Date: November 26, 2013

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Re: Arlington Forest Branch, Bailey's Branch, Fairlington/Bradlee, Four Mile Run Middle & Upper Mainstem, Lucky Run, Pimmit Run Tributary, and Upper Long Branch Watershed Retrofit Plan Catalogued and Prioritized Sites

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The Center for Watershed Protection, Inc. (CWP) is pleased to present this final report for the Arlington Forest Branch, Bailey's Branch, Fairlington/Bradlee, Four Mile Run Middle & Upper Mainstem, Lucky Run, Pimmit Run Tributary, and Upper Long Branch Watershed Retrofit Plans.

A 'retrofit' is a stormwater management facility designed to store, infiltrate, and/or treat stormwater runoff from a contributing drainage area for which a stormwater management facility currently does not exist or is ineffective. Overall, the broad objective for these retrofit plans is to reduce stormwater runoff pollutants and volumes to the maximum extent practicable across the watersheds given the built-out nature of and extensive development within the watersheds.

These retrofit plans serve as a key piece of Arlington County's Stormwater Master Plan. Other aspects of the Stormwater Master Plan include the Stream Inventory and the Storm Sewer Capacity Plan. Accomplishing the runoff and pollutant reduction goals of the retrofit plans and the Stormwater Master plan as a whole will lead to better water quality in Arlington County's waterways, and in the Chesapeake Bay.

In order to develop these comprehensive watershed retrofit plans, six key tasks were undertaken, each of which is described further below:

- Office Assessment
- Public Involvement
- Field Work and Compilation of Potential Retrofit Sites
- Development of Ranking Factors
- Treatment Volume and Pollutant Removal Calculations
- Concept Designs

Office Assessment
This project began with an office assessment of potential retrofit sites, based upon procedures outlined in Urban Stormwater Retrofit Practices (Schueler, et. al). The office assessment was guided by the Stormwater Retrofit Objectives and the Specific Goals and Preliminary Screening Rules (Attachment 1), which were developed jointly by CWP and Arlington County.

It should be noted that these rules were not necessarily strictly adhered to during the field assessment stage of the project. They were used only to determine the suitable sites to visit

when reviewing the watershed during the office assessment, and as a general guide in the field. For example, a potential retrofit site was not discounted or avoided in the field if it became apparent that the contributing drainage area was less than 0.25 acres, even though this was set as a minimum for office assessment purposes.

The office assessment involved analysis of an aerial photo of the watershed in combination with other Geographic Information System (GIS) "layers," such as topographic contours, utilities, and property boundaries. Using this data, CWP selected sites to visit during field work. Selected sites included:

- Public properties
- Institutional properties (schools and churches)
- Stormwater inlets on wide, flat streets (greater than 28' with less than 5% slope)
- Stormwater inlets on cul-de-sacs
- Large commercial properties (typically greater than 1 acre)

Public Involvement

Following the office assessment, a public stakeholder meeting was held on November 30, 2011 to introduce the project to the public and collect ideas for additional retrofit locations. Several potential retrofit locations were identified during the meeting and added to the list of sites to visit.

A second public stakeholder meeting was held on May 2, 2012 to report the results of the field work and compilation of data. Stakeholders were given the opportunity to review the interim report, which included all the proposed retrofit sites.

Field Work and Compilation of Potential Retrofit Sites

Field work was conducted on September 20th – September 22nd, October 4th – October 6th, November 15th – November 17th, November 30th, and December 6th – December 7th, 2011 to assess the existing conditions and retrofit suitability of all of the sites highlighted during the office assessment and stakeholder meeting. Field visits to the sites identified in the office assessment yielded numerous potential retrofit projects, as shown in **Table 1.**

Table 1. Potential Retrofit Sites by Watershed

Watershed	Office Assessment Sites Identified	Potential Retrofit Projects Developed
Arlington Forest Branch	5	11
Bailey's Branch	19	16
Fairlington/Bradlee	41	32
Four Mile Run, Middle Mainstem	109	68
Four Mile Run, Upper Mainstem 1	104	88
Four Mile Run, Upper Mainstem 2	74	86
Lucky Run	19	15
Pimmit Run Tributary	0	0
Upper Long Branch	13	11
Total	**384**	**327**

The number of potential retrofits includes some initially identified sites where multiple projects were developed. At each site where a stormwater retrofit appeared feasible, photographs were taken and field forms were filled out with the information necessary to develop concept designs. All of the information gathered in the field was then reviewed for accuracy and consistency, and organized into a site catalog. A summary map of all the potential retrofit sites and their respective drainage areas is included as Attachment 2.

Development of Ranking Factors

Following the compilation of the potential retrofit sites, a scoring system was developed as a means of ranking and prioritizing them. Taking pertinent information from the field forms, points were awarded for each of eight weighted ranking factors, resulting in potential retrofit rankings from 0 – 100 (or more in some cases). The eight factors include four "primary" factors, and four "secondary" factors (see Attachment 3).

Primary Ranking Factors

Phosphorus Removal

A score of 10 points per pound of phosphorous removed is given to each retrofit, and the score is given a weight of 2.5. See "Treatment Volume and Pollutant Removal Calculations" section below.

Impervious Area Acreage

The size of the contributing drainage area is credited at 5 points per acre. The score for the contributing drainage area is given a weight of 2.0.

Potential Utility or Site Constraints

As certain site constraints can greatly affect retrofit construction, potential retrofits with site constraints that would cause a significant conflict with implementation of the retrofit, including water or gas mains, difficult slopes, or the need for significant excavation are a score of 0, those with possible site constraints or less severe site constraints are given a score of 5, and sites without any identifiable constraints are given a score of 10. For utilities, in particular, the general guidelines can be found in **Table 2**. The score for the utility or site constraint factor is given a weight of 1.5.

Table 2. Potential Utility or Site Constraints Scoring Scheme

Utility	Low = 10 pts	Medium = 5 pts	High = 0 pts
Water	Verified free of conflicts	Possible conflict or project limits adjusted due to location of line	Verified conflict
Sanitary		Possible or verified conflict	
Gas		Possible conflict or project limits adjusted due to location of line	Verified conflict
Electric (to street lights)		Possible or verified conflict	

Property Ownership

Since public land is generally easier for installation and maintenance of stormwater retrofits, public land is given a higher score than private land. Private land is given a score of 0; school properties receive a score of 4; road right-of-ways receive a score of 7; and park or government lands receive a score of 10. The score for property ownership is given a weight of 1.5.

Secondary Ranking Factors

Potential for Quick Implementation

Retrofits that have the potential for quick implementation are given a higher score because they can lead to more immediate water quality results, or, in some cases, are time-dependent, and construction plans must be completed quickly. Two types of projects were considered to have potential for quick implementation: 1. Projects that

coincide with planned construction in the area, and 2. Projects that have no road cuts, new curbing, or other road changes; include no major structural work (beyond curb cuts, underdrains, and overflows), and are located on public property. These projects are given a score of 10. Projects that do not fit either category are given a score of 0 for this factor. The score for quick implementation potential is given a weight of 1.0.

Treatment of an Existing Drainage Problem or Identified Hotspot

Occasionally, potential retrofit sites are located where a drainage problem or hotspot already exists, and the retrofit will help solve the problem. Projects that will address an existing drainage problem or hotspot receive a score of 10, while projects that do not receive a score of 0. This factor is given a weight of 0.5.

County Maintenance Burden

Potential retrofits that are expected to have a high maintenance burden are given a lower score for this factor. For the most part, the level of maintenance required is based upon the practice to be implemented (**Table 3**). High maintenance burden projects are given a score of 0, medium maintenance burden projects are given a score of 5, and low maintenance burden projects are given a score of 10, as shown in the table below. The score for County maintenance burden is given a weight of 0.5.

Table 3. Maintenance Burden Scoring Scheme

High = 0 pts	Street Bioretention, Permeable Pavement
Medium = 5 pts	Bioretention, Dry Swale*, Filtering Practices, Rain Garden, Rainwater Harvesting, Tree Pits, Underground Detention Retrofit, Wet Swale
Low = 10 pts	Bioswale*, Constructed Wetland, Downspout Disconnection, Grass Channel*, Impervious Cover Removal, Sheetflow to a Conservation Area, Stormwater Planters
*If located along a street, practice is to be treated as Street Bioretention	

Educational Opportunity

Potential retrofits that represent good educational opportunities are given a higher score for this factor. Retrofits that can include educational signage, including residential streets with sidewalks, receive a score of 5, retrofits in parks receive a score of 8, and retrofits at schools receive a score of 10. This factor is given a weight of 0.5.

An example scoring sheet that includes all of the screening factors as well as a summary of each site's score and rank and the "master spreadsheet",that contains all of the scoring calculations for each potential retrofit is included in Attachment 3. Attachment 4 contains a compilation of photographs, scoring sheets, and field forms for each of the potential retrofit sites visited in the field.

Treatment Volume and Pollutant Removal Calculations

Once all of the potential retrofit sites were compiled, calculations were made regarding the treatment volume and pollutant removal benefits provided by the retrofits, individually, and in aggregate. **Table 4** indicates the collective benefits of the retrofits in each watershed.

Table 4. Watershed Retrofit Benefits							
Watershed	Total Acreage Treated (acres)	Impervious Acreage Treated (acres)	% of Watershed Treated	% of Impervious Area Treated	Annual Phosphorus Removal (lbs/yr)	Annual Nitrogen Removal (lbs/yr)	Annual TSS Removal (lbs/yr)
Arlington Forest Branch	15.38	7.12	17.93%	22.00%	7.21	83.11	5,045.67
Bailey's Branch	14.81	7.10	9.87%	9.37%	9.21	102.79	6,616.18
Fairlington Bradlee	31.52	14.61	11.83%	12.65%	19.20	225.60	13,103.41
Four Mile Run Middle	66.36	30.02	7.40%	8.20%	36.65	426.38	24,766.96
Four Mile Run Upper Mainstem 1	106.98	46.19	19.29%	23.21%	50.57	601.55	33,746.72
Four Mile Run Upper Mainstem 2	155.10	57.23	14.73%	16.61%	68.13	860.16	41,834.13
Lucky Run	24.85	10.01	17.72%	17.12%	11.59	141.67	7,458.86
Upper Long Branch	24.56	12.19	15.47%	23.33%	9.74	113.56	6,619.08

Pollutant loading rates from the Chesapeake Bay Program (CBP) Model were used to calculate pollutant loads for total nitrogen (TN), total phosphorus (TP), and total suspended sediment (TSS), shown in **Table 5**. These values were used to determine the pollutant loads for each site prior to any stormwater retrofits.

Table 5. CBP Annual Urban Runoff Loads per Acres		
Parameter	**Urban Impervious**	**Urban Pervious**
TN (lbs)	16.86	10.07
TP (lbs)	1.62	0.41
TSS (lbs)	1,171.32	175.80

The Chesapeake Stormwater Network (CSN) National Rainfall Frequency Analysis runoff reduction equations were used to determine the percentage of pollutant load removed by the retrofits (see **Error! Reference source not found.**1, **Error! Reference source not found.**, and **Error! Reference source not found.** below).

Equation 1 TN Removal Percentage for Runoff Reduction

$$TN\ Removal\ \% = 0.0308x^5 - 0.2562x^4 + 0.8634x^3 - 1.5285x^2 + 1.501x - 0.013$$

Equation 2 TP Removal Percentage for Runoff Reduction

$$TP\ Removal\ \% = 0.0304x^5 + 0.2619x^4 + 0.9161x^3 - 1.6837x^2 + 1.7072x - 0.0091$$

Equation 3 TSS Removal Percentage for Runoff Reduction

$$TSS\ Removal\ \% = 0.0326x^5 - 0.2806x^4 + 0.9816x^3 - 1.8039x^2 + 1.8292x - 0.0093$$

$$x = runoff\ depth\ captured\ per\ impervious\ acre\ in\ the\ contributing\ drainage\ area\ for\ each\ proposed\ retrofit$$

By multiplying the percent of pollutant removal by the annual pollutant load, the total amount of pollutants removed for each retrofit was found.

Concept Designs

Development of concept designs was the final step of the Watershed Retrofit Plans. Eighteen of the top-rated potential retrofits were selected for further concept development. The concepts are included in Attachment 5. For each concept, aspects of the design were developed, with both existing and proposed conditions described in detail. The concept designs also include a preliminary plan view, cross section, and profile to further illustrate the retrofit. These drawings will need to be improved with greater detail once topographic surveys of the sites are complete. Appendices describing the suggested filter media, plant selection, and maintenance plans were also provided.

With submittal of this final report, CWP has completed the Arlington Forest Branch, Bailey's Branch, Fairlington/Bradlee, Four Mile Run Middle & Upper Mainstem, Lucky Run, Pimmit Run Tributary, and Upper Long Branch Watershed Retrofit Plans. However, should it be necessary, CWP is available to assist with any of these retrofit projects as Arlington County moves from planning to implementation.

Attachments

Attachment 1: Stormwater Retrofit Objectives, Specific Goals and Preliminary Screening Rules
Attachment 2: Maps of Stormwater Retrofit Locations and Drainage Areas
Attachment 3: Example Scoring Sheet, Site Ranking Summary, and Abbreviated Master Spreadsheets
Attachment 4: First Visit Photographs, Field Forms, and Individual Scoring Sheets
Attachment 5: Concept Designs

References

Schueler, T., Hirschman, D., Novotney, M., and J. Zielinski. 2007. *Urban Stormwater Retrofit Practices Version 1.0*. Center for Watershed Protection. Ellicott City, MD.