City of Bowie
Environmental Infrastructure Action Strategy Plan
WRAS Assessment Report
(Memo 4)

Memorandum

Environmental Resources Management

200 Harry S. Truman Pkwy, Suite 400

Annapolis, MD 21401-7351

(410) 266-0006
(410) 266- 8912 (Fax)

To: Joe Meinert, Director, City of Bowie Department of Planning and Economic Development

From: Clive Graham

Date: July 16, 2007

Subject: Environmental Infrastructure Action Strategy Plan Memo 4.

Project Inventory and Narrative

This memo and accompanying tables comprise one of a series of products designed to the assist City staff as they update the City of Bowie's (the City) 2003 Green Infrastructure (GI) Strategy Plan in the form of an Environmental Infrastructure Plan. This memo identifies restoration, conservation and preservation opportunities in the form of specific projects and measures that could be implemented in support of the Plan but focuses primarily on the green infrastructure, surface water protection, and urban forest management components of the Environmental Infrastructure Plan.

The projects and measures in the memo derive from a broad range of sources including:

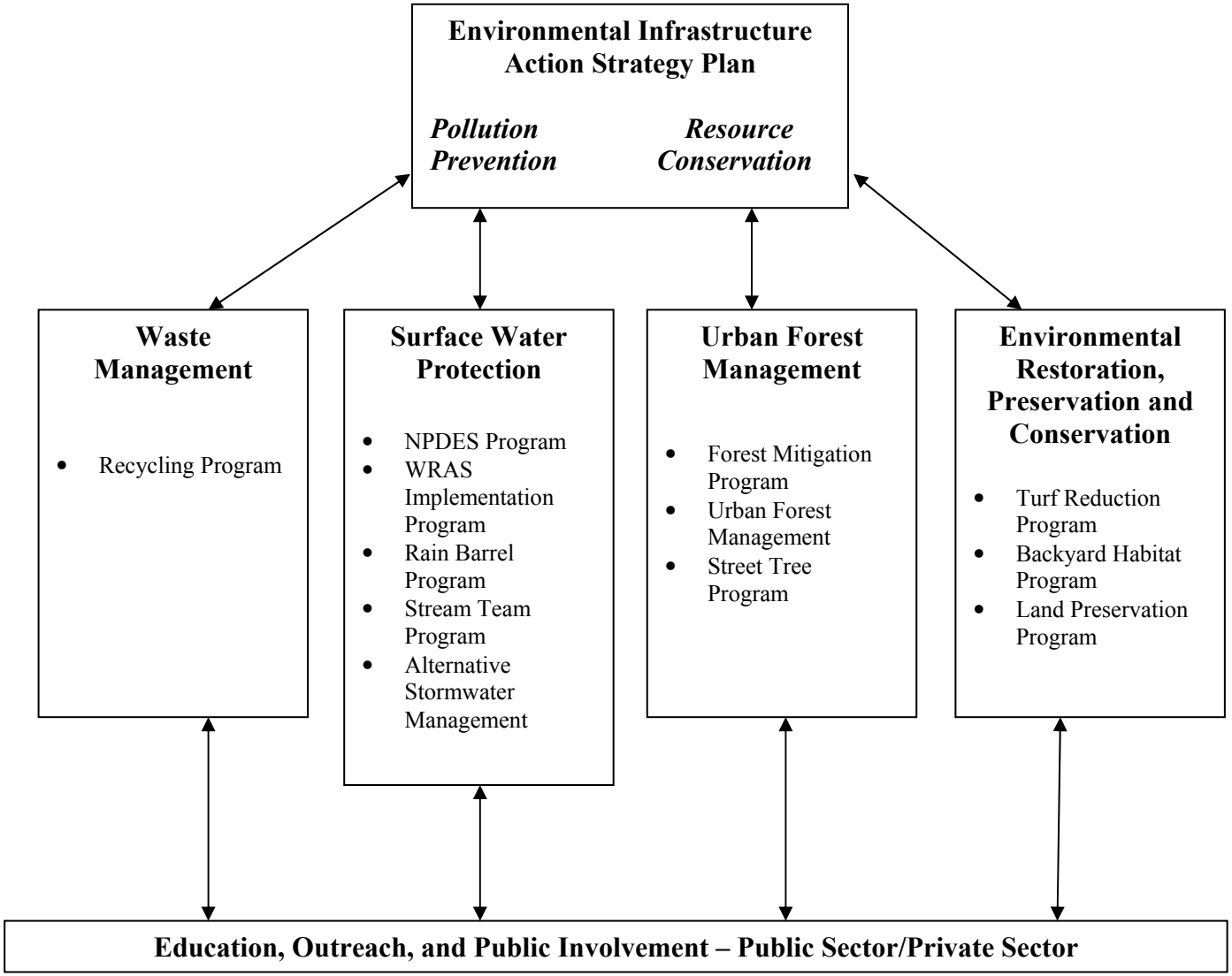
- The City's National Pollutant Discharge Elimination System program;
- Field investigations;
- Watershed Restoration Action Strategies (WRAS) for the Upper Patuxent and Western Branch watersheds;
- The City's draft green infrastructure network map;
- The City's Forest Mitigation Sites Inventory;
- The findings from Memo 2 developed for this project; and
- Ongoing discussions with City staff and the Steering Committee.

The projects and measures are summarized in Table 1 (excluding the rankings). Table 1A lists the Surface Water Protection projects by subwatershed. The link between Table 1 and Table 1A is made via the rows in Table 1 that refer to the subwatersheds.

Table 1 provides the following information (moving left to right through the columns) for all projects:

1. Total ranking score.
2. Project number.
3. Environmental Infrastructure Plan element (see Figure 1).
4. Environmental Infrastructure Plan program (see Figure 1). The elements and programs are in separate columns to facilitate sorting.

Organization of the City of Bowie's Environmental Infrastructure Action Strategy Plan



5. Project type. Three types are identified: (1) restoration, conservation and preservation projects; (2) programmatic changes; and (3) education and outreach. The first type can be further categorized as pollution prevention or resource conservation measures, which appear in the box at the top of Figure 1. Education and outreach appear in the box at the bottom of Figure 1.
6. Project description.
7. Location. General information is provided. Note that many of the projects would be citywide.
8. Project source. Provides the original source for the project so that the project can be easily looked up for additional information. Some projects are ERM recommendations. In some cases we suggest adjustments to the scope of a previously proposed project when we conclude that these adjustments would more fully implement the goals of the Environmental Infrastructure Plan or other relevant City programs. An example is project #5 that would include expanding the recommendation in the Forest Mitigation Site Inventory to perform Forest Stand Delineations on some sites in the inventory to all the "high priority" forest mitigation sites.
9. Ranking Criteria, Total Score, and Rank. Eight criteria provide a framework for prioritizing the projects in Table 1. Scores are assigned to each project for all applicable criteria, and the scores are summed. The projects are prioritized according to the sum of the scores for each criterion. Higher scores correspond to higher priorities. The individual ranking criteria are as follows:
    1. *Degree of impact*: Higher scores are given to projects with the potential to have larger or more significant impacts on affected components of the Environmental Infrastructure plan.
    2. *Capital cost:* Projects with low likely capital costs are scored higher than projects with high costs.
    3. *Operating cost:* Projects with low likely operating costs are scored higher than projects with high costs.
    4. *Implementation horizon:* Higher scores are given to projects that can be implemented over a comparatively short time frame because they are often more attractive and require a shorter-term commitment of resources. Projects with long implementation times scored lower.
    5. *Visibility*, likelihood to gain public support: Quantifies the visibility of a project to the public. The most visible projects receive the highest scores; low-profile projects that would not attract public attention receive lower scores.
    6. *Potential for shared responsibility*: Refers to potential for the City to transfer ownership or responsibility for a given project to a third party. Highest scores are assigned to projects that could readily be implemented, at least in part, by an

entity other than the City of Bowie, thereby making maximum use of city resources.

7. *Geographic distribution:* Citywide projects that would be implemented throughout the City are scored higher than projects that affect smaller areas of the City.
8. *Transferability*: Projects that could serve as a model for other jurisdictions, receive higher scores than more conventional projects.

10. Rationale. A statement explaining why the project is needed.
11. Notes. Additional information and commentary about the project.

Table 1 lists the projects in order from highest to lowest rank. The top project is to form stream teams. The next three projects ranked equally: establishing a water quality testing program that covers all Bowie's watersheds; establish new baseline of streambank length with eroding banks; and establish a program to test for family-level benthic index of biotic integrity in streams.

Table 1A lists and ranks surface water protection projects. Most of the projects were identified in the Upper Patuxent and Western Branch WRASs. Other surface water protection projects derive from fieldwork conducted for the Environmental Infrastructure Plan. ERM spent considerable time carefully reviewing the hundreds of watershed restoration projects identified in the WRASs to decide the best way to assist the City in prioritizing its projects. We selected an approach that modifies the comprehensive Basin Condition Score (BCS) data in the WRASs as a framework for prioritization. This approach consisted of the following steps:

1. Selecting a subset of appropriate metrics from the BCS to analyze;
2. Combining the selected metrics into a new index that would indicate differences in overall score between each subwatershed;
3. Determining restoration priorities in each watershed based on the difference in overall environmental condition;
4. Creating a master list of all surface water protection projects.
5. Determining which projects correspond most closely to the restoration priorities identified for each watershed in step 3; and
6. Developing a prioritized list of problems, organized by subwatershed and by problem type.

The results of the analysis are that certain types of problems noted in the WRAS, including pipe outfalls and erosion, should be priorities for restoration in all of Bowie's subwatersheds, but that other restoration priorities change somewhat according to the condition of each subwatershed. In the most degraded subwatersheds (Green Branch,

Tributary 1, Tributary 2, Tributary 3, and Tributary 4), the City should focus on a limited set of project types that are likely to have significant, positive water quality outcomes. In the other watersheds that are in better condition (Collington Branch Middle, Black Branch, Collington Branch Lower, Collington Branch Upper, Mill Branch, Horsepen Branch, and Marsh Branch), restoration activities should address existing degradations while also preventing further deterioration. Because restoration priorities are defined more broadly as subwatershed condition improves, more types of projects could be considered priorities in the subwatersheds that are comparatively good condition. Appendix 1 to this memo provides a more detailed explanation of the approach that was used to modify the BCS in order to specifically identify potential actions for improving the condition of impaired streams in the City of Bowie, and the results of the analysis of the individual watersheds using the modified BCS methodology.

Appendix 1: Analysis of WRAS Projects (6-8-07)

The Upper Patuxent and Western Branch WRASs provide a Basin Condition Score (BCS) for each of the subwatersheds within the Upper Patuxent and Western Branch watersheds. The BCS is a composite of over 20 individual metrics, and was developed for use in ranking all of the subwatersheds covered by the WRASs for restoration activities (see table at the end of this Appendix for the full BCS scores from the WRASs). Although the BCS is useful for comparing conditions in different subwatersheds, some of the metrics in the BCS are more useful than others in identifying potential actions for improving the condition of impaired streams. ERM selected the metrics in the BCS that are more useful in identifying restoration actions, and ranked overall subwatershed condition using these metrics. ERM then used the specific outputs from the modified index to identify opportunities for improving overall stream conditions in each of Bowie's subwatersheds.

Step 1. The first step in this process was to select a subset of appropriate metrics from the comprehensive BCS to analyze. We focused on metrics that are direct measures of a specific type of problem and/or were quantitative measures of stream condition that could be directly affected by specific actions that the City could accomplish. We also included metrics that are responsive to changes in short, medium, and long-term changes in stream condition. This approach modified the BCS to place more emphasis on identifying specific problems and practicable remedies to those problems within each subwatershed. Table A-1 below explains why each metric was included in our analysis.

Table A-1 Metrics included in the modified BCS analysis

Metric	Justification for Inclusion
Current % Impervious Surface (LC1_VAL)	The amount of impervious surface has been conclusively linked with the occurrence of sensitive fish species in a watershed. The City of Bowie has implemented a limited number of projects to reduce impervious surface coverage.
Future % Impervious Surface (LC4_VAL)	The City of Bowie can influence the amount of impervious surface within its boundaries in the future.
% Watershed Protected (LC6_VAL)	Protected lands can be maintained in perpetuity in natural cover types, which improve/preserve water quality. Several strategies, including purchase, easements, and dedication of land are available to City of Bowie to preserve land.
% Streambank length with eroding banks (HC1_VAL)	Eroding streambanks contribute fine sediment directly to streams, which can negatively impact habitat for fish and invertebrates. Eroding streambanks can generally be stabilized by grading and vegetating streambanks.
# pipe outfalls/sq. mile of watershed (HC2_VAL)	Pipe outfalls can introduce pollutants to streams, and cause erosion. The City can identify and regulate illicit discharges, and retrofit existing SWM facilities to reduce the impacts associated with these outfalls .
Overall habitat rating (HC5_VAL)	This metric is correlated with the ecological health of the aquatic ecosystem, and is a useful benchmark for tracking the overall physical condition of a stream.
Index of biological integrity (LR1VAL)	Benthic macroinvertebrates are sensitive to localized changes in aquatic system health because they have very limited capacity to avoid negative impacts. Controlling input of fine sediments, solar heating, and scour during high flows and improving water quality will improve this metric score.

Metric	Justification for Inclusion
Anadromous fish use (LR2SCORE)	Anadromous fish are sensitive to degradation over time because they return to the same streams each season. Controlling input of fine sediments and improving water quality will improve this score.
Presence/absence of sensitive species (LR3SCORE)	Sensitive species are a direct indicator of high-quality habitat within a subwatershed.
Fish IBI scores (LR4_VALUE)	Fish reflect water quality and habitat quality over long time frames because of prolonged exposures to ambient environmental conditions. Long-term improvement in habitat quality associated with reductions in sedimentation and scour and increases in water quality, canopy closure, and macroinvertebrate health will improve this score
Stream baseflow condition (HY2VALUE)	Maintaining baseflow is a critical habitat feature for aquatic organisms, but urban streams often dry under drought conditions. Stormwater management techniques that promote on-site infiltration maintain baseflow.
Nitrate concentration (WQ1VAL)	Excess nutrient loading is a main impairment of water quality in the Chesapeake Bay and its tributaries. Controlling nutrient-rich stormwater runoff will improve this score, and ultimately increase dissolved oxygen in streams.
Orthophosphate concentration (WQ2VAL)	Excess nutrient loading is a main impairment of water quality in the Chesapeake Bay and its tributaries. Controlling nutrient-rich stormwater runoff will improve this score, and ultimately increase dissolved oxygen in streams.

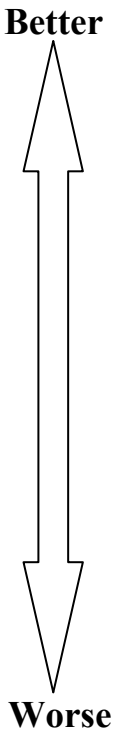
Step 2. The second step was to combine the selected metrics into an index that would indicate differences in overall environmental conditions between each subwatershed. Using the *unweighted*[1] scoring system for each of the selected metrics from the WRAS, which places the same emphasis on each metric in the score, we ranked the overall condition of the subwatersheds using the metrics in Table A-1. Table A-2 summarizes the individual metric scores for each of the subwatersheds in Bowie. The results of our analysis indicate that Green Branch, Tributary 1, Tributary 2, Tributary 3, and Tributary 4 are the most severely degraded watersheds in the Upper Patuxent Watershed in Bowie, whereas Collington Branch Middle, Black Branch, Collington Branch Lower, Collington Branch Upper, Mill Branch, Horsepen Branch, and Marsh Branch are in fair condition. See table at the end of this Appendix for the full ERM BCS scores. Table A-3 ranks the subwatersheds according to basin condition in ERM's modified BCS.

[1] In the BCS the unweighted score normalizes the results of each of the different raw data categories, that is, puts them in a number format that allows them to be read on a standard scale and compared. For example, in the Green Branch subwatershed, it would be difficult to determine whether the 34% impervious surface coverage has a greater or less severe impact than the 15% stream bank length with eroding banks. In the BCS unweighted scoring system, these scores are normalized on a scale of 1 through 10; the impervious surface is given a score of 10 and the eroding streambanks are given a score of 4, indicating that impervious surface coverage is more severe across the subwatershed than streambank erosion.

Table A-2 Individual metric scores for each of the Subwatersheds in Bowie

Subwatershed	Current % Impervious	Future % Impervious	% Watershed Protected	% stream bank length with eroding banks	# pipe outfalls per sq. mile of watershed	Overall habitat rating	Index of biological integrity	Anadromous fish use	Presence/absence of sensitive species	IBI for fish sampling locations	Stream baseflow condition	Nitrate concentration	Orthophosphate concentration	Total Score
Collington Branch Middle	7	10	10	4	10	7	7	10	1	6	1	1	1	75
Collington Branch Upper	4	10	10	1	7	7	10	10	10	4	1	7	1	82
Mill Branch	4	7	10	1	4	21	7	7	10	1	4	6	6	87
Horsepen Branch	7	7	10	4	7	30	7	7	1	1	4	4	1	90
Marsh Branch	10	7	10	1	7	17	6	10	1	6	4	10	6	93
Tributary 2	10	10	10	1	10	17	6	10	10	6	4	6	6	104
Tributary 1	10	10	10	1	7	17	6	10	10	6	7	6	6	104
Tributary 4	10	10	10	7	7	17	6	10	10	6	4	6	6	107
Tributary 3	10	10	10	4	10	30	10	10	10	6	4	4	1	119
Green Branch	10	10	10	4	10	30	7	10	10	7	4	7	1	120
Black Branch	1	7	10	10	4	4	7	10	1	4	4	7	7	76
Collington Branch Lower	4	10	10	10	7	7	7	7	1	6	1	4	4	78

Table A-3 Overall condition ranking using the modified BCS.

Subwatershed	Condition
Collington Branch Middle	
Black Branch	
Collington Branch Lower	
Collington Branch Upper	
Mill Branch	
Horsepen Branch	
Marsh Branch	
Tributary 2	
Tributary 1	
Tributary 4	
Tributary 3	
Green Branch	

Step 3. The third step in the process was to determine the restoration priorities in each subwatershed. To restore the more degraded subwatersheds (Green Branch, Tributary 1, Tributary 3, Tributary 2, and Tributary 4), the City should focus on actions that have immediate benefits in terms of water quality. Restoration goals in these watersheds should include stormwater management retrofits, sedimentation and erosion control measures, and locating and eliminating illicit discharges. Channel alterations, inadequate buffers, and fish barriers should be secondary considerations until the more serious problems with stormwater management, sedimentation and erosion, and illicit discharges are addressed.

Illicit discharges and stormwater discharges can potentially have significant effects on stream health, depending on the type and quantity of dissolved contaminants in the water being discharged and the velocity of the discharge. In all of the more degraded subwatersheds except Tributary 4, the City should give special consideration to SWM retrofits and eliminating illicit discharges. SWM retrofits and eliminating illicit discharges would be particularly important in the Green Branch and Tributary 3 subwatersheds because these subwatersheds have the highest number of outfalls per square mile of all the subwatersheds in Bowie. The Tributary 4 subwatershed has the highest percentage of eroding streambanks of any subwatershed in the City, which suggests that sedimentation and erosion control may be the most pressing stream restoration need in that subwatershed.

Horsepen Branch, Mill Branch, Marsh Branch, Collington Branch Upper, Collington Branch Lower, Black Branch, and Collington Branch Middle are in somewhat better condition that the other subwatersheds in the City (Table A-3). Restoration activities in these subwatersheds should address existing degradation and also prevent further deterioration. Thus, the priorities for these watersheds include not only the same types of projects as the priorities for the most degraded watersheds, but also other projects that would prevent further deterioration of intact environmental values and functions. Our analysis resulted in the following insights into the restoration priorities for each of these four subwatersheds:

- Mill Branch, Collington Branch Upper, Collington Branch Lower, Black Branch, and Collington Branch Middle have future percent impervious scores higher than current percent impervious scores. This suggests that preservation of land with natural cover would be a key component of restoring streams in these subwatersheds. Land preservation efforts should target expansion of stream buffers where possible. The WRAS did not identify inadequate buffers in the Black Branch subwatershed within Bowie, but expanding stream buffers in Bowie would improve water quality and habitat downstream. The Collington Branch subwatersheds have moderate to high densities of pipe outfalls, which suggest that addressing pipe outfalls should also be a priority in these watersheds.

- Erosion was a severe problem in both the Black Branch and Collington Branch Lower subwatersheds, and stabilization of eroding banks should be a priority in both subwatersheds. The WRAS did not identify specific eroding areas in the Black Branch subwatershed within Bowie, but to the extent that erosion could be minimized in Bowie, habitat conditions in the Black Branch subwatershed would improve downstream.

- Collington Branch Middle had the lowest nutrient (nitrate and orthophosphate) loads of any subwatershed in Bowie. Minimization of new SWM facilities and preservation/expansion of stream buffers would help to maintain nutrient levels in the Collington Branch Middle subwatershed near their present levels.

- Among the subwatersheds in fair condition, Horsepen Branch subwatershed had the most degraded habitat. Minimization of future road crossings would be an appropriate strategy for minimizing further physical habitat degradation in this subwatershed, because road crossings contribute significantly to habitat alterations in streams. The Horsepen Branch subwatershed also had low nutrient (nitrate and orthophosphate) loads. Minimization of new SWM facilities would help to maintain nutrient levels in the Horsepen Branch subwatershed near their present levels. Emphasis on expanding and maintaining stream buffers, minimizing new outfalls, and addressing problems with existing outfalls in this subwatershed would discourage additional road crossings and SWM facilities, at least near streams.

- The Marsh Branch subwatershed had the highest nitrogen and second highest orthophosphate concentrations of any of the other subwatersheds in Bowie. Black Branch had the highest orthophosphate and second-highest nitrogen levels of any subwatershed in Bowie. However; the number of pipe outfalls in these subwatersheds is not conspicuously high when compared

to the other subwatersheds, indicating that non-point sources may play a proportionately larger role in nutrient enrichment in these subwatersheds than in others. Expanding vegetative buffers would mitigate the effects of non-point source nutrient discharges on streams in the Marsh Branch and Black Branch subwatersheds.

Step 4. In Step 4 we created a master list of all surface water quality protection projects. This comprised the following projects:

- All WRAS problem sites for the following watersheds Collington Branch Middle, Collington Branch Upper, Mill Branch, Horsepen Branch, and Marsh Branch, Tributary 2.
- All WRAS problem sites except for fish barriers, channel alterations, and inadequate buffers in the more degraded watersheds, Tributary 1, Tributary 4, Tributary 3, and Green Branch
- The projects from our fieldwork of sites in May 2007 (see ERM Fieldwork tab in the surface water quality problems workbook).
- The Low Impact Development (LID) Retrofit projects identified in Appendix B of the Upper Patuxent River WRAS (see LID Retrofits tab in the surface water quality problems workbook)

Step 5. The fifth step was to determine which problems and projects in the master list correspond most closely to the restoration priorities identified for each watershed in step 3. For example, illicit discharges, which were identified as a restoration priority in Step 3, correspond to pipe outfalls, which are one of the problem types identified in the WRASs. Addressing inadequate buffers, which were documented as problems in the WRASs, would fulfill the "expand buffers" restoration goal identified in step 3. Table A-4 lists the restoration priorities and corresponding problem types for each watershed, and reflects the prioritization system used in Table 1A (see Step 6 below for an explanation of the final ranking system).

Table A-4 Relationship between restoration priorities from Step 3 and priority problem types

Watershed	Subwatershed	Restoration Priorities (from analysis of the WRAS BCS)	Priority 1 Problem Types (from WRAS problem site inventory and LID supplement)
Upper Patuxent	Tributary 1 Green Branch	• SWM retrofits → Pipe outfalls • Eliminating illicit discharges • Reducing impervious surface → Impervious surface/LID • Sedimentation and erosion control → Erosion	
Upper Patuxent	Tributary 2	• SWM retrofits → Pipe outfalls • Eliminating illicit discharges	

Watershed	Subwatershed	Restoration Priorities (from analysis of the WRAS BCS)	Priority 1 Problem Types (from WRAS problem site inventory and LID supplement)
		• Sedimentation and erosion control → Erosion	
Upper Patuxent	Tributary 3	• SWM retrofits → Pipe outfalls • Eliminating illicit discharges → Pipe outfalls • Sedimentation and erosion control → Erosion	
Upper Patuxent	Tributary 4	• Sedimentation and erosion control → Erosion • SWM retrofits → Pipe outfalls • Eliminating illicit discharges → Pipe outfalls	
Upper Patuxent	Marsh Branch Mill Branch	• Maintaining/reducing nutrient loads → Expand buffers • Sedimentation and erosion control → Erosion • SWM retrofits → Pipe outfalls • Eliminating illicit discharges → Pipe outfalls	
Upper Patuxent	Horsepen Branch	• Maintaining/reducing nutrient loads → Expand buffers • SWM retrofits → Pipe outfalls • Eliminating illicit discharges → Pipe outfalls • Sedimentation and erosion control → Erosion	
Western Branch	Collington Branch Middle	• Maintaining/reducing nutrient loads → Expand buffers • SWM retrofits → Pipe outfalls • Eliminating illicit discharges → Pipe outfalls • Sedimentation and erosion control → Erosion	
Western Branch	Collington Branch Upper	• Maintaining/reducing nutrient loads → Expand buffers • SWM retrofits → Pipe outfalls • Eliminating illicit discharges → Pipe outfalls	
Western Branch	Collington Branch Lower	• Maintaining/reducing nutrient loads → Expand buffers • Sedimentation and erosion control → Erosion • SWM retrofits → Pipe outfalls • Eliminating illicit discharges → Pipe outfalls	
Western Branch	Black Branch*	• Maintaining/reducing nutrient loads → Expand buffers • Sedimentation and erosion control → Erosion	

*The WRAS only documented one exposed pipe and one fish barrier as problems within Bowie in the Black Branch subwatershed. Neither of these problem sites correspond to the basin-wide restoration goals for the Black Branch subwatershed as determined by our modified BCS analysis. However; expanding buffers and controlling erosion

would be beneficial from a basin-wide perspective, and Bowie should focus on buffer expansion and erosion control in addition addressing the exposed pipe and fish barrier documented in the WRAS.

Step 6. In this step we performed the final prioritization to create Table 1A. First we grouped the problem sites in the master list by type within each watershed. We then assigned each problem type a priority rank (from 1 to 6) according to the corresponding restoration priority for each watershed. For the more degraded watersheds, the priority 1 problems were limited to pipe outfalls, erosion, and impervious surface, plus the LID Retrofit Projects. The priority ranks for each problem type in the priority 1 group were customized within each watershed according to the watershed-specific restoration priorities in Table A-4. Pipe outfalls were generally the top priority in the most degraded watersheds, but for the Tributary 4 watershed erosion control was a higher priority than pipe outfalls. For the watersheds in better condition, the priority 1 rank included inadequate buffers in addition to pipe outfalls, erosion, impervious surface, and LID retrofits.

For all the watersheds, the projects that were not ranked as priority 1 were ranked in descending order (from 2 to 6) as follows (note that some watersheds do not have problems in all categories and may not have projects ranked 5 or 6):

- Unusual conditions;
- Channel alterations;
- Exposed pipes;
- Trash dumping, and
- Fish barriers.

Unusual conditions require investigation in the field before the appropriate corrective action can be determined, so these problems were ranked higher than the other non-priority 1 sites. These sites may warrant re-classification once field investigations are complete. Channel alterations often have significant habitat-related impacts, so they were ranked as the next highest priority. Exposed pipes do not necessarily represent a problem now but could have potentially serious implications in the future, so they were ranked next highest on the list. Trash dumping represents a comparatively minor ecological impact but is visually unpleasant, so trash dumping was the next highest priority. Fish barriers were ranked as the lowest priority across all watersheds because the more serious problems should be addressed before the impacted areas are re-opened to sensitive anadromous fish populations.

We then sorted the problem sites within each type by the total severity, accessibility, and correctability score from the WRASs. The final product (Table 1A) is a prioritized list of problems, organized by subwatershed and by problem type. It is important to note that the WRAS scores should only be used to prioritize sites within each problem type and priority rank.

Basin Condition Scores from the Upper Patuxent WRAS, only showing watersheds in Bowie

factors ERM considered in its modified assessment for Bowie

Raw data not available for original BCS; average scores were used in the weighted scores.

NAME	Current % impervious LC1_VAL	Number of road xings LC2VAL	Forest polygon edge/area LC3VAL	Future %impervious LC4VAL	% of subwatershed in proposed greenway LC5_Val	% watershed protected LC6VAL	% watershed in ag use LC7VAL	% stream bank length with eroding banks HC1VAL	# pipe outfalls per sq. mile of watershed HC2VAL	% of buffer impairment HC3VAL	% of stream mileage lost to fish barriers HC4_VAL	Overall habitat rating HC5_VAL	% of stream miles with channel alterations HC6VAL	Index of biological integrity LR1VAL	Anadromous fish use LR2SCORE	Presence/absence of sensitive species LR3SCORE	IBI for fish sampling locations LR4_VALUE	% developed land in floodplain HY1VALUE	Stream baseflow condition HY2VALUE	Nitrate concentration WQ1VAL	Orthophosphate concentration WQ2VA
GREEN BRANCH	0.34	5.8	0.0046	0.36	28	0.28	9.00	0.15	11	0.08	0.38	30.00	0.03	2.14	10	10	2.000	0.15	14	0.460	0.003
TRIBUTARY 4	0.28	5.6	0.0061	0.73	14	0.04	0.00	0.25	6	0.01	0.78		0.14		10	10		0.25	16		
TRIBUTARY 1	0.31	3.4	0.0080	0.44	3	0.04	0.00	0.05	9	0.09	0.80		0.03		10	10		0.05	11		
MILL BRANCH	0.17	6.5	0.0021	0.22	23	0.22	20.00	0.09	5	0.08	0.41	21.00	0.01	2.29	7	10	4.125	0.09	16		
TRIBUTARY 2	0.32	1.5	0.0024	0.32	18	0.19	0.00	0.00	27	0.08	0.00		0.05		10	10		0.00	13		
HORSEPEN BRANCH	0.19	4.7	0.0052	0.24	1	0.14	2.00	0.16	8	0.08	0.97	23.60	0.03	2.26	7	1	4.125	0.16	15	0.280	0.003
TRIBUTARY 3	0.36	3.5	0.0058	0.34	6	0.12	0.00	0.19	19	0.07	0.88	30.00	0.01	1.29	10	10		0.19	13	0.140	0.002
MARSH BRANCH	0.26	3.6	0.0044	0.25	48	0.30	0.00	0.09	8	0.02	0.23		0.05		10	1		0.09	13		

Unweighted Scoring

	LC1	LC2	LC3	LC4	LC5	LC6	LC7Score	HC1	HC2	HC3	HC4	HC5	HC6	LR1	LR2	LR3	LR4	HY1	HY2	WQ1	WQ2
GREEN BRANCH	10.0	10.0	1.0	10.0	4.0	10.0	1.0	4.0	10.0	1.0	10.0	30.0	1.0	7.0	10.0	10	7.0	4.0	4.0	7.0	1.0
TRIBUTARY 4	10.0	10.0	4.0	10.0	7.0	10.0	1.0	7.0	7.0	1.0	10.0	16.50	4.0	5.50	10.0	10	5.50	6.0	4.0	5.50	5.50
TRIBUTARY 1	10.0	10.0	4.0	10.0	10.0	10.0	1.0	1.0	7.0	1.0	10.0	16.50	1.0	5.50	10.0	10	5.50	4.0	7.0	5.50	5.50
MILL BRANCH	4.0	10.0	1.0	7.0	4.0	10.0	4.0	1.0	4.0	1.0	10.0	21.0	1.0	7.0	7.0	10	1.0	4.0	4.0	5.50	5.50
TRIBUTARY 2	10.0	1.0	1.0	10.0	7.0	10.0	1.0	1.0	10.0	1.0	1.0	16.50	1.0	5.50	10.0	10	5.50	1.0	4.0	5.50	5.50
HORSEPEN BRANCH	7.0	10.0	1.0	7.0	10.0	10.0	1.0	4.0	7.0	1.0	10.0	30.0	1.0	7.0	7.0	1	1.0	6.0	4.0	4.0	1.0
TRIBUTARY 3	10.0	10.0	1.0	10.0	10.0	10.0	1.0	4.0	10.0	1.0	10.0	30.0	1.0	10.0	10.0	10	5.50	6.0	4.0	4.0	1.0
MARSH BRANCH	10.0	10.0	1.0	7.0	1.0	10.0	1.0	1.0	7.0	1.0	7.0	16.50	1.0	5.50	10.0	1	5.50	4.0	4.0	10.0	5.50

	LC1	LC2	LC3	LC4	LC5	LC6	LC7	HC1	HC2	HC3	HC4	HC5	HC6	LR1	LR2	LR3	LR4	HY1	HY2	WQ1	WQ2
Weighting	3	1	1	2	2	2	2	3	1	3	3	3	2	3	1	1	3	2	1	1	1

Weighted Scoring

	LC1	LC2	LC3	LC4	LC5	LC6		HC1	HC2	HC3	HC4	HC5	HC6	LR1	LR2	LR3	LR4	HY1	HY2	WQ1	WQ2
GREEN BRANCH	30	10	1	20	8	20	2	12	10	3	30	90	2	21	10	10	21	8	4	7	1
TRIBUTARY 4	30	10	4	20	14	20	2	21	7	3	30	49.5	8	16.5	10	10	16.5	12	4	5.5	5.5
TRIBUTARY 1	30	10	4	20	20	20	2	3	7	3	30	49.5	2	16.5	10	10	16.5	8	7	5.5	5.5
MILL BRANCH	12	10	1	14	8	20	8	3	4	3	30	63	2	21	7	10	3	8	4	5.5	5.5
TRIBUTARY 2	30	1	1	20	14	20	2	3	10	3	3	49.5	2	16.5	10	10	16.5	2	4	5.5	5.5
HORSEPEN BRANCH	21	10	1	14	20	20	2	12	7	3	30	90	2	21	7	1	3	12	4	4	1
TRIBUTARY 3	30	10	1	20	20	20	2	12	10	3	30	90	2	30	10	10	16.5	12	4	4	1
MARSH BRANCH	30	10	1	14	2	20	2	3	7	3	21	49.5	2	16.5	10	1	16.5	8	4	10	5.5

Final Scores	**Water Quality Conditions**	**Living Resource Conditions**	**Habitat Conditions**	**Landscape Conditions**	**Hydrologic Conditions**	**Overall Score**
GREEN BRANCH	8	62	147	91	12	320
TRIBUTARY 4	11	53	119	100	16	299
TRIBUTARY 1	11	53	95	106	15	280
MILL BRANCH	11	41	105	73	12	242
TRIBUTARY 2	11	53	71	88	6	229
HORSEPEN BRANCH	5	32	144	88	16	285
TRIBUTARY 3	5	67	147	103	16	338
MARSH BRANCH	16	44	86	79	12	236

	Ranking	**Watershed**
GREEN BRANCH	229	TRIBUTARY 2
TRIBUTARY 4	236	MARSH BRANCH
TRIBUTARY 1	242	MILL BRANCH
MILL BRANCH	280	TRIBUTARY 1
TRIBUTARY 2	285	HORSEPEN BRANCH
HORSEPEN BRANCH	289	MOUNT NEBO
TRIBUTARY 3	320	GREEN BRANCH
MARSH BRANCH	338	TRIBUTARY 3

Western Branch BCS Scores for Watersheds in the City of Bowie

Weighted Scoring	LC1	LC2	LC3	LC4	LC5	LC6	LC7	HC1	HC2	HC3	HC4	HC5	HC6	LR1	LR2	LR3	LR4	HY1	HY2	WQ1	WQ2			
Back Branch	3	4	4	20	8	20	8	16.5	10	16.5	16.5	21	11	21	10	1	3	2	4	10	5.5		Back Branch	16.5
Collington Branch Middle	21	10	4	20	2	20	2	12	10	12	30	21	2	21	10	1	16.5	2	1	1	1		Collington Bra	30
Northeast Branch Lower	3	1	4	8	2	20	8	3	10	12	30	12	2	21	10	1	16.5	8	1	4	1		Northeast Bra	30
Collington Branch Upper	12	10	4	20	8	20	8	3	7	30	30	21	2	30	10	10	12	2	1	7	1		Collington Bra	30

Final Scores	**Water Quality Conditions**	**Living Resource Conditions**	**Habitat Conditions**	**Landscape Conditions**	**Hydrologic Conditions**	**Overall Score**		**Rank**	**Watershed**
Collington Tributary 1	8	49	69	70	3	199		162	Western Branch Mainstem
Collington Tributary 2	11	49	83	73	6	221		178	Northeast Branch Lower
Collington Tributary 3	11	40	111	70	9	241		182	Black Branch
Turkey Branch	16	49	101	82	15	262		199	Collington Tributary 1
Back Branch	16	35	92	67	6	215		200	Charles Branch Lower
Charles Branch SW Branch	16	53	92	70	12	242		209	Folly Branch
Federal Spring Branch	16	49	101	76	15	256		215	Back Branch
Cabin Branch	16	44	84	83	14	240		220	Collington Branch Middle
East Branch	11	44	113	65	3	236		221	Collington Tributary 2
Black Branch	14	44	63	55	6	182		223	Collington Branch Lower
Collington Branch Lower	8	46	93	67	9	223		223	Northeast Branch Upper
Collington Branch Middle	2	49	87	79	3	220		236	East Branch
Baldhill Branch	16	53	83	106	9	266		240	Cabin Branch
Folly Branch	5	62	51	82	9	209		241	Collington Tributary 3
Lottsford Branch	11	44	105	88	3	251		242	Charles Branch SW Branch
Northeast Branch Upper	8	58	69	85	3	223		248	Northeast Branch Mainstem
Northeast Branch Lower	5	49	69	46	9	178		248	Collington Branch Upper
Northeast Branch Mainstem	20	35	102	88	3	248		251	Lottsford Branch
Southwest Branch Lower	16	53	92	106	12	278		251	Charles Branch Upper
Southwest Branch Upper	16	62	92	109	16	294		256	Federal Spring Branch
Collington Branch Upper	8	62	93	82	3	248		262	Turkey Branch
Charles Branch Upper	16	68	98	58	12	251		266	Baldhill Branch
Western Branch Mainstem	11	17	69	56	9	162		278	Southwest Branch Lower
Charles Branch Lower	16	38	86	52	9	200		294	Southwest Branch Upper

ERM BCS Ranking Worksheet for Bowie Watersheds

	Current % impervious	Future %impervious	% watershed protected	% stream bank length with eroding banks	# pipe outfalls per sq. mile of watershed	Overall habitat rating	Index of biological integrity	Anadromous fish use	Presence/absence of sensitive species	IBI for fish sampling locations	Stream baseflow condition	Nitrate concentration	Orthophosphate concentration	
NAME	LC1_VAL	LC4VAL	LC6VAL	HC1VAL	HC2VAL	HC5_VAL	LR1VAL	LR2SCORE	LR3SCORE	LR4_VALUE	HY2VALUE	WQ1VAL	WQ2VA	
GREEN BRANCH	0.34	0.36	0.28	0.15	11	30.00	2.14	10	10	2.000	14	0.460	0.003	
TRIBUTARY 4	0.28	0.73	0.04	0.25	6			10	10		16			
TRIBUTARY 1	0.31	0.44	0.04	0.05	9			10	10		11			
MILL BRANCH	0.17	0.22	0.22	0.09	5	21.00	2.29	7	10	4.125	16			
TRIBUTARY 2	0.32	0.32	0.19	0.00	27			10	10		13			
HORSEPEN BRANCH	0.19	0.24	0.14	0.16	8	23.60	2.26	7	1	4.125	15	0.280	0.003	
TRIBUTARY 3	0.36	0.34	0.12	0.19	19	30.00	1.29	10	10		13	0.140	0.002	
MARSH BRANCH	0.26	0.25	0.30	0.09	8			10	1		13			
Unweighted Scoring														
	LC1	LC4	LC6	HC1	HC2	HC5	LR1	LR2	LR3	LR4	HY2	WQ1	WQ2	Total Score
GREEN BRANCH	10.0	10.0	10.0	4.0	10.0	30.0	7.0	10.0	10	7.0	4.0	7.0	1.0	120
TRIBUTARY 4	10.0	10.0	10.0	7.0	7.0	16.50	5.50	10.0	10	5.50	4.0	5.50	5.50	107
TRIBUTARY 1	10.0	10.0	10.0	1.0	7.0	16.50	5.50	10.0	10	5.50	7.0	5.50	5.50	104
MILL BRANCH	4.0	7.0	10.0	1.0	4.0	21.0	7.0	7.0	10	1.0	4.0	5.50	5.50	87
TRIBUTARY 2	10.0	10.0	10.0	1.0	10.0	16.50	5.50	10.0	10	5.50	4.0	5.50	5.50	104
HORSEPEN BRANCH	7.0	7.0	10.0	4.0	7.0	30.0	7.0	7.0	1	1.0	4.0	4.0	1.0	90
TRIBUTARY 3	10.0	10.0	10.0	4.0	10.0	30.0	10.0	10.0	10	5.50	4.0	4.0	1.0	119
MARSH BRANCH	10.0	7.0	10.0	1.0	7.0	16.50	5.50	10.0	1	5.50	4.0	10.0	5.50	93
COLLINGTON MIDDLE	7	10	10	4	10	7	7	10	1	6	1	1	1	75
COLLINGTON UPPER	4	10	10	1	7	7	10	10	10	4	1	7	1	82
BLACK BRANCH	1	7	10	10	4	4	7	10	1	4	4	7	7	76
COLLINGTON LOWER	4	10	10	10	7	7	7	7	1	5.500	1	4	4	78
Final Scores														
GREEN BRANCH	120													
TRIBUTARY 4	107													
TRIBUTARY 1	104													
MILL BRANCH	87													
TRIBUTARY 2	104													
HORSEPEN BRANCH	90													
TRIBUTARY 3	119													
MARSH BRANCH	93													
COLLINGTON MIDDLE	75													
COLLINGTON UPPER	82													
BLACK BRANCH	76													
COLLINGTON LOWER	78													

Table 1 City of Bowie Environmental Infrastructure Restoration, Conservation and Preservation Opportunities																	
	Environmental Infrastructure							Ranking Criteria, Total Score, and Rank									
Total Ranking Score (see Columns I to P). Max potential = 31	**Project ID Number**	**Element**	**Program**	**Project Type (1) restoration, conservation and preservation projects; (2) programmatic changes; and, (3) education & outreach**	**Description**	**Location**	**Project Source (document, page #)**	**1. Degree of Impact – potential to achieve Environmental Infrastucture objectives High= 4-5 Intermediate=3 Low =1**	**2. Capital/Initial Cost High=0 Intermediate=3 Low =5**	**3. Operating/On going Cost High=0 Intermediate=3 Low =5**	**4. Completion implementation horizon Short=4 (5 years) Intermediate=2 (5-10) Long=0 (10 plus)**	**5. Visibility to the public likelihood to gain public support High=5 Intermediate=3 Low =1**	**6. Potential for implementation to be shared between the City and others. High=2 Intermediate=1 Low =0**	**7. Geographic distribution across the City of Bowie Wide=3 Intermediate=2 Local =1**	**8. Transferability-potential to serve as a model/demo for other jurisdictions High=2 Intermediate=1 Low =0**	**Rationale**	**Notes**
28	9	Surface Water Protection	Stream Team Program	3	Create stream teams	Citywide	NPDES General Discharge Permit	5	5	3	4	5	2	3	1	This project would provide a volunteer workforce to accomplish projects throughout the City. Establishing this workforce would enable the City to initiate or supplement projects that are currently understaffed. Volunteers could play a critical role in implementation of many of the Environmental Infrastructure Plan's recommendations.	High Schools such as Bowie HS have community service requirements. Students may be interested in participating in stream teams to fulfill some of their requirements.
24	8	Surface Water Protection	NPDES Program	2	Establish a water quality testing program that covers all Bowie's watersheds.	Citywide	ERM observation.	5	3	3	4	3	2	3	1	Under the NPDES program DPW currently tests for water quality in three out of Bowie's 12 watersheds. Some limited testing was done in a few watersheds during the WRAS process. ERM collected some wq data in 2007 in four watersheds. Testing in all watersheds on a consistent basis., is important. With training, stream teams could conduct tests. At a minimum test for nitrate and orthophosphate concentrations in Bowie's streams	DPW should consider data sampling downstream of the discharge location at Bowie Gateway Center. See additional notes in comment box.
24	29	Surface Water Protection	WRAS Implementation Program	1	Establish new baseline of streambank length with eroding banks	Citywide	ERM observation.	3	5	5	4	1	2	3	1	Streambank erosion length was collected as part of the WRAS, but since it is 4 years since the 2003 Stream Corridor Assessment data should be confirmed as part of stream team reconnaissance so that a good base for assessing progress is established.	Based on the 2003 Stream Corridor Assessment, the Basin Condition Score states that 19% of the stream bank length in Trib 3 was eroding – note BCS only used banks moderate in severity or greater. Table 1a lists 4 total eroding areas in Trib 3 totaling 6,500 linear feet (3 mod or greater for 5,800 lf)
24	31	Surface Water Protection	WRAS Implementation Program	1	Establish a program to test for family-level benthic index of biotic integrity in streams	Citywide	ERM observation.	3	5	3	4	3	2	3	1	Family level IBI is a good measure of habitat quality	The macroinvertebrate IBI can be computed at the family level or at a lower taxonomic rank (genus or species). The family-level IBI is less analytically robust than the genus- or species-level IBI, but it could be computed by volunteers after they take the DNR's free macroinvertebrate taxonomy course. An IBI calculated at the genus or species rank requires taxonomic skills that are beyond the capabilities of most volunteers, but is a more discriminating indicator of stream condition than the family-level IBI. IBI scores range from 1 to 5, where scores of 2.9 or below are considered poor and 4 to 5 is good.
23	36	Environmental Conservation	Land Preservation	1	Complete a Land Preservation Plan including specific acreage targets for open space, environmental conservation, and passive recreation lands.	Citywide	Staff	5	3	5	4	3	0	3	0	Analysis is needed before developing specific acreage targets. City does not have a good baseline of acres of land protected/unprotected in different categories.	
23	5	Urban Forest Management	Forest Mitigation Program	2	Perform Forest Stand Delineations and develop Forest Mitigation Plans for the highest priority sites on the Forest Mitigation Sites Inventory. The highest priority sites would be selected from the 37 high priority sites on the current inventory.	Citywide	ERM recommendation	5	5	5	4	1	0	3	0	This measure would refine the City's plans with regards to its high-priority forest mitigation sites in order to maximize the environmental value of each of the sites. Opportunities exist to partner with other groups for afforestation projects. The City's Forest Mitigation Site Inventory recommends that FSDs be performed on "some" the City's 37 "high priority" forest mitigation sites (Forest Mitigation Site Inventory, pg 4), but does not provide sufficient information to identify the most critical of these areas with respect to water quality and connectivity of the GI network. See additional notes in comment box i	FSDs and Tree Conservation Plans are necessary to identify the areas within each each mitigation site where afforestation or preservation would most benefit water quality (i.e.; ~25 ft afforestation areas in deforested or grassy riparian areas, ~50-100 ft afforestation areas between outfalls and stream channels, etc) or GI connectivity (i.e.; critical connections). The City should prepare FSDs and Tree Conservation Plans that identify the most important areas to afforest or preserve existing forest to benefit water quality and connectivity of the GI network at all high priority sites in the Mill Branch, Horsepen Branch, and Marsh Branch watersheds (as delineated in the Upper Patuxent WRAS). This measure could also be implemented at high priority sites in the Tributary 1, 2, 3, 4 and Green Branch watersheds (also from the Upper Patuxent WRAS), but only as a priority at sites where afforestation or preservation could be employed as part of natural erosion control or bioretention facilities. See additional notes in comment box
23	13	Waste Management	Recycling	3	Expand education and outreach to encourage recycling	Citywide	Steering committee	3	5	5	4	3	0	3	0	Expanding the recycling program would have the potential to significantly reduce the environmental impact of household and office wastes, would be a highly visible measure to the public, and could foster cooperation between the City and other organizations. It could be implemented over a large part of the City and could serve as an example for other jurisdictions of ways to involve the public in environmental programs. Costs associated with addressing multiple problems would likely be significant.	
23	28	Environmental Restoration, Preservation, and Conservation	Backyard Habitat	1,3	Establish a backyard habitat program:	Citywide	Action Plans	1	5	5	4	3	2	3	0	A backyard habitat program would complement the City's GI and forest mitigation programs by enhancing the environmental value of private lands throughout the City, but especially adjacent to City-owned lands that are reforested or otherwise improved. This measure would be visible to the public, could create opportunities for partnerships between the City and other entities, and could serve as a model for other jurisidictions. Because it would require public participation and active promotion on the part of City staff, it would likely require several years to be fully implemented.	1. Develop educational materials for landowners to use in creating backyard habitats. 2. Conduct public workshops on how to create backyard habitats. 3. Establish demonstration project at a school.
22	26	Surface Water Protection	Rain Barrel Program	1	Establish a rain barrel program.	Citywide	Action Plans	3	3	5	4	3	1	3	0	Rain barrels are an effective means of reducing stormwater volumes, and could be implemented in a phased approach across the City. Large-scale implementation of rain barrels would likely require several years of active promotion in the community by City-staff. Rain barrels present an opportunity for the City to partner with citizens in a City-wide conservation project.	1) Promote rain barrels at public workshops. 2) Provide rain barrels or vouchers for rain barrels. 3) Track participation in the program.
21	19	Surface Water Protection	WRAS Implementation Program	1	Address water quality and habitat problems identified in the Upper Patuxent River WRAS for the Black Branch subwatershed. Two problems identified: exposed pipe and a fish barrier. See Table 1A.	Throughout Black Branch subwatershed	Upper Patuxent WRAS	1	5	5	4	1	2	1	2	Implementing the specific restoration actions for any of the subwatersheds included in the WRASs would have significant positive effects on stream health, but would have a relatively long planning horizon.	
21	25	Urban Forest Management	Urban Forest Management Program	1	Establish an urban forest canopy goal for the City	Citywide	ERM observation	3	5	5	4	1	0	3	0	Setting an afforestation goal is the first step toward increasing the City's canopy coverage. Determing an appropriate goal will require consultation with DPW and Community Services at a minimum. .A City tree analysis was conducted in 2001 using City Green, rapid ecosystem analysis, identified a total canopy of 2,482 acres (24% of urban area).	1. Complete leaf-out analysis to establish existing baseline. 2. Determine afforestation goal for street tree program. 3. Add afforestation goal for non-street tree afforestation projects.

Table 1 City of Bowie Environmental Infrastructure Restoration, Conservation and Preservation Opportunities																	
		Environmental Infrastructure						Ranking Criteria, Total Score, and Rank									
Total Ranking Score (see Columns I to P). Max potential = 31	**Project ID Number**	**Element**	**Program**	**Project Type (1) restoration, conservation and preservation projects; (2) programmatic changes; and, (3) education & outreach**	**Description**	**Location**	**Project Source (document, page #)**	**1. Degree of Impact – potential to achieve Environmental Infrastucture objectives High= 4-5 Intermediate=3 Low =1**	**2. Capital/Initial Cost High=0 Intermediate=3 Low =5**	**3. Operating/On going Cost High=0 Intermediate=3 Low =5**	**4. Completion implementation horizon Short=4 (5 years) Intermediate=2 (5-10) Long=0 (10 plus)**	**5. Visibility to the public likelihood to gain public support High=5 Intermediate=3 Low =1**	**6. Potential for implementation to be shared between the City and others. High=2 Intermediate=1 Low =0**	**7. Geographic distribution across the City of Bowie Wide=3 Intermediate=2 Local =1**	**8. Transferability-potential to serve as a model/demo for other jurisdictions High=2 Intermediate=1 Low =0**	**Rationale**	**Notes**
20	27	Urban Forest Management	Forest Mitigation Program	2	Establish forest mitigation banking program in cooperation with the M-NCPPC to allow credit for afforestation projects.	Citywide	Action Plans	1	5	5	4	1	0	3	1	A forest mitigation banking system would provide incentives for the City to afforest sites independent of development presssure, which is is expected to decrease in the future. Forest banking would have water, air, and habitat-quality benefits throughout the City. This measure would be visible to the public, could create opportunities for partnerships between the City and other entities, and could serve as a model for other jurisidictions. An effective banking system requires agreement with Prince George's County on performance standards for forest mitigation banks.	
20	32	Surface Water Protection	Alternative Stormwater Management	1	Identify buildings and/or businesses to target for retrofit or installation of new green roofs	Citywide	ERM observation.	1	5	5	2	3	2	2	0	Green roofs contribute to the objective of restoring flow patterns in streams to mimic natural flows to the extent possible. By identifying candidate buildings the city can assist in encouraging the installation of green roofs.	
19	34	Surface Water Protection	Alternative Stormwater Management	1	Encourage stormwater Retrofit projects as identified in the Upper Patuxent WRAS	Upper Patuxent, especially Green Branch	Upper Patuxent River WRAS, Appendix B	4	0	5	2	3	2	1	2	Mitigate the effects of uncontrolled runoff to the Patuxent River through the use of innovative and environmentally sensitive development techniques and state-of-the-art storm water management practices.	
18	2	Environmental Conservation	Land Preservation	1	Green Infrastructure land protection/acquisition. Review options for adding lands to the GI network.	Citywide	ERM observation.	5	3	5	0	1	1	3	0	Acquisition and/or protection of open space is critical to implementation of the GI network and to the overall Environmental Infrastructure Plan. Costs associated with acquisition would likely be high, but ongoing costs following acquisition would be minimal. Opportunities exist to leverage grants and other external funding sources to protect land. The GI initiative could serve as a model for other jurisdictions depending on its success, but individual additions to the GI network will not likely attract significant public attention unless publicized by the City. One option is to use Program Open Space funds, currently used primarily for recreation.	Land could be preserved across the entire City, and would present opportunities for cooperation with private landowners, funding organizations, and other government agencies. Visibility to the public would depend on how and where land was preserved, and would would vary on a case-by-case basis. Costs associated with this project could change in the future with changes in property values.
18	6	Urban Forest Management	Urban Forest Management	2	Complete an Urban Forest Management Plan. Forest Mitigation Sites Inventory recommends this plan for areas that should be afforested but are less than 10,000 sf and/or less.	Citywide	Forest Mitigation Sites Inventory, pg. 10, with ERM recommendations.	1	5	5	4	0	0	3	0	An Urban Forest Management Plan (UFMP) will allow the City to use street trees as a mitigation technique. It would be applicable at any site designated for afforestation over 10,000 sq ft., but would not likely generate significant interest from the public or from other jurisdictions.	A UFMP could include an updated estimate of acreage that should be reserved for mitigation of City-led projects, and a market analysis to determine the value of excess land in the mitigation inventory on the open market. If the City is currently reserving more land than it would forseeably use and a market analysis determines that the private market for mitigation sites is susceptible to downturn, the City should consider sale of excess sites.
18	7	Urban Forest Management	Forest Mitigation Program	1	Control Phragmites at Forest Mitigation Sites Inventory Sites 4 and 6	Huntington South Parcels and Northridge SWM Swales	Forest Mitigation Sites Inventory, ERM recommendation	1	5	5	4	1	1	1	0	Controlling Phragmites at Sites 4 and 6 could begin immediately and would be highly visible restoration project, although the measure would likely require ongoing maintenance, and the long term success of Phragmites control is often questionable.	Phragmites is an invasive species that is typically difficult to eradicate, but eradication is somewhat more straightforward in SWM ponds than in other locations because rhizomes can be removed during routine maintenance of the SWM facility. Removal of invasive species including Phragmites in Huntington South Parcels and Northridge SWM Swales is consistent with management of the GI network for native species.
16	11	Surface Water Protection	NPDES Program	2	Eliminate illicit storm drain discharges.	Citywide	NPDES General Discharge Permit	5	0	0	0	5	1	3	2	Eliminating illicit storm drain discharges would have the potential to have significant, wide-ranging effects on stream condition. Costs associated with eliminating illicit discharges could increase in the future due to increases in discharge volume or the effects of the discharges on stream condition, so prompt action could save money over the long term. Dischargers would be liable for the costs of eliminating illicit discharges, so this measure would be a cost-effective strategy to improve stream condition for the City. Elliminating illicit discharges is concept that the public can easily understand, so this measure could attract significant public support. Costs associated with addressing multiple problems would likely be significant.	1. Create citywide database of storm drain outfalls 24" and larger 2. Inspect. 3. Develop illicit discharge detection program 4. Identify/eliminate source where possible.
16	1	Urban Forest Management	Forest Mitigation Program	1	Forest mitigation demonstration. Site 37 Westview SWM Parcels (integrate wildldife habitat)	Collington Branch Upper watershed	Forest Mitigation Sites Inventory	1	3	5	4	1	1	1	0		
16	3	Urban Forest Management	Forest Mitigation Program	1	Forest mitigation demonstration. Site 66 Black Sox Swales (integrate SWM functionality);	Mill Branch watershed	Forest Mitigation Sites Inventory	1	3	5	4	1	1	1	0		
16	4	Urban Forest Management	Forest Mitigation Program	1	Forest mitigation demonstration. Site 23 Gallant Fox Park (demonstrate forest mitigation banking);	Tributary 3 watershed	Forest Mitigation Sites Inventory	1	3	5	4	1	1	1	0		
16	12	Urban Forest Management	Forest Mitigation Program	1	Forest mitigation demonstration. Site 67 Church Road Park;	Collington Branch Middle watershed	Forest Mitigation Sites Inventory	1	3	5	4	1	1	1	0		
16	35	Urban Forest Management	Forest Mitigation Program	1	Forest mitigation demonstration. Site 13 Former Bowie Levitt-built Sewage Treatment Plant	Tributary 2 watershed	Forest Mitigation Sites Inventory	1	3	5	4	1	1	1	0		
16	33	Surface Water Protection	WRAS Implementation Program	2	Install a stream gage in a stream to measure water flow	Target watershed (Green Branch?)	ERM observation.	5	0	3	2	1	2	1	2	A stream gage is the only way to directly measure flows. Data from a gage would be very valuable in measuring the effects of measures designed to modify flows (swm retrofits, rain barrels, green roofs, pipe outfall retrofits).	Estimated gage cost is $10,000 - providing continuous data outputs to a remote workstation. Possible demonstration project that could be of interest to grantors. Should only be installed in a watershed where much restoration effort would be targeted (such as Green Branch) A reference watershed, if available, could provide targets for restoration flows.
15	10	Surface Water Protection	WRAS Implementation Program	1	Address water quality and habitat problems identified in the Upper Patuxent River WRAS for the Green Branch subwatershed. Top 3 problem categories: Pipe Outfalls, Impervious surface/LID, erosion, See Table 1A.	Throughout Green Branch subwatershed	Upper Patuxent WRAS	5	0	0	0	5	2	1	2	Implementing the specific restoration actions for any of the subwatersheds included in the WRASs would have significant positive effects on stream health, but would have a relatively long planning horizon. Costs associated with addressing multiple problems would likely be significant.	
15	14	Surface Water Protection	WRAS Implementation Program	1	Address water quality and habitat problems identified in the Western Branch WRAS for the Collington Branch Upper subwatershed. Top 3 problem categories: Inadequate Buffers, Pipe Outfalls, Unusual Conditions. See Table 1A.	Throughout Collington Branch Upper subwatershed	Western Branch WRAS	5	0	0	0	5	2	1	2	Implementing the specific restoration actions for any of the subwatersheds included in the WRASs would have significant positive effects on stream health, but would have a relatively long planning horizon. The two Collington Branch subwatersheds and the Tributary 3 subwatershed are slightly larger than the other subwatersheds, so restoration of these subwatersheds would affect a greater portion of the City, and received a slighly higher score than the other subwatersheds. Costs associated with addressing multiple problems would likely be significant.	

Table 1 City of Bowie Environmental Infrastructure Restoration, Conservation and Preservation Opportunities																	
	Environmental Infrastructure							Ranking Criteria, Total Score, and Rank									
Total Ranking Score (see Columns I to P). Max potential = 31	**Project ID Number**	**Element**	**Program**	**Project Type (1) restoration, conservation and preservation projects; (2) programmatic changes; and, (3) education & outreach**	**Description**	**Location**	**Project Source (document, page #)**	**1. Degree of Impact – potential to achieve Environmental Infrasturcture objectives High= 4-5 Intermediate=3 Low =1**	**2. Capital/Initial Cost High=0 Intermediate=3 Low =5**	**3. Operating/On going Cost High=0 Intermediate=3 Low =5**	**4. Completion implementation horizon Short=4 (5 years) Intermediate=2 (5-10) Long=0 (10 plus)**	**5. Visibility to the public likelihood to gain public support High=5 Intermediate=3 Low =1**	**6. Potential for implementation to be shared between the City and others. High=2 Intermediate=1 Low =0**	**7. Geographic distribution across the City of Bowie Wide=3 Intermediate=2 Local =1**	**8. Transferability-potential to serve as a model/demo for other jurisdictions High=2 Intermediate=1 Low =0**	**Rationale**	**Notes**
15	15	Surface Water Protection	WRAS Implementation Program	1	Address water quality and habitat problems identified in the Western Branch WRAS for the Collington Branch Lower subwatershed. Top 3 problem categories: Inadequate Buffers, Erosion, Pipe Outfalls.. See Table 1A.	Throughout Collington Branch Lower subwatershed	Western Branch WRAS	5	0	0	0	5	2	1	2	Implementing the specific restoration actions for any of the subwatersheds included in the WRASs would have significant positive effects on stream health, but would have a relatively long planning horizon. The two Collington Branch subwatersheds and the Tributary 3 subwatershed are slightly larger than the other subwatersheds, so restoration of these subwatersheds would affect a greater portion of the City, and received a slighly higher score than the other subwatersheds. Costs associated with addressing multiple problems would likely be significant.	
15	22	Surface Water Protection	WRAS Implementation Program	1	Address water quality and habitat problems identified in the Upper Patuxent River WRAS for the Mill Branch subwatershed. Top 3 problem categories: Inadequate Buffers, Erosion, Pipe Outfalls.. See Table 1A.	Throughout Mill Branch subwatershed	Upper Patuxent WRAS	5	0	0	0	5	2	1	2	Implementing the specific restoration actions for any of the subwatersheds included in the WRASs would have significant positive effects on stream health, but would have a relatively long planning horizon. Costs associated with addressing multiple problems would likely be significant.	
15	23	Surface Water Protection	WRAS Implementation Program	1	Address water quality and habitat problems identified in the Upper Patuxent River WRAS for the Horsepen Branch subwatershed. Top 3 problem categories: Inadequate Buffers, Pipe Outfalls, Erosion. See Table 1A.	Throughout Horsepen Branch subwatershed	Upper Patuxent WRAS	5	0	0	0	5	2	1	2	Implementing the specific restoration actions for any of the subwatersheds included in the WRASs would have significant positive effects on stream health, but would have a relatively long planning horizon.	
15	24	Surface Water Protection	WRAS Implementation Program	1	Address water quality and habitat problems identified in the Upper Patuxent River WRAS for the Collington Middle subwatershed. Top 3 problem categories: Inadequate Buffers, Pipe Outfalls, Erosion. See Table 1A.	Throughout Collington Middle subwatershed	Western Branch WRAS	5	0	0	0	5	2	1	2	Implementing the specific restoration actions for any of the subwatersheds included in the WRASs would have significant positive effects on stream health, but would have a relatively long planning horizon. Costs associated with addressing multiple problems would likely be significant.	
14	16	Surface Water Protection	WRAS Implementation Program	1	Address water quality and habitat problems identified in the Upper Patuxent River WRAS for the Tributary 1 subwatershed. Top 3 problem categories: Pipe Outfalls, Impervious surface/LID, erosion, See Table 1A.	Throughout Tributary 1 subwatershed	Upper Patuxent WRAS	4	0	0	0	5	2	1	2	Implementing the specific restoration actions for any of the subwatersheds included in the WRASs would have significant positive effects on stream health, but would have a relatively long planning horizon. Costs associated with addressing multiple problems would likely be significant.	
14	17	Surface Water Protection	WRAS Implementation Program	1	Address water quality and habitat problems identified in the Upper Patuxent River WRAS for the Tributary 3 subwatershed. Top 3 problem categories: Pipe Outfalls, Erosion, Unusual Conditions. See Table 1A.	Throughout Tributary 3 subwatershed	Upper Patuxent WRAS	4	0	0	0	5	2	1	2	Implementing the specific restoration actions for any of the subwatersheds included in the WRASs would have significant positive effects on stream health, but would have a relatively long planning horizon. The two Collington Branch subwatersheds and the Tributary 3 subwatershed are slightly larger than the other subwatersheds, so restoration of these subwatersheds would affect a greater portion of the City, and received a slighly higher score than the other subwatersheds. Costs associated with addressing multiple problems would likely be significant.	
14	18	Surface Water Protection	WRAS Implementation Program	1	Address water quality and habitat problems identified in the Upper Patuxent River WRAS for the Tributary 4 subwatershed. Top 3 problem categories: Erosion, Pipe Outfalls, Unusual Conditions. See Table 1A.	Throughout Tributary 4 subwatershed	Upper Patuxent WRAS	4	0	0	0	5	2	1	2	Implementing the specific restoration actions for any of the subwatersheds included in the WRASs would have significant positive effects on stream health, but would have a relatively long planning horizon. Costs associated with addressing multiple problems would likely be significant.	
14	20	Surface Water Protection	WRAS Implementation Program	1	Address water quality and habitat problems identified in the Upper Patuxent River WRAS for the Tributary 2 subwatershed. Top 3 problem categories: Pipe Outfalls, Unusual Conditions, Exposed pipes. See Table 1A.	Throughout Tributary 2 subwatershed	Upper Patuxent WRAS	4	0	0	0	5	2	1	2	Implementing the specific restoration actions for any of the subwatersheds included in the WRASs would have significant positive effects on stream health, but would have a relatively long planning horizon. Costs associated with addressing multiple problems would likely be significant.	
14	21	Surface Water Protection	WRAS Implementation Program	1	Address water quality and habitat problems identified in the Upper Patuxent River WRAS for the Marsh Branch subwatershed. Top 3 problem categories: Inadequate Buffers, Erosion, Pipe Outfalls.. See Table 1A.	Throughout Marsh Branch subwatershed	Upper Patuxent WRAS	4	0	0	0	5	2	1	2	Implementing the specific restoration actions for any of the subwatersheds included in the WRASs would have significant positive effects on stream health, but would have a relatively long planning horizon. Costs associated with addressing multiple problems would likely be significant.	
14	30	Environmental Restoration, Preservation, and Conservation	Turf Reduction	1	Allow regeneration of natural vegetation at SWM facilities, removing turf where consistent with the specific operational and maintenance requirements of each facility. 13 sites identified; see notes column, of which 6 are identified as high priority afforestation sites (Project #5)	Citywide	ERM recommendation	1	3	5	2	1	0	2	0	The habitat value of SWM ponds is limited, but replacing turf with native vegetation would enhance habitat values at these sites, and could provide some additional benefits associated with bioretention. This measure would not likely be highly visible to the public, nor would there be significant opportunities to partner with other organizations to implement this action. However; this action could be implemented over at numerous sites over a large portion of the City.	Sites from Mitigation Sites Synopsis Report 5_06.doc. 6. Northridge SWM Swales. 10. Whitehall SWM Swales. 12. Overbrook SWM Swales 15. Idlewild SWM Swales 17. North Meadowbrook SWM Swales 18. South Meadowbrook SWM Swales 19. Free State SWM Swales 34. Buckingham SWM Swales 36. Stewart's Landing SWM Parcels 38. Long Ridge Swales 44. Kenilworth SWM Swales 51. Heather Hills SWM Swales 59. Pin Oak Village SWM Swales
12	37	Urban Forest Management	Street Tree Program	1	Plant a minimum of 150 trees per year through 2012. Reassess how many additional street trees could be accomodated on City streets.	Citywide	Staff	1	0	5	2	1	0	3	0	City replaces fewer than 150 street trees per year. Planning staff feel this number could be increased.	The majority of them would be replacements (130 or so). See also Proect #6 Urban Forest Management Plan (UFMP) that will allow the City to use street trees as a mitigation technique

Table 1A City of Bowie Surface Water Quality Restoration, Conservation and Preservation Opportunities (see Memo 4 Appendix A for explanation)

Problem Type	Site Number	Priority Rank	WRAS Score
COLLINGTON BRANCH UPPER			
Inadequate Buffer	WB308210	1	6
Inadequate Buffer	WB308202	1	7
Inadequate Buffer	WB312102	1	8
Inadequate Buffer	WB328302	1	8
Inadequate Buffer	WB300205	1	9
Inadequate Buffer	WB325302	1	9
Inadequate Buffer	WB313101	1	10
Pipe Outfall	WB314213	1	5
Pipe Outfall	WB308205	1	6
Pipe Outfall	WB300204	1	7
Pipe Outfall	WB302201	1	7
Pipe Outfall	WB303201	1	7
Pipe Outfall	WB308201	1	7
Pipe Outfall	WB308204	1	7
Pipe Outfall	WB308207	1	7
Pipe Outfall	WB308208	1	7
Pipe Outfall	WB308209	1	7
Pipe Outfall	WB312101	1	7
Pipe Outfall	WB314201	1	7
Pipe Outfall	WB314202	1	7
Pipe Outfall	WB314203	1	7
Pipe Outfall	WB314204	1	7
Pipe Outfall	WB314205	1	7
Pipe Outfall	WB314207	1	7
Pipe Outfall	WB314208	1	7
Pipe Outfall	WB314209	1	7
Pipe Outfall	WB314210	1	7
Pipe Outfall	WB314211	1	7
Pipe Outfall	WB314212	1	7
Pipe Outfall	WB316105	1	7
Pipe Outfall	WB316106	1	7
Pipe Outfall	WB321305	1	7
Pipe Outfall	WB322301	1	7
Pipe Outfall	WB322302	1	7
Pipe Outfall	WB307201	1	8
Pipe Outfall	WB307202	1	8
Pipe Outfall	WB307203	1	8
Pipe Outfall	WB307204	1	8
Pipe Outfall	WB307206	1	8
Pipe Outfall	WB313201	1	8
Pipe Outfall	WB328305	1	8
Pipe Outfall	DPW 05-07 3	1	8
Pipe Outfall	DPW 05-07 4	1	8
Pipe Outfall	DPW 05-07 2	1	9
Unusual Conditions	WB325301	2*	11
Unusual Conditions	WB328303	2*	11
Unusual Condition	DPW 05-07 1	2*	4
Channel Alterations	WB300201	3	7

Problem Type	Site Number	Priority Rank	WRAS Score
Channel Alterations	WB300205	3	8
Channel Alterations	WB303202	3	9
Trash Dumping	WB313302	4	8
Trash Dumping	WB321303	4	8
Trash Dumping	WB330301	4	8
Fish Barriers	WB316103	5	8
Fish Barriers	WB330302	5	8
Fish Barriers	WB307210	5	9
Fish Barriers	WB308206	5	9
Fish Barriers	WB321302	5	9
Fish Barriers	WB328304	5	9
Fish Barriers	WB307207	5	10
Fish Barriers	WB308203	5	10
Fish Barriers	WB313301	5	10
Fish Barriers	WB300202	5	11
Fish Barriers	WB307205	5	11
Fish Barriers	WB307209	5	11
Fish Barriers	WB314206	5	11
Fish Barriers	WB321304	5	11
COLLINGTON BRANCH MIDDLE			
Inadequate Buffers	WB330305	1	4
Inadequate Buffers	WB345303	1	6
Pipe Outfalls	WB344404	1	5
Pipe Outfalls	WB334304	1	7
Pipe Outfalls	WB337402	1	7
Pipe Outfalls	WB337403	1	7
Pipe Outfalls	WB340401	1	7
Pipe Outfalls	WB350301	1	7
Pipe Outfalls	WB331303	1	8
Pipe Outfalls	WB331305	1	8
Pipe Outfalls	WB329301	1	9
Pipe Outfalls	WB345301	1	9
Pipe Outfalls	WB345305	1	9
Erosion	WB340402	1	6
Unusual Conditions	WB334301	2*	9
Exposed Pipe	WB334404	3	6
Trash Dumping	WB334403	4	7
Trash Dumping	WB345302	4	7
Trash Dumping	WB333301	4	8
Trash Dumping	WB345307	4	8
Trash Dumping	WB344401	4	9
Fish Barriers	WB331304	5	7
Fish Barriers	WB334305	5	7
Fish Barriers	WB337404	5	7
Fish Barriers	WB339101	5	7
Fish Barriers	WB331307	5	8
Fish Barriers	WB343101	5	8
Fish Barriers	WB344405	5	8
Fish Barriers	WB345304	5	8
Fish Barriers	WB328307	5	9
Fish Barriers	WB331306	5	9
Fish Barriers	WB334301	5	9

Problem Type	Site Number	Priority Rank	WRAS Score
Fish Barriers	WB345306	5	9
Fish Barriers	WB331301	5	10
Fish Barriers	WB331302	5	10
Fish Barriers	WB340102	5	10
COLLINGTON BRANCH LOWER			
Inadequate Buffer	WB356203	1	6
Inadequate Buffer	WB349201	1	7
Inadequate Buffer	WB350203	1	7
Inadequate Buffer	WB351303	1	7
Inadequate Buffer	WB351311	1	8
Erosion	WB351305	1	8
Erosion	WB350303	1	10
Erosion	WB360302	1	10
Pipe Outfall	WB355201	1	6
Pipe Outfall	WB350201	1	7
Pipe Outfall	WB350204	1	7
Pipe Outfall	WB350205	1	7
Pipe Outfall	WB350206	1	7
Pipe Outfall	WB356201	1	7
Pipe Outfall	WB356202	1	7
Pipe Outfall	WB356204	1	7
Pipe Outfall	WB356205	1	7
Pipe Outfall	WB356206	1	7
Pipe Outfall	WB356208	1	7
Pipe Outfall	WB356209	1	7
Pipe Outfall	WB356210	1	7
Pipe Outfall	WB351301	1	8
Pipe Outfall	WB351309	1	8
Pipe Outfall	WB351310	1	8
Pipe Outfall	WB351312	1	9
Exposed Pipe	WB356207	2	7
Trash Dumping	WB356211	3	6
Trash Dumping	WB360301	3	9
Fish Barriers	WB351302	4	8
Fish Barriers	WB351304	4	8
Fish Barriers	WB351308	4	8
Fish Barriers	WB350302	4	9
Fish Barriers	WB351307	4	10
Fish Barriers	WB356301	4	10
Fish Barriers	WB356302	4	10
BLACK BRANCH			
Exposed Pipe	WB354402	1	7
Fish Barrier	WB354401	2	6
TRIBUTARY 1			
Pipe Outfalls	UP100301	1	7
Pipe Outfalls	UP104308	1	7
Pipe Outfalls	UP107402	1	7
Pipe Outfalls	UP102302	1	7
Pipe Outfalls	UP102304	1	8

Problem Type	Site Number	Priority Rank	WRAS Score
Pipe Outfalls	UP104303	1	8
Pipe Outfalls	UP101301	1	8
Pipe Outfalls	UP101302	1	8
Pipe Outfalls	UP104304	1	8
Pipe Outfalls	UP104306	1	8
Pipe Outfalls	UP104307	1	8
Impervious surface	Site ID: SOE2	1	
Impervious surface	Site ID: RES	1	
Erosion	UP109401	1	6
Erosion	UP106404	1	7
Erosion	UP110406	1	8
Erosion	UP103305	1	9
Erosion	UP110404	1	9
Unusual Conditions	UP103301	2*	7
Unusual Conditions	UP106402	2*	8
Unusual Conditions	UP103307	2*	10
Exposed Pipes	UP104305	3	9
Exposed Pipes	UP110402	3	11
Trash Dumping	UP109403	4	7
Trash Dumping	UP110401	4	7
Trash Dumping	UP102303	4	8
Trash Dumping	UP110405	4	8
Trash Dumping	UP103303	4	8
Trash Dumping	UP107401	4	9
GREEN BRANCH			
Pipe Outfalls	UP616408	1	7
Pipe Outfalls	UP602201	1	7
Pipe Outfalls	UP602203	1	7
Pipe Outfalls	UP604403	1	7
Pipe Outfalls	UP607204	1	7
Pipe Outfalls	UP610404	1	7
Pipe Outfalls	UP616406	1	7
Pipe Outfalls	UP607201	1	7
Pipe Outfalls	UP607202	1	7
Pipe Outfalls	UP607205	1	7
Pipe Outfalls	UP613203	1	7
Pipe Outfalls	UP620403	1	8
Pipe Outfalls	UP610401	1	8
Impervious Surface	Site ID: BORD	1	
Impervious Surface	Site ID: TARG	1	
Impervious Surface	Site ID: HDB1	1	
Impervious Surface	Site ID: SPOR	1	
Impervious Surface	Site ID: HOME	1	
Impervious Surface	Site ID: PETS	1	
Impervious Surface	Site ID: PIER	1	
Impervious Surface	Site ID: STAP	1	
Erosion	UP616402	1	7
Erosion	UP604309	1	9
Unusual Conditions	UP604405	2*	7
Unusual Conditions	UP604307	2*	8
Exposed Pipes	UP607203	3	7
Exposed Pipes	UP616407	3	7

Problem Type	Site Number	Priority Rank	WRAS Score
Exposed Pipes	UP604402	3	8
Exposed Pipes	UP604313	3	9
HORSEPEN BRANCH			
Inadequate Buffers	UP869301	1	5
Inadequate Buffers	UP864402	1	6
Inadequate Buffers	UP881404	1	6
Inadequate Buffers	UP886403	1	7
Inadequate Buffers	UP865404	1	7
Inadequate Buffers	UP836205	1	7
Inadequate Buffers	UP842202	1	8
Inadequate Buffers	UP857201	1	8
Inadequate Buffers	UP840101	1	9
Inadequate Buffers	UP875303	1	9
Inadequate Buffers	UP824305	1	11
Pipe Outfalls	UP846203	1	6
Pipe Outfalls	UP872401	1	7
Pipe Outfalls	UP820202	1	7
Pipe Outfalls	UP842204	1	7
Pipe Outfalls	UP859201	1	7
Pipe Outfalls	UP860205	1	7
Pipe Outfalls	UP860206	1	7
Pipe Outfalls	UP864403	1	7
Pipe Outfalls	UP864405	1	7
Pipe Outfalls	UP865401	1	7
Pipe Outfalls	UP865402	1	7
Pipe Outfalls	UP880401	1	7
Pipe Outfalls	UP835106	1	7
Pipe Outfalls	UP821201	1	7
Pipe Outfalls	UP842203	1	7
Pipe Outfalls	UP842205	1	7
Pipe Outfalls	UP860204	1	7
Pipe Outfalls	UP875301	1	7
Pipe Outfalls	UP886407	1	7
Pipe Outfalls	UP807301	1	8
Pipe Outfalls	UP807302	1	8
Pipe Outfalls	UP807303	1	8
Pipe Outfalls	UP836204	1	8
Pipe Outfalls	UP860202	1	8
Pipe Outfalls	UP876303	1	8
Pipe Outfalls	UP888405	1	8
Pipe Outfalls	UP853104	1	8
Pipe Outfalls	UP886404	1	8
Pipe Outfalls	UP886405	1	9
Erosion	UP882401	1	7
Erosion	UP880402	1	7
Erosion	UP824302	1	8
Erosion	UP835201	1	8
Erosion	UP866401	1	8
Erosion	UP846204	1	9
Erosion	UP853103	1	10
Erosion	UP825302	1	10
Erosion	UP835104	1	11

Problem Type	Site Number	Priority Rank	WRAS Score
Unusual Conditions	UP866403	2*	5
Unusual Conditions	UP885408	2*	6
Unusual Conditions	UP888402	2*	6
Unusual Conditions	UP836202	2*	7
Unusual Conditions	UP819401	2*	8
Unusual Conditions	UP841101	2*	9
Unusual Conditions	UP808303	2*	9
Unusual Conditions	UP860201	2*	9
Unusual Conditions	UP824301	2*	11
Channel Alterations	UP836206	3	6
Channel Alterations	UP865405	3	8
Channel Alterations	UP875302	3	8
Channel Alterations	UP876305	3	8
Channel Alterations	UP826301	3	9
Channel Alterations	UP876301	3	9
Channel Alterations	UP886402	3	10
Channel Alterations	UP881402	3	11
Channel Alterations	UP876302	3	12
Exposed Pipes	UP885409	4	4
Exposed Pipes	UP864001	4	7
Exposed Pipes	UP885406	4	7
Exposed Pipes	UP885401	4	11
Trash Dumping	UP888401	5	6
Trash Dumping	UP886406	5	7
Trash Dumping	UP834401	5	8
Trash Dumping	UP836203	5	8
Trash Dumping	UP841102	5	9
Trash Dumping	UP885405	5	10
Fish Barriers	UP840102	6	7
Fish Barriers	UP820201	6	8
Fish Barriers	UP836201	6	8
Fish Barriers	UP864401	6	8
Fish Barriers	UP885407	6	8
Fish Barriers	UP885410	6	8
Fish Barriers	UP865403	6	8
Fish Barriers	UP825301	6	8
Fish Barriers	UP842202	6	8
Fish Barriers	UP853102	6	8
Fish Barriers	UP880104	6	8
Fish Barriers	UP864404	6	8
Fish Barriers	UP835202	6	9
Fish Barriers	UP860203	6	9
Fish Barriers	UP865406	6	9
Fish Barriers	UP866402	6	9
Fish Barriers	UP808301	6	9
Fish Barriers	UP808302	6	9
Fish Barriers	UP865407	6	10
Fish Barriers	UP876304	6	10
Fish Barriers	UP824303	6	10
Fish Barriers	UP835105	6	10
Fish Barriers	UP854104	6	10
Fish Barriers	UP886401	6	10
Fish Barriers	UP842201	6	11

Problem Type	Site Number	Priority Rank	WRAS Score
MARSH BRANCH			
Inadequate Buffers	UP405301	1	7
Inadequate Buffers	UP401305	1	9
Erosion	UP407302	1	7
Erosion	UP411401	1	8
Erosion	UP410303	1	10
Erosion	UP412402	1	10
Erosion	UP409302	1	11
Erosion	UP410304	1	11
Pipe Outfalls	UP404301	1	7
Pipe Outfalls	UP404306	1	7
Pipe Outfalls	UP407301	1	7
Pipe Outfalls	UP401301	1	8
Pipe Outfalls	UP401302	1	8
Pipe Outfalls	UP401303	1	8
Pipe Outfalls	UP401304	1	8
Pipe Outfalls	UP404302	1	8
Pipe Outfalls	UP405304	1	8
Pipe Outfalls	UP407303	1	8
Pipe Outfalls	UP404307	1	8
Unusual Condition	DPW 05-07 5	2*	7
Unusual Condition	DPW 05-07 8	2*	10
Channel Alterations	UP404308	3	8
Channel Alterations	UP410302	3	11
Trash Dumping	UP404303	3	8
Fish Barriers	UP404305	4	8
Fish Barriers	UP404304	4	8
Fish Barriers	UP405303	4	9
Fish Barriers	UP411402	4	9
Fish Barriers	UP405302	4	9
Fish Barriers	UP410301	4	10
Fish Barriers	UP412401	4	10
MILL BRANCH			
Inadequate Buffers	UP704302	1	6
Inadequate Buffers	UP713303	1	7
Inadequate Buffers	UP711301	1	8
Inadequate Buffers	UP718302	1	8
Inadequate Buffers	UP715302	1	9
Inadequate Buffers	UP722304	1	9
Inadequate Buffers	UP713302	1	10
Inadequate Buffers	UP728101	1	11
Erosion	UP728102	1	6
Erosion	UP719301	1	8
Erosion	UP720401	1	8
Erosion	UP722301	1	8
Erosion	UP730301	1	8
Erosion	UP715303	1	8
Erosion	UP719303	1	9
Erosion	UP713305	1	10
Pipe Outfalls	UP715304	1	7
Pipe Outfalls	UP721303	1	7

Problem Type	Site Number	Priority Rank	WRAS Score
Pipe Outfalls	UP722302	1	7
Pipe Outfalls	UP723304	1	7
Pipe Outfalls	UP713306	1	7
Pipe Outfalls	UP710301	1	7
Pipe Outfalls	UP710303	1	7
Pipe Outfalls	UP721301	1	7
Pipe Outfalls	UP721302	1	7
Pipe Outfalls	UP721304	1	7
Pipe Outfalls	UP722305	1	7
Pipe Outfalls	UP704301	1	8
Pipe Outfalls	UP723305	1	8
Pipe Outfalls	UP713301	1	9
Pipe Outfalls	UP713304	1	11
Channel Alteration	UP710302	2	8
Channel Alteration	UP721201	2	8
Channel Alteration	UP705301	2	9
Channel Alteration	UP718301	2	9
Channel Alteration	UP718303	2	9
Channel Alteration	UP720201	2	9
Exposed Pipes	UP721203	3	6
Exposed Pipes	UP720202	3	7
Trash Dumping	UP715305	4	9
Trash Dumping	UP723302	4	9
Fish Barriers	UP715305	5	8
Fish Barriers	UP723301	5	8
Fish Barriers	UP715301	5	9
Fish Barriers	UP721206	5	9
Fish Barriers	UP716301	5	10
Fish Barriers	UP721202	5	10
Fish Barriers	UP728104	5	10
Fish Barriers	UP722303	5	10
Fish Barriers	UP718305	5	11
TRIBUTARY 3			
Pipe Outfalls	UP305402	1	7
Pipe Outfalls	UP308405	1	7
Pipe Outfalls	UP308406	1	7
Pipe Outfalls	UP309101	1	7
Pipe Outfalls	UP309102	1	7
Pipe Outfalls	UP312102	1	7
Pipe Outfalls	UP312103	1	7
Pipe Outfalls	UP312108	1	7
Pipe Outfalls	UP312110	1	7
Pipe Outfalls	UP312111	1	7
Pipe Outfalls	UP312112	1	7
Pipe Outfalls	UP312113	1	7
Pipe Outfalls	UP314202	1	7
Pipe Outfalls	UP315204	1	7
Pipe Outfalls	UP315205	1	7
Pipe Outfalls	UP318207	1	7
Pipe Outfall	DPW 05-07 12	1	7
Pipe Outfalls	UP305401	1	8
Pipe Outfalls	UP308407	1	8

Problem Type	Site Number	Priority Rank	WRAS Score
Pipe Outfalls	UP315201	1	8
Pipe Outfalls	UP320202	1	8
Pipe Outfalls	UP304204	1	8
Pipe Outfalls	UP307202	1	8
Pipe Outfalls	UP310201	1	8
Pipe Outfalls	UP310203	1	8
Pipe Outfalls	UP313201	1	8
Pipe Outfalls	UP313203	1	8
Pipe Outfalls	UP313204	1	8
Pipe Outfalls	UP315206	1	8
Pipe Outfalls	UP315207	1	8
Pipe Outfalls	UP316201	1	8
Pipe Outfalls	UP316202	1	8
Pipe Outfalls	UP317204	1	8
Pipe Outfalls	UP318201	1	8
Pipe Outfalls	UP318204	1	8
Pipe Outfalls	UP318205	1	8
Pipe Outfalls	UP320201	1	8
Pipe Outfalls	UP321203	1	8
Pipe Outfalls	UP304203	1	8
Pipe Outfalls	UP307201	1	8
Pipe Outfalls	UP307205	1	8
Pipe Outfalls	UP309403	1	8
Pipe Outfalls	UP310202	1	8
Pipe Outfalls	UP310204	1	8
Pipe Outfalls	UP317201	1	8
Pipe Outfalls	UP317202	1	8
Pipe Outfalls	UP318202	1	8
Pipe Outfalls	UP318208	1	8
Pipe Outfalls	UP320204	1	8
Pipe Outfalls	UP309402	1	9
Pipe Outfall	DPW 05-07 11	1	9
Pipe Outfall	DPW 05-07 13	1	9
Erosion	UP308403	1	5
Erosion	UP316203	1	7
Erosion	UP312106	1	8
Erosion	UP312101	1	9
Unusual Condition	DPW 05-07 6	2*	8
Unusual Condition	DPW 05-07 9	2*	8
Unusual Condition	DPW 05-07 10	2*	10
Exposed Pipes	UP314203	3	6
Exposed Pipes	UP308401	3	7
Exposed Pipes	UP319202	3	9
Exposed Pipes	UP322202	3	10
Trash Dumping	UP322204	4	7
TRIBUTARY 4			
Erosion	UP508403	1	7
Erosion	UP505406	1	7
Erosion	UP509407	1	7
Erosion	UP504405	1	9
Pipe Outfalls	UP505405	1	7
Pipe Outfalls	UP505401	1	7

Problem Type	Site Number	Priority Rank	WRAS Score
Pipe Outfalls	UP505403	1	7
Pipe Outfalls	UP508404	1	7
Pipe Outfalls	UP506404	1	8
Unusual Conditions	UP504403	2*	7
Unusual Condition	DPW 05-07 7	2*	8
Unusual Condition	UP508001	2*	10
Exposed Pipes	UP508401	3	9
TRIBUTARY 2			
Pipe Outfalls	UP204201	1	7
Pipe Outfalls	UP200212	1	7
Pipe Outfalls	UP200213	1	7
Pipe Outfalls	UP200202	1	8
Pipe Outfalls	UP200201	1	8
Pipe Outfalls	UP200204	1	8
Pipe Outfalls	UP200205	1	8
Pipe Outfalls	UP200206	1	8
Pipe Outfalls	UP200207	1	8
Pipe Outfalls	UP200208	1	8
Pipe Outfalls	UP200209	1	8
Pipe Outfalls	UP200210	1	8
Pipe Outfalls	UP200211	1	8
Pipe Outfalls	UP201202	1	8
Pipe Outfalls	UP202204	1	8
Pipe Outfalls	UP202201	1	9
Pipe Outfalls	UP202202	1	9
Pipe Outfalls	UP203202	1	9
Unusual Conditions	UP205401	2*	10
Unusual Conditions	UP203203	2*	11
Exposed Pipe	UP201201	3	8

* = Unusual condition. May warrant re-classification once field investigations are complete