ Residential ☐ Commercial ☐ Institutional
☐ Industrial ☒ Transport-Related ☒ Park
☐ Undeveloped ☐ Other:_____
Possible Conflicts Due to Adjacent Land Use? ☐ Yes ☒ No
If Yes, Describe:

Access:
☒ No Constraints
Constrained due to
☐ Slope ☐ Space
☐ Utilities ☐ Tree Impacts
☐ Structures ☐ Property
Ownership
☐ Other:_____

Conflicts with Existing Utilities:

	Yes	Possible/ Modifiable	No	Unknown
Sewer:	☐	☒	☐	☐
Water:	☐	☐	☒	☐
Gas:	☐	☒	☐	☐
Electric to Streetlights:	☐	☐	☒	☐
Other:	☐	☐	☐	☐

Potential Permitting Factors:

Dam Safety Permits Necessary	☐ Probable	☒ Not Probable
Impacts to Wetlands	☐ Probable	☒ Not Probable
Impacts to a Stream	☒ Probable	☐ Not Probable
Floodplain Fill	☐ Probable	☒ Not Probable
Impacts to Forests	☐ Probable	☒ Not Probable
Impacts to Specimen Trees	☒ Probable	☐ Not Probable

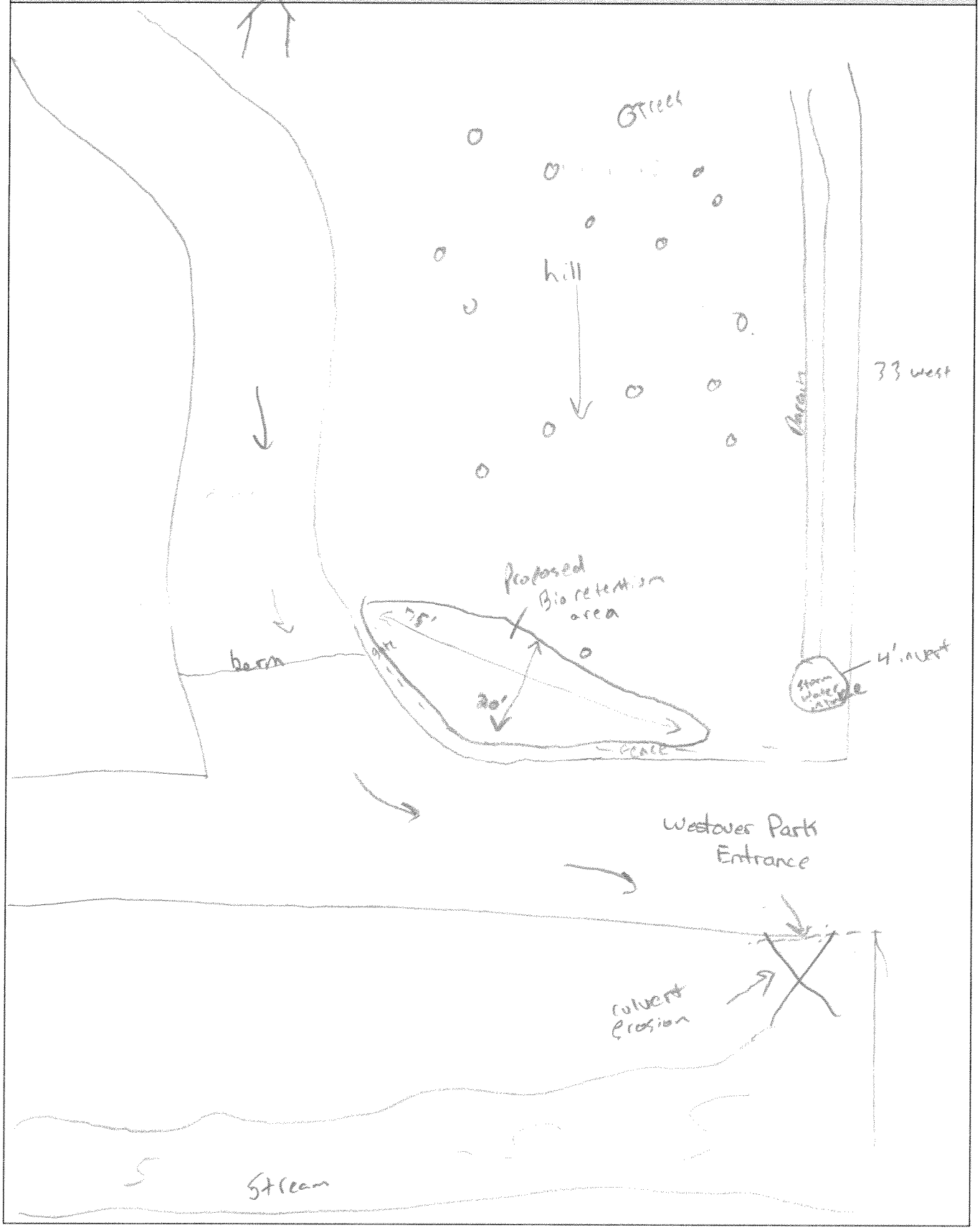
How many? 1
Approx. DBH 6"

Other factors:_____

Soils:

Soil auger test holes:	☐ Yes	☒ No
Evidence of poor infiltration (clays, fines):	☐ Yes	☒ No
Evidence of shallow bedrock:	☐ Yes	☒ No
Evidence of high water table (gleying, saturation):	☐ Yes	☒ No

SKETCH


Street
hill
33 west
Proposed Bio retention area
75'
30'
berm
4' culvert
storm water inlet
Westover Park Entrance
culvert erosion
stream

DESIGN OR DELIVERY NOTES

Will need to create a berm across the roadway to direct water into the bioretention.

Proposed bioretention length = 75', but there is the potential to expand this if the surface area needs to be increased to treat the drainage area.

FOLLOW-UP NEEDED TO COMPLETE FIELD CONCEPT

- ☐ Confirm property ownership
- ☐ Confirm drainage area
- ☐ Confirm drainage area impervious cover
- ☐ Confirm volume computations
- ☐ Complete concept sketch
- ☐ Obtain existing stormwater practice as-builts
- ☐ Obtain site as-builts
- ☐ Obtain detailed topography
- ☐ Obtain utility mapping
- ☐ Confirm storm drain invert elevations
- ☐ Confirm soil types
- ☐ Other:_____

INITIAL FEASIBILITY AND CONSTRUCTION CONSIDERATIONS

Site location at the park entrance makes this a good candidate for a demonstration project. There are a few trees that would need to be worked around.

SITE CANDIDATE FOR FURTHER INVESTIGATION:	☐ YES	☐ NO	☐ MAYBE
IS SITE CANDIDATE FOR EARLY ACTION PROJECT(S):	☐ YES	☐ NO	☐ MAYBE
IF NO, SITE CANDIDATE FOR OTHER RESTORATION PROJECT(S):	☐ YES	☐ NO	☐ MAYBE

IF YES, TYPE(S):_____

RRI

WATERSHED:	SUBWATERSHED:	UNIQUE SITE ID: H-22-B
DATE:	ASSESSED BY: DJT FM	CAMERA ID: PICTURES: 95-96
GPS ID:	LMK ID:	LAT: LONG:

SITE DESCRIPTION

Name: Westover Park Parking
Address:

Ownership: ☒ Public ☐ Private ☐ Unknown
If Public, Government Jurisdiction: ☐ Local ☐ State ☐ DOT ☐ Other:

Corresponding USSR/USA Field Sheet? ☐ Yes ☐ No If yes, Unique Site ID:

Proposed Retrofit Location:

Storage
- ☐ Existing Pond
- ☐ Below Outfall
- ☐ In Road ROW
- ☐ Other:
- ☐ Above Roadway Culvert
- ☐ In Conveyance System
- ☐ Near Large Parking Lot

On-Site
- ☐ Hotspot Operation
- ☒ Small Parking Lot
- ☐ Individual Street
- ☐ Underground
- ☐ Individual Rooftop
- ☐ Small Impervious Area
- ☐ Landscape / Hardscape
- ☐ Other:

DRAINAGE AREA TO PROPOSED RETROFIT

Drainage Area ≈ 0.94
Imperviousness ≈ 100 %
Impervious Area ≈ 0.94

Notes: Parking Lot = 130 x 370
48,100

Drainage Area Land Use:
- ☐ Residential
  - ☐ SFH (< 1 ac lots)
  - ☐ SFH (> 1 ac lots)
  - ☐ Townhouses
  - ☐ Multi-Family
- ☐ Commercial
- ☐ Institutional
- ☐ Industrial
- ☐ Transport-Related
- ☒ Park
- ☐ Undeveloped
- ☐ Other:

EXISTING STORMWATER MANAGEMENT

Existing Stormwater Practice: ☒ Yes ☐ No ☐ Possible
If Yes, Describe:
Small rain garden
20 x 30

Describe Existing Site Conditions, Including Existing Site Drainage and Conveyance:
Existing Street Width (if applicable):

Large parking lot draining to one corner
w/ small rain garden

Existing Head Available:
5.2'

Note where points are measured from: (i.e. street elevation to catch basin invert, manhole rim to catch basin invert, other)
1.3 Top
6.5 Bottom of slope

0.5
1.3
5.2
Unique Site ID: H-22-B

PROPOSED RETROFIT

Purpose of Retrofit:
☒ Water Quality ☐ Recharge ☐ Channel Protection ☐ Flood Control
☐ Demonstration / Education ☐ Repair ☐ Other:_____

Retrofit Volume Computations - Target Storage:

Retrofit Volume Computations - Available Storage:

Proposed Retrofit Practice: (Runoff Reduction)
☐ Disconnection ☒ Bioretention ☐ Bio Swale
☐ Expanded Tree Pit ☐ Infiltration ☐ Green Roof
☐ Permeable Pavement ☐ Rainwater Harvesting

Proposed Retrofit Practice: (Stormwater Treatment)
☐ Constructed Wetland ☐ Wet Swale ☐ Wet Pond
☐ Filtering Practice ☐ Proprietary:_____
☐ Other: _____

Retrofit Category (as defined by Chesapeake Bay Program):
☐ New BMP ☒ BMP Enhancement ☐ BMP Restoration ☐ BMP Conversion ☐ Not CBP-approved

Describe Elements of Proposed Retrofit, Including Surface Area, Maximum Depth of Treatment, and Conveyance:

Available Width:	
Available Length:	
Available Area:	
Ponding Depth:	
Soil Depth:	

To drip line of tree = 64 x 45
Past drip line = 89 x 45

SITE CONSTRAINTS

Adjacent Land Use:
☐ Residential ☐ Commercial ☐ Institutional
☐ Industrial ☐ Transport-Related ☒ Park
☐ Undeveloped ☐ Other:_____
Possible Conflicts Due to Adjacent Land Use? ☐ Yes ☐ No
If Yes, Describe:

Access:
☒ No Constraints
Constrained due to
☐ Slope ☐ Space
☐ Utilities ☐ Tree Impacts
☐ Structures ☐ Property
Ownership
☐ Other:_____

Conflicts with Existing Utilities: bottom of slope

	Yes	Possible/ Modifiable	No	Unknown
Sewer:	☐	☒	☐	☐
Water:	☐	☐	☐	☐
Gas:	☐	☐	☐	☐
Electric to Streetlights:	☐	☐	☐	☐
Other:	☐	☐	☐	☐

Potential Permitting Factors:

Dam Safety Permits Necessary	☐ Probable	☒ Not Probable
Impacts to Wetlands	☐ Probable	☒ Not Probable
Impacts to a Stream	☐ Probable	☒ Not Probable
Floodplain Fill	☐ Probable	☒ Not Probable
Impacts to Forests	☐ Probable	☒ Not Probable
Impacts to Specimen Trees	☐ Probable	☒ Not Probable

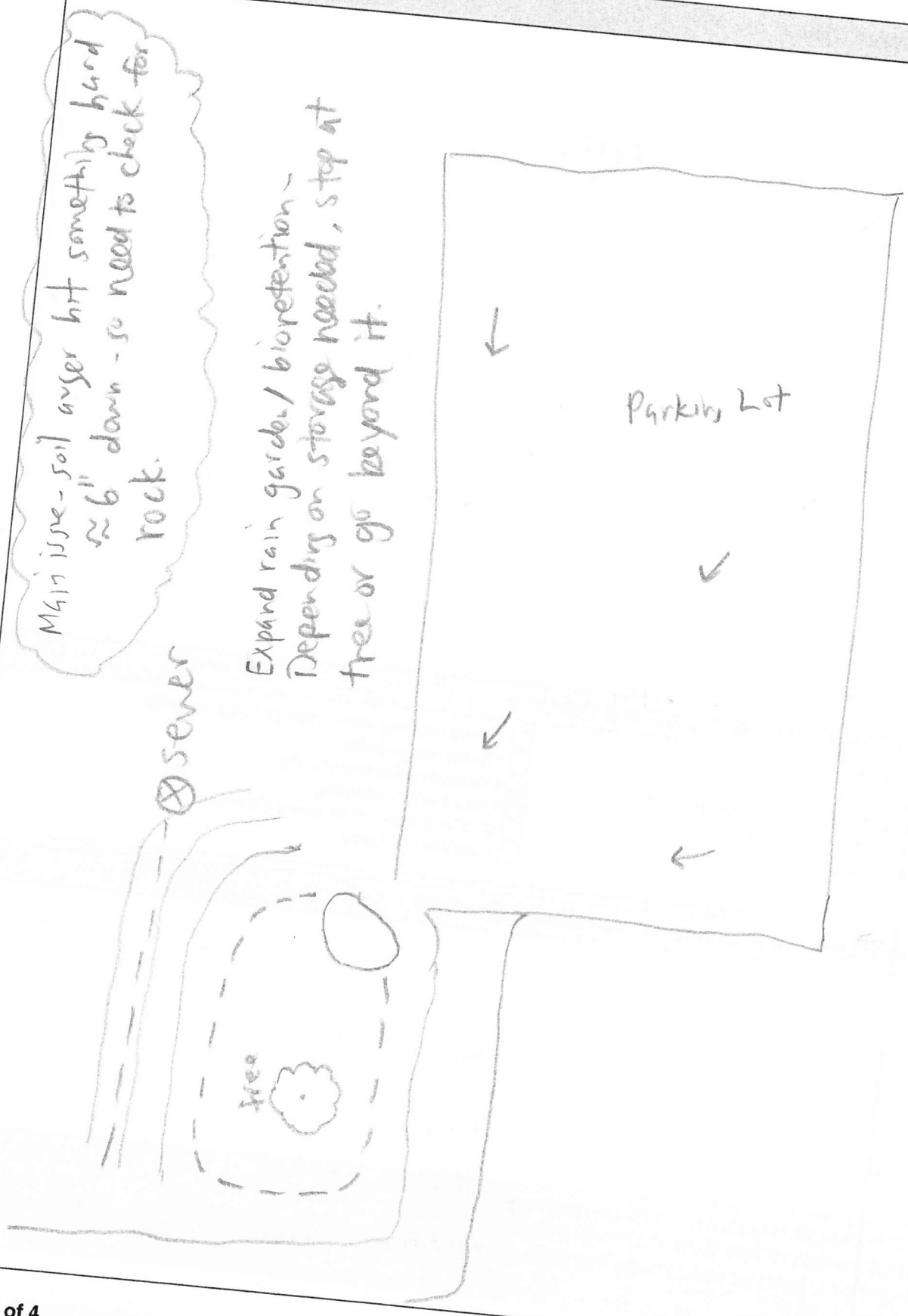
How many?_____
Approx. DBH_____

Other factors:_____

Soils:

Soil auger test holes:	☒ Yes	☐ No	clay loam - but only a few inches to rock! Needs to be checked.
Evidence of poor infiltration (clays, fines):	☐ Yes	☐ No	
Evidence of shallow bedrock:	☐ Yes	☐ No	
Evidence of high water table (gleying, saturation):	☐ Yes	☐ No	

SKETCH



Unique Site ID: H-22-B

DESIGN OR DELIVERY NOTES

- Check for rock

FOLLOW-UP NEEDED TO COMPLETE FIELD CONCEPT

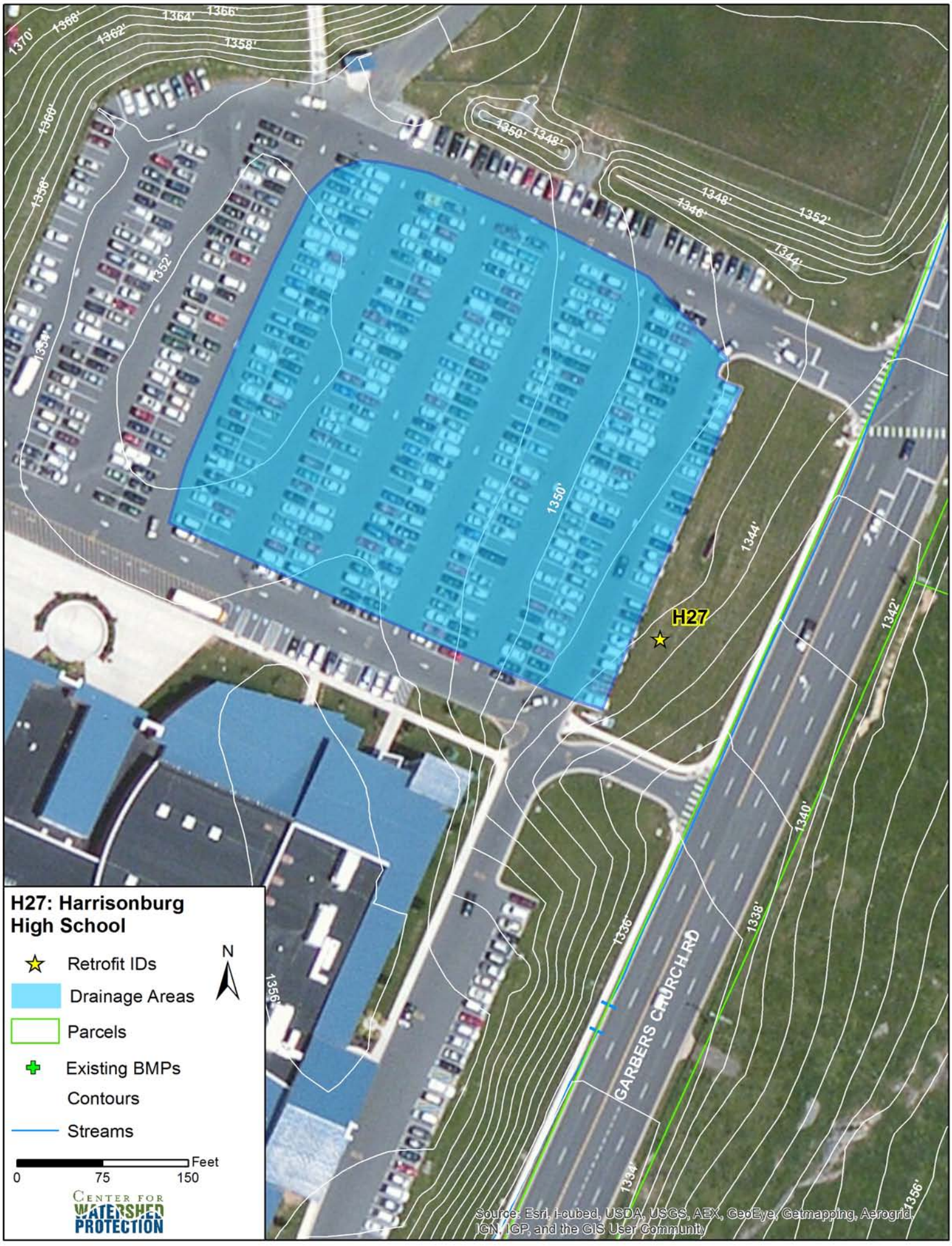
- [ ] Confirm property ownership
- [ ] Confirm drainage area
- [ ] Confirm drainage area impervious cover
- [x] Confirm volume computations
- [ ] Complete concept sketch
- [ ] Obtain existing stormwater practice as-builts
- [ ] Obtain site as-builts
- [x] Obtain detailed topography
- [x] Obtain utility mapping
- [ ] Confirm storm drain invert elevations
- [ ] Confirm soil types
- [ ] Other:_____

INITIAL FEASIBILITY AND CONSTRUCTION CONSIDERATIONS

SITE CANDIDATE FOR FURTHER INVESTIGATION:	☐ YES	☐ NO	☐ MAYBE
IS SITE CANDIDATE FOR EARLY ACTION PROJECT(S):	☐ YES	☐ NO	☐ MAYBE
IF NO, SITE CANDIDATE FOR OTHER RESTORATION PROJECT(S):	☐ YES	☐ NO	☐ MAYBE

IF YES, TYPE(S):_____

H27: Harrisonburg High School


H27
GARBERS CHURCH RD
1370'
1368'
1366'
1364'
1362'
1360'
1358'
1356'
1354'
1352'
1350'
1348'
1346'
1344'
1342'
1340'
1338'
1336'
1334'
H27: Harrisonburg High School
Retrofit IDs
Drainage Areas
Parcels
Existing BMPs
Contours
Streams
N
Feet
0
75
150
CENTER FOR WATERSHED PROTECTION
Source: Esri, i-cubed, USDA, USGS, AEX, GeoEye, Getmapping, Aerogrid, IGN, IGP, and the GIS User Community

H27: Harrisonburg High School

Score: 43

Rank: 10

Investigators: Wes Runion, Jeremy Harold, Lisa Fraley-McNeal

Figure 1: *Convert this area to bioretention*

Figure 2: *Parking lot drainage to the proposed site*

Description: Approximately 2 acres of the parking lot currently drains to inlets along the eastern edge of the lot. There is a large grass area between the parking lot and Garbers Church Rd that is unused except for a school sign (Figure 1).

Proposed Retrofit: A bioretention practice is proposed for the grass area between the parking lot and Garbers Church Rd. Relocation of the school sign can be avoided by installing the practice to the south of the sign and near the parking lot. However, relocation of the sign may be desired for aesthetic purposes. There is adequate space to install a 25' x 100' bioretention and the underdrain would be tied into the existing inlet at the southernmost corner of the lot. The parking lot inlet would be blocked and curb cuts would direct parking lot drainage into the practice. This bioretention would be a good demonstration project due to visibility of the site, ability to treat a large amount of impervious cover, and the potential to involve students in the construction process.

WATERSHED:	SUBWATERSHED:	UNIQUE SITE ID: H27	
DATE: 20 March 2013	ASSESSED BY: Wes Lisa	CAMERA ID:	PICTURES:
GPS ID:	LMK ID:	LAT:	LONG:

SITE DESCRIPTION

Name: HHS
Address: Barbers church Rd

Ownership: ☐ Public ☐ Private ☐ Unknown
If Public, Government Jurisdiction: ☒ Local ☐ State ☐ DOT ☐ Other:

Corresponding USSR/USA Field Sheet? ☐ Yes ☐ No If yes, Unique Site ID:

Proposed Retrofit Location:

Storage
- ☐ Existing Pond
- ☐ Below Outfall
- ☐ In Road ROW
- ☐ Other:
- ☐ Above Roadway Culvert
- ☐ In Conveyance System
- ☐ Near Large Parking Lot

On-Site
- ☐ Hotspot Operation
- ☒ Small Parking Lot
- ☐ Individual Street
- ☐ Underground
- ☐ Individual Rooftop
- ☐ Small Impervious Area
- ☐ Landscape / Hardscape
- ☐ Other:

DRAINAGE AREA TO PROPOSED RETROFIT

Drainage Area ≈ 2.12 ac
Imperviousness ≈ 100 %
Impervious Area ≈ 2.12 ac

Notes:

Drainage Area Land Use:
- ☐ Residential
  - ☐ SFH (< 1 ac lots)
  - ☐ SFH (> 1 ac lots)
  - ☐ Townhouses
  - ☐ Multi-Family
- ☐ Commercial
- ☒ Institutional
- ☐ Industrial
- ☐ Transport-Related
- ☐ Park
- ☐ Undeveloped
- ☐ Other:

EXISTING STORMWATER MANAGEMENT

Existing Stormwater Practice: ☒ Yes ☐ No ☐ Possible
If Yes, Describe:

School drainage is treated by a detention pond at the southern end of the property.

Describe Existing Site Conditions, Including Existing Site Drainage and Conveyance:
Existing Street Width (if applicable):

2/3 parking lot drained into stormwater system through parking lot inlets. Large grassy area at the front of the parking lot.

Existing Head Available:

9½' measured from manhole rim to catch basin invert

Note where points are measured from: (i.e. street elevation to catch basin invert, manhole rim to catch basin invert, other)

PROPOSED RETROFIT

Purpose of Retrofit:
☒ Water Quality ☐ Recharge ☐ Channel Protection ☐ Flood Control
☒ Demonstration / Education ☐ Repair ☐ Other:_____

Retrofit Volume Computations - Target Storage:
7,311 ft³

Retrofit Volume Computations - Available Storage:
4,197 ft³

Proposed Retrofit Practice: (Runoff Reduction)
☐ Disconnection ☒ Bioretention ☐ Bio Swale
☐ Expanded Tree Pit ☐ Infiltration ☐ Green Roof
☐ Permeable Pavement ☐ Rainwater Harvesting

Proposed Retrofit Practice: (Stormwater Treatment)
☐ Constructed Wetland ☐ Wet Swale ☐ Wet Pond
☐ Filtering Practice ☐ Proprietary:_____
☐ Other: _____

Retrofit Category (as defined by Chesapeake Bay Program):
☒ New BMP ☐ BMP Enhancement ☐ BMP Restoration ☐ BMP Conversion ☐ Not CBP-approved

Describe Elements of Proposed Retrofit, Including Surface Area, Maximum Depth of Treatment, and Conveyance:
Create bioretention area b/w parking lot & Barbers church Rd to capture runoff from parking lot. Tie underdrain into existing parking lot inlet.

Available Width:	35'
Available Length:	100'
Available Area:	3500ft²
Ponding Depth:	1'
Soil Depth:	36"

SITE CONSTRAINTS

Adjacent Land Use:
☐ Residential ☐ Commercial ☒ Institutional
☐ Industrial ☐ Transport-Related ☐ Park
☐ Undeveloped ☐ Other:_____
Possible Conflicts Due to Adjacent Land Use? ☐ Yes ☒ No
If Yes, Describe:

Access:
☒ No Constraints
Constrained due to
☐ Slope ☐ Space
☐ Utilities ☐ Tree Impacts
☐ Structures ☐ Property
Ownership
☐ Other:_____

Conflicts with Existing Utilities:

	Yes	Possible/ Modifiable	No	Unknown
Sewer:	☐	☐	☒	☐
Water:	☐	☐	☐	☒
Gas:	☐	☐	☒	☐
Electric to Streetlights:	☐	☐	☒	☐
Other:	☐	☒	☐	☐

School sign located in grass area

Potential Permitting Factors:

Dam Safety Permits Necessary	☐ Probable	☒ Not Probable
Impacts to Wetlands	☐ Probable	☒ Not Probable
Impacts to a Stream	☐ Probable	☒ Not Probable
Floodplain Fill	☐ Probable	☒ Not Probable
Impacts to Forests	☐ Probable	☒ Not Probable
Impacts to Specimen Trees	☐ Probable	☒ Not Probable

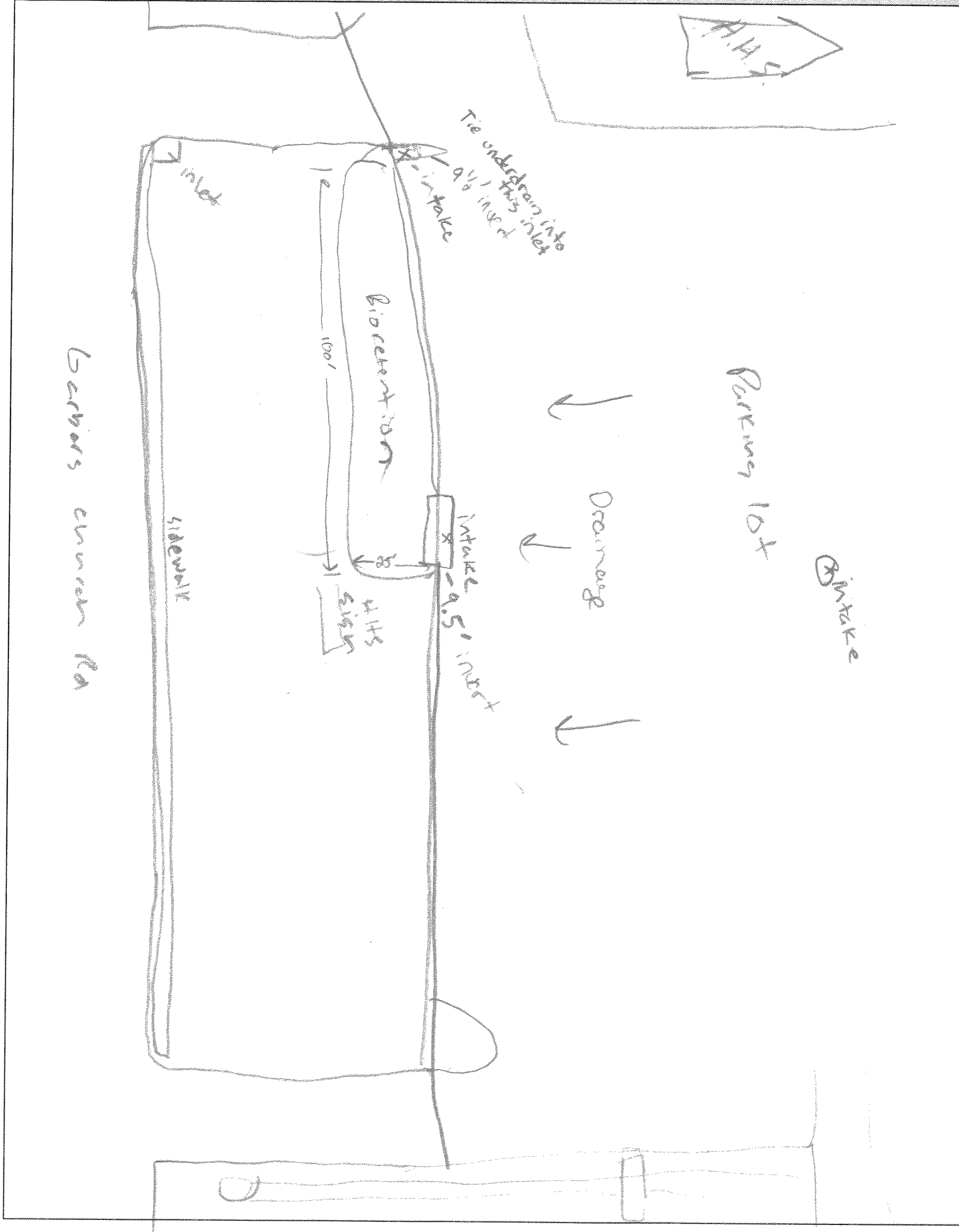
How many?_____
Approx. DBH_____

Other factors:_____

Soils:

Soil auger test holes:	☐ Yes	☒ No
Evidence of poor infiltration (clays, fines):	☐ Yes	☒ No
Evidence of shallow bedrock:	☐ Yes	☒ No
Evidence of high water table (gleying, saturation):	☐ Yes	☒ No

SKETCH


inlet
intake
Tie underdrain into this inlet
Bioretention
100'
25'
intake
9.5' invert
sidewalk
Gerbers Church Rd
Parking lot
Drainage
intake

DESIGN OR DELIVERY NOTES

May need to relocate or work around the concrete high school sign.

FOLLOW-UP NEEDED TO COMPLETE FIELD CONCEPT

- ☐ Confirm property ownership
- ☐ Confirm drainage area
- ☐ Confirm drainage area impervious cover
- ☒ Confirm volume computations
- ☐ Complete concept sketch
- ☐ Obtain existing stormwater practice as-builts
- ☐ Obtain site as-builts
- ☐ Obtain detailed topography
- ☐ Obtain utility mapping
- ☐ Confirm storm drain invert elevations
- ☐ Confirm soil types
- ☐ Other:_____

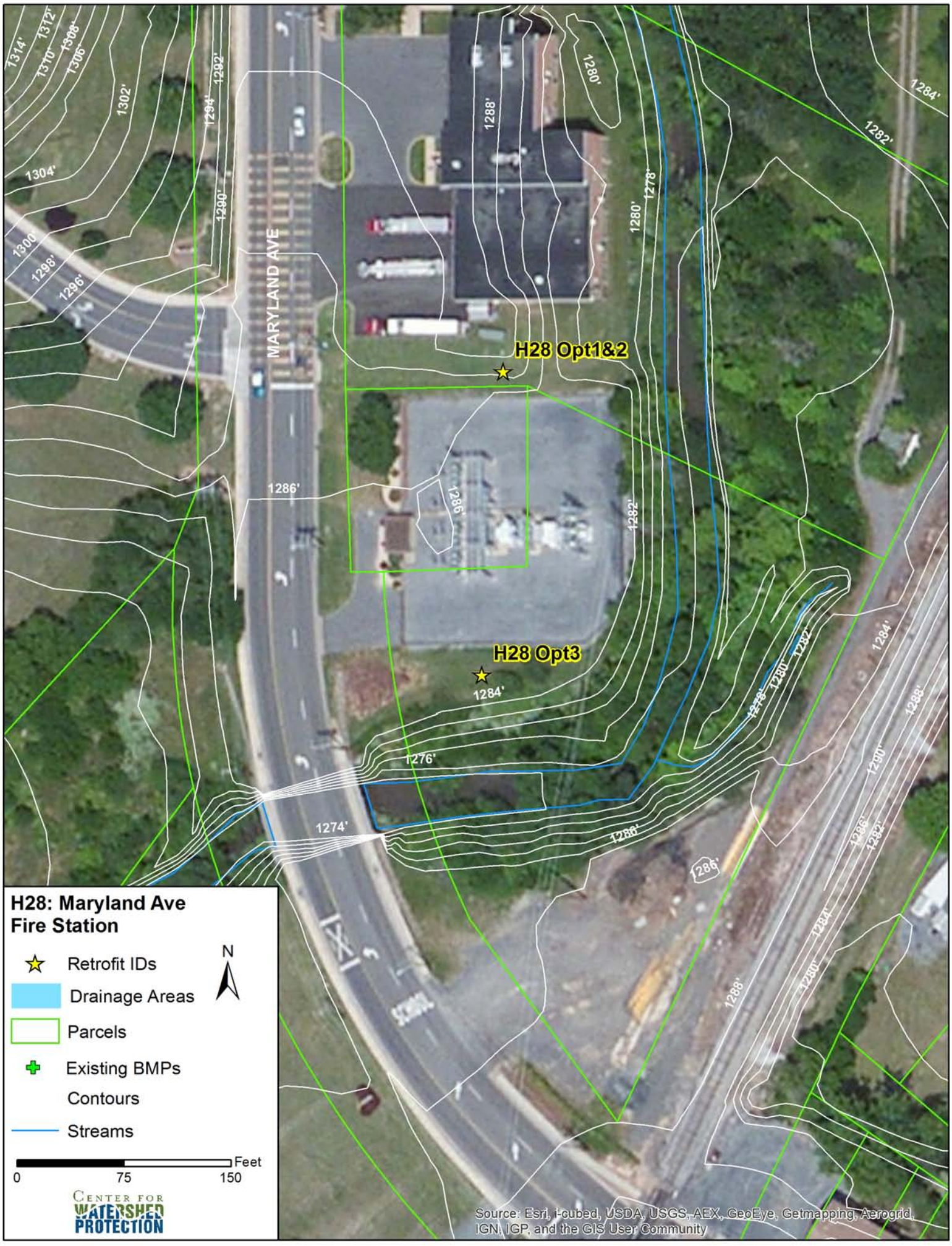
INITIAL FEASIBILITY AND CONSTRUCTION CONSIDERATIONS

Good site for demonstration project in front of school.

SITE CANDIDATE FOR FURTHER INVESTIGATION:	☐ YES	☐ NO	☐ MAYBE
IS SITE CANDIDATE FOR EARLY ACTION PROJECT(S):	☐ YES	☐ NO	☐ MAYBE
IF NO, SITE CANDIDATE FOR OTHER RESTORATION PROJECT(S):	☐ YES	☐ NO	☐ MAYBE

IF YES, TYPE(S):_____

H28: Maryland Ave Fire Station


MARYLAND AVE
H28 Opt1&2
H28 Opt3
1284'
1286'
1276'
1274'
1288'
1280'
1282'
1278'
1290'
1292'
1294'
1296'
1298'
1300'
1302'
1304'
1306'
1308'
1310'
1312'
1314'
H28: Maryland Ave Fire Station
Retrofit IDs
Drainage Areas
Parcels
Existing BMPs
Contours
Streams
N
Feet
0
75
150
Center for Watershed Protection
Source: Esri, i-cubed, USDA, USGS, AEX, GeoEye, Getmapping, Aerogrid, IGN, IGP, and the GIS User Community

H28: Maryland Ave Fire Station – Options 1, 2, & 3

Score: 34 (Option 3)
Rank: 27 (Option 27)
Investigators: Joe Battiata, Thanh Dang

Figure 1: *Option 1 (Bioretention) & 2 (Filter Strip) location (between fire station seen on left and electrical substation seen on right)*

Figure 2: *Option 3 location – south of and adjacent to electric substation (seen on left)*

Description: The fire station parking lot runoff and the water from the frequent fire truck washing drains to Maryland Ave curb and gutter and then discharge directly into the adjacent creek, approximately 200 feet south of the fire station entrance. The parking lot is approximately 10,000 ft^2 in size. This retrofit is located in the narrow grass strip adjacent to the southern edge of the fire station between the fire station and the electrical substation (Option 1 & 2; Figure 1), or further south in the grass strip between the electrical substation and the creek (Option 3, Figure 2).

Proposed Retrofit:

Option 1: This retrofit option requires that a trench drain be built across the fire station entrance to capture the rainwater runoff and the truck wash runoff prior to entering the Maryland Ave curb and gutter drainage system. The trench drain would then discharge to the proposed 30' x 80' bioretention area and the underdrain would daylight to the existing creek behind the fire station.

Option 2: The existing gas line located in the grass strip described above may be a main transmission line and excavation of any depth may not be acceptable. In this case, the area can be converted to a 30' x 80' filter strip through minor grading of the surface. The style or model of trench drain would need to be carefully selected in order to ensure the shallowest depth possible.

Option 3: This option avoids the requirement for a trench drain in the fire station entrance, as well as the possible disturbance of the ground over the gas main, by allowing the runoff to enter the Maryland Ave curb and gutter, flowing approximately 200 feet past an existing electrical substation, through a proposed curb cut and into a grass strip. This option increases the drainage area being treated (includes the Maryland Ave drainage as well as the entire fire station parking area) and therefore requires a larger 35' x 80' bioretention footprint.

WATERSHED:	SUBWATERSHED:	UNIQUE SITE ID: H28	
DATE: 3/20/13	ASSESSED BY:	CAMERA ID:	PICTURES:
GPS ID:	LMK ID:	LAT:	LONG:

SITE DESCRIPTION

Name: FIRE STATION ON MARYLAND AVE
Address:

Ownership: ☒ Public ☐ Private ☐ Unknown
If Public, Government Jurisdiction: ☐ Local ☐ State ☐ DOT ☐ Other:

Corresponding USSR/USA Field Sheet? ☐ Yes ☐ No If yes, Unique Site ID:

Proposed Retrofit Location:

Storage
- ☐ Existing Pond
- ☐ Below Outfall
- ☐ In Road ROW
- ☒ Other: ADJACENT TO FIRESTATION & ELECT. SUBSTATION
- ☐ Above Roadway Culvert
- ☐ In Conveyance System
- ☐ Near Large Parking Lot

On-Site
- ☒ Hotspot Operation
- ☒ Small Parking Lot
- ☐ Individual Street
- ☐ Underground
- ☐ Individual Rooftop
- ☐ Small Impervious Area
- ☐ Landscape / Hardscape
- ☐ Other:

DRAINAGE AREA TO PROPOSED RETROFIT

Drainage Area ≈ APPROX. 10,000 FT²
Imperviousness ≈ 100 % OPTION 1 & 2
Impervious Area ≈ 10,000 FT²

Notes: OPTION 3 LOCATION INCREASES DA (MARYLAND AVE DRAINAGE) TO 0.83 Ac (100% IMPERVIOUS)

Drainage Area Land Use:
- ☐ Residential
  - ☐ SFH (< 1 ac lots)
  - ☐ SFH (> 1 ac lots)
  - ☐ Townhouses
  - ☐ Multi-Family
- ☐ Commercial
- ☐ Institutional
- ☒ Industrial
- ☐ Transport-Related
- ☐ Park
- ☐ Undeveloped
- ☐ Other: FIRE STA

EXISTING STORMWATER MANAGEMENT

Existing Stormwater Practice: ☐ Yes ☒ No ☐ Possible
If Yes, Describe:

Describe Existing Site Conditions, Including Existing Site Drainage and Conveyance:
Existing Street Width (if applicable):
FIRESTATION DRIVE WAY — TRUCK WASHING

Existing Head Available:
HEAD AVAILABLE IF RUN AN UNDER DRAIN ALL THE WAY TO CREEK

Note where points are measured from: (i.e. street elevation to catch basin invert, manhole rim to catch basin invert, other)

PROPOSED RETROFIT

Purpose of Retrofit:
☒ Water Quality ☐ Recharge ☐ Channel Protection ☐ Flood Control
☐ Demonstration / Education ☐ Repair ☐ Other:_____

Retrofit Volume Computations - Target Storage:

Retrofit Volume Computations - Available Storage:

Proposed Retrofit Practice: (Runoff Reduction)
☒ Disconnection ☒ Bioretention ☐ Bio Swale
☐ Expanded Tree Pit ☐ Infiltration ☐ Green Roof
☐ Permeable Pavement ☐ Rainwater Harvesting

Proposed Retrofit Practice: (Stormwater Treatment)
☐ Constructed Wetland ☐ Wet Swale ☐ Wet Pond
☐ Filtering Practice ☐ Proprietary:_____
☐ Other: _____

Retrofit Category (as defined by Chesapeake Bay Program):
☒ New BMP ☐ BMP Enhancement ☐ BMP Restoration ☐ BMP Conversion ☐ Not CBP-approved

Describe Elements of Proposed Retrofit, Including Surface Area, Maximum Depth of Treatment, and Conveyance:
USE VEGETATED FILTER OR BIORETENTION TO FILTER TRUCK WASH WATER

OPTION 1 & 2

Available Width:	~30'
Available Length:	~80'
Available Area:	2,400 ft²
Ponding Depth:	6"
Soil Depth:	18"-24"

OPTION 3
35 x 80' = 2,800 ft²

SITE CONSTRAINTS

Adjacent Land Use:
☐ Residential ☐ Commercial ☒ Institutional
☐ Industrial ☐ Transport-Related ☐ Park
☐ Undeveloped ☐ Other: FIRE STATION / ELECTRIC SUB STA.
Possible Conflicts Due to Adjacent Land Use? ☐ Yes ☒ No
If Yes, Describe:

Access:
☒ No Constraints
Constrained due to
☐ Slope ☐ Space
☐ Utilities ☐ Tree Impacts
☐ Structures ☐ Property
Ownership
☐ Other:_____

Conflicts with Existing Utilities:

	Yes	Possible/ Modifiable	No	Unknown
Sewer:	☐	☐	☒	☐
Water:	☐	☐	☒	☐
Gas:	☒	☒	☐	☐
Electric to Streetlights:	☐	☐	☒	☐
Other:	☐	☐	☐	☐

_____

Potential Permitting Factors:

Dam Safety Permits Necessary	☐ Probable	☒ Not Probable
Impacts to Wetlands	☐ Probable	☒ Not Probable
Impacts to a Stream	☐ Probable	☒ Not Probable
Floodplain Fill	☐ Probable	☒ Not Probable
Impacts to Forests	☐ Probable	☒ Not Probable
Impacts to Specimen Trees	☐ Probable	☒ Not Probable

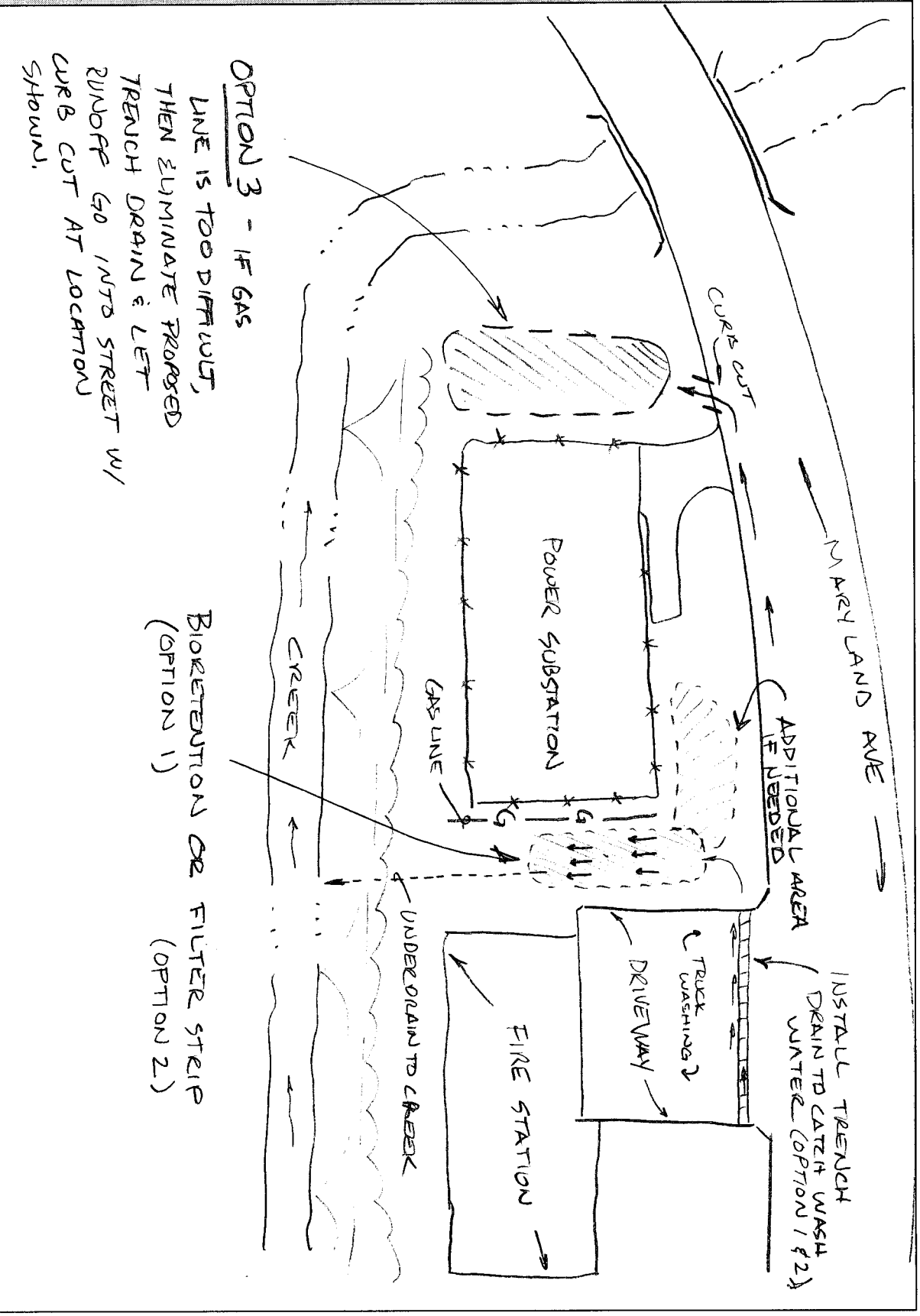
How many?_____
Approx. DBH_____

Other factors:_____
_____

Soils:

Soil auger test holes:	☐ Yes	☒ No
Evidence of poor infiltration (clays, fines):	☐ Yes	☒ No
Evidence of shallow bedrock:	☐ Yes	☒ No
Evidence of high water table (gleying, saturation):	☐ Yes	☒ No

SKETCH


MARYLAND AVE
CURB CUT
ADDITIONAL AREA IF NEEDED
INSTALL TRENCH DRAIN TO CATCH WASH WATER (OPTION 1 & 2)
TRUCK WASHING
DRIVEWAY
FIRE STATION
POWER SUBSTATION
GAS LINE
G
G
UNDERDRAIN TO CREEK
CREEK
OPTION 3 - IF GAS LINE IS TOO DIFFICULT, THEN ELIMINATE PROPOSED TRENCH DRAIN & LET RUNOFF GO INTO STREET W/ CURB CUT AT LOCATION SHOWN.
BIORETENTION OR FILTER STRIP
(OPTION 1)
(OPTION 2)

Design or Delivery Notes

OPTION 1 : BIORETENTION W/ UNDERDRAIN TO CREEK

OPTION 2: FILTER STRIP (IF EX. GAS LINE IS TOO DIFFICULT TO
DA = 10,000 ft² = 0.23 Ac (FH DRIVEWAY TRUCK WASH AREA)
FOR BOTH OPTION 1 & 2

OPTION B : IF GAS LINE CONFLICTS – LET WASH WATER EXIT FIRE HOUSE DRIVEWAY TO STREET. CREATE CURB CUT BEFORE LAST CURB INLET ON MARYLAND AVE TO DIVERT ROAD RUNOFF + FIRE HOUSE DRIVEWAY
DA = 0.83 Ac – FH DRIVEWAY TRUCK WASH AREA (0.23 Ac)
+ ROAD WAY + ADJ. FH ENTRANCE (FRONT OF FIREHOUSE MAIN BLDG.) 0.60 Ac

DA = 10,000 ft²

Follow-up Needed to Complete Field Concept

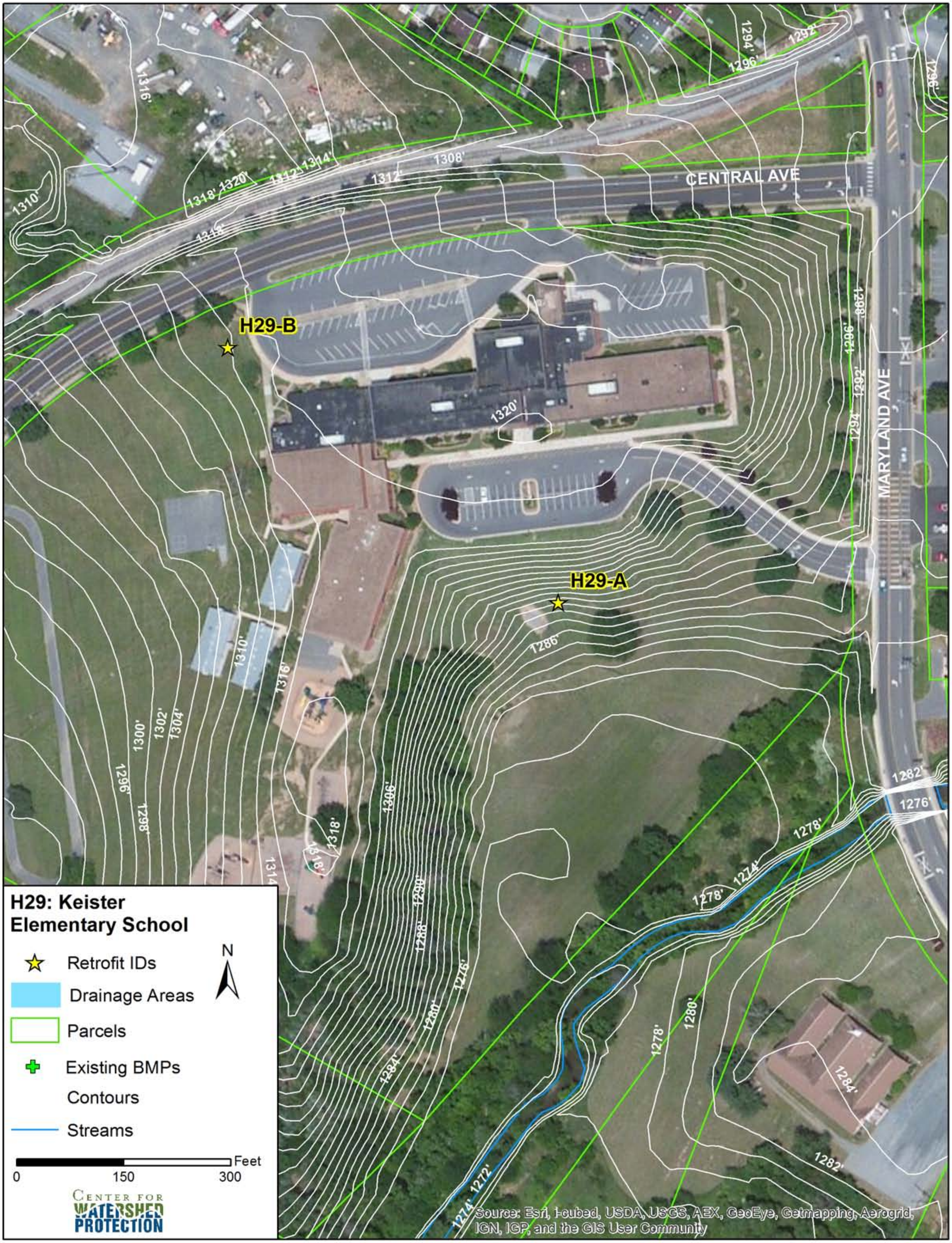
- ☐ Confirm property ownership
- ☒ Confirm drainage area
- ☐ Confirm drainage area impervious cover
- ☒ Confirm volume computations
- ☐ Complete concept sketch
- ☐ Obtain existing stormwater practice as-builts
- ☐ Obtain site as-builts
- ☒ Obtain detailed topography
- ☒ Obtain utility mapping
- ☐ Confirm storm drain invert elevations
- ☒ Confirm soil types
- ☐ Other: _____

Initial Feasibility and Construction Considerations

Site Candidate for Further Investigation:	☐ Yes	☐ No	☐ Maybe
Is Site Candidate for Early Action Project(s):	☐ Yes	☐ No	☐ Maybe
If no, site candidate for other Restoration Project(s):	☐ Yes	☐ No	☐ Maybe

If yes, type(s): _____

H29: Keister Elementary School


H29: Keister Elementary School
Retrofit IDs
Drainage Areas
Parcels
Existing BMPs
Contours
Streams
N
Feet
0
150
300
CENTER FOR WATERSHED PROTECTION
H29-A
H29-B
CENTRAL AVE
MARYLAND AVE
1320'
1318'
1316'
1314'
1312'
1310'
1308'
1306'
1304'
1302'
1300'
1298'
1296'
1294'
1292'
1290'
1288'
1286'
1284'
1282'
1280'
1278'
1276'
1274'
1272'
Source: Esri, i-cubed, USDA, USGS, AEX, GeoEye, Getmapping, Aerogrid, IGN, IGP, and the GIS User Community

H29-A: Keister Elementary School

Score: 50
Rank: 5
Investigators: Joe Battiata, Thanh Dang

Figure 1: *Parking lot contributing drainage area*

Figure 2: *Proposed retrofit location at storm drain outfall near toe of slope*

Description: The Keister Elementary School includes two large parking lots. Retrofit H29-A serves the parking lot in the rear of the building (Figure 1). The parking lot is approximately 0.6 acres and is served by a drainage system consisting of two curb inlets that discharge to a single outfall near the bottom of a large slope (Figure 2). The existing outfall condition consists of a riprap energy dissipater that appears to be periodically sprayed with herbicide to keep vegetation and nuisance conditions down.

Proposed Retrofit: This retrofit consists of a 10’ x 70’ bioretention area benched into the lower portion of the hillside at the location of the existing outfall. Approximately 5 to 7 feet of vertical elevation is available below the outfall to accommodate the excavation for a full depth bioretention basin and underdrain.

H29-B: Keister Elementary School

Score: 41

Rank: 12

Investigators: Joe Battiata, Thanh Dang

Figure 1: *Parking lot contributing drainage area and existing erosion*

Figure 2: *Existing drainage outlets to relieve ponding in parking lot*

Description: The Keister Elementary School includes two large parking lots. Retrofit H29-B serves the front parking lot and bus loop (Figure 1). The drainage appears to have been modified to eliminate a ponding area. Three small diameter pipes were added to a section of sidewalk to drain approximately 0.17 acres of the impervious cover. The outlet appears to be subject to erosion (Figures 1 & 2).

Proposed Retrofit: This retrofit is a 15’ x 35’ bioretention basin that ideally will not require an underdrain. If required due to poor soils, the gentle slopes away from the parking lot will require the underdrain be extended in order to daylight. However, there is plenty of room if this is found necessary.

WATERSHED:	SUBWATERSHED:	UNIQUE SITE ID: H29	
DATE: 3/20/13	ASSESSED BY: JG, JB	CAMERA ID:	PICTURES:
GPS ID:	LMK ID:	LAT:	LONG:

SITE DESCRIPTION

Name: KEISTER ELEMENTARY SCHOOL
Address:

Ownership: ☒ Public ☐ Private ☐ Unknown
If Public, Government Jurisdiction: ☐ Local ☐ State ☐ DOT ☐ Other:

Corresponding USSR/USA Field Sheet? ☐ Yes ☐ No If yes, Unique Site ID:

Proposed Retrofit Location:

Storage
- ☐ Existing Pond
- ☐ Below Outfall
- ☐ In Road ROW
- ☐ Other:
- ☐ Above Roadway Culvert
- ☐ In Conveyance System
- ☐ Near Large Parking Lot

On-Site
- ☐ Hotspot Operation
- ☐ Small Parking Lot
- ☐ Individual Street
- ☐ Underground
- ☐ Individual Rooftop
- ☐ Small Impervious Area
- ☐ Landscape / Hardscape
- ☐ Other:

DRAINAGE AREA TO PROPOSED RETROFIT

	H29A	H29B
Drainage Area ≈	0.60 Ac.	0.17 Ac
Imperviousness ≈	88 %	100%
Impervious Area ≈	0.53 Ac	0.17 Ac

Notes:

Drainage Area Land Use:
- ☐ Residential
  - ☐ SFH (< 1 ac lots)
  - ☐ SFH (> 1 ac lots)
  - ☐ Townhouses
  - ☐ Multi-Family
- ☐ Commercial
- ☒ Institutional
- ☐ Industrial
- ☐ Transport-Related
- ☐ Park
- ☐ Undeveloped
- ☐ Other:

EXISTING STORMWATER MANAGEMENT

Existing Stormwater Practice: ☐ Yes ☒ No ☐ Possible
If Yes, Describe:

Describe Existing Site Conditions, Including Existing Site Drainage and Conveyance:
Existing Street Width (if applicable):

H29 A – TOE OF SLOPE BELOW PARKING LOT. OUTFALL FROM SINGLE PIPE

H29 B – ADJACENT TO PARKING LOT (FRONT). 4 3 SMALL PIPES DRAIN PAVEMENT UNDER SIDEWALK TO GRASS AREA

Existing Head Available: A. 3 ft. OR MORE
B. 2.5 ft. or MORE – gentle grade away from parking

Note where points are measured from: (i.e. street elevation to catch basin invert, manhole rim to catch basin invert, other)

PROPOSED RETROFIT

Purpose of Retrofit:
☒ Water Quality ☐ Recharge ☐ Channel Protection ☐ Flood Control
☐ Demonstration / Education ☐ Repair ☐ Other:_____

Retrofit Volume Computations - Target Storage:
A: 1,880 ft³ B: 590 ft³

Retrofit Volume Computations - Available Storage:
A: 700 ft³ B: 595 ft³
↳ MAY BE INCREASED W/ ADDITIONAL GRADING

Proposed Retrofit Practice: (Runoff Reduction)
☐ Disconnection ☒ Bioretention ☐ Bio Swale
☐ Expanded Tree Pit ☐ Infiltration ☐ Green Roof
☐ Permeable Pavement ☐ Rainwater Harvesting

Proposed Retrofit Practice: (Stormwater Treatment)
☐ Constructed Wetland ☐ Wet Swale ☐ Wet Pond
☐ Filtering Practice ☐ Proprietary:_____
☐ Other: _____

Retrofit Category (as defined by Chesapeake Bay Program):
☐ New BMP ☐ BMP Enhancement ☐ BMP Restoration ☐ BMP Conversion ☐ Not CBP-approved

Describe Elements of Proposed Retrofit, Including Surface Area, Maximum Depth of Treatment, and Conveyance:

AREA MAY BE INCREASED IF NEEDED AND GRADES ALLOW.

	A	B
Available Width:	10'	15
Available Length:	70'	35
Available Area:		
Ponding Depth:	12"	12"
Soil Depth:	24"	18"

SITE CONSTRAINTS

Adjacent Land Use:
☐ Residential ☐ Commercial ☒ Institutional
☐ Industrial ☐ Transport-Related ☐ Park
☐ Undeveloped ☐ Other:_____
Possible Conflicts Due to Adjacent Land Use? ☐ Yes ☐ No
If Yes, Describe:

Access:
☒ No Constraints (B)
Constrained due to
☒ Slope (A) ☐ Space
☐ Utilities ☐ Tree Impacts
☐ Structures ☐ Property
Ownership
☐ Other:_____

Conflicts with Existing Utilities: A+B

	Yes	Possible/ Modifiable	No	Unknown
Sewer:	☐	☐	☒	☐
Water:	☐	☐	☒	☐
Gas:	☐	☐	☒	☐
Electric to Streetlights:	☐	A ☒	☐	☐
Other:	☐	☐	☐	☐

Potential Permitting Factors:

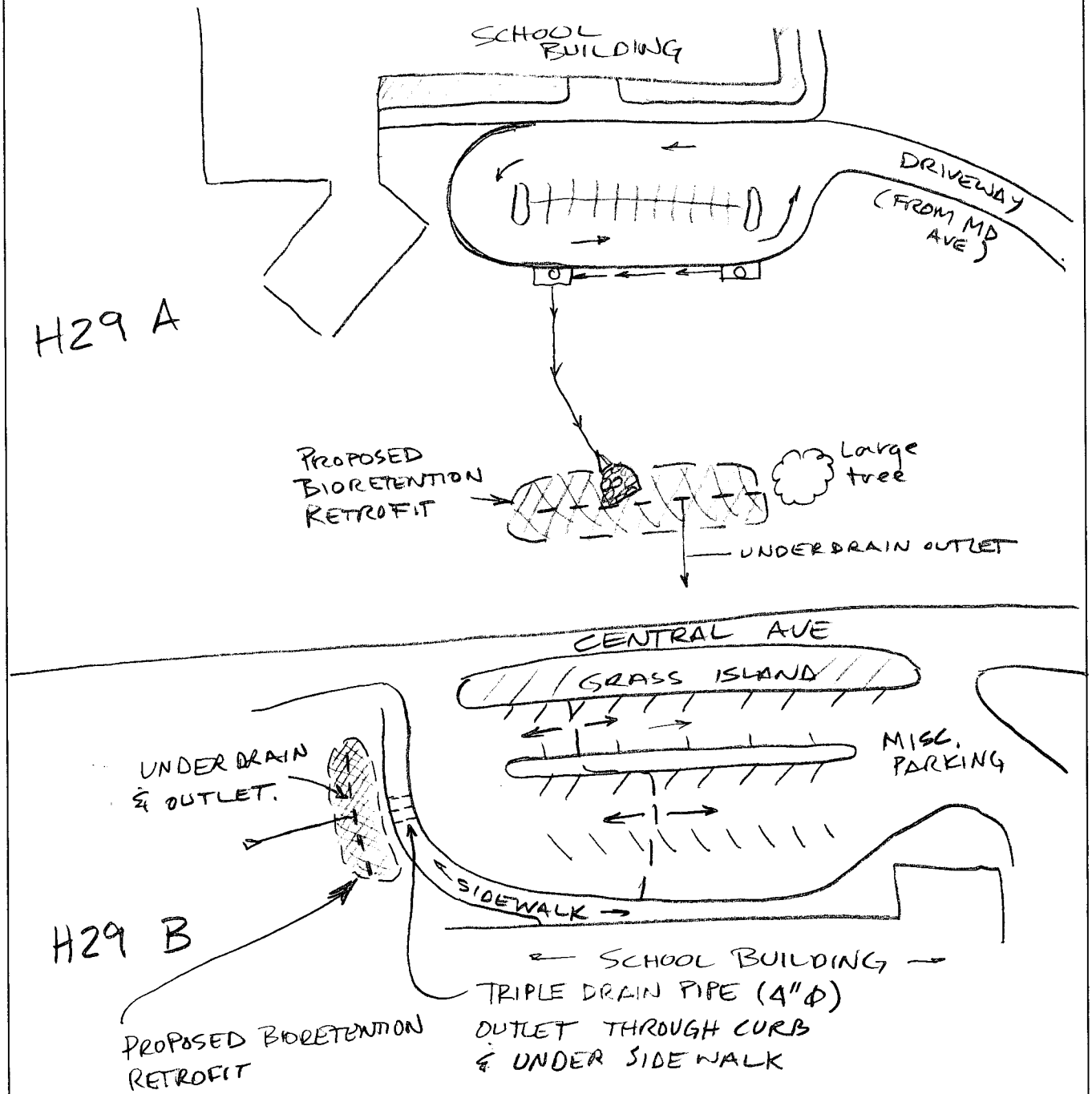
Dam Safety Permits Necessary	☐ Probable	☒ Not Probable
Impacts to Wetlands	☐ Probable	☒ Not Probable
Impacts to a Stream	☐ Probable	☒ Not Probable
Floodplain Fill	☐ Probable	☒ Not Probable
Impacts to Forests	☐ Probable	☒ Not Probable
Impacts to Specimen Trees	☐ Probable	☒ Not Probable

How many?_____
Approx. DBH_____

Other factors:_____

Soils:
Soil auger test holes: ☐ Yes ☐ No
Evidence of poor infiltration (clays, fines): ☐ Yes ☒ No
Evidence of shallow bedrock: ☐ Yes ☒ No
Evidence of high water table (gleying, saturation): ☐ Yes ☒ No

SKETCH


SCHOOL BUILDING
DRIVEWAY (FROM MD AVE)
H29 A
PROPOSED BIORETENTION RETROFIT
Large tree
UNDERDRAIN OUTLET
CENTRAL AVE
GRASS ISLAND
MISC. PARKING
UNDER DRAIN & OUTLET.
SIDEWALK
H29 B
SCHOOL BUILDING
TRIPLE DRAIN PIPE (4"Φ) OUTLET THROUGH CURB & UNDER SIDEWALK
PROPOSED BIORETENTION RETROFIT

Design or Delivery Notes

H29A – WILL REQUIRE ACCESS TO TOE OF SLOPE ADJACENT TO GENERAL ATHLETIC FIELDS.
- REQUIRE FOREBAY + LARGE STORM OVERFLOW
- UNDERDRAIN TO OUTLET TO FIELDS

H29B – ADJACENT TO BUS LOOP
- EXISTING TRIPLE PIPE OUTLET THROUG CURB.
- SHALLOW PONDING & SOIL DEPTH WILL HELP MINIMIZE LENGTH TO DAYLIGHT UNDRAIN.
- EXCAVATE GRASS AREA AS NEEDED

Follow-up Needed to Complete Field Concept

- ☐ Confirm property ownership
- ☐ Confirm drainage area
- ☐ Confirm drainage area impervious cover
- ☐ Confirm volume computations
- ☐ Complete concept sketch
- ☐ Obtain existing stormwater practice as-builts
- ☐ Obtain site as-builts
- ☐ Obtain detailed topography
- ☐ Obtain utility mapping
- ☐ Confirm storm drain invert elevations
- ☐ Confirm soil types
- ☐ Other:_____

Initial Feasibility and Construction Considerations

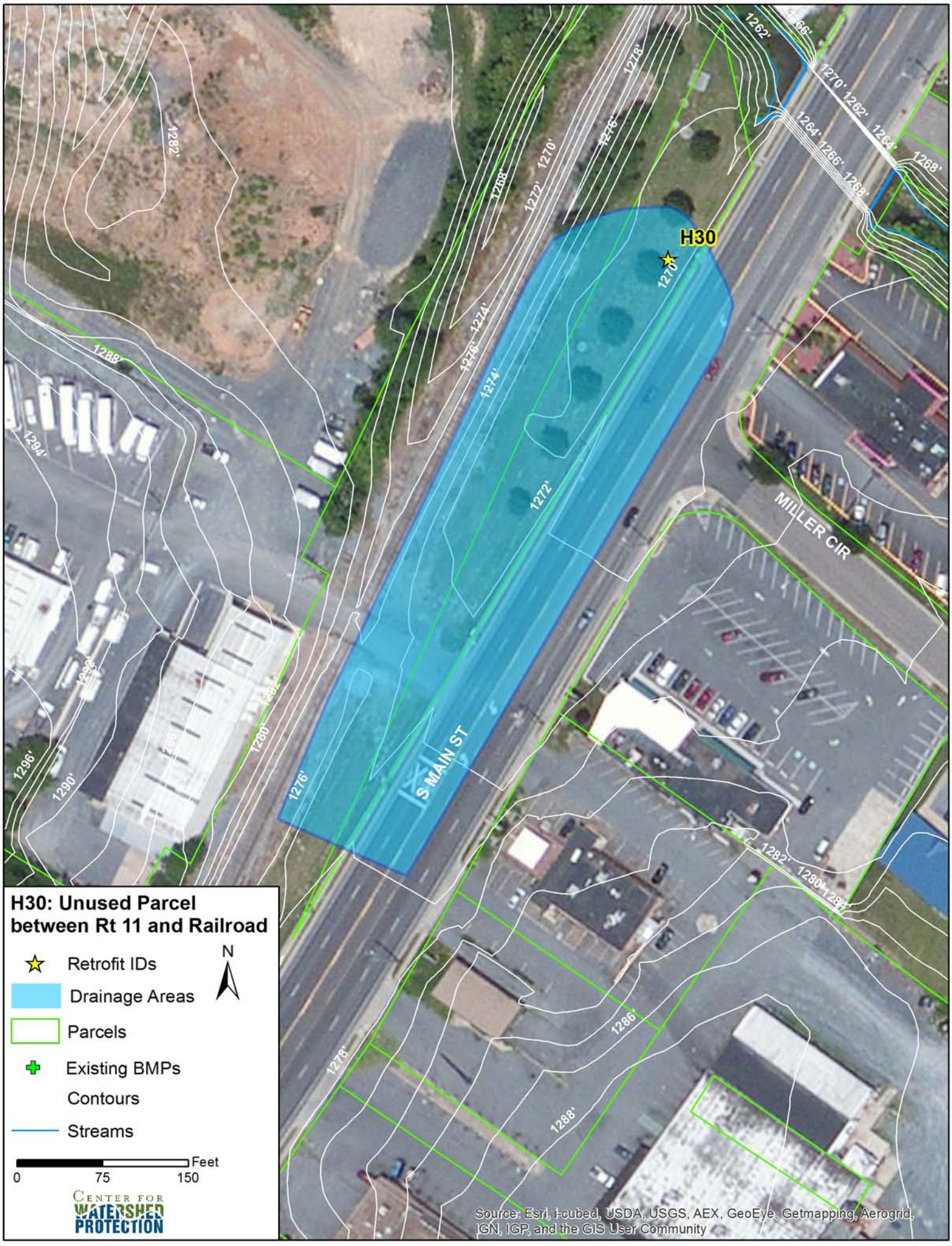
H29A – DIFFICULT ACCESS; AREA OF RETROFIT MAY BE EXPANDABLE.

H29B – EASY ACCESS

Site Candidate for Further Investigation:	☐ Yes	☐ No	☐ Maybe
Is Site Candidate for Early Action Project(s):	☐ Yes	☐ No	☐ Maybe
If no, site candidate for Other Restoration Project(s):	☐ Yes	☐ No	☐ Maybe

If yes, type(s):_____

H30: Unused Parcel between Rt 11 and Railroad


H30
S MAIN ST
MILLER CIR
1262'
1264'
1266'
1268'
1270'
1272'
1274'
1276'
1278'
1280'
1282'
1284'
1286'
1288'
1290'
1294'
1296'
H30: Unused Parcel between Rt 11 and Railroad
Retrofit IDs
Drainage Areas
Parcels
Existing BMPs
Contours
Streams
N
Feet
0
75
150
Center for Watershed Protection
Source: Esri, i-cubed, USDA, USGS, AEX, GeoEye, Getmapping, Aerogrid, IGN, IGP, and the GIS User Community

H30: Unused Parcel Between Rt. 11 and Railroad

Score: 36

Rank: 25

Investigators: Wes Runion, Jeremy Harold, Lisa Fraley-McNeal

Figure 1: *Convert this area to bioswale*

Figure 2: *Rip-rap at downstream end of grass swale*

Description: Approximately 1.3 acres of Rt. 11 near the intersection with Miller Circle, adjacent grass area, and railroad tracks drain to an unused parcel between the road and railroad. Runoff then drains across the parcel through an existing grass swale and to the stream (Figure 1). The downstream end of the swale contains rip-rap to stabilize the stream bank (Figure 2).

Proposed Retrofit: This retrofit concept converts the existing grass swale and additional grass area of the unused parcel to a bioswale. There is adequate space to install a 15' x 70' bioswale. The practice would overflow to the rip-rap area at the downstream end of the existing swale and into the stream. An existing road inlet along Rt. 11 would need to be blocked and roadway drainage directed to the bioswale. A sanitary sewer line runs the length of the parcel near the railroad and would need to be avoided. In addition, several trees are located along the parcel that should either be avoided or relocated.

WATERSHED:	SUBWATERSHED:	UNIQUE SITE ID: 1430	
DATE: 3-20-13	ASSESSED BY: Lisa Wes Jeremy	CAMERA ID:	PICTURES: 50-53
GPS ID:	LMK ID:	LAT:	LONG:

SITE DESCRIPTION

Name: Unused Parcel
Address:

Ownership: ☑ Public ☐ Private ☐ Unknown
If Public, Government Jurisdiction: ☐ Local ☐ State ☐ DOT ☐ Other:

Corresponding USSR/USA Field Sheet? ☐ Yes ☒ No If yes, Unique Site ID:

Proposed Retrofit Location:

Storage
- ☐ Existing Pond
- ☐ Below Outfall
- ☐ In Road ROW
- ☐ Other:
- ☐ Above Roadway Culvert
- ☐ In Conveyance System
- ☐ Near Large Parking Lot

On-Site
- ☐ Hotspot Operation
- ☐ Small Parking Lot
- ☒ Individual Street
- ☐ Underground
- ☐ Individual Rooftop
- ☐ Small Impervious Area
- ☐ Landscape / Hardscape
- ☒ Other: Unused Parcell

DRAINAGE AREA TO PROPOSED RETROFIT

Drainage Area ≈ 1.32 ac
Imperviousness ≈ 42% %
Impervious Area ≈ 0.55 ac

Notes:

Drainage Area Land Use:
- ☐ Residential
  - ☐ SFH (< 1 ac lots)
  - ☐ SFH (> 1 ac lots)
  - ☐ Townhouses
  - ☐ Multi-Family
- ☐ Commercial
- ☐ Institutional
- ☐ Industrial
- ☒ Transport-Related
- ☐ Park
- ☐ Undeveloped
- ☐ Other:

EXISTING STORMWATER MANAGEMENT

Existing Stormwater Practice: ☐ Yes ☒ No ☐ Possible
If Yes, Describe:

Describe Existing Site Conditions, Including Existing Site Drainage and Conveyance:
Existing Street Width (if applicable):

Unused Parcels of Land between Rt. 11 (Road) & Rail Road Tracks

Existing Head Available:	Note where points are measured from: (i.e. street elevation to catch basin invert, manhole rim to catch basin invert, other)

PROPOSED RETROFIT

Purpose of Retrofit:
☒ Water Quality ☐ Recharge ☐ Channel Protection ☐ Flood Control
☐ Demonstration / Education ☐ Repair ☐ Other:_____

Retrofit Volume Computations - Target Storage:
2,512 ft³

Retrofit Volume Computations - Available Storage:
1,259 ft³

Proposed Retrofit Practice: (Runoff Reduction)
☐ Disconnection ☒ Bioretention ☐ Bio Swale
☐ Expanded Tree Pit ☐ Infiltration ☐ Green Roof
☐ Permeable Pavement ☐ Rainwater Harvesting

Proposed Retrofit Practice: (Stormwater Treatment)
☐ Constructed Wetland ☐ Wet Swale ☐ Wet Pond
☐ Filtering Practice ☐ Proprietary:_____
☐ Other: _____

Retrofit Category (as defined by Chesapeake Bay Program):
☒ New BMP ☐ BMP Enhancement ☐ BMP Restoration ☐ BMP Conversion ☐ Not CBP-approved

Describe Elements of Proposed Retrofit, Including Surface Area, Maximum Depth of Treatment, and Conveyance:
Install Bioretention to treat Road drainage. At inlet from roadway.

Available Width:	15'
Available Length:	70'
Available Area:	1050 sqFt
Ponding Depth:	1'
Soil Depth:	18"

Overflow to existing RIP rap Swale into Stream.

Need to determine available head. Assumed 4' head available for preliminary calculations

SITE CONSTRAINTS

Adjacent Land Use:
☐ Residential ☐ Commercial ☐ Institutional
☐ Industrial ☒ Transport-Related ☐ Park
☐ Undeveloped ☐ Other:_____
Possible Conflicts Due to Adjacent Land Use? ☐ Yes ☐ No
If Yes, Describe:

Access:
☒ No Constraints
Constrained due to
☐ Slope ☐ Space
☐ Utilities ☐ Tree Impacts
☐ Structures ☐ Property
Ownership
☐ Other:_____

Conflicts with Existing Utilities:

	Yes	Possible/ Modifiable	No	Unknown
Sewer:	☒	☐	☐	☐
Water:	☐	☐	☒	☐
Gas:	☐	☐	☒	☐
Electric to Streetlights:	☐	☐	☒	☐
Other:	☐	☐	☒	☐

Potential Permitting Factors:

Dam Safety Permits Necessary	☐ Probable	☒ Not Probable
Impacts to Wetlands	☐ Probable	☒ Not Probable
Impacts to a Stream	☐ Probable	☒ Not Probable
Floodplain Fill	☐ Probable	☒ Not Probable
Impacts to Forests	☐ Probable	☒ Not Probable
Impacts to Specimen Trees	☐ Probable	☒ Not Probable

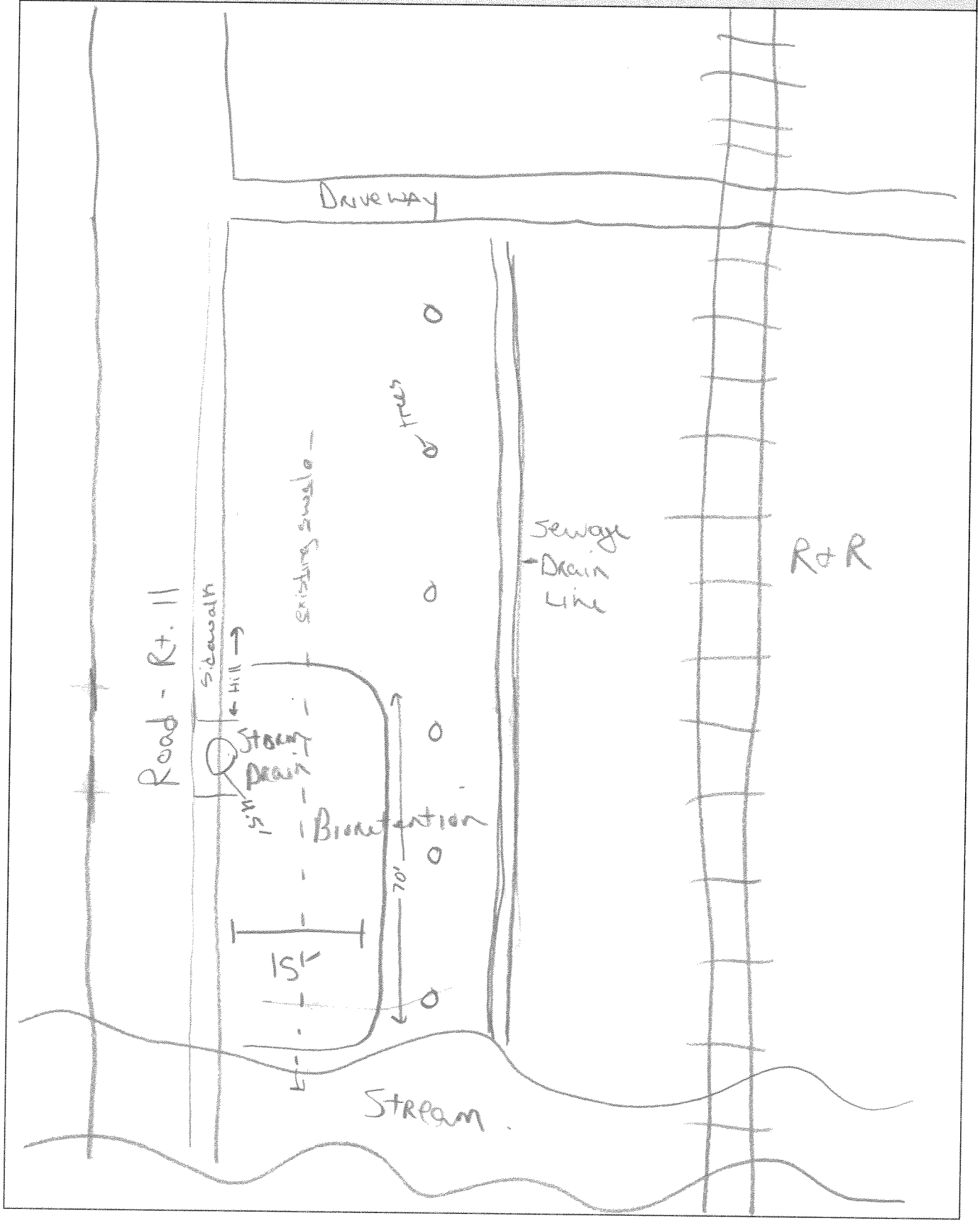
How many?_____
Approx. DBH_____

Other factors:_____

Soils:

Soil auger test holes:	☐ Yes	☒ No
Evidence of poor infiltration (clays, fines):	☐ Yes	☒ No
Evidence of shallow bedrock:	☐ Yes	☒ No
Evidence of high water table (gleying, saturation):	☐ Yes	☒ No

SKETCH


Driveway
Road - Rt. 11
sidewalk
Hill
existing shrubs
trees
Storm Drain
Bioretention
15'
70'
Sewage Drain Line
R&R
Stream

DESIGN OR DELIVERY NOTES

Size Larger as needed

Relocate as needed for sewer.

Block existing road inlet and direct drainage into bioretention area.

FOLLOW-UP NEEDED TO COMPLETE FIELD CONCEPT

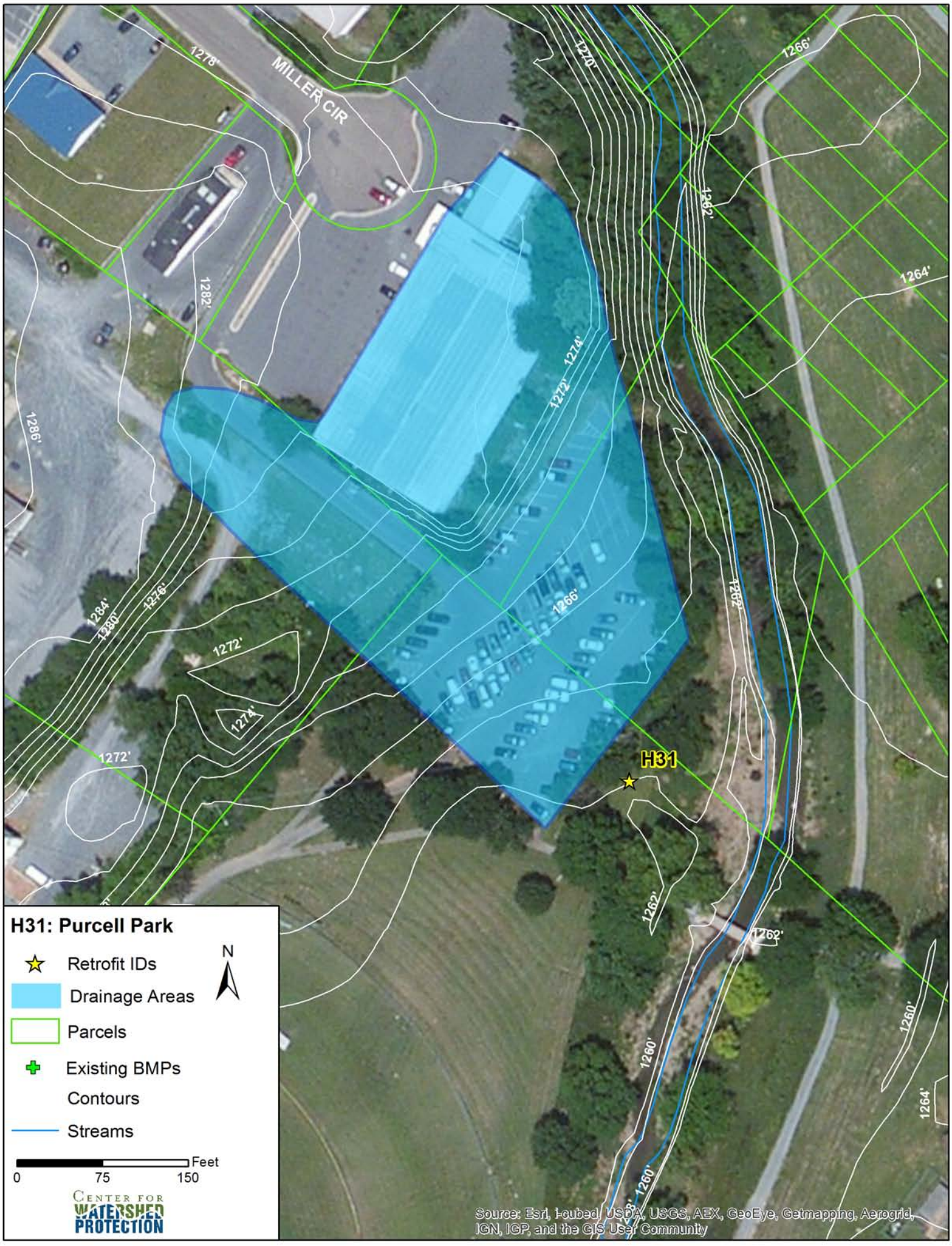
- ☐ Confirm property ownership
- ☐ Confirm drainage area
- ☐ Confirm drainage area impervious cover
- ☐ Confirm volume computations
- ☐ Complete concept sketch
- ☐ Obtain existing stormwater practice as-builts
- ☐ Obtain site as-builts
- ☐ Obtain detailed topography
- ☒ Obtain utility mapping
- ☐ Confirm storm drain invert elevations
- ☐ Confirm soil types
- ☐ Other:_____

INITIAL FEASIBILITY AND CONSTRUCTION CONSIDERATIONS

SITE CANDIDATE FOR FURTHER INVESTIGATION:	☐ YES	☐ NO	☐ MAYBE
IS SITE CANDIDATE FOR EARLY ACTION PROJECT(S):	☐ YES	☐ NO	☐ MAYBE
IF NO, SITE CANDIDATE FOR OTHER RESTORATION PROJECT(S):	☐ YES	☐ NO	☐ MAYBE

IF YES, TYPE(S):_____

H31: Purcell Park


MILLER CIR
1278'
1270'
1266'
1262'
1264'
1282'
1274'
1272'
1286'
1284'
1280'
1276'
1266'
1262'
1272'
1274'
1272'
H31
1262'
1262'
1260'
1260'
1264'
1260'
H31: Purcell Park
Retrofit IDs
Drainage Areas
Parcels
Existing BMPs
Contours
Streams
N
Feet
0
75
150
Center for Watershed Protection
Source: Esri, i-cubed, USDA, USGS, AEX, GeoEye, Getmapping, Aerogrid, IGN, IGP, and the GIS User Community

H31: Purcell Park

Score: 41

Rank: 13

Investigators: Wes Runion, Jeremy Harold, Lisa Fraley-McNeal

Figure 1: *Convert this area to bioretention*

Figure 2: *Drainage through conservation easement*

Description: Approximately 2 acres of parking lot, building, and adjacent grass area drain across the parking lot to an entrance of Purcell Park. Runoff ponds at the park entrance (Figure 1) and then drains through a conservation easement and into the nearby stream. Some erosion is occurring through the conservation easement, as shown in Figure 2.

Proposed Retrofit: A bioretention practice is proposed for the area where runoff currently ponds at the park entrance. There is adequate space to build a 25' x 50' bioretention. The practice would overflow to the existing drainage pathway through the easement. A step-pool system is also proposed along the drainage pathway to prevent erosion. Alternatively, a level spreader could be installed at the overflow to disperse water through the conservation easement and prevent further degradation of the existing drainage pathway. Tree impacts and a light pole will need to be avoided and picnic tables may need to be relocated. The location at the park entrance would make this bioretention a good demonstration project.

RRI

WATERSHED:	SUBWATERSHED:	UNIQUE SITE ID: H31
DATE: 3-20-13	ASSESSED BY: WES Jeremy	CAMERA ID: PICTURES: 53-59
GPS ID:	LMK ID:	LAT: LONG:

SITE DESCRIPTION

Name: Purcell Park
Address:

Ownership: ☒ Public ☐ Private ☐ Unknown
If Public, Government Jurisdiction: ☒ Local ☐ State ☐ DOT ☐ Other:

Corresponding USSR/USA Field Sheet? ☐ Yes ☐ No If yes, Unique Site ID:

Proposed Retrofit Location:

Storage
- ☐ Existing Pond
- ☐ Below Outfall
- ☐ In Road ROW
- ☐ Other:
- ☐ Above Roadway Culvert
- ☐ In Conveyance System
- ☐ Near Large Parking Lot

On-Site
- ☐ Hotspot Operation
- ☒ Small Parking Lot
- ☐ Individual Street
- ☐ Underground
- ☒ Individual Rooftop
- ☐ Small Impervious Area
- ☐ Landscape / Hardscape
- ☐ Other:

DRAINAGE AREA TO PROPOSED RETROFIT

Drainage Area ≈ 1.94 ac
Imperviousness ≈ 69.6 %
Impervious Area ≈ 1.35 ac

Notes:

Drainage Area Land Use:
- ☐ Residential
  - ☐ SFH (< 1 ac lots)
  - ☐ SFH (> 1 ac lots)
  - ☐ Townhouses
  - ☐ Multi-Family
- ☒ Commercial
- ☐ Institutional
- ☐ Industrial
- ☐ Transport-Related
- ☒ Park
- ☐ Undeveloped
- ☐ Other:

EXISTING STORMWATER MANAGEMENT

Existing Stormwater Practice: ☐ Yes ☒ No ☐ Possible
If Yes, Describe:

Describe Existing Site Conditions, Including Existing Site Drainage and Conveyance:
Existing Street Width (if applicable):

Parking lot drainage causing erosion at bottom through conservation easement into stream.

Existing Head Available:	Note where points are measured from: (i.e. street elevation to catch basin invert, manhole rim to catch basin invert, other)

PROPOSED RETROFIT

Purpose of Retrofit:
☒ Water Quality ☐ Recharge ☒ Channel Protection ☐ Flood Control
☒ Demonstration / Education ☐ Repair ☐ Other: _____

Retrofit Volume Computations - Target Storage:
5,127 ft³

Retrofit Volume Computations - Available Storage:
1,307 ft³

Proposed Retrofit Practice: (Runoff Reduction)
☐ Disconnection ☒ Bioretention ☐ Bio Swale
☐ Expanded Tree Pit ☐ Infiltration ☐ Green Roof
☐ Permeable Pavement ☐ Rainwater Harvesting

Proposed Retrofit Practice: (Stormwater Treatment)
☐ Constructed Wetland ☐ Wet Swale ☐ Wet Pond
☐ Filtering Practice ☐ Proprietary: _____
☐ Other: _____

Retrofit Category (as defined by Chesapeake Bay Program):
☒ New BMP ☐ BMP Enhancement ☐ BMP Restoration ☐ BMP Conversion ☐ Not CBP-approved

Describe Elements of Proposed Retrofit, Including Surface Area, Maximum Depth of Treatment, and Conveyance:
Create Bioretention site below parking lot to capture run off from building & Parking lot. Will overflow to existing Drainage Path, but will stabilize w/ step pool system.

Available Width:	25'
Available Length:	50'
Available Area:	~~1250 ft²~~
Ponding Depth:	6"
Soil Depth:	18"

Need to determine available head - for preliminary calculation purposes, 4' head was assumed.

SITE CONSTRAINTS

Adjacent Land Use:
☐ Residential ☐ Commercial ☐ Institutional
☐ Industrial ☐ Transport-Related ☒ Park
☐ Undeveloped ☐ Other: _____
Possible Conflicts Due to Adjacent Land Use? ☐ Yes ☒ No
If Yes, Describe:

Access:
☐ No Constraints
Constrained due to
☐ Slope ☐ Space
☒ Utilities ☒ Tree Impacts
☐ Structures ☐ Property
Ownership
☐ Other: _____

Conflicts with Existing Utilities:

	Yes	Possible/ Modifiable	No	Unknown
Sewer:	☐	☐	☒	☐
Water:	☐	☐	☒	☐
Gas:	☐	☐	☒	☐
Electric to Streetlights:	☐	☒	☐	☐
Other:	☐	☐	☐	☐

Potential Permitting Factors:

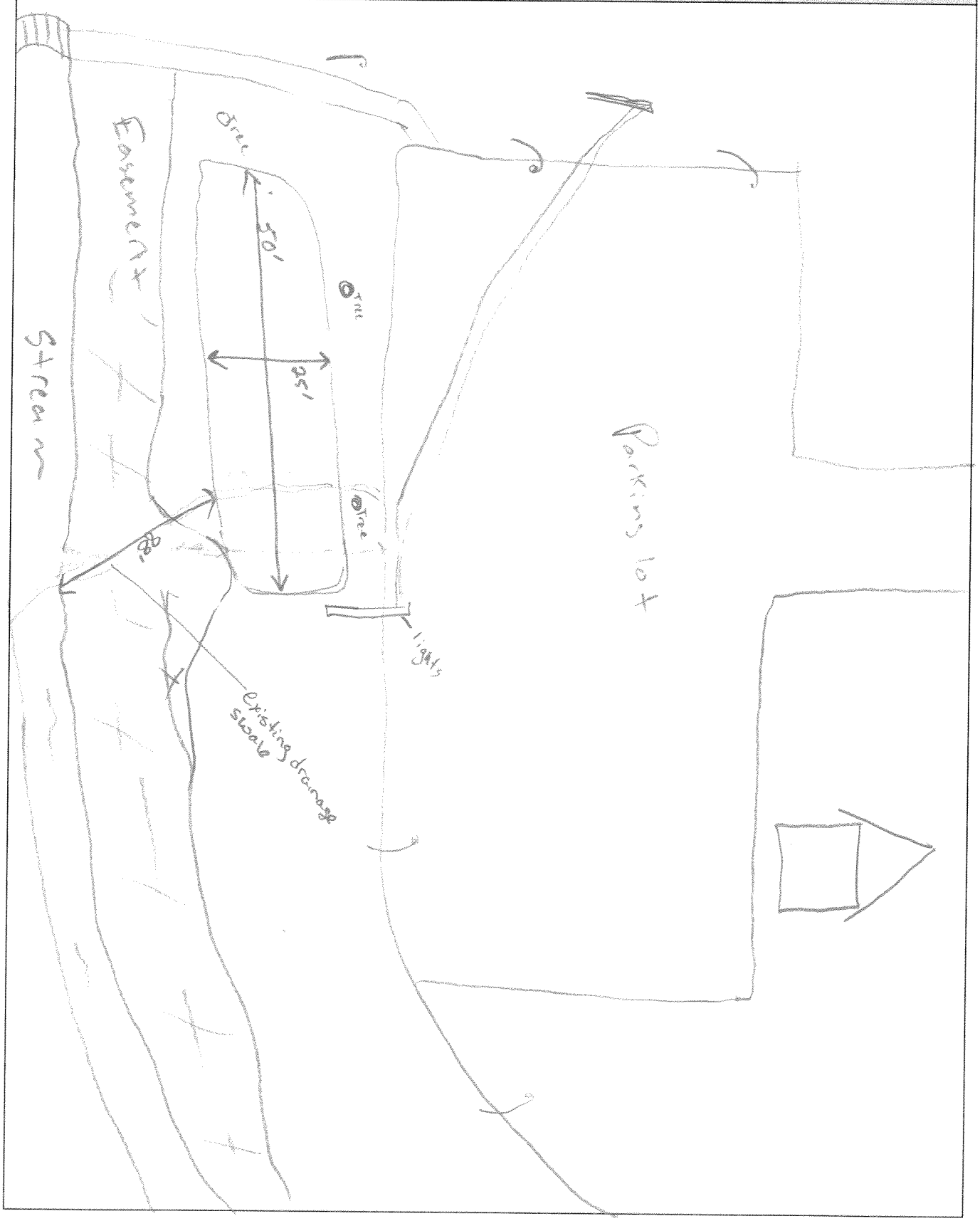
Dam Safety Permits Necessary	☐ Probable	☐ Not Probable
Impacts to Wetlands	☐ Probable	☐ Not Probable
Impacts to a Stream	☐ Probable	☐ Not Probable
Floodplain Fill	☐ Probable	☐ Not Probable
Impacts to Forests	☐ Probable	☐ Not Probable
Impacts to Specimen Trees	☒ Probable	☐ Not Probable

How many? 3
Approx. DBH 15"

Other factors: _____

Soils:
Soil auger test holes: ☐ Yes ☒ No
Evidence of poor infiltration (clays, fines): ☐ Yes ☒ No
Evidence of shallow bedrock: ☐ Yes ☒ No
Evidence of high water table (gleying, saturation): ☐ Yes ☒ No

SKETCH


Tree
Easement
20'
Tree
25'
Stream
Tree
Parking lot
lights
existing drainage
sloave

DESIGN OR DELIVERY NOTES

Will need to avoid tree impacts if possible.

FOLLOW-UP NEEDED TO COMPLETE FIELD CONCEPT

- ☐ Confirm property ownership
- ☐ Confirm drainage area
- ☐ Confirm drainage area impervious cover
- ☐ Confirm volume computations
- ☐ Complete concept sketch
- ☐ Obtain existing stormwater practice as-builts
- ☐ Obtain site as-builts
- ☐ Obtain detailed topography
- ☐ Obtain utility mapping
- ☐ Confirm storm drain invert elevations
- ☐ Confirm soil types
- ☐ Other:_____

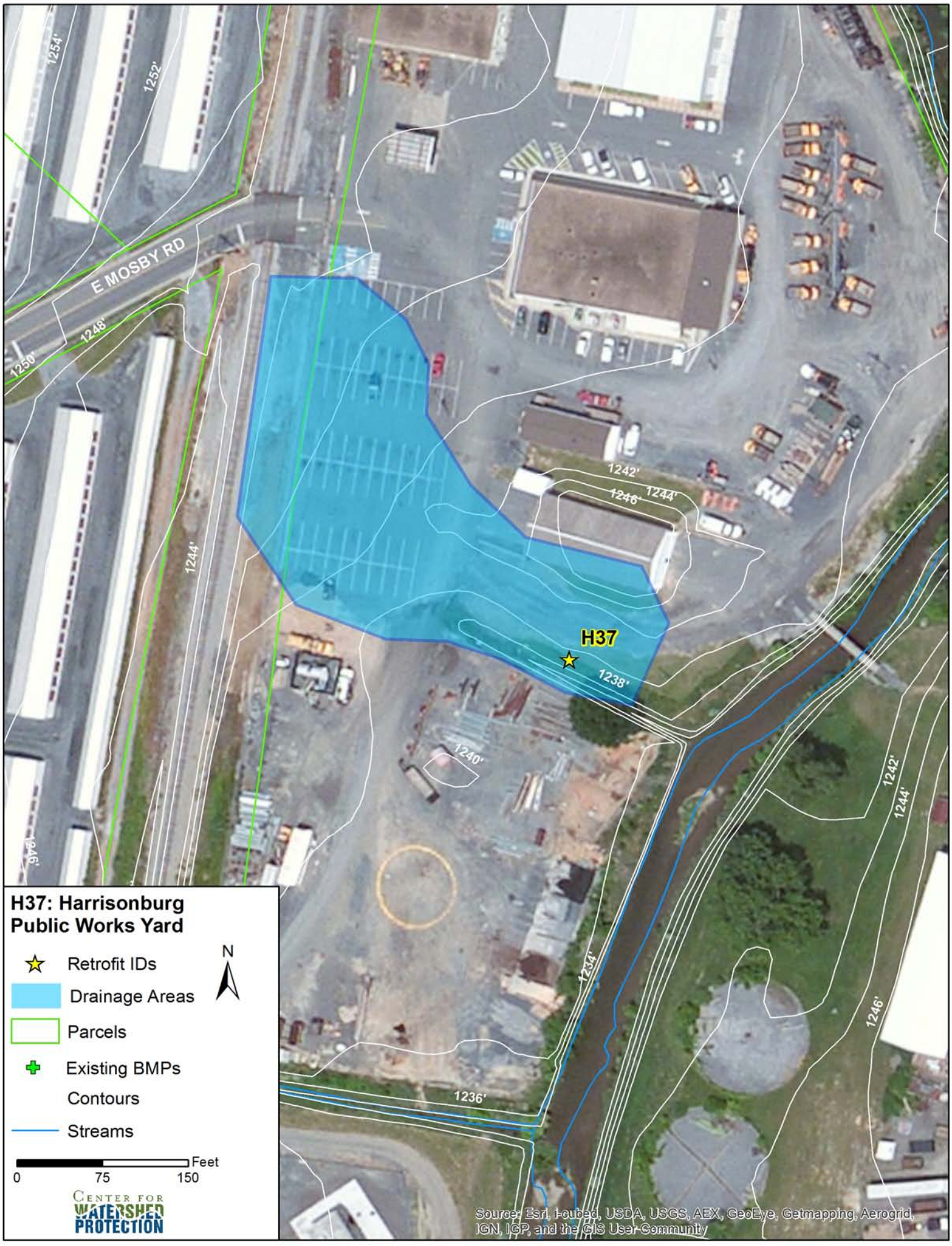
INITIAL FEASIBILITY AND CONSTRUCTION CONSIDERATIONS

Good demonstration project due to location.

SITE CANDIDATE FOR FURTHER INVESTIGATION:	☐ YES	☐ NO	☐ MAYBE
IS SITE CANDIDATE FOR EARLY ACTION PROJECT(S):	☐ YES	☐ NO	☐ MAYBE
IF NO, SITE CANDIDATE FOR OTHER RESTORATION PROJECT(S):	☐ YES	☐ NO	☐ MAYBE

IF YES, TYPE(S):_____

H37: Harrisonburg Public Works Yard


H37
E MOSBY RD
1254'
1252'
1250'
1248'
1246'
1244'
1242'
1240'
1238'
1236'
1234'
H37: Harrisonburg Public Works Yard
Retrofit IDs
Drainage Areas
Parcels
Existing BMPs
Contours
Streams
N
Feet
0
75
150
Center for Watershed Protection
Source: Esri, i-cubed, USDA, USGS, AEX, GeoEye, Getmapping, Aerogrid, IGN, IGP, and the GIS User Community

H37: Harrisonburg Public Works Yard

Score: 42
Rank: 11
Investigators: Rick Altizer, Chris Swann

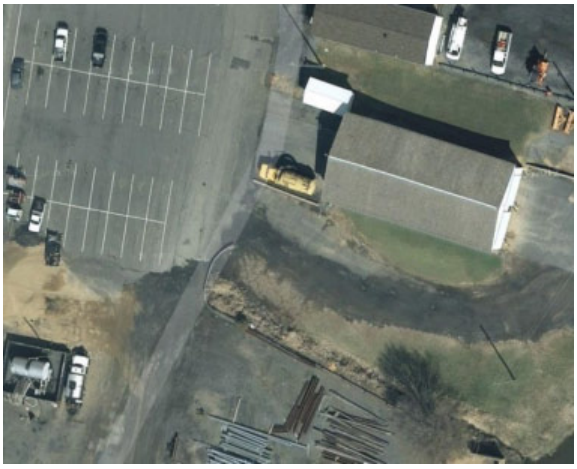


Figure 2: *Aerial view (Source: Google Maps)*

Figure 1: *Wet swale location*

Description: The site drains approximately one acre and is near a salt storage shed for the Harrisonburg Public Works department (Figure 1). It consists of buildings, asphalt parking lots, and gravel parking. A drainage channel carries runoff directly into Blacks Run and contains some cattails and other wetland plant indicators. A portion of the channel appears to remain filled with water for extended periods of time.

Proposed Retrofit: The concept is to treat the runoff from the impervious areas through conversion of the current channel to a 25' x 100'wet swale, which would provide water quality treatment in addition to conveyance (Figure 2). Due to proximity to the salt storage area, the plants used in the swale should be salt tolerant. A constructed wetland could be an alternate choice for the location, although the small drainage area to the site may make this choice less feasible. There is a sanitary sewer line near the stream that will need to be avoided.

There is also opportunity to replant floodplain areas on the site with trees, assuming that this area will not be used in future expansion. Tree planting would help enhance the stream buffer and provide filtering for the runoff.

H37-PP1: Harrisonburg Public Works Yard

Score: N/A
Rank: N/A
Investigators: Rick Altizer, Chris Swann

Figure 1: *Leaking sanitary sewer line*

Description: The investigators came across a sanitary sewer line with obvious signs of overflow (Figure 1). The sewer line is located on the banks of a channel that lead directly to Blacks Run. The overflow was reported directly to the Harrisonburg Water & Sewer Department in-person.

Proposed Retrofit: The concept is to repair the sewer stack and examine the line to ensure that there is not a blockage.

WATERSHED: HARRISONBURG P.W. FAC.	SUBWATERSHED:	UNIQUE SITE ID: H37	
DATE: 3-20-13	ASSESSED BY: CPS/JPH	CAMERA ID: OLYMPUS BLUE EXT	PICTURES: 55-62
GPS ID:	LMK ID:	LAT:	LONG:

SITE DESCRIPTION

Name: CITY OF HARRISONBURG PUBLIC WORKS
Address: 320 EAST MOSBY ROAD

Ownership: ☑ Public ☐ Private ☐ Unknown
If Public, Government Jurisdiction: ☑ Local ☐ State ☐ DOT ☐ Other:

Corresponding USSR/USA Field Sheet? ☐ Yes ☐ No If yes, Unique Site ID:

Proposed Retrofit Location:

Storage
- ☐ Existing Pond
- ☐ Below Outfall
- ☐ In Road ROW
- ☐ Other:
- ☐ Above Roadway Culvert
- ☐ In Conveyance System
- ☐ Near Large Parking Lot

On-Site
- ☐ Hotspot Operation
- ☑ Small Parking Lot
- ☐ Individual Street
- ☐ Underground
- ☐ Individual Rooftop
- ☐ Small Impervious Area
- ☐ Landscape / Hardscape
- ☐ Other:

DRAINAGE AREA TO PROPOSED RETROFIT

Drainage Area ≈ 1 ACRE
Imperviousness ≈ 90 %
Impervious Area ≈ .88

Notes:

Drainage Area Land Use:
- ☐ Residential
  - ☐ SFH (< 1 ac lots)
  - ☐ SFH (> 1 ac lots)
  - ☐ Townhouses
  - ☐ Multi-Family
- ☐ Commercial
- ☐ Institutional
- ☐ Industrial
- ☐ Transport-Related
- ☐ Park
- ☐ Undeveloped
- ☑ Other: DPW

EXISTING STORMWATER MANAGEMENT

Existing Stormwater Practice: ☐ Yes ☑ No ☐ Possible
If Yes, Describe:

Describe Existing Site Conditions, Including Existing Site Drainage and Conveyance:
Existing Street Width (if applicable):

DPW PARKING LOT, SALT & GRIT STORAGE BUILDING, GRAVEL STORAGE LOT OUTFALLING INTO BLACKS RUN

Existing Head Available:	Note where points are measured from: (i.e. street elevation to catch basin invert, manhole rim to catch basin invert, other)

PROPOSED RETROFIT

Purpose of Retrofit:
☒ Water Quality ☐ Recharge ☐ Channel Protection ☐ Flood Control
☐ Demonstration / Education ☐ Repair ☐ Other:_____

Retrofit Volume Computations - Target Storage:

Retrofit Volume Computations - Available Storage:

Proposed Retrofit Practice: (Runoff Reduction)
☐ Disconnection ☐ Bioretention ☒ Bio Swale
☐ Expanded Tree Pit ☐ Infiltration ☐ Green Roof
☐ Permeable Pavement ☐ Rainwater Harvesting

Proposed Retrofit Practice: (Stormwater Treatment)
☒ Constructed Wetland ☐ Wet Swale ☐ Wet Pond
☐ Filtering Practice ☐ Proprietary:_____
☐ Other: _____

Retrofit Category (as defined by Chesapeake Bay Program):
☒ New BMP ☐ BMP Enhancement ☐ BMP Restoration ☐ BMP Conversion ☐ Not CBP-approved

Describe Elements of Proposed Retrofit, Including Surface Area, Maximum Depth of Treatment, and Conveyance:

PROPOSED CONSTRUCTED WETLAND ON DPW PROPERTY ADJACENT TO SALT STORAGE BUILDING.
IF NOT WETLAND
BIOSWALES

Available Width:	26'
Available Length:	130'
Available Area:	
Ponding Depth:	12"
Soil Depth:	

SITE CONSTRAINTS

Adjacent Land Use:
☐ Residential ☐ Commercial ☒ Institutional
☐ Industrial ☐ Transport-Related ☐ Park
☐ Undeveloped ☐ Other:_____
Possible Conflicts Due to Adjacent Land Use? ☐ Yes ☐ No
If Yes, Describe:

Access:
☒ No Constraints
Constrained due to
☐ Slope ☐ Space
☐ Utilities ☐ Tree Impacts
☐ Structures ☐ Property
Ownership
☐ Other:_____

Conflicts with Existing Utilities:

	Yes	Possible/ Modifiable	No	Unknown
Sewer:	☐	☒	☐	☐
Water:	☐	☐	☒	☐
Gas:	☐	☐	☒	☐
Electric to Streetlights:	☐	☐	☒	☐
Other:	☐	☐	☒	☐

_____

Potential Permitting Factors:

Dam Safety Permits Necessary	☐ Probable	☒ Not Probable
Impacts to Wetlands	☐ Probable	☒ Not Probable
Impacts to a Stream	☐ Probable	☒ Not Probable
Floodplain Fill	☐ Probable	☒ Not Probable
Impacts to Forests	☐ Probable	☒ Not Probable
Impacts to Specimen Trees	☐ Probable	☒ Not Probable

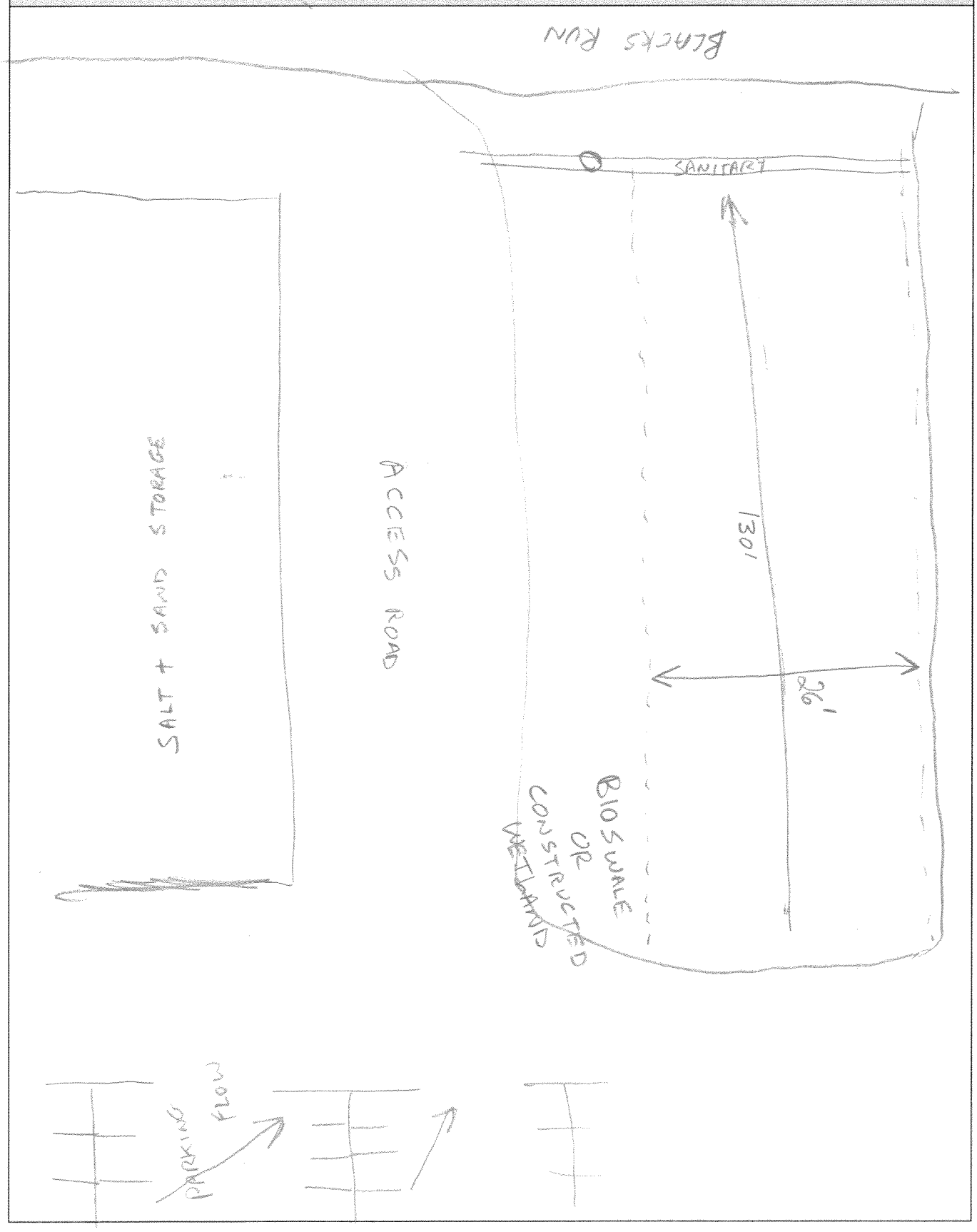
How many?_____
Approx. DBH_____

Other factors:_____
_____

Soils:

Soil auger test holes:	☐ Yes	☒ No
Evidence of poor infiltration (clays, fines):	☐ Yes	☒ No
Evidence of shallow bedrock:	☐ Yes	☒ No
Evidence of high water table (gleying, saturation):	☐ Yes	☒ No

SKETCH


Blacks Run
SANITARY
SALT + SAND STORAGE
ACCESS ROAD
130'
26'
BIOSWALE OR CONSTRUCTED WETLAND
EXISTING ROAD
N 70°W

DESIGN OR DELIVERY NOTES

FOLLOW-UP NEEDED TO COMPLETE FIELD CONCEPT

- ☐ Confirm property ownership
- ☒ Confirm drainage area
- ☐ Confirm drainage area impervious cover
- ☐ Confirm volume computations
- ☒ Complete concept sketch
- ☐ Obtain existing stormwater practice as-builts
- ☐ Obtain site as-builts
- ☐ Obtain detailed topography
- ☐ Obtain utility mapping
- ☐ Confirm storm drain invert elevations
- ☒ Confirm soil types
- ☐ Other:_____

INITIAL FEASIBILITY AND CONSTRUCTION CONSIDERATIONS

SITE CANDIDATE FOR FURTHER INVESTIGATION:	☒ YES	☐ NO	☐ MAYBE
IS SITE CANDIDATE FOR EARLY ACTION PROJECT(S):	☐ YES	☒ NO	☐ MAYBE
IF NO, SITE CANDIDATE FOR OTHER RESTORATION PROJECT(S):	☒ YES	☐ NO	☐ MAYBE

IF YES, TYPE(S): RIPARIAN REFORESTATION

Utility Impacts **UT**

WATERSHED/SUBSHED: HARRIS SCHOOL	**DATE:** 3/20/13	**ASSESSED BY:** RA, CPS
SURVEY REACH ID: H37-PP1	**TIME:** ___:___ AM/PM	**PHOTO ID:** (*Camera-Pic #*) OLYMPUS /#
SITE ID: (*Condition-#*) **UT-** H37	**LAT** ___° ___' ___" **LONG** ___° ___' ___" **LMK:** ___	**GPS:** (*Unit ID*)

TYPE:
- [x] Leaking sewer
- [ ] Exposed pipe
- [ ] Exposed manhole
- [ ] Other:

MATERIAL:
- [x] Concrete
- [ ] Corrugated metal
- [ ] Smooth metal
- [ ] PVC
- [ ] Other:

LOCATION:
- [ ] Floodplain
- [x] Stream bank
- [ ] Above stream
- [ ] Stream bottom
- [ ] Other:

POTENTIAL FISH BARRIER:
- [ ] Yes
- [x] No

PIPE DIMENSIONS:
Diameter: ___ in
Length exposed: ___ ft

CONDITION:
- [ ] Joint failure
- [ ] Pipe corrosion/cracking
- [ ] Protective covering broken
- [ ] Manhole cover absent
- [x] Other: STACK COLLAPSE

EVIDENCE OF DISCHARGE:

COLOR	[ ] None [ ] Clear [ ] Dark Brown [ ] Lt Brown [ ] Yellowish [ ] Greenish [ ] Other:
ODOR	[ ] None [x] Sewage [ ] Oily [ ] Sulfide [ ] Chlorine [ ] Other:
DEPOSITS	[ ] None [x] Tampons/Toilet Paper [ ] Lime [ ] Surface oils [ ] Stains [ ] Other:

POTENTIAL RESTORATION CANDIDATE [x] Structural repairs [ ] Pipe testing [ ] Citizen hotlines [ ] Dry weather sampling
[ ] no [ ] Fish barrier removal [ ] Other:

If yes to fish barrier, Water Drop: _____ (in)

UTILITY IMPACT SEVERITY: (*Circle #*)

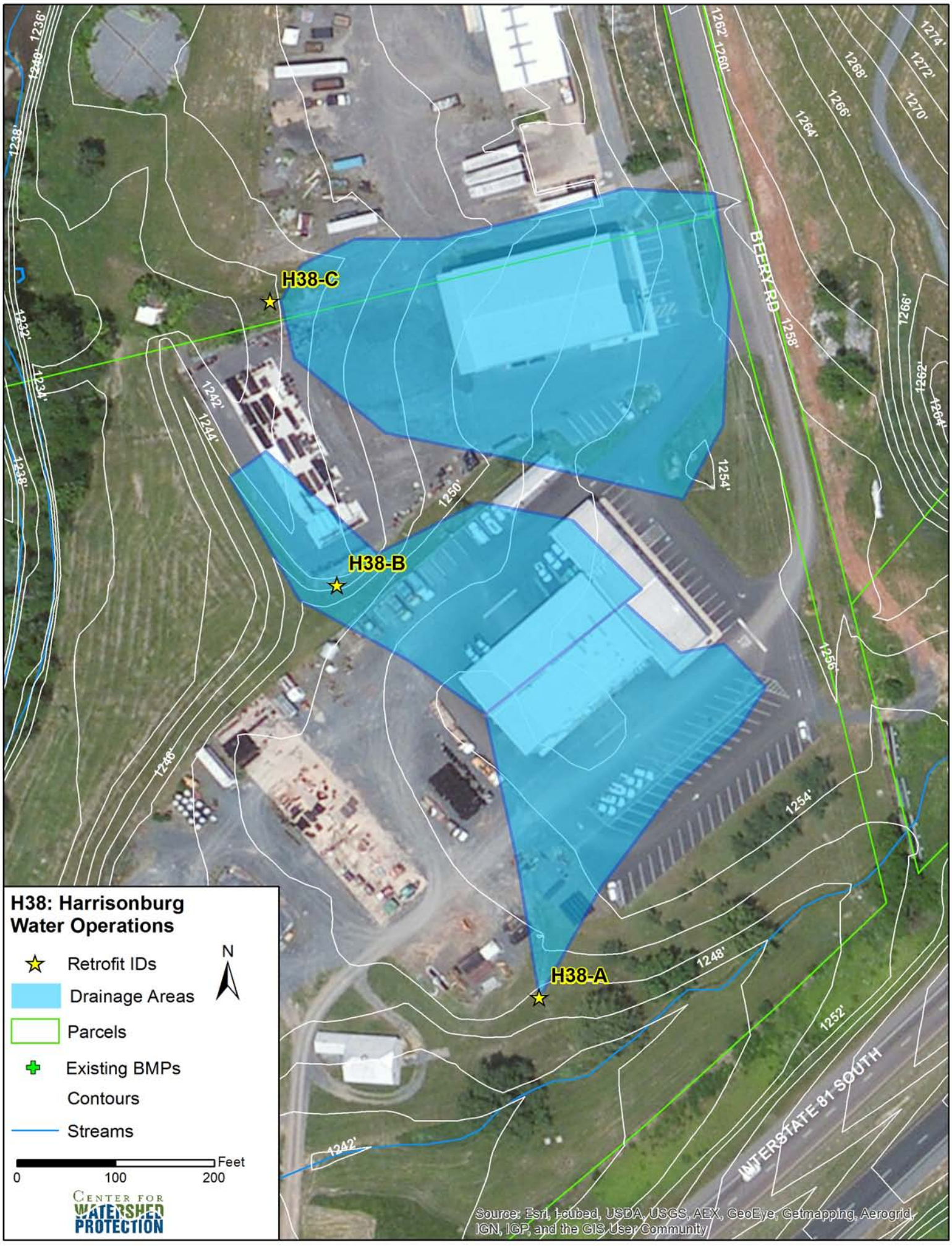
Leaking= [ ] 5

5	4	3	2	1
Section of pipe undermined by erosion and could collapse in the near future; a pipe running across the bed or suspended above the stream; a long section along the edge of the stream where nearly the entire side of the pipe is exposed; or a manhole stack that is located in the center of the stream channel and there is evidence of stack failure.	A moderately long section of pipe is partially exposed but there is no immediate threat that the pipe will be undermined and break in the immediate future. The primary concern is that the pipe may be punctured by large debris during a large storm event.			Small section of exposed pipe, stream bank near the pipe is stable; the pipe is across the bottom of the stream but only a small portion of the top of the pipe exposed; the pipe is exposed but is reinforced with concrete and it is not causing a blockage to upstream fish movement; a manhole stack that is at the edge of the stream and does not extend very far out into the active stream channel.

NOTES:
EVIDENCE OF SEWER OVERFLOW
SEWER STACK APPEARS DAMAGED

REPORTED TO LOCAL AUTHORITIES [ ] Yes [ ] No

H38: Harrisonburg Water Operations


H38-C
H38-B
H38-A
BEERY RD
INTERSTATE 81 SOUTH
1236'
1240'
1238'
1232'
1234'
1242'
1244'
1246'
1250'
1254'
1256'
1258'
1260'
1262'
1264'
1266'
1268'
1270'
1272'
1274'
1248'
1252'
H38: Harrisonburg Water Operations
Retrofit IDs
Drainage Areas
Parcels
Existing BMPs
Contours
Streams
N
Feet
0
100
200
CENTER FOR WATERSHED PROTECTION
Source: Esri, i-cubed, USDA, USGS, AEX, GeoEye, Getmapping, Aerogrid, IGN, IGP, and the GIS User Community

H38-A: Harrisonburg Water and Sewer Department

Score: 40
Rank: 16
Investigators: Rick Altizer, Chris Swann

Figure 2: *Aerial view (Source: Google Maps)*

Figure 1: *Bioretention location*

Description: This site consists of the Harrisonburg Water & Sewer offices and service building, an asphalt parking lot, and a gravel storage area (Figure 1). The 0.75 acre drainage area currently goes to a large grassy area and then eventually to a channel located near the tree in Figure 2. Conveyance from the parking lot is through sheet flow. Rooftop runoff is collected in a trench drain outside the building forebays and then carried to an outfall (indicated by the rocks in Figure 2) near the proposed retrofit site.

Proposed Retrofit: The concept is to treat the runoff from the rooftop and parking lot with a 30’ x 30’ bioretention system. The site has room for expansion if necessary and is located away from the storage areas so it will not interfere with daily operations.

H38-B: Harrisonburg Public Works Storage Yard

Score: 36
Rank: 26
Investigators: Rick Altizer, Chris Swann

Figure 1: *Aerial view (Source: Google Maps)*

Figure 2: *Bioretention location*

Description: This site consists of a Harrisonburg Public Works storage building, an asphalt parking lot, and a gravel storage area (Figure 1). The 0.70 drainage area currently goes to a grassy area (Figure 2) at the edge of the paved storage surface and follows the edge of the lot until it spills onto a large grassy area. Conveyance from the parking lot is through sheet flow. Rooftop runoff from the Water and Sewer Building is also conveyed to this location as indicated by the green pipe on the left side of Figure 2.

Proposed Retrofit: The concept is to treat the runoff from the rooftop and parking lot with a 15' x 100' linear bioretention system that can be sized longer if necessary. The width of the bioretention system is based on the location of a berm at the edge of the parking lot that helps direct the flow. It could not be determined if the berm was a natural feature or was created during site development.

H38-C: Harrisonburg Recycling Center

Score: 40

Rank: 15

Investigators: Rick Altizer, Chris Swann

Figure 1: *Aerial view (Source: Google Maps)*

Figure 2: *Bioretention location (Source: Google Maps)*

Description: This site consists of the Harrisonburg Recycling Center operations and a gravel storage area (Figure 1). The 1.6 acre drainage area currently goes to an outfall (Figure 2) located between the Recycling Center and the edge of the paved storage surface for the Public Works storage facility from site H38-B. Conveyance is through sheet flow for some of the site and through pipes for a portion of H38-A (the grassed area in front of the Water and Sewer Building) and H38-B (the inlet in front the building). The outfall contained a large amount of vegetation, including some cattails and small trees growing in the project location at the time of the site visit.

Proposed Retrofit: The concept is to treat the runoff with a bioretention system. The practice would be teardrop-shaped with a maximum width of 40', a minimum width near the outfall of 20', and an overall length of 70'. The practice will drain into a large grassy area downslope. One site constraint is a brick storage building located at the edge of the property that limits expansion lengthwise. There is also fencing between the parcels for the Recycling Center and the Public Words storage building that will need to be removed.

WATERSHED: Water & Sewer Dept	SUBWATERSHED:	UNIQUE SITE ID: H38-A

DATE: 3/20/13	ASSESSED BY:	CAMERA ID:	PICTURES: 63-64
GPS ID:	LMK ID:	LAT:	LONG:

SITE DESCRIPTION

Name: Harrisonburg Water & Sewer Dept
Address: 2155 Beery Rd

Ownership: ☒ Public ☐ Private ☐ Unknown
If Public, Government Jurisdiction: ☒ Local ☐ State ☐ DOT ☐ Other:_____

Corresponding USSR/USA Field Sheet? ☐ Yes ☒ No If yes, Unique Site ID:_____

Proposed Retrofit Location:

Storage
- ☐ Existing Pond
- ☐ Below Outfall
- ☐ In Road ROW
- ☐ Above Roadway Culvert
- ☐ In Conveyance System
- ☐ Near Large Parking Lot
- ☐ Other:_____

On-Site
- ☐ Hotspot Operation
- ☒ Small Parking Lot
- ☐ Individual Street
- ☐ Underground
- ☒ Individual Rooftop
- ☐ Small Impervious Area
- ☐ Landscape / Hardscape
- ☐ Other:_____

DRAINAGE AREA TO PROPOSED RETROFIT

Drainage Area ≈ .75
Imperviousness ≈ 80 %
Impervious Area ≈ .60

Notes:

Drainage Area Land Use:
- ☐ Residential
  - ☐ SFH (< 1 ac lots)
  - ☐ SFH (> 1 ac lots)
  - ☐ Townhouses
  - ☐ Multi-Family
- ☐ Commercial
- ☒ Institutional
- ☐ Industrial
- ☐ Transport-Related
- ☐ Park
- ☐ Undeveloped
- ☐ Other:_____

EXISTING STORMWATER MANAGEMENT

Existing Stormwater Practice: ☐ Yes ☒ No ☐ Possible
If Yes, Describe:

Describe Existing Site Conditions, Including Existing Site Drainage and Conveyance:
Existing Street Width (if applicable):_____

TRENCH DRAIN FOR 1/2 OF BLDG ROOF - DISCHARGES TO GRASSY AREA
PARKING LOT ALSO DRAINS TO SAME AREA
CONVEYANCE BY SHEET FLOW TO SMALL INTERMITTENT STREAM

Existing Head Available:	Note where points are measured from: (i.e. street elevation to catch basin invert, manhole rim to catch basin invert, other)

PROPOSED RETROFIT

Purpose of Retrofit:
☒ Water Quality ☐ Recharge ☐ Channel Protection ☐ Flood Control
☐ Demonstration / Education ☐ Repair ☐ Other:_____

Retrofit Volume Computations - Target Storage:

Retrofit Volume Computations - Available Storage:

Proposed Retrofit Practice: (Runoff Reduction)
☐ Disconnection ☒ Bioretention ☐ Bio Swale
☐ Expanded Tree Pit ☐ Infiltration ☐ Green Roof
☐ Permeable Pavement ☐ Rainwater Harvesting

Proposed Retrofit Practice: (Stormwater Treatment)
☐ Constructed Wetland ☐ Wet Swale ☐ Wet Pond
☐ Filtering Practice ☐ Proprietary:_____
☐ Other: _____

Retrofit Category (as defined by Chesapeake Bay Program):
☒ New BMP ☐ BMP Enhancement ☐ BMP Restoration ☐ BMP Conversion ☐ Not CBP-approved

Describe Elements of Proposed Retrofit, Including Surface Area, Maximum Depth of Treatment, and Conveyance:

BIORETENTION AREA
OR BIO SWALE

Available Width:	38'
Available Length:	38'
Available Area:	
Ponding Depth:	
Soil Depth:	

SITE CONSTRAINTS

Adjacent Land Use:
☐ Residential ☐ Commercial ☒ Institutional
☐ Industrial ☐ Transport-Related ☐ Park
☐ Undeveloped ☐ Other:_____
Possible Conflicts Due to Adjacent Land Use? ☐ Yes ☐ No
If Yes, Describe:

Access:
☒ No Constraints
Constrained due to
☐ Slope ☐ Space
☐ Utilities ☐ Tree Impacts
☐ Structures ☐ Property
Ownership
☐ Other:_____

Conflicts with Existing Utilities:

	Yes	Possible/ Modifiable	No	Unknown
Sewer:	☐	☐	☒	☐
Water:	☐	☐	☒	☐
Gas:	☐	☐	☒	☐
Electric to Streetlights:	☐	☐	☒	☐
Other:	☐	☐	☒	☐

_____

Potential Permitting Factors:

Dam Safety Permits Necessary	☐ Probable	☒ Not Probable
Impacts to Wetlands	☐ Probable	☒ Not Probable
Impacts to a Stream	☐ Probable	☒ Not Probable
Floodplain Fill	☐ Probable	☒ Not Probable
Impacts to Forests	☐ Probable	☒ Not Probable
Impacts to Specimen Trees	☐ Probable	☐ Not Probable

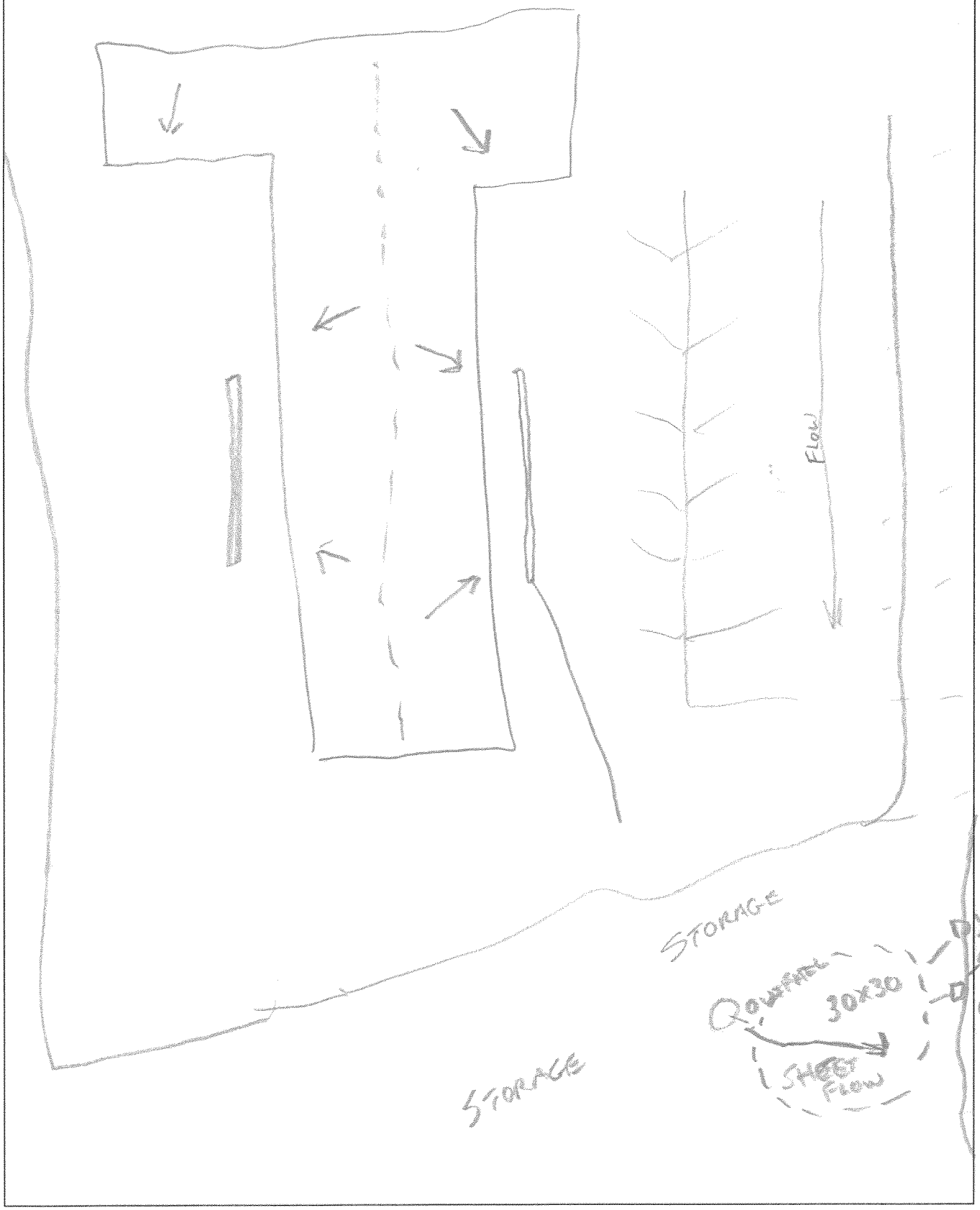
How many?_____
Approx. DBH_____

Other factors:_____
_____

Soils:

Soil auger test holes:	☐ Yes	☒ No
Evidence of poor infiltration (clays, fines):	☐ Yes	☒ No
Evidence of shallow bedrock:	☐ Yes	☒ No
Evidence of high water table (gleying, saturation):	☐ Yes	☒ No

SKETCH



DESIGN OR DELIVERY NOTES

FOLLOW-UP NEEDED TO COMPLETE FIELD CONCEPT

- ☐ Confirm property ownership
- ☐ Confirm drainage area
- ☐ Confirm drainage area impervious cover
- ☐ Confirm volume computations
- ☐ Complete concept sketch
- ☐ Obtain existing stormwater practice as-builts
- ☐ Obtain site as-builts
- ☐ Obtain detailed topography
- ☐ Obtain utility mapping
- ☐ Confirm storm drain invert elevations
- ☐ Confirm soil types
- ☐ Other:_____

INITIAL FEASIBILITY AND CONSTRUCTION CONSIDERATIONS

SITE CANDIDATE FOR FURTHER INVESTIGATION:	☐ YES	☐ NO	☐ MAYBE
IS SITE CANDIDATE FOR EARLY ACTION PROJECT(S):	☐ YES	☐ NO	☐ MAYBE
IF NO, SITE CANDIDATE FOR OTHER RESTORATION PROJECT(S):	☐ YES	☐ NO	☐ MAYBE

IF YES, TYPE(S):_____

RRI

WATERSHED: HARRISONBURG	SUBWATERSHED: HARRISONBURG	UNIQUE SITE ID: H38-B	
DATE:	ASSESSED BY:	CAMERA ID:	PICTURES:
GPS ID:	LMK ID:	LAT:	LONG:

SITE DESCRIPTION

Name: HPW STORAGE FACILITY
Address: BERRY ROAD

Ownership: ☐ Public ☐ Private ☐ Unknown
If Public, Government Jurisdiction: ☐ Local ☐ State ☐ DOT ☐ Other:

Corresponding USSR/USA Field Sheet? ☐ Yes ☐ No If yes, Unique Site ID:

Proposed Retrofit Location:

Storage
- ☐ Existing Pond
- ☐ Above Roadway Culvert
- ☐ Below Outfall
- ☐ In Conveyance System
- ☐ In Road ROW
- ☐ Near Large Parking Lot
- ☐ Other:

On-Site
- ☐ Hotspot Operation
- ☑ Individual Rooftop
- ☑ Small Parking Lot
- ☐ Small Impervious Area
- ☐ Individual Street
- ☐ Landscape / Hardscape
- ☐ Underground
- ☐ Other:

DRAINAGE AREA TO PROPOSED RETROFIT

Drainage Area ≈ .70 acres
Imperviousness ≈ 90 %
Impervious Area ≈ .63

Notes:

Drainage Area Land Use:
- ☐ Residential
  - ☐ SFH (< 1 ac lots)
  - ☐ SFH (> 1 ac lots)
  - ☐ Townhouses
  - ☐ Multi-Family
- ☐ Commercial
- ☐ Institutional
- ☐ Industrial
- ☐ Transport-Related
- ☐ Park
- ☐ Undeveloped
- ☐ Other:

EXISTING STORMWATER MANAGEMENT

Existing Stormwater Practice: ☐ Yes ☑ No ☐ Possible
If Yes, Describe:

Describe Existing Site Conditions, Including Existing Site Drainage and Conveyance:
Existing Street Width (if applicable):

TRENCH DRAIN + ROOFTOP DRAIN COVERS ½ BLDG

Existing Head Available:	Note where points are measured from: (i.e. street elevation to catch basin invert, manhole rim to catch basin invert, other)

PROPOSED RETROFIT

Purpose of Retrofit:
☑ Water Quality ☐ Recharge ☐ Channel Protection ☐ Flood Control
☐ Demonstration / Education ☐ Repair ☐ Other:_____

Retrofit Volume Computations - Target Storage:

Retrofit Volume Computations - Available Storage:

Proposed Retrofit Practice: (Runoff Reduction)
☐ Disconnection ☐ Bioretention ☑ Bio Swale
☐ Expanded Tree Pit ☐ Infiltration ☐ Green Roof
☐ Permeable Pavement ☐ Rainwater Harvesting

Proposed Retrofit Practice: (Stormwater Treatment)
☐ Constructed Wetland ☐ Wet Swale ☐ Wet Pond
☐ Filtering Practice ☐ Proprietary:_____
☐ Other: _____

Retrofit Category (as defined by Chesapeake Bay Program):
☑ New BMP ☐ BMP Enhancement ☐ BMP Restoration ☐ BMP Conversion ☐ Not CBP-approved

Describe Elements of Proposed Retrofit, Including Surface Area, Maximum Depth of Treatment, and Conveyance:

BIO SWALE RUNNING ALONG EDGE OF PARKING LOT DISCHARGE TO GRASSY AREA

Available Width:	15'
Available Length:	256'
Available Area:	
Ponding Depth:	
Soil Depth:	

SITE CONSTRAINTS

Adjacent Land Use:
☐ Residential ☐ Commercial ☐ Institutional
☐ Industrial ☐ Transport-Related ☐ Park
☐ Undeveloped ☑ Other: DPW

Possible Conflicts Due to Adjacent Land Use? ☐ Yes ☑ No
If Yes, Describe:

Access:
☑ No Constraints
Constrained due to
☐ Slope ☐ Space
☐ Utilities ☐ Tree Impacts
☐ Structures ☐ Property
Ownership
☐ Other:_____

Conflicts with Existing Utilities:

	Yes	Possible/ Modifiable	No	Unknown
Sewer:	☐	☐	☑	☐
Water:	☐	☐	☑	☐
Gas:	☐	☐	☑	☐
Electric to Streetlights:	☐	☐	☑	☐
Other:	☐	☐	☑	☐

_____

Potential Permitting Factors:

Dam Safety Permits Necessary	☐ Probable	☑ Not Probable
Impacts to Wetlands	☐ Probable	☑ Not Probable
Impacts to a Stream	☐ Probable	☑ Not Probable
Floodplain Fill	☐ Probable	☑ Not Probable
Impacts to Forests	☐ Probable	☑ Not Probable
Impacts to Specimen Trees	☐ Probable	☑ Not Probable

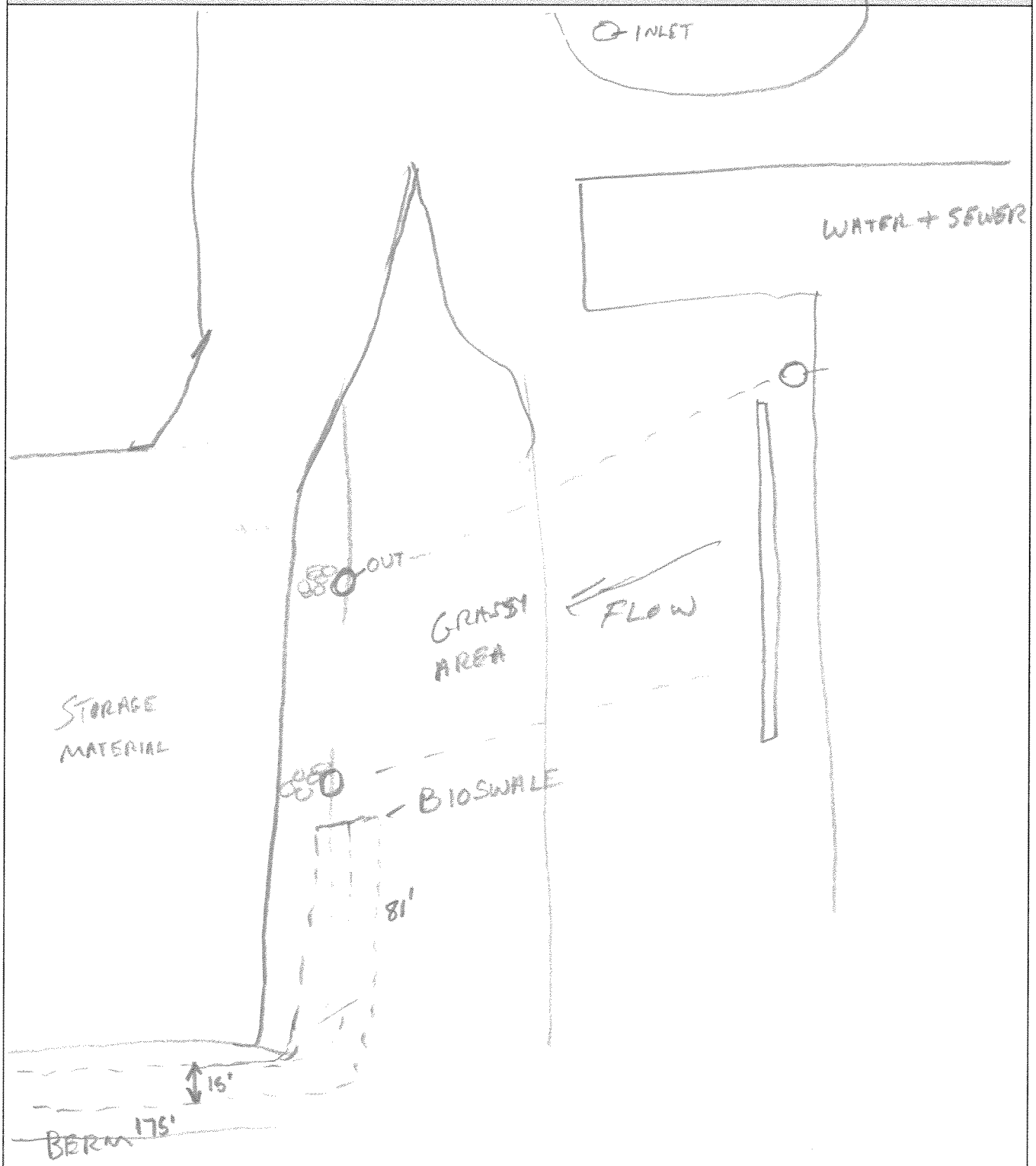
How many?_____
Approx. DBH_____

Other factors:_____
_____

Soils:

Soil auger test holes:	☐ Yes	☑ No
Evidence of poor infiltration (clays, fines):	☐ Yes	☑ No
Evidence of shallow bedrock:	☐ Yes	☑ No
Evidence of high water table (gleying, saturation):	☐ Yes	☑ No

SKETCH


INLET
WATER + SEWER
OUT
GRASSY AREA
FLOW
STORAGE MATERIAL
BIOSWALE
81'
15'
BERM 175'

DESIGN OR DELIVERY NOTES

FOLLOW-UP NEEDED TO COMPLETE FIELD CONCEPT

- ☐ Confirm property ownership
- ☑ Confirm drainage area
- ☐ Confirm drainage area impervious cover
- ☐ Confirm volume computations
- ☑ Complete concept sketch
- ☐ Obtain existing stormwater practice as-builts
- ☐ Obtain site as-builts
- ☐ Obtain detailed topography
- ☐ Obtain utility mapping
- ☐ Confirm storm drain invert elevations
- ☐ Confirm soil types
- ☐ Other:_____

INITIAL FEASIBILITY AND CONSTRUCTION CONSIDERATIONS

SITE CANDIDATE FOR FURTHER INVESTIGATION:	☐ YES	☐ NO	☐ MAYBE
IS SITE CANDIDATE FOR EARLY ACTION PROJECT(S):	☐ YES	☐ NO	☐ MAYBE
IF NO, SITE CANDIDATE FOR OTHER RESTORATION PROJECT(S):	☐ YES	☐ NO	☐ MAYBE

IF YES, TYPE(S):_____

WATERSHED: HPW Recycling	SUBWATERSHED: HARRISONBURG	UNIQUE SITE ID: H38-C	
DATE: 3/20/13	ASSESSED BY: CPB/RA	CAMERA ID: OLYMPUS BLUE	PICTURES: Google
GPS ID:	LMK ID:	LAT:	LONG:

SITE DESCRIPTION

Name: HARRISONBURG RECYCLING CENTER
Address: 2065 BERRY ROAD

Ownership: ☒ Public ☐ Private ☐ Unknown
If Public, Government Jurisdiction: ☒ Local ☐ State ☐ DOT ☐ Other:

Corresponding USSR/USA Field Sheet? ☐ Yes ☐ No If yes, Unique Site ID:

Proposed Retrofit Location:

Storage
- ☐ Existing Pond
- ☐ Below Outfall
- ☐ In Road ROW
- ☐ Other:
- ☐ Above Roadway Culvert
- ☐ In Conveyance System
- ☐ Near Large Parking Lot

On-Site
- ☐ Hotspot Operation
- ☒ Small Parking Lot
- ☐ Individual Street
- ☐ Underground
- ☒ Individual Rooftop
- ☐ Small Impervious Area
- ☐ Landscape / Hardscape
- ☐ Other:

DRAINAGE AREA TO PROPOSED RETROFIT

Drainage Area ≈ 1.6 acres
Imperviousness ≈ 85 %
Impervious Area ≈ 1.36

Notes:

Drainage Area Land Use:
- ☐ Residential
  - ☐ SFH (< 1 ac lots)
  - ☐ SFH (> 1 ac lots)
  - ☐ Townhouses
  - ☐ Multi-Family
- ☐ Commercial
- ☐ Institutional
- ☐ Industrial
- ☐ Transport-Related
- ☐ Park
- ☐ Undeveloped
- ☒ Other: DPW STORAGE RECYCLING

EXISTING STORMWATER MANAGEMENT

Existing Stormwater Practice: ☐ Yes ☒ No ☐ Possible
If Yes, Describe:

Describe Existing Site Conditions, Including Existing Site Drainage and Conveyance:
Existing Street Width (if applicable):

OUTFALL LEADING TO DEPRESSIONAL AREA BERMED TO ACT AS TEMPORARY STORAGE AND TO PROTECT BLDG
CONVEYANCE IS BOTH SHEET FLOW AND DRAINAGE PIPE

Existing Head Available:	Note where points are measured from: (i.e. street elevation to catch basin invert, manhole rim to catch basin invert, other)
NONE	

PROPOSED RETROFIT

Purpose of Retrofit:
☑ Water Quality ☐ Recharge ☐ Channel Protection ☐ Flood Control
☐ Demonstration / Education ☐ Repair ☐ Other:_____

Retrofit Volume Computations - Target Storage:

Retrofit Volume Computations - Available Storage:

Proposed Retrofit Practice: (Runoff Reduction)
☐ Disconnection ☑ Bioretention ☐ Bio Swale
☐ Expanded Tree Pit ☐ Infiltration ☐ Green Roof
☐ Permeable Pavement ☐ Rainwater Harvesting

Proposed Retrofit Practice: (Stormwater Treatment)
☐ Constructed Wetland ☐ Wet Swale ☐ Wet Pond
☐ Filtering Practice ☐ Proprietary:_____
☐ Other: _____

Retrofit Category (as defined by Chesapeake Bay Program):
☐ New BMP ☐ BMP Enhancement ☐ BMP Restoration ☐ BMP Conversion ☐ Not CBP-approved

Describe Elements of Proposed Retrofit, Including Surface Area, Maximum Depth of Treatment, and Conveyance:

TEAR DROP SHAPED BIORETENTION

Available Width:	20' 40'
Available Length:	78
Available Area:	
Ponding Depth:	
Soil Depth:	

SITE CONSTRAINTS

Adjacent Land Use:
☐ Residential ☐ Commercial ☐ Institutional
☐ Industrial ☐ Transport-Related ☐ Park
☐ Undeveloped ☑ Other: DPW RECYCLING & STORAGE
Possible Conflicts Due to Adjacent Land Use? ☐ Yes ☑ No
If Yes, Describe:

Access:
☑ No Constraints
Constrained due to
☐ Slope ☐ Space
☐ Utilities ☐ Tree Impacts
☐ Structures ☐ Property
Ownership
☐ Other:_____

Conflicts with Existing Utilities:

	Yes	Possible/ Modifiable	No	Unknown
Sewer:	☐	☐	☑	☐
Water:	☐	☐	☑	☐
Gas:	☐	☐	☑	☐
Electric to Streetlights:	☐	☐	☑	☐
Other:	☐	☐	☑	☐

_____

Potential Permitting Factors:

Dam Safety Permits Necessary	☐ Probable	☑ Not Probable
Impacts to Wetlands	☐ Probable	☑ Not Probable
Impacts to a Stream	☐ Probable	☑ Not Probable
Floodplain Fill	☐ Probable	☑ Not Probable
Impacts to Forests	☐ Probable	☑ Not Probable
Impacts to Specimen Trees	☐ Probable	☑ Not Probable

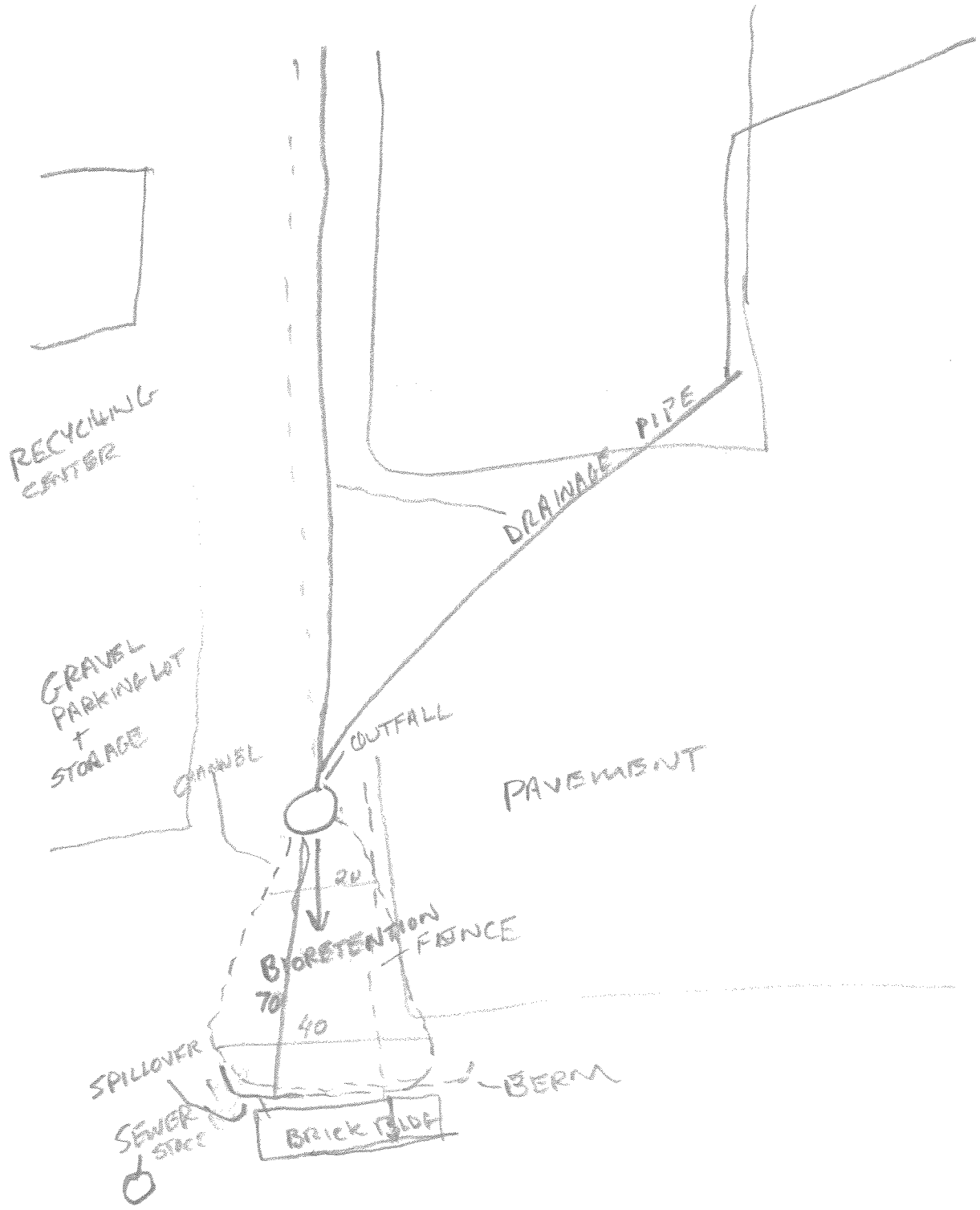
How many?_____
Approx. DBH_____

Other factors:_____
_____

Soils:

Soil auger test holes:	☐ Yes	☑ No
Evidence of poor infiltration (clays, fines):	☐ Yes	☑ No
Evidence of shallow bedrock:	☐ Yes	☑ No
Evidence of high water table (gleying, saturation):	☐ Yes	☑ No

SKETCH


RECYCLING CENTER
DRAINAGE PIPE
GRAVEL PARKING LOT + STORAGE
CHANNEL
OUTFALL
PAVEMENT
20'
BIORETENTION
FENCE
70'
40'
SPILLOVER
BERM
SEWER STUB
BRICK HEADWALL

DESIGN OR DELIVERY NOTES

- ALREADY SOME CATTAILS IN PLACE SO SOME WETLAND PLANTS CAN SURVIVE
- REMOVE FENCE FROM MIDDLE OF PRACTICE
- MORE ROOM (LENGTH) MAY BE AVAILABLE IF NECESSARY

FOLLOW-UP NEEDED TO COMPLETE FIELD CONCEPT

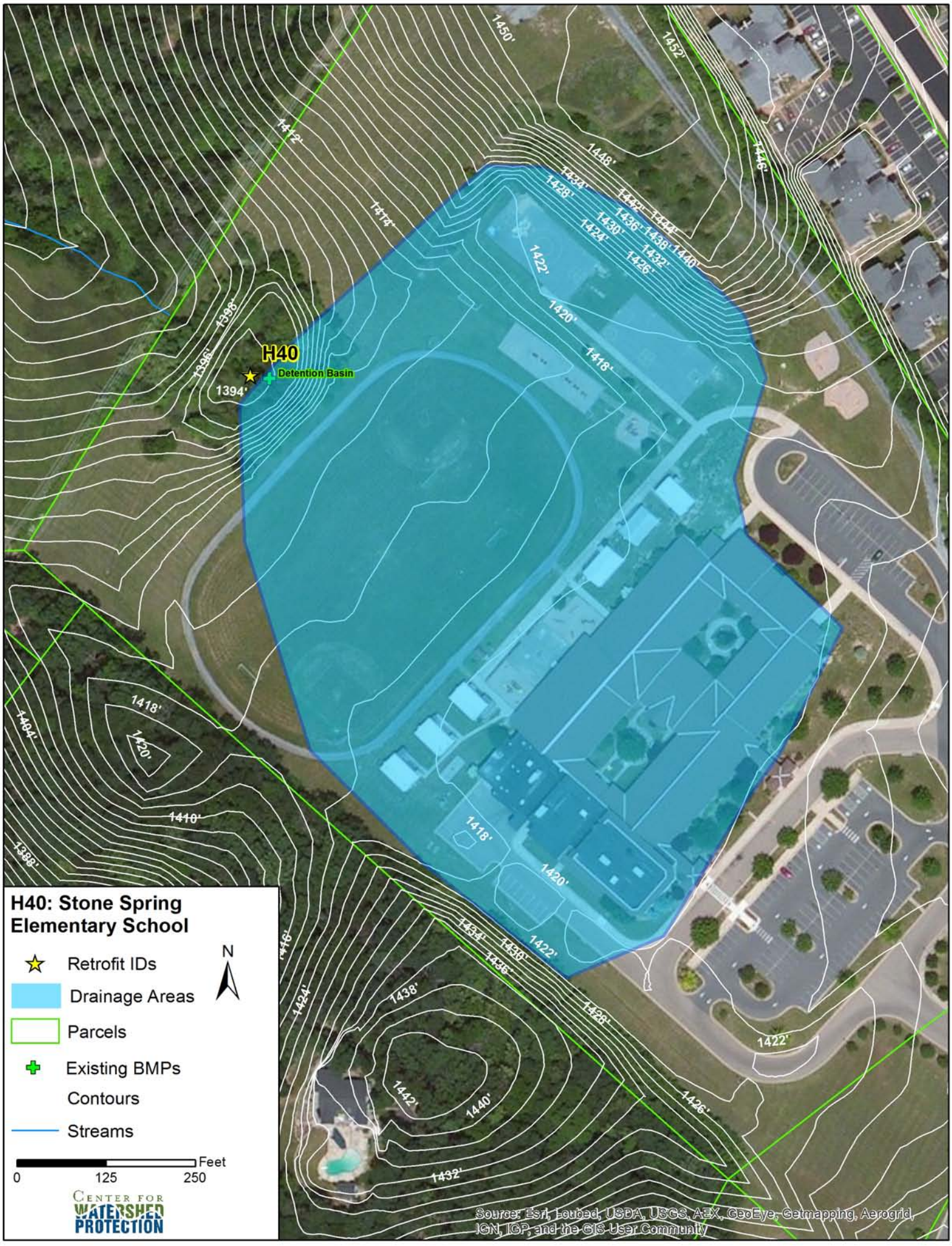
- ☐ Confirm property ownership
- ☑ Confirm drainage area
- ☐ Confirm drainage area impervious cover
- ☐ Confirm volume computations
- ☑ Complete concept sketch
- ☐ Obtain existing stormwater practice as-builts
- ☐ Obtain site as-builts
- ☐ Obtain detailed topography
- ☐ Obtain utility mapping
- ☐ Confirm storm drain invert elevations
- ☐ Confirm soil types
- ☐ Other:_____

INITIAL FEASIBILITY AND CONSTRUCTION CONSIDERATIONS

SITE CANDIDATE FOR FURTHER INVESTIGATION:	☑ YES	☐ NO	☐ MAYBE
IS SITE CANDIDATE FOR EARLY ACTION PROJECT(S):	☐ YES	☑ NO	☐ MAYBE
IF NO, SITE CANDIDATE FOR OTHER RESTORATION PROJECT(S):	☐ YES	☑ NO	☐ MAYBE

IF YES, TYPE(S):_____

H40: Stone Spring Elementary School


H40
Detention Basin
1394'
1450'
1452'
1412'
1448'
1446'
1434'
1428'
1442'
1444'
1414'
1430'
1436'
1438'
1424'
1432'
1440'
1426'
1422'
1420'
1418'
1396'
1398'
1418'
1494'
1420'
1410'
1388'
1418'
1420'
1422'
1434'
1438'
1436'
1424'
1438'
1428'
1422'
1442'
1440'
1426'
1432'
H40: Stone Spring Elementary School
Retrofit IDs
Drainage Areas
Parcels
Existing BMPs
Contours
Streams
N
Feet
0
125
250
Center for Watershed Protection
Source: Esri, i-cubed, USDA, USGS, AEX, GeoEye, Getmapping, Aerogrid, IGN, IGP, and the GIS User Community

H40: Stone Spring Elementary School

Score: N/A
Rank: N/A
Investigators: Rick Altizer, Chris Swann

Figure 1: *Detention Basin 1*

Figure 2: *Detention Basin 2*

Description: Two detention ponds provide treatment to the school. They each had a large amount of vegetation (Figures 1 and 2) that may be preventing them from treating the full storage volume as originally designed.

Proposed Retrofit: The concept is to perform pond maintenance on the two detention ponds. This would include checking elevations for sediment cleanout and clearing trees as necessary to increase storage volume.

Miscellaneous **MI**

WATERSHED/SUBSHED: HARRISONBURG	**DATE:** 3 / 20 / 13	**ASSESSED BY:** RA, CPS
SURVEY REACH ID: H40	**TIME:**___:___AM/PM	**PHOTO ID:** (*Camera-Pic #*) OLYMPUS#
SITE ID: (*Condition-#*) MI-H40	**LAT**___°___'___" **LONG** ___°___'___" **LMK:** ___	**GPS:** (*Unit ID*)

POTENTIAL RESTORATION CANDIDATE ☐ Storm water retrofit ☐ Stream restoration ☐ Riparian Management
☐ no ☐ Discharge Prevention ☒ Other: LANDSCAPE MAINTENANCE

DESCRIBE:
2 DETENTION PONDS IN NEED OF MAINTENANCE
TREES IN POND AND ON BANKS.

REPORTED TO LOCAL AUTHORITIES ☐ Yes ☐ No

WATERSHED/SUBSHED:	**DATE:** ___/___/___	**ASSESSED BY:**
SURVEY REACH ID:	**TIME:**___:___AM/PM	**PHOTO ID:** (*Camera-Pic #*) /#
SITE ID: (*Condition-#*) **MI-**___	**LAT**___°___'___" **LONG** ___°___'___" **LMK:** ___	**GPS:** (*Unit ID*)

POTENTIAL RESTORATION CANDIDATE ☐ Storm water retrofit ☐ Stream restoration ☐ Riparian Management
☐ no ☐ Discharge Prevention ☐ Other:

DESCRIBE:

REPORTED TO LOCAL AUTHORITIES ☐ Yes ☐ No

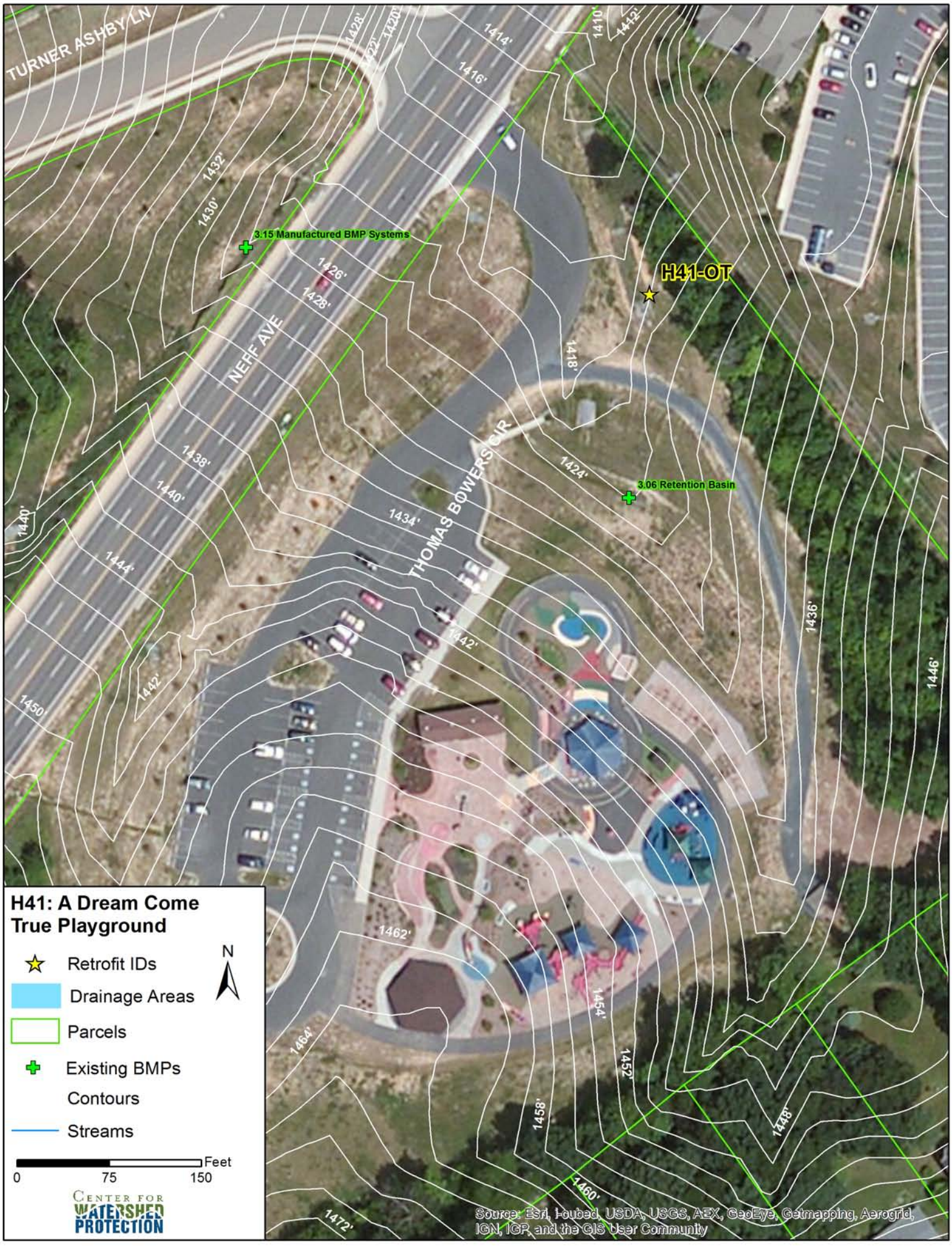
WATERSHED/SUBSHED:	**DATE:** ___/___/___	**ASSESSED BY:**
SURVEY REACH ID:	**TIME:**___:___AM/PM	**PHOTO ID:** (*Camera-Pic #*) /#
SITE ID: (*Condition-#*) **MI-**___	**LAT**___°___'___" **LONG** ___°___'___" **LMK:** ___	**GPS:** (*Unit ID*)

POTENTIAL RESTORATION CANDIDATE ☐ Storm water retrofit ☐ Stream restoration ☐ Riparian Management
☐ no ☐ Discharge Prevention ☐ Other:

DESCRIBE:

REPORTED TO LOCAL AUTHORITIES ☐ Yes ☐ No

H41: A Dream Come True Playground


TURNER ASHBY LN
NEFF AVE
THOMAS BOWERS CIR
3.15 Manufactured BMP Systems
3.06 Retention Basin
H41-OT
1410'
1412'
1414'
1416'
1418'
1420'
1422'
1424'
1426'
1428'
1430'
1432'
1434'
1436'
1438'
1440'
1442'
1444'
1446'
1448'
1450'
1452'
1454'
1456'
1458'
1460'
1462'
1464'
1472'
H41: A Dream Come True Playground
Retrofit IDs
Drainage Areas
Parcels
Existing BMPs
Contours
Streams
N
Feet
0
75
150
Center for Watershed Protection
Source: Esri, i-cubed, USDA, USGS, AEX, GeoEye, Getmapping, Aerogrid, IGN, IGP, and the GIS User Community

H41-OT: A Dream Come True Playground Outfall Erosion

Score: N/A
Rank: N/A
Investigators: Wes Runion, Jeremy Harold, Lisa Fraley-McNeal

Figure 1: *Erosion downstream of outfall*

Description: The outfall shown in Figure 1 conveys discharge from an adjacent retention basin treating runoff from the playground and a portion of the parking lot. The outfall also conveys runoff from residential land upslope of the playground. Stabilization has been attempted through rip-rap near the pipe opening and matting along the grass swale heading downhill from the outfall. However, erosion is still occurring in spite of these attempts.

Proposed Solutions: Secure banks below pipe outfall with erosion control matting and allow grass to grow tall. This will at least slow down the rate of erosion. A more advanced solution would be to create a step-pool system or regenerative stormwater conveyance to prevent erosion and provide water quality benefits.

WATERSHED/SUBSHED: | **DATE:** 3/20/13 | **ASSESSED BY:** Lisa, Wes

SURVEY REACH ID: 44 | **TIME:** ___:___ AM/PM | **PHOTO ID:** (*Camera-Pic #*) See Olympus #66, 67

SITE ID (*Condition-#*): OT-41 | **LAT** ___° ___' ___" **LONG** ___° ___' ___" | **LMK** ___ | **GPS:** (*Unit ID*)

A Dream Come True Playground

BANK: ☐ LT ☐ RT ☐ Head

FLOW: ☒ None ☐ Trickle ☐ Moderate ☐ Substantial ☐ Other:

TYPE: ☒ Closed pipe ☐ Open channel

MATERIAL: ☒ Concrete ☐ Metal ☐ PVC/Plastic ☐ Brick ☐ Other: | ☐ Concrete ☐ Earthen ☐ Other:

SHAPE: ☒ Single ☐ Double ☒ Circular ☐ Elliptical ☐ Triple ☐ Other: | ☐ Trapezoid ☐ Parabolic ☐ Other:

DIMENSIONS: Diameter: 1½' (ea) | Depth: ___ (in) | Width (Top): ___ (in) | " (Bottom): ___ (in) | NOT APPLICABLE

SUBMERGED: ☒ No ☐ Partially ☐ Fully

CONDITION: ☒ None ☐ Chip/Cracked ☐ Peeling Paint ☐ Corrosion ☐ Other:

ODOR: ☒ No ☐ Gas ☐ Sewage ☐ Rancid/Sour ☐ Sulfide ☐ Other:

DEPOSITS/STAINS: ☒ None ☐ Oily ☐ Flow Line ☐ Paint ☐ Other:

VEGGIE DENSITY: ☒ None ☐ Normal ☐ Inhibited ☐ Excessive ☐ Other:

PIPE BENTHIC GROWTH: ☒ None ☐ Brown ☐ Orange ☐ Green ☐ Other:

POOL QUALITY: ☐ No pool ☐ Good ☐ Odors ☐ Colors ☐ Oils ☐ Suds ☐ Algae ☐ Floatables ☐ Other:

FOR FLOWING ONLY

COLOR: ☐ Clear ☐ Brown ☐ Grey ☐ Yellow ☐ Green ☐ Orange ☐ Red ☐ Other:

TURBIDITY: ☐ None ☐ Slight Cloudiness ☐ Cloudy ☐ Opaque

FLOATABLES: ☐ None ☐ Sewage (toilet paper, etc.) ☐ Petroleum (oil sheen) ☐ Other:

OTHER CONCERNS: ☐ Excess Trash (paper/plastic bags) ☐ Dumping (bulk) ☐ Excessive Sedimentation ☐ Needs Regular Maintenance ☒ Bank Erosion ☐ Other:

POTENTIAL RESTORATION CANDIDATE ☐ no ☐ Discharge investigation ☐ Storm water retrofit ☐ Stream daylighting ☐ Other: ☒ Local stream repair/outfall stabilization

If yes for daylighting:

Length of vegetative cover from outfall: ___ ft Type of existing vegetation: ___ Slope: ___ °

If yes for stormwater:

Is stormwater currently controlled? ☐ Yes ☐ No ☐ Not investigated

Land Use description: ___

Area available:

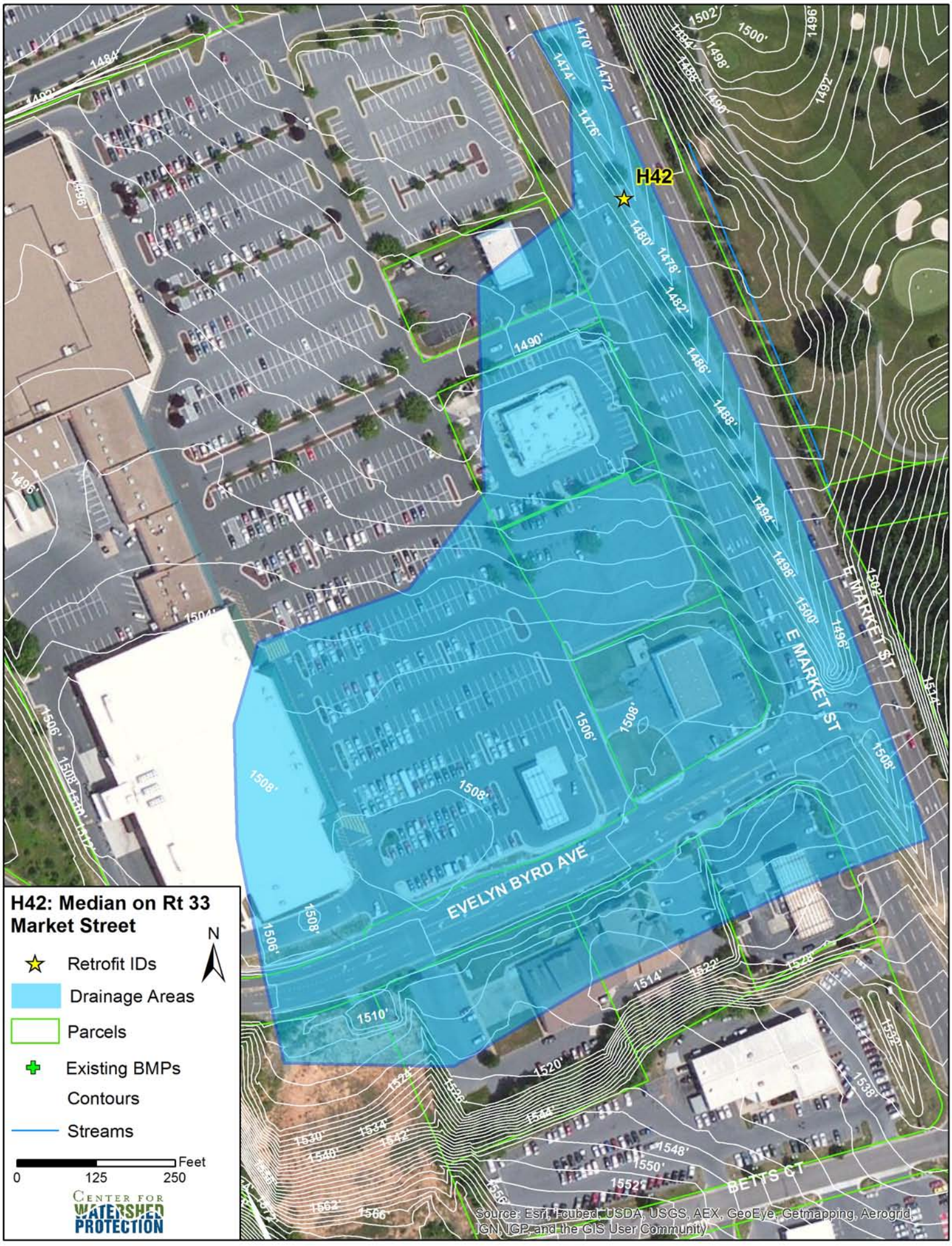
OUTFALL SEVERITY: *(circle #)*	Heavy discharge with a distinct color and/or a strong smell. The amount of discharge is significant compared to the amount of normal flow in receiving stream; discharge appears to be having a significant impact downstream.	Small discharge; flow mostly clear and odorless. If the discharge has a color and/or odor, the amount of discharge is very small compared to the stream's base flow and any impact appears to be minor / localized.	Outfall does not have dry weather discharge; staining; or appearance of causing any erosion problems.
	5	4	3 (2) 1

SKETCH/NOTES:

Regenerative Stormwater conveyance or a simple step pool system. Existing downstream channel is eroded.

REPORTED TO AUTHORITIES: ☐ YES ☒ NO

H42: Median on Rt 33 Market Street


H42
E MARKET ST
EVELYN BYRD AVE
BETTS CT
H42: Median on Rt 33
Market Street
N
Retrofit IDs
Drainage Areas
Parcels
Existing BMPs
Contours
Streams
Feet
0
125
250
Center for
Watershed
Protection
Source: Esri, i-cubed, USDA, USGS, AEX, GeoEye, Getmapping, Aerogrid, IGN, IGP, and the GIS User Community

H42: Median on Route 33 Market Street

Score: 76
Rank: 11
Investigators: Rick Altizer, Chris Swann

Figure 1: *Rock-lined conveyance channel*

Figure 2: *Median with final outfall*

Description: This site has a large drainage area of approximately 88.5 acres that includes several commercial establishments with large amounts of imperviousness. The Route 33 median contains a rip-rap channel to convey road drainage and runoff from several parking lots, as well as some residential runoff (Figure 1). After passing through this part of the median, water is carried under a road crossing into another rock-lined area (Figure 2) and then through an outfall to eventually be discharged into Siebert Creek.

Proposed Retrofit: The concept here is to develop a regenerative stormwater conveyance system (RSC) to provide treatment. The estimated space available is roughly 20' X 1,000' in the portion of the median from the intersection with Evelyn Byrd Avenue downhill to the first road crossing to enter the Skyline Village shopping center. Due to the steep slope and the amount of drainage to the system, this practice might provide the best opportunity to convey runoff while protecting the median sidewalls from erosion and improving the aesthetic look of the median.

The large amount of drainage to this location may call for additional measures to reduce the volume and velocity of the runoff. RSC systems can be used for large drainage areas, but may require larger stone, which could create a public safety hazard in the median. A second RSC system installed in the next median uphill can provide additional treatment and reduce velocity in the downhill slope. Onsite retrofit practices on some of the commercial parking lots may also help to reduce the intensity of the runoff and prevent the RSC from being overwhelmed in large storms.

WATERSHED: HARRISONBURG	SUBWATERSHED: HARRISONBURG	UNIQUE SITE ID: H42	
DATE: 3/20/13	ASSESSED BY: CPS/RA	CAMERA ID: OLYMPUS BLUE DOT	PICTURES: 73-74
GPS ID:	LMK ID:	LAT:	LONG:

SITE DESCRIPTION

Name: RTE 33 MEDIAN
Address:

Ownership: ☒ Public ☐ Private ☐ Unknown
If Public, Government Jurisdiction: ☒ Local ☐ State ☐ DOT ☐ Other:

Corresponding USSR/USA Field Sheet? ☐ Yes ☒ No If yes, Unique Site ID:

Proposed Retrofit Location:

Storage
- ☐ Existing Pond
- ☐ Below Outfall
- ☒ In Road ROW
- ☐ Other:
- ☐ Above Roadway Culvert
- ☒ In Conveyance System
- ☐ Near Large Parking Lot

On-Site
- ☐ Hotspot Operation
- ☐ Small Parking Lot
- ☐ Individual Street
- ☐ Underground
- ☐ Individual Rooftop
- ☐ Small Impervious Area
- ☐ Landscape / Hardscape
- ☐ Other:

DRAINAGE AREA TO PROPOSED RETROFIT

Drainage Area ≈ 88.5
Imperviousness ≈ 57.4 %
Impervious Area ≈ 50.8

Notes:

Drainage Area Land Use:
- ☐ Residential
  - ☐ SFH (< 1 ac lots)
  - ☐ SFH (> 1 ac lots)
  - ☐ Townhouses
  - ☐ Multi-Family
- ☒ Commercial
- ☐ Institutional
- ☐ Industrial
- ☒ Transport-Related
- ☐ Park
- ☐ Undeveloped
- ☐ Other:

EXISTING STORMWATER MANAGEMENT

Existing Stormwater Practice: ☐ Yes ☒ No ☐ Possible
If Yes, Describe:

Describe Existing Site Conditions, Including Existing Site Drainage and Conveyance:
Existing Street Width (if applicable):

ROAD MEDIAN - ROCK WRAPPED CHANNEL
2 OUTFALLS IN MEDIAN

Existing Head Available:	Note where points are measured from: (i.e. street elevation to catch basin invert, manhole rim to catch basin invert, other)

PROPOSED RETROFIT

Purpose of Retrofit:
☒ Water Quality ☐ Recharge ☐ Channel Protection ☐ Flood Control
☐ Demonstration / Education ☐ Repair ☐ Other:_____

Retrofit Volume Computations - Target Storage:

Retrofit Volume Computations - Available Storage:

Proposed Retrofit Practice: (Runoff Reduction)
☐ Disconnection ☒ Bioretention ☐ Bio Swale
☐ Expanded Tree Pit ☐ Infiltration ☐ Green Roof
☐ Permeable Pavement ☐ Rainwater Harvesting

Proposed Retrofit Practice: (Stormwater Treatment)
☐ Constructed Wetland ☐ Wet Swale ☐ Wet Pond
☐ Filtering Practice ☐ Proprietary:_____
☐ Other: _____

Retrofit Category (as defined by Chesapeake Bay Program):
☒ New BMP ☐ BMP Enhancement ☐ BMP Restoration ☐ BMP Conversion ☐ Not CBP-approved

Describe Elements of Proposed Retrofit, Including Surface Area, Maximum Depth of Treatment, and Conveyance:

RSCS SYSTEM IN ROAD CONVEYANCE SYSTEM
SLOPE IN 4 - 6% RANGE
BIOSWALE MAY WORK WITH CHECKDAMS

Available Width:	20'
Available Length:	1000'
Available Area:	
Ponding Depth:	
Soil Depth:	

SITE CONSTRAINTS

Adjacent Land Use:
☐ Residential ☐ Commercial ☐ Institutional
☐ Industrial ☒ Transport-Related ☐ Park
☐ Undeveloped ☐ Other:_____
Possible Conflicts Due to Adjacent Land Use? ☐ Yes ☒ No
If Yes, Describe:

Access:
☒ No Constraints
Constrained due to
☐ Slope ☐ Space
☐ Utilities ☐ Tree Impacts
☐ Structures ☐ Property
Ownership
☐ Other:_____

Conflicts with Existing Utilities:

	Yes	Possible/ Modifiable	No	Unknown
Sewer:	☐	☒	☐	☐
Water:	☐	☐	☒	☐
Gas:	☐	☐	☒	☐
Electric to Streetlights:	☐	☐	☒	☐
Other:	☐	☐	☒	☐

_____

Potential Permitting Factors:

Dam Safety Permits Necessary	☐ Probable	☒ Not Probable
Impacts to Wetlands	☐ Probable	☒ Not Probable
Impacts to a Stream	☐ Probable	☒ Not Probable
Floodplain Fill	☐ Probable	☒ Not Probable
Impacts to Forests	☐ Probable	☒ Not Probable
Impacts to Specimen Trees	☐ Probable	☒ Not Probable

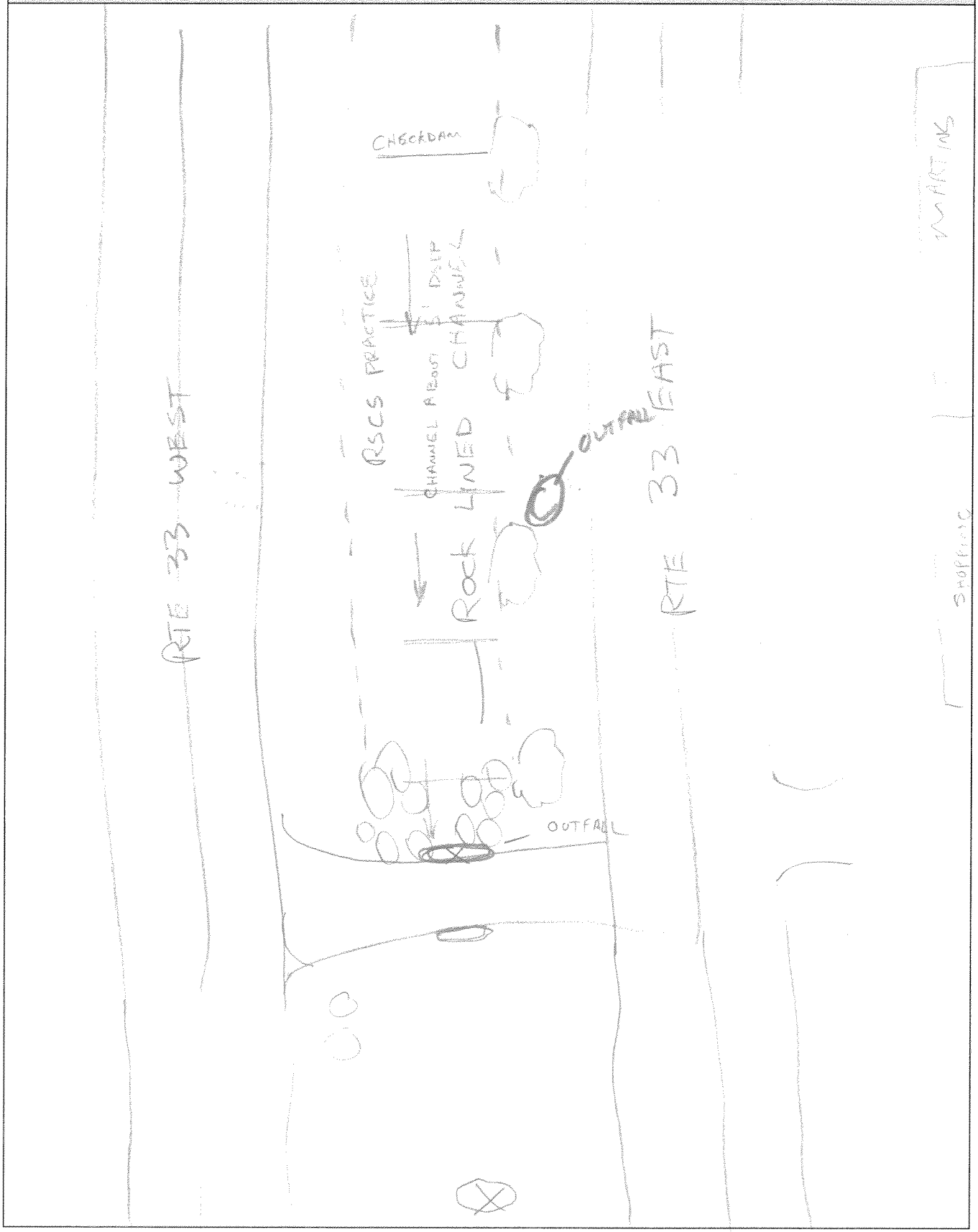
How many?_____
Approx. DBH_____

Other factors:_____
_____

Soils:

Soil auger test holes:	☐ Yes	☒ No
Evidence of poor infiltration (clays, fines):	☐ Yes	☒ No
Evidence of shallow bedrock:	☐ Yes	☒ No
Evidence of high water table (gleying, saturation):	☐ Yes	☒ No

SKETCH


CHECKDAM
RSCS PRACTICE
DRIP
CHANNEL FLOW
LINED
ROCK
OUTFALL
RTE 33 WEST
RTE 33 EAST
OUTFALL

DESIGN OR DELIVERY NOTES

- MAY NEED TO CREATE POOL NEAR OUTFALL AT LOWER END OF MEDIAN - APPEARS TO PICK UP LARGE DRAINAGE AREA
- COULD PUT MORE RSCS IN NEXT MEDIAN BEYOND INTERSECTION OF 33 + EVELYN BIRD AVENUE
- SOME ONSITE TREATMENT PRACTICES MAY BE NECESSARY IN UPPER DRAINAGE AREA TO REDUCE VOLUME + VELOCITY

FOLLOW-UP NEEDED TO COMPLETE FIELD CONCEPT

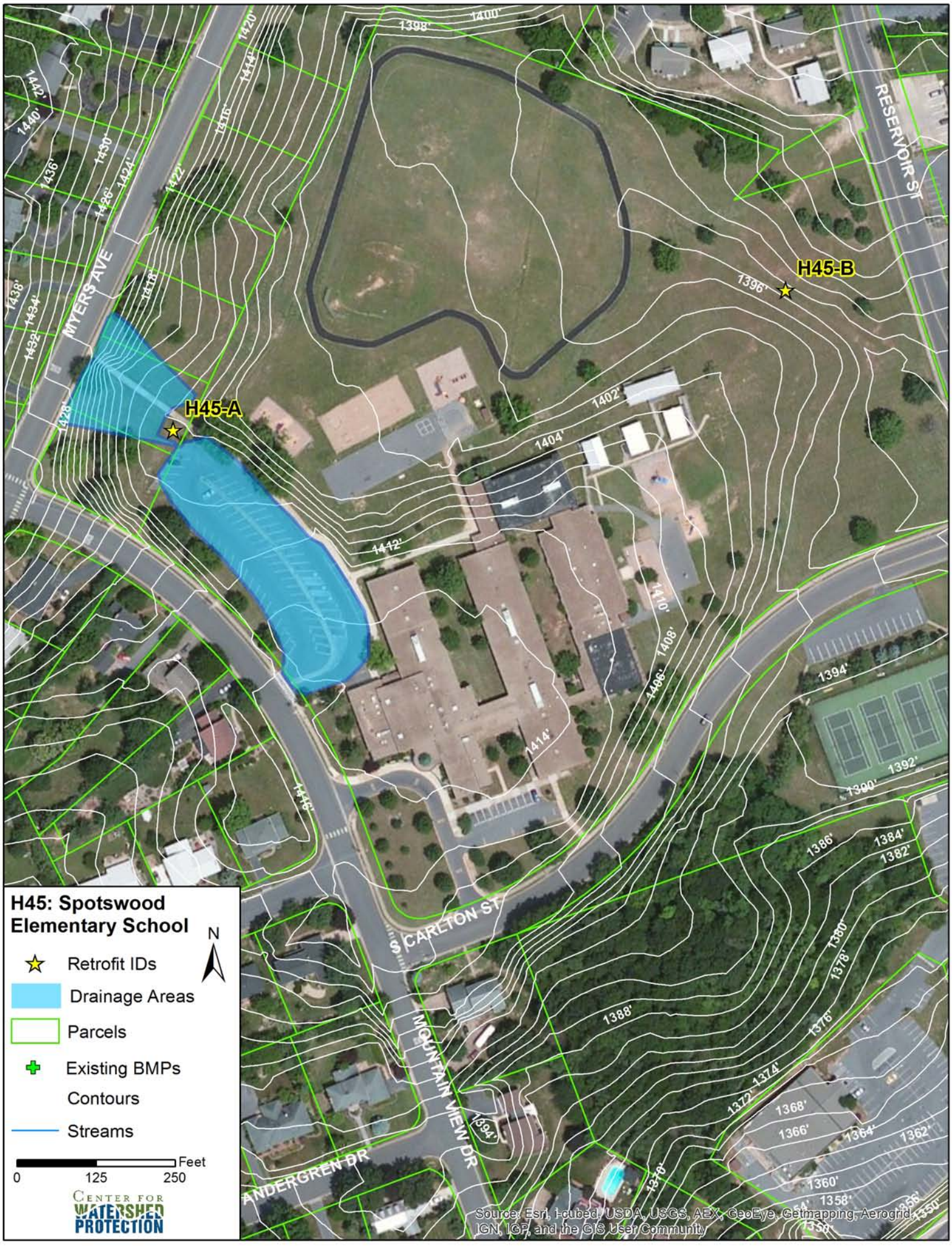
- [ ] Confirm property ownership
- [x] Confirm drainage area
- [ ] Confirm drainage area impervious cover
- [ ] Confirm volume computations
- [x] Complete concept sketch
- [ ] Obtain existing stormwater practice as-builts
- [ ] Obtain site as-builts
- [x] Obtain detailed topography
- [ ] Obtain utility mapping
- [ ] Confirm storm drain invert elevations
- [ ] Confirm soil types
- [ ] Other: _____

INITIAL FEASIBILITY AND CONSTRUCTION CONSIDERATIONS

SITE CANDIDATE FOR FURTHER INVESTIGATION:	[x] YES	[ ] NO	[ ] MAYBE
IS SITE CANDIDATE FOR EARLY ACTION PROJECT(S):	[ ] YES	[x] NO	[ ] MAYBE
IF NO, SITE CANDIDATE FOR OTHER RESTORATION PROJECT(S):	[ ] YES	[ ] NO	[ ] MAYBE

IF YES, TYPE(S): _____

H45: Spotswood Elementary School


H45-A
H45-B
MYERS AVE
RESERVOIR ST
S CARLTON ST
MOUNTAIN VIEW DR
ANDERGREN DR
1442'
1440'
1438'
1436'
1434'
1432'
1430'
1428'
1426'
1424'
1422'
1420'
1418'
1416'
1414'
1412'
1410'
1408'
1406'
1404'
1402'
1400'
1398'
1396'
1394'
1392'
1390'
1388'
1386'
1384'
1382'
1380'
1378'
1376'
1374'
1372'
1370'
1368'
1366'
1364'
1362'
1360'
1358'
1356'
1354'
1350'
H45: Spotswood Elementary School
N
Retrofit IDs
Drainage Areas
Parcels
Existing BMPs
Contours
Streams
Feet
0
125
250
Center for Watershed Protection
Source: Esri, i-cubed, USDA, USGS, AEX, GeoEye, Getmapping, Aerogrid, IGN, IGP, and the GIS User Community

H45-A: Spotswood Elementary, Bioretention

Score: 38

Rank: 20

Investigators: Megan O'Gorek, Laurel Woodworth

Figure 1: *Small rain garden filled with grit and dirt*

Figure 2: *Opposite view of rain garden and lot*

Description: Runoff from 1.14 acres of the parking lot and adjacent hillside behind Spotswood Elementary School drains to one corner of the lot into a small rain garden. Unfortunately, the rain garden is under-sized and has been overwhelmed by fine gravel and sediment coming off the asphalt (Figure 1).

Proposed Retrofit: A retrofit of the existing rain garden is proposed to replace it with a more expansive and engineered bioretention practice with a surface area of approximately 42' x 48'. The practice would extend out from the location of the current rain garden and go under the concrete sidewalk in Figure 2. A culvert or trench drain could connect flow between the two sides of the bioretention. There is a small grass ditch downhill from the rain garden into which an underdrain pipe and overflow could be directed. Having the walkway cross over/through the bioretention area will serve as an attractive feature on the landscape.

Since children are in the vicinity, the ponding depth should be kept to no more than 6".

H45-B: Spotswood Elementary, Turf Retrofit

Score: N/A

Rank: N/A

Investigators: Megan O'Gorek, Laurel Woodworth

Figure 1: *Mowed turf at Reservoir & Carlton St.*

Figure 2: *Mowed turf along Reservoir Street*

Description: Many acres of the Spotswood Elementary School campus are maintained as mowed turf grass (Figures 1 &2). Although some of this area is used for recreation and other uses, a large portion of it is not. Keeping lawns mowed regularly is a big investment in time, labor, and fossil fuels.

Proposed Solutions: For portions of the campus that are not used, especially along Reservoir Street and S. Carlton Street, consider changing the landscape maintenance style. These areas can be planted with trees, converted to forest area, and/or converted to wildflower and native grass meadows. Each of these types of ground cover do a better job of reducing runoff than does mowed turf.

An example of a turf hillside at James Madison University converted in 2012 to a meadow of native plants is shown in Figure 3 below.

Figure 3: *Turf converted to meadow at JMU (Photo: Bobby Whitescarver)*

RRI

WATERSHED:	SUBWATERSHED:	UNIQUE SITE ID: H45-A

DATE: 3/19/13	ASSESSED BY: LW	CAMERA ID:	PICTURES: 3156-3158
GPS ID:	LMK ID:	LAT:	LONG:

SITE DESCRIPTION

Name: Spotswood Elementary School
Address:

Ownership: ☑ Public ☐ Private ☐ Unknown
If Public, Government Jurisdiction: ☑ Local ☐ State ☐ DOT ☐ Other:

Corresponding USSR/USA Field Sheet? ☐ Yes ☑ No If yes, Unique Site ID:

Proposed Retrofit Location:

Storage
- ☐ Existing Pond
- ☐ Below Outfall
- ☐ In Road ROW
- ☐ Above Roadway Culvert
- ☐ In Conveyance System
- ☐ Near Large Parking Lot
- ☐ Other:

On-Site
- ☐ Hotspot Operation
- ☑ Small Parking Lot
- ☐ Individual Street
- ☐ Underground
- ☐ Individual Rooftop
- ☐ Small Impervious Area
- ☐ Landscape / Hardscape
- ☐ Other:

DRAINAGE AREA TO PROPOSED RETROFIT

Drainage Area ≈ 1.14 ac
Imperviousness ≈ 72.8 %
Impervious Area ≈ 0.83

Notes:

Drainage Area Land Use:
- ☐ Residential
  - ☐ SFH (< 1 ac lots)
  - ☐ SFH (> 1 ac lots)
  - ☐ Townhouses
  - ☐ Multi-Family
- ☐ Commercial
- ☑ Institutional
- ☐ Industrial
- ☐ Transport-Related
- ☐ Park
- ☐ Undeveloped
- ☐ Other:

EXISTING STORMWATER MANAGEMENT

Existing Stormwater Practice: ☒ Yes ☐ No ☐ Possible
If Yes, Describe:

- Undersized rain garden, overwhelmed by parking lot dirt to fines (back parking lot)

Describe Existing Site Conditions, Including Existing Site Drainage and Conveyance:
Existing Street Width (if applicable):

Back parking lot drains to bottom corner to existing small rain garden

Existing Head Available:

4.5'

Note where points are measured from: (i.e. street elevation to catch basin invert, manhole rim to catch basin invert, other)

~ rain garden + ditch near playground surface

PROPOSED RETROFIT

Purpose of Retrofit:
☑ Water Quality ☐ Recharge ☐ Channel Protection ☐ Flood Control
☑ Demonstration / Education ☑ Repair (enlargen) ☐ Other:_____

Retrofit Volume Computations - Target Storage:
3108cf

Retrofit Volume Computations - Available Storage:

Proposed Retrofit Practice: (Runoff Reduction)
☐ Disconnection ☑ Bioretention ☐ Bio Swale
☐ Expanded Tree Pit ☐ Infiltration ☐ Green Roof
☐ Permeable Pavement ☐ Rainwater Harvesting

Proposed Retrofit Practice: (Stormwater Treatment)
☐ Constructed Wetland ☐ Wet Swale ☐ Wet Pond
☐ Filtering Practice ☐ Proprietary:_____
☐ Other: _____

Retrofit Category (as defined by Chesapeake Bay Program):
☐ New BMP ☐ BMP Enhancement ☐ BMP Restoration ☑ BMP Conversion ☐ Not CBP-approved

Describe Elements of Proposed Retrofit, Including Surface Area, Maximum Depth of Treatment, and Conveyance:
- Expand existing rain garden into a larger bioretention
- Expand into grass area on both sides of sidewalk
- run ponding area under the sidewalk, using culvert
- Tie underdrain to existing ditch

Available Width:	48'
Available Length:	48'
Available Area:	
Ponding Depth:	~0.5'
Soil Depth:	

SITE CONSTRAINTS

Adjacent Land Use:
☑ Residential ☐ Commercial ☑ Institutional
☐ Industrial ☐ Transport-Related ☐ Park
☐ Undeveloped ☐ Other:_____
Possible Conflicts Due to Adjacent Land Use? ☐ Yes ☐ No
If Yes, Describe:

Access:
☑ No Constraints
Constrained due to
☐ Slope ☐ Space
☐ Utilities ☐ Tree Impacts
☐ Structures ☐ Property
Ownership
☐ Other:_____

Conflicts with Existing Utilities:

	Yes	Possible/ Modifiable	No	Unknown
Sewer:	☐	☐	☑	☐
Water:	☐	☐	☑	☐
Gas:	☐	☐	☑	☐
Electric to Streetlights:	☐	☐	☑	☐
Other:	☐	☐	☐	☐

Potential Permitting Factors:

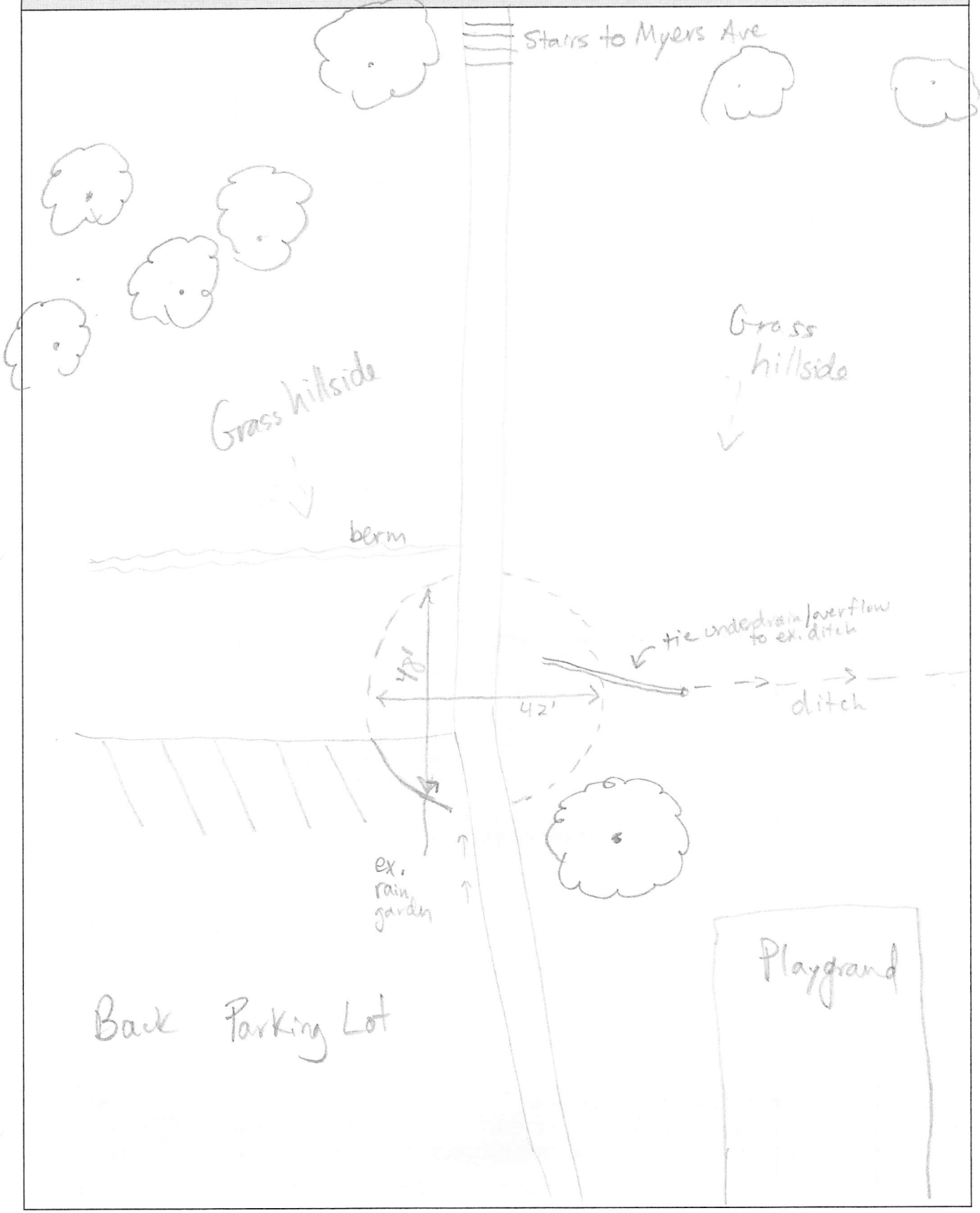
Dam Safety Permits Necessary	☐ Probable	☑ Not Probable
Impacts to Wetlands	☐ Probable	☑ Not Probable
Impacts to a Stream	☐ Probable	☑ Not Probable
Floodplain Fill	☐ Probable	☑ Not Probable
Impacts to Forests	☐ Probable	☑ Not Probable
Impacts to Specimen Trees	☐ Probable	☑ Not Probable

How many?_____
Approx. DBH_____

Other factors: Stay clear of large tree

Soils:
Soil auger test holes: ☐ Yes ☐ No
Evidence of poor infiltration (clays, fines): ☐ Yes ☐ No
Evidence of shallow bedrock: ☐ Yes ☐ No
Evidence of high water table (gleying, saturation): ☐ Yes ☐ No

SKETCH


Stairs to Myers Ave
Grass hillside
Grass hillside
berm
tie underdrain/overflow to ex. ditch
42'
ditch
ex. rain garden
Playground
Back Parking Lot

DESIGN OR DELIVERY NOTES

- Keep ponding level to a minimum
- Stay away from tree dripline during excavation

FOLLOW-UP NEEDED TO COMPLETE FIELD CONCEPT

- ☐ Confirm property ownership
- ☐ Confirm drainage area
- ☐ Confirm drainage area impervious cover
- ☑ Confirm volume computations
- ☐ Complete concept sketch
- ☐ Obtain existing stormwater practice as-builts
- ☐ Obtain site as-builts
- ☐ Obtain detailed topography
- ☐ Obtain utility mapping
- ☐ Confirm storm drain invert elevations
- ☑ Confirm soil types
- ☐ Other:_____

INITIAL FEASIBILITY AND CONSTRUCTION CONSIDERATIONS

SITE CANDIDATE FOR FURTHER INVESTIGATION:	☐ YES	☐ NO	☐ MAYBE
IS SITE CANDIDATE FOR EARLY ACTION PROJECT(S):	☐ YES	☐ NO	☐ MAYBE
IF NO, SITE CANDIDATE FOR OTHER RESTORATION PROJECT(S):	☐ YES	☐ NO	☐ MAYBE

IF YES, TYPE(S):_____

WATERSHED:	SUBWATERSHED:	UNIQUE SITE ID: H45-B	
DATE: 3/19/13	ASSESSED BY: LW	CAMERA ID:	PICTURES: 3153-3155 59-61
GPS ID:	LMK ID:	LAT:	LONG:

SITE DESCRIPTION

Name: Spotswood Elementary School
Address: _____

Ownership: ☑ Public ☐ Private ☐ Unknown
If Public, Government Jurisdiction: ☑ Local ☐ State ☐ DOT ☐ Other: _____

Corresponding USSR/USA Field Sheet? ☐ Yes ☑ No If yes, Unique Site ID: _____

Proposed Retrofit Location:

Storage
- ☐ Existing Pond
- ☐ Below Outfall
- ☐ In Road ROW
- ☐ Other: _____
- ☐ Above Roadway Culvert
- ☐ In Conveyance System
- ☐ Near Large Parking Lot

On-Site
- ☐ Hotspot Operation
- ☐ Small Parking Lot
- ☐ Individual Street
- ☐ Underground
- ☐ Individual Rooftop
- ☐ Small Impervious Area
- ☑ Landscape / Hardscape
- ☐ Other: _____

DRAINAGE AREA TO PROPOSED RETROFIT

Drainage Area ≈ _____
Imperviousness ≈ _____ %
Impervious Area ≈ _____

Notes:

Drainage Area Land Use:
- ☐ Residential
  - ☐ SFH (< 1 ac lots)
  - ☐ SFH (> 1 ac lots)
  - ☐ Townhouses
  - ☐ Multi-Family
- ☐ Commercial
- ☐ Institutional
- ☐ Industrial
- ☐ Transport-Related
- ☐ Park
- ☐ Undeveloped
- ☐ Other: _____

EXISTING STORMWATER MANAGEMENT

Existing Stormwater Practice: ☐ Yes ☑ No ☐ Possible
If Yes, Describe:

Describe Existing Site Conditions, Including Existing Site Drainage and Conveyance:
Existing Street Width (if applicable): _____

Turf

Existing Head Available:	Note where points are measured from: (i.e. street elevation to catch basin invert, manhole rim to catch basin invert, other)

PROPOSED RETROFIT

Purpose of Retrofit:
☐ Water Quality ☐ Recharge ☐ Channel Protection ☐ Flood Control
☐ Demonstration / Education ☐ Repair ☐ Other:_____

Retrofit Volume Computations - Target Storage:

Retrofit Volume Computations - Available Storage:

Proposed Retrofit Practice: (Runoff Reduction)
☐ Disconnection ☐ Bioretention ☐ Bio Swale
☐ Expanded Tree Pit ☐ Infiltration ☐ Green Roof
☐ Permeable Pavement ☐ Rainwater Harvesting

Proposed Retrofit Practice: (Stormwater Treatment)
☐ Constructed Wetland ☐ Wet Swale ☐ Wet Pond
☐ Filtering Practice ☐ Proprietary:_____
☐ Other: _____

Retrofit Category (as defined by Chesapeake Bay Program):
☐ New BMP ☐ BMP Enhancement ☐ BMP Restoration ☐ BMP Conversion ☐ Not CBP-approved

Describe Elements of Proposed Retrofit, Including Surface Area, Maximum Depth of Treatment, and Conveyance:

- Plant trees on hillsides along Myers Ave. and anywhere else on property that is not utilized ← Reservoir St.
- Wildflower meadow along Reservoir St. side

Available Width:	
Available Length:	
Available Area:	
Ponding Depth:	
Soil Depth:	

SITE CONSTRAINTS

Adjacent Land Use:
☐ Residential ☐ Commercial ☐ Institutional
☐ Industrial ☐ Transport-Related ☐ Park
☐ Undeveloped ☐ Other:_____
Possible Conflicts Due to Adjacent Land Use? ☐ Yes ☐ No
If Yes, Describe:

Access:
☐ No Constraints
Constrained due to
☐ Slope ☐ Space
☐ Utilities ☐ Tree Impacts
☐ Structures ☐ Property
Ownership
☐ Other:_____

Conflicts with Existing Utilities:

	Yes	Possible/ Modifiable	No	Unknown
Sewer:	☐	☐	☐	☐
Water:	☐	☐	☐	☐
Gas:	☐	☐	☐	☐
Electric to Streetlights:	☐	☐	☐	☐
Other:	☐	☐	☐	☐

_____

Potential Permitting Factors:

Dam Safety Permits Necessary	☐ Probable	☐ Not Probable
Impacts to Wetlands	☐ Probable	☐ Not Probable
Impacts to a Stream	☐ Probable	☐ Not Probable
Floodplain Fill	☐ Probable	☐ Not Probable
Impacts to Forests	☐ Probable	☐ Not Probable
Impacts to Specimen Trees	☐ Probable	☐ Not Probable

How many?_____
Approx. DBH_____

Other factors:_____
_____

Soils:

Soil auger test holes:	☐ Yes	☐ No
Evidence of poor infiltration (clays, fines):	☐ Yes	☐ No
Evidence of shallow bedrock:	☐ Yes	☐ No
Evidence of high water table (gleying, saturation):	☐ Yes	☐ No

SKETCH

DESIGN OR DELIVERY NOTES

FOLLOW-UP NEEDED TO COMPLETE FIELD CONCEPT

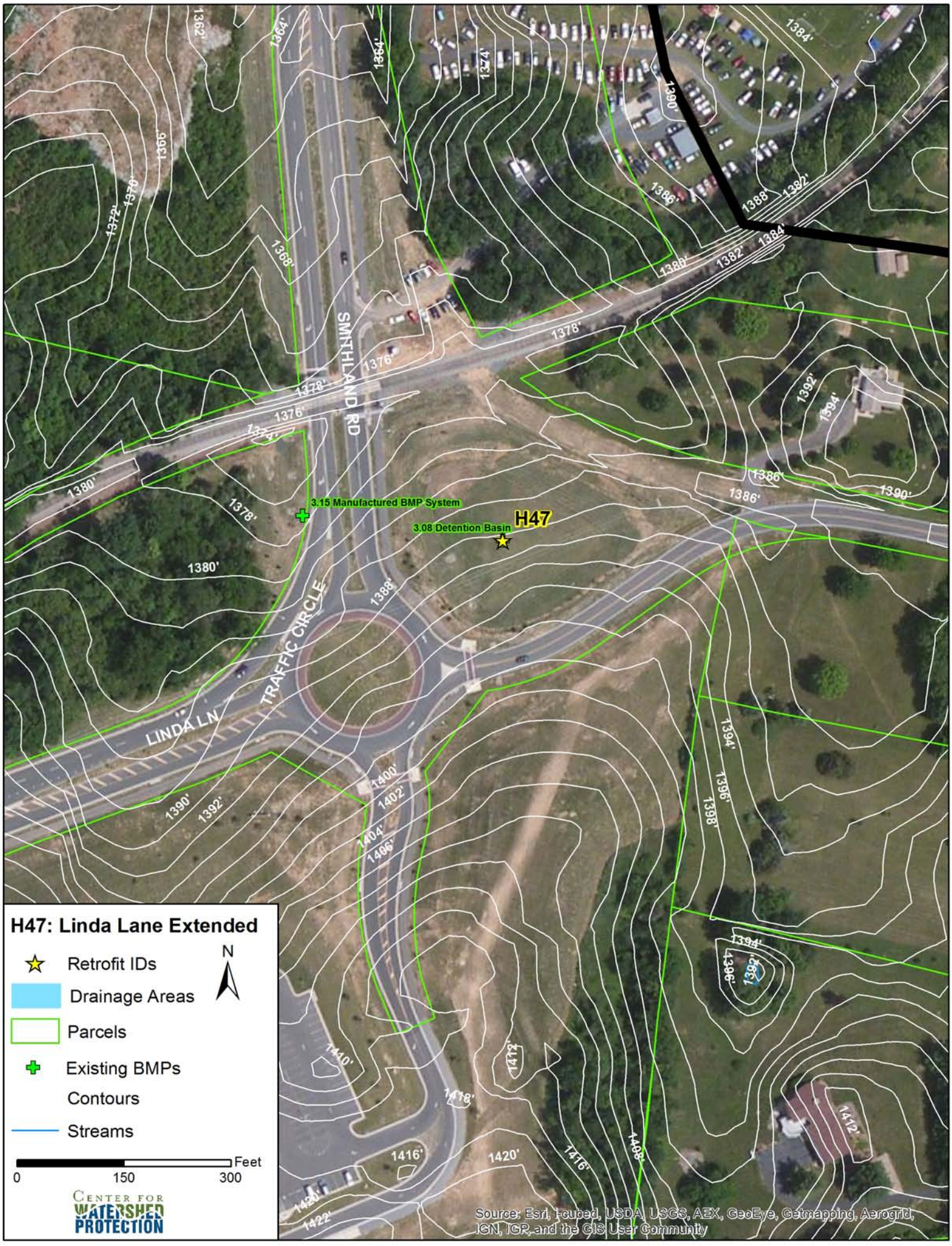
- ☐ Confirm property ownership
- ☐ Confirm drainage area
- ☐ Confirm drainage area impervious cover
- ☐ Confirm volume computations
- ☐ Complete concept sketch
- ☐ Obtain existing stormwater practice as-builts
- ☐ Obtain site as-builts
- ☐ Obtain detailed topography
- ☐ Obtain utility mapping
- ☐ Confirm storm drain invert elevations
- ☐ Confirm soil types
- ☐ Other:_____

INITIAL FEASIBILITY AND CONSTRUCTION CONSIDERATIONS

SITE CANDIDATE FOR FURTHER INVESTIGATION:	☐ YES	☐ NO	☐ MAYBE
IS SITE CANDIDATE FOR EARLY ACTION PROJECT(S):	☐ YES	☐ NO	☐ MAYBE
IF NO, SITE CANDIDATE FOR OTHER RESTORATION PROJECT(S):	☐ YES	☐ NO	☐ MAYBE

IF YES, TYPE(S):_____

H47: Linda Lane Extended


H47
3.15 Manufactured BMP System
3.08 Detention Basin
SMITHLAND RD
LINDA LN
TRAFFIC CIRCLE
1362'
1364'
1366'
1368'
1370'
1372'
1374'
1376'
1378'
1380'
1382'
1384'
1386'
1388'
1390'
1392'
1394'
1396'
1398'
1400'
1402'
1404'
1406'
1408'
1410'
1412'
1414'
1416'
1418'
1420'
1422'
H47: Linda Lane Extended
Retrofit IDs
Drainage Areas
Parcels
Existing BMPs
Contours
Streams
N
Feet
0
150
300
Center for Watershed Protection
Source: Esri, i-cubed, USDA, USGS, AEX, GeoEye, Getmapping, Aerogrid, IGN, IGP, and the GIS User Community

H47: Linda Lane Extended

Score: 60
Rank: 3
Investigators: Joe Battiata

Figure 1: *View of riser structure and standing water*

Figure 2: *Close-up view of extended detention orifice and trash rack (water surface at the invert of the orifice)*

Description: Linda Lane Extended includes several different stormwater quality BMPs. This basin was designed as an extended detention basin in accordance with the VA SWM Handbook (Blue Book). As shown in Figures 1 & 2, the basin has been "over-excavated" such that there is ponding water below the elevation of the outlet. The City indicated that the basin may have been built with excess storage volume.

Proposed Retrofit: Either the extended detention volume can be converted to a wetland cell, or the basin can be excavated. Minor modifications to the riser structure will be required. In order to "convert" this basin, the storage volume needed to maintain compliance with the channel and flood protection requirements must be assessed against what was actually built (and may require a survey to verify the current volume). It may also be worth assessing the basin to determine if it meets the new stormwater requirements.

H50: Old South High St


H50
S HIGH ST
S HIGH ST
OLD SOUTH HIGH ST
CANTRELL AVE
1324'
1322'
1318'
1316'
1312'
1310'
1308'
1306'
1304'
1302'
1300'
1298'
1296'
1294'
1292'
1290'
1314'
H50: Old South High St
Retrofit IDs
Drainage Areas
Parcels
Existing BMPs
Contours
Streams
N
Feet
0
50
100
Center for Watershed Protection
Source: Esri, i-cubed, USDA, USGS, AEX, GeoEye, Getmapping, Aerogrid, IGN, IGP, and the GIS User Community

H50: Old South High St

Score: 39
Rank: 17
Investigators: Joe Battiata, Thanh Dang

Figure 1: *Dead end of Old South High Street. Block drainage inlets to force runoff towards camera.*

Figure 2: *Area of proposed bioretention retrofit between Old South High Street and South High Street. Picture taken from culvert opening under Cantrell Ave.*

Description: The Old South High Street was cut by the construction of the new intersection of Cantrell Ave and South High Street. The resulting dead end at the Cantrell Ave embankment (Figure 1) is served by two drainage inlets that connect to a drainage system that serves the new roadway alignment. A culvert under Cantrell Ave was also installed to capture the surface drainage from the green space between the new South High Street and Old South High Street (Figure 2). This culvert can serve as the overflow for the proposed retrofit located in the green space (Figure 2).

Proposed Retrofit: The proposed retrofit will capture runoff from approximately 1.5 acres of Old South High Street and portions of the adjacent lots (57% impervious). A diversion berm of asphalt is required to drain the runoff from the dead end street and bypass the existing inlets while also preserving access to the existing driveway (Figure 1). The bioretention underdrain can be connected into the existing curb inlet shown in Figure 1 (with an upturned elbow if needed), and the overflow can be directed to the existing culvert under Cantrell Ave.

These improvements can be incorporated into improving pedestrian movement from Old South High Street towards the intersection of South High Street and Cantrell Ave. The steps shown in the background of Figure 1 are adequate for those travelling west on Cantrell Ave; however, any pedestrians travelling towards the JMU Campus cut across the cul-de-sac and the grass area to the intersection (observed numerous times during the site assessment).

WATERSHED:	SUBWATERSHED:	UNIQUE SITE ID: 1450	
DATE: 3/20/13	ASSESSED BY:	CAMERA ID:	PICTURES:
GPS ID:	LMK ID:	LAT:	LONG:

SITE DESCRIPTION

Name: OLD SOUTH HIGH STREET
Address: OLD SOUTH HIGH STREET AT CANTRELL AVE DEAD END

Ownership: ☒ Public ☐ Private ☐ Unknown
If Public, Government Jurisdiction: ☐ Local ☐ State ☐ DOT ☐ Other:

Corresponding USSR/USA Field Sheet? ☐ Yes ☒ No If yes, Unique Site ID: 1450

Proposed Retrofit Location:

Storage
- ☐ Existing Pond
- ☐ Below Outfall
- ☒ In Road ROW
- ☐ Other:
- ☒ Above Roadway Culvert
- ☐ In Conveyance System
- ☐ Near Large Parking Lot

On-Site
- ☐ Hotspot Operation
- ☐ Small Parking Lot
- ☒ Individual Street
- ☐ Underground
- ☐ Individual Rooftop
- ☐ Small Impervious Area
- ☐ Landscape / Hardscape
- ☐ Other:

DRAINAGE AREA TO PROPOSED RETROFIT

Drainage Area ≈ 1.59 Ac
Imperviousness ≈ 57 %
Impervious Area ≈ 0.91

Notes:

Drainage Area Land Use:
- ☒ Residential
  - ☒ SFH (< 1 ac lots)
  - ☐ SFH (> 1 ac lots)
  - ☐ Townhouses
  - ☐ Multi-Family
- ☐ Commercial
- ☐ Institutional
- ☐ Industrial
- ☐ Transport-Related
- ☐ Park
- ☐ Undeveloped
- ☐ Other:

EXISTING STORMWATER MANAGEMENT

Existing Stormwater Practice: ☐ Yes ☒ No ☐ Possible
If Yes, Describe:

Describe Existing Site Conditions, Including Existing Site Drainage and Conveyance:
Existing Street Width (if applicable):

OLDER HOMES - SET CLOSE TO ROAD, NARROW RESIDENTIAL STREET W/ SIDEWALK BOTH SIDES.

Existing Head Available:
4 ft Less depth of BIORETENTION SURFACE AREA

Note where points are measured from: (i.e. street elevation to catch basin invert, manhole rim to catch basin invert, other)

PROPOSED RETROFIT

Purpose of Retrofit:
☒ Water Quality ☐ Recharge ☐ Channel Protection ☐ Flood Control
☒ Demonstration / Education ☐ Repair ☐ Other:_____

Retrofit Volume Computations - Target Storage:

Retrofit Volume Computations - Available Storage:

SOME EXCAVATION REQ'D

Proposed Retrofit Practice: (Runoff Reduction)
☐ Disconnection ☒ Bioretention ☐ Bio Swale
☐ Expanded Tree Pit ☐ Infiltration ☐ Green Roof
☐ Permeable Pavement ☐ Rainwater Harvesting

Proposed Retrofit Practice: (Stormwater Treatment)
☐ Constructed Wetland ☐ Wet Swale ☐ Wet Pond
☐ Filtering Practice ☐ Proprietary:_____
☐ Other: _____

Retrofit Category (as defined by Chesapeake Bay Program):
☒ New BMP ☐ BMP Enhancement ☐ BMP Restoration ☐ BMP Conversion ☐ Not CBP-approved

Describe Elements of Proposed Retrofit, Including Surface Area, Maximum Depth of Treatment, and Conveyance:

Available Width:	*
Available Length:	*
Available Area:	2,300 ft
Ponding Depth:	12"
Soil Depth:	18"

VARIABLE

SITE CONSTRAINTS

Adjacent Land Use:
☒ Residential ☐ Commercial ☐ Institutional
☐ Industrial ☐ Transport-Related ☐ Park
☐ Undeveloped ☐ Other:_____
Possible Conflicts Due to Adjacent Land Use? ☐ Yes ☐ No
If Yes, Describe:

Access:
☒ No Constraints
Constrained due to
☐ Slope ☐ Space
☐ Utilities ☐ Tree Impacts
☐ Structures ☐ Property
Ownership
☐ Other:_____

Conflicts with Existing Utilities:

	Yes	Possible/ Modifiable	No	Unknown
Sewer:	☐	☐	☒	☐
Water:	☐	☐	☒	☐
Gas:	☐	☐	☒	☐
Electric to Streetlights:	☐	☐	☒	☐
Other:	☐	☐	☒	☐

Potential Permitting Factors:

Dam Safety Permits Necessary	☐ Probable	☒ Not Probable
Impacts to Wetlands	☐ Probable	☒ Not Probable
Impacts to a Stream	☐ Probable	☒ Not Probable
Floodplain Fill	☐ Probable	☒ Not Probable
Impacts to Forests	☐ Probable	☒ Not Probable
Impacts to Specimen Trees	☐ Probable	☒ Not Probable

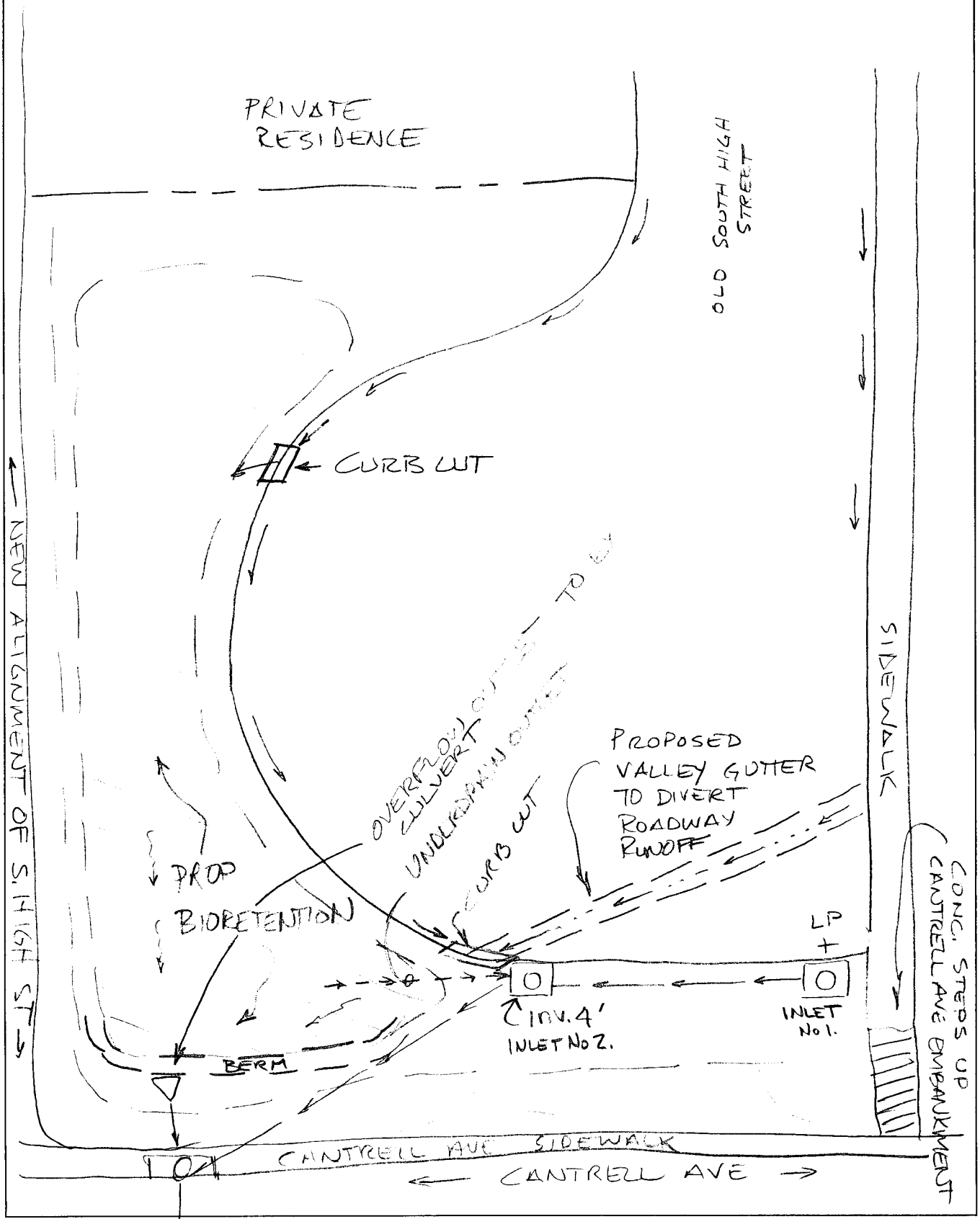
How many?_____
Approx. DBH_____

Other factors:_____

Soils:

Soil auger test holes:	☐ Yes	☒ No
Evidence of poor infiltration (clays, fines):	☐ Yes	☒ No
Evidence of shallow bedrock:	☐ Yes	☒ No
Evidence of high water table (gleying, saturation):	☐ Yes	☒ No

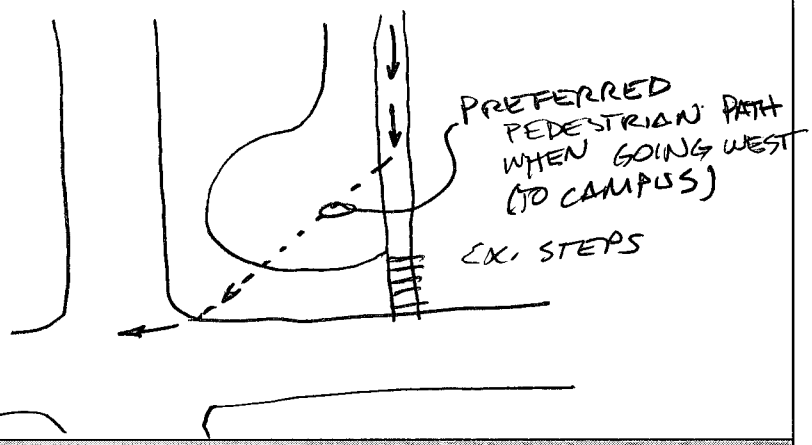
SKETCH


PRIVATE RESIDENCE
OLD SOUTH HIGH STREET
CURB CUT
NEW ALIGNMENT OF S. HIGH ST
OVERFLOW CULVERT
UNDERDRAIN OUTLET
CURB CUT
PROPOSED VALLEY GUTTER TO DIVERT ROADWAY RUNOFF
SIDEWALK
PROP BIORETENTION
LP
INV. 4'
INLET No 2.
INLET No 1.
CONC. STEPS UP CANTRELL AVE EMBANKMENT
BERM
CANTRELL AVE SIDEWALK
CANTRELL AVE

DESIGN OR DELIVERY NOTES

- VALLEY GUTTER TO BE CUT INTO EX. PAVMT TO DIVERT RUNOFF TO OTHER SIDE OF CIRCLE (BYPASS BOTH CURB INLETS)

- PEDESTRIAN PATTERN - PEOPLE GO DIRECTLY TO INTERSECTION OF CANTRELL & SO. MAIN (AND DONT USE EX STEPS) DESIGN CAN INCLUDE PEDESTRIAN PATH OVER/THRU BIORETENTION AREA



FOLLOW-UP NEEDED TO COMPLETE FIELD CONCEPT

- ☐ Confirm property ownership
- ☐ Confirm drainage area
- ☐ Confirm drainage area impervious cover
- ☐ Confirm volume computations
- ☐ Complete concept sketch
- ☐ Obtain existing stormwater practice as-builts
- ☐ Obtain site as-builts
- ☒ Obtain detailed topography
- ☐ Obtain utility mapping
- ☒ Confirm storm drain invert elevations
- ☒ Confirm soil types
- ☐ Other: _____

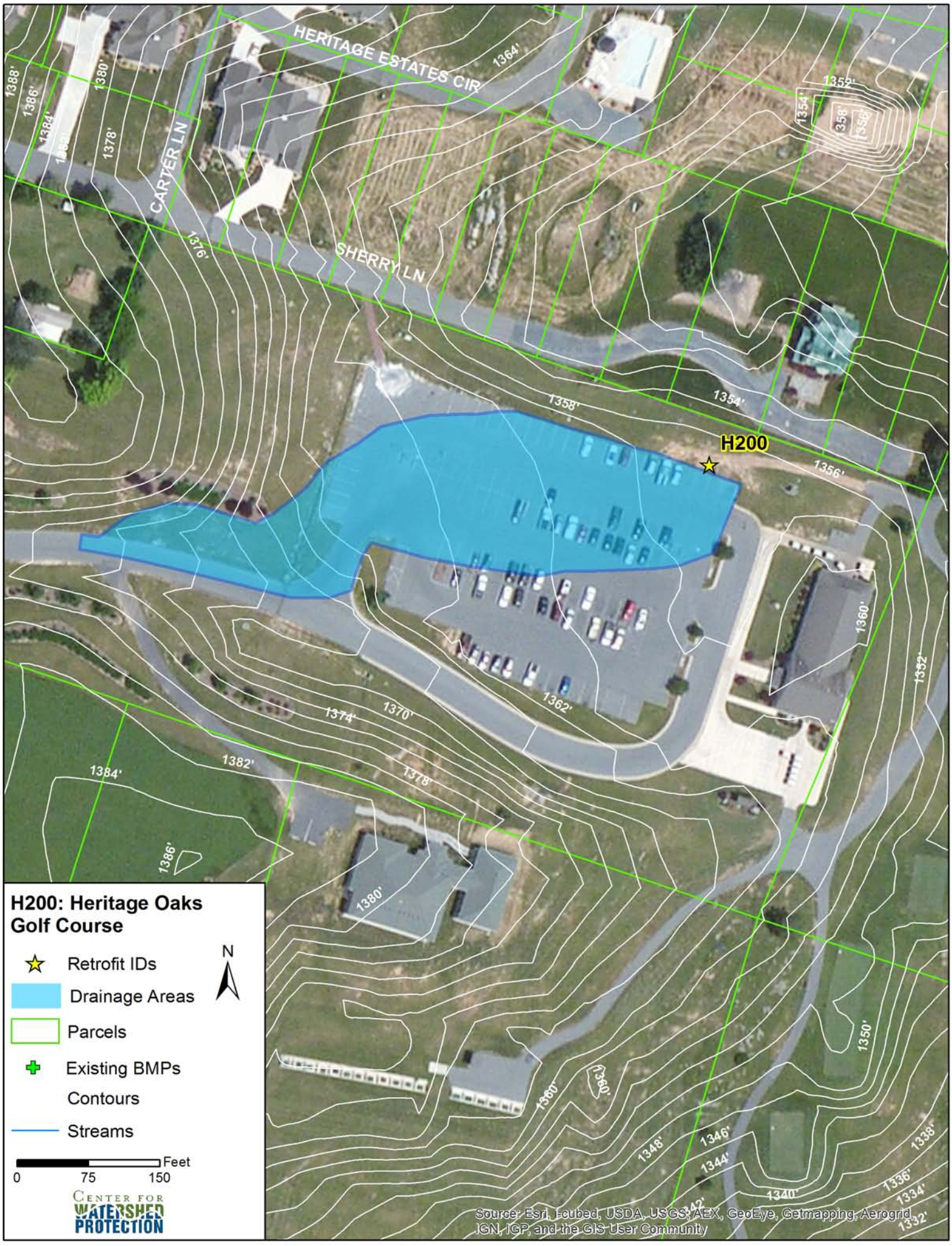
INITIAL FEASIBILITY AND CONSTRUCTION CONSIDERATIONS

- INLET No.1 + 2 CAN REMAIN AS STREET OVERFLOW.
- VALLEY GUTTER REDIRECTS FLOW TO NEW CURB CUT
-

SITE CANDIDATE FOR FURTHER INVESTIGATION:	☒ YES	☐ NO	☐ MAYBE
IS SITE CANDIDATE FOR EARLY ACTION PROJECT(S):	☒ YES	☐ NO	☐ MAYBE
IF NO, SITE CANDIDATE FOR OTHER RESTORATION PROJECT(S):	☐ YES	☐ NO	☐ MAYBE

IF YES, TYPE(S): _____

H200: Heritage Oaks Golf Course


HERITAGE ESTATES CIR
CARTER LN
SHERRY LN
H200
1388'
1386'
1384'
1380'
1378'
1376'
1364'
1359'
1358'
1356'
1354'
1360'
1362'
1374'
1370'
1382'
1352'
1350'
1348'
1346'
1344'
1342'
1340'
1338'
1336'
1334'
1332'
H200: Heritage Oaks Golf Course
Retrofit IDs
Drainage Areas
Parcels
Existing BMPs
Contours
Streams
N
Feet
0
75
150
Center for Watershed Protection
Source: Esri, i-cubed, USDA, USGS, AEX, GeoEye, Getmapping, Aerogrid, IGN, IGP, and the GIS User Community

H200: Heritage Oaks Golf Course

Score: 37
Rank: 21
Investigators: Thanh Dang, David Hirschman

NO IMAGE AVAILABLE

Description: The approximately 1-acre parking lot drains to 3 inlets at the east end of the parking lot, closest to the clubhouse building. There is a grass area between the parking lot and fence on the property boundary.

Proposed Retrofit: Much of the runoff flows to the inlet at the northeast corner of the parking lot (closest to the grass area). This runoff can be diverted to a bioretention area constructed in the grass area. There is adequate space to build a 40' by 80' bioretention, but only 40' by 55' is needed to capture runoff from 1" of rainfall. The underdrain can be tied into the existing inlet.

H200-Alt: Heritage Oaks Golf Course Regenerative Conveyance

Score: 100

Rank: Outlier – top rank

Investigators: Thanh Dang, David Hirschman

Figure 1: *Eroded ditch below existing outfall in golf course*

Description: The parking lot and some of the golf course drain to an existing drainage swale south of the parking lot and clubhouse (Figure 1). There is some existing erosion within the swale, and there are many large limestone boulders lining the swale.

Proposed Retrofit: This retrofit is an alternative to H200, which is a bioretention area that would treat only the parking lot. This concept has a much larger drainage area (approximately 100 acres compared to just over 1 acre for H200) and would treat runoff from the golf course in addition to the parking lot and clubhouse. The retrofit concept is a "Regenerative Stormwater Conveyance" (RSC) system. This system uses boulder weirs, riffles, and an underlying bed of sand and woodchips to treat and infiltrate runoff as it moves down the swale. The RSC could be made to look much like the existing swale (without the erosion) and could likely reuse some of the existing boulders.

WATERSHED:	SUBWATERSHED:	UNIQUE SITE ID: H200	
DATE: 3/21/13	ASSESSED BY: DJH LFM	CAMERA ID:	PICTURES: 97-100 ✓ RSC Site
GPS ID:	LMK ID:	LAT:	LONG:

SITE DESCRIPTION

Name: Heritage Oaks Golfcourse
Address: Gaithers church Rd

Ownership: ☑ Public ☐ Private ☐ Unknown
If Public, Government Jurisdiction: ☑ Local ☐ State ☐ DOT ☐ Other:

Corresponding USSR/USA Field Sheet? ☐ Yes ☐ No If yes, Unique Site ID:

Proposed Retrofit Location:

Storage
- ☐ Existing Pond
- ☐ Below Outfall
- ☐ In Road ROW
- ☐ Other:
- ☐ Above Roadway Culvert
- ☐ In Conveyance System
- ☐ Near Large Parking Lot

On-Site
- ☐ Hotspot Operation
- ☒ Small Parking Lot
- ☐ Individual Street
- ☐ Underground
- ☐ Individual Rooftop
- ☐ Small Impervious Area
- ☐ Landscape / Hardscape
- ☐ Other:

DRAINAGE AREA TO PROPOSED RETROFIT

Drainage Area ≈ 1.08
Imperviousness ≈ 82 %
Impervious Area ≈ 0.89

Notes:

Drainage Area Land Use:
- ☐ Residential
  - ☐ SFH (< 1 ac lots)
  - ☐ SFH (> 1 ac lots)
  - ☐ Townhouses
  - ☐ Multi-Family
- ☐ Commercial
- ☒ Institutional
- ☐ Industrial
- ☐ Transport-Related
- ☐ Park
- ☐ Undeveloped
- ☐ Other:

EXISTING STORMWATER MANAGEMENT

Existing Stormwater Practice: ☐ Yes ☒ No ☐ Possible
If Yes, Describe:

Describe Existing Site Conditions, Including Existing Site Drainage and Conveyance:
Existing Street Width (if applicable):

parking lot drains to 3 inlets
sheet flow to northside of lot where proposed bioretention

Existing Head Available:
3.54 ft

Note where points are measured from: (i.e. street elevation to catch basin invert, manhole rim to catch basin invert, other)
~~Manhole rim to invert~~
INVERT TO PAVEMENT SURFACE
Use 4.0 in Arlington Table

PROPOSED RETROFIT

Purpose of Retrofit:
☒ Water Quality ☐ Recharge ☐ Channel Protection ☐ Flood Control
☒ Demonstration / Education ☐ Repair ☐ Other:_____

Retrofit Volume Computations - Target Storage:

Retrofit Volume Computations - Available Storage:

Proposed Retrofit Practice: (Runoff Reduction)
☐ Disconnection ☒ Bioretention ☐ Bio Swale
☐ Expanded Tree Pit ☐ Infiltration ☐ Green Roof
☐ Permeable Pavement ☐ Rainwater Harvesting

Proposed Retrofit Practice: (Stormwater Treatment)
☐ Constructed Wetland ☐ Wet Swale ☐ Wet Pond
☐ Filtering Practice ☐ Proprietary:_____
☐ Other: _____

Retrofit Category (as defined by Chesapeake Bay Program):
☒ New BMP ☐ BMP Enhancement ☐ BMP Restoration ☐ BMP Conversion ☐ Not CBP-approved

Describe Elements of Proposed Retrofit, Including Surface Area, Maximum Depth of Treatment, and Conveyance:

INSTALL BIORENTENTION IN EXISTING GRASSY AREA NEXT TO PARKING LOT. UNDERDRAIN TO TIE INTO EXISTING INLET

Available Width:	40'
Available Length:	80'
Available Area:	
Ponding Depth:	
Soil Depth:	

→ Note from spread sheet – Only need 40'x55' to capture 1.0", so spreadsheet uses that dimension. It could be oversized if desirable.

SITE CONSTRAINTS

Adjacent Land Use:
☐ Residential ☐ Commercial ☐ Institutional
☐ Industrial ☐ Transport-Related ☐ Park
☐ Undeveloped ☐ Other:_____
Possible Conflicts Due to Adjacent Land Use? ☑ Yes ☐ No
If Yes, Describe:
NEED TO RELOCATE DRIVE AREA

Access:
☒ No Constraints
Constrained due to
☐ Slope ☐ Space
☐ Utilities ☐ Tree Impacts
☐ Structures ☐ Property
Ownership
☐ Other:_____

Conflicts with Existing Utilities:

	Yes	Possible/ Modifiable	No	Unknown
Sewer:	☐	☐	☒	☐
Water:	☐	☐	☒	☐
Gas:	☐	☐	☒	☐
Electric to Streetlights:	☐	☐	☒	☐
Other:	☐	☐	☒	☐

_____

Potential Permitting Factors:

Dam Safety Permits Necessary	☐ Probable	☒ Not Probable
Impacts to Wetlands	☐ Probable	☒ Not Probable
Impacts to a Stream	☐ Probable	☒ Not Probable
Floodplain Fill	☐ Probable	☒ Not Probable
Impacts to Forests	☐ Probable	☒ Not Probable
Impacts to Specimen Trees	☐ Probable	☐ Not Probable

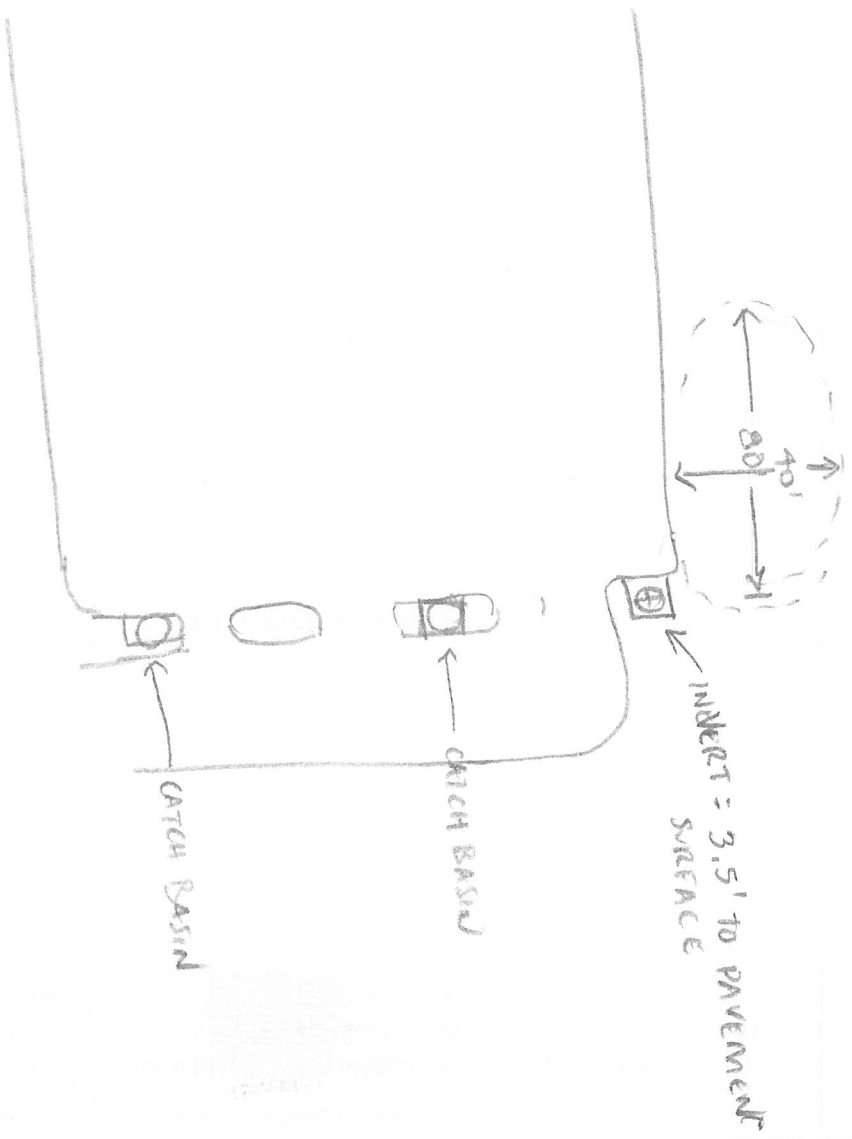
How many?_____
Approx. DBH_____

Other factors:_____
_____

Soils:

Soil auger test holes:	☐ Yes	☒ No
Evidence of poor infiltration (clays, fines):	☐ Yes	☒ No
Evidence of shallow bedrock:	☐ Yes	☒ No
Evidence of high water table (gleying, saturation):	☐ Yes	☒ No

SKETCH



DESIGN OR DELIVERY NOTES

FOLLOW-UP NEEDED TO COMPLETE FIELD CONCEPT

- ☐ Confirm property ownership
- ☐ Confirm drainage area
- ☐ Confirm drainage area impervious cover
- ☐ Confirm volume computations
- ☐ Complete concept sketch
- ☐ Obtain existing stormwater practice as-builts
- ☐ Obtain site as-builts
- ☐ Obtain detailed topography
- ☐ Obtain utility mapping
- ☐ Confirm storm drain invert elevations
- ☐ Confirm soil types
- ☐ Other:_____

INITIAL FEASIBILITY AND CONSTRUCTION CONSIDERATIONS

SITE CANDIDATE FOR FURTHER INVESTIGATION:	☐ YES	☐ NO	☐ MAYBE
IS SITE CANDIDATE FOR EARLY ACTION PROJECT(S):	☐ YES	☐ NO	☐ MAYBE
IF NO, SITE CANDIDATE FOR OTHER RESTORATION PROJECT(S):	☐ YES	☐ NO	☐ MAYBE

IF YES, TYPE(S):_____

H201: Fire Station #3


1476'
1474'
1474'
1472'
1478'
1476'
1482'
1486'
1488'
1480'
1486'
1480'
DEYERLE AVE
LUCY DR
H201
H201: Fire Station #3
Retrofit IDs
Drainage Areas
Parcels
Existing BMPs
Contours
Streams
N
Feet
0
50
100
CENTER FOR WATERSHED PROTECTION
Source: Esri, i-cubed, USDA, USGS, AEX, GeoEye, Getmapping, Aerogrid, IGN, IGP, and the GIS User Community

H201: Fire Station #3

Score: 41

Rank: 14

Investigators: Thanh Dang, David Hirschman, Lisa Fraley-McNeal

Figure 1: *Existing inlet at edge of parking lot*

Description: The parking lot and building drain to the existing inlet in a depressed grassy area (Figure 1).

Proposed Retrofit: The inlet can be raised and the existing depression converted to a triangle-shaped bioretention area. The underdrain can go into the existing structure. The bioretention area would be approximately 35’ long and range in width from 9’ at the tip of the triangle (closest to the building) and 12’ at the wide end (closest to the road).

RRI

WATERSHED:	SUBWATERSHED:	UNIQUE SITE ID: H-201	
DATE: 3/21/13	ASSESSED BY:	CAMERA ID:	PICTURES: 106-108
GPS ID:	LMK ID:	LAT:	LONG:

SITE DESCRIPTION

Name: FIRE STATION #3
Address: LUCY DRIVE

Ownership: ☑ Public ☐ Private ☐ Unknown
If Public, Government Jurisdiction: ☑ Local ☐ State ☐ DOT ☐ Other:_____

Corresponding USSR/USA Field Sheet? ☐ Yes ☐ No If yes, Unique Site ID:_____

Proposed Retrofit Location:

Storage
- ☐ Existing Pond
- ☐ Below Outfall
- ☐ In Road ROW
- ☐ Other:_____
- ☐ Above Roadway Culvert
- ☐ In Conveyance System
- ☐ Near Large Parking Lot

On-Site
- ☐ Hotspot Operation
- ☑ Small Parking Lot
- ☐ Individual Street
- ☐ Underground
- ☐ Individual Rooftop
- ☐ Small Impervious Area
- ☐ Landscape / Hardscape
- ☐ Other:_____

DRAINAGE AREA TO PROPOSED RETROFIT

Drainage Area ≈ 0.45
Imperviousness ≈ 75 %
Impervious Area ≈ 0.28

Notes:

Drainage Area Land Use:
- ☐ Residential
  - ☐ SFH (< 1 ac lots)
  - ☐ SFH (> 1 ac lots)
  - ☐ Townhouses
  - ☐ Multi-Family
- ☐ Commercial
- ☒ Institutional
- ☐ Industrial
- ☐ Transport-Related
- ☐ Park
- ☐ Undeveloped
- ☐ Other:_____

EXISTING STORMWATER MANAGEMENT

Existing Stormwater Practice: ☐ Yes ☒ No ☐ Possible
If Yes, Describe:

Describe Existing Site Conditions, Including Existing Site Drainage and Conveyance:
Existing Street Width (if applicable):_____

PARKING LOT "SHEET FLOW" TO INLET IN GRASSY AREA

FIRE DEPT VEHICLE WASHWATER

Existing Head Available:	Note where points are measured from: (i.e. street elevation to catch basin invert, manhole rim to catch basin invert, other)
3.9'	FROM TOP OF INLET TO GROUND SURFACE

PROPOSED RETROFIT

Purpose of Retrofit:
☒ Water Quality ☐ Recharge ☐ Channel Protection ☐ Flood Control
☐ Demonstration / Education ☐ Repair ☐ Other:_____

Retrofit Volume Computations - Target Storage:

Retrofit Volume Computations - Available Storage:

Proposed Retrofit Practice: (Runoff Reduction)
☐ Disconnection ☒ Bioretention ☐ Bio Swale
☐ Expanded Tree Pit ☐ Infiltration ☐ Green Roof
☐ Permeable Pavement ☐ Rainwater Harvesting

Proposed Retrofit Practice: (Stormwater Treatment)
☐ Constructed Wetland ☐ Wet Swale ☐ Wet Pond
☐ Filtering Practice ☐ Proprietary:_____
☐ Other: _____

Retrofit Category (as defined by Chesapeake Bay Program):
☒ New BMP ☐ BMP Enhancement ☐ BMP Restoration ☐ BMP Conversion ☐ Not CBP-approved

Describe Elements of Proposed Retrofit, Including Surface Area, Maximum Depth of Treatment, and Conveyance:

Available Width:	9
Available Length:	34
Available Area:	
Ponding Depth:	12"
Soil Depth:	24"

SITE CONSTRAINTS

Adjacent Land Use:
☐ Residential ☒ Commercial ☒ Institutional
☐ Industrial ☐ Transport-Related ☐ Park
☐ Undeveloped ☐ Other:_____
Possible Conflicts Due to Adjacent Land Use? ☐ Yes ☒ No
If Yes, Describe:

Access:
☒ No Constraints
Constrained due to
☐ Slope ☐ Space
☐ Utilities ☐ Tree Impacts
☐ Structures ☐ Property
Ownership
☐ Other:_____

Conflicts with Existing Utilities:

	Yes	Possible/ Modifiable	No	Unknown
Sewer:	☐	☐	☒	☐
Water:	☐	☒	☐	☐
Gas:	☐	☐	☐	☒
Electric to Streetlights:	☐	☐	☐	☐
Other:	☐	☐	☒	☐

_____

Potential Permitting Factors:

Dam Safety Permits Necessary	☐ Probable	☒ Not Probable
Impacts to Wetlands	☐ Probable	☒ Not Probable
Impacts to a Stream	☐ Probable	☒ Not Probable
Floodplain Fill	☐ Probable	☒ Not Probable
Impacts to Forests	☐ Probable	☒ Not Probable
Impacts to Specimen Trees	☐ Probable	☒ Not Probable

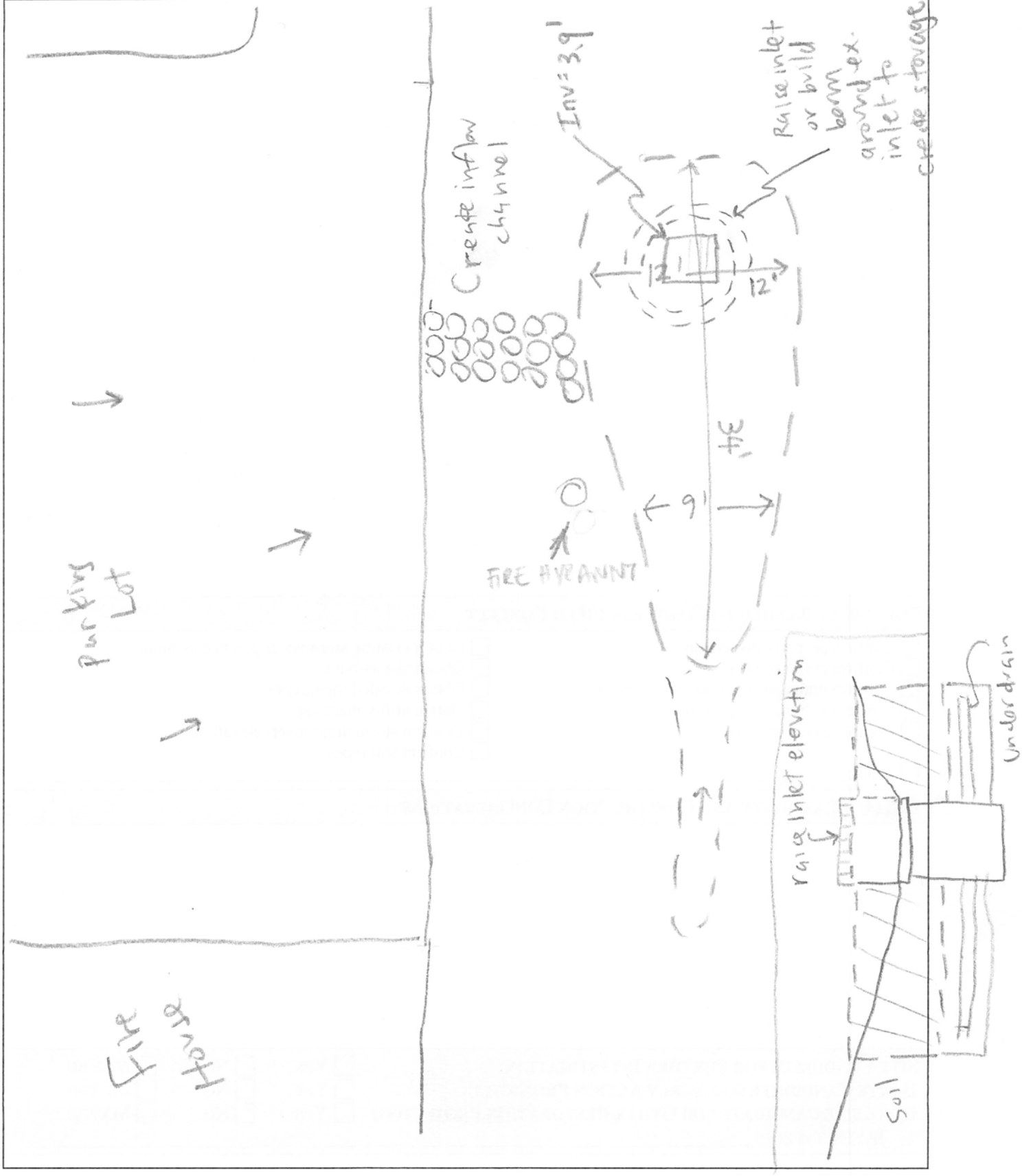
How many?_____
Approx. DBH_____

Other factors:_____
_____

Soils:

Soil auger test holes:	☐ Yes	☒ No
Evidence of poor infiltration (clays, fines):	☐ Yes	☒ No
Evidence of shallow bedrock:	☐ Yes	☐ No
Evidence of high water table (gleying, saturation):	☐ Yes	☒ No

SKETCH


Inv=3.9'
Raise inlet or build berm around ex. inlet to create storage
Create inflow channel
12'
12'
34'
9'
FIRE HYDRANT
Parking Lot
Hour
Underdrain
raise inlet elevation
soil

DESIGN OR DELIVERY NOTES

FOLLOW-UP NEEDED TO COMPLETE FIELD CONCEPT

- ☐ Confirm property ownership
- ☐ Confirm drainage area
- ☐ Confirm drainage area impervious cover
- ☐ Confirm volume computations
- ☐ Complete concept sketch
- ☐ Obtain existing stormwater practice as-builts
- ☐ Obtain site as-builts
- ☐ Obtain detailed topography
- ☐ Obtain utility mapping
- ☐ Confirm storm drain invert elevations
- ☐ Confirm soil types
- ☐ Other:_____

INITIAL FEASIBILITY AND CONSTRUCTION CONSIDERATIONS

SITE CANDIDATE FOR FURTHER INVESTIGATION:	☐ YES	☐ NO	☐ MAYBE
IS SITE CANDIDATE FOR EARLY ACTION PROJECT(S):	☐ YES	☐ NO	☐ MAYBE
IF NO, SITE CANDIDATE FOR OTHER RESTORATION PROJECT(S):	☐ YES	☐ NO	☐ MAYBE

IF YES, TYPE(S):_____