

Total Maximum Daily Load Restoration Plan for Bacteria

2018 Annual TMDL Assessment Report

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With support from:

URS ESA JOINT VENTURE

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SECTION ONE INTRODUCTION

1.1 BACKGROUND

Anne Arundel County (the County) currently has 19 waterways with U.S. Environmental Protection Agency (EPA)-approved Total Maximum Daily Loads (TMDLs) associated with bacteria impairments. Fecal coliform is identified as the cause of impairment in the TMDLs for 15 of the 19 waterways. E. coli and Enterococci are identified as the impairments for two TMDLs each. The County is required by its National Pollutant Discharge Elimination System (NPDES) Municipal Separate Storm Sewer System (MS4) permit (11-DP-3316, MD0068306) to develop a TMDL Restoration Plan to address the Stormwater Waste Load Allocations (SW-WLAs) identified in the TMDL reports developed by the Maryland Department of the Environment (MDE). The Anne Arundel County Department of Public Works (DPW) Watershed Protection and Restoration Program (WPRP) developed a combined Draft Bacteria TMDL Restoration Plan to address the 19 bacteria TMDLs. The restoration plan was submitted to MDE on February 12, 2015. The County received comments from the MDE on May 19, 2015, and comments were addressed in the February 2016 submittal. The revised Bacteria TMDL Restoration Plan was made available for public review and comments for 30 days from June 15 to July 14, 2016.

1.2 OVERVIEW OF PROGRESS REPORT

The County implemented multiple restoration strategies within the first year of submitting the Draft Bacteria TMDL Restoration Plan in February, 2015. Several additional restoration strategies are currently in the planning stages and are included as part of the Capital Improvement Program (CIP) projects. These include restoration strategies that address human sources of bacteria (Tier A) as well restoration strategies that address non-human sources of bacteria (Tier B).

This report documents the progress made during fiscal year (FY) 18, July 1, 2017 – June 30, 2018, by the County towards achieving the bacteria TMDL goals after one year of the development of the TMDL Restoration Plan. This report was prepared in consultation with several County departments, including the Department of Health and the DPW's WPRP and Technical Engineering divisions within the Bureau of Engineering, using existing County data and other reports.

1.3 TIER A STRATEGIES

Tier A strategies are those that address potential human sources of bacteria, such as septic system effluent from poorly maintained septic systems, sanitary sewage overflows, and illicit connections that discharge household human wastewater into the MS4. The progress in implementing Tier A strategies during the past year is described below.

1.3.1 Elimination of Household Illicit Connections

Restoration Plan Goal

Under the household illicit connection program, the Restoration Plan states that approximately 150 outfalls are evaluated each year, resulting in detection and elimination of 2 percent of the outfalls that have illicit connections.

Progress

The County currently conducts field screening of outfalls to identify illicit connections from residences and businesses. This process of illicit discharge detection and elimination (IDDE) is required to meet the County’s NPDES MS4 permit requirement. As a part of this program, approximately 150 outfalls are sampled every year, and all identified illicit connections are investigated and eliminated immediately.

During the 2018 reporting period, the County conducted targeted outfall sampling in areas near I-97 just south of I-695, near the intersection of Route 100 with I-97, along Route 3 south of Route 32, and south of U.S. Route 50. which are located within the Furnace Creek, Marley Creek, South River Mainstem, and Upper Patuxent River watersheds. In 2018, the County evaluated 151 outfalls and confirmed that 6 outfalls had illicit connections. At the time of this progress assessment, final results of the 2018 evaluations are pending. From 2005 to 2018, 51 illicit connections were detected out of 2,105 outfalls surveyed, as documented in the County’s Annual NPDES MS4 reports. Based on this, the Countywide illicit discharge detection and elimination (IDDE) program has resulted in the elimination of illicit dischargers at a rate of 2.42 percent, up from 2 percent as identified in the plan and up from the FY 2017 rate of 2.29 percent. Table 1 shows IDDE rate and associated estimation of bacteria load reductions for each bacterial TMDL watershed.

Table 1. IDDE Rate per TMDL Watershed and Estimated Bacteria Load Reductions.

TMDL Watershed	IDDE Rate (%)	Bacteria Load Reduction (%)
Magothy River/Mainstem	0.184	10.62
Magothy River/Forked Creek	0.011	1.37
Magothy River/Tar Cove	0.019	0.80
Patapsco River Lower North Branch	0.249	13.69
Patapsco River/Furnace Creek	0.182	10.11
Patapsco River/Marley Creek	0.149	13.08
Patuxent River Upper	0.037	1.36
Rhode River/Bear Neck Creek	0.009	0.64
Rhode River/Cadle Creek	0.004	0.31
Severn River Mainstem	0.441	22.10
Severn River/Mill Creek	0.028	1.86
Severn River/Whitehall and Meredith Creek	0.021	1.15
South River/Duvall Creek	0.009	0.79

TMDL Watershed	IDDE Rate (%)	Bacteria Load Reduction (%)
South River Mainstem	0.242	13.30
South River/Ramsey Lake	0.005	0.14
South River/Selby Bay	0.004	0.19
W. Chesapeake Bay/Tracy and Rockhold Creeks	0.023	0.30
West River Mainstem	0.023	1.68
West River/Parish Creek	0.003	0.23

1.3.2 Abatement of Sanitary Sewer Overflows

Restoration Plan Goal

Abatement of sanitary sewer overflows through wastewater projects that are designed to improve the reliability of the sanitary system. Table 4-2 in the Restoration Plan listed the active sewage pump stations upgrade projects.

Progress

The status of specific wastewater projects that are considered sewage pumping station (SPS) upgrades or otherwise designed to improve the reliability of the sanitary system was provided by the Technical Engineering Division (G. Heiner, pers. Communication September 25, 2018) and are listed in Table 2. In addition to including the updated status and budget of the SPS projects listed in Table 4-2 of the Restoration Plan, Table 2 also includes new sanitary system improvement projects as identified by DPW. As shown in Table 2, the following projects were completed in FY18: Jennifer Road SPS Upgrade and Rolling Knolls Elementary School Sewer Extension. The number of SPS projects in each TMDL watershed included in the Center for Watershed Protection's (CWP) Watershed Treatment Model (WTM; Caraco 2013) and the estimated percent bacteria load reductions are provided in **Error! Reference source not found.**

In FY18, there were 24 sanitary sewer overflows (SSOs) reported in the County's Bacteria TMDL watersheds, up from eight (8) in FY17 (Figure 1). The net volume of spilled material in Bacteria TMDL watersheds in FY18 was 61,030 gallons, up from 3,770 gallons in FY17 (Figure 2). Locations and quantities of SSOs within bacteria TMDL watersheds are shown in Figure 3. Despite this increase, the net volume spilled in FY18 was the fourth lowest amount in the 17 years of available data. Sewage blockages due to roots, rags, grease, and debris resulted in spills totaling 44,800 gallons. Contractor damage contributed to 10,100 gallons spilled.

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Table 2. List of Discrete Sewage Pumping Station Upgrade Projects Active or Completed in FY 2018 in Bacteria TMDL Watersheds.

Project	Project Title	Current Status	Description	TMDL Watershed	Qty. of Pump Stations Being Upgraded	Total Budgeted Costs ³	Expended and/or Encumbered as of 9/2/2018
S797800	Furnace Barn Sewer Replacement ²	Active	Construct a new sewer line under Sawmill Creek	Patapsco River / Furnace Creek	0	\$154,000	\$59,508
S799200	Mayo Collection Sys Upgrade ²	Active	Expansion of Mayo Wastewater Collection and Conveyance System to accommodate planned growth within Mayo Sewer service area	Rhode River/Cadle Creek	18	\$11,722,829	\$5,553,662
S804300	Jennifer Road SPS Upgrade ²	Complete	Upgrades to Jennifer Rd sewage pump station; pump station force main replacement	Severn River Mainstem	1	\$9,360,000	\$8,721,212
S805402	Marley SPS Improvements ²	Active	Construction & inspection of improvements to the wet well at the Marley SPS.	Patapsco River/Marley Creek	1	\$48,551	\$34,792
S806207	SPS Fac Gen Replace	Active	Generator replacement/CMI services at all sites	Multiple	multiple	\$1,672,009 ⁴	\$549,882
S806200	SPS Fac Gen Replacement ²	Active	Generator Replacement (Phase 4 contract)	South River Mainstem, Forked Creek, Mill Creek	5	\$2,380,172 ⁴	\$2,372,643
S806200	SPS Fac Gen Replacement ²	Active	Generator replacement (Phase 5 contract)	Magothy River Mainstem, Duvall Creek	5 ⁵	\$1,050,090 ⁴	\$1,050,090
S806200	SPS Fac Gen Replacement ²	Active	Generator replacement (Design 1 and Phase 6 contracts)	Patapsco River LNB*	2 ⁶	\$5,554,894 ⁴	\$4,565,205

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S806200	SPS Fac Gen Replace	Active	Generator replacement (Design 2 and Phase 7 contracts)	West River Mainstem	5	\$4,275,350 ⁴	\$2,893,446
S806200	SPS Fac Gen Replacement	Active	Generator Replacement (Phase 8 contract)	Severn Mainstem	7	\$613,222 ⁴	\$60,525
S806200	SPS Fac Gen Replacement	Active	Generator Replacement and Installation (Phase 9 contract)	Severn River Mainstem	5	\$1,995,226 ⁴	\$36,748
S806200	SPS Fac Gen Replacement	Active	Generator Replacement and Installation (Phase 10 contract)	Severn Mainstem, Parish Creek, Tracy/Rockhold Creeks	4	\$1,661,214 ⁴	\$787,740
S806200	SPS Fac Gen Replacement	Active	Generator Replacement and Installation (Phase 11 contract)	Magothy River Mainstem, Severn River Mainstem	3	\$1,830,354 ⁴	\$454,596
S806200	SPS Fac Gen Replacement	Active	Generator Replacement and Installation (Phase 12 contract)	Severn River Mainstem, Marley/Furnace Creeks	5	\$12,707 ⁴	\$12,707
S806200	SPS Fac Gen Replacement	Active	Generator Replacement and Installation (Phase 13 contract)	Severn River Mainstem, Marley/Furnace Creeks	6	\$1,411,400 ⁴	\$166,843
S806200	SPS Fac Gen Replacement	Active	Generator Evaluation, Replacement, Installation (Phase 14 contract)	Marley/Furnace Creeks, Bear Neck Creek	3	\$505.79 ⁴	\$505.79
S806200	SPS Fac Gen Replacement	Active	Installation of Elec. Feeders for Backup Power (Phase 15 contract)	Severn River Mainstem	5	\$1,000,446 ⁴	\$765,576

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S806700	Cinder Cove FM Rehab ²	Active	Construction of 10,000 linear feet of 30" force main	Patapsco River / Furnace Creek	0	\$12,499,000	\$8,907,967
S806900	Rolling Knolls ES Sewer Extension ²	Complete	Design and construction of sanitary sewer extension to accommodate new elementary school	South River Mainstem/Severn River Mainstem	0	\$3,134,700	\$3,040,723
S808100	CATTAIL CREEK FM REPLACEMENT ¹	Active	Construction of the replacement of 17,000 lf of 24" and greater force main (FM) beginning at the Cattail Creek SPS and ending at a gravity manhole in College Parkway. This project will replace aging, at-risk infrastructure to increase the reliability of the conveyance system and reduce risks for spills resulting from infrastructure failures	Magothy River Mainstem	0	\$17,121,000	\$112
X7388000	Sewer Main Replace/Recon ²	Active	Maintenance and replacement of sewer main lines countywide	Countywide	0	\$105,818,246	\$48,853,604
				Total	—	\$394,429,720	\$88,888,087

¹ Indicates new project.

² Data have been updated since being listed in Table 1 of the Total Maximum Daily Load Restoration Plan for Bacteria 2016 Annual Report (January 2017).

³ Total Budgeted Cost derived from FY2016 Anne Arundel County Approved Capital Budget and Program and includes current and prior appropriation and approved program totals through FY 24

⁴ Total Budgeted Cost for this project includes completed and active SPS upgrades countywide; however, the total budget is not broken down at the level of individual projects. Some individual projects may be outside of bacteria TMDL watersheds. Therefore, only the total project cost is listed.

⁵ In previous years, it was erroneously reported that this project included 6 pump stations in TMDL watersheds. New information has resulted in the exclusion of one pump station that was previously reported.

⁶ In previous years, it was erroneously reported that this project included 8 pump stations in TMDL watersheds. New information has resulted in the exclusion of six pump stations that were previously reported.

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Table 3. SPS Upgrade Projects in TMDL Watersheds.

TMDL Watershed ID	Number of SPS Upgrades	Bacteria Load Reductions (%)
Magothy River Mainstem	11	1.84
Magothy River/Forked	1	6.20
Magothy River/Tar Cove	N/A	N/A
Patapsco River Lower North Branch	2	2.56
Patapsco River/Furnace Creek	4	2.30
Patapsco River/Marley Creek	5	2.95
Patuxent River Upper	N/A	N/A
Rhode River/Bear Neck Creek	2	4.61
Rhode River/Cadle Creek	18	17.04
Severn River Mainstem	30	1.13
Severn River/Mill Creek	0	0
Severn River/Whitehall and Meredith Creek	0	0
South River/Duvall Creek	1	6.40
South River Mainstem	9	0.40
South River/Ramsey Lake	0	0
South River/Selby Bay	0	0
W. Chesapeake Bay/Tracy and Rockhold Creeks	5	0.22
West River Mainstem	5	2.00
West River/Parish Creek	1	12.90

N/A – SPS upgrade projects are not applicable as these are rural watersheds

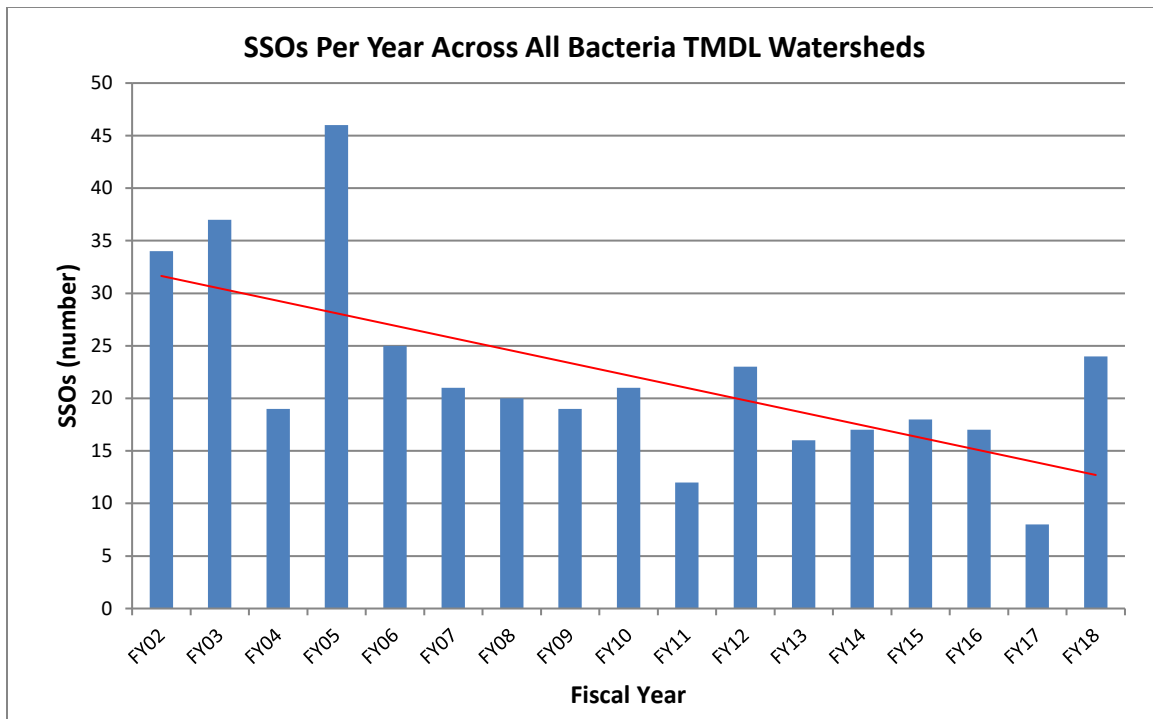


Figure 1. Number of SSOs per year across all Bacteria TMDL watersheds, FY02 – FY18.

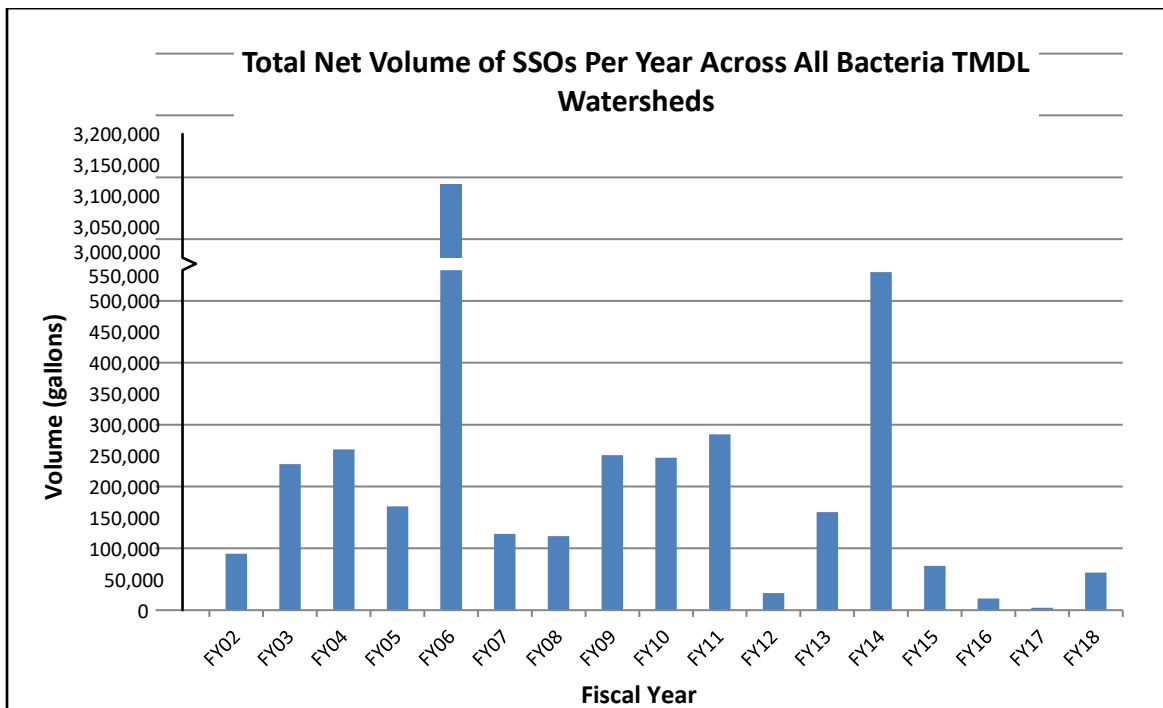


Figure 2. Total Volume (gallons) of SSOs per year across all Bacteria TMDL watersheds, FY02 – FY18.

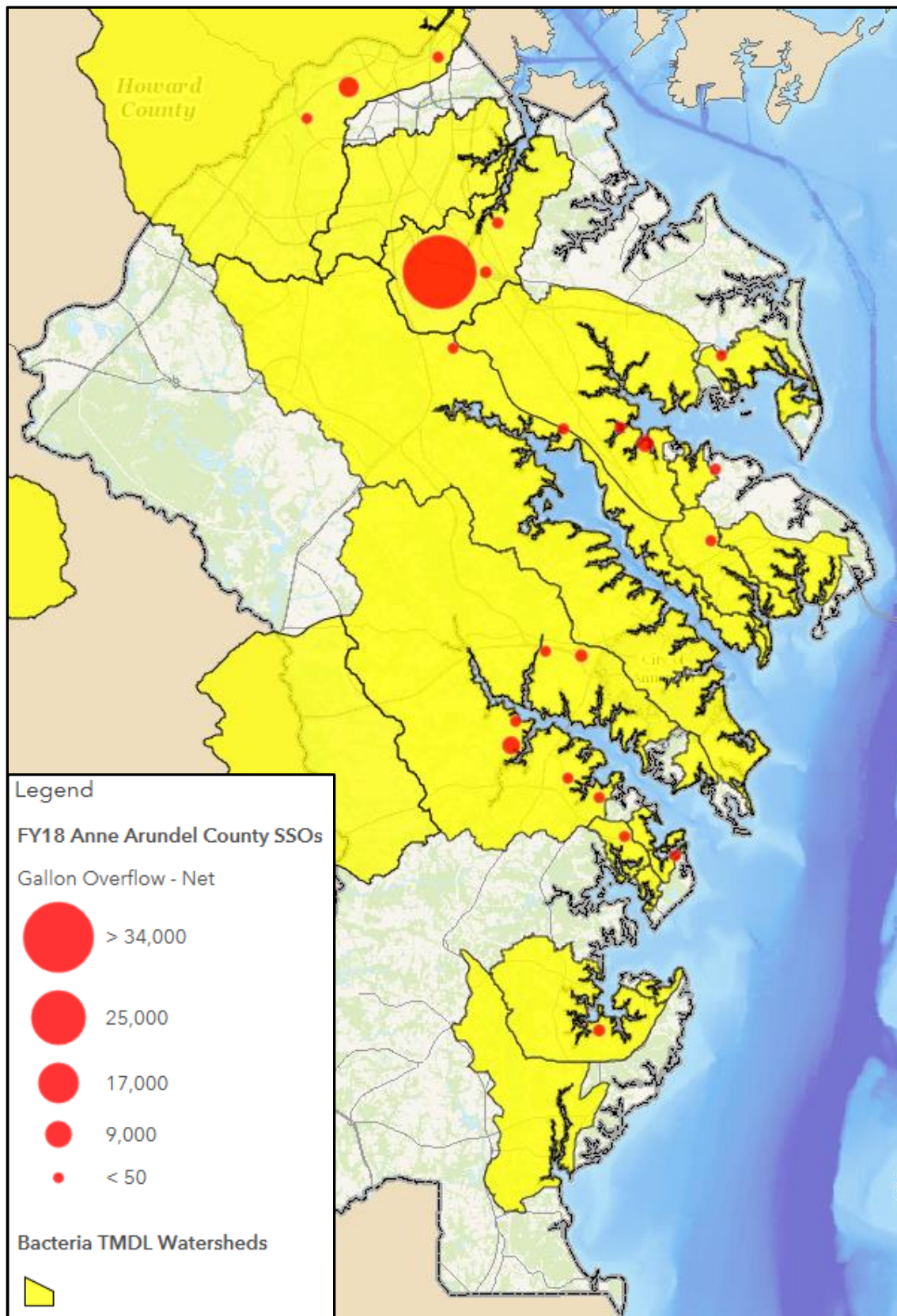


Figure 3. Locations and quantities of SSOs within bacteria TMDL watersheds, FY18.

1.3.3 Retirement of County Septic Systems

Restoration Plan Goal

The Restoration Plan presents the retirement of septic systems at a rate of 20-40 systems per year.

Progress

Septic systems that are “retired” are connected to the County’s sanitary sewer system that has the capacity to handle the increased load. Within TMDL watersheds, The County retired 8 On-Site Disposal Systems (OSDS) in FY 2018, 20 in FY 2017, nine (9) OSDS in FY 2016, 21 OSDS in FY 2015, and 35 OSDS in FY 2014. From FY 2014 to FY 2018, the County has averaged 19 retired OSDS per year within TMDL watersheds. An additional 2 OSDS were retired in non-TMDL watersheds in FY 2018. Table 4 shows the projected number of OSDSs to be retired by 2025 in each bacteria TMDL watershed along with estimated bacteria load reductions.

Table 4. Projected Number of OSDS to Be Retired by 2025 in Each TMDL Watershed and Estimated Bacteria Load Reductions.

TMDL Watershed ID	Number of Septic Systems That Would Be Retired by 2025	Bacteria Load Reductions (%)
Magothy River Mainstem	88	0.26
Magothy River/Forked	2	0.11
Magothy River/Tar Cove	31	0.46
Patapsco River Lower North Branch	3	0.10
Patapsco River/Furnace Creek	5	0.07
Patapsco River/Marley Creek	0	0
Patuxent River Upper	5	0.38
Rhode River/Bear Neck Creek	0	0
Rhode River/Cadle Creek	0	0
Severn River Mainstem	100	0.20
Severn River/Mill Creek	21	0.63
Severn River/Whitehall and Meredith Creek	6	0.42
South River/Duvall Creek	0	0
South River Mainstem	31	0.29
South River/Ramsey Lake	0	0
South River/Selby Bay	0	0
W. Chesapeake Bay/Tracy and Rockhold Creeks	0	0
West River Mainstem	0	0
West River/Parish Creek	0	0

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The cost - \$35,000 to \$40,000 per connection – along with homeowner participation are identified as the primary constraints for retiring OSDSs and connecting to the public sanitary sewer system. Though not identified as a goal in the Restoration Plan, the County has also undertaken an initiative to reduce the number of onsite disposal systems. The Bureau of Engineering large and small Capital Improvement Programs (CIPs) initiated development of conceptual layouts to connect approximately 20,000 OSDS identified in the County, 16,000 of which are located in the bacteria impaired watersheds. According to the Department of Health, approximately 5,000 of these connections are located within Health Department Problem Areas (HDPAs) – areas with poor soils, steep slopes, high groundwater tables, and well set-backs. Being located within a bacteria impaired watershed is also one of the factors used to prioritize HDPAs.

In September 2017, the County ranked and prioritized 20 HDPAs for connection to the municipal sanitary sewer system (Anne Arundel County, 2017). 10 of the 20 prioritized HDPAs are located in watersheds with bacteria-associated TMDLs, with six (6) being designated as “high priority” (Table 5). The total number of individual connections in HDPAs within watersheds with bacteria-associated TMDLs is 5,930. Two of the HDPAs (Huntsmore and Laurel Acres) will require the construction of regional sewage pumping stations for connection to the sanitary sewer system. Six (6) of the HDPAs (Edgewater Beach North, Laurel Acres, Edgewater Beach South, Palisades on the Severn, Chelsea Beach, and Amberly) are located within the floodplain.

Table 5. Health Department Priority Areas (HDPAs) in with bacteria TMDLs watersheds

HDPA	TMDL Watershed	Priority	Number of Connections
Clearview Village	Magothy Mainstem	High	364
Huntsmore, Pasadena	Magothy Mainstem	High	993
Gingerville Manor	South River Mainstem	High	263
Edgewater Beach (North)	South River Mainstem	High	259
Laurel Acres	Magothy Mainstem	High	183
Edgewater Beach (South)	South River Mainstem	High	305
Palisades on the Severn/Herald Harbor	Severn Mainstem	Medium	1,730
Chelsea Beach	Magothy Mainstem	Medium	1,236
Amberly	Whitehall & Meredith Creeks	Low	188
Long Point on the Magothy	Tar Cove	Low	409

In February 2017, a Septic Task Force was created, consisting of staff from relevant County departments as well as representatives from the local business and environmental communities. The Septic Task Force's stated goals included developing recommendations that will inform decision making, and identifying short term strategies and long term approaches to reducing septic system loads. Key questions discussed by the group include where and how residents could connect to public sewer systems, how will septic conversion projects be financed, and what policies are required to develop a successful conversion program. The task force met once monthly from February to July in 2017, with a close-out meeting held in March 2018. A Final Report was produced in June 2018. Anne Arundel County's Department of Public Works is currently working on procuring an OSDS Conversion Program Manager to assist in implementing the OSDS conversion or retirement program. Targeted approaches such as community-based and/or watershed-based approaches are being considered for implementation. Successful implementation of this program would reduce bacteria loads from OSDS.

In 2017, the County also applied for and received a grant to evaluate the feasibility of County take-over of select private minor wastewater treatment facilities to either convey to existing County facilities or to construct new advanced treatment package plants utilizing the same discharge location. Five feasible projects were identified, two of which are located in watersheds with bacteria-related TMDLs (South River Mainstem and Patapsco River Lower North Branch). The study, which assessed cost-benefit aspects and policy outcome impacts of the individual projects, was completed in March 2018. More detailed investigations of the potential projects are planned for the future.

1.4 TIER B STRATEGIES

Tier B strategies are those that address non-human sources of bacteria, such as pet waste, wildlife waste, and livestock waste. The progress of implementation of Tier B strategies is described below.

1.4.1 Implementing New Stormwater Management Projects and Retrofitting Pre-2002 Stormwater Management Facilities to Meet Current MDE Criteria

Restoration Plan Goal

The County is underway with the restoration of 20 percent of currently unmanaged impervious areas through implementing new stormwater management projects and retrofitting existing stormwater management facilities to meet current MDE requirements

Progress

Fifty-two (52) projects are identified to be completed from 2017 to 2018 within the watersheds with bacteria impairment. Projects included Step Pool Storm Conveyance (SPSC), stream restoration, wet ponds, and retention ponds. Furthermore, the County refined data for the impervious area to be treated on previously retrofitted stormwater management facilities. New projects, project status, and updated data are shown in Appendix A. This information was

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entered into the proposed conditions in the WTM to estimate the bacteria load reductions that would be attained from implementing this strategy. In addition to including the updated drainage area and treated impervious area of the stormwater management projects listed in Table 4-5 of the Restoration Plan, Appendix A also includes new stormwater management projects planned by the County in the bacteria impaired watersheds. Table 6 shows a breakdown of proposed urban stormwater projects by bacteria TMDL watershed.

Table 6. Proposed Urban Stormwater Projects in TMDL Watersheds

TMDL Watershed ID	Number of Urban Retrofit Projects Proposed	Drainage Area Proposed to Be Treated (acres)	Impervious Area Proposed to Be Treated (acres)	Bacteria Load Reductions (%)
Magothy River Mainstem	38	666.9	209.0	1.41
Magothy River/Forked	2	83.9	10.0	8.85
Magothy River/Tar Cove	0	0	0	0
Patapsco River Lower North Branch	29	838.6	425.6	4.54
Patapsco River/Furnace Creek	15	141.8	59.1	1.01
Patapsco River/Marley Creek	10	187.1	65.4	1.23
Patuxent River Upper	0	0	0	0
Rhode River/Bear Neck Creek	5	18.9	5.3	0.63
Rhode River/Cadle Creek	0	0	0	0
Severn River Mainstem	25	758.5	166.3	0.84
Severn River/Mill Creek	3	24.5	4.9	(0.05)
Severn River/Whitehall and Meredith Creek	2	50.6	9.5	1.13
South River/Duvall Creek	3	12.7	3.8	2.35
South River Mainstem	26	374	144.0	1.15
South River/Ramsey Lake	0	0	0	0
South River/Selby Bay	0	0	0	0
W. Chesapeake Bay/Tracy and Rockhold Creeks	0	0	0	0
West River Mainstem	1	1.4	0.9	0.08
West River/Parish Creek	0	0	0	0

During FY 2018, the County explored the use of curb inlet filtration units housing anti-microbial media as a method to reduce bacteria loads entering the stormdrain system. After consulting with a representative from the manufacturer, the County learned that the efficiency of the anti-microbial media was greatly reduced if used in a curb-inlet setting, and that the County lacked the infrastructure for which the anti-microbial media was designed for use for optimal bacteria reduction.

1.4.2 Riparian Buffer Education

Restoration Plan Goal

The Restoration Plan recommends that a riparian buffer education program be implemented in areas where the buffer is reduced, altered, or where private property abuts the waterway.

Progress

Anne Arundel County and the Maryland Department of Natural Resources (DNR) continue to provide support to the Anne Arundel County Watershed Stewards Academy (WSA). WSA trains and certifies Master Watershed Stewards to engage in educational outreach and implement water quality improvement projects throughout their community. One such program WSA manages is the Backyard Buffers program which, according to the WSA website, planted 2,358 tree seedlings in Anne Arundel County in 2018.

1.4.3 Expanded Pet Waste Education Program

Restoration Plan Goal

The Restoration Plan recommends pet waste education programs such as increasing pet waste stations, increasing signage, developing public service announcements, improving management of pet waste at public parks and providing grants to communities to install pet waste stations.

Progress

The County is collaborating with the University of Maryland, as part of the Partnership for Action Learning in Sustainability program, on a prototype for implementing pet waste education. In addition, as with Riparian Buffer Education, Master Watershed Stewards trained through the WSA are given the knowledge and resources needed to teach their communities about the importance of cleaning up pet waste and provide pet waste stations where needed. Prompted by a citizen complaint, the County continued its outreach efforts with an informational flyer mailed to residents of targeted neighborhoods in the northern part of the county.

In early 2017, the County partnered with the Chesapeake Bay Program's Citizen Stewardship Team in developing a citizen stewardship survey, which included questions regarding pet waste disposal; the survey was distributed to 600 random households in the County. Survey data was received by the County in October 2017 and is currently being used to determine the extent of proper pet waste disposal County-wide. Information from the 2017 survey has also been used to inform a pilot outreach campaign in neighborhoods within the Rhode River/Cadle Creek and Magothy Mainstem watersheds, which is scheduled to launch in early 2019. The project will involve yard signage for community members who "pledge" to keep their yards free of pet waste. The pilot project will explore and evaluate different outreach strategies and may also include quantitative monitoring of pet waste in neighborhood common areas.

The County will also be distributing a short survey to neighborhood and homeowners associations in Spring 2019 in an effort to obtain information regarding which neighborhoods have pet waste stations, how many they have, and who maintains them. The survey will also be used to gauge communities' interest in obtaining pet waste stations. The WPRP has purchased

three pet waste stations which it will make available to communities that express interest. While pet waste stations are installed in all County parks that have specific dog park areas, there are several local County parks that do not have pet waste stations installed. More research on new potential pet waste station installations will continue into 2019.

1.4.4 Live Stock Fencing (Two TMDL Watersheds Only)

Restoration Plan Goal

The Restoration Plan recommends installation of livestock fencing along streams in pasture areas in Patuxent River Upper and West River Mainstem watersheds.

Two Year Progress

Livestock fencing was identified as a low priority restoration strategy as it has limited applicability in only two of the watersheds. No additional exclusion fencing was installed in Anne Arundel County in FY 2018 (J. Czajkowski, pers. Communication October 10, 2018). A total of 54,520 linear feet of livestock exclusion fencing has been installed in the West River and Patuxent River watersheds combined since 2002.

1.4.5 Canada Goose Management (Site-Specific)

Restoration Plan Goal

The Restoration Plan recommends adoption of various techniques for the management of Canada goose population including implementation of exclusion methods, habitat alteration and bird dispersal method.

Progress

Although this strategy was given a low priority at the time of the previous annual update, the County has begun to research methods of goose management and possible locations where management would be applicable. The County has also begun discussions with the Maryland Aviation Administration to begin evaluating nuisance bird presence at County-owned stormwater facilities within four miles of BWI Airport.

1.4.6 Additional Outreach Opportunities

Restoration Plan Goal

The Restoration Plan recommends additional outreach programs for homeless population, stray animals and expanded outreach programs for marinas.

Progress

Outreach programs for homeless population and stray animals are currently identified as low priority strategies for the County to meet the bacteria TMDL goals; however the County continued to perform outreach via social media targeting boaters as a follow-up to informational brochures covering proper boat sewage disposal practices and pumpout locations produced during the last reporting period.

The Maryland Clean Marinas program recognizes marinas that meet standards of pollution prevention established by Maryland Department of Natural Resources and the Maryland Clean Marina Committee, including standards of sewage handling, waste containment and disposal, and stormwater management. Certified Clean Marinas are re-inspected every three years to ensure continued compliance. With the addition of two certifications in FY 2018, 50 of the estimated 165 marinas in Anne Arundel County are now certified Clean Marinas (Maryland DNR, 2017).

1.5 POLLUTANT LOAD REDUCTIONS

Bacteria load reductions that would be achieved from the implementation of the proposed restoration strategies were quantified using the Center for Watershed Protection's spreadsheet based Watershed Treatment Model and existing literature review.

All Tier A strategies and two Tier B strategies (Implementing New Stormwater Management Projects and Retrofitting Pre-2002 Stormwater Management Facilities to Meet Current MDE Criteria, Riparian Buffer Education Program) were modeled using CWP's Watershed Treatment Model to estimate the potential bacteria load reductions from them.

Potential bacteria load reductions from remaining Tier B strategies (Expanded Pet Waste Education Program, Canada Goose Management and Livestock Fencing) were estimated using existing literature review.

Based on the FY 2018 County information, the following restoration strategies were modeled using CWP's Watershed Treatment Model to update the bacteria load reductions. Data sources for the FY 2018 model include:

- Restoration of 20 percent of the untreated impervious area through urban stormwater management retrofits based on 2018 updated County data
- Elimination of household connections based on 2,105 sampled outfalls under the Illicit Discharge Detection and Elimination program from 2005 to 2018.
- Abatement of sanitary sewer overflows (SSOs) for Magothy River Mainstem and Severn River Mainstem based on the new sewage pump station projects identified by the Department of Public Works
- Retirement of OSDs and subsequent connection to the County's sanitary sewer system.

Table 7 provides a comparison of estimated bacteria load reductions quantified for the four above mentioned strategies in each bacteria TMDL watershed as modelled between reporting years 2017 and 2018. Implementation of urban stormwater management retrofits slightly reduced the percent bacteria load reductions in Severn River/Mill Creek and West River

Mainstem watersheds because the impervious cover treated, designed rainfall treatment depth for the stormwater projects was updated in the FY2018 dataset compared to data from the previous reporting period. Additionally, in the Severn River/Mill Creek watershed, the decrease in percent bacteria load reductions can be attributed to the fact that the proposed stormwater projects include converting infiltration basins with high bacteria removal efficiencies to wet ponds with lower bacteria removal efficiencies. No stormwater management projects were proposed in Magothy River/Tar Cove, Patuxent River Upper, Rhode River/Cadle Creek, South River/Ramsey Lake, South River/Selby Bay, W. Chesapeake Bay/Tracy and Rockhold Creeks, and West River/Parish watersheds. The percent bacteria load reductions increased for all the remaining watersheds because of updated impervious cover treated and designed rainfall treatment depth and addition of new stormwater projects in FY 2018.

The increase in the IDDE rate resulted in a slight increase in percent bacteria load reductions across all watersheds. The Patapsco River/Furnace Creek watershed showed the greatest change with a 0.76 percent increase bacteria load reductions. The South River/Ramsey Lake, South River/Selby Bay, and West River/Parish Creek watersheds showed minimal change with a 0.01 percent increase in bacteria load reductions.

The Patapsco River Lower North Branch and Patapsco River/Furnace Branch watersheds showed a slight reduction in the percentage of bacteria load reductions compared to the FY2017 modeling results because the number of pump stations being upgraded in these watersheds was revised in the FY 2018 data. In all other watersheds, percent bacteria load reductions either increased or did not change when compared to the FY 2017 modeling results.

There were no changes or updates to the data related to the retirement of County septic systems; therefore, the percent bacteria load reductions from this Tier A strategy is unchanged. Monitoring in the pet waste outreach focus areas would be needed to evaluate the progress and quantify the bacteria load reductions from of this strategy. The County has not initiated the low priority strategies of Canada Goose Management and Livestock Fencing, therefore the progress from these strategies are not quantified as well.

Overall, an increase in percent bacteria load reductions was observed in all watersheds compared to the previous reporting period except for the Severn River/Mill Creek and Patapsco River/Furnace Creek watersheds. The overall percent bacteria load reductions reduced by 0.19 in Patapsco River/Furnace Creek watershed and 0.06 in Severn River/Mill Creek watershed.

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Table 7. Estimated Load Reductions for Proposed Strategies in Bacteria TMDL Watershed

Watershed	Restoration of 20% Untreated Impervious Area through Urban Stormwater Management Retrofits (%)		Eliminate Illicit Household Connections (%)		Abatement of SSOs (%)		Retirement of OSDS (%)		Total Cumulative Reduction (%)	
	FY2017	FY2018	FY2017	FY2018	FY2017	FY2018	FY2017	FY2018	FY2015-FY2017	FY2015-FY2018
Magothy River Mainstem	1.01	1.41	10.21	10.62	1.37	1.84	0.26	0.26	12.85	14.13
Magothy River/Forked Creek	0	8.85	1.29	1.37	0	6.20	0.11	0.11	1.40	16.53
Magothy River/Tar Cove	0	0	0.77	.80	N/A	N/A	0.46	0.46	1.23	1.26
Patapsco River Lower North Branch	1.10	4.45	13.22	13.69	4.96	2.56	0.10	0.10	19.38	20.89
Patapsco River/Furnace Creek	0.46	1.01	9.35	10.11	3.80	2.30	0.07	0.07	13.68	13.49
Patapsco River/Marley Creek	0.75	1.23	12.61	13.08	2.10	2.95	0	0	15.46	17.26
Patuxent River Upper	0	0	1.30	1.36	N/A	N/A	0.38	0.38	1.68	1.74
Rhode River/Bear Neck Creek	0	0.63	0.61	0.64	0	4.61	0	0	0.61	5.88
Rhode River/Cadle Creek	0	0	0.29	0.31	8.50	17.04	0	0	8.79	17.35
Severn River Mainstem	0.73	0.84	21.54	22.10	0.45	1.13	0.20	0.20	22.92	24.27
Severn River/Mill Creek	0.10	(0.05)	1.77	1.86	0	0	0.63	0.63	2.50	2.44

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Severn River/Whitehall and Meredith Creek	0.60	1.13	1.10	1.15	0	0	0.42	0.42	2.12	2.70
South River Mainstem	0.80	1.15	12.90	13.30	6.40	6.40	0	0	8.84	9.54
South River/Duvall Creek	1.69	2.35	0.75	0.79	0.31	0.40	0.29	0.29	14.30	15.14
South River/Ramsey Lake	0	0	0.13	0.14	0	0	0	0	0.13	0.14
South River/Selby Bay	0	0	0.18	0.19	0	0	0	0	0.18	0.19
W. Chesapeake Bay/Tracy and Rockhold Creeks	0	0	0.28	0.30	0	0.22	0	0	0.28	0.52
West River Mainstem	0.11	0.08	1.59	1.68	0	2.00	0	0	1.70	3.76
West River/Parish Creek	0	0	0.22	0.23	12.90	12.90	0	0	13.12	13.13

SECTION TWO MONITORING

As noted in the Restoration Plan, there are five different monitoring programs operating in the County including the County’s ongoing NPDES MS4 Assessment of Controls monitoring of the Parole Plaza outfall and Church Creek; MDE’s shellfish harvesting area monitoring; the County Department of Health’s bacteria monitoring of public bathing beaches; the community-sponsored Operation Clearwater, which is (as of summer 2018) monitoring water quality at select locations along the Magothy River, Rock Creek and Severn River; and the County’s Stream Restoration Project Monitoring, all of which monitor bacteria concentration.

2.1 ASSESSMENT OF CONTROLS MONITORING

In compliance with County NPDES MS4 permit requirements, the County samples stormwater runoff in the Church Creek watershed. A variety of parameters are measured, including bacteria (*E. coli*). Church Creek is located in Annapolis, MD within the South River Mainstem subwatershed, which is listed as impaired for Fecal Coliform. Church Creek MS4 stormwater sampling is conducted by private consultant at two different monitoring stations – the upstream Parole Plaza station and the downstream Church Creek station. During summer 2015, significant discrepancies were observed in *E.coli* counts between samples taken at the upstream Parole Plaza monitoring station and the downstream Church Creek monitoring station on the same date throughout the hydrograph. Upon County review of these data and in response to these discrepancies, the County began conducting synoptic bacteria sampling at the two MS4 monitoring stations as well as four other locations along Church Creek. Limited data collection

occurred in 2016, and in 2017 a more robust growing season synoptic sampling program was developed. The County continued synoptic sampling at Church Creek during summer 2018. Synoptic studies allow for detailed investigations of the geographic distribution of particular water quality characteristics at a given time, as all samples are synchronized to be taken at the same time. The intent of this work is to determine what, if any, unidentified source of bacteria is contributing to the disparity in results observed between these two stations.

2.2 SHELLFISH HARVESTING MONITORING STATIONS

MDE uses the monitoring data from the shellfish harvesting area monitoring stations to prepare the Integrated Report for Surface Water Quality which includes a surface water quality assessment of the State waters, and for the development of TMDLs. In order to demonstrate support of the shellfish harvesting designated use, the measured level of fecal coliform in water (expressed as MPN/100 ml) must have a median of less than the MDE criterion level of 14 and a 90th percentile of less than 49, calculated from a minimum of 30 samples taken over a three year period.

Annual (fiscal year) median bacteria concentrations based on historical monitoring data for 41 monitoring stations in 15 available TMDL watersheds (as presented in Appendix C of the Restoration Plan) can be found in Appendix B of this Annual Assessment. A comparison of MDE's monitoring data for FY17 and FY18 is provided in Table 8.

Annual median bacteria concentrations for FY18 were below the MDE criterion level at 38 monitoring stations and above the MDE criterion level at 3 stations. Median bacteria concentrations decreased at 25 stations from FY17 to FY18 and increased at 6 stations from FY17 to FY18; median bacteria concentrations remained the same at 10 stations. 90th percentile bacteria concentrations in FY18 were at or below the MDE criterion level at 20 monitoring stations and above the MDE criterion level at 21 stations. 90th percentile bacteria concentrations decreased at 19 stations from FY17 to FY18 and increased at 20 stations from FY17 to FY18; median bacteria concentrations remained the same at 2 stations. Analysis of the historical data shows an overall downward trend in yearly median bacteria concentrations at 30 of the 42 monitoring stations.

In December 2017, approximately 145 acres of shellfish harvesting waters in the Rhode River receiving drainage from the Rhode River/Bear Neck Creek TMDL watershed were upgraded from "restricted" to "conditionally approved" by MDE. MDE has noted that when the upper Rhode River was initially placed under restriction, the source of elevated bacteria levels was unknown; as such, the reason behind the improvement is also unknown (J. Backus, personal communication, October 31, 2017), though it was coincident with the County's enhanced bacteria education efforts. Subsequently, MDE established a second monitoring station within the remaining restricted waters of the Rhode River. The County will continue to review the monitoring data as well as the Integrated Report for Surface Water Quality Assessment to assess whether the bacteria TMDLs are meeting the MDE's water quality criterion for bacteria.

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Table 8. Comparison of MDE Shellfish Harvesting Area Monitoring Data

Bacteria TMDL Watershed	Monitoring Data Source	Monitoring Station	Median (MPN/100ml) ¹		90 th Percentile (MPN/100ml) ²	
			FY17	FY18	FY17	FY18
Magothy Mainstem	MDE	0301001	1.0	1.0	23.0	35.8
Magothy Mainstem	MDE	0301001A	9.1	3.6	43.0	888.6
Magothy Mainstem	MDE	0301001C	1.0	1.0	9.1	9.1
Magothy Mainstem	MDE	0301800	1.0	1.0	9.1	8.0
Magothy River/Forked Creek	MDE	0301011	23.0	43.0	43.0	1014.0
Magothy River/Tar Cove	MDE	0301005C	3.6	1.0	39.0	23.0
Magothy River/Tar Cove	MDE	0301006B	11.2	1.0	204.0	210.6
Magothy River/Tar Cove	MDE	0301801	1.0	1.0	12.7	13.8
Magothy River/Tar Cove	MDE	0301802	1.0	1.0	12.8	8.0
Rhode River/Bear Neck Creek	MDE	0307120A	4.0	4.0	20.2	43.0
Rhode River/Cadle Creek	MDE	0307019	5.0	4.0	34.2	63.0
Severn River Mainstem	MDE	0304152	42.1	23.0	150.0	83.0
Severn River Mainstem	MDE	0304150	42.3	7.3	139.9	83.0
Severn River Mainstem	MDE	0304002A	3.6	7.3	39.6	20.2
Severn River Mainstem	MDE	0304005	3.6	1.0	22.2	20.2
Severn River Mainstem	MDE	0304008	1.0	3.0	41.0	21.4
Severn River Mainstem	MDE	0304011	3.6	1.0	416.3	36.2
Severn River Mainstem	MDE	0304016	2.3	1.0	40.2	64.6
Severn River Mainstem	MDE	0304020	3.3	1.0	41.0	9.1
Severn River Mainstem	MDE	0304028	1.0	3.6	110.3	20.2
Severn River Mainstem	MDE	0304029	1.0	1.0	139.3	39.0
Severn River Mainstem	MDE	0303200	1.0	1.0	43.0	23.0
Severn River Mainstem	MDE	0303202	2.3	1.0	416.3	12.7
Severn River Mainstem	MDE	0303204	2.3	1.0	6.9	8.74
Severn River/Mill Creek	MDE	0303006	9.3	9.1	225.3	127.8
Severn River/Whitehall and Meredith Creek	MDE	0303005	5.4	3.6	23.0	123.0
Severn River/Whitehall and Meredith Creek	MDE	0303005A	31.0	9.1	144.3	416.0
South River/Duvall Creek	MDE	0306104	9.1	3.6	240.0	376.6
South River/Duvall Creek	MDE	0306013A	16.1	3.6	23.0	79.0
South River Mainstem	MDE	0306110	7.3	3.6	240.0	138.6
South River Mainstem	MDE	0306211	2.3	3.6	218.3	383.0
South River Mainstem	MDE	0306002	9.1	3.6	41.0	898.6
South River Mainstem	MDE	0306205	7.3	3.6	376.6	128.6
South River Mainstem	MDE	0306111	23.0	3.6	75.0	93
South River Mainstem	MDE	0306208A	3.6	3.6	88.0	43.0

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Bacteria TMDL Watershed	Monitoring Data Source	Monitoring Station	Median (MPN/100ml) ¹		90 th Percentile (MPN/100ml) ²	
			FY17	FY18	FY17	FY18
South River/Ramsey Lake	MDE	0306115A	13.3	9.1	225.3	460.0
South River/Selby Bay	MDE	0306801	23.0	9.1	240.0	83.0
South River/Selby Bay	MDE	0306115	3.6	1.0	23.0	39.0
W. Chesapeake Bay/Tracy and Rockhold Creeks	MDE	0501004	9.1	19.0	200.6	240.0
West River Mainstem	MDE	0307205	3.6	3.6	79.0	93.0
West River/Parish Creek	MDE	0307011	3.6	1.0	43.0	43.0

¹ The MDE Criterion for Median Sample (MPN/100ml) is 14

² The MDE Criterion for 90th Percentile Sample (MPN/100ml) is 43.

2.3 HEALTH DEPT. MONITORING OF BATHING BEACHES

The Anne Arundel County Department of Health, under State of Maryland regulations, conducts water quality sampling at 81 community bathing beach sites along area creeks and rivers from Memorial Day to Labor Day either weekly or biweekly. The water bodies are tested for levels of enterococci bacteria. If enterococci counts exceed the acceptable level or when a sewage spill impacts a waterway the Department of Health will issue an advisory against swimming and other direct water contact activities. The advisory remains in effect until test results show enterococci counts are within acceptable levels. The acceptable level for bodies of water sampled is 104 MPN (Most Probable Number) of colonies of organisms per 100 milliliters of water.

2.4 OPERATION CLEARWATER AND NGO MONITORING

Several NGOs also conduct water quality monitoring for bacteria within the County's TMDL watersheds. Operation Clearwater has provided regular bacteria monitoring at waterfront recreational areas throughout Anne Arundel County for 42 years. In 2018, Operation Clearwater conducted weekly monitoring of microbial (Enterococci) water quality at 44 sites around the County from Memorial Day through Labor Day. Further information about Operation Clearwater, including monitoring data, can be found online at <http://severnriver.org/projects/clearwater/>.

The West/Rhode Riverkeeper also conducted weekly water quality monitoring for Enterococci bacteria from Memorial Day through Labor Day in 2018 at 14 sites along the West and Rhode Rivers. Partners at the Anne Arundel Community College monitored enterococci weekly at six locations along the Rhode River and its tributaries from May through August 2017 as part of an effort to characterize water quality in the Rhode River prior to the conversion of the Mayo Water Reclamation Facility from a treatment plant to a pumping station (Domanski, 2017). The conversion was completed in October 2017 and the first full season of post-conversion monitoring was accomplished from May through August 2018. Results of the first season of monitoring will be presented in the FY2019 annual TMDL assessment report.

2.5 CIP RESTORATION PROJECT MONITORING

In August 2018, the County broke ground on a stream restoration project at Furnace Branch located in Glen Burnie. The project includes the removal of an existing concrete floodway and restoring a natural stream channel and floodplain. Furnace Branch lies within the highly impaired Furnace Branch subwatershed, which is listed as impaired for Enterococci. As part of this project, a water quality monitoring program has been established to determine what water quality benefits occur due to restoration activity. During the pre-restoration monitoring work occasional elevated bacteria (*E. coli*) counts and observation of an overflowing sewer manhole (subsequently repaired), prompted a more thorough investigation of conditions along the channelized portion of the stream, upstream of the monitoring station, between Kent Rd and 7th Avenue. In summer 2017, the County began collecting additional bacteria samples under baseflow conditions from locations along the main stem that bracket known sewer crossings, as well as from storm drain outfalls discharging to the reach of interest. Bacteria sampling was discontinued with the initiation of construction in August and will resume after construction is completed.

2.6 COUNTYWIDE BIOMONITORING

The County performs biological monitoring in accordance with Maryland Biological Stream Sampling protocols at 13 targeted CIP sites within bacteria TMDL watersheds, with benthic sampling occurring annually and fish sampling occurring triennially. Of these sites, three (including a reference site) are within the Severn Mainstem watershed, eight are within the Magothy Mainstem watershed, and two are within the Furnace Branch watershed. Biological monitoring has also been performed as a component of a separate study at 15 sites along Sawmill Creek and its tributaries within the Furnace Creek bacteria TMDL watershed in 2017 and 2018. Biological monitoring at Sawmill Creek sites is expected to continue at least until 2021.

SECTION THREE CONCLUSION

In Section 7 (Implementation Schedule and Milestone) of the TMDL Restoration Plan, the following programmatic criteria were identified to be achieved by the end of the 2019 milestone year by the County towards meeting the TMDL goals. Table 9 provides the County's progress towards achieving the implementation milestones.

Table 9. 2019 Milestone Programmatic Criteria

Programmatic Criteria	Progress
20% of impervious area managed with SPSC or other high-performing BMP (meet NPDES MS4 Permit/WIP goal).	The County continues to make progress towards completing new and retrofit stormwater management facilities projects in accordance with County goals. For the amount of impervious acres managed within bacteria TMDL watersheds, refer to the geodatabase submitted as part of the County's FY2018 NPDES MS4 Annual Report.
Continued triennial inspection and maintenance of constructed BMPs.	During 2018 the County continued triennial inspection and maintenance of constructed BMPs to verify functionality.
50% of planned septic systems connected to sewers, if funding allows.	The County successfully secured Chesapeake Bay Trust Funding to advance the County's efforts to connect septic systems to public sewer. This funding enabled the County to prioritize watersheds for septic conversion. The County has developed conceptual layouts and cost estimates for approximately 140 separate projects. Individual tasks have been completed through the use of consultants. The County oversaw the creation of a Septic Task Force which met monthly between February and July in 2017, with a close-out meeting held in March 2018; A Final Report was produced in June 2018. The County will procure OSDS Conversion Program Manager to assist in implementing the OSDS conversion or retirement program. The County received a grant to evaluate the feasibility of County take-over of select private minor wastewater treatment facilities to either convey to existing County facilities or to construct new advanced treatment package plants utilizing the same discharge location. Five feasible projects were identified, two of which are located in bacteria TMDL watersheds with bacteria TMDLs. More detailed investigations of the potential projects are planned for the future.
Pet waste education program continues; implement additional television PSAs, videos, social media, etc. as funds allow.	Throughout 2018 the County highlighted proper pet waste management practices through its social media outlets, and at community events and presentations. Results of a 2017 survey are being utilized to inform outreach strategies, including pilot projects in two communities in 2019. A 2019 survey will be distributed to communities to gauge interest in pet waste stations – WPRP has purchased three pet waste stations to be made available for interested communities. WPRP will further investigate the number and locations of pet waste stations at County parks.
Streamside livestock fencing completed.	Two livestock fencing projects were implemented in the West River watershed during 2017. Department of Agriculture does not foresee any additional exclusion fencing being installed in the County.

Implementation of a multi-media expanded pet waste outreach program was identified as a strategy that would provide the highest bacteria load reductions among 9 of the 19 TMDL watersheds. The County has continued the development of a robust pet waste outreach program, with a pilot program to be launched in the Rhode River/Cadle Creek and Magothy Mainstem watersheds in spring 2019. The results of the pilot program, which will include yard signage and survey of select community organizations and HOAs, will inform the County on the most effective outreach strategy (or strategies) to use for a County-wide outreach effort. Methodology for evaluating the effectiveness and quantifying the bacteria load reductions for the adopted pet waste outreach program is still needed.

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On September 14, 2018 a resolution supporting a “No Discharge Zone” for the all waters of the County was introduced to the County Council, which would prohibit the discharge of marine vessel sewage into waters of the County, whether treated or not. On October 8, 2018, the County Council passed the resolution, which is currently awaiting state and federal approval. If approved, boaters would be required to dispose of sewage at designated pump-out stations.

The County is currently in the beginning stages of developing a long-term bacteria monitoring program within one of the County’s 19 bacteria TMDL watersheds, with monitoring intended to begin in earnest in Summer 2019.

There are some restoration strategies such as Canada Goose Management, Livestock Fencing and outreach opportunities for management of homeless population and stray animals which currently have not been initiated by the County as these were given a low priority. Evaluation of their effectiveness needs to be conducted if these strategies are to be implemented.

Continual monitoring of the effectiveness of implemented strategies is recommended. This is because most restoration techniques require time to produce quantifiable benefits at the watershed level from their implementation time. Data collected by MDE from shellfish harvesting monitoring stations, as well as the Integrated Report for Surface Water Quality, will continue to be reviewed to determine the effectiveness of the implemented restoration strategies as well as to determine if any of the bacteria TMDL water bodies become eligible for removal from the TMDL list through the achievement of water quality standards for bacteria.

SECTION FOUR REFERENCES

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Appendix A

**County CIP Urban Stormwater Retrofit Projects Proposed in the
Bacteria TMDL Watersheds through FY18**

Restoration ID	TMDL Watershed	Project Description	Existing Project Type	Proposed Project Type	Drainage Area (acres)	Impervious Area (acres)	Rainfall Depth (inches)	Projected Year of Completion	Year of Completion
AA14RST000098	Magothy River Mainstem	Longfellow Drive Pond Retrofit	Extended Detention Structure, Dry	Retention Pond	17.62	4.39	0.38	2014	2014
AA14RST000099	Magothy River Mainstem	Copperwood Ct Pond Retrofit #2		Step Pool Conveyance System	0.00	0.00	0.06	2014	2014
AA14RST000100	Magothy River Mainstem	Copperwood Ct Pond Retrofit	Retention Pond	Retention Pond	7.58	2.89	0.36	2014	2014
AA14RST000101	Magothy River Mainstem	Sylvan Ave Pond Retrofit	Extended Detention Structure, Dry	Retention Pond	10.36	4.65	0.33	2014	2014
AA14RST000102	Magothy River Mainstem	Lahinch Dr SWM Pond Retrofit	Extended Detention Structure, Dry	Retention Pond	35.03	7.66	0.29	2014	2014
AA14RST000103	Magothy River Mainstem	Tarks Lane Pond Retrofit	Wet Pond – Wetland	Retention Pond	25.93	5.51	0.59	2014	2014
AA14RST000104	Magothy River Mainstem	Sylvan Ave Pond Retrofit #2		Step Pool Conveyance System	0.00	0.00	0.15	2014	2014
AA14RST000105	Magothy River Mainstem	Collington Court Pond Retrofit	Detention Structure Dry (Dry Pond)	Retention Pond	37.41	6.82	0.34	2014	2014
AA14RST000106	Magothy River Mainstem	Mayfield Rd and Gladnor Rd Pond Retrofit	Detention Structure Dry (Dry Pond)	Retention Pond	6.18	2.66	1.19	2014	2014
AA14RST000107	Magothy River Mainstem	Amesbury Ct. Pond Retrofit	Wet Pond – Wetland	Retention Pond	35.55	4.88	0.52	2014	2014
AA14RST000108	Magothy River Mainstem	Longfellow Drive Pond Retrofit #2		Step Pool Conveyance System	0.00	0.00	0.04	2014	2014
AA15RST000085	Magothy River Mainstem	Earleigh Heights Rd at B&A Trail Pond Retrofit	Extended Detention Structure, Wet	Retention Pond	12.89	3.69	2.60	2015	2015
AA15RST000086	Magothy River Mainstem	Evon Ct Pond Retrofit	Detention Structure Dry (Dry Pond)	Retention Pond	8.92	2.85	2.60	2015	2015
AA15RST000087	Magothy River Mainstem	Colleen Garden/Severndale GST Pond Retrofit	Infiltration Trench	Retention Pond	21.09	5.55	0.15	2015	2015
AA15RST000088	Magothy River Mainstem	Colleen Garden Ln Pond Retrofit	Detention Structure Dry (Dry Pond)	Retention Pond	3.03	1.10	0.55	2015	2015
AA15RST000089	Magothy River Mainstem	Waycross Way Pond Retrofit	Wet Pond – Wetland	Retention Pond	45.54	12.82	0.48	2015	2015
AA15RST000091	Magothy River Mainstem	244 Kennedy Drive Pond Retrofit	Infiltration Basin	Retention Pond	2.28	0.89	1.33	2015	2015
AA15RST000094	Magothy River Mainstem	109 Chelsea Grove Ct Pond Retrofit	Detention Structure Dry (Dry Pond)	Retention Pond	13.12	2.84	0.38	2015	2015
AA15RST000096	Magothy River Mainstem	Finnegan Dr Pond Retrofit	Infiltration Basin	Retention Pond	7.16	2.23	1.52	2015	2015
AA16RST000017	Magothy River Mainstem	8013 Tick Neck Road Pond Retrofit	Extended Detention Structure, Dry	Retention Pond	52.71	23.14	0.12	2015	2016
AA16RST000018	Magothy River Mainstem	603 Deering Road Pond Retrofit	Extended Detention Structure, Wet	Retention Pond	50.12	23.14	0.51	2015	2016
AA16RST000027	Magothy River Mainstem	725 Bridge Drive Pond Retrofit	Extended Detention Structure, Dry	Retention Pond	3.89	1.07	1.45	2016	2016
AA16RST000031	Magothy River Mainstem	Dividing Creek AACC Pond Retrofit #1	Extended Detention Structure, Dry	Retention Pond	15.11	12.84	1.00	2016	2016
AA16RST000032	Magothy River Mainstem	Dividing Creek AACC Pond Retrofit #2	Infiltration Trench	Bioretention	7.72	6.55	0.38	2016	2016
AA16RST000033	Magothy River Mainstem	Grosvenor Lane Bioretention		Bioretention	4.08	0.55	0.32	2015	2016
AA16RST000085	Magothy River Mainstem	Will O Brooke Drive Outfall Stabilization		Step Pool Conveyance System	4.68	1.49	2.60	2017	2018
AA16RST000086	Magothy River Mainstem	Pinewood Road Storm Drain SPSC		Step Pool Conveyance System	26.72	7.79	1.42	2016	2017
AA17RST000004	Magothy River Mainstem	Old Mill RD Outfall Stabilization		Step Pool Conveyance System	15.09	1.80	0.78	2019	-
AA17RST000015	Magothy River Mainstem	Randell Road Bioretention (Round Bay Community)		Rain Gardens	1.50	0.38	0.49	2018	2018
AA17RST000024	Magothy River Mainstem	Upper Mill Creek Stream Restoration BMP 824	Retention Pond	Step Pool Conveyance System	22.60	4.50	0.55	2020	-
AA17RST000033	Magothy River Mainstem	Cypress Creek Recreation Bioretention		Bioretention	0.76	0.45	1.08	2012	2017
AA17RST000034	Magothy River Mainstem	Cypress Creek Park and Ride Bioretention		Bioretention	6.46	3.80	0.99	2012	2017
AA17RST000049	Magothy River Mainstem	Dunkeld Manor SWM Retrofit	Infiltration Basin	Step Pool Conveyance System	18.26	7.60	0.49	2012	2017
AA18RST000035	Magothy River Mainstem	Wee Lad and Lassie Bioretention		Bioretention	1.20	0.25	1.25	2018	2018
AA18RST000042	Magothy River Mainstem	Berrywood Community Bioretention and Swale		Bio-Swale	3.54	0.96	2.07	-	-
AA18RST000047	Magothy River Mainstem	Harting Farm Pond 1 Retrofit	Retention Pond	Extended Detention Structure, Wet	58.95	18.59	0.59	-	-
AA18RST000048	Magothy River Mainstem	Harting Farm Pond 2 Retrofit	Retention Pond	Extended Detention Structure, Wet	81.95	22.53	2.60	-	-
AA18RST000049	Magothy River Mainstem	Harting Farm Pond 3 Retrofit	Retention Pond	Extended Detention Structure, Wet	1.85	0.19	2.60	-	-

Restoration ID	TMDL Watershed	Project Description	Existing Project Type	Proposed Project Type	Drainage Area (acres)	Impervious Area (acres)	Rainfall Depth (inches)	Projected Year of Completion	Year of Completion
AA15RST000100	Magothy River/Forked Creek	Buena Vista Outfall Restoration Phase 2		Step Pool Conveyance System	18.80	4.90	0.50	2015	2015
AA18RST000023	Magothy River/Forked Creek	Forked Creek Outfall Retrofit - U15O002		Step Pool Conveyance System	65.09	5.08	2.08	2021	-
AA16RST000011	Patapsco River Lower North Branch	Jerome Avenue Pond Retrofit	Extended Detention Structure, Dry	Infiltration Basin	4.63	1.54	1.55	2015	2016
AA16RST000020	Patapsco River Lower North Branch	Musical Way Pond Retrofit	Extended Detention Structure, Wet	Infiltration Basin	16.82	3.77	0.59	2015	2016
AA16RST000024	Patapsco River Lower North Branch	Severn Road / Carriage Drive Pond Retrofit	Extended Detention Structure, Dry	Retention Pond	11.20	4.81	0.76	2015	2016
AA16RST000030	Patapsco River Lower North Branch	806 Central Ave (Linthicum) Pond Retrofit	Extended Detention Structure, Wet	Retention Pond	1.53	1.01	0.37	2015	2016
AA16RST000047	Patapsco River Lower North Branch	Groveland Road Pond Retrofit	Detention Structure Dry (Dry Pond)	Infiltration Basin	12.38	3.79	0.62	2019	-
AA16RST000060	Patapsco River Lower North Branch	Gesna Dr Retrofit	Detention Structure Dry (Dry Pond)	Shallow Marsh	30.47	11.81	0.76	2019	-
AA16RST000061	Patapsco River Lower North Branch	Tuckerman Dr Retrofit	Detention Structure Dry (Dry Pond)	ED – Wetland	92.56	22.23	1.79	2019	-
AA16RST000062	Patapsco River Lower North Branch	Fairbanks Dr Retrofit	Detention Structure Dry (Dry Pond)	Shallow Marsh	14.40	6.35	0.70	2019	-
AA16RST000064	Patapsco River Lower North Branch	Green Moss Glen Retrofit	Detention Structure Dry (Dry Pond)	Micropool Extended Detention Pond	23.38	7.23	0.88	2021	-
AA16RST000066	Patapsco River Lower North Branch	Ridge Commons Blvd Retrofit	Extended Detention Structure, Dry	Extended Detention Structure, Wet	24.08	10.59	2.60	2019	-
AA16RST000075	Patapsco River Lower North Branch	Northrup Grumman Bioswale 1		Bio-Swale	0.55	0.55	0.68	2017	2017
AA16RST000076	Patapsco River Lower North Branch	Northrup Grumman Grass Swale 2		Grass Swale	0.00	1.40	0.60	-	-
AA16RST000077	Patapsco River Lower North Branch	Northrup Grumman Bioretention Area 1		Micro-Bioretention	0.00	0.50	1.36	-	-
AA16RST000078	Patapsco River Lower North Branch	Northrup Grumman Pervious Pavement 1		Permeable Pavements	0.97	0.75	1.36	2017	2017
AA16RST000079	Patapsco River Lower North Branch	Northrup Grumman Pervious Pavement 3A-2		Permeable Pavements	1.51	1.20	1.20	2017	2017
AA16RST000080	Patapsco River Lower North Branch	Northrup Grumman Pervious Pavement 3B		Permeable Pavements	1.26	1.23	1.49	2017	2017
AA16RST000081	Patapsco River Lower North Branch	Northrup Grumman Pervious Pavement 2		Permeable Pavements	0.53	0.50	0.65	2017	2017
AA17RST000001	Patapsco River Lower North Branch	Riverside Park Stormwater Management Retrofit		Step Pool Conveyance System	8.27	4.55	0.99	2019	-
AA17RST000002	Patapsco River Lower North Branch	Chesapeake Arts Center Stormwater Management Retro		Infiltration Trench	4.09	2.64	1.00	2019	-
AA17RST000003	Patapsco River Lower North Branch	Brooklyn Park Stormwater Management Retrofit		Infiltration Trench	7.01	2.80	1.00	2019	-
AA17RST000022	Patapsco River Lower North Branch	Maritime Institute (Maritime Blvd) Pond Retrofit	Detention Structure Dry (Dry Pond)	Step Pool Conveyance System	17.50	9.20	0.85	2021	-
AA17RST000030	Patapsco River Lower North Branch	Northrup Grumman ESD Pervious Pavement 3A-1		Permeable Pavements	1.51	1.20	2.06	2016	2017
AA17RST000031	Patapsco River Lower North Branch	Northrup Grumman ESD Raingarden		Rain Gardens	0.03	0.03	2.52	2016	2017
AA17RST000035	Patapsco River Lower	Peach Orchard SWM Retrofit		Retention Pond	43.70	10.92	0.99	2012	2017

Restoration ID	TMDL Watershed	Project Description	Existing Project Type	Proposed Project Type	Drainage Area (acres)	Impervious Area (acres)	Rainfall Depth (inches)	Projected Year of Completion	Year of Completion
	North Branch								
AA18RST000005	Patapsco River Lower North Branch	Walmart Arundel Mills Pond Opti Retrofit	Retention Pond	Retention Pond	33.76	13.40	2.60	2019	-
AA18RST000010	Patapsco River Lower North Branch	Arundel Mills Limited Partnership CMAC Pond Retrofit	Retention Pond	Retention Pond	196.70	159.70	2.60	2018	-
AA18RST000017	Patapsco River Lower North Branch	Hock Business Park (Corporate Blvd) Pond Retrofit	Detention Structure Dry (Dry Pond)	Sand Filter	89.16	52.57	1.40	2021	-
AA18RST000018	Patapsco River Lower North Branch	International Drive Pond Retrofit	Detention Structure Dry (Dry Pond)	Wet Pond – Wetland	137.35	74.28	0.20	2021	-
AA18RST000022	Patapsco River Lower North Branch	Concorde Circle Dry Pond Retrofit	Detention Structure Dry (Dry Pond)	Step Pool Conveyance System	63.29	15.05	2.21	2021	-
AA16RST000014	Patapsco River/Furnace Creek	Lochaber Court Pond Retrofit	Extended Detention Structure, Dry	Retention Pond	14.64	3.43	0.84	2015	2016
AA16RST000025	Patapsco River/Furnace Creek	McNeil Court Pond Retrofit	Extended Detention Structure, Dry	Retention Pond	8.15	3.13	1.15	2015	2016
AA16RST000041	Patapsco River/Furnace Creek	Chalmers Ave Pond Retrofit	Detention Structure Dry (Dry Pond)	Infiltration Basin	18.99	5.31	0.99	2017	2017
AA16RST000044	Patapsco River/Furnace Creek	Towering Oaks Court Pond Retrofit	Detention Structure Dry (Dry Pond)	Retention Pond	7.95	3.23	2.60	2018	-
AA16RST000045	Patapsco River/Furnace Creek	Baby Baer Court Pond Retrofit	Detention Structure Dry (Dry Pond)	Infiltration Basin	11.37	3.24	2.60	2017	2017
AA16RST000072	Patapsco River/Furnace Creek	Juneberry Way Pond Retrofit - SPSC	Detention Structure Dry (Dry Pond)	Step Pool Conveyance System	5.40	3.10	0.86	2017	2017
AA17RST000005	Patapsco River/Furnace Creek	Heritage Hills Back Creek Phase 2 Retrofits	Detention Structure Dry (Dry Pond)	Step Pool Conveyance System	9.53	4.10	0.99	2019	-
AA17RST000006	Patapsco River/Furnace Creek	Heritage Hills Back Creek Phase 2 Retrofits		Bioretention	0.63	0.25	0.98	2019	-
AA17RST000007	Patapsco River/Furnace Creek	Heritage Hills Back Creek Phase 2 Retrofits		Bioretention	4.05	2.40	1.00	2019	-
AA17RST000008	Patapsco River/Furnace Creek	Heritage Hills Back Creek Phase 2 Retrofits		Bioretention	1.96	0.53	1.00	2019	-
AA17RST000009	Patapsco River/Furnace Creek	Heritage Hills Back Creek Phase 2 Retrofits		Bioretention	4.29	1.90	0.99	2019	-
AA17RST000023	Patapsco River/Furnace Creek	Sawmill Hollins Ferry RD Pond Retrofit BMP 190	Detention Structure Dry (Dry Pond)	Infiltration Basin	32.10	19.45	2.60	2018	2018
AA18RST000028	Patapsco River/Furnace Creek	Sawmill Creek - Cromwell Elementary School Bioretention #1		Bioretention	9.98	3.75	1.02	2019	
AA18RST000029	Patapsco River/Furnace Creek	Sawmill Creek - Cromwell Elementary School Bioretention #2		Bioretention	3.56	1.67	1.00	-	-
AA18RST000030	Patapsco River/Furnace Creek	Sawmill Creek - Cromwell Elementary School Vortechs Unit #1		Other	9.22	3.56	0.00	-	-
AA16RST000016	Patapsco River/Marley Creek	Hospital Drive Pond #3 SWM Retrofit SPSC	Extended Detention Structure, Dry	Step Pool Conveyance System	31.70	15.80	0.92	2015	2016
AA16RST000034	Patapsco River/Marley Creek	Sun Valley Condos Pond Retrofit	Extended Detention Structure, Dry	Retention Pond	5.46	1.84	0.37	2016	2016
AA16RST000054	Patapsco River/Marley Creek	Hospital Drive / Foxwell Bend Road Pond Retrofit	Extended Detention Structure, Dry	Extended Detention Structure, Wet	30.09	11.28	1.84	2017	2018
AA16RST000055	Patapsco River/Marley Creek	Fox Cub Court Pond Retrofit	Extended Detention Structure, Wet	Extended Detention Structure, Wet	16.19	6.67	2.37	2017	2018
AA16RST000082	Patapsco River/Marley Creek	Hospital Drive Pond 2 Retrofit SPSC		Step Pool Conveyance System	13.04	5.84	0.93	2016	2016

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AA17RST000010	Patapsco River/Marley Creek	Mill Race Pond Retrofit	Detention Structure Dry (Dry Pond)	Wet Pond – Wetland	47.79	14.51	2.13	2018	-
AA17RST000012	Patapsco River/Marley Creek	Empowering Believers Church Rain Garden 6		Rain Gardens	0.17	0.20	2.17	2016	2017
AA17RST000013	Patapsco River/Marley Creek	Empowering Believers Church Rain Garden 2		Rain Gardens	0.54	0.50	1.07	2016	2017
AA17RST000014	Patapsco River/Marley Creek	Empowering Believers Church Rain Garden 1		Rain Gardens	0.26	0.30	0.85	2016	2017
AA17RST000050	Patapsco River/Marley Creek	Grays Luck SWMP Retrofit	Detention Structure Dry (Dry Pond)	Step Pool Conveyance System	41.90	8.42	0.50	2014	2017
AA18RST000037	Rhode River/Bear Neck Creek	Holly Hill Harbor Community Park Constructed Wetland A		ED – Wetland	1.13	0.39	0.27	2019	-
AA18RST000038	Rhode River/Bear Neck Creek	Holly Hill Harbor Community Park Constructed Wetland B		ED – Wetland	1.13	0.39	0.32	2019	-
AA18RST000039	Rhode River/Bear Neck Creek	Holly Hill Harbor Community Park Constructed Wetland C		ED – Wetland	2.14	0.46	0.52	2019	-
AA18RST000040	Rhode River/Bear Neck Creek	Holly Hill Harbor Community Park Constructed Wetland D		ED – Wetland	7.15	2.02	0.04	2019	-
AA18RST000041	Rhode River/Bear Neck Creek	Holly Hill Harbor Community Park Constructed Wetland E		ED – Wetland	7.32	2.06	0.05	2019	-
AA15RST000092	Severn River Mainstem	Knollwood Road Outfall		Step Pool Conveyance System	9.49	2.55	1.03	2015	2015
AA15RST000093	Severn River Mainstem	Western District Police Station	Detention Structure Dry (Dry Pond)	Retention Pond	2.28	1.34	1.70	2015	2015
AA15RST000097	Severn River Mainstem	Wetherfield Pond SWM Retrofit	Detention Structure Dry (Dry Pond)	Retention Pond	16.50	4.78	1.00	2015	2015
AA15RST000098	Severn River Mainstem	Denington Lane Outfall		Step Pool Conveyance System	122.37	38.24	0.50	2015	2015
AA15RST000101	Severn River Mainstem	Old Bay Ridge Rd/Abandoned RR Embankment Sinkhole		Step Pool Conveyance System	126.57	20.06	0.02	2015	2015
AA15RST000102	Severn River Mainstem	Olde Severna Park Outfall Retrofit Birch Court		Step Pool Conveyance System	37.83	15.86	0.49	2015	2015
AA16RST000009	Severn River Mainstem	Annapolis Mall Pond Retrofit	Extended Detention Structure, Wet	Retention Pond	0.00	0.00	0.00	-	-
AA16RST000012	Severn River Mainstem	1275 Odenton Road Pond Retrofit	Detention Structure Dry (Dry Pond)	Retention Pond	3.95	2.04	1.00	2016	2016
AA16RST000040	Severn River Mainstem	Valentine Creek SWM Retrofit	Detention Structure Dry (Dry Pond)	ED – Wetland	34.89	3.31	1.65	2017	2017
AA16RST000067	Severn River Mainstem	Pasture Brook Rd Retrofit	Detention Structure Dry (Dry Pond)	ED – Wetland	49.42	13.03	1.01	2018	2017
AA16RST000073	Severn River Mainstem	Maryland Therapeutic Riding Center SPSC		Step Pool Conveyance System	26.60	2.38	2.48	2015	2016
AA16RST000088	Severn River Mainstem	Buttonwood Trail Outfall Repair SPSC		Step Pool Conveyance System	8.54	3.31	0.48	2015	2016
AA16RST000090	Severn River Mainstem	Picture Spring Branch Outfall Restoration		Step Pool Conveyance System	24.30	1.73	0.50	2016	2016
AA17RST000011	Severn River Mainstem	Lakeland Road Outfall Stabilization	Dry Swale	Step Pool Conveyance System	44.87	13.06	0.97	2019	-
AA17RST000016	Severn River Mainstem	Coventry Court Dry Channel RSC- Category 2		Step Pool Conveyance System	2.40	1.50	0.28	2017	2017
AA17RST000017	Severn River Mainstem	Herald Harbor Bonaparte RD #2 CPO		Step Pool Conveyance System	17.59	4.88	0.05	2017	2017
AA17RST000018	Severn River Mainstem	Winchester on the Severn Dry Channel RSC		Step Pool Conveyance System	18.75	5.07	0.28	2017	2018
AA17RST000025	Severn River Mainstem	Sappington Hill Pond Retrofit	Extended Detention Structure, Wet	Retention Pond	15.32	3.69	1.82	2016	2017
AA17RST000026	Severn River Mainstem	Fairfield Drive Pond Retrofit	Extended Detention Structure, Wet	Retention Pond	25.31	7.64	0.44	2016	2017
AA17RST000027	Severn River Mainstem	Dellwood Court Outfall Sand Filter		Sand Filter	1.33	0.27	1.58	2017	2017
AA17RST000028	Severn River Mainstem	Dellwood Court Outfall Bioretention		Bioretention	3.88	0.53	0.44	2016	2017
AA17RST000029	Severn River Mainstem	Dellwood Court Infiltration Trench		Infiltration Trench	0.57	0.31	0.70	2017	2017
AA17RST000051	Severn River Mainstem	Windswept Estates Pond Retrofit	Extended Detention Structure, Dry	Step Pool Conveyance System	15.50	6.05	0.50	2014	2017
AA18RST000001	Severn River Mainstem	Jabez SWM BMP 33 Retrofit	Shallow Marsh	Shallow Marsh	119.00	12.60	0.99	2018	2018

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AA18RST000019	Severn River Mainstem	Sappington Hill BMP 1280 Pond Retrofit	Retention Pond	Extended Detention Structure, Wet	31.28	2.04	2.60	2019	-
AA16RST000019	Severn River/Mill Creek	Comanche Rd Retrofit	Infiltration Basin	Retention Pond	12.99	2.60	0.64	2015	2016
AA16RST000021	Severn River/Mill Creek	Old Sturbridge Rd Retrofit	Infiltration Basin	Retention Pond	7.74	1.55	0.80	2015	2016
AA16RST000022	Severn River/Mill Creek	Nickerson Way Retrofit	Infiltration Basin	Retention Pond	3.73	0.75	0.97	2015	2016
AA16RST000058	Severn River/Whitehall and Meredith Creek	Pennington Ln South Retrofit	Extended Detention Structure, Dry	Step Pool Conveyance System	24.21	4.69	0.99	2018	2018
AA18RST000044	Severn River/Whitehall and Meredith Creek	Asbury Broadneck United Methodist Church - SPSC		Step Pool Conveyance System	26.39	4.85	0.10	-	-
AA15RST000095	South River Mainstem	Dillon Court Pond Retrofit	Detention Structure Dry (Dry Pond)	Retention Pond	15.21	2.80	1.25	2015	2015
AA15RST000099	South River Mainstem	South Down Shores Stream Restoration		Step Pool Conveyance System	23.80	3.20	0.49	2015	2015
AA16RST000001	South River Mainstem	Preserve at Broad Creek Pond Retrofit - SPSC	Retention Pond	Step Pool Conveyance System	11.04	4.59	0.74	2015	2016
AA16RST000008	South River Mainstem	Historic London Town Step Pools and Rain Garden		Rain Gardens	0.70	0.50	1.00	2013	2016
AA16RST000013	South River Mainstem	St Andrews Pond Retrofit	Extended Detention Structure, Dry	Multiple Pond System	7.97	2.45	2.60	2016	2016
AA16RST000028	South River Mainstem	Loch Haven Manor Pond	Extended Detention Structure, Dry	Retention Pond	8.26	2.19	1.56	2015	2016
AA16RST000035	South River Mainstem	Wordsworth Dr Retrofit	Retention Pond	Retention Pond	69.67	27.15	2.46	2017	2017
AA16RST000038	South River Mainstem	Sharpsburg Dr Retrofit	Detention Structure Dry (Dry Pond)	Retention Pond	32.96	3.97	1.26	2017	2017
AA16RST000039	South River Mainstem	Annapolis Harbour Center Pond Retrofit	Retention Pond	Extended Detention Structure, Wet	36.30	27.10	1.92	2017	2018
AA16RST000069	South River Mainstem	2662 Riva Rd Retrofit	Detention Structure Dry (Dry Pond)	Micro-Bioretenion	19.54	12.53	0.85	2020	-
AA16RST000084	South River Mainstem	Stepneys Ln Retrofit	Detention Structure Dry (Dry Pond)	Wet Pond – Wetland	0.00	38.82	1.07	-	-
AA16RST000089	South River Mainstem	Cinnamon Lane Outfall Rehabilitation		Step Pool Conveyance System	20.91	0.43	0.49	2016	2016
AA16RST000091	South River Mainstem	Annapolis Corporate Park SPSC #1		Step Pool Conveyance System	18.84	0.00	0.50	2015	2016
AA16RST000092	South River Mainstem	Annapolis Corporate Park SPSC #2		Step Pool Conveyance System	15.76	4.41	0.50	2015	2016
AA16RST000093	South River Mainstem	Camp Woodlands Pre-Treatment		Step Pool Conveyance System	7.80	2.09	0.49	2015	2016
AA16RST000094	South River Mainstem	Annapolis Harbour Center SPSC		Step Pool Conveyance System	50.33	3.50	0.49	2016	2016
AA18RST000021	South River Mainstem	Broad Creek Headwaters Phase I Dept of Health SPSC		Step Pool Conveyance System	7.01	1.11	0.53	2018	2018
AA18RST000024	South River Mainstem	Killarney House and Neighbors Beards Creek Community BMPs		Step Pool Conveyance System	20.56	4.77	2.41	2018	2018
AA18RST000025	South River Mainstem	Sylvan Shores Stormwater Infrastructure Upgrade Bioretention #1		Bioretention	0.32	0.18	0.36	2018	2018
AA18RST000026	South River Mainstem	Sylvan Shores Stormwater Infrastructure Upgrade Bioretention #2		Bioretention	0.77	0.27	0.47	2018	2018
AA18RST000027	South River Mainstem	Sylvan Shores Stormwater Infrastructure Upgrade Bioretention #3		Bioretention	0.77	0.16	0.99	2018	2018
AA18RST000031	South River Mainstem	Edgewater Beach Grass Swale		Grass Swale	0.82	0.19	0.44	2018	2018
AA18RST000032	South River Mainstem	Edgewater Beach Bioswale		Bio-Swale	0.82	0.19	0.07	2018	2018
AA18RST000033	South River Mainstem	Broad Creek Health Department StormTech BMP		Other	1.10	1.11	0.84	2018	2018
AA18RST000036	South River Mainstem	United Church of Christ Pond Retrofit		Bioretention	0.88	0.26	2.60	2018	2018
AA18RST000043	South River Mainstem	Center for Applied Technology South - Bioretention		Bioretention	1.84	0.00	1.72	-	-
AA15RST000090	South River/Duvall Creek	Old Annapolis Neck Road	Detention Structure Dry (Dry Pond)	Retention Pond	3.04	0.86	2.56	2015	2015
AA16RST000007	South River/Duvall Creek	Hillsmere Beach Road Kayak Area CPO / Bioretention		Bioretention	9.00	2.52	0.22	2015	2016
AA17RST000019	South River/Duvall Creek	St. Anne School of Annapolis Rain Garden		Rain Gardens	0.63	0.37	1.51	2017	2017

Restoration ID	TMDL Watershed	Project Description	Existing Project Type	Proposed Project Type	Drainage Area (acres)	Impervious Area (acres)	Rainfall Depth (inches)	Projected Year of Completion	Year of Completion
AA17RST000020	West River Mainstem	Avalon Shores Fire Dept Stormwater Wetland		Bio-Swale	1.37	0.86	0.71	2016	2017

¹ Indicates new project or a project that has previously not been included in Total Maximum Daily Load Restoration Plan for Bacteria (January 2017) and 2016 Annual TMDL Assessment Report (January 2017)

² Data has been updated since being listed in Table 2 of the 2016 Annual TMDL Assessment Report (January 2017).

³ The type of proposed project has been updated since being listed in Table 2 of the 2016 Annual TMDL Assessment Report (January 2017)

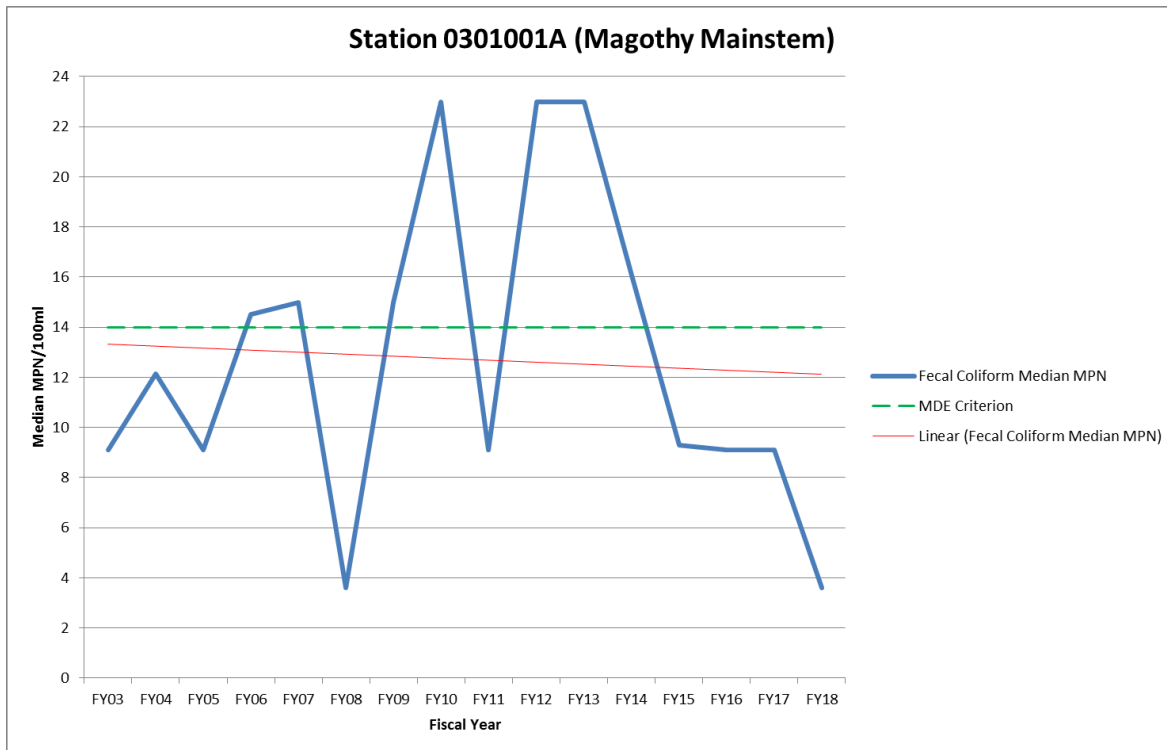
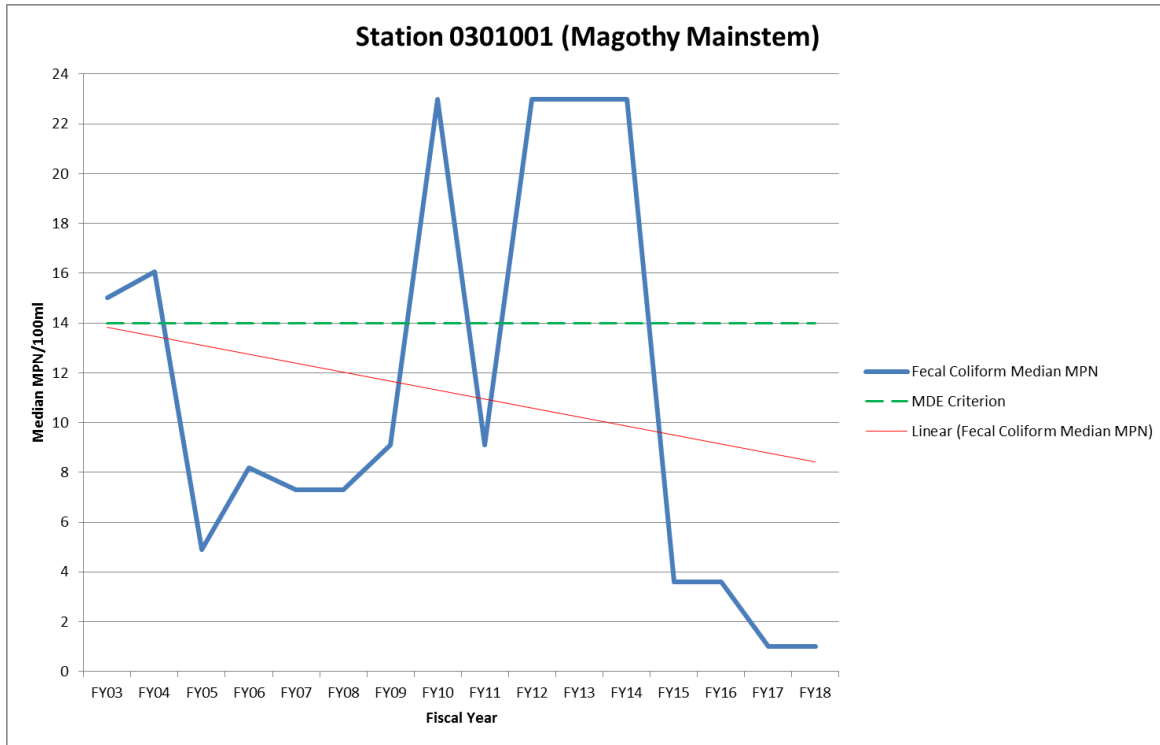
⁴ This project is included in the Magothy River Mainstem Watershed in this Plan even though it is listed under Baltimore Harbor Watershed in the County GIS data. This is due to a discrepancy in the watershed boundaries between the County and the MDE GIS data

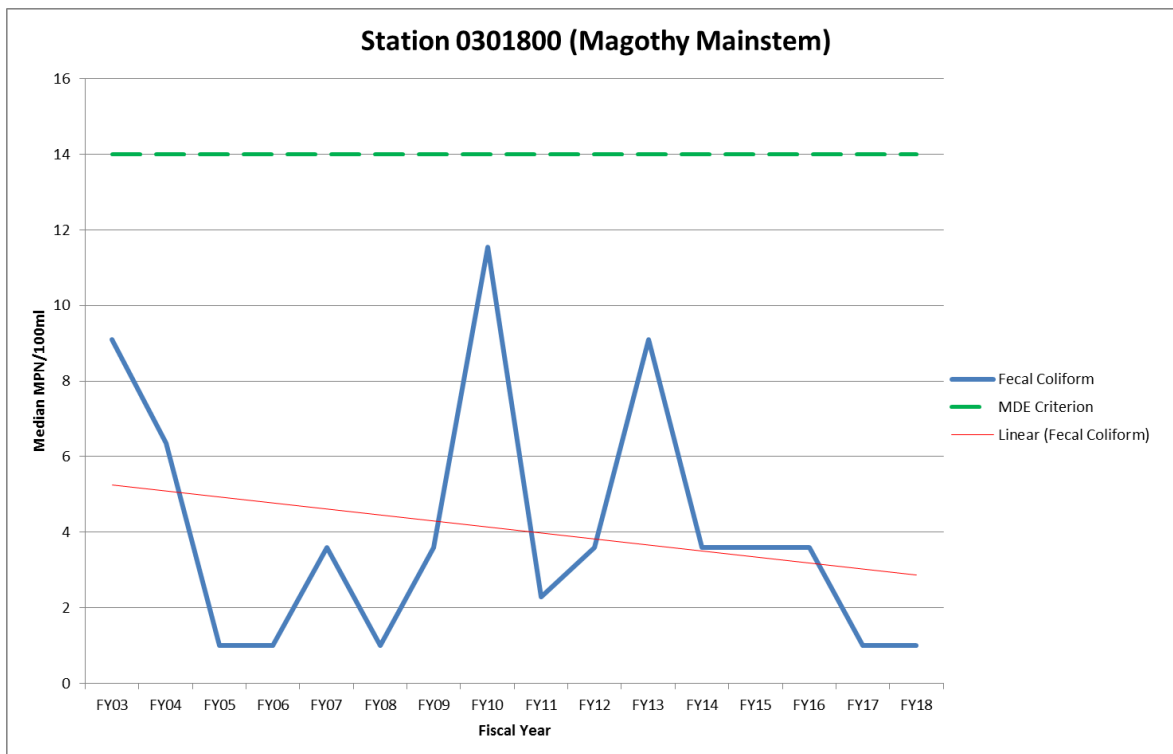
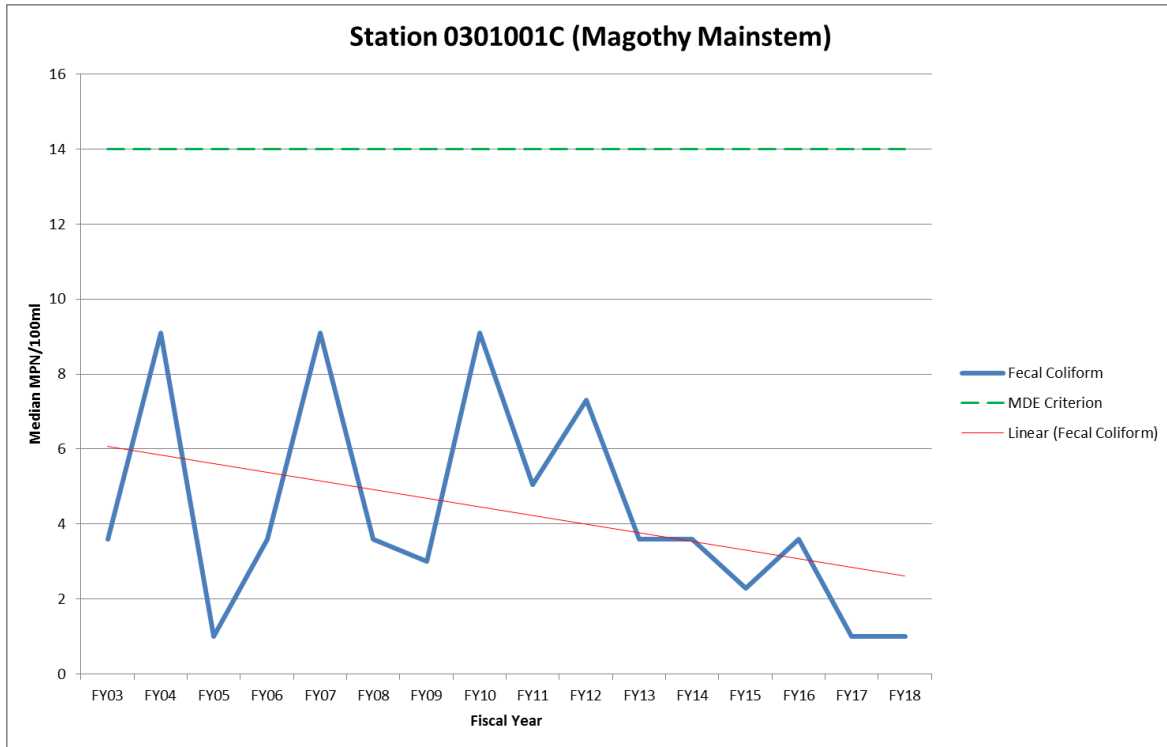
⁵ This project is included in the Marley Creek Watershed in this Plan even though it is listed under Severn River Watershed in the County GIS data. This is due to a discrepancy in the watershed boundaries between the County and the MDE GIS data

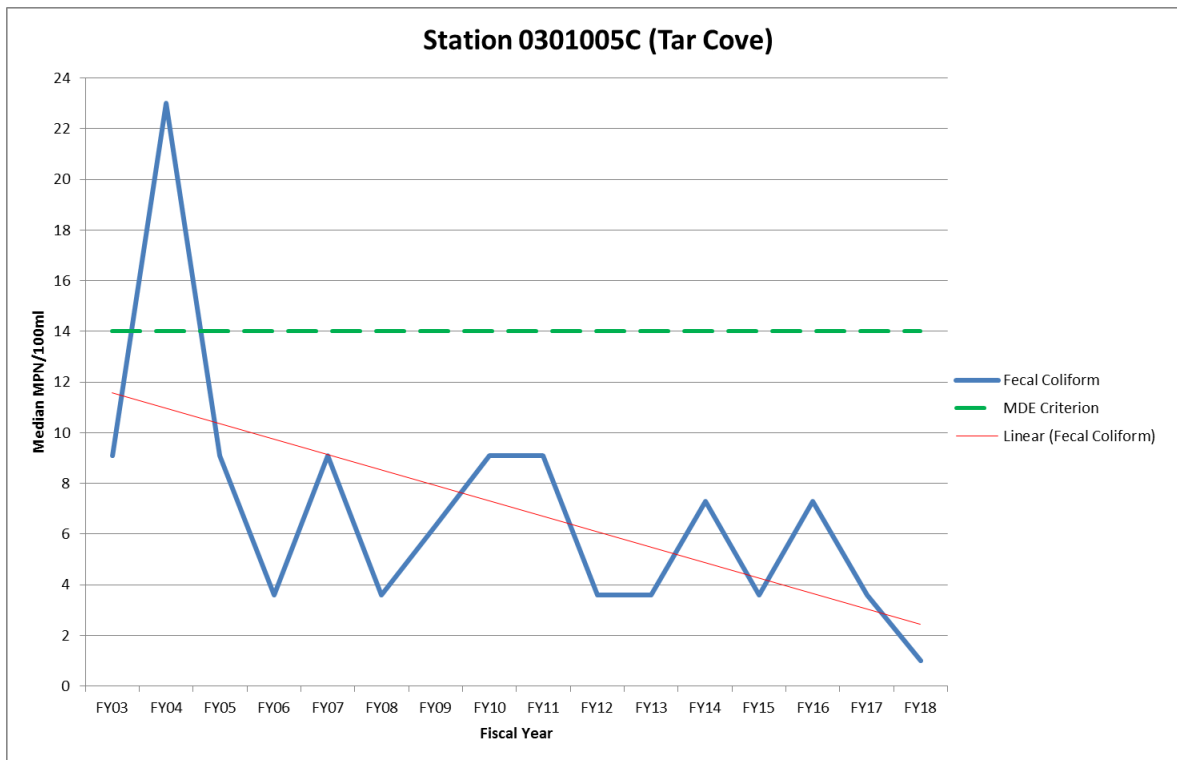
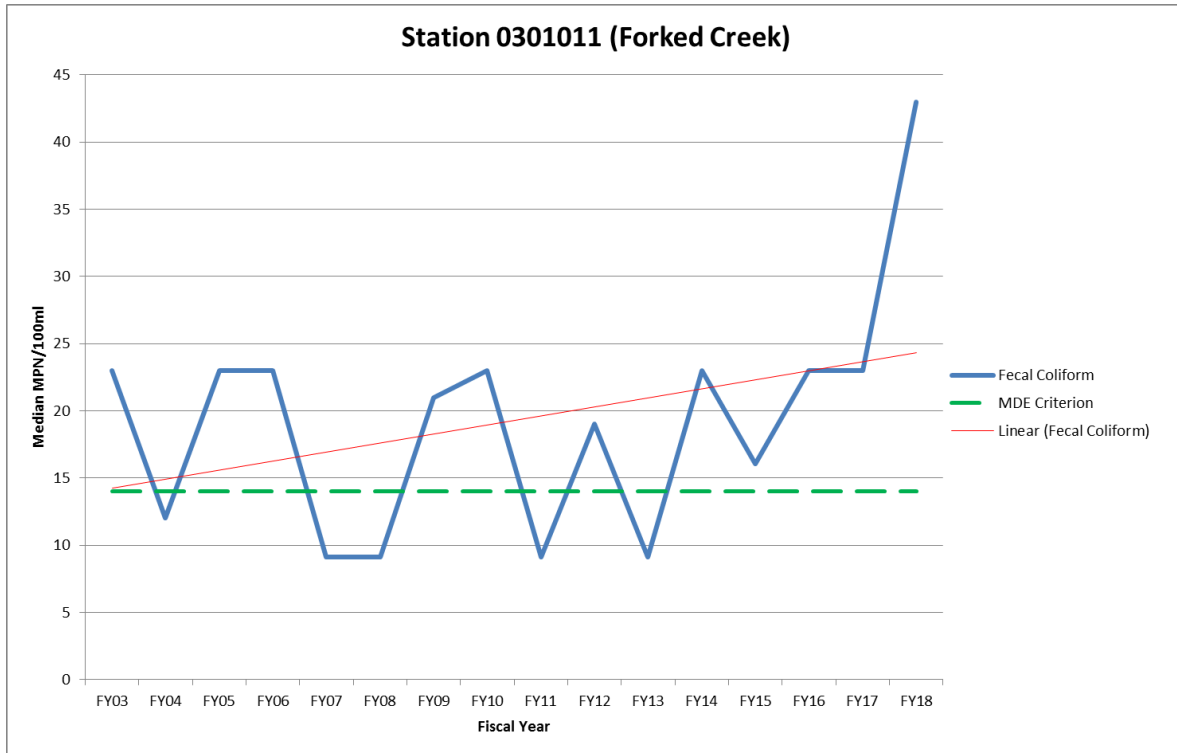
⁶ At the time of this report, the actual number of impervious acres treated had not yet been provided to the County. This table will be updated when the correct information is received.

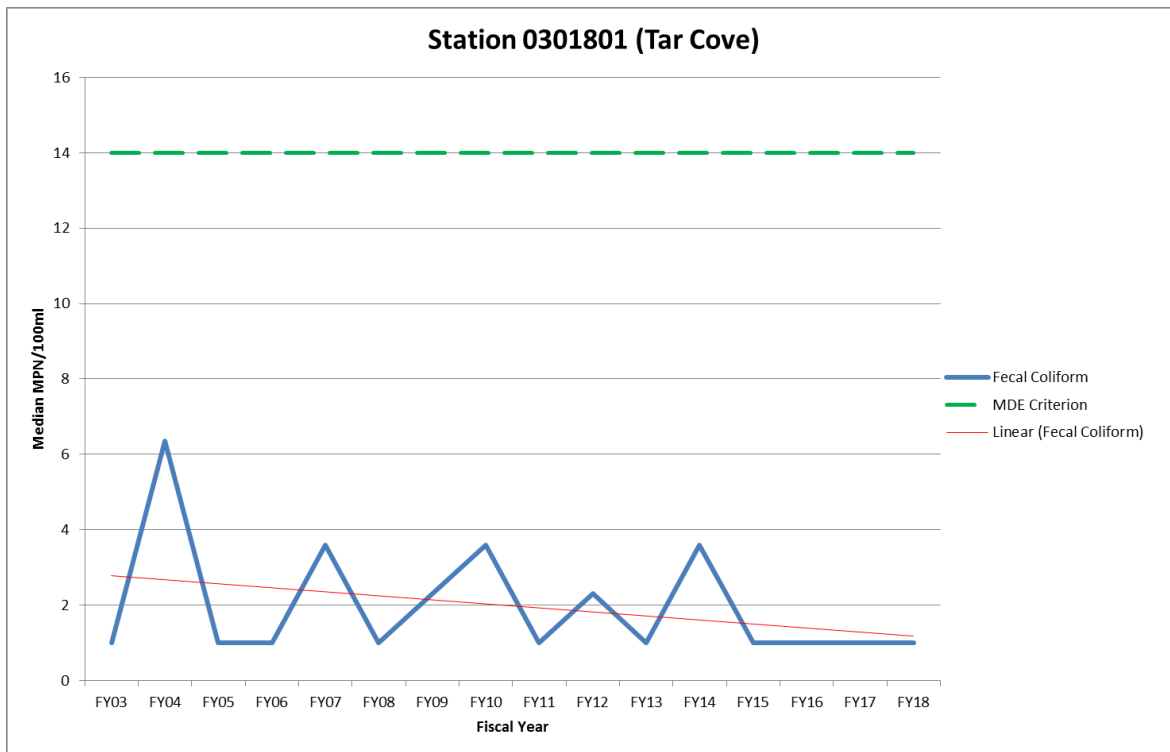
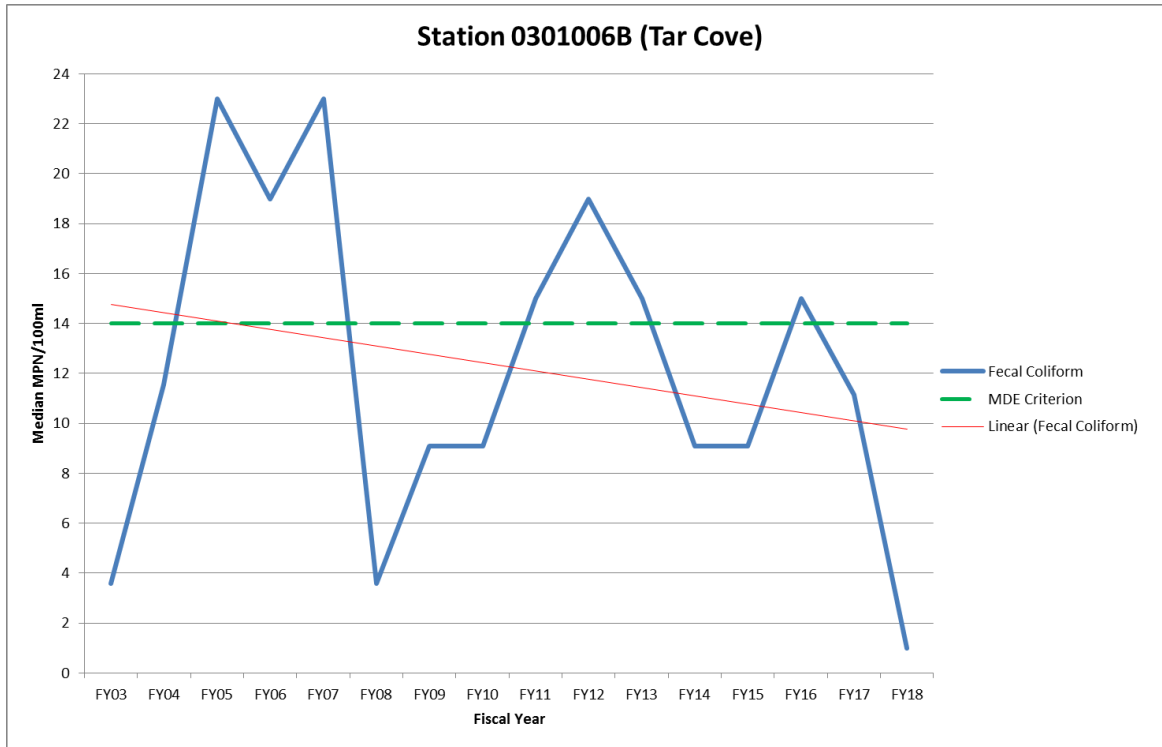
Appendix B

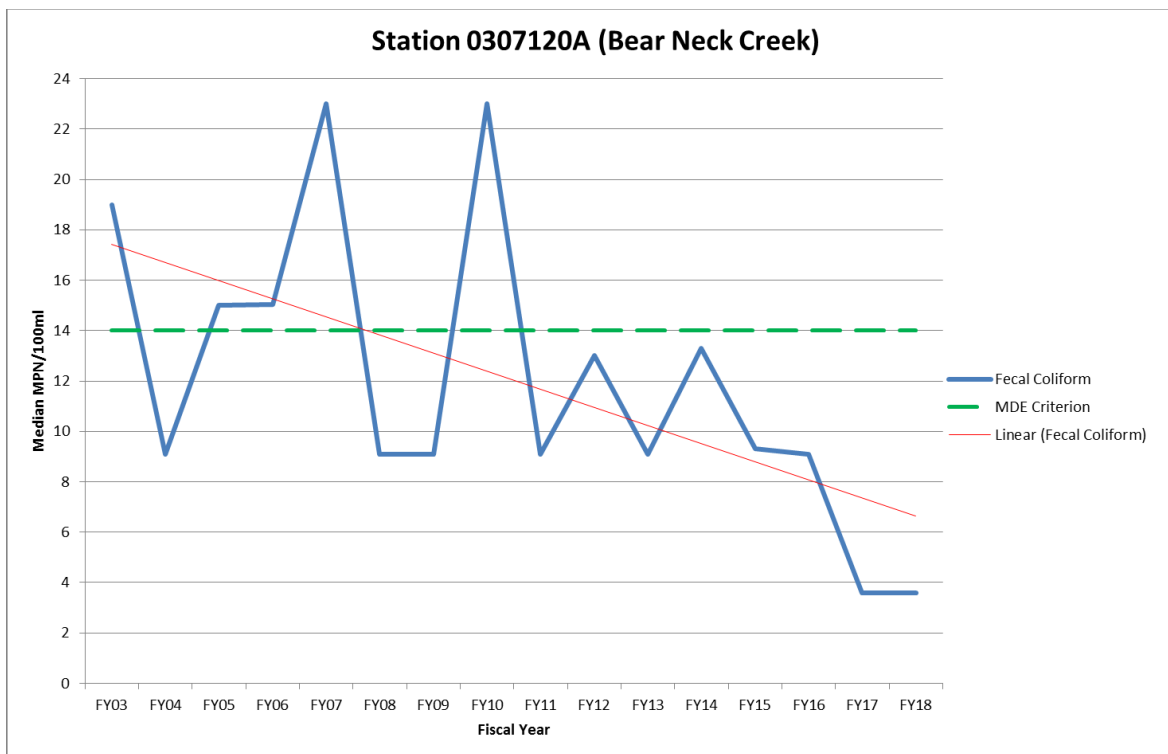
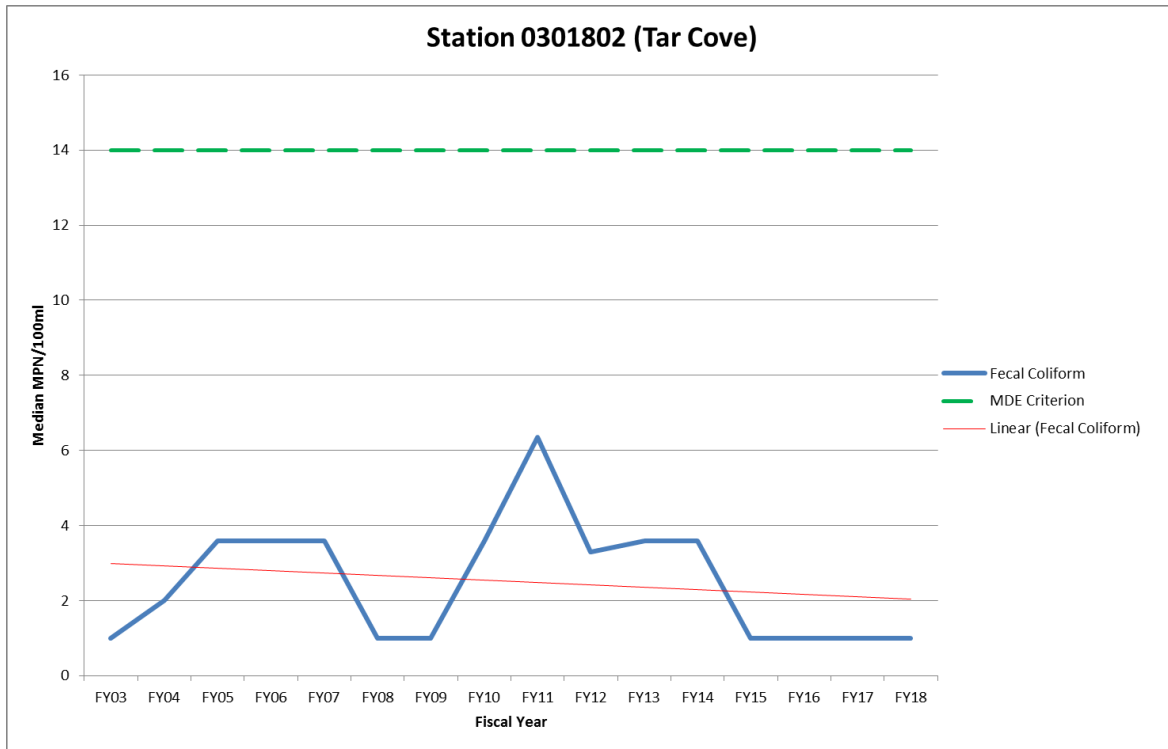
**Annual Median Bacteria Concentrations at MDE Shellfish Harvesting
Monitoring Stations within TMDL Watersheds**

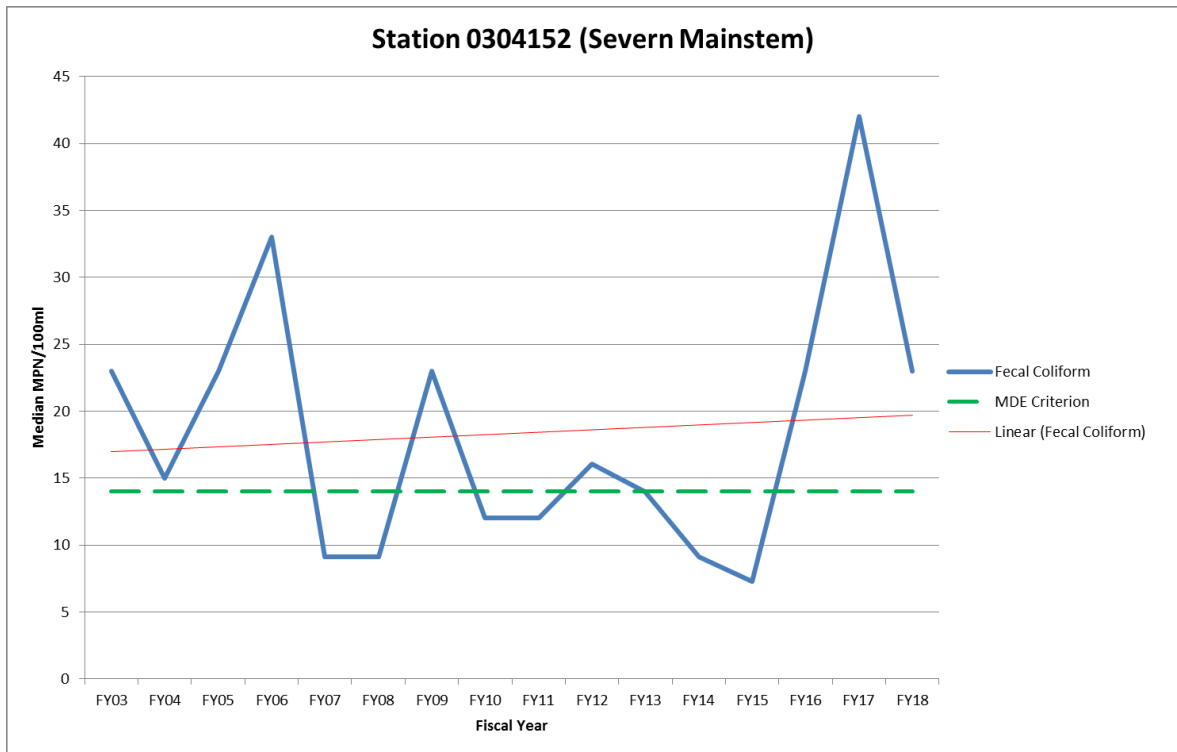
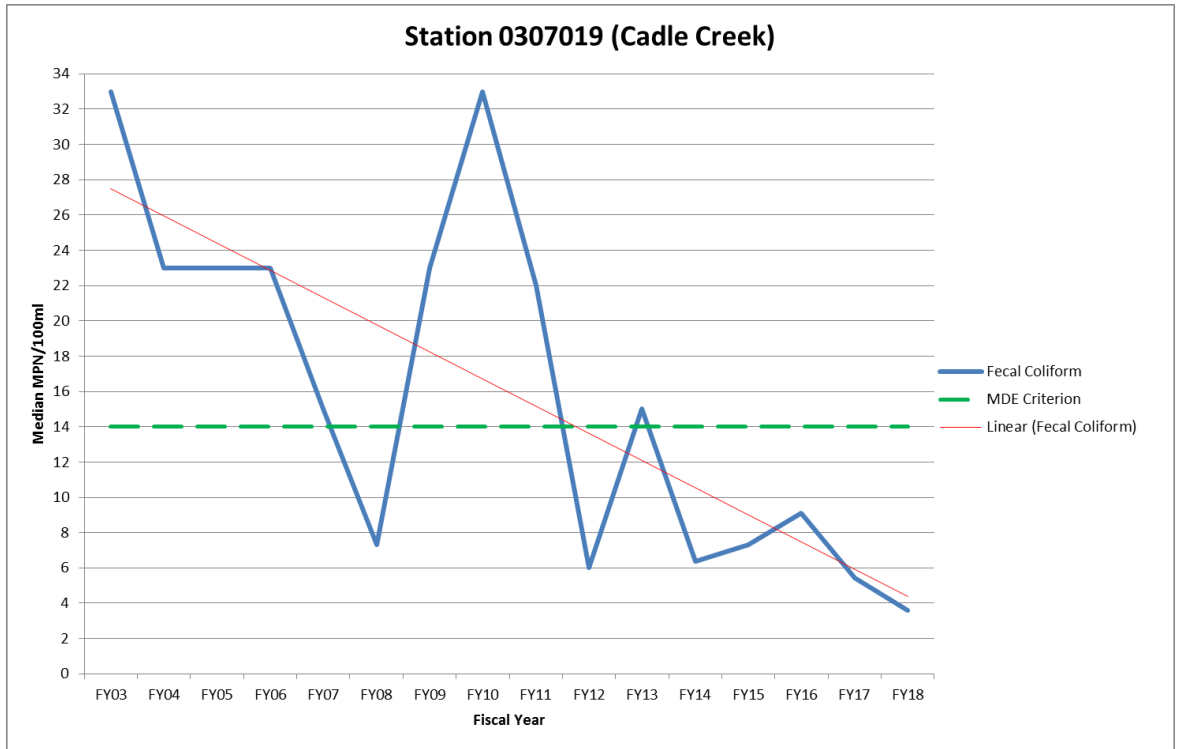


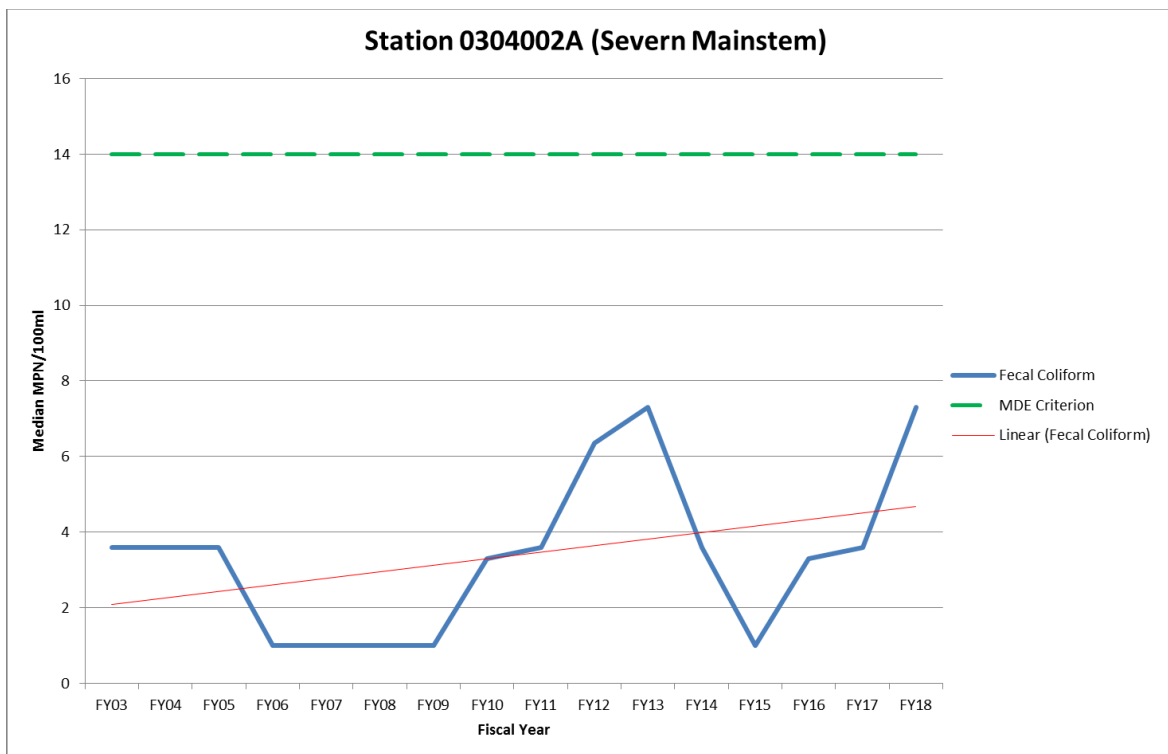
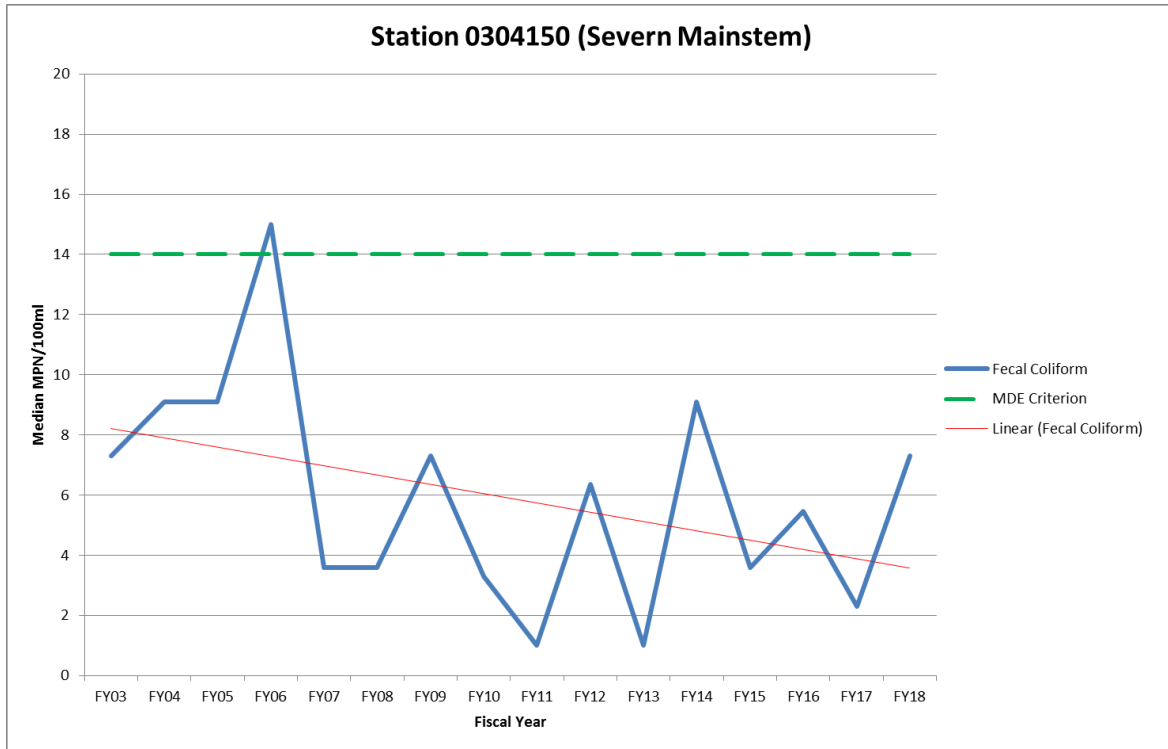


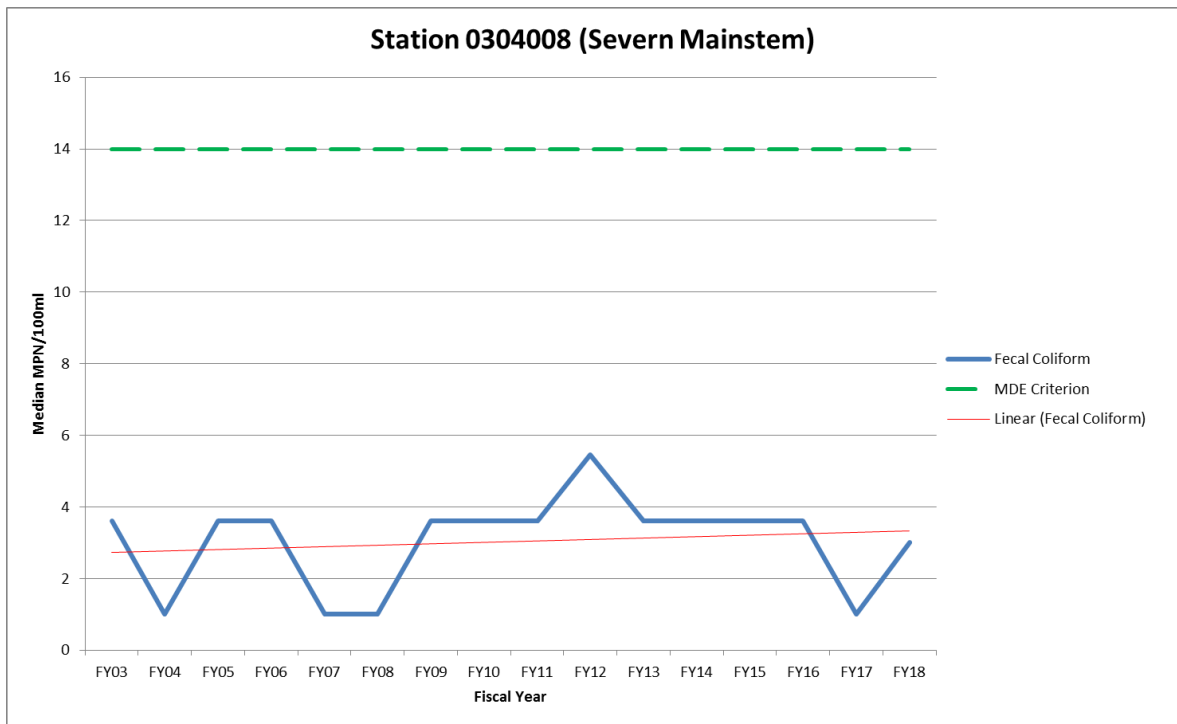
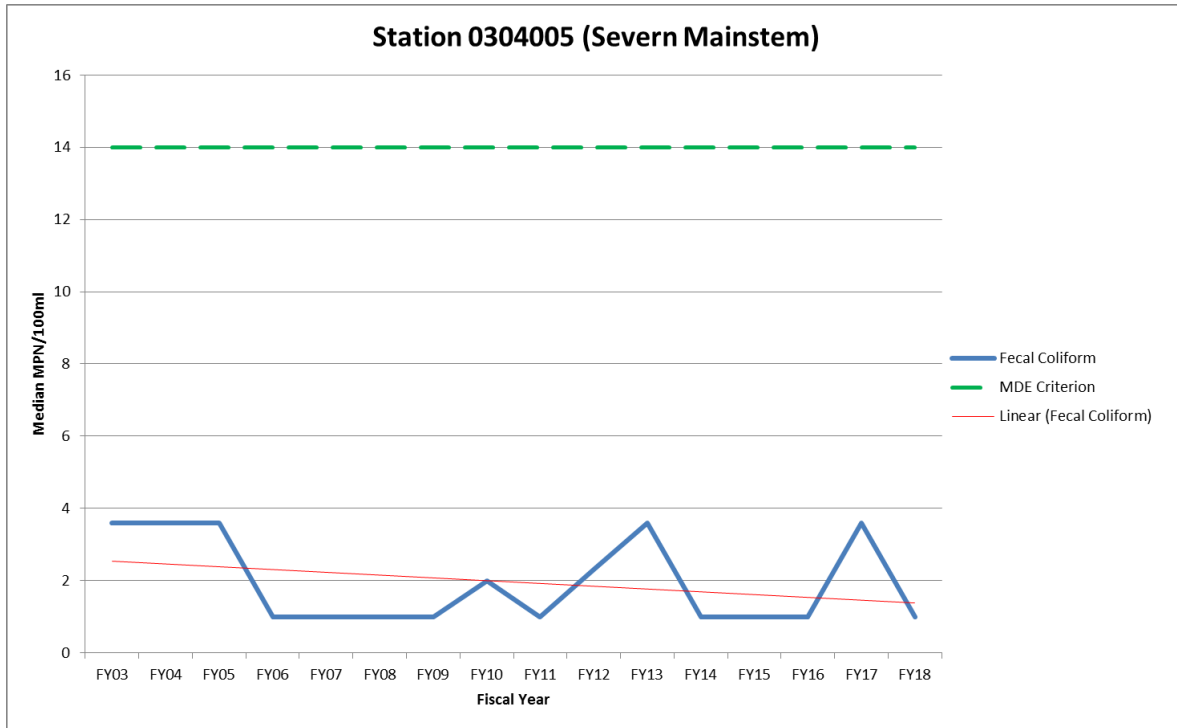


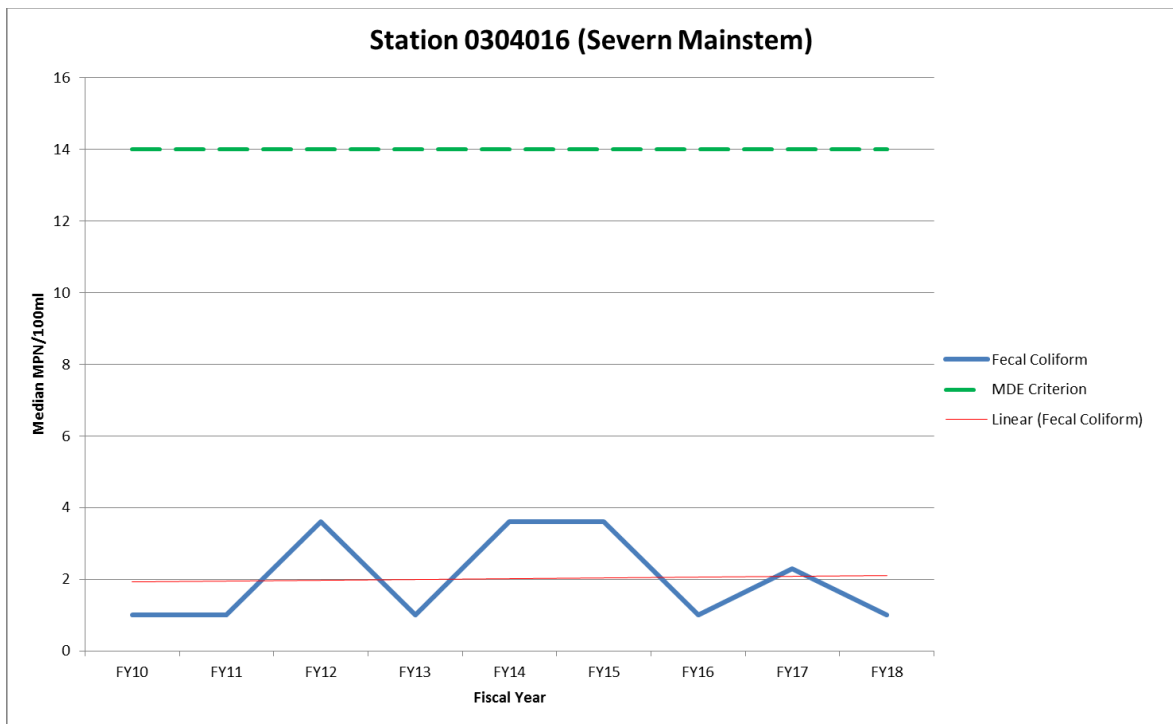
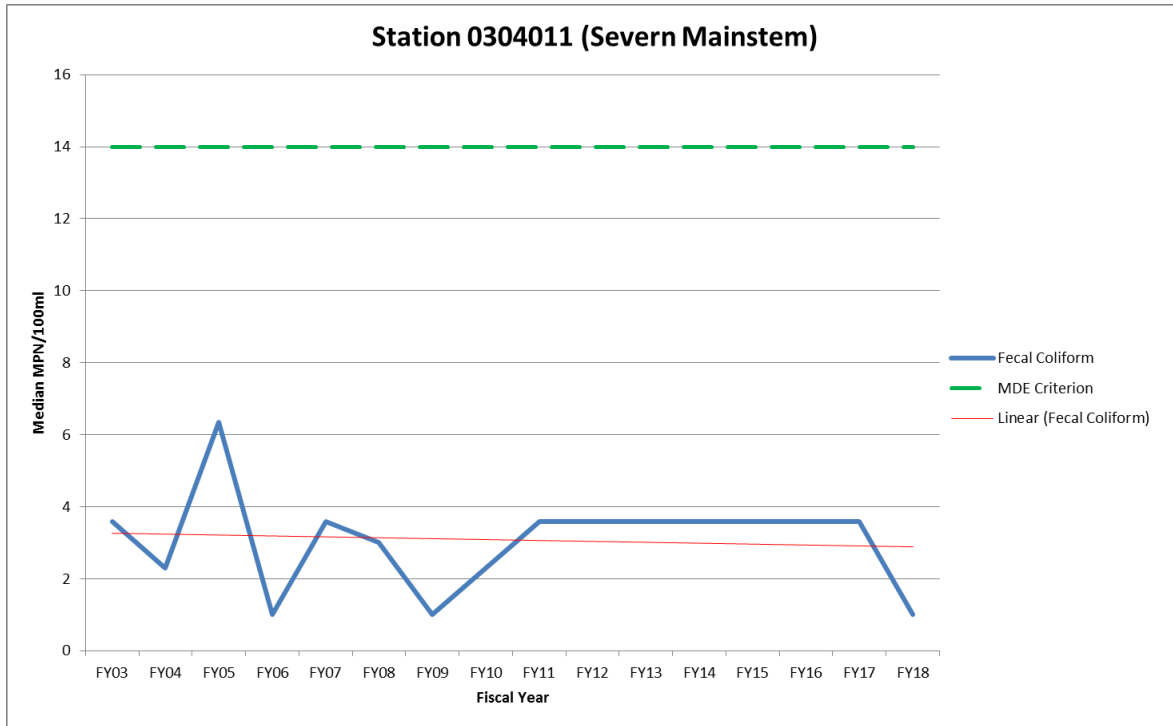


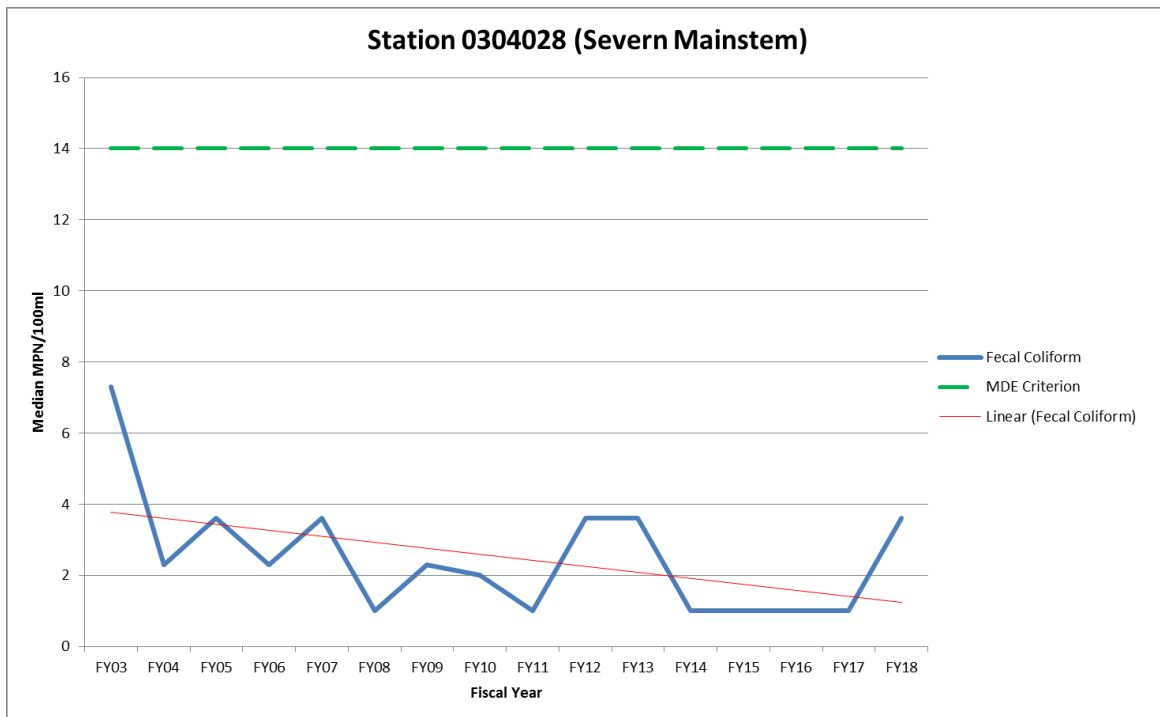
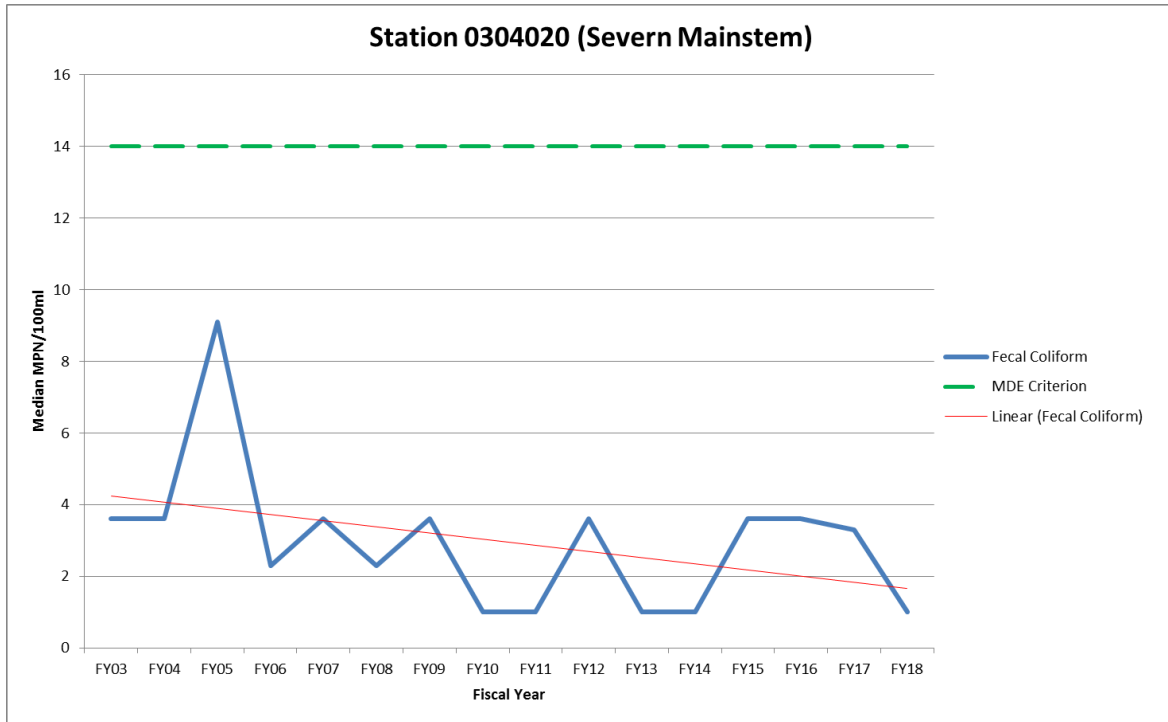


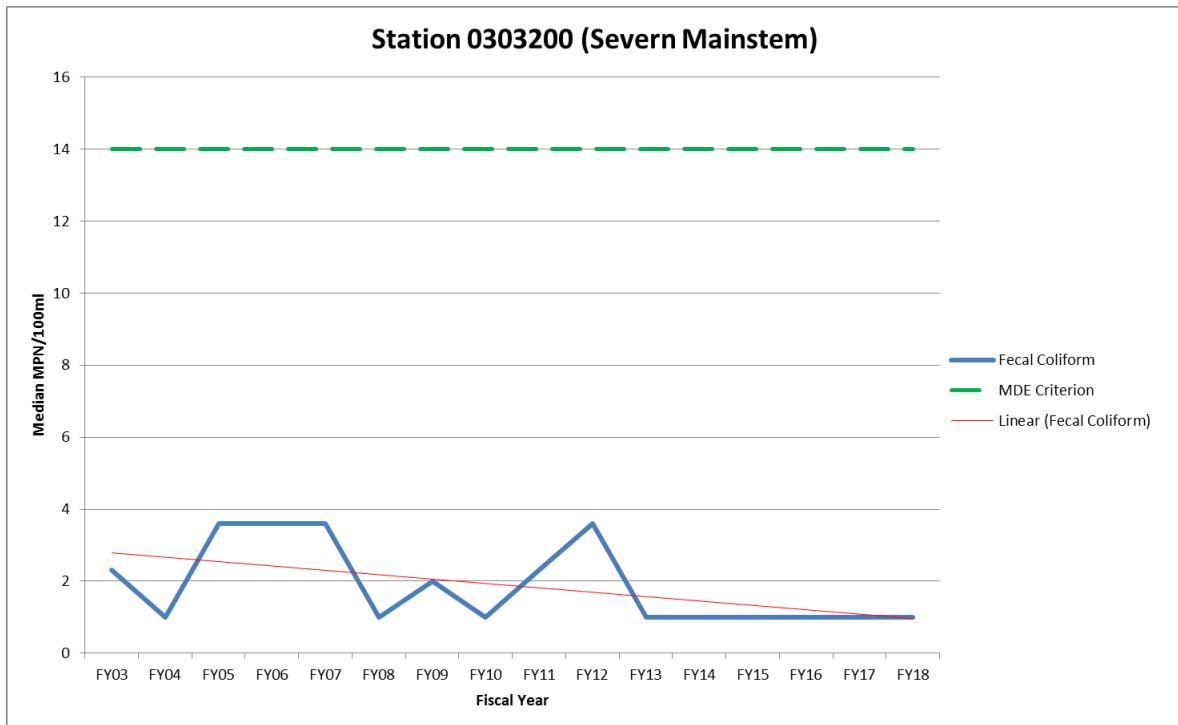
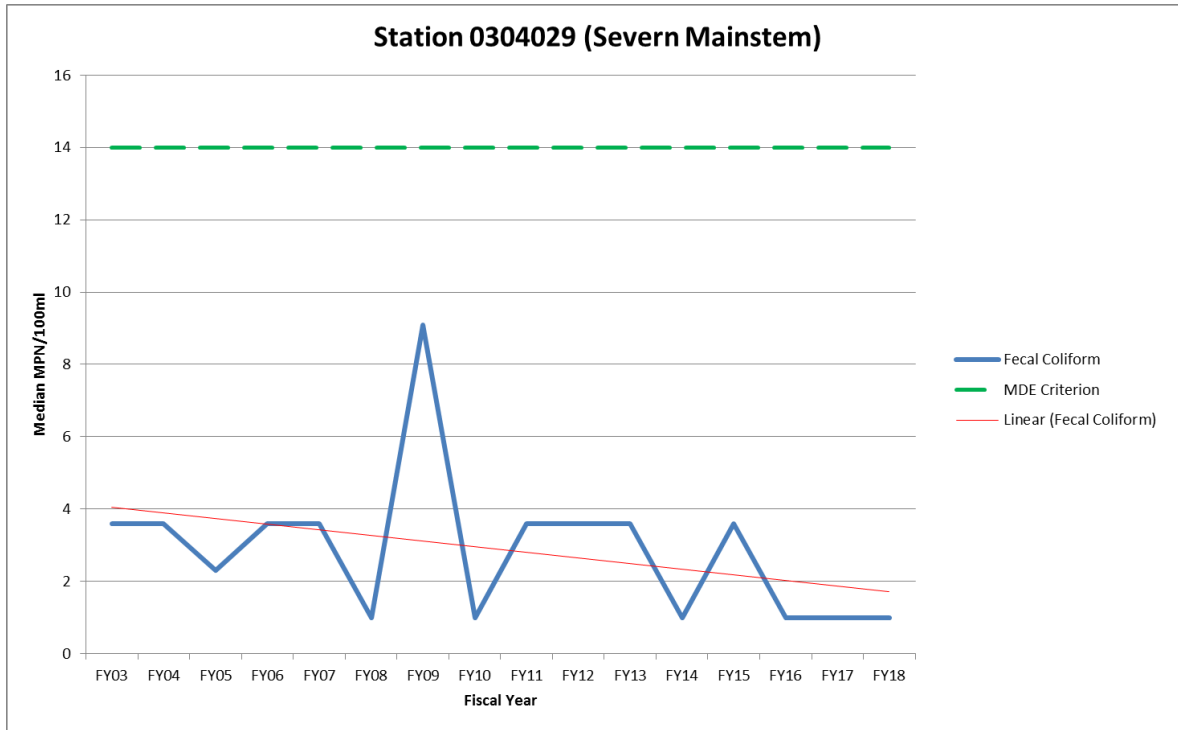


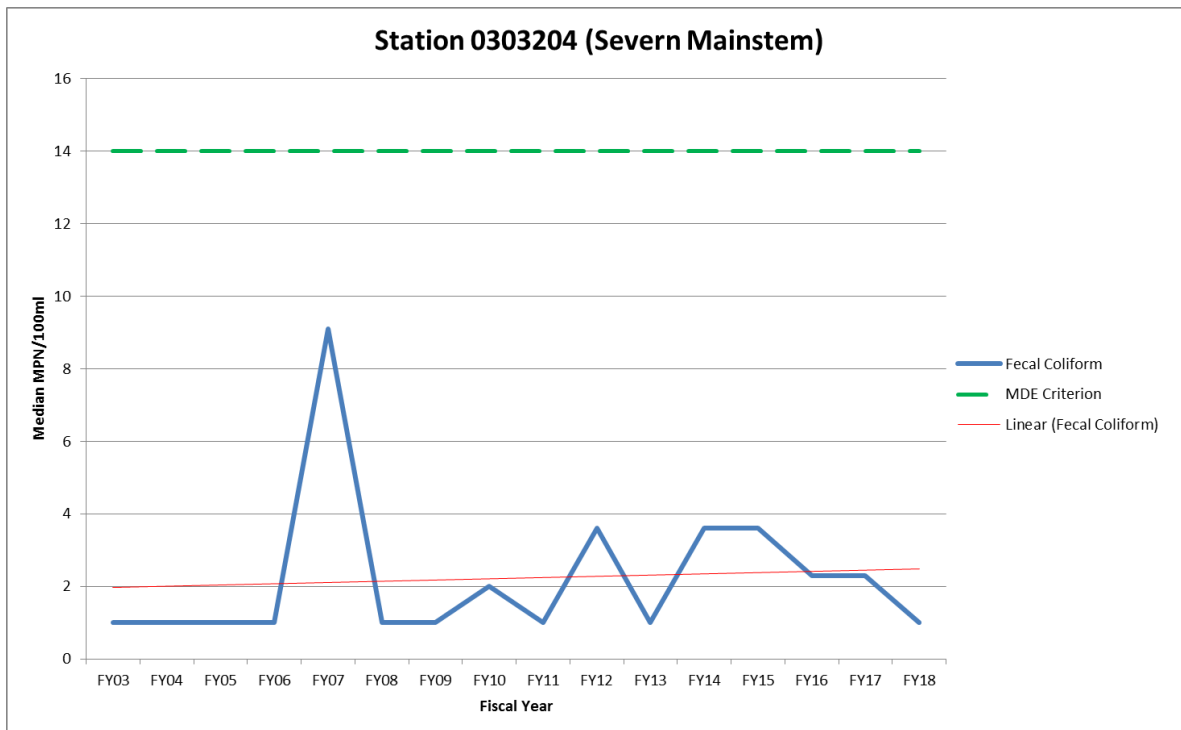
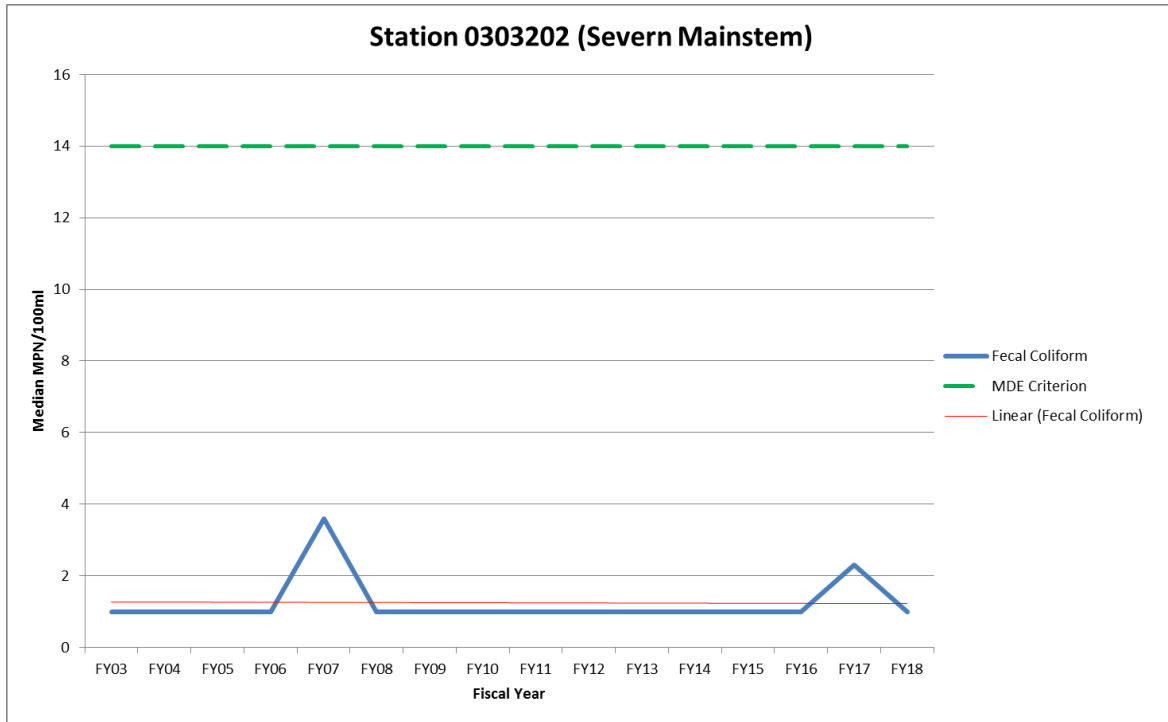


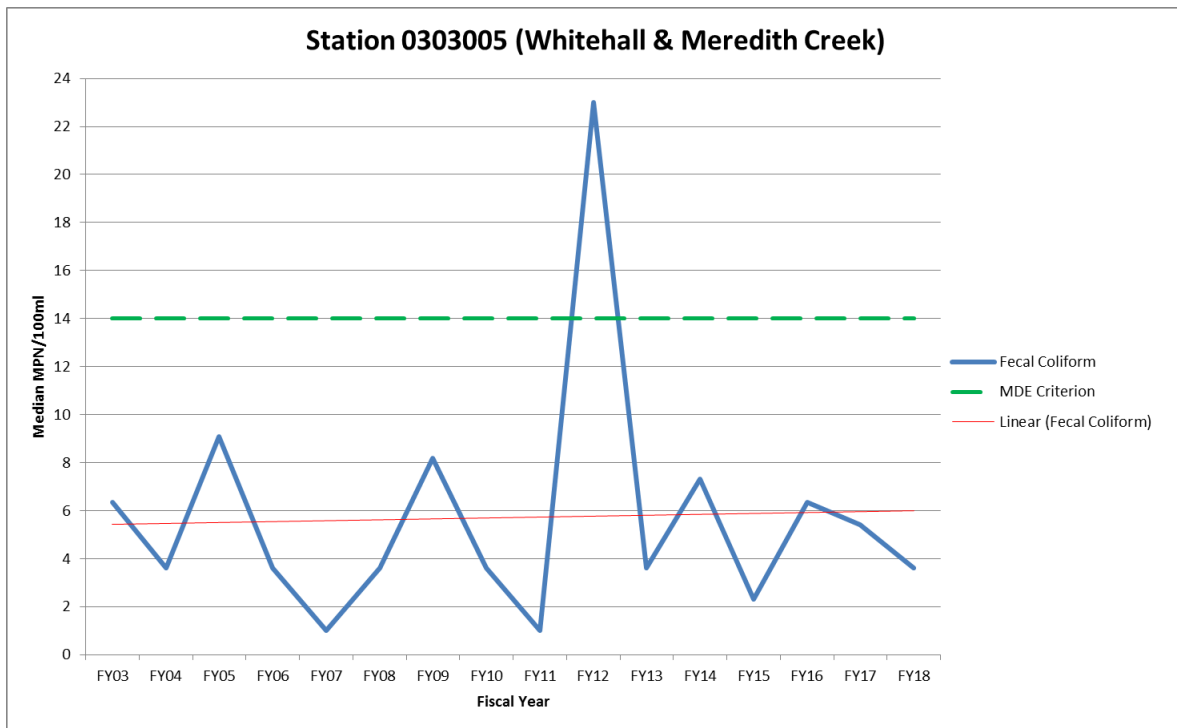
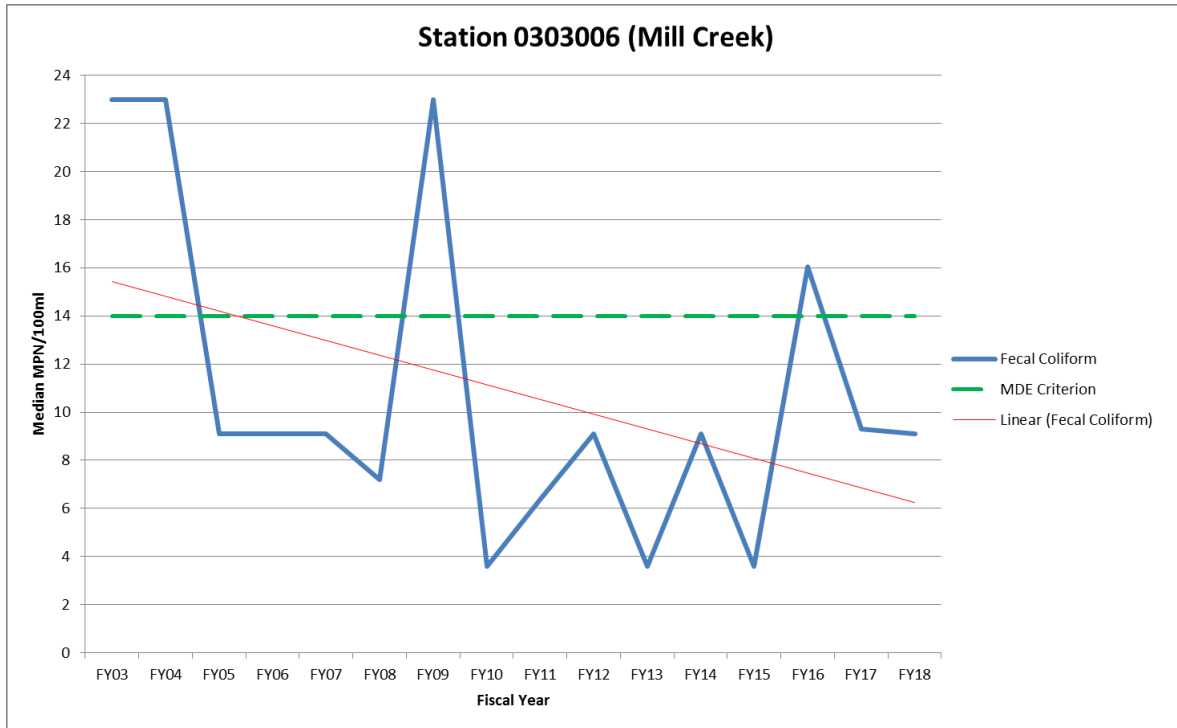


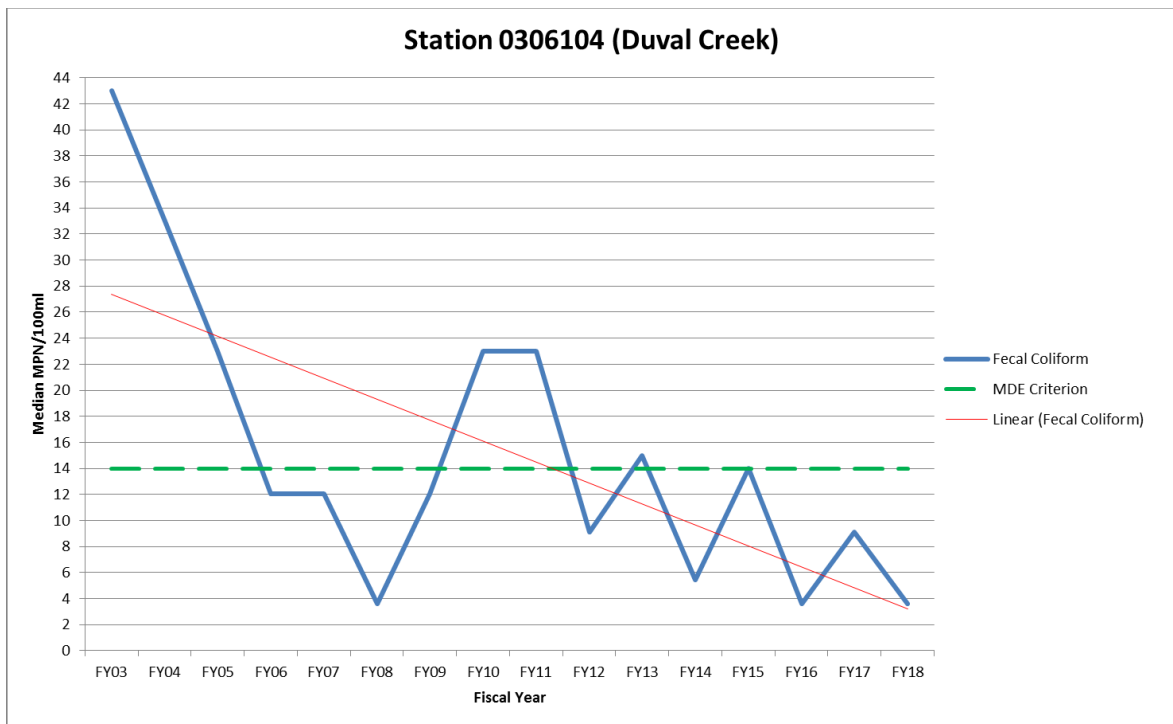
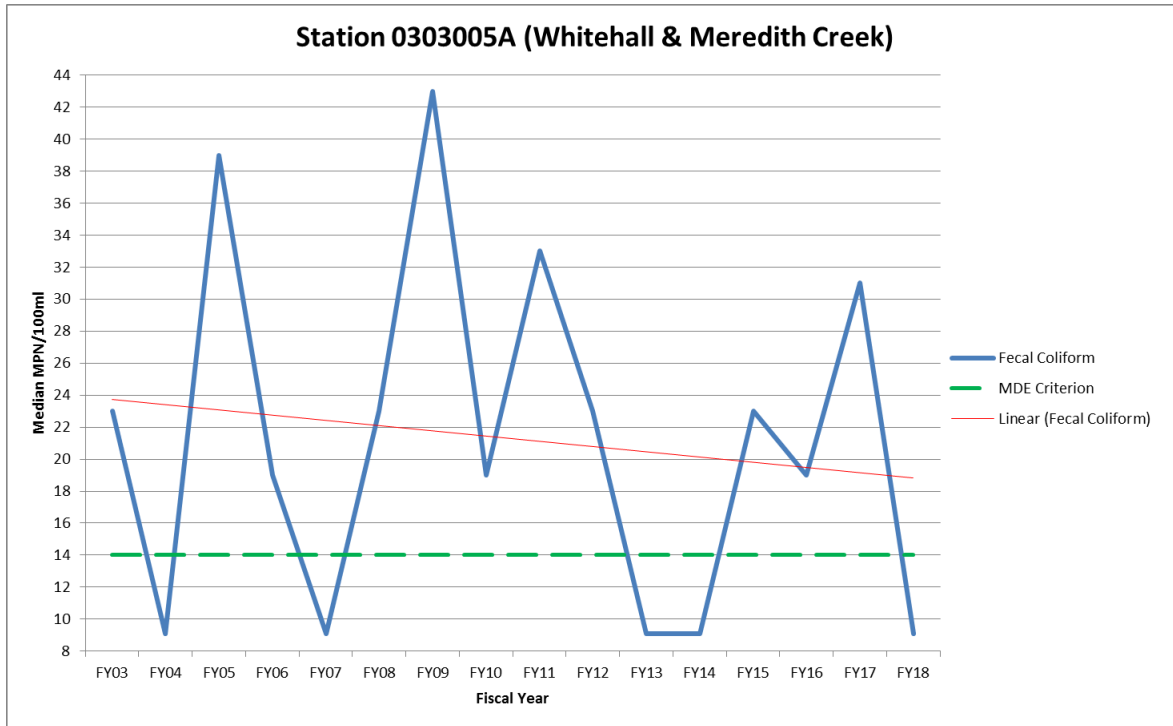


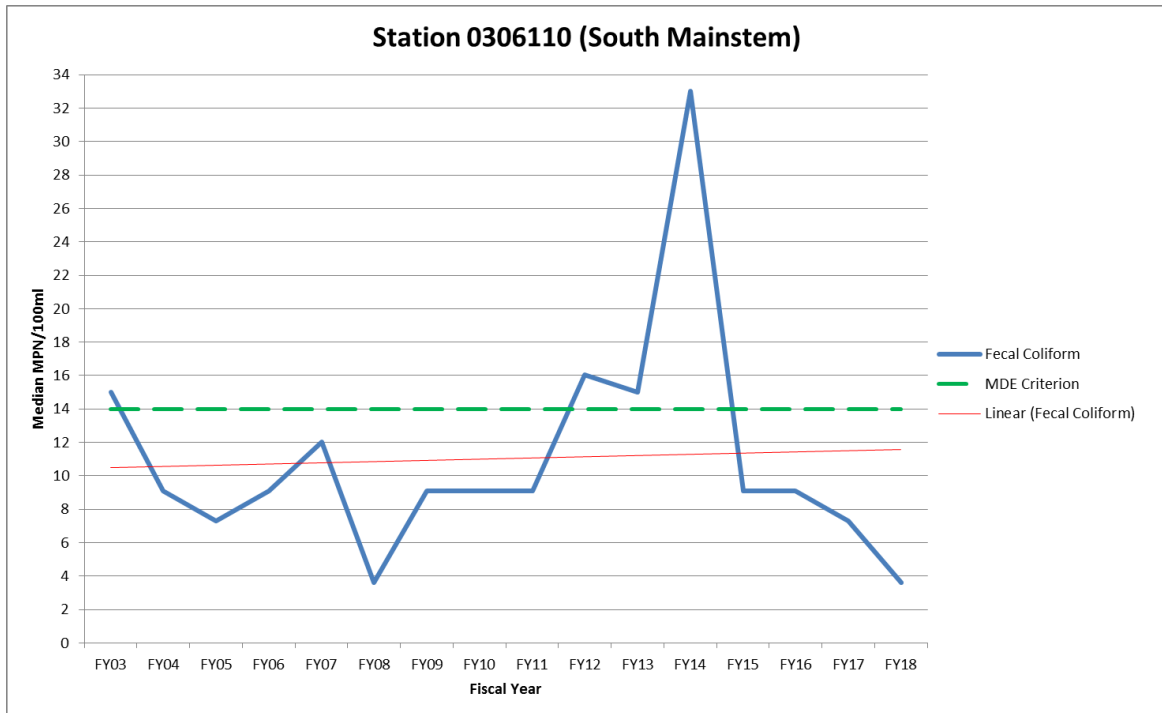
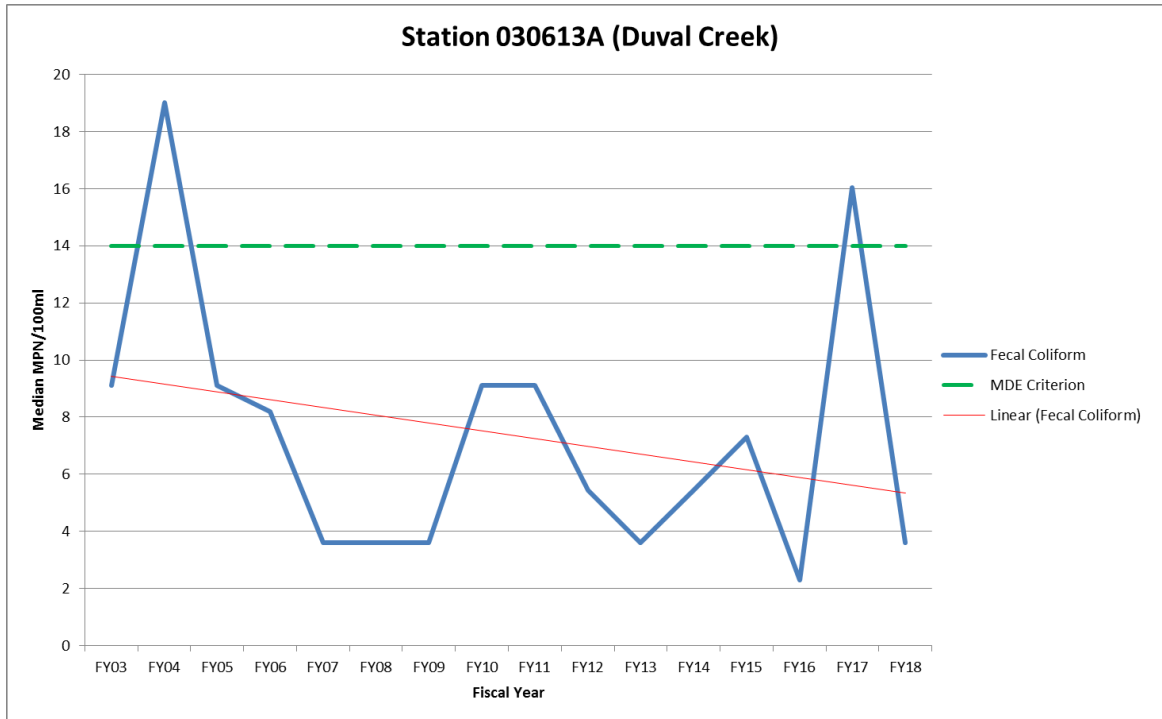


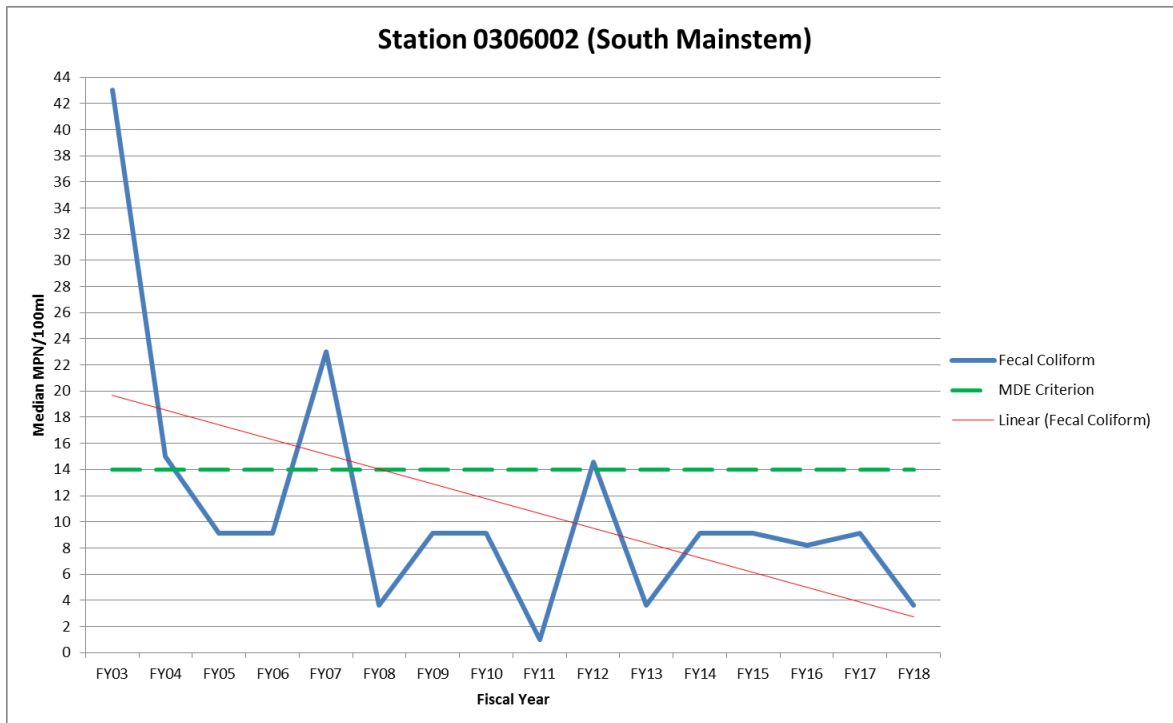
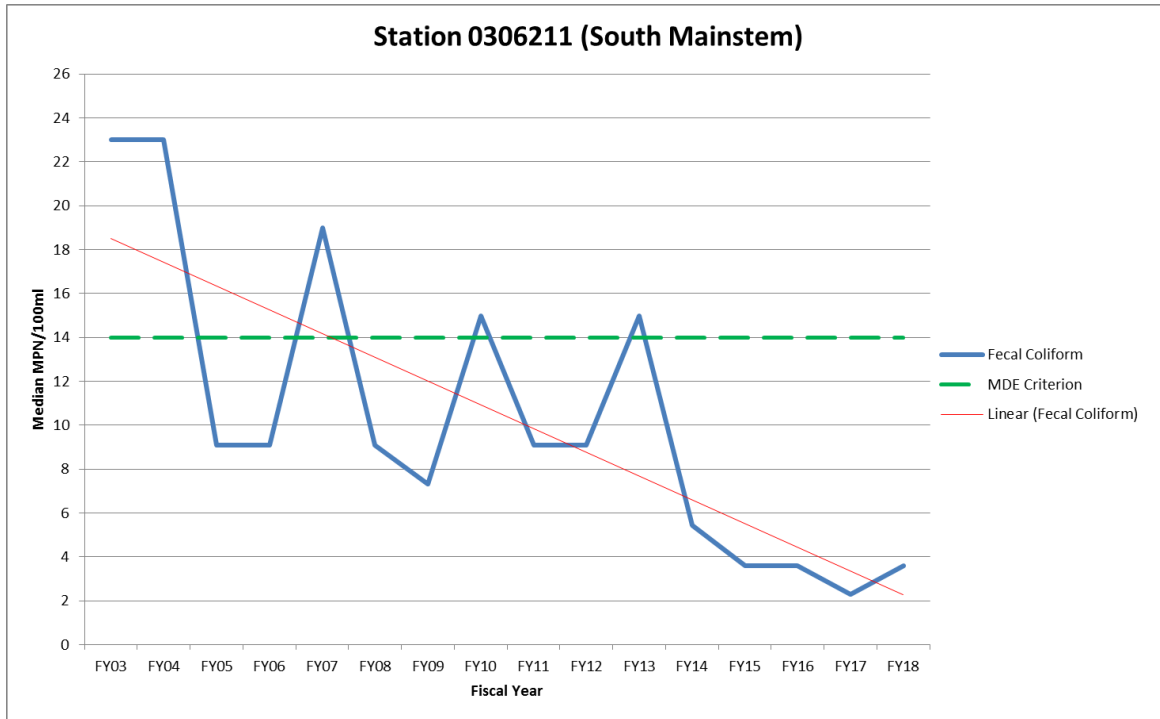


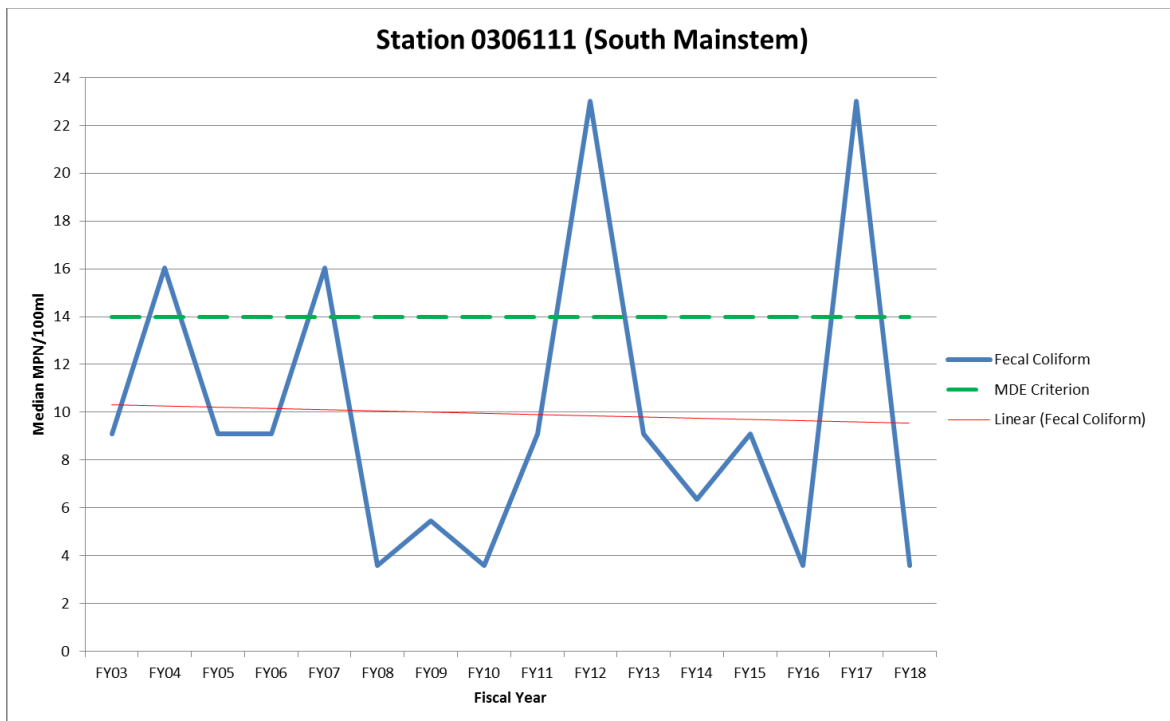
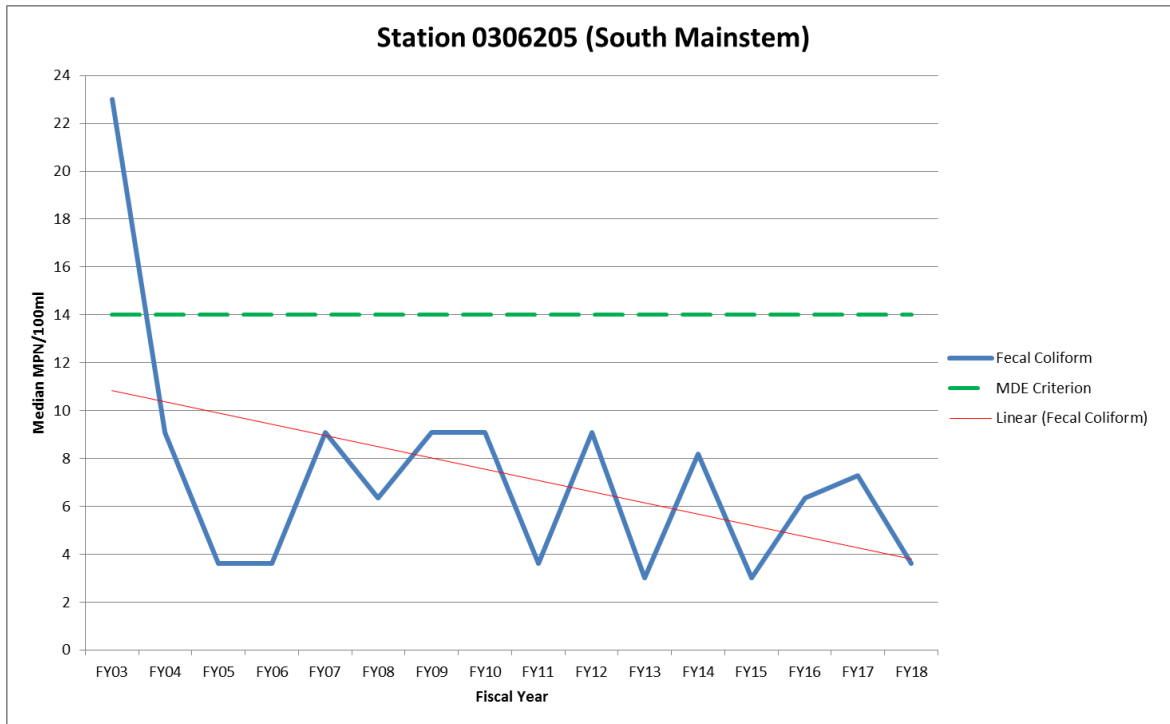


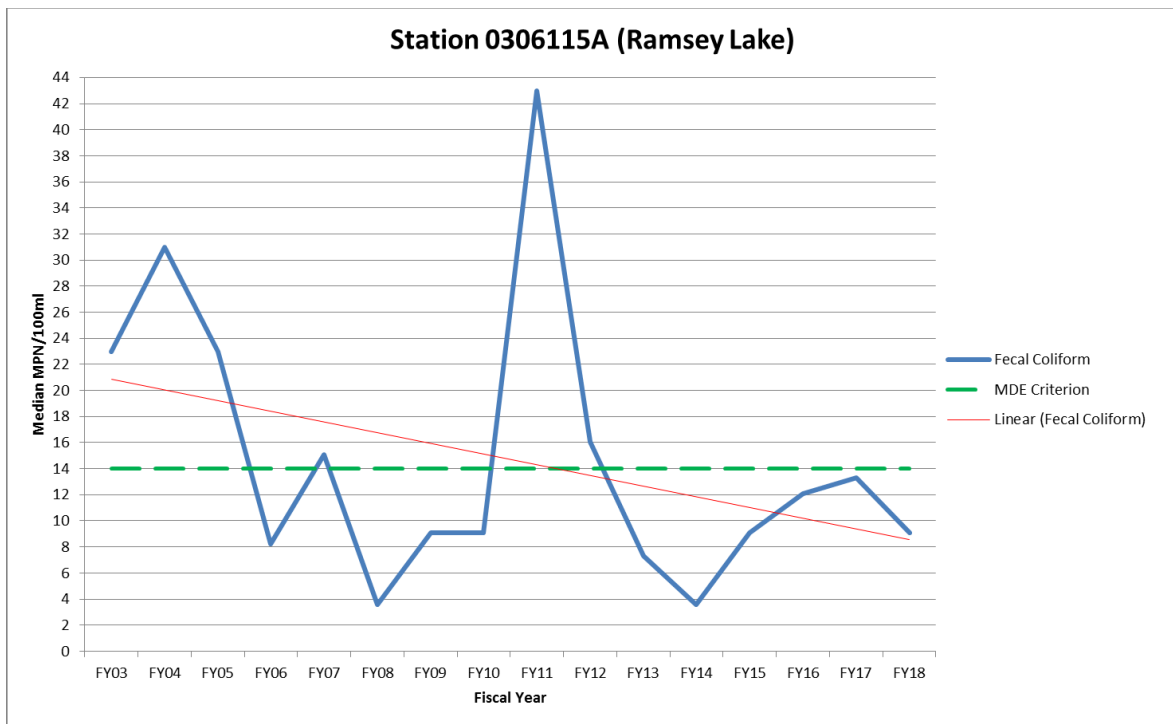
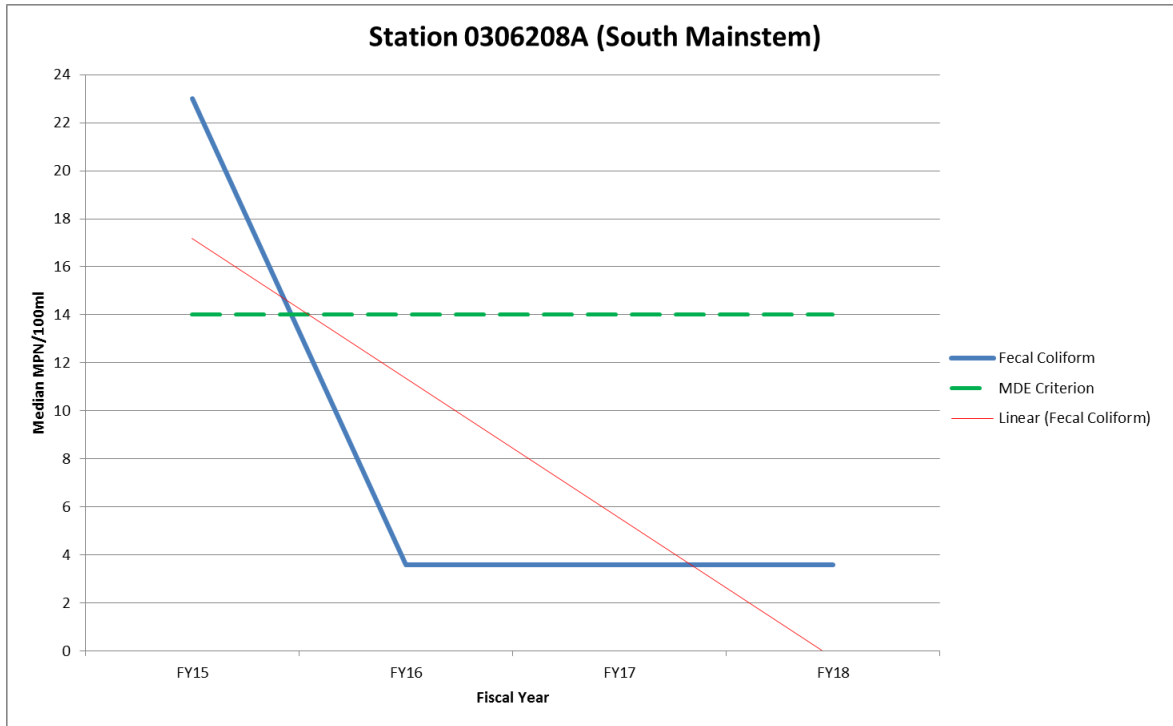


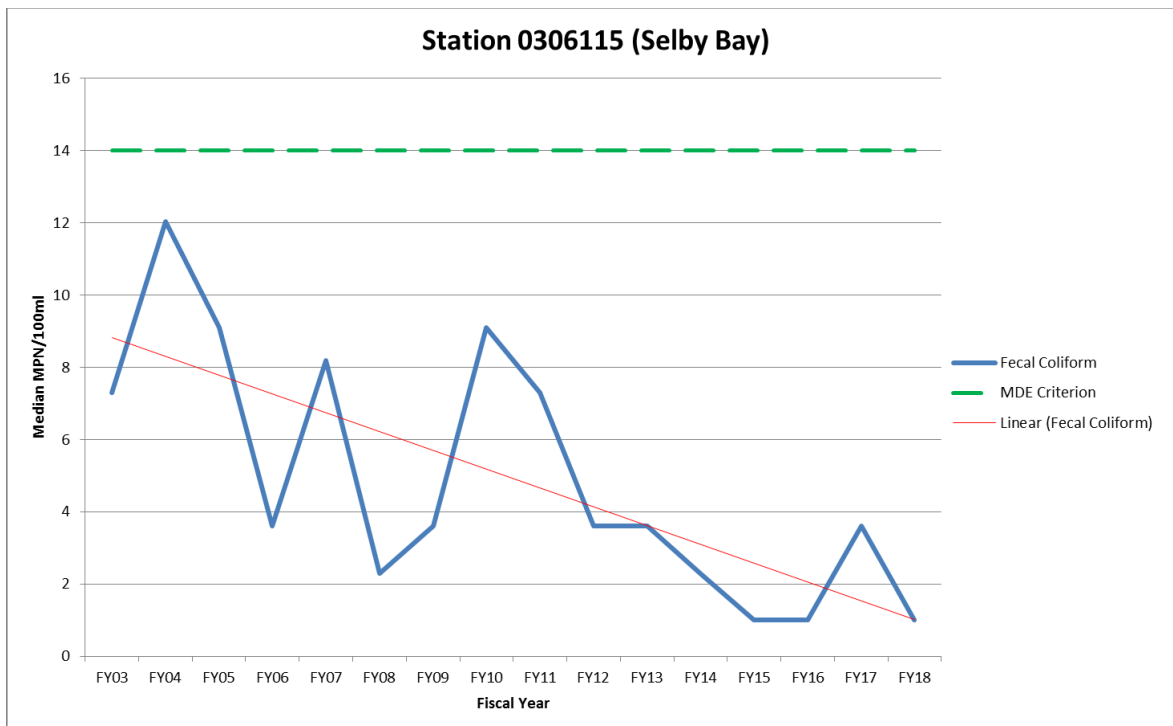
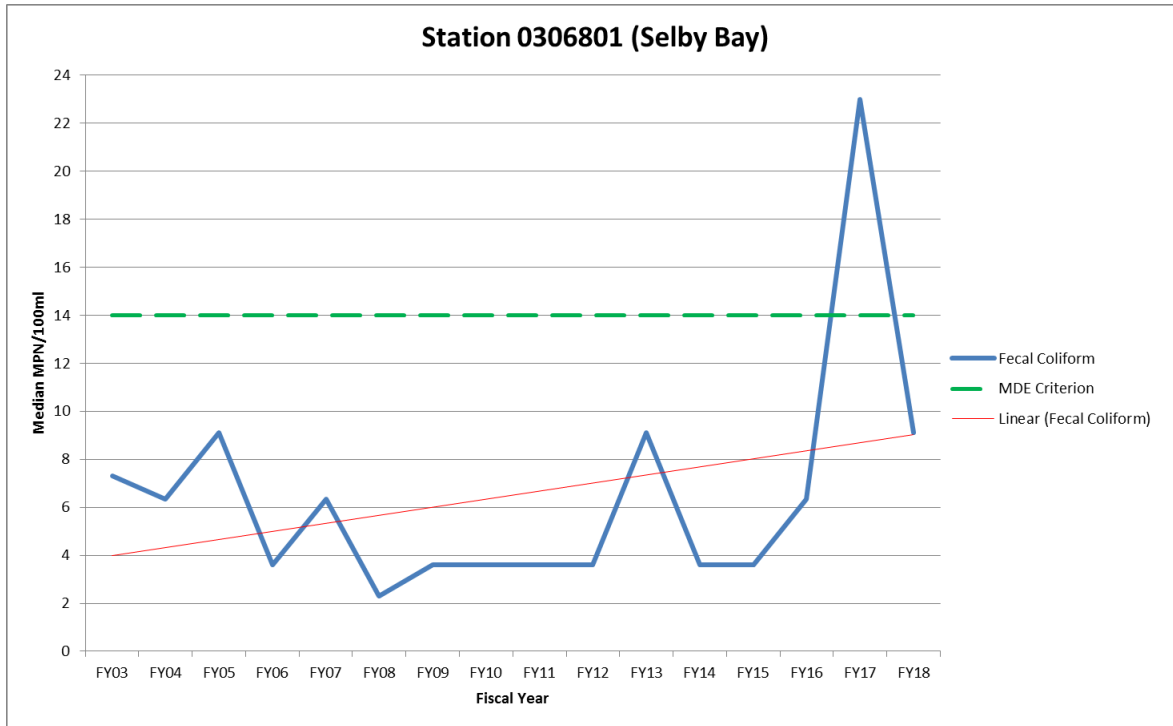


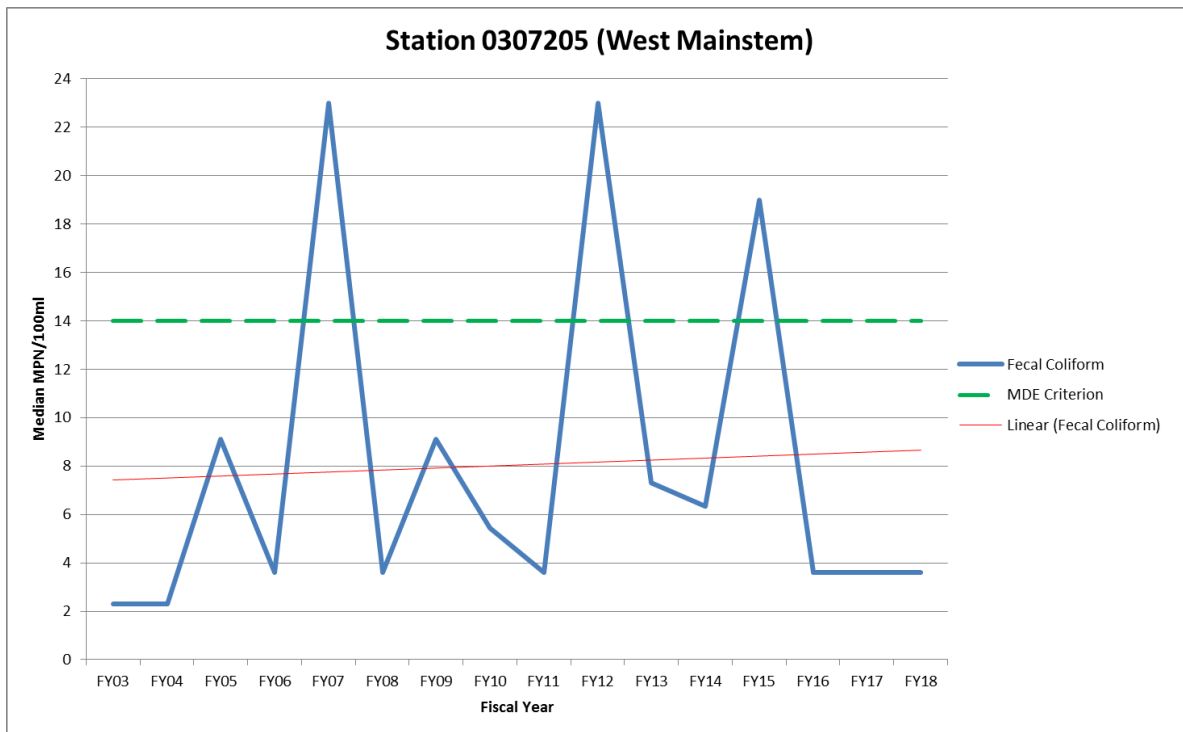
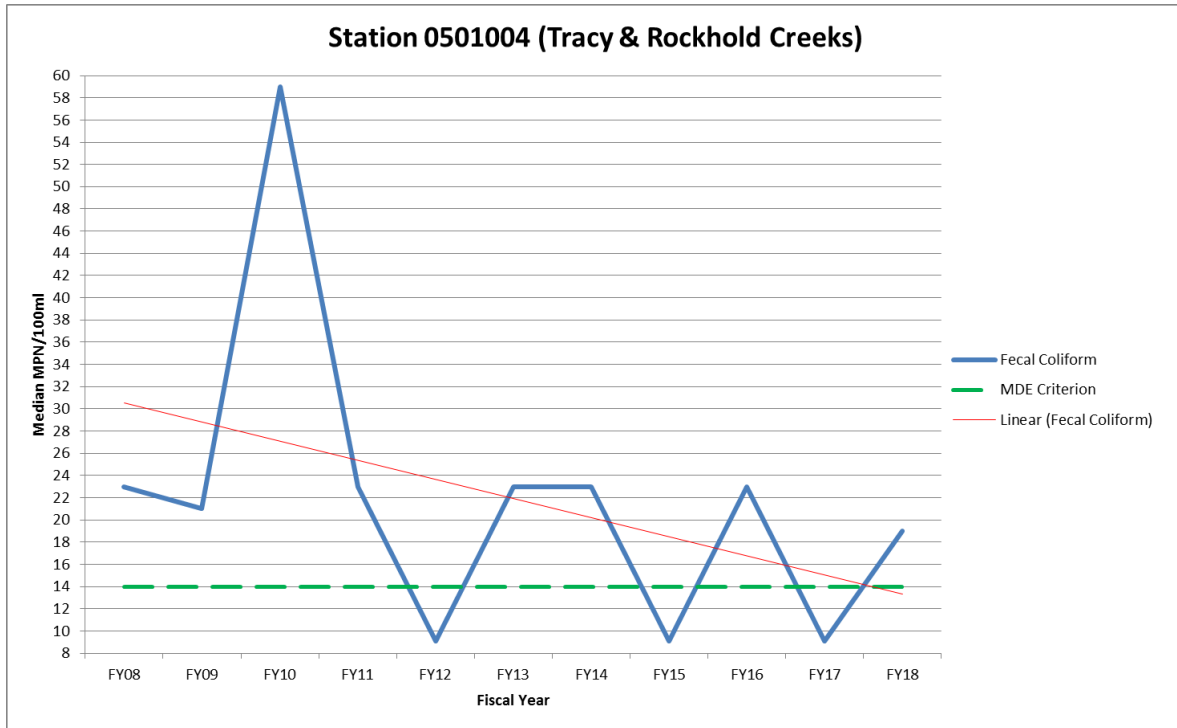


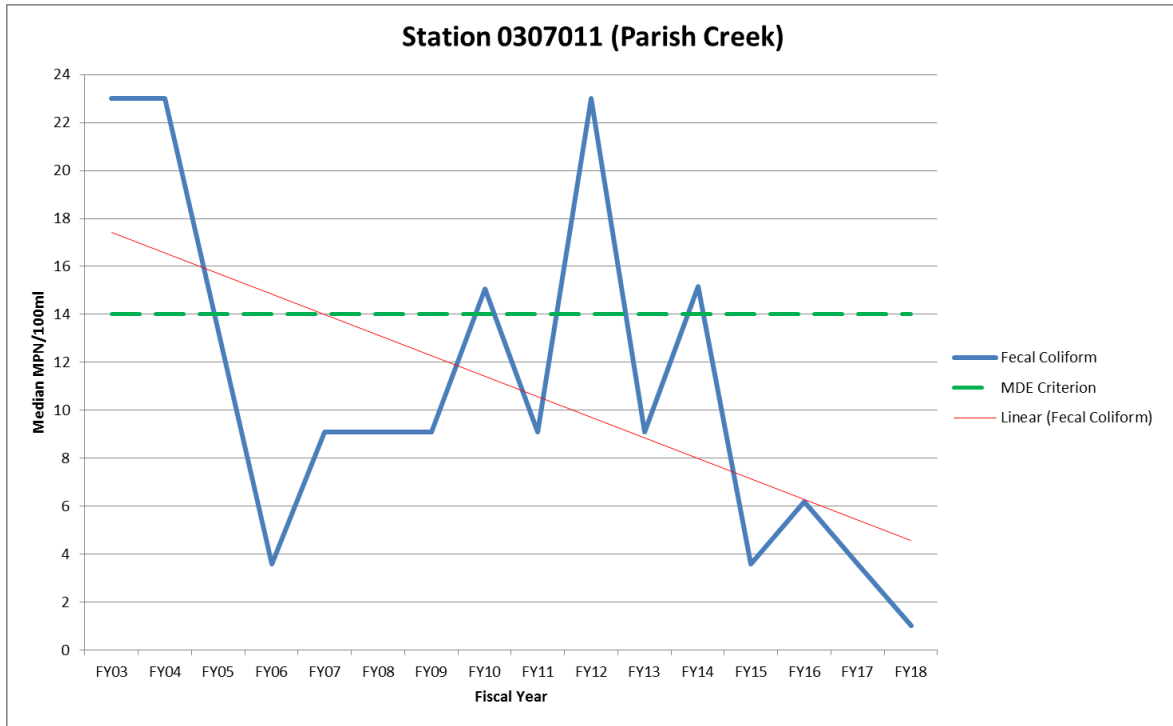












Appendix C

**MDE Observations on FY2017 Annual Bacteria TMDL Assessment
Report and County Response**

MDE's Water and Science Administration provided comments on the TMDL Compliance sections of Anne Arundel County's 2017 NPDES MS4 Annual Report on May 11, 2018. Attachment 2 (appended to the May 11, 2017 MDE comment letter) serves as MDE's formal approval of Anne Arundel County's stormwater wasteload allocation implementation plans including the Bacteria TMDL restoration plan. MDE determined that "Anne Arundel County's SW-WLA implementation plans, responsive to local water quality impairments an EPA approved TMDLs, have met permit contidion Part 1.IV.E.2.b. Therefore, MDE has made the decision to approve these plans." MDE's observations specific to the FY2017 Annual Bacteria TMDL Restoration Plan Assessment follow:

MDE Observations:

For the 19 bacteria TMDLs, the County provided updates on milestones, restoration plans, and implementation schedules. The programmatic milestones and progress for FY2017 include:

Completing 25% of all planned new and retrofit SWM BMPs. The County continues to make progress on implementing BMPs as described above.

Continue triennial maintenance inspections on existing BMPs. The status of the County's SWM BMP inspection program is also described above.

Complete 25% of the planned septic system to sewer connections. The County secured funding, and developed conceptual layouts and cost estimates for 140 separate projects.

Start implementing pet waste education program, including media campaigns and communit outreach. The results from the expanded outreach and findings of Anne Arundel Couty Stormwater Survey will be used to develop a more structured program for FY2018; and

Implement livestock fencing in the Upper Patuxent and West River watersheds. The County completed two livestock fencing projects in the West River watershed in FY2017.

County Response:

Anne Arundel County continues to implement stormwater restoration projects and explore program management strategies to further reduce bacteria loads to TMDL watersheds.