Anchor Bay *E. coli* Reduction Plan

For St. Clair County's portion of the Anchor Bay Watershed

Meldrum Creek in Casco Twp. south of Meisner Road

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I. PROBLEM STATEMENT

Section 303(d) of the federal Clean Water Act and the United States Environmental Protection Agency's Water Quality Planning and Management Regulations require states to develop Total Maximum Daily Loads (TMDL) for water bodies that are not meeting Water Quality Standards (WQS).

In 2002, an *Escherichia coli (E. coli)* TMDL assessment was completed for Crapau (aka: Crapaud, Crapo and Crepeau) Creek, which flows from St. Clair County (SCC) and Macomb County (MC) MI, and into Lake St. Clair (Figure 1). In 2007, an *E. coli* TMDL assessment was also completed for the Lake St. Clair Metropolitan and Memorial Beaches in Macomb County. These two beaches are located on Lake St. Clair, 7 miles and 13 miles across the lake from SCC respectively (Figure 1).

In 2010, the SCC Health Department (SCCHD), in partnership with the SCC Drain Office (SCCDO) and three local communities in the watershed, received funding from the Michigan Department of Environmental Quality (MDEQ) and the American Recovery and Reinvestment Act to develop an *E. coli* TMDL implementation plan for SCC's portion of the Anchor Bay watershed (hereafter called the study area).

This plan identifies the activities necessary to reduce *E. coli* in tributaries of study area.

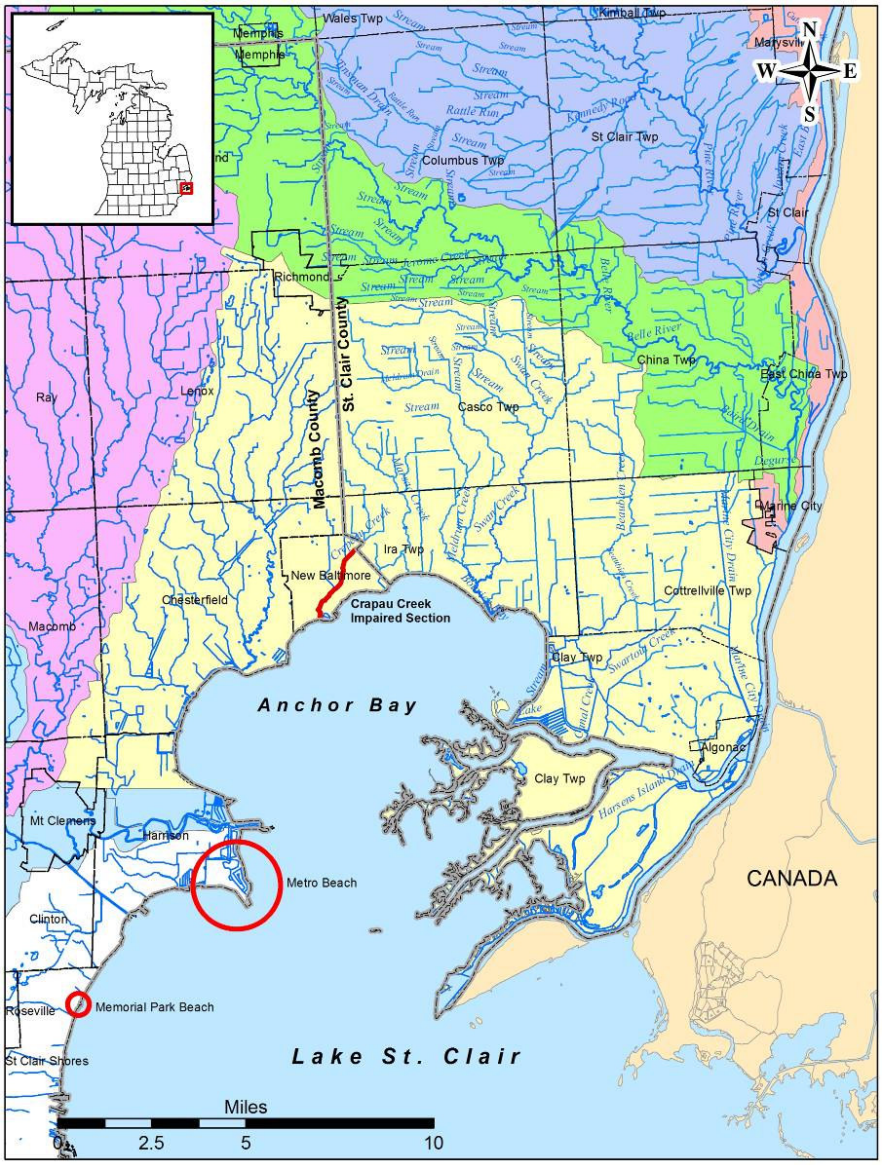

Figure 1. *E. coli* TMDLs in the Lake St. Clair Watershed

II. TMDL DESCRIPTIONS

Crapau Creek TMDL

The Crapau Creek TMDL is limited to two miles of the creek where recreational uses are impaired by elevated *E. coli* levels. The impaired section is entirely within New Baltimore, Macomb County. Drainage to the listed reach includes the headwaters in SCC and accounts for approximately 37% of the Crapau Creek watershed. Since this was a concentration-based TMDL, actual load allocations were not calculated. However, the relative load allocations for SCC communities were reported as 15% for Casco Township and 22% for Ira Township based on contributing drainage area (MDEQ 2002).

Lake St. Clair Metropolitan and Memorial Beaches

Recreational uses at the Lake St. Clair Metropolitan and Memorial Beaches are also impaired by elevated *E. coli* levels. While the distance of tributaries in SCC from these beaches seems far enough away to make their affect on these beaches minimal, modeling of particle flow has demonstrated that under predominate wind conditions "hypothetical particles released from the North Channel St. Clair River, moved west along the coast of Anchor Bay and around to L'Anse Creuse Bay past both TMDL beaches and circulating back north along the coast …" (MDEQ 2007). Therefore, tributaries to Anchor Bay were considered in this TMDL.

According to the TMDL, twenty municipalities have land area within the Lake St. Clair watershed and SCC's portion makes up 48% of the watershed area. As with the Crapau Creek TMDL, the TMDL was concentration-based and actual load allocations were not calculated. However, relative load allocations for SCC communities were indicated as 17% for Clay Township, 13% for Casco Township, 10% for Cottrellville Township, 7% for Ira Township and 1% for City of Algonac based on contributing drainage area. Unfortunately, the TMDL did not account for the Clinton River watershed, although it was mentioned as a source of *E. coli* for these beaches. If the Clinton River watershed were taken into account, SCC's relative load allocation would decrease to 10% total.

Nonetheless, Anchor Bay tributaries exhibit *E. coli* concentrations above WQS, and SCC and the local communities have a responsibility to reduce *E. coli* concentrations to the maximum extent practical.

III. CHARACTERISTICS OF THE STUDY AREA

The study area encompasses about 111 square miles and drains to the Lake St. Clair. The study area is divided into eight main sub-basins as shown in Figure 2. There are approximately 198 miles of streams in the study area with the eight major tributaries being (listed from west to east):

- Crapau Creek,
- Marsac Creek,
- Swan Creek,
- Palms Road Drain,
- Beaubien Creek,
- Swartout Drain,
- Harsens Island Drain, and
- Marine City Drain and Direct Drainage.

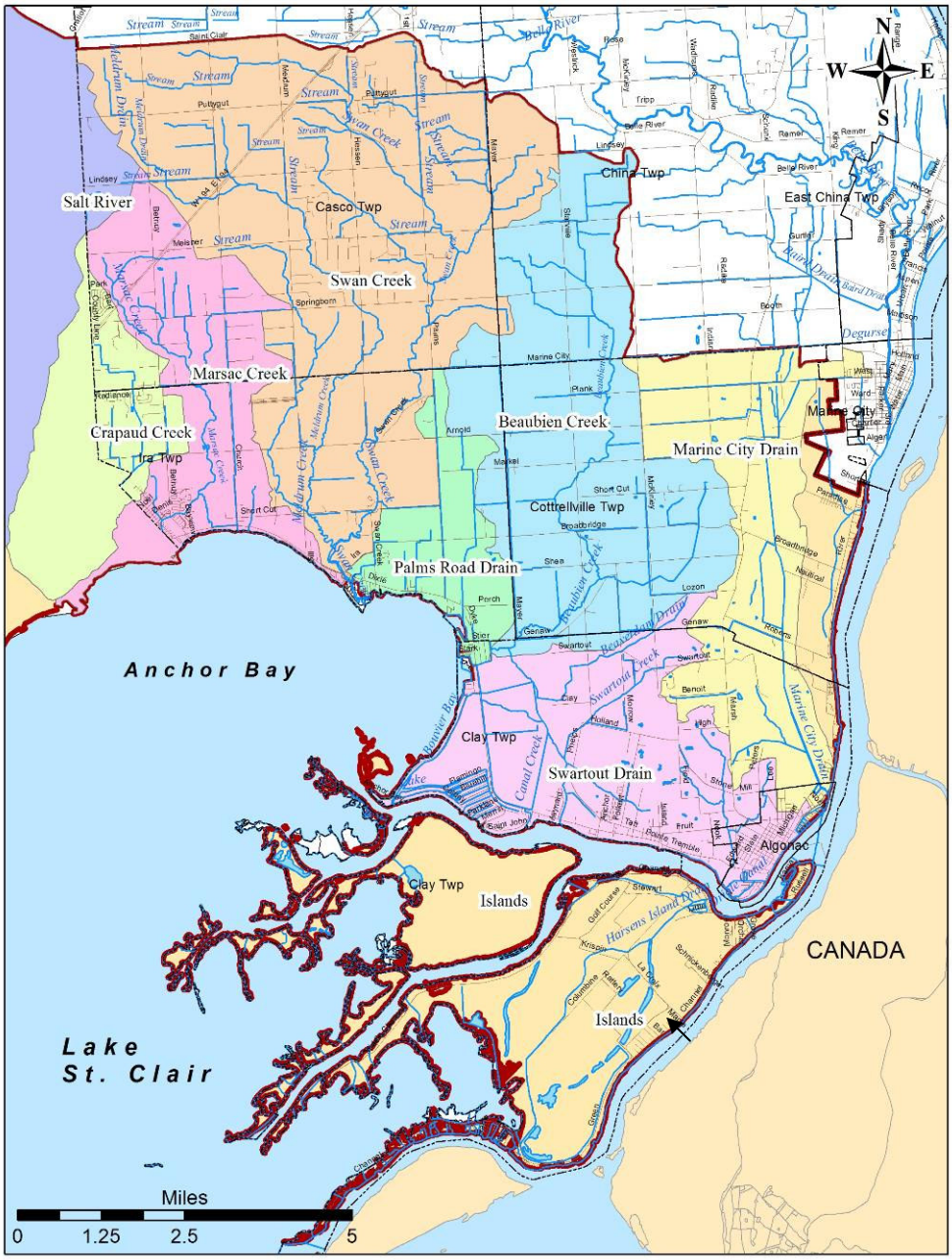

Figure 2. Study Area

The SCCDO has jurisdiction over 24 designated county drains in the study area that provide approximately 59% (116 miles) of the drainage (ECT 2004).

Topography of the watershed varies from level to gently sloping terrain. The soils are generally characterized as poorly draining with high clay content, although there are limited areas of sandy soils (FTC&H 2006a).

The study area is divided into six municipal jurisdictions as shown in Table 1. The study area contains approximately 10,500 occupied households[1] based on 2010 U.S. Department of Census data and is home to approximately 22,000 residents. SCC and three of the six local municipalities in the study area hold National Pollutant Discharge Elimination System (NPDES) permits to discharge storm water from municipal separate storm sewer systems (MS4s).

Table 1. Size and NPDES Regulated Status of Communities within the Study Area

Community		Study Area		Storm Water Permittee
		(mi^2)	(%)	
Largest ↓ Smallest	Clay Township	36	33	√
	Casco Township	29	26	
	Cottrellville Township	21	19	
	Ira Township	17	15	√
	China Township	6.3	6	
	Algonac	1.4	1	√
	Total	**111**	**100%**	

Sanitary sewage disposal in the study area is handled by public sanitary sewer/wastewater treatment plant, private sewer/lagoon systems for two mobile home parks, and private septic systems. The sanitary sewer service area hugs the shoreline along Anchor Bay and the St. Clair River (Figure 3) and serves almost 9,300 dwellings with treatment at the Algonac Wastewater Treatment Plant.

There are approximately 5,400 dwellings served by private septic systems in the study area. The largest community in square mileage, Clay Township, also has the greatest number of private septic systems (Table 2).

Figure 3. Estimated 2005 Sanitary Sewer Service Area (SEMCOG)

[1] Estimated based on the number of households within each municipality and the portion of each community within the study area.

Table 2. Number of Dwellings Served by Sanitary Sewers and Septic Systems

Community		Total Number of Dwellings	Sanitary Sewage Disposal	
			Public Wastewater Treatment Plant*	Private Onsite Septic System**
Largest # of dwellings ↓ Smallest # of dwellings	Clay Township	4,950	3,046	1,904
	Cottrellville Township	3,175	2,500‡	675
	Ira Township	2,225	1,740‡	485
	China Township	1,301	138	1,163
	Algonac	1,855	1,855	0
	Casco Township	1,200†	0	1,200
	Total	**11,651**	**9,279**	**5,427**

*Based on survey of the local communities.
**Estimated based on total number of dwellings in the community minus those served by sanitary sewers.
†Doesn't include Americana Estates Mobile Home Park, which operates a lagoon wastewater treatment system.
‡Including mobile home parks.

There are several NPDES-permitted dischargers of treated sanitary wastewater in the study area as listed in Table 3 (FTC&H 2006a). The entities that discharge treated wastewater to surface waters have a fecal coliform effluent limit of 200 colonies per 100 ml based on a geometric mean of 5 or more samples over 30 days. The MDEQ assumes that *E. coli* WQS are being met when these dischargers met their fecal coliform limit (MDEQ 2002).

Table 3. NPDES Permits for Wastewater Dischargers

Facility Name	Permit #	Receiving Water
Consumers Energy – St. Clair Compressor Station	GW1010168	Groundwater
Millstone Pond Mobile Home Park (MHP)	MI0055816	Crapau Creek
Americana Estates of Casco MHP	MI0027073	Marsac Creek
Anchor Bay Schools-Casco	MIG580328	Marsac Creek
MDOT I-94 WB/SB Rest Area	MIG580027	Marsac Creek
MDOT I-94 EB/NB Rest Area	MIG580026	Swan Creek
Old Club Wastewater Treatment Plant (WWTP)	MIG570210	St. Clair River
Algonac WWTP	MI0020389	St. Clair River

IV. RECENT *E. COLI* REDUCTION INITIATIVES

Significant progress has been made reducing bacteria in the study area since the Crapau Creek and Lake St. Clair Metropolitan and Memorial Beaches TMDLs were approved. Based on a 2009 evaluation of activities being conducted in the Anchor Bay watershed, **"**BMPs to reduce bacteria and protect source water were the most successful across the watershed. Communities spent significant resources to maintain and improve sanitary sewer infrastructure, and both counties implemented Illicit Discharge Elimination Programs (IDEP) that resulted in an estimated reduction of over 8 million gallons of sewage (into the Anchor Bay watershed) per year. In addition, Macomb County (MC) and New Baltimore conducted numerous surveys and a bacterial source tracking project in an effort to locate sources of *E. coli* for Crapau Creek." (SCCHD 2009).

Descriptions of recent *E. coli* reduction activities are included below.

Illicit Discharge Elimination Programs

The SCCHD and SCCDO worked together to identify and correct 110 illicit discharges (failing septic systems) in Anchor Bay since 2002. These corrections are estimated to be an equivalent reduction of more than 8 million gallons of sewage discharge per year to Anchor Bay tributaries based on an estimate of 131 gallons per day per household, with 50 gallons of sewage per person, and 2.62 persons per household (SCCHD 2009).

MC Health Department (MCHD) IDEP staff conducted 406 investigations within the Anchor Bay watershed since 2002. These investigations led to the identification of 70 illicit discharges of which 63 were corrected by January 2009. These corrections have eliminated an estimated 3 million gallons of sewage per year from the Anchor Bay watershed based on the same assumptions identified above (SCCHD 2009).

The MCHD also enacted a septic system ordinance in August 2002 aimed at recognizing and reducing septic system failures before untreated effluent escapes to the environment. The ordinance requires that a registered evaluator inspect the septic system to ensure it is in good operating condition at the time of property sale or transfer. If a failure is found, property owners are given 30 days to provide a corrective action plan and 180 days to implement the corrective actions. The ordinance has resulted in almost 5,000 inspections and the identification of hundreds of failures[2] (personal communication, Steve Lichota, 9/7/2011).

[2] Failures are defined as backup of sewage into the building, direct discharge to a water course, ground surface or storm sewer, standing liquid above the invert of the septic tank outlet, or dilapidation of the physical septic tank structure (MCHD 2002).

Bacterial Source Tracking, Crapau Creek

In 2006, the Crapau Creek Inter-county Drain Board conducted a bacterial source tracking analysis on Crapau Creek to determine the origin of the elevated *E. coli* concentrations. The study indicated that *E. coli* from both human and avian hosts are impacting the Creek with avian sources being found more frequently. On behalf of the Crapau Creek Inter-county Drain Board, the MCPWO partnered with the City of New Baltimore to conduct a bacterial source tracking analysis on Crapau Creek and at the New Baltimore Park Beach in 2006 to determine the source of the elevated *E. coli* concentrations. During the study, *E. coli* concentrations were quantified at several locations along the Creek and the Beach during dry and wet weather conditions. A subset of these samples were analyzed for the human and bird gene biomarker using polymerase chain reaction DNA analytical technology. The results of the study were as follows (ECT 2007):

1. *E. coli* contamination from a human sources(s) is impacting the Creek downstream of 25 Mile/ Arnold Road during dry weather conditions;
2. Human sources are contributing to the elevated *E. coli* counts along the entire Creek during wet weather conditions;
3. Crapau Creek is unlikely to be impacting New Baltimore Park Beach, as there is no correlation between the *E. coli* counts found at the Creek outlet and at the Beach;
4. *E. coli* contamination from human and avian sources was found at both Beach locations regardless of the weather conditions;
5. *E. coli* from avian sources appears to be more prevalent in the Creek and at the Beach, than *E. coli* from human sources;
6. Human contamination was present in only 35% of the samples that had *E. coli* concentrations between 300 and 10,000 cfu/100mL, while bird contamination was found in 75% of these samples;
7. Human and bird contamination were found in virtually all samples with *E. coli* concentrations above 10,000 cfu/100mL; and
8. The beach sand is not the source of *E. coli* found in the aqueous beach samples.

Public Education

In 2003, SCC and local municipalities initiated outreach efforts regarding pet waste clean up, reporting of illicit discharges, and maintenance of septic systems. Education efforts include dog bag dispensers at all the township's local parks, maintenance of an illicit discharge reporting hotline, educational presentations to civic groups and students, and the distribution of pet waste, septic system maintenance, and IDEP brochures at municipal buildings and various fairs, festivals and presentations.

The SCCHD and the school districts also sponsored a poster contest for 3rd – 6th graders from 2004 – 2008 in which hundreds of students participated and positive evaluations were always received. Funding cuts have eliminated this activity in recent years.

V. CURRENT CONDITIONS

There are several potential sources of *E. coli* that could be affecting the study area including:

- Failing septic systems,
- Illicit connections to storm drains,
- Sanitary sewer overflows,
- Drainage from improperly operated sewage lagoons or package treatment plants,
- Direct fecal input or runoff from farm animals, and
- Direct input and runoff containing fecal matter from pets, wildlife and birds (FTC&H 2006a).

In addition, re-suspended sediment is another potential *E. coli* source in the study area. This is based on the fact that high levels of *E. coli* have been found in sediment in other areas of the Great Lakes (LaLiberte and Grimes 1982, and Burton, et al 1987) and can re-suspend during storm water runoff. Therefore, although not mentioned in the Anchor Bay Watershed Management Plan (WMP) or the TMDLs, re-suspended sediment is another potential *E. coli* source.

Michigan's E. coli Limits

Michigan's water quality standards (WQSs) for E. coli are a monthly maximum of 130 organisms per 100 mL over a 30-day period and a daily maximum of 300 organisms per 100 mL for the recreational season (May 1st through October 30th). Full body contact activities, such as swimming, are not recommended when E. coli concentrations exceed these values. These WQSs apply to all surface waters in the State. Additional detail on Michigan's E. coli WQSs is included in Appendix A.

2008 – 2010 *E. coli* Monitoring Data

For over fifteen years, the SCCHD has routinely collected water quality samples along tributaries and the St. Clair River and Anchor Bay shorelines during the summer swimming season. Data prior to 2008 was not considered due to the identification and correction of over 100 septic systems within the study area between 2002 and 2008.

Samples taken from the study area's shoreline from 2008 – 2010 indicate that *E. coli* levels typically meet *E. coli* WQS (Table 4). For the tributaries, data from 2008 - 2010 indicate that Crapau Creek and Marsac Creek had the most samples above the daily WQS of 300 cfu/100 mL with 61% and 63% of them above the WQS, respectively (Table 5).

Table 4. 2008-2010 Shoreline *E. coli* Data Summary for Routinely Monitored Sites

Site ID	Site Description	Number of samples			
		Total	0-300 cfu/100 mL	301-999 cfu/100 mL	≥ 1,000 cfu/100 mL
M01	Algonac Boardwalk	43	43 (100%)	0	0
M02	Algonac State Park	45	44 (98%)	0	1 (2%)
M12	Browns Landing	43	43 (100%)	0	0
M15	DNR Boat Launch	44	43 (98%)	1 (2%)	0
M18	Frank Schonovers Dock	44	44 (100%)	0	0
M20	Johnnie Legas Pier	46	46 (100%)	0	0
M34	S. of 1825 South Channel Dr	44	44 (100%)	0	0
M38	Tin Fish	46	45 (98%)	0	1 (2%)

Table 5. 2008-2010 Tributary *E. coli* Data Summary for Routinely Monitored Sites

Site ID	Site Description	Number of samples			
		Total	0 - 300 cfu/100 mL	301 - 999 cfu/100 mL	≥ 1,000 cfu/100 mL
46.3	Crapau Creek at County Line Road*	125	48 (38%)	28 (22%)	49 (39%)
39.1	Marsac Creek at M29*	117	57 (49%)	31 (26%)	29 (25%)
M24	Marsac Creek at Arnold Road	40	15 (37%)	14 (35%)	11 (28%)
M36	Swan Creek at Shortcut Road	40	28 (70%)	12 (30%)	0
M03	Beaubien Creek at Starville Road	39	25 (64%)	9 (23%)	5 (13%)
M37	Swartout Creek at Phelps Road south of Holland Road	38	17 (45%)	16 (42%)	5 (13%)

*MCHD data. Source: RWQIMS.com

In 2010, the SCCHD added several new monitoring locations along Crapau, Marsac, Swan, Meldrum, Beaubien and Swartout Creeks to potentially narrow down the location of the water quality problems in these waterways. Based on this limited data set, the following observations were made:

- Benoit Drain, a tributary of Crapau Creek, had relatively low *E. coli* counts;
- Marsac Creek had elevated *E. coli* counts at Marine City Hwy and at Arnold Road;
- Meldrum Drain, a tributary of Swan Creek, had high *E. coli* counts, but the upper portion of Swan Creek in Casco Twp had lower concentrations;
- Intermittent *E. coli* counts did not allow for segmentation of Beaubien Creek; and
- A lack of flow in the Beaverdam Drain prevented further segmentation of Swartout Creek.

A complete listing of the individual results from the routine and targeted sampling efforts and a map of the monitoring locations are provided in Appendix B.

Screening Discharge Points

In 2010 and 2011, the SCCHD screened SCC's MS4 discharge points. Staff recorded the following physical characteristics of the outfall and receiving waters: odor, color and clarity of the discharge, outfall staining, the presence of floatables and deposits, size and material of the outfall, and notes on the physical status of the stream and streambank (i.e.: erosion, buffer zones, etc.). When flow from a discharge point was observed, it was sampled for *E. coli.*

The following 23 discharge points under the jurisdiction of the SCCDO were screened for presence of illicit discharges:

- Geyman
- Lester Brammel
- Clippert
- Robbins
- MC Dredge Cut
- Pearl Beach
- Bay
- Crapau
- Marsac
- Parker-Clay
- Colony
- Demars
- Schmidt
- Casco
- St. Mary's
- Harsens's Island Drain
- Dana
- Crocker
- Beaubien
- Palms
- Pelton
- Hammer
- Meldrum

No signs of illicit discharges were found at these discharge points except for the Clippert and Hammer Drains which had elevated *E. coli* counts. These drains will be resampled to confirm the readings. The discharge point for the Crocker Drain also needs to be revisited for screening as indicated in Table 6. The complete results of the MS4 discharge point screening for the SCCDO are included in Appendix C.

Table 6. Summary of Follow Up for the SCCDO Discharge Point Screening

Drain Name	Receiving Water	Discharge Pt. Location	Issue	Follow Up
Clippert	St. Clair River	Cottrellville Township	Elevated *E. coli*.	Resample without algal influence.
Hammer	St. Clair River	Ira Township	Elevated *E. coli*.	Resample to confirm reading.
Crocker	St. Clair River	Clay Township	Outlet influence by lake water. Upstream manhole couldn't be screened because it was plugged with sediment.	Re-inspect after manhole is cleaned out.

SCCHD staff also screened MS4 discharge points under the jurisdiction of the SCC Road Commission (SCCRC) in the same manner as conducted for the drains under the jurisdiction of the SCCDO. The following road/stream crossings were surveyed:

Marsac Creek
- Hessen Road
- Arnold Road
- Shortcut Road

Swan Creek
- Marine City Highway
- Arnold Road
- Shortcut Road
- Ira Road

No signs of illicit discharges were identified as a result of screening the discharge points of the SCCRC.

SCCHD staff also screened MS4 discharge points under the jurisdiction of Algonac, Ira Township and Clay Township. No signs of illicit discharges were found at Ira or Clay Township's discharge points. One elevated sample was taken at a discharge point in Algonac, but was later attributed to nonpoint sources. To reconfirm a lack of illicit discharges in Algonac's MS4, the discharge points were rescreened by SCC's consultant. No illicit discharges were found during rescreening.

Results of Surveys in Prioritized Areas

In response to 2010 monitoring data, four drains were prioritized for in-depth surveys by the SCCHD and SCCDO. They are:

- Crapau Creek
- Meldrum Creek
- Marsac Creek
- Swartout Creek

Each of these drains was walked by SCCHD and SCCDO with the primary objective of identifying potential *E. coli* sources. During these surveys, all discrete conveyances (outfalls) were screened for illicit discharges and nonpoint source issues were recorded. The length of Crapau, Marsac, Meldrum and Swartout Creeks that were surveyed extended 3, 6, 10 and 3 miles, respectively.

The SCCHD also targeted Ira and Casco Townships for "windshield" surveys of road ditches, because the vast majority of septic system failures identified in 2002 – 2008 surveys were found during this type of survey. Ira and Casco Townships were chosen because three of the priority creeks (Crapau, Marsac and Meldrum) drain these townships. The road ditches tributary to the fourth priority creek (Swartout), which drains parts of Clay and Cottrellville, had been previously surveyed in 2009 (Table 7).

Table 7. Road Ditch Survey Completion Dates

Community	Completed in
Casco Township	2011
China Township	2003
Clay Township including Harsens Island	2009
Cottrellville Township	2009
Ira Township	2011

Failing Septic Systems

Very few failing septic systems were found during the road ditch and creek surveys. In total twelve suspicious discharges were noted of which three have been confirmed as failing septic systems and four have been confirmed as legal sump pump discharges. Six suspicious outfalls (4 in Casco, 1 in Ira and 1 in Clay) still need follow up sampling to confirm an illicit discharge. In addition, a failed septic system was discovered on Harsens Island in response to a complaint received during the project. A summary of the septic systems that need to be corrected (including ones from the 2002 – 2008 survey) is provided in Table 8. The suspicious outfalls, mentioned above, will be investigated by the SCCHD to determine if they are failed septic systems.

During the course of responding to the illicit discharge complaint on Harsens Island, staff discussed the number of island homes, in the southeast portion of the study area, which do not have septic system records at the Health Department. This lack of record indicates to staff that a system was installed prior to approximately 1970 or a septic system was never installed at all. This lack of record does not necessarily indicate an illicit discharge because residents may be pumping out a septic tank and properly disposing the waste on a regular basis with a contractor. Staff thought that knowing the location of homes that do not have records may be a good way to target island surveys in the future. They also thought that future surveys should be conducted during weekends because so many homeowners are weekend residents. Finally, after responding to several calls from Harsens Island residents due to a story in the Harsens's Island Newspaper regarding the illicit discharge investigation, staff believes that this newspaper may be one of the best outreach vehicles to encourage illicit discharge reporting on the islands in the future.

Table 8. Summary of all Known Outstanding Failed Septic Systems

Receiving Water	Address	Discovered by	Comments
Meldrum Creek	5672 Hessen Road Casco Township	2002-2008 drain survey	Bench warrant out for homeowner
Meldrum Creek	5883 Hessen Road Casco Township	2011 drain survey	Correction expected by end of 2011
Meldrum Creek via road ditch	3679 Bethuy Road Casco Township	2011 road ditch survey	
Meldrum Creek	4729 Meldrum Road Casco Township	2011 drain survey	

Receiving Water	Address	Discovered by	Comments
Marine City Drain	6171 Genaw Road Clay Township	2002-2008 drain survey	Correction expected by end of 2011
Marine City Drain	7663 Marsh Road Cottrellville Township	2002-2008 drain survey	
St. Clair River via Dana Drain	529 Sheldon St. Algonac	2002-2008 drain survey	Sanitary sewer tie-in due in Sept. 2011
St. Clair River via Grand Pointe Cut	371 Grand Pointe Cut Harsens Island	2011 complaint investigation	Correction expected by end of 2011

Nonpoint Sources

With the exception of Crapau Creek, numerous nonpoint source issues, likely impacting *E. coli* conditions, were identified in each stream. These issues included obstructions, streambank and upland erosion, illegal dumping and encroachment on the drain easement, and agricultural practices. Researchers have routinely found sediment *E. coli* counts much higher than water column *E. coli* counts (LaLiberte and Grimes 1982, and Burton, et al 1987), and therefore it stands to reason that excessive flow or obstructions that are causing instream erosion would contribute to elevated *E. coli* counts. In a supplemental effort to activities of this grant project, limited sediment sampling was conducted in August 2011 on Crapau, Marsac, Meldrum, and Swartout Creeks to determine the applicability of this assumption in the study area. The results indicate that *E. coli* is present in sediment between 10 and 8,664 cfu/gram with the highest geometric means found in Marsac, Meldrum and Swartout Creeks (see Appendix D). Therefore, if resuspended, it would contribute water column *E. coli* concentrations.

Researchers have also found elevated *E. coli* in seaweed washed up on beaches (Whitman, et al, 2003). Therefore, it stands to reason that an activity such as dumping of grass clippings and debris in a water body may also provide a suitable environment for *E. coli* to thrive and contribute to elevated instream *E. coli* counts.

Crapau Creek had very few nonpoint source issues. Only two minor log jams were encountered along Crapau Creek and its tributary, the Benoit Drain. In contrast, Marsac, Meldrum and Swartout Creeks collectively had hundreds of instances of erosion and stream obstructions as summarized in Table 9. In addition, dumping of grass clippings was also observed once in Marsac and Swartout Creeks. One encroachment issue was also observed in Marsac and Meldrum Creeks. The apparent cause(s) of the nonpoint source issues were noted and are summarized in Table 9. Additional detail including maps of the surveyed drains and locations of nonpoint source issues is provided in Appendix E.

Agricultural use in the study area has declined and few large active farms remain. As a result, agricultural issues were not very prevalent as compared to more intensively farmed areas in other parts of the county. The most common agricultural issues noted were a lack of riparian buffer

along the drain easement and eroding banks. In addition, four direct sources of *E. coli* were identified as shown in Table 10.

Table 9. Nonpoint Source Issues Identified along Crapau, Marsac, Meldrum and Swartout Creeks

Nonpoint Source Issue	Location	Apparent Cause/Type
Streambank/Upland Erosion	Marsac Creek: 31 instances[3] Meldrum Creek: 200 instances Swartout Creek: 30 instances	Excessive instream flow, lack of riparian buffers, log jams, wildlife burrowing, horse crossings, livestock crossings
Stream obstructions	Crapau Creek: 2 instances Marsac Creek: 32 instances[4] Meldrum Creek: 156 instances Swartout Creek: 53 instances	Created by woody debris, manmade objects/debris, block culverts, make-shift bridges
Illegal dumping in the drain easement	Marsac Creek: 1 instance Swartout Creek: 1 instance	Grass clippings
Encroachment on the drain	Marsac Creek: 1 instance Meldrum Creek: 1 instance	Firewood storage, permanent non-agricultural structures

Table 10. Direct *E. coli* Sources from Agricultural Facilities

Receiving Water	Address	Discovered by	Issue
Swan Creek	8496 Arnold Road Ira Township	2011 road ditch survey & complaint investigation	Manure stored along the drain banks
Swan Creek	5584 Palms Road Casco Township	2011 drain survey	Runoff from the horse and stable area is draining to the floodplain
Swan Creek	Labuhn Rd east of Hessen Rd & north of Lindsey Rd Casco Township	2011 drain survey	Unrestricted cattle access to the Creek
Meldrum Creek	5883 Hessen Road Casco Township	2011 drain survey	Unrestricted cattle access to the Creek

[3] Estimated based on field notes and not recorded by GPS in the field. As a result, the numbers of instances are likely underestimated when compared to Meldrum and Swartout Creeks.
[4] ibid.

Point Sources

Both historic and recent point source *E. coli* issues have been identified in the study area. In 2008, the compliance status of most of the NPDES permittees was reviewed for the period between June 2003 and May 2008. This review identified numerous water quality effluent limit violations most notable at Millstone Pond MHP as summarized in Table 11. Package treatment plant and lagoon discharges were noted as a great concern to Anchor Bay stakeholders (FTC&H 2006a). As such, the 2009 Anchor Bay WMP Addendum made the recommendation to "Improve permit violations at Millstone MHP package treatment plant."

Table 11. NPDES Permit Violations 2003-2008

Facility Name	Violations	Associated Water Quality Parameter
Millstone Pond MHP	125	CBOD, TP, NH3, DO, TSS, pH, Fecal
Americana Estates of Casco MHP	None	
Anchor Bay Schools-Casco	None	
MDOT I-94 WB/SB Rest Area	2	TSS, BOD
MDOT I-94 EB/NB Rest Area	2	TSS, BOD
Old Club Wastewater Treatment Plant	15	Fecal, DO, pH, TRC, TP

Water quality parameter key: BOD = biochemical oxygen demand, CBOD = carbonaceous biochemical oxygen demand, DO = dissolved oxygen, fecal = fecal coliform, NH3 = ammonia, TP = total phosphorus, TRC = total residual chlorine, TSS = total suspended solids

Recently, one point source discharge was identified along Marsac Creek. A compost facility was found discharging dark brown water during dry weather conditions. The discharge was sampled near the property line, analyzed for limited parameters and found to have elevated *E. coli* (>11,870 cfu/100 mL) and total phosphorus (5.4 mg/L) concentrations. In 2011, this dark brown discharge was observed and tested high for *E. coli* ½ mile downstream at Marine City Highway as well as 1 ½ miles downstream at Arnold Road. This indicates that this is not a one-time incident and the volume of the discharge is variable. This facility does not have a NPDES permit and should not be discharging during dry or wet weather conditions. The SCCDO and Casco Township are actively working with MDEQ to develop a strategy to work with the property owner to eliminate this discharge.

Summary of Sources

Based on the drain and road ditch surveys described above, it was determined if previously known or suspected sources were impacting the study area. Table 11 identifies the confirmed and unconfirmed *E. coli* sources. The confirmed sources include the following: failing septic systems, resuspended sediment, drainage from a non-permitted facility, manure runoff from agricultural properties, direct fecal input from farm animals, and illegal dumping.

Table 12. Confirmed and Unconfirmed Sources

Confirmed Sources	Receiving Water	Rationale
Failing septic systems	Dana Drain Grand Point Cut Meldrum Creek Marine City Drain	• 4 septic system failures found during the 2002-2008 outfall survey that are still outstanding • 4 septic system failures found 2010 - 2011 • 5 suspicious outfalls found 2010 – 2011 that need further investigations
Re-suspended sediment	Marsac Creek Meldrum Creek Swartout Creek	• Numerous eroded streambanks and stream blockages found during nonpoint source surveys • Numerous areas noted as lacking riparian buffer.
Drainage from non-permitted facilities	Marsac Creek	• Direct discharge from compost facility at 5877 Bethuy Rd. Casco Twp.
Drainage from improperly operated sewage lagoons or package treatment plants	Crapau Creek	• Numerous historic violations at Millstone MHP. • Not observed, although limited investigations were conducted.
Manure impacted runoff from agricultural facilities	Swan Creek	• Cow manure piles observed along banks • Horses and stable runoff observed in the floodplain
Direct fecal input from farm animals	Swan Creek Meldrum Creek	• 2 cow pastures with open access to the drain
Direct fecal input or contaminated runoff from wildlife	Crapau Creek Marsac Creek Meldrum Creek Swartout Creek	• Observed in several locations during the nonpoint source surveys • Avian sources identify during the Crapau Creek BST survey
Illegal dumping of grass clippings	Marsac Creek Swartout Creek	• 2 instances found during the nonpoint source surveys
Unconfirmed Sources	**Receiving Water**	**Rationale**
Illicit connections to storm drains during dry conditions	NA	• None found
Sanitary sewer overflows	NA	• None reported.

VI. *E. COLI* REDUCTION ACTIVITIES

Based on the confirmed sources and the information available for the study area, the following *E. coli* reduction activities are recommended. Recommendations were arranged into two types of strategy for implementation: Watershed-wide and Sub-basin specific.

There are five watershed-wide strategies recommended for implementation across the study area:

1. Identify and Correct Failing Septic Systems,
2. Public Education,
3. Agricultural sources,
4. Reduce Upland and Instream Erosion, and
5. Maintain Sanitary Systems.

Sub-basin Strategies are more site-specific and based on conditions found in each subwatershed. The suggested lead agency is listed in parentheses following each activity.

Watershed-Wide Strategies

1. Identify and Correct Failing Septic Systems

SCC's illicit discharge elimination program should be maintained because it has demonstrated great success in reducing sources of bacteria. The following provides recommendations for activities to include in this program that reaches across the study area:

- Follow-up on any newly identified failed septic systems (SCCHD).
- Conduct road ditch "windshield" surveys (once every 5 years) to identify any new failed septic systems (SCCHD and SCCRC). The recommended schedule for these surveys is as follows:
    - 2013: China Township
    - 2014: Cottrellville and Clay Townships (including the Islands)
    - 2016: Ira and Casco Townships
- Continue to use routine sampling data from the tributaries and along the shoreline of Anchor Bay to prioritize potential sources of *E. coli* (SCCHD and SCCDO).
- Screen MS4 discharge points one time every five years to detect potential sources of *E. coli* (SCCDO).
- Follow up on MS4 discharge points that were screened and need resampling. (SCCDO/ SCCHD).

2. Public Education

Public education is an important component to reducing septic system, and pet and wildlife sources of bacteria. The following provides a list of the education activities that should be implemented across the study area:

- Promote septic system maintenance:
    - Send a postcard reminding folks to conduct septic system pump outs (SCCHD).
    - Continue distributing septic system maintenance brochures (SCCHD).
- Promote pollution reporting hotline:
    - Reinstitute the IDEP Reporting Hotline poster contest (SCCHD and Algonac Community School District).
    - Use the Harsens's Island newsletter and other local municipal newsletters to publicize the illicit discharge reporting hotline (SCCHD and local municipalities).
    - Update the 2004 IDEP brochure and distribute education materials promoting the reporting of illicit discharges (SCCHD).
- Promote pet waste cleanup and no feeding of birds:
    - Continue efforts to educate the public about picking up pet waste and not feeding the birds (SCC and local communities).
- Promote the importance of attenuating storm water flows need for reduced storm water flows (SCCDO, SCCHD).
- Promote no dumping and cleanup activities:
    - Create a mailer or brochure to encourage residents not to dump grass clippings or other debris into water ways. Target homeowners where dumping of grass clippings was noted during surveys. Provide copies of brochures to local building inspectors to distribute. (SCCHD and SCCDO).
    - Publicize problems of illegal dumping and sponsor River Day clean up events (SCCHD).

3. Agricultural Sources

SCC found a relatively small amount of agricultural problems during this project, but these should be discussed with a representative from the Natural Resources Conservation Service (NRCS) and the St. Clair Conservation District (SCCD) to identify how these can be corrected.

- Review agricultural problems identified in this project and how they can be corrected (NRCS/SCCHD/SCCDO).

4. Reduce Upland and Instream Erosion

As noted several times in this plan, instream and upland erosion is a critical source of sedimentation and degradation for tributaries across the study area and it may also be a source of bacteria. In an effort to reduce bacteria levels erosion should be reduced. Causes of erosion noted during surveys were storm water flows, log jams, and lack of riparian buffer.

There are several recommended Best Management Practices (BMPs) that are part of the watershed-side strategy to Reduce Upland and Instream Erosion. They include:

- Adopt storm water ordinance:

    - Adopt and enforce the model storm water ordinance, previously developed for the Anchor Bay watershed that provides standards to reduce runoff flow rates, control storm water volume, and protect floodplains. This ordinance includes the following recommended design standards: detention of 100-year storm with a maximum release rate of 0.15 cfs/acre, 24-hour detention for a 1.5 year storm, and treatment of the first 0.5 inches of rainfall (FTC&H 2006b) (SCCDO and Local communities, with priority in Ira and Casco to address problems in Marsac and Swan Creeks).
- Adopt a riparian buffer ordinance / policy:
    - Drain easements (SCCDO).
    - MS4 and natural water courses (Local communities, with priority in Ira and Casco to address problems in Marsac and Swan Creeks).
- Remove log jams and stabilize stream banks:
    - Stabilize stream banks using bioengineering techniques where applicable (SCCDO).
    - Use woody debris management BMPs to remove obstructions from drains.[5]
    - Conduct selective cutting of dead ash and fallen trees along drain banks to prevent future flow obstruction; however, do not remove all vegetation.
    - Eliminate homemade road crossing and replace plugged culverts.
- Encourage new/ redevelopment projects to use LID techniques:
    - Provide incentives for implementing green infrastructure (GI) /Low Impact Development (LID) [6] on private property in SCCDO rules, SCCRC standards, and local community storm water ordinances (SCCDO, SCCRC, local communities).
    - Employ GI/LID techniques to attenuate flows on public properties (SCCDO and Local communities, with priority in Ira and Casco to address problems in Marsac and Swan Creeks).
- Conserve areas to maintain infiltration and storage of storm water:
    - Identify priority areas needing storm water storage and high quality habitat where storage could be directed (SCCDO, Local communities).
    - Identify grant opportunities to purchase, conserve and restore land.

The most critical areas where this group of BMPs is needed are listed in priority:

1. Swan Creek (including Meldrum Creek);
2. Marsac Creek; and
3. Swartout and Beaubien Creeks.

[5] For further information on Woody Debris Management: http://www.semcog.org/PrinterFriendly.aspx?id=1482
[6] For further information on LID best management practices: http://library.semcog.org/InmagicGenie/DocumentFolder/LIDManualWeb.pdf

This prioritization is based on the number of issues identified during the nonpoint source survey/mile of stream[7], previous surveys of streams, staff knowledge of sub basin characteristics, and the past history of *E.coli* levels found at monitoring locations.

The Swan Creek (including Meldrum Creek), being the number one priority for Reduction of Upland and Instream Erosion BMPs, also provides opportunity for Casco and Ira Townships and the County to focus activities, such as woody debris management, stabilization and infiltration practices in one critical area, and coordinate them with efforts to adopt similar regulatory policies for LID, storm water design and buffers.

5. Maintain Sanitary Systems

While this project found no problems with sanitary cross connections, continued maintenance of these systems is critical for preventing potential overflows. It is recommended that these activities be implemented across the study area:

- Continue maintenance efforts on sanitary sewer systems to reduce the chance of sanitary sewer overflows (City of Algonac, Ira Township, Clay Township and Cottrellville Township).

Sub-Basin Strategies

Crapau Creek

E.coli Sources: NPDES permit violations, birds and wildlife

Although tributary to the impaired reach in Macomb County, few *E.coli* sources were identified in the SCC portion of Crapau Creek. Therefore, the recommended reduction strategies are limited to the following:

- Conduct more frequent inspections at Millstone Pond Mobile Home Park to determine compliance with NPDES effluent limits. Also provide a listing of any recent violations to local stakeholders, so the status of their compliance efforts are well understood (MDEQ).
- Determine the impact of detention ponds on *E. coli* levels in the Creek by conducting routine storm water monitoring at detention pond outlets. If they results indicate an impact, determine if they are eligible for NPDES permits (MDEQ).

Marsac Creek

E.coli Sources: Non-permitted drainage from a compost facility, instream soil erosion caused by lack of stream bank buffers, stream obstructions and excessive flow:

- Compost facility discharge and encroachment :

[7] The number of problems on Marsac Creek was likely underestimated due to data collection problems with the GPS.

    - Follow-up on Indian Summer Recycling Facility discharge to eliminate the discharge observed and sampled on June 7, 2011 or determine the need for an NPDES permit (MDEQ).
    - Follow up on Indian Summer Recycling Facility discharge to ensure discharges to the Marsac Creek drain have been eliminated and the easement is free from compost piles. (SCCDO).
- Reduce Upland and Instream Erosion (#2 priority).
  In addition to the BMPs recommended for this watershed-wide strategy, the following provides some detail of critical areas and potential opportunities specific to this sub basin:
    - The drain segment that exhibits the largest amount of erosion and log jams is between Meisner Road and Marine City Hwy (SCCDO).
    - Acquire the wooded land, south of the mobile home park in New Baltimore (or another appropriate area) for storm water detention and infiltration.
    - Eliminate homemade crossings (see map & survey summaries for locations).
    - Clean out blocked culverts (see map & survey summaries for locations).

Swan Creek (including Meldrum Creek)

E.coli Sources: Agricultural issues, septic systems, instream soil erosion mainly caused by stream obstructions and excessive flow

- Follow-up on the previously identified failed septic systems as shown in Table 8 (SCCHD):
    - 5672 Hessen Road, Casco Township (bench warrant)
    - 5883 Hessen Road, Casco Township (correction expected by end of 2011)
    - 3679 Bethuy Road, Casco Township (correction expected by end of 2011)
    - 4729 Meldrum Road, Casco Township (correction expected by end of 2011)
- Request assistance from SC Conservation District/NRCS to improve cattle access, manure storage and runoff practices, as appropriate, for the following properties (SCCHD, SCCDO):
    - 8496 Arnold Road, Ira Township
    - 5584 Palms Road, Casco Township
    - Labuhn Rd east of Hessen Rd & north of Lindsey Rd, Casco Township
    - 5883 Hessen Road, Casco Township
- Request assistance from SC Conservation District/NRCS to improve riparian buffers along agricultural properties (see map for locations).
- Reduce Upland and Instream Erosion (#1 priority)
  In addition to the BMPs recommended for this watershed-wide strategy, the following provides some detail of critical areas and potential opportunities specific to this sub basin:

- The drain segment that exhibits the largest amount of erosion and log jams is between Short Cut Rd and Puttygut Rd. (SCCDO).
- Review survey results and identify critical areas for land conservation and storm water detention.
- Review survey results and determine the number of homemade crossings that need be addressed and number of culverts that need replacement.
    - Examples: old concrete dam, old concrete bridge, tractor tires, telephone pole and lumber/log bridge as found at sites Mel133, Mel152, Mel159, Mel387, and Mel397, respectively. (see map and survey summaries for locations)

Swartout Drain

E.coli Sources: Septic systems, instream soil erosion mainly caused by stream obstructions and excessive flow

- Follow up on MS4 discharge points that need revisiting as identified in Table 6 (SCCDO and SCCHD):
    - Clippert
    - Hammer
    - Crocker
- Reduce Upland and Instream Erosion (#3 priority).
  In addition to the BMPs recommended for this watershed-wide strategy, the following provides some detail of critical areas and potential opportunities specific to this sub basin:
    - The drain segment that exhibits the largest amount of erosion and log jams is between Swartout Rd and Phelps Rd. (SCCDO).
    - Identify areas suitable for storm water storage and LID practices (SCCDO, local communities).
    - Review survey results and determine the number of homemade crossings that need be addressed and number of culverts that need replacement.
        - Examples: plywood, cedar poles, and lumber as found at sites Swa136, Swa146, and Swa147, respectively (see map and survey summaries for locations).
        - Example: small culvert blockage found at site Swa150 (see map and survey summaries for locations).
- Follow-up on the previously identified failed septic system draining to the Dana Drain as shown in Table 8 (SCCHD) (Although this drain directly discharges to the North Channel its proximity to the Swart Out sub basin made its inclusion here appropriate):
    - 529 Sheldon St., Algonac (sanitary sewer tie-in due Sept 2011).

Beaubien Creek

E.coli Sources: Instream soil erosion from stream obstructions and excessive flow

Although Beaubien Creek has exhibited relatively low levels of E.coli and was not surveyed during this project, it has been surveyed before and conditions were found to be very similar as those found in the Swartout Drain subwatershed. It is a very rural, light residential sub watershed with a lot of wooded areas, log jams and relatively healthy waterways and good connection to the Bay. Therefore, the Beaubien Creek sub-basin was prioritized the same (#3) as Swartout Creek for the watershed wide strategy of Reduction of Upland and Instream Erosion BMPs.

In addition to this strategy of BMPs, activities planned as part of the Identify and Correct Failing Septic Systems strategy, such as windshield road drain surveys in China, Cottreville and Clay Townships, and activities planned as part of the Public Education strategy is sufficient for *E. coli* reduction strategies in this sub basin.

Harsens Island Drain

E.coli Sources: Septic systems

While this project only identified one septic system problem on Harsens Island, this failure was found by complaint; not screening efforts on the Harsens Island Drain, where no problems and very low *E.coli* levels were found. Freighter wakes and the connection of many canals to the North and South channels of the St. Clair River make *E.coli* sampling in and around Harsens Island and the adjacent islands Clay Township very difficult. The amount of shoreline in this area provides ample opportunities for illicit discharges to go directly into canals and major waterways. Therefore, the following measures are recommended:

- Follow-up on the previously identified failed septic system discharging to Grand Point Cut as shown in Table 8 (SCCHD):
    - 371 Grand Pointe Cut, Harsens Island (correction expected by end of 2011).
- Research septic system records in Harsens Island and work with the Clay Township building inspector to prioritize future surveys on Harsens Island and the surrounding flats area (SCCHD and Clay Township).
- Perform targeted surveys during weekend hours when more property owners are in residence.
- Promote hot line reporting and septic system maintenance on the islands as described in the public education strategy.

Palms Road Drain

E.coli Sources: None known

While discharge point sampling did not indicate *E. coli* levels high enough to warrant source investigations, the discharge point sampling location was also located in a sanitary sewer service area. The next time SCC screens this drain, a sample should be taken in the portion of the drain that is outside sewer service. Strategies associated with Identify and Correct Failing Septic Systems and Public Education are recommended for maintaining low bacteria levels in this sub basin and monitoring for potential future problems.

Marine City Drain

E.coli Sources: Septic systems

Although *E.coli* levels in the Marine City Drain did not warrant investigations during this project, there are two failing septic systems that need correction. In addition, previous surveys have shown this drain to be in need of woody debris management and a reduction of peak and total runoff volumes. Because *E.coli* levels are historically relatively low, these activities are a lower priority for *E.coli* removal than other subwatersheds but BMPs associated with the Reduce Upland and Instream Erosion Strategy are all still highly recommended.

- Follow-up on the previously identified failed septic systems as shown in Table 8 (SCCHD):
    - 6171 Genaw Road, Clay Township
    - 7663 Marsh Road, Cottrellville Township

VII. MONITORING AND EVALUATION

According to Michigan's water quality standards, all waters of the state are to have *E. coli* concentrations under 130 cfu/100 mL based on a 30 day geometric mean and under 300 cfu/100 mL based on a daily geometric mean to support full body contract recreation (see Appendix A). However, this standard is very difficult to achieve except in the most pristine watersheds or in large open waters. Therefore, interim milestones are needed to access whether the recommended activities are effective at reducing *E. coli* levels. The percentage of exceedences of the daily water quality standard for data collected between 2008 and 2010 was utilized to determine interim milestones. A 3 year period was used to account for variable weather conditions which can greatly impact *E. coli* levels. Interim milestones were established based on a 50% reduction in the current number of exceedences (Table 13).

Using the 3 most recent years of *E. coli* data, the number of exceedences should be recalculated at the end of the 2018 sampling season. This gives local stakeholders 5 years to implement some of the recommended activities. At this time, *E. coli* reduction activities and the interim milestones should be reevaluated to determine if the activities are effective, if the interim milestones were reasonable and if the milestones need to be modified.

E. coli monitoring is recommended at least on a weekly basis at the sites listed in Table 13 during the 3 years prior to determining the number of exceedences for comparison to the interim milestones. This suggests that monitoring should take place during the 2016-2018 recreational seasons (May 1st – October 30th). Monitoring prior to 2016 would be useful to determine the presence of trends and if there are new major *E. coli* sources.

Table 13. Current *E. coli* Exceedences and Interim Milestones

Site ID	Site Description	Current Conditions	Interim Milestones
		2008-2010 % of Samples > 300 cfu/100 mL	2016-2018 % of Samples > 300 cfu/100 mL
46.3	Crapau Creek at County Line Road	61%	31%
39.1	Marsac Creek at M29	51%	26%
M24	Marsac Creek at Arnold Road	63%	32%
M36	Swan Creek at Shortcut Road	30%	15%
M03	Beaubien Creek at Starville Road	36%	18%
M37	Swartout Creek at Phelps Road south of Holland Road	55%	28%

As previously indicated, SCC and three of the six local municipalities in the study area are regulated under NPDES storm water regulation which requires annually report on storm water activities. These reports will include information about activities which can be used to gauge the success of the recommendations of this plan. These narrative reports in combination with *E. coli* monitoring data will be used by the Anchor Bay Watershed Advisory Group members to gauge success at improving *E. coli* levels in tributaries of the study area.

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