6 Benefits of Plan Implementation

6.1 Introduction

This section presents the modeled benefits of the projects proposed in the Accotink Creek Watershed Management Plan. The results show that there would be a significant pollutant reduction in many WMAs, and measurable reductions watershed-wide, after the implementation of the proposed projects. Hydrologic benefits are not as high, with runoff volume reduced about 2 percent and peak flows even less for the whole watershed.

For a number of reasons, project selection and recommendation tended towards two types of projects: 1) projects that would improve runoff quality by reducing pollutants and 2) projects that would help restore eroding streams and reduce the subsequent negative sediment and nutrient loads caused by the erosion. There were fewer large projects proposed to improve watershed hydrology (i.e. reduce volume and velocity of stormwater).

The primary reason is that the Accotink Creek watershed is substantially built out, having been developed before stormwater management regulations came into effect to require new development to manage stormwater runoff. As a result, there are fewer existing stormwater management ponds which can be retrofitted in Accotink Creek than in other watersheds, and little open space in which to plan and develop new ponds.

Projects that improve quality of stormwater runoff can be easier to implement in already developed areas. These include parking lot BMP/LID retrofits and area-wide projects, both of which involve small treatment systems dispersed throughout an area, with treatment focused on inlets and other parts of the publicly-owned storm drain system. Stream restoration projects, many sited in publicly-owned areas, also have significant water quality benefits by eliminating stream bank erosion.

It should be noted that the quantified benefits presented in this section do not include non-structural projects. These types of projects can provide significant improvements in both water quality and quantity. Downspout disconnection, tree planting, buffer restoration and implementation of rain gardens and rain barrels can reduce excessive stormwater runoff from entering our stream systems. Benefits are difficult to model; however, because the outcome of the programs to change behavior is highly variable.

6.2 Models and Scenarios

In order to assess the benefits of the Accotink Creek Watershed Management Plan, final hydrologic, hydraulic and pollutant loading modeling was conducted for three separate scenarios:

- *Existing Conditions:* represented watershed conditions at the time the plan was prepared,
- *Future Conditions without Projects:* represented watershed conditions that included forecast for changes in land use and,
- *Future Conditions with Projects:* added the proposed projects in this plan to the *Future Conditions without Projects* scenario.

All the proposed projects were modeled for pollutant reductions. Hydrologic and hydraulic benefits were calculated for the 10-year projects with significant storage, such as new

stormwater ponds, pond retrofits, or some culvert retrofits. Additional information about the models used in this plan may be found in Section 2, while detailed results are discussed in Appendix B.

- Hydrologic modeling was conducted using SWMM. This model uses parameters for land cover, soils and stormwater management to estimate the amount and timing of runoff and stream flow that is generated from precipitation. Modeling was done for two precipitation events: the 2-year storm, with a 50 percent probability of occurrence in any one year, and the 10-year storm, which has a 10 percent probability of occurrence in any one year.

- HEC-RAS was used for hydraulic modeling. This model takes stream flow and estimates the speed and depth of the water. When the results are compared with elevations of buildings and structures, it is possible to determine whether or not they will be impacted.

- Pollutant loading is a type of water quality modeling that estimates how much of a particular pollutant (i.e. total suspended solids (TSS), total nitrogen (TN) or total phosphorus (TP) is being generated and delivered to streams and other water bodies through various land-use activities. The spreadsheet-based STEPL model was used to estimate stormwater runoff loads and assess the reductions of these pollutants through implementation of the proposed projects. Pollutant loads from stream erosion were estimated based on the length and severity of erosion identified in the SPA assessment. Stream restoration projects were assumed to reduce the TSS, TN, and TP loads to zero for the entire length of the restored reach.

6.3 Hydrology

Comparisons between the *Future Conditions without Projects* and *Future Conditions with Projects* scenarios showed a reduction in runoff volume of three percent for the 2-year event and two percent for the 10-year event. The peak flow reductions were negligible for both events. Again, because the Accotink Creek watershed is already built out with little land available for quantity control projects, there were few opportunities to create projects to capture and treat excess stormwater runoff. A summary of the results is presented in Tables 6-1 and 6-2.

The modeled hydrological benefits showed an unusual result in several cases where runoff volume or flow became larger after projects have been implemented. Most of these increases were well under one percent and were a result of minor changes in the model between the two scenarios, not a function of the project itself.

One case, in Mainstem 3, showed an interesting result of implementing retrofits for detention. In this case, the detained 2-year peak from Long Branch North coincided with the undetained peak flowing in Accotink Creek. Detention in this case caused a higher peak than would have occurred if the flows from Long Branch North had not been held back. After reviewing the model, it was decided that the substantial flow reductions from Long Branch North justified the modestly higher peak in Mainstem 3, particularly since it was completely attenuated by the time it reached Mainstem 4.

6.4 Hydraulics

The future conditions HEC-RAS hydraulic model was updated to show results of projects by incorporating the flows from the SWMM model of future conditions with projects. A Flood Mitigation project, located in Long Branch South was included in the model. This project is a culvert retrofit under the existing railroad behind the Newington Industrial Park (AC9600). The

Future Conditions without Projects model showed the crossing will be overtopped for the 10- and 100-year storm event. By increasing the cross-sectional area that the flow can pass through, both storm over-toppings were eliminated in the *Future Conditions with Projects* scenario.

6.5 Pollutant Loading

The pollutant load model results showed slight increases in the modeled pollutant loads between the *Existing Conditions* and *Future Conditions without Projects* scenarios for all the WMAs. The increases are a result of land use changes and associated pollutant loads modeled in STEPL. Stream erosion was not a factor, since it was assumed that stream characteristics and erosion loads would not change for these scenarios.

Stream erosion and STEPL results were both included in the comparison of the *Future Conditions without Projects* and *Future Conditions with Projects* scenarios. This comparison showed that the 10-year implementation plan reduced sediment by about fifteen percent, and nitrogen and phosphorus by about four and a half and seven percent, respectively. With all the proposed projects for the 10- and 25-year plans included, the model results showed reductions of about sixteen percent for sediment, six percent for nitrogen, and eight percent for phosphorus. Several WMAs saw large pollutant reductions, most notably Bear Branch whose projects will reduce sediment by 54 percent, nitrogen by 14 percent and phosphorous by 25 percent.

6.6 Plan Cost and Benefits

The total estimated cost of the 120 structural projects for the 10-year plan is $75 million. Implementation of the 109 11-25 year structural projects adds $12 million for a total of $87 million. It should be noted that the 10-year plan costs are more accurate as these projects were scoped in more detail.

The benefits of the plan include eliminating the overtopping of one crossing, reducing flooding potential, restoration of twelve miles of streams and one mile of stream buffers. Pollutant loads would be reduced by as much as 3,032 tons per year of sediment, 9,914 pounds per year of nitrogen and 2,758 pounds per year of phosphorus for the 10-year implementation plan. The full 25-year plan implementation would reduce pollutant loading by 3,149 tons per year of sediment, 12,376 pounds per year of nitrogen and 3,244 pounds per year of phosphorous. These benefits will help meet the County's goals for water quality and stream improvements and provide a positive impact on the residents and conditions of the watershed.

Table 6-1: Pollutant Loading and Flow Reduction by Watershed

Watershed	Area (ac)	Scenario[3]	Runoff Volume (in)[1]		Peak Flow (cfs/ac)[1]		TSS (lb/ac/yr)[2]	TN (lb/ac/yr)[2]	TP (lb/ac/yr)[2]
			2-Year	10-Year	2-Year	10-Year			
Accotink Creek	32,679	Existing Conditions	1.155	2.897	0.113	0.316	1,218.0	6.3372	1.1369
		Future Without Projects	1.252	3.017	0.118	0.325	1,235.6	6.6310	1.1796
		Future With Projects(10 yr)	1.212	2.958	0.117	0.324	1,050.1	6.3277	1.0952
		Future With Projects(25 yr)					1,042.9	6.2524	1,0804
		Reduction (10-year Plan)	0.040 (3%)	0.059 (2%)	0.001 (1%)	0.001 (0%)	185.5 (15.0%)	0.3033 (4.6%)	0.0844 (7.2%)
		Reduction (25-year Plan)	N/A	N/A	N/A	N/A	192.7 (15.6%)	0.3786 (5.7%)	0.0992 (8.4%)

[1]Flow is cumulative
[2]Loads are representative of individual land area contributions
[3]25-year projects were not evaluated in the hydrologic model

Table 6-2: Pollutant Loading and Flow Reduction by WMA

WMA	Area (ac)	Scenario[3]	Runoff Volume (in)[1]		Peak Flow (cfs/ac)[1]		TSS (lb/ac/yr)[2]	TN (lb/ac/yr)[2]	TP (lb/ac/yr)[2]
			2-Year	10-Year	2-Year	10-Year			
Bear Branch	1,392.2	Existing	1.303	3.057	0.460	0.990	2,380.1	8.0691	1.6352
		Future without projects	1.336	3.095	0.486	1.009	2,392.1	8.3029	1.6714
		Future 10-yr projects	1.336	3.096	0.495	1.007	1,109.9	7.1542	1.2507
		Future 25-yr projects	N/A	N/A	N/A	N/A	1,092.3	6.9431	1.2110
		Reduction 10-yr projects	0.000 (0%)	-0.001 (0%)	-0.009 (0%)	-0.003 (0%)	1,282.2 (53.6%)	1.1487 (13.8%)	0.4207 (25.2%)
		Reduction 25-yr projects	N/A	N/A	N/A	N/A	1,299.8 (54.3%)	1.3598 (16.4%)	0.4604 (27.5%)
Crook Branch	1,099.0	Existing	1.282	3.028	0.483	1.024	1,325.7	6.4708	1.1743
		Future without projects	1.299	3.049	0.492	1.041	1,330.6	6.5674	1.1898
		Future 10-yr projects	1.300	3.050	0.493	1.043	798.9	5.8523	0.9716
		Future 25-yr projects	N/A	N/A	N/A	N/A	798.0	5.8435	0.9697
		Reduction 10-yr projects	-0.001 (0%)	-0.001 (0%)	-0.001 (0%)	-0.002 (0%)	531.7 (40.0%)	0.7151 (10.9%)	0.2182 (18.3%)
		Reduction 25-yr projects	N/A	N/A	N/A	N/A	532.6 (40.0%)	0.7239 (11.0%)	0.2201 (18.5%)
Daniels Run[4]	1,208.7	Existing	1.046	2.683	0.377	0.827	1,095.4	5.2317	0.9392
		Future without projects	1.048	2.685	0.377	0.827	1,095.6	5.2336	0.9391
		Future 10-yr projects	1.042	2.673	0.376	0.818	1,095.6	5.2336	0.9391
		Future 25-yr projects	N/A	N/A	N/A	N/A	1,095.6	5.2336	0.9391
		Reduction 10-yr projects	0.006 (1%)	0.012 (0%)	0.001 (0%)	0.009 (1%)	0.0 (0.0%)	0.0000 (0.0%)	0.0000 (0.0%)
		Reduction 25-yr projects	N/A	N/A	N/A	N/A	0.0 (0.0%)	0.0000 (0.0%)	0.0000 (0.0%)

WMA	Area (ac)	Scenario[3]	Runoff Volume (in)[1]		Peak Flow (cfs/ac)[1]		TSS (lb/ac/yr)[2]	TN (lb/ac/yr)[2]	TP (lb/ac/yr)[2]
			2-Year	10-Year	2-Year	10-Year			
Hunters Branch	1,202.4	Existing	1.452	3.22	0.28	0.678	1,364.5	7.5810	1.3570
		Future without projects	1.544	3.329	0.299	0.708	1,393.9	8.1460	1.4406
		Future 10-yr projects	1.544	3.329	0.299	0.708	1,046.6	7.8101	1.3227
		Future 25-yr projects	N/A	N/A	N/A	N/A	1,045.1	7.7964	1.3201
		Reduction 10-yr projects	0.000 (0%)	0.000 (0%)	0.000 (0%)	0.000 (0%)	347.3 (24.9%)	0.3359 (4.1%)	0.1179 (8.2%)
		Reduction 25-yr projects	N/A	N/A	N/A	N/A	348.8 (25.0%)	0.3496 (4.3%)	0.1205 (8.4%)
Long Branch Central	2,429.4	Existing	1.284	3.011	0.356	0.734	2,458.4	7.5343	1.5767
		Future without projects	1.300	3.030	0.360	0.740	2,463.7	7.6391	1.5934
		Future 10-yr projects	1.296	3.026	0.353	0.728	2,323.9	7.2312	1.4982
		Future 25-yr projects	N/A	N/A	N/A	N/A	2,313.9	7.1295	1.4774
		Reduction 10-yr projects	0.004 (0%)	0.004 (0%)	0.007 (2%)	0.012 (2%)	139.8 (5.7%)	0.4079 (5.3%)	0.0952 (6.0%)
		Reduction 25-yr projects	N/A	N/A	N/A	N/A	149.8 (6.1%)	0.5096 (6.7%)	0.1160 (7.3%)
Long Branch North	1,487.4	Existing	1.581	3.359	0.517	1.077	1,726.0	8.2507	1.4779
		Future without projects	1.695	3.494	0.634	1.220	1,760.1	9.0027	1.5694
		Future 10-yr projects	1.697	3.498	0.610	1.103	820.6	8.0358	1.2431
		Future 25-yr projects	N/A	N/A	N/A	N/A	817.0	7.9956	1.2355
		Reduction 10-yr projects	-0.002 (0%)	-0.004 (0%)	0.024 (4%)	0.117 (10%)	939.5 (53.4%)	0.9669 (10.7%)	0.3263 (20.8%)
		Reduction 25-yr projects	N/A	N/A	N/A	N/A	943.1 (53.6%)	1.0071 (11.2%)	0.3339 (21.3%)
Long Branch South	3,121.3	Existing	1.677	3.470	0.246	0.577	836.5	7.9910	1.2598
		Future without projects	1.801	3.615	0.283	0.668	915.3	8.9723	1.3981
		Future 10-yr projects	1.809	3.627	0.264	0.680	851.5	8.4506	1.2949
		Future 25-yr projects	N/A	N/A	N/A	N/A	841.4	8.3722	1.2791
		Reduction 10-yr projects	-0.008 (0%)	-0.012 (0%)	0.019 (7%)	-0.012 (0%)	63.8 (7.0%)	0.5217 (5.8%)	0.1032 (7.4%)
		Reduction 25-yr projects	N/A	N/A	N/A	N/A	73.9 (8.1%)	0.6001 (6.7%)	0.1190 (8.5%)
Mainstem 1	3,652.6	Existing	1.486	3.231	0.554	1.162	1,596.3	7.8558	1.4165
		Future without projects	1.523	3.275	0.574	1.198	1,608.7	8.0490	1.4428
		Future 10-yr projects	1.527	3.280	0.543	1.149	1,596.1	7.9183	1.4175
		Future 25-yr projects	N/A	N/A	N/A	N/A	1,590.2	7.8567	1.4045
		Reduction 10-yr projects	-0.004 (0%)	-0.005 (0%)	0.031 (5%)	0.049 (4%)	12.6 (0.8%)	0.1307 (1.6%)	0.0253 (1.8%)
		Reduction 25-yr projects	N/A	N/A	N/A	N/A	18.5 (1.1%)	0.1923 (2.4%)	0.0383 (2.7%)

WMA	Area (ac)	Scenario[3]	Runoff Volume (in)[1]		Peak Flow (cfs/ac)[1]		TSS (lb/ac/yr)[2]	TN (lb/ac/yr)[2]	TP (lb/ac/yr)[2]
			2-Year	10-Year	2-Year	10-Year			
Mainstem 2	2,069.4	Existing	1.157	2.867	0.251	0.621	2,329.4	6.8232	1.4503
		Future without projects	1.215	2.935	0.261	0.640	2,338.5	7.0804	1.4861
		Future 10-yr projects	1.215	2.935	0.258	0.640	2,223.2	6.9346	1.4396
		Future 25-yr projects	N/A	N/A	N/A	N/A	2,222.1	6.9220	1.4369
		Reduction 10-yr projects	0.000 (0%)	0.000 (0%)	0.003 (1%)	0.000 (0%)	115.3 (4.9%)	0.1458 (2.1%)	0.0465 (3.1%)
		Reduction 25-yr projects	N/A	N/A	N/A	N/A	116.4 (5.0%)	0.1584 (2.2%)	0.0492 (3.3%)
Mainstem 3	3,127.9	Existing	1.321	3.036	0.215	0.533	1,613.9	7.2637	1.3729
		Future without projects	1.360	3.084	0.219	0.550	1,620.0	7.4293	1.3956
		Future 10-yr projects	1.360	3.085	0.222	0.550	1,266.0	6.9986	1.2600
		Future 25-yr projects	N/A	N/A	N/A	N/A	1,246.4	6.7573	1.2101
		Reduction 10-yr projects	0.000 (0%)	-0.001 (0%)	-0.003 (-1%)	0.000 (0%)	354.0 (21.9%)	0.4307 (5.8%)	0.1356 (9.7%)
		Reduction 25-yr projects	N/A	N/A	N/A	N/A	373.6 (23.1%)	0.6720 (9.0%)	0.1855 (13.3%)
Mainstem 4	1,811.6	Existing	1.271	2.980	0.165	0.454	1,311.5	6.2792	1.1355
		Future without projects	1.272	2.981	0.172	0.471	1,314.6	6.3122	1.1404
		Future 10-yr projects	1.273	2.982	0.172	0.471	875.5	5.7437	0.9704
		Future 25-yr projects	N/A	N/A	N/A	N/A	863.0	5.6171	0.9470
		Reduction 10-yr projects	-0.001 (0%)	-0.001 (0%)	0.000 (0%)	0.000 (0%)	439.1 (33.4%)	0.5685 (9.0%)	0.1700 (14.9%)
		Reduction 25-yr projects	N/A	N/A	N/A	N/A	451.6 (34.4%)	0.6951 (11.0%)	0.1934 (17.0%)
Mainstem 5	2,444.7	Existing	1.285	2.968	0.151	0.419	1,119.7	6.7839	1.1870
		Future without projects	1.311	3.000	0.156	0.431	1,129.5	6.9422	1.2093
		Future 10-yr projects	1.312	3.003	0.156	0.431	956.7	6.7701	1.1498
		Future 25-yr projects	N/A	N/A	N/A	N/A	949.5	6.6827	1.1346
		Reduction 10-yr projects	-0.001 (0%)	-0.003 (0%)	0.000 (0%)	0.000 (0%)	172.8 (15.3%)	0.1721 (2.5%)	0.0595 (4.9%)
		Reduction 25-yr projects	N/A	N/A	N/A	N/A	180.0 (15.9%)	0.2595 (3.7%)	0.0747 (6.2%)
Mainstem 6	1,531.7	Existing	1.207	2.909	0.146	0.399	523.8	5.7462	0.9450
		Future without projects	1.273	2.994	0.149	0.412	538.9	6.0661	0.9976
		Future 10-yr projects	1.283	3.008	0.149	0.412	502.4	5.8895	0.9600
		Future 25-yr projects	N/A	N/A	N/A	N/A	499.3	5.8660	0.9551
		Reduction 10-yr projects	-0.010 (0%)	-0.014 (0%)	0.000 (0%)	0.000 (0%)	36.5 (6.8%)	0.1766 (2.9%)	0.0376 (3.8%)
		Reduction 25-yr projects	N/A	N/A	N/A	N/A	39.6 (7.3%)	0.2001 (3.3%)	0.0425 (4.3%)

WMA	Area (ac)	Scenario[3]	Runoff Volume (in)[1]		Peak Flow (cfs/ac)[1]		TSS (lb/ac/yr)[2]	TN (lb/ac/yr)[2]	TP (lb/ac/yr)[2]
			2-Year	10-Year	2-Year	10-Year			
Mainstem 7	2,391.3	Existing	1.480	3.252	0.134	0.368	511.0	6.5664	0.9739
		Future without projects	1.691	3.503	0.139	0.380	554.8	7.4372	1.1042
		Future 10-yr projects	1.681	3.489	0.139	0.379	531.3	7.2365	1.0708
		Future 25-yr projects	N/A	N/A	N/A	N/A	523.8	7.1778	1.0607
		Reduction 10-yr projects	0.010 (1%)	0.014 (0%)	0.000 (0%)	0.001 (0%)	23.5 (4.2%)	0.2007 (2.7%)	0.0334 (3.0%)
		Reduction 25-yr projects	N/A	N/A	N/A	N/A	31.0 (5.6%)	0.2594 (3.5%)	0.0435 (3.9%)
Mainstem 8	3,233.4	Existing	0.880	2.468	0.115	0.319	186.1	3.4934	0.5347
		Future without projects	0.894	2.484	0.119	0.329	191.5	3.5900	0.5495
		Future 10-yr projects	0.886	2.472	0.119	0.327	186.5	3.5349	0.5389
		Future 25-yr projects	N/A	N/A	N/A	N/A	185.6	3.5272	0.5375
		Reduction 10-yr projects	0.008 (1%)	0.012 (0%)	0.000 (0%)	0.002 (1%)	5.0 (2.6%)	0.0551 (1.5%)	0.0106 (1.9%)
		Reduction 25-yr projects	N/A	N/A	N/A	N/A	5.9 (3.1%)	0.0628 (1.7%)	0.0120 (2.2%)
Potomac[4]	479.3	Existing	Tidal	Tidal	Tidal	Tidal	101.3	1.6476	0.2595
		Future without projects	Tidal	Tidal	Tidal	Tidal	106.4	1.8268	0.2890
		Future 10-yr projects	Tidal	Tidal	Tidal	Tidal	106.4	1.8268	0.2890
		Future 25-yr projects	N/A	N/A	N/A	N/A	106.4	1.8268	0.2890
		Reduction 10-yr projects	Tidal	Tidal	Tidal	Tidal	0.0 (0.0%)	0.0000 (0.0%)	0.0000 (0.0%)
		Reduction 25-yr projects	N/A	N/A	N/A	N/A	0.0 (0.0%)	0.0000 (0.0%)	0.0000 (0.0%)

[1]Flow is cumulative
[2]Loads are representative of individual land area contributions
[3]25-year projects were not evaluated in the hydrologic model
[4]No projects were proposed in the Daniels Run or Potomac WMAs

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