

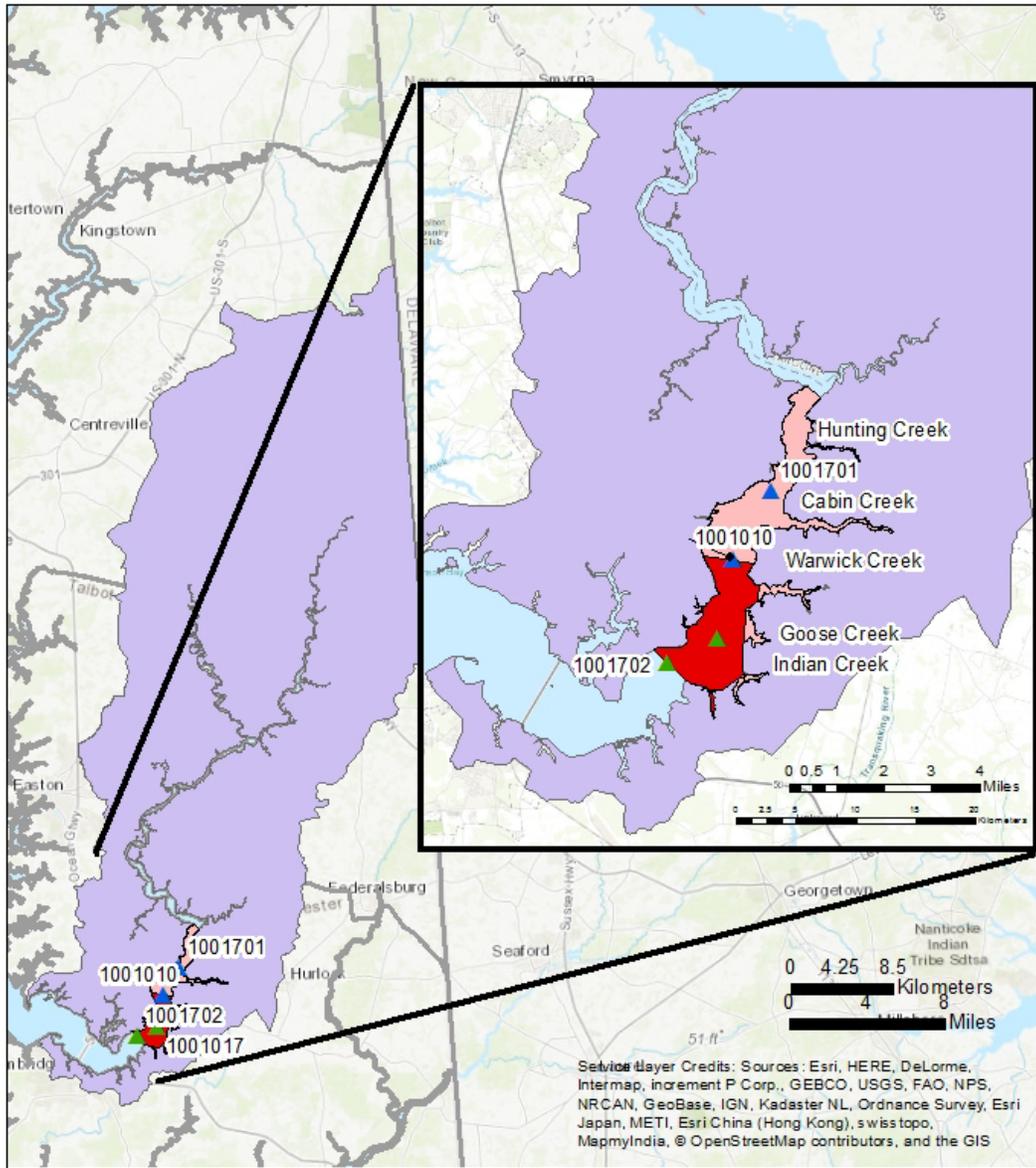
## **Appendix E: Extended Restricted Shellfish Harvesting Area in Lower Choptank River Mainstem**

### **Background**

On November 15, 2006, the U.S. Environmental Protection Agency (USEPA) approved the “Total Maximum Daily Loads of Fecal Coliform for the Restricted Shellfish Harvesting Area in the Lower Choptank River Mainstem in Dorchester and Talbot Counties, Maryland” developed by the Maryland Department of the Environment (MDE). In 2010, subsequent to the approval of the TMDL by USEPA, a shellfish harvesting area directly downstream of the impairment addressed in the 2006 TMDL was listed as impaired on the Integrated Report (IR).

Despite not being explicitly assessed within the 2006 TMDL due to the absence of an impairment, the 2010 listing was entirely covered by the 2006 modeling. The watershed for the 2010 listing was fully defined within the drainage to the 2006 TMDL segment; watershed loads and the water quality and hydrodynamics of this reach were explicitly simulated in the HEM-3D model for the TMDL. Within the TMDL, median reductions of 36.21% and 90<sup>th</sup>-percentile reductions of 65.53% were applied evenly to all of the subwatersheds draining directly to both the original impairment and to the 2010 impairment. Based on the spatial compatibility of the 2010 listing within the 2006 TMDL framework, the reductions needed to meet the 2006 TMDL will result in a similar water quality response for the 2010-listed shellfish harvesting area. This addendum will demonstrate that these TMDL reductions would result in the attainment of water quality standards in that segment, and that the TMDL framework is fully protective of the mainstem section of the Lower Choptank River Mainstem that was listed in 2010.

With the approval of this addendum by the USEPA, the shellfish harvesting area covered by the 2006 TMDL will be extended to cover the assessment unit MD-CHOMH2-Lower\_Choptank\_River\_Mainstem-2. Figure E-1 depicts the location of the 2006 TMDL and the area added to that TMDL covered by this addendum.



- ▲ Stations listed as impaired in 2010
- ▲ Stations Addressed in 2006 TMDL
- 4a-Impaired, 2006 TMDL
- 5-Impaired, 2010 Listing
- Lower Choptank 2006 TMDL Drainage Area

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**Maryland**  
Department of the Environment

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Boyd K. Rutherford, Lt. Governor  
Ben Grumbles, Secretary

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**Figure E-1. Restricted Shellfish Harvesting Area in the Lower Choptank River Mainstem**

### Water Quality Assessment

Maryland’s listing methodology for shellfish harvesting waters states, “In order to demonstrate support of the shellfish harvesting designated use, the measured level of fecal coliform in water, expressed as MPN/100 ml (most probable number of colony forming units per 100 milliliters), must have a median of less than 14 and a 90<sup>th</sup>-percentile of less than 49, calculated from a minimum of 30 samples taken over a three year period” (MDE 2017).

The 2010 listing is based on the fecal coliform data at Stations 10-01-017 and 10-01-702. A data assessment based on 30 samples collected from 7/24/2013 to 1/28/2017 is shown in Table E-1. The median and 90<sup>th</sup> percentile fecal coliform concentration values at two stations located in the extended restricted area are all below the criteria.

**Table E-1: Water Quality Assessment of Fecal Coliform at Stations 10-01-017 and 10-01-702**

Based on the most recent 30 samples from 7/24/2013 to 1/28/2017		
Station	Median (MPN/100ml)	90th percentile (MPN/100ml)
10-01-017	11.6	39.4
10-01-702	9.1	43
Criterion	14	49

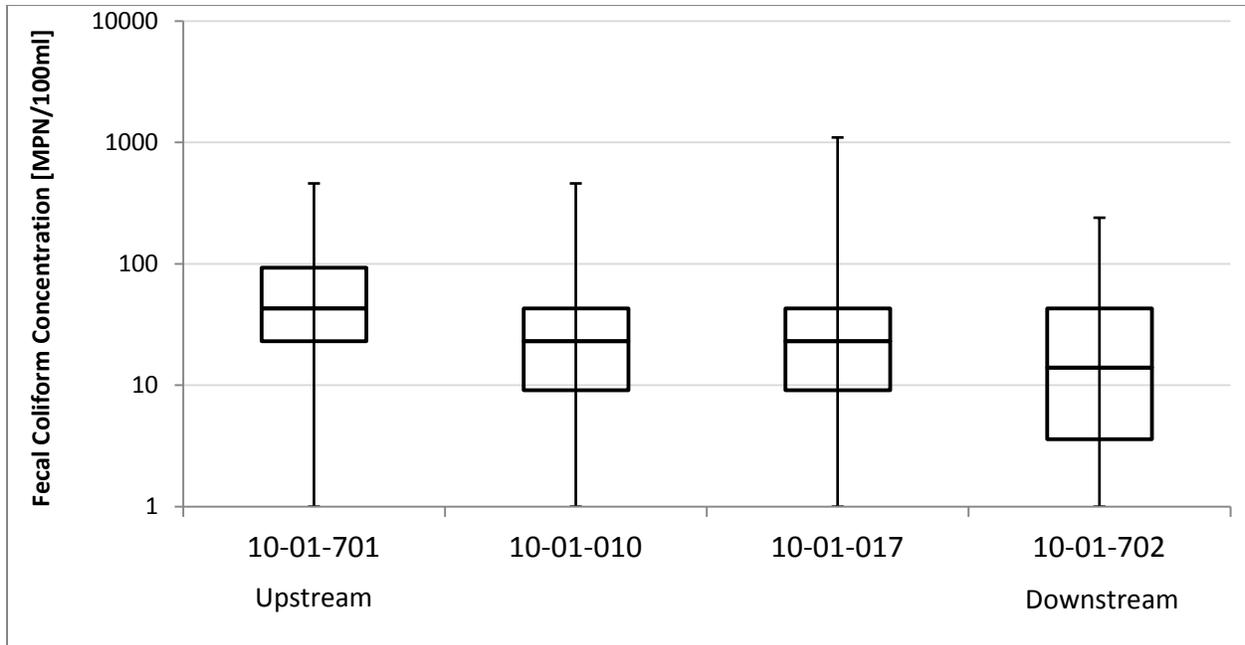
### Watershed

The watershed covered by the 2006 TMDL for fecal coliform in the Lower Choptank River, shown in Figure E-1, is coincident with the watershed that drains to Stations 10-01-017 and 10-01-702. These two stations are located directly downstream of the restricted shellfish harvesting area addressed by the TMDL, so any implementation actions for the 2006 TMDL would provide a benefit there as well.

In order to understand the spatial patterns of fecal coliform concentrations within the river, data from four mainstem stations were analyzed, dating from April 2000 to January 2017. From upstream to downstream the Stations are 10-01-701 and 10-01-010, located in the shellfish harvesting area addressed by the original TMDL, and 10-01-017 and 10-01-702, located downstream of the extended restricted area, closer to the mainstem of the Chesapeake Bay. The locations of these stations are shown in Figure E-1.

### Data Analysis

Figure E-2 shows a box plot of the fecal coliform concentrations at these four stations, for data collected over the last 17 years. The plot shows maximum, 90<sup>th</sup>-percentile, median and 25<sup>th</sup>-percentile fecal coliform concentrations decreasing with proximity to the mainstem of the Chesapeake Bay.



**Figure E-2: Box and Whisker Plot of Fecal Coliform Concentration**

This result was supported statistically through paired sample t-tests, of each consecutive upstream-downstream station combination. The paired sample t-test is based on pairing the results of two samples taken on the same date from adjacent monitoring stations to determine whether the fecal coliform concentrations from the two stations are significantly different from each other. These tests generally showed decreases in fecal concentration between the consecutive stations moving downstream, although a slight increase was observed between the mean values from station 10-01-010 to station 10-01-017.

**Table E-2: Comparison of upstream-downstream fecal coliform counts (MPN/100 mL)**

t-Test: Paired Two Sample for Means	Test 1		Test 2		Test 3	
Station	10-01-701	10-01-010	10-01-010	10-01-017	10-01-017	10-01-702
Mean	61	54	54	56	56	30
Variance	5039	7964	7964	18822	18822	2316
Observations	184	184	184	184	184	184
Pearson Correlation	0.2033		0.6019		0.2260	
Hypothesized Mean Difference	0		0		0	
df	183		183		183	
t Stat	1.0326		-0.3205		2.5915	
P(T<=t) one-tail	1.52E-01		3.74E-01		5.16E-03	
t Critical one-tail	1.6532		1.6532		1.6532	

**Conclusion**

The results of this analysis support the inclusion of the 2010 listing in the Lower Choptank River mainstem, MD-CHOMH2-Lower\_Choptank\_River\_Mainstem-2, in the TMDL for fecal coliform in the Lower Choptank River mainstem. First, the drainage area to the 2010 listing is identical to the drainage area described in the 2006 TMDL, meaning that any implementation for the TMDL will benefit the area in the 2010 listing as well. Second, since fecal coliform

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concentrations are consistently lower in the area listed in 2010, the attainment of water quality criteria in areas covered by the 2006 TMDL will result in fecal coliform levels at Stations 10-01-017 and 10-01-702 that are below the criteria.

**References:**

- Maryland Department of the Environment (MDE). 2006. *Total Maximum Daily Loads of Fecal Coliform for the Restricted Shellfish Harvesting Area in the Lower Choptank River Mainstem in Dorchester and Talbot Counties, Maryland*.  
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