Illicit Discharge Detection and Elimination (IDDE) Plan

May 2020

Town of Marion, Massachusetts

Table of Contents

Illicit Discharge Detection and Elimination Plan

Tables

Figures

Appendices

1 Introduction

1.1 MS4 Program

This Illicit Discharge Detection and Elimination (IDDE) Plan has been developed by the Town of Marion (Town) to address the requirements of the United States Environmental Protection Agency's (USEPA's) 2016 National Pollutant Discharge Elimination System (NPDES) General Permit for Stormwater Discharges from Small Municipal Separate Storm Sewer Systems (MS4) in Massachusetts, hereafter referred to as the "MS4 Permit." The MS4 Permit was signed April 4, 2016 and became effective July 1, 2018 after a 1-year postponement.

The MS4 Permit requires that each regulated community address six Minimum Control Measures. These measures include the following:

1. Public Education and Outreach
2. Public Involvement and Participation
3. Illicit Discharge Detection and Elimination Program
4. Construction Site Stormwater Runoff Control
5. Stormwater Management in New Development and Redevelopment (Post Construction Stormwater Management); and
6. Good Housekeeping and Pollution Prevention for Permittee Owned Operations.

Under Minimum Control Measure 3, the Town is required to implement an IDDE program to systematically find and eliminate sources of non-stormwater discharges to its municipal stormwater collection system and implement procedures to prevent such discharges. The IDDE program must also be recorded in a written (hardcopy or electronic) document. This IDDE Plan has been prepared to address this requirement.

1.2 Illicit Discharges

An "illicit discharge" is any discharge to a stormwater collection system that is not composed entirely of stormwater, with the exception of discharges pursuant to a NPDES permit (other than the NPDES permit for discharges from the MS4) and discharges resulting from fire-fighting activities.

Illicit discharges may take a variety of forms. Illicit discharges may enter the stormwater collection system through direct or indirect connections. Direct connections may be relatively obvious, such as cross-connections of sewer services to the stormwater collection system. Indirect illicit discharges may be more difficult to detect or address, such as failing septic systems that discharge untreated sewage to a ditch within the MS4, or a sump pump that discharges contaminated water on an intermittent basis.

Some illicit discharges are intentional, such as dumping used oil (or other pollutant) into catch basins, a resident or contractor illegally tapping a new sewer lateral into a stormwater drain pipe to avoid the costs of a sewer connection fee and service, and illegal dumping of yard wastes into surface waters.

Some illicit discharges are related to the unsuitability of original infrastructure to the modern regulatory environment. Examples of illicit discharges in this category include connected floor drains in old buildings, as well as sanitary sewer overflows that enter the stormwater collection system. Sump pumps legally connected to the stormwater collection system may be used inappropriately, such as for the disposal of floor wash water or old household products, in many cases due to a lack of understanding on the part of the homeowner.

Elimination of some discharges may require substantial costs and efforts, such as funding and designing a project to reconnect sanitary sewer laterals. Others, such as improving self-policing of dog waste management, can be accomplished by outreach in conjunction with the minimal additional cost of dog waste bins and the municipal commitment to dispose of collected materials on a regular basis.

Regardless of the intention, when not addressed, illicit discharges can contribute high levels of pollutants, such as heavy metals, toxics, oil, grease, solvents, nutrients, and pathogens to surface waters.

1.3 Allowable Non-Stormwater Discharges

The following categories of non-stormwater discharges are allowed under the MS4 Permit unless the Town, USEPA or Massachusetts Department of Environmental Protection (MassDEP) identifies any category or individual discharge of non-stormwater discharge as a significant contributor of pollutants to the MS4:

- Water line flushing
- Landscape irrigation
- Diverted stream flows
- Rising ground water
- Uncontaminated ground water infiltration (as defined at 40 CFR 35.2005(20))
- Uncontaminated pumped groundwater
- Discharge from potable water sources
- Foundation drains
- Air conditioning condensation
- Irrigation water, springs
- Water from crawl space pumps
- Footing drains
- Lawn watering
- Individual resident car washing
- De-chlorinated swimming pool discharges
- Street wash waters
- Residential building wash waters without detergents

If these discharges are identified as significant contributors to the MS4, they must be considered an “illicit discharge” and addressed in the IDDE Plan (i.e., control these sources so they are no longer significant contributors of pollutants, and/or eliminate them entirely).

1.4 Receiving Waters and Impairments

Table 1-1 lists the "impaired waters" within the boundaries of Marion's regulated area based on the final 2014 Massachusetts Integrated List of Waters produced by MassDEP. Impaired waters are water bodies that do not meet water quality standards for one or more designated use(s) such as recreation or aquatic habitat.

Table 1-1. Impaired Waters

Water Body Name	Segment ID	Category	Impairment(s)	Associated Approved TMDL
Sippican River	MA95-06 MA95-07	5 4a	Chlorophyll-a, Dissolved Oxygen, Fish-Passage Barrier, Fecal Coliform	36172
Weweantic River	MA95-05	5	Estuarine Bioassessments, Fecal Coliform, Total Nitrogen	36172
Aucoot Creek/Aucoot Cove	MA95-71 MA95-72	5 5	Dissolved Oxygen, Fecal Coliform, Total Nitrogen, Nutrient/Eutrophication Biological Indicators	36172
Hammett Cove	MA95-56	5	Estuarine Bioassessments, Fecal Coliform, Total Nitrogen	36172
Sippican Harbor	MA95-69	4a	Fecal Coliform	36172
Inner Sippican Harbor	MA95-70	5	Estuarine Bioassessments, Fecal Coliform, Total Nitrogen, Nutrient/Eutrophication Biological Indicators	36172

Category 2 Waters – attaining some uses, and other uses not assessed.
Category 4a Waters – impaired water bodies with a completed Total Maximum Daily Load (TMDL).
Category 5 Waters – impaired water bodies that require a TMDL.
"Approved TMDLs" are those that have been approved by EPA as of the date of issuance of the 2016 MS4 Permit.

Additional IDDE-related requirements must be implemented in catchment areas tributary to an impaired waterbody or waterbody with an approved TMDL. Requirements are based on the pollutant of concern and include the following for the Town:

- **Pollutants of Concern**– If an outfall discharges directly into a water quality limited water or a water subject to an approved TMDL, dry weather samples will be analyzed for the pollutant(s) of concern identified as the cause of impairment.

- **Pathogens and Bacteria** – Catchments draining to any waterbody impaired for bacteria or pathogens shall be designated either Problem Catchments or High priority in implementation of the IDDE program.

1.5 IDDE Program Goals, Framework, and Timeline

The goals of the IDDE program are to find and eliminate illicit discharges to the stormwater collection system and to prevent illicit discharges from happening in the future. The program consists of the following major components as outlined in the MS4 Permit:

- Legal authority and regulatory mechanism to prohibit illicit discharges and enforce this prohibition
- Stormwater collection system mapping
- Inventory and ranking of outfalls
- Dry weather outfall screening
- Catchment investigations
- Identification/confirmation of illicit sources
- Illicit discharge removal
- Follow-up screening
- Employee training.

The IDDE investigation procedure framework is shown in **Figure 1-1.** The required timeline for implementing the IDDE program is shown in **Table 1-2**.

Figure 1-1. IDDE Investigation Procedure Framework

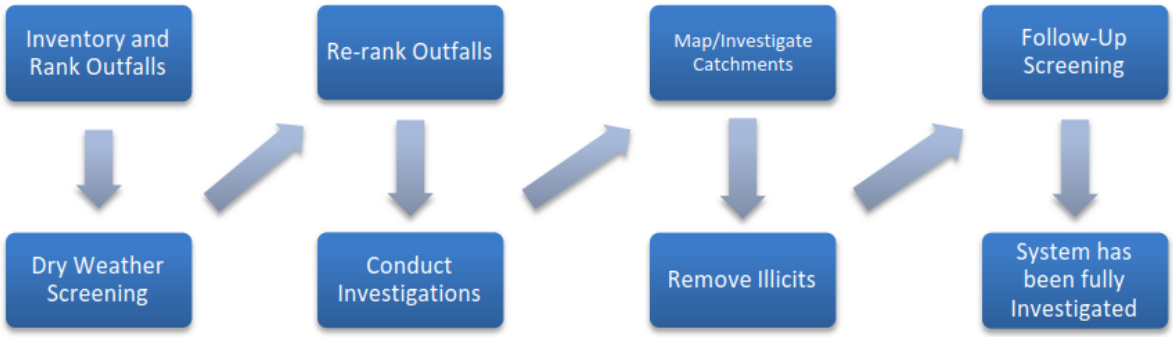


Table 1-2. IDDE Program Implementation Timeline

IDDE Program Requirement	Completion Date from Effective Date of Permit					
	1 Year	1.5 Years	2 Years	3 Years	7 Years	10 Years
Written IDDE Program Plan	***X***					
SSO Inventory	***X***					
Written Catchment Investigation Procedure		***X***				
Phase I Mapping			***X***			
Phase II Mapping						***X***

IDDE Program Requirement	Completion Date from Effective Date of Permit					
	1 Year	1.5 Years	2 Years	3 Years	7 Years	10 Years
IDDE Regulatory Mechanism or By-law (Already in place)				***X***		
Dry Weather Outfall Screening				***X***		
Follow-up Ranking of Outfalls and Interconnections				***X***		
Catchment Investigations – Problem Outfalls					***X***	
Catchment Investigations – all Problem, High and Low Priority Outfalls						***X***

1.6 Work Completed to Date

The 2003 MS4 Permit required each MS4 community to develop a plan to detect illicit discharges using a combination of stormwater collection system mapping, adopting a regulatory mechanism to prohibit illicit discharges and enforce this prohibition, and identifying tools and methods to investigate suspected illicit discharges. Each MS4 community was also required to define how confirmed discharges would be eliminated and how the removal would be documented.

In conformance with the 2003 MS4 Permit, the Town adopted and enforced a regulatory mechanism to prohibit illicit discharges (Sewer Use Regulations, Article VI). In addition, through partnership with the Buzzards Bay National Estuary Program (BBNEP) a map of outfalls and receiving waters was developed.

2 Authority and Statement of IDDE Responsibilities

2.1 Legal Authority

The Town has adopted Sewer Use Regulations that gives them the authority to implement an IDDE Plan. A copy of the most recent Sewer Use Regulations will be maintained in **Appendix A** and provides the Town with adequate legal authority to:

- Prohibit illicit discharges
- Investigate suspected illicit discharges
- Eliminate illicit discharges, including discharges from properties not owned by or controlled by the MS4 that discharge into the MS4 system
- Implement appropriate enforcement procedures and actions.

2.2 Statement of Responsibilities

The Department of Public Works is the lead department responsible for implementing the IDDE program.

3 Stormwater System Mapping

Through partnership with BBNEP, the Town's outfalls were mapped during the effective dates of the 2003 MS4 Permit. A copy of the existing stormwater collection system map is provided in **Appendix B**. The 2016 MS4 Permit requires a more detailed stormwater collection system map than was required by the 2003 MS4 Permit. The revised mapping is intended to facilitate the identification of key infrastructure, factors influencing proper system operation, and the potential for illicit discharges.

The 2016 MS4 Permit requires the stormwater collection system map to be updated in two phases as outlined below. The Town will report on the progress towards completion of the stormwater collection system map in each annual report. Updates to the stormwater mapping will be included in **Appendix B**.

3.1 Phase I Mapping

Phase I mapping must be completed within two (2) years of the effective date of the permit and include the following information:

- Outfalls and receiving waters (previously required by the MS4-2003 permit)
- Open channel conveyances (swales, ditches, etc.)
- Interconnections with other MS4s and other stormwater collection systems
- Municipally owned stormwater treatment structures
- Water bodies identified by name and indication of all use impairments as identified on the most recent EPA approved Massachusetts Integrated List of Waters report
- Initial catchment delineations

The Town has completed the following updates to its stormwater mapping to meet the Phase I requirements:

- Completed mapping of outfalls
- Identified interconnections with other MS4s and other stormwater collection systems
- Identified water body names and indications of all use impairments

The Town will update its stormwater mapping within two years (2) of the effective permit to include the remaining Phase I information.

3.2 Phase II Mapping

Phase II mapping must be completed within ten (10) years of the effective date of the permit and include the following information:

- Outfall spatial location (latitude and longitude with a minimum accuracy of +/-30 feet)
- Pipes
- Manholes

- Catch basins
- Refined catchment delineations (Catchment delineations must be updated to reflect information collected during catchment investigations)
- Municipal Sanitary Sewer system

The Town will update its stormwater mapping within ten (10) years of the effective permit to include the remaining following Phase II information.

3.3 Additional Recommended Mapping Elements

Although not a requirement of the 2016 MS4 Permit, the Town of Marion may include the following recommended elements in its stormwater collection system mapping in the future:

- Stormwater collection pipe material, size (pipe diameter)
- Sanitary sewer system pipe material, size (pipe diameter), age
- Privately owned stormwater treatment structures
- Where a municipal sanitary sewer system exists, properties known or suspected to be served by a septic system, especially in high density urban areas
- Area where the Town's MS4 has received or could receive flow from septic system discharges
- Seasonal high-water table elevations impacting sanitary alignments
- Topography
- Orthophotography
- Alignments, dates and representation of work completed of past illicit discharge investigations
- Locations of suspected confirmed and corrected illicit discharges with dates and flow estimates

4 Sanitary Sewer Overflows (SSOs)

The 2016 MS4 Permit requires municipalities to prohibit illicit discharges, including sanitary sewer overflows (SSOs), to the stormwater collection system. SSOs are discharges of untreated sanitary wastewater from a municipal sanitary sewer that can contaminate surface waters, cause serious water quality problems and property damage, and threaten public health. SSOs can be caused by blockages, line breaks, power failures, improper sewer design, vandalism, and sewer defects that allow stormwater and groundwater to overload the system.

The Town has completed an inventory of SSOs that have discharged to the MS4 within the five (5) years prior to the effective date of the 2016 MS4 Permit (**Appendix C**). Based on review of available documentation one (1) SSO was recorded in this period. In 2018, the Town had one SSO located along the Littleneck pumping station force main which was discovered to be cracked due to roots from a nearby tree. This SSO was not capacity related. The Sewer Department staff repaired the pipe and removed the tree to prevent further damage. In 2017, a force main failure occurred on the Silvershell Pumping Station force main as the result of an outside contractor working on Town streets, but no SSOs resulted from this event.

As future SSOs occur, the following information will be included in the inventory, if available:

1. Location (approximate street crossing/address and receiving water, if any);
2. A clear statement of whether the discharge entered a surface water directly or entered the MS4;
3. Date(s) and time(s) of each known SSO occurrence (i.e., beginning and end of any known discharge);
4. Estimated volume(s) of the occurrence;
5. Description of the occurrence indicating known or suspected cause(s);
6. Mitigation and corrective measures completed with dates implemented; and
7. Mitigation and corrective measures planned with implementation schedules.

Upon detection of an SSO, the Town of Marion will eliminate it as expeditiously as possible and take interim measures to minimize the discharge of pollutants to and from its MS4 until the SSO is eliminated. Upon becoming aware of an SSO to the MS4, the Town of Marion will provide oral notice to EPA within 24 hours and written notice to EPA and MassDEP within five (5) days.

The inventory in **Appendix C** will be updated when new SSOs are detected. The SSO inventory will be included in the annual report, including the status of mitigation and corrective measures to address each identified SSO.

5 Assessment and Priority Ranking of Outfalls

The MS4 Permit requires an assessment and priority ranking of outfalls in terms of their potential to have illicit discharges and SSOs and the related public health significance. The ranking helps determine the priority order for performing IDDE investigations and meeting permit milestones.

5.1 Outfall Catchment Delineations

A catchment is the area that drains to an individual outfall[1] or interconnection.[2] The catchments for each of the MS4 outfalls will be identified to define contributing areas for investigation of potential sources of illicit discharges. Catchments are typically identified based on topographic contours and mapped stormwater collection infrastructure, where available. As described in **Section 3**, initial catchment delineations will be completed as part of the Phase I mapping, and refined catchment delineations will be completed as part of the Phase II mapping to reflect information collected during catchment investigations.

5.2 Outfall and Interconnection Inventory and Initial Ranking

An initial outfall and interconnection inventory and priority ranking is required to assess illicit discharge potential based on existing information. The initial inventory and ranking will be completed within one (1) year from the effective start date of the permit. An updated inventory and ranking will be provided in each annual report thereafter. The inventory will be updated annually to include data collected in connection with dry weather screening and other relevant inspections.

The outfall and interconnection inventory will identify each outfall and interconnection discharging from the MS4, record its location and condition, and provide a framework for tracking inspections, screenings and other IDDE program activities.

Outfalls and interconnections will be classified into one of the following categories:

[1] **Outfall** means a point source as defined by 40 CFR § 122.2 as the point where the municipal separate storm sewer discharges to waters of the United States. An outfall does not include open conveyances connecting two municipal separate storm sewers or pipes, tunnels or other conveyances that connect segments of the same stream or other waters of the United States and that are used to convey waters of the United States. Culverts longer than a simple road crossing shall be included in the inventory unless the Town can confirm that they are free of any connections and simply convey waters of the United States.

[2] **Interconnection** means the point (excluding sheet flow over impervious surfaces) where the Town's MS4 discharges to another MS4 or other storm sewer system, through which the discharge is conveyed to waters of the United States or to another storm sewer system and eventually to a water of the United States.

1. **Problem Outfalls**: Outfalls/interconnections with known or suspected contributions of illicit discharges based on existing information shall be designated as Problem Outfalls. This shall include any outfalls/interconnections where previous screening indicates likely sewer input. Likely sewer input indicators are any of the following:

    - Olfactory or visual evidence of sewage,
    - Ammonia ≥ 0.5 mg/L, surfactants ≥ 0.25 mg/L, and bacteria levels greater than the water quality criteria applicable to the receiving water, or
    - Ammonia ≥ 0.5 mg/L, surfactants ≥ 0.25 mg/L, and detectable levels of chlorine.

    Dry weather screening and sampling, as described in **Section 6** of this IDDE Plan and Part 2.3.4.7.b of the MS4 Permit, is not required for Problem Outfalls.

2. **High Priority Outfalls**: Outfalls/interconnections that have not been classified as Problem Outfalls and that are:

    - Discharging to an area of concern to public health due to proximity of public beaches, recreational areas, drinking water supplies or shellfish beds.
    - Determined by the Town as high priority based on the characteristics listed below or other available information.

3. **Low Priority Outfalls**: Outfalls/interconnections determined by the Town as low priority based on the characteristics listed below or other available information.

4. **Excluded outfalls**: Outfalls/interconnections with no potential for illicit discharges may be excluded from the IDDE program. This category is limited to roadway stormwater collection in undeveloped areas with no dwellings and no sanitary sewers; stormwater collection for athletic fields, parks or undeveloped green space and associated parking without services; cross-country stormwater collection alignments (that neither cross nor are in proximity to sanitary sewer alignments) through undeveloped land.

Outfalls will be ranked into the above priority categories (except for excluded outfalls, which may be excluded from the IDDE program) based on the following characteristics of the defined initial catchment areas, where information is available. Additional relevant characteristics, including location-specific characteristics, may be considered but must be documented in this IDDE Plan.

- **Previous screening results** – previous screening/sampling results indicate likely sewer input (see criteria above for Problem Outfalls).

- **Poor receiving water quality** – the following guidelines are recommended to identify waters as having a high illicit discharge potential:
    - Exceeding water quality standards for bacteria
    - Ammonia levels above 0.5 mg/l
    - Surfactants levels greater than or equal to 0.25 mg/l

- **Density of generating sites** – Generating sites are those places, including institutional, municipal, commercial, or industrial sites, with a potential to generate pollutants that could contribute to illicit discharges. Examples of these sites include, but are not limited to: car dealers, car washes, gas stations, garden centers, boat yards, and industrial manufacturing areas.

- **Culverted streams** – Any river or stream that is culverted for distances greater than a simple roadway crossing may have a high illicit discharge potential.

- **Water quality limited waterbodies** – Outfalls that discharge to waters with approved TMDLs applicable to the Town, where illicit discharges have the potential to contain the pollutant identified as the cause of the water quality impairment.

- **Sewer conversion** – Contributing catchment areas that were once serviced by septic systems, but have been converted to sewer connections may have a high illicit discharge potential.

- **Surrounding density of aging septic systems** – Septic systems thirty years or older in residential land use areas are prone to have failures and may have a high illicit discharge potential.

The following criteria are recommended to be considered by the MS4 Permit, but ultimately do not apply to the Town and were not included.

- **Age of development and infrastructure** – Industrial areas greater than 40 years old and areas where the sanitary sewer system is more than 40 years old will probably have a high illicit discharge potential. Developments 20 years or younger will probably have a low illicit discharge potential. The Town of Marion's system is almost entirely greater than 40 years old, limiting the usefulness of this criteria to prioritize catchment areas.

- **Historic combined sewer systems** – Contributing areas that were once serviced by a combined sewer system, but have been separated may have a high illicit discharge potential. The Town of Marion does not have a history of combined sewers.

- **Past discharge complaints and reports –** there are no available records related to past discharge complaints.

A copy of the initial outfall and interconnection inventory and priority ranking is included in **Appendix D**. The inventory will be updated by the DPW Superintendent annually. The updated inventory will be included in the annual report, including the status of mitigation and corrective measures to identify illicit discharges.

6 Dry Weather Outfall Screening and Sampling

Dry weather flow is a common indicator of potential illicit connections. The MS4 Permit requires all outfalls/interconnections (excluding Problem and excluded Outfalls) to be inspected for the presence of dry weather flow. Dry weather outfall screening starts with High Priority outfalls and is followed by Low Priority outfalls, based on the initial priority rankings described in the previous section.

6.1 Weather Conditions

Dry weather outfall screening and sampling may occur when no more than 0.1 inches of rainfall has occurred in the previous 24-hour period and no significant snow melt is occurring. For purposes of determining dry weather conditions, program staff will use precipitation data from New Bedford Regional Airport (KEWB). If New Bedford (KEWB) is not available or not reporting current weather data, then Plymouth Municipal Airport (KPYM) will be used as a back-up.

6.2 Dry Weather Screening/Sampling Procedure

6.2.1 General Procedure

The dry weather outfall inspection and sampling procedure consists of the following general steps:

1. Identify outfalls to be screened/sampled based on initial outfall inventory and priority ranking

2. Acquire the necessary staff, mapping, and field equipment (see **Table 6-1** for list of field equipment)

3. Conduct the outfall inspection during dry weather:

    a. Identify and photograph the outfall

    b. Record the inspection information and outfall characteristics on tablet

    c. Look for and record visual/olfactory evidence of pollutants in flowing outfalls including odor, color, turbidity, and floatable matter (suds, bubbles, excrement, toilet paper or sanitary products).

    d. Observe outfalls for deposits and stains, vegetation, and damage to outfall structures

4. If flow is observed, sample and test the flow following the procedures described in the following sections.

5. If no flow is observed, but evidence of illicit flow exists (illicit discharges are often intermittent or transitory), revisit the outfall during dry weather within one week of the initial observation, if practicable, to perform a second dry weather screening and sample any observed flow.

6. Update the outfall/interconnection inventory and priority ranking based on screening and sampling data.

7. Include all screening data in the annual report.

Previous outfall screening/sampling conducted under the 2003 MS4 Permit will be used to satisfy the dry weather outfall/screening requirements of the 2016 MS4 Permit only if the previous screening and sampling was substantially equivalent to that required by the 2016 MS4 Permit, including the list of analytes outlined in Section 2.3.4.7.b.iii.4 of the 2016 permit.

6.2.2 Field Equipment

Table 6-1 lists typical field equipment used for dry weather outfall screening and sampling.

Table 6-1. Typical Field Equipment List

	Field Log Book		Form of Identification
	Ammonia Kit		Safety Vest
	Surfactant Kit		Steel Toed Boots
	Chlorine Kit or Test Strips		Safety Glasses
	Water Quality Sonde		Time Keeping Device
	Laboratory Sample Containers		Tablets/iPads
	Empty Plastic Jugs (for kit disposal)		GPS Receiver (if needed)
	IDDE Plan		Chain of Custody Forms
	Property Owner Notification Letter		Extra Sampling Kits & Lab Containers
	Cooler		Ice
	Pre-labeled sampling bottles		De-ionized water
	Plastic Bags (for temporary dams)		Dissolved Oxygen Meter
	Plumbers Putty		Coolers
	Hand-held Pump		First Aid Kits
	Measuring tape		Trash Bags
	Flashlight		Hand Sanitizer
	Sampling Rod		Zip Ties/Duct Tape
	Latex Gloves		Bucket (for carrying supplies)
	Hip Waders or Rubber Boots		Health & Safety Plan
	Shovel & Pickaxe or J-Hook		Safety Cones
	Small Mallet or Hammer		Pens & Sharpies
			Paper Towels

6.2.3 Sample Collection and Analysis

If flow is present during a dry weather outfall inspection, a sample will be collected and analyzed for the required permit parameters[3] listed in **Table 6-2**.

Table 6-1. Sampling Parameters and Analysis Methods

Analyte or Parameter	Instrumentation (Portable Meter)	Field Test Kit
Ammonia	CHEMetrics™ V-2000 Colorimeter Hach™ DR/890 Colorimeter Hach™ Pocket Colorimeter™ II	CHEMetrics™ K-1410 CHEMetrics™ K-1510 (series) Hach™ NI-SA Hach™ Ammonia Test Strips
Surfactants (Detergents)	CHEMetrics™ I-2017	CHEMetrics™ K-9400 and K-9404 Hach™ DE-2
Chlorine	CHEMetrics™ V-2000, K-2513 Hach™ Pocket Colorimeter™ II	SenSafe Free Chlorine Test Strips Hach Model CN-80
Conductivity	CHEMetrics™ I-1200 YSI Pro30 YSI EC300A Oakton 450	NA
Temperature	YSI Pro30 YSI EC300A Oakton 450	NA
Salinity	YSI Pro30 YSI EC300A Oakton 450	NA
Indicator Bacteria: *E. coli* (freshwater) or Enterococcus (saline water)	EPA certified laboratory procedure (40 CFR § 136)[4]	NA
Pollutants of Concern[1]	EPA certified laboratory procedure (40 CFR § 136)[4]	NA

[1] Where the discharge is directly into a water quality limited water or a water subject to an approved TMDL, the sample must be analyzed for the pollutant(s) of concern identified as the cause of the water quality impairment.

The general procedure for collection of outfall samples is as follows:

[3] Other potentially useful parameters, although not required by the MS4 Permit, include **fluoride** (indicator of potable water sources in areas where water supplies are fluoridated), **potassium** (high levels may indicate the presence of sanitary wastewater), and **optical brighteners** (indicative of laundry detergents).

[4] 40 CFR § 136: http://www.ecfr.gov/cgi-bin/text-idx?SID=b3b41fdea0b7b0b8cd6c4304d86271b7&mc=true&node=pt40.25.136&rgn=div5

1. Fill out all sample information on sample bottles and tablet (see **Appendix E** for Sample Labels)

2. Put on protective gloves (nitrile/latex/other) before sampling

3. Collect sample with dipper or directly in sample containers. If possible, collect water from the flow directly in the sample bottle. Be careful not to disturb sediments.

4. If using a dipper or other device, triple rinse the device with distilled water and then in water to be sampled (not for bacteria sampling)

5. Use test strips, test kits, and field meters (rinse similar to dipper) for most parameters (see **Table 6-2**)

6. Place laboratory samples on ice for analysis of bacteria and pollutants of concern

7. Fill out chain-of-custody form (see **Appendix E** for Sample Chain of Custody form) for laboratory samples

8. Deliver samples to a certified laboratory within six hours of sample collection

9. Dispose of used test strips and test kit ampules properly

10. Decontaminate all testing personnel and equipment

During sampling the following protocols shall be followed:

1. Do not eat, drink or smoke during sample collection and processing.

2. Do not collect or process samples near a running vehicle.

3. Do not park vehicles in the immediate sample collection area, including both running and non-running vehicles.

4. Never touch the inside surface of a sample container or lid, even with gloved hands.

5. Never allow the inner surface of a sample container or lid to be contacted by any material other than the sample water.

6. Collect samples while facing upstream (for outfall samples within a waterbody) and so as not to disturb water or sediments in the outfall pipe or ditch.

7. Do not overfill sample containers, and do not dump out any liquid in them. Liquids are often added to sample containers intentionally by the analytical laboratory as a preservative or for pH adjustment.

8. Do not allow any object or material to fall into or contact the collected water sample.

9. Replace and tighten sample container lids immediately after sample collection.

In the event that an outfall is submerged, either partially or completely, or inaccessible, field staff will proceed to the first accessible upstream manhole or structure for the observation and sampling and report the location with the screening results. Field staff will continue to the next upstream structure until there is no longer an influence from the receiving water on the visual inspection or sampling.

Field test kits or field instrumentation are permitted for all parameters except indicator bacteria and any pollutants of concern. Field kits need to have appropriate detection limits and ranges. **Table 6-2** lists various field test kits and field instruments that can be used for outfall sampling associated with the 2016 MS4 Permit parameters, other than indicator bacteria and other pollutants of concern. Analytic procedures and user's manuals for field test kits and field instrumentation are provided in **Appendix F**.

Testing for indicator bacteria and any pollutants of concern must be conducted using analytical methods and procedures found in 40 CFR § 136.[4] Samples for laboratory analysis must also be stored and preserved in accordance with procedures found in 40 CFR § 136. **Table 6-3** lists analytical methods, detection limits, hold times, and preservatives for laboratory analysis of dry weather sampling parameters.

Table 6-2. Required Analytical Methods, Detection Limits, Hold Times, and Preservatives

Analyte or Parameter	Pollutant Causing Impairment	Analytical Method	Detection Limit	Max. Hold Time	Preservative
BOD5	Dissolved Oxygen	**EPA**: SM 5210	2 mg/L	48 hours	Ice
Total Nitrogen (freshwater)	Total Nitrogen	**EPA**: 351.1/351.2 + 353.2 **SM**: 4500-N_{org}, 4500-NH_3	**EPA**: 0.01 mg/L **SM**: 0.01 mg/L	28 days	Ice + H_2SO_4 to pH <2
Indicator Bacteria: *E. coli* *Enterococci*		*E. coli* **EPA**: 1603 **SM**: 9221B, 9221F , 9223 B **Other**: Colilert®, Colilert-18® *Enterococci* **EPA**: 1603 **SM**: 1106.1, 1600 **Other**: Enterolert®	*E. coli* **EPA**: 1 cfu/100mL **SM**: 2 MPN/100mL **Other**: 1 MPN/100mL	6 hours (to lab) 6 hours (to lab)	Ice Ice

SM = Standard Methods

[4] 40 CFR § 136: http://www.ecfr.gov/cgi-bin/text-idx?SID=b3b41fdea0b7b0b8cd6c4304d86271b7&mc=true&node=pt40.25.136&rgn=div5

Note that the following pollutants of concern are present in Town receiving waters, but are not required to be monitored under the MS4 Permit:

- Estuarine Bioassessments
- Fish-Passage Barrier

6.3 Interpreting Outfall Sampling Results

Outfall analytical data from dry weather sampling can be used to help identify the major type or source of discharge. **Table 6-4** shows values identified by the U.S. EPA and the Center for Watershed Protection as typical screening values for select parameters. These represent the typical concentration (or value) of each parameter expected to be found in stormwater. Screening values that exceed these benchmarks may be indicative of pollution and/or illicit discharges.

Table 6-3. Benchmark Field Measurements for Select Parameters[5]

Analyte or Parameter	Benchmark
Olfactory or Visual	Evidence of sanitary input
Ammonia	>0.5 mg/L
Conductivity	>2,000 µS/cm
Surfactants	>0.25 mg/L
Chlorine	>0.02 mg/L (detectable levels per the 2016 MS4 Permit)
Indicator Bacteria[5]: *E. coli* *Enterococcus*	*E. coli*: the geometric mean of the five most recent samples taken during the same bathing season shall not exceed 126 colonies per 100 ml and no single sample taken during the bathing season shall exceed 235 colonies per 100 ml *Enterococcus:* the geometric mean of the five most recent samples taken during the same bathing season shall not exceed 33 colonies per 100 ml and no single sample taken during the bathing season shall exceed 61 colonies per 100 ml

6.4 Follow-up Ranking of Outfalls and Interconnections

The Town will update and re-prioritize the initial outfall and interconnection rankings based on information gathered during dry weather screening. The rankings will be updated

[5] Massachusetts Water Quality Standards: http://www.mass.gov/eea/docs/dep/service/regulations/314cmr04.pdf

periodically as dry weather screening information becomes available but will be completed within three (3) years of the effective date of the permit.

Outfalls/interconnections where relevant information was found indicating sewer input to the MS4 or sampling results indicating sewer input are highly likely to contain illicit discharges from sanitary sources. Such outfalls/interconnections will be ranked as Problem Outfalls for investigation. Other outfalls and interconnections may be re-ranked based on any new information from the dry weather screening.

7 Catchment Investigations

Once stormwater outfalls with evidence of illicit discharges have been identified, various methods can be used to trace the source of the potential discharge within the outfall catchment area. Catchment investigation techniques include but are not limited to review of maps, historic plans, and records; manhole observation; dry and wet weather sampling; video inspection; smoke testing; and dye testing. This section outlines a systematic procedure to investigate outfall catchments to trace the source of potential illicit discharges. All data collected as part of the catchment investigations will be recorded and reported in each annual report.

7.1 System Vulnerability Factors

The Town will review relevant mapping and historic plans and records to identify areas within the catchment with higher potential for illicit connections. The following information will be reviewed:

- Plans related to the construction of the stormwater collection network
- Plans related to the construction of the sewer network
- Prior work on stormwater or sewer lines

Based on the review of this information, the presence of any of the following **System Vulnerability Factors (SVFs)** will be identified for each catchment:

- History of SSOs, including, but not limited to, those resulting from wet weather, high water table, or fat/oil/grease blockages
- Common or twin-invert manholes serving stormwater and sanitary sewer alignments
- Common trench construction serving both stormwater and sanitary sewer alignments
- Crossings of stormwater and sanitary sewer alignments where the sanitary system is above the stormwater drain system
- Sanitary sewer alignments known or suspected to have been constructed with an underdrain system
- Inadequate sanitary sewer level of service (LOS) resulting in regular surcharging, customer back-ups, or frequent customer complaints
- Areas formerly served by combined sewer systems
- Sanitary sewer infrastructure defects such as leaking service laterals, cracked, broken, or offset sanitary infrastructure, directly piped connections between stormwater and sanitary sewer infrastructure, or other vulnerability factors identified through Inflow/Infiltration Analyses, Sanitary Sewer Evaluation Surveys, or other infrastructure investigations
- Sewer pump/lift stations, siphons, or known sanitary sewer restrictions where power/equipment failures or blockages could readily result in SSOs

The 2016 Permit recommends inclusion of any sanitary sewer and stormwater infrastructure greater than 40 years old as a SVF. However, given that much of Marion's infrastructure

exceeds 40 years old, this criterion has little usefulness as an SVF. Therefore, it is not being considered for this IDDE Plan.

An SVF inventory will be documented for each catchment, retained as part of this IDDE Plan, and included in the annual report. A copy of the most recent SVF inventory will be kept in **Appendix H**.

7.2 Dry Weather Manhole Inspections

The Town will implement a dry weather stormwater collection network investigation that involves systematically and progressively observing, sampling and evaluating key junction manholes in the MS4 to determine the approximate location of suspected illicit discharges or SSOs.

The Town will be responsible for implementing the dry weather manhole inspection program and making updates as necessary. Infrastructure information will be incorporated into the stormwater collection system map, and catchment delineations will be refined based on the field investigation, where necessary. The SVF inventory will also be updated based on information obtained during the field investigations, where necessary.

Several important terms related to the dry weather manhole inspection program are defined by the MS4 Permit as follows:

- **Junction Manhole** is a manhole or structure with two or more inlets accepting flow from two or more MS4 alignments. Manholes with inlets solely from private stormwater lines, individual catch basins, or both are not considered junction manholes for these purposes.

- **Key Junction Manholes** are those junction manholes that can represent one or more junction manholes without compromising adequate implementation of the illicit discharge program. Adequate implementation of the illicit discharge program would not be compromised if the exclusion of a particular junction manhole as a key junction manhole would not affect the Town's ability to determine the possible presence of an upstream illicit discharge. A junction manhole may be excluded if located upstream from another located in the immediate vicinity or that is serving a stormwater collection alignment with no potential for illicit connections.

For all catchments identified for investigation, during dry weather, field crews will systematically inspect key junction manholes for evidence of illicit discharges. This program involves progressive inspection and sampling at manholes in the stormwater collection network to isolate and eliminate illicit discharges.

The manhole inspection methodology will be conducted in one of two ways (or a combination of both):

- By working progressively up from the outfall and inspecting key junction manholes

along the way, or

- By working progressively down from the upper parts of the catchment toward the outfall.

For most catchments, manhole inspections will proceed from the outfall moving up into the system. However, the decision to move up or down the system depends on the nature of the stormwater collection system and the surrounding land use and the availability of information on the catchment and stormwater collection system. Moving up the system can begin immediately when an illicit discharge is detected at an outfall, and only a map of the stormwater collection system is required. Moving down the system requires more advanced preparation and reliable stormwater collection system information on the upstream segments of the stormwater collection system, but may be more efficient if the sources of illicit discharges are believed to be located in the upstream portions of the catchment area. Once a manhole inspection methodology has been selected, investigations will continue systematically through the catchment.

Inspection of key junction manholes will proceed as follows:

1. Manholes will be opened and inspected for visual and olfactory evidence of illicit connections.

2. If flow is observed, a sample will be collected and analyzed at a minimum for ammonia, chlorine, and surfactants. Field kits can be used for these analyses. Sampling and analysis will be in accordance with procedures outlined in **Section 6**. Additional indicator sampling may assist in determining potential sources (e.g., bacteria for sanitary flows, conductivity to detect tidal backwater, etc.).

3. Where sampling results or visual or olfactory evidence indicate potential illicit discharges or SSOs, the area draining to the junction manhole will be flagged for further upstream manhole investigation and/or isolation and confirmation of sources.

4. Subsequent key junction manhole inspections will proceed until the location of suspected illicit discharges or SSOs can be isolated to a pipe segment between two manholes.

5. If no evidence of an illicit discharge is found, catchment investigations will be considered complete upon completion of key junction manhole sampling.

7.3 Wet Weather Outfall Sampling

Where a minimum of one SVF is identified based on previous information or the catchment investigation, a wet weather investigation must also be conducted at the associated outfall. The Town will be responsible for implementing the wet weather outfall sampling program and making updates as necessary.

Outfalls will be inspected and sampled under wet weather conditions, to the extent necessary, to determine whether wet weather-induced high flows in sanitary sewers or high groundwater in areas served by septic systems result in discharges of sanitary flow to the MS4.

Wet weather outfall sampling will proceed as follows:

1. At least one wet weather sample will be collected at the outfall for the same parameters required during dry weather screening.

2. Wet weather sampling will occur during or after a storm event of sufficient depth or intensity to produce a stormwater discharge at the outfall. There is no specific rainfall amount that will trigger sampling, although minimum storm event intensities that are likely to trigger sanitary sewer interconnections are preferred. To the extent feasible, sampling should occur during the spring (March through June) when groundwater levels are relatively high.

3. If wet weather outfall sampling indicates a potential illicit discharge, then additional wet weather source sampling will be performed, as warranted, or source isolation and confirmation procedures will be followed as described in **Section 7.4**.

4. If wet weather outfall sampling does not identify evidence of illicit discharges, and no evidence of an illicit discharge is found during dry weather manhole inspections, catchment investigations will be considered complete.

7.4 Source Isolation and Confirmation

Once the source of an illicit discharge is approximated between two manholes, more detailed investigation techniques will be used to isolate and confirm the source of the illicit discharge. The following methods may be used in isolating and confirming the source of illicit discharges:

- Sandbagging
- Smoke Testing
- Dye Testing
- CCTV/Video Inspections
- Optical Brightener Monitoring
- IDDE Canines

These methods are described in the sections below. Instructions and Standard Operating Procedures (SOPs) for these and other IDDE methods are provided in **Appendix I**.

Public notification is an important aspect of a detailed source investigation program. Prior to smoke testing or dye testing the Town will notify property owners in the affected area. Smoke testing notification will include hanging notifications for single family homes, businesses and building lobbies for multi-family dwellings.

7.4.1 Sandbagging

This technique can be particularly useful when attempting to isolate intermittent illicit discharges or those with very little perceptible flow. The technique involves placing sandbags or similar barriers (e.g., caulking, weirs/plates, or other temporary barriers) within outlets to manholes to form a temporary dam that collects any intermittent flows that may occur. Sandbags are typically left in place for 48 hours and should only be installed when dry weather is forecast. If flow has collected behind the sandbags/barriers after 48 hours it can be assessed using visual observations or by sampling. If no flow collects behind the sandbag, the upstream pipe network can be ruled out as a source of the intermittent discharge. Finding appropriate durations of dry weather and the need for multiple trips to each manhole makes this method both time-consuming and somewhat limiting.

7.4.2 Smoke Testing

Smoke testing involves injecting non-toxic smoke into drain lines and noting the emergence of smoke from sanitary sewer vents in illegally connected buildings or from cracks and leaks in the system itself. Typically, a smoke bomb or smoke generator is used to inject the smoke into the system at a catch basin or manhole and air is then forced through the system. Test personnel are placed in areas where there are suspected illegal connections or cracks/leaks, noting any escape of smoke (indicating an illicit connection or damaged stormwater infrastructure). It is important when using this technique to make proper notifications to area residents and business owners as well as local police and fire departments.

If the initial test of the stormwater collection system is unsuccessful then a more thorough smoke-test of the sanitary sewer lines can also be performed. Unlike stormwater line smoke tests, buildings that do not emit smoke during sanitary sewer smoke tests may have problem connections and may also have sewer gas venting inside, which is hazardous.

It should be noted that smoke may cause minor irritation of respiratory passages. Residents with respiratory conditions may need to be monitored or evacuated from the area of testing altogether to ensure safety during testing.

7.4.3 Dye Testing

Dye testing involves flushing non-toxic dye into plumbing fixtures such as toilets, showers, and sinks and observing nearby stormwater lines and sewer manholes as well as stormwater outfalls for the presence of the dye. Similar to smoke testing, it is important to inform local residents and business owners. Police, fire, and local public health staff should also be notified prior to testing in preparation of responding to citizen phone calls concerning the dye and their presence in local surface waters.

A team of two or more people is needed to perform dye testing (ideally, all with two-way radios). One person is inside the building, while the others are stationed at the appropriate stormwater and sanitary sewer manholes (which should be opened) and/or outfalls. The person inside the building adds dye into a plumbing fixture (i.e., toilet or sink) and runs a

sufficient amount of water to move the dye through the plumbing system. The person inside the building then radios to the outside crew that the dye has been dropped, and the outside crew watches for the dye in the stormwater and sanitary sewer lines, recording the presence or absence of the dye.

The test can be relatively quick (about 30 minutes per test), effective (results are usually definitive), and inexpensive. Dye testing is best used when the likely source of an illicit discharge has been narrowed down to a few specific houses or businesses.

7.4.4 CCTV/Video Inspection

Another method of source isolation involves the use of mobile video cameras that are guided remotely through stormwater lines to observe possible illicit discharges. IDDE program staff can review the videos and note any visible illicit discharges. While this tool is both effective and usually definitive, it can be costly and time consuming when compared to other source isolation techniques.

7.4.5 Optical Brightener Monitoring

Optical brighteners are fluorescent dyes that are used in detergents and paper products to enhance their appearance. The presence of optical brighteners in surface waters or dry weather discharges suggests there is a possible illicit discharge or insufficient removal through adsorption in nearby septic systems or wastewater treatment. Optical brightener monitoring can be done in two ways. The most common, and least expensive, methodology involves placing a cotton pad in a wire cage and securing it in a pipe, manhole, catch basin, or inlet to capture intermittent dry weather flows. The pad is retrieved at a later date and placed under UV light to determine the presence/absence of brighteners during the monitoring period. A second methodology uses handheld fluorometers to detect optical brighteners in water sample collected from outfalls or ambient surface waters. Use of a fluorometer, while more quantitative, is typically more costly and is not as effective at isolating intermittent discharges as other source isolation techniques.

7.4.6 IDDE Canines

Dogs specifically trained to smell human related sewage are becoming a cost-effective way to isolate and identify sources of illicit discharges. While not widespread at the moment, the use of IDDE canines is growing as is their accuracy. The use of IDDE canines is not recommended as a standalone practice for source identification; rather it is recommended as a tool to supplement other conventional methods, such as dye testing, in order to fully verify sources of illicit discharges.

7.5 Illicit Discharge Removal

When the specific source of an illicit discharge is identified, the Town will exercise its authority as necessary to require its removal within 60 days of its identification. The annual report will

include the status of IDDE investigation and removal activities including the following information for each confirmed source:

- The location of the discharge and its source(s)
- A description of the discharge
- The method of discovery
- Date of discovery
- Date of elimination, mitigation or enforcement action OR planned corrective measures and a schedule for completing the illicit discharge removal
- Estimate of the volume of flow removed

7.5.1 Confirmatory Outfall Screening

Within one (1) year of removal of all identified illicit discharges within a catchment area, confirmatory outfall or interconnection screening will be conducted. The confirmatory screening will be conducted in dry weather unless System Vulnerability Factors have been identified, in which case both dry weather and wet weather confirmatory screening will be conducted. If confirmatory screening indicates evidence of additional illicit discharges, the catchment will be scheduled for additional investigation.

7.6 Ongoing Screening

Upon completion of all catchment investigations and illicit discharge removal and confirmation (if necessary), each outfall or interconnection will be re-prioritized for screening and scheduled for ongoing screening once every five (5) years. Ongoing screening will consist of dry weather screening and sampling consistent with the procedures described in **Section 6** of this plan. Ongoing wet weather screening and sampling will also be conducted at outfalls where wet weather screening was required due to System Vulnerability Factors and will be conducted in accordance with the procedures described in **Section 7.3**. All sampling results will be reported in the annual report.

8 Training

Annual IDDE training will be made available to all employees involved in the IDDE program. This training will at a minimum include information on how to identify illicit discharges and SSOs and may also include additional training specific to the functions of particular personnel and their function within the framework of the IDDE program. Training records will be maintained in **Appendix J**. The frequency and type of training will be included in the annual report.

9 Progress Reporting

The progress and success of the IDDE program will be evaluated on an annual basis. The evaluation will be documented in the annual report and will include the following indicators of program progress:

- Number of SSOs and illicit discharges identified and removed
- Number and percent of total outfall catchments served by the MS4 evaluated using the catchment investigation procedure
- Number of dry weather outfall inspections/screenings
- Number of wet weather outfall inspections/sampling events
- Number of enforcement notices issued
- All dry weather and wet weather screening and sampling results
- Estimate of the volume of sewage removed, as applicable
- Number of employees trained annually

The success of the IDDE program will be measured by the IDDE activities completed within the required permit timelines.

Appendix A

Legal Authority (IDDE Bylaw or Ordinance)

The Town is given legal authority through the Sewer Use Regulations. A copy of these regulations can be found online at:

https://www.marionma.gov/sites/marionma/files/uploads/sewer_use_regulations.pdf

Appendix B

Stormwater Collection System Mapping

N

Wareham

Sippican River
(MA95-06, MA95-07)

Impairments:
Chlorophyll-a
Fish-Passage Barrier
Fecal Coliform
Oxygen, Dissolved

Impairments:
Estuarine Bioassessments
Fecal Coliform
Nitrogen (Total)

Weweantic River
(MA95-04, MA95-05)

Old Landing Underground
Treatment Structure

Hammet Cove
(MA95-56)

Impairments:
Estuarine Bioassessments
Fecal Coliform
Nitrogen (Total)

Inner Sippican Harbor
(MA95-70)

Island Wharf
Bioretention

Impairments:
Fecal Coliform
Nitrogen (Total)
Nutrient/Eutrophication Biological Indicators

South Street Underground
Treatment Structure

Sprague's Cove
Constructed Wetland

Impairments:
Fecal Coliform

Sippican Harbor
(MA95-69)

Aucoot Creek
(MA95-71, MA95-72)

Impairments:
Fecal Coliform
Nitrogen (Total)
Nutrient/Eutrophication Biological Indicators
Oxygen, Dissolved

Impairments:
Fecal Coliform
Nitrogen (Total)
Nutrient/Eutrophication Biological Indicators
Oxygen, Dissolved

Aucoot Cove
(MA95-09)

Legend

- Catch Basins
- Interconnections
- Stormwater Pipe
- Structural BMPs
- MS4 Area
- Municipality Border

MS4 Outfalls by Recieving Water

- AUCOOT CREEK
- HAMMETT COVE
- INNER SIPPICAN HARBOR
- SIPPICAN HARBOR
- SIPPICAN RIVER
- WEWEANTIC RIVER
- WINGS COVE

0 375 750 1,500 2,250 3,000 Feet

Note: Impairments listed are from the Massachusetts Year 2014 Integrated List of Waters

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Name	Receiving Water
MRAC6DP-03	AUCOOT CREEK
MRAC6DP-06	AUCOOT CREEK
MRAC6DP-07	AUCOOT CREEK
MRAC6DP-13	AUCOOT CREEK
MRAC6DP-16	AUCOOT CREEK
MRAC6DP-20	AUCOOT CREEK
MRAC6DP-22	AUCOOT CREEK
MRAC6DP-27	AUCOOT CREEK
MRAC6DP-31	AUCOOT CREEK
MRACABDP-04	AUCOOT CREEK
MRACGCDP-01	AUCOOT CREEK
MRACGCDP-03	AUCOOT CREEK
MRACOLDP-01	AUCOOT CREEK
MRACRKDP-02	AUCOOT CREEK
MRACRKDP-08	AUCOOT CREEK
MRIS6DP-78	HAMMETT COVE
MRIS6DP-79	HAMMETT COVE
MRIS6DP-82	HAMMETT COVE
MRIS6DP-83	HAMMETT COVE
MRIS6DP-85	HAMMETT COVE
MRIS6DP-87	HAMMETT COVE
MRIS6DP-93	HAMMETT COVE
MRISCEDP-01	HAMMETT COVE
MRISCRDP-01	HAMMETT COVE
MRISCRDP-02	HAMMETT COVE
MRISJEDP-02	HAMMETT COVE
MRISJEDP-05	HAMMETT COVE
MRISPODP-18	HAMMETT COVE
MRISPODP-21	HAMMETT COVE
MRISPODP-23	HAMMETT COVE
MRISPODP-31	HAMMETT COVE
MRISPRDP-02	HAMMETT COVE
MRISPRDP-04	HAMMETT COVE
MRIS195DP-51	INNER SIPPICAN HARBOR
MRIS6DP-47	INNER SIPPICAN HARBOR
MRIS6DP-60	INNER SIPPICAN HARBOR
MRIS6DP-66	INNER SIPPICAN HARBOR
MRIS6DP-68	INNER SIPPICAN HARBOR
MRISCTDP-01	INNER SIPPICAN HARBOR
MRISFRDP-13	INNER SIPPICAN HARBOR
MRISFRDP-27A	INNER SIPPICAN HARBOR
MRISFRDP-27B	INNER SIPPICAN HARBOR
MRISFRDP-27C	INNER SIPPICAN HARBOR
MRISFRDP-29	INNER SIPPICAN HARBOR
MRISFRDP-31	INNER SIPPICAN HARBOR
MRISFRDP-46	INNER SIPPICAN HARBOR
MRISFRDP-49	INNER SIPPICAN HARBOR
MRISFRDP-55	INNER SIPPICAN HARBOR
MRISFRDP-63	INNER SIPPICAN HARBOR
MRISFRDP-67	INNER SIPPICAN HARBOR
MRISFRDP-78	INNER SIPPICAN HARBOR
MRISFRDP-80	INNER SIPPICAN HARBOR
MRISFRDP-83	INNER SIPPICAN HARBOR
MRISIWDP-01	INNER SIPPICAN HARBOR
MRISIWDP-02	INNER SIPPICAN HARBOR
MRISIWDP-03	INNER SIPPICAN HARBOR
MRISIWDP-04	INNER SIPPICAN HARBOR
MRISMADP-21	INNER SIPPICAN HARBOR
MRISMIDP-01	INNER SIPPICAN HARBOR
MRISMIDP-02	INNER SIPPICAN HARBOR
MRISMPDP-02	INNER SIPPICAN HARBOR
MRISPCDP-01	INNER SIPPICAN HARBOR

MRISSPDP-10	INNER SIPPICAN HARBOR
MRISSPDP-33	INNER SIPPICAN HARBOR
MRISTADP-01	INNER SIPPICAN HARBOR
MRISTADP-05	INNER SIPPICAN HARBOR
MRISWADP-01	INNER SIPPICAN HARBOR
MRISWADP-07	INNER SIPPICAN HARBOR
MRISWADP-08	INNER SIPPICAN HARBOR
MRISWADP-10	INNER SIPPICAN HARBOR
MROSCODP-01	SIPPICAN HARBOR
MROSCVDP-01	SIPPICAN HARBOR
MROSOKDP-02	SIPPICAN HARBOR
MROSSSDP-01	SIPPICAN HARBOR
MRISCUDP-03	SIPPICAN RIVER
MRISFRDP-81	SIPPICAN RIVER
MRISPODP-02	SIPPICAN RIVER
MRISPODP-07	SIPPICAN RIVER
MRISPODP-09	SIPPICAN RIVER
MRISPODP-10	SIPPICAN RIVER
MRISPODP-11	SIPPICAN RIVER
MRWE6DP-107	SIPPICAN RIVER
MRWEBLDP-01	SIPPICAN RIVER
MRWEBRDP-01	SIPPICAN RIVER
MRWEBRDP-04	SIPPICAN RIVER
MRWEBUDP-01	SIPPICAN RIVER
MRWEBUDP-03	SIPPICAN RIVER
MRWEBUDP-05	SIPPICAN RIVER
MRWEBUDP-06	SIPPICAN RIVER
MRWEBUDP-20	SIPPICAN RIVER
MRWECUDP-04	SIPPICAN RIVER
MRWECUDP-05	SIPPICAN RIVER
MRWEICDP-06	SIPPICAN RIVER
MRWEPODP-01	SIPPICAN RIVER
MRWEPPDP-01	SIPPICAN RIVER
MRWEPWDP-09	SIPPICAN RIVER
MRWERIDP-01	SIPPICAN RIVER
MRWERVDP-01	SIPPICAN RIVER
MRWERVDP-02	SIPPICAN RIVER
MRWEWEDP-02	SIPPICAN RIVER
MRWE6DP-108	WEWANTIC RIVER
MRWE6DP-110	WEWANTIC RIVER
MRISDEDP-05	WEWEANTIC RIVER
MRWECNDP-01	WEWEANTIC RIVER
MRWEEDDP-02	WEWEANTIC RIVER
MRWESTDP-05	WEWEANTIC RIVER
MRISDEDP-01	WINGS COVE
MRISJODP-01	WINGS COVE
MRWCJNDP-05	WINGS COVE
MRWCJODP-03	WINGS COVE
MRWCJODP-08	WINGS COVE
MRWCJODP-10	WINGS COVE

Appendix C

Sanitary Sewer Overflow Inventory

Sanitary Sewer Overflow Inventory

Town of Marion, Massachusetts

Notes: Inventory will contain SSO records for a minimum of the past five years

Upon becoming aware of an SSO to the MS4, provide oral notice to EPA within 24 hours and written notice to EPA and MassDEP within five days

Revision Date: 5/29/2019

Year	Comments	Location	Discharge Statement	Start Date & Time	End Date & Time	Estimated Volume	Description	Mitigation Completed	Mitigation Planned
Reporting Year	Additional notes	Approximate street crossing/address and receiving water, if any	Clear statement of whether the discharge entered a surface water directly or entered the MS4	Date(s) and time(s) of each known SSO occurance (i.e., beginning and end of any known discharge)		Estimated volume of the occurance in Gallons	Description of the occurance indicating known or suspected cause(s)	Mitigation and corrective measures completed with dates implemented	Mitigation and corrective measures planned with implementation schedules
2014	No reported SSOs in 2014	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2015	No reported SSOs in 2015	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2016	No reported SSOs in 2016	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2017	No reported SSOs in 2017. A force main failure occurred on the Silvershell Pumping Station force main as the result of an outside contractor working on Town streets, but no SSOs resulted from this event.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2018	One reported SSO in 2018. Not capacity related.	Opposite #11 Hermitage Road. Fracture was found in woods in an easment bewteen the pump station and Hermitage Road.	Discharged to the ground surface. Did not enter a surface water or MS4 system.	7/13/2018 13:00	7/13/2018 15:00	< 330 gal	Cracked due to roots from a nearby tree and the weight that it endured.	Sewer Department staff repaired the pipe and removed the tree along with surrounding roots to prevent further damage on 7/13/2018. Rinsed outside of pipe and installed a wrap-around band repair clamp, tightened bolts and sealed the fracture.	Nothing planned. DPW recommends evaluation aof other pipes in the Town made of the same material to check for any potential issues.
2019	One reported SSO in 2019.	Opposite #7 Hermitage Road . Hole was in the roadside easement.	Discharged to ground surface. Did not enter a surface water or MS4 system.	4/18/2019 14:35	4/18/2019 15:15	~ 4-5 gal	Outside contractor was working nearby, hit the pipe and caused a break. Water was not under force; pump was not runing at the time. Pipe runs uphill so the water flowed backward under gravity.	DPW was onsite and was able to mitigate on 4/18/2019. The station was shut off immediately to prevent flow, and the water was drained. Referred to SPCC Plan to mitigate the spill. Outside company removed the coupling installed a wrap-arounf brand repair clamp, tightened bolts and sealed the seam.	Nothing planned. DPW recommends properly locating and recording locations of all sewer lines in accordance with new CMOM regulations.

Appendix D

Outfall and Interconnection Inventory and Priority Ranking

Town of Marion, Massachusetts
Priority Ranking of Outfalls/Interconnections

		Outfall General Inspection Results						Excluded Outfall Screening		Problem Outfall Screening			High Priority Screening			Discharge Screening Factor Scores							
Outfall or Interconnection ID	Receiving Water	Pipe Dimensions	Shape	Material	Latitude	Longitude	Physical Condition	Excluded Outfall	Reason for Exclusion	Most Recent Dry Weather Sampling Date	Was Evidence of Sewer Input Found?	Problem Outfall	Receiving Water Impaired for Bacteria?	Discharges to an Area of Concern?	High Priority Outfall	Area of Concern	Poor Receiving Water Quality	Density of Generating Sites	Previous Septic Systems	Existing Septic Systems	Culvereted Streams	Water Quality Limited Waterbodies	Total Score	Outfall Designation
MRACABDP-04	AUCOOT COVE							No					Yes	No	No	0	2	1			0	2	7	Low
MRACGCDP-01	AUCOOT COVE							No					Yes	No	No	0	2	1			0	2	7	Low
MRACGCDP-03	AUCOOT COVE							No					Yes	No	No	0	2	1			0	2	7	Low
MRACOLDP-01	AUCOOT COVE							No					Yes	No	No	0	2	1			0	2	6	Low
MRACRKDP-02	AUCOOT CREEK							No					Yes	No	No	0	2	1			0	2	7	Low
MRACRKDP-08	AUCOOT CREEK							No					Yes	No	No	1	2	1			0	2	8	High
MRIS6DP-93	HAMMETT COVE							No					Yes	No	No	0	2	1			0	2	7	Low
MRISCEDP-01	HAMMETT COVE							No					Yes	No	No	0	2	1			0	2	6	Low
MRISCRDP-01	HAMMETT COVE							No					Yes	No	No	1	2	1			0	2	7	Low
MRISCRDP-02	HAMMETT COVE							No					Yes	No	No	1	2	1			0	2	7	Low
MRISJEDP-02	HAMMETT COVE							No					Yes	No	No	0	2	1			0	2	7	Low
MRISPODP-18	HAMMETT COVE							No					Yes	No	No	0	2	1			0	2	7	Low
MRISPODP-21	HAMMETT COVE							No					Yes	No	No	0	2	1			0	2	7	Low
MRISPODP-23	HAMMETT COVE							No					Yes	No	No	0	2	1			0	2	7	Low
MRISPODP-31	HAMMETT COVE							No					Yes	No	No	0	2	1			0	2	6	Low
MRISPRDP-02	HAMMETT COVE							No					Yes	Yes	Yes	2	2	1			0	2	8	High
MRISPRDP-04	HAMMETT COVE							No					Yes	Yes	Yes	2	2	1			0	2	8	High
MRIS6DP-60	INNER SIPPICAN HARBOR							No					Yes	No	No	0	2	2			2	2	10	High
MRISCTDP-01	INNER SIPPICAN HARBOR							No					Yes	No	No	0	2	2			0	2	8	High
MRISFRDP-13	INNER SIPPICAN HARBOR							No					Yes	No	No	0	2	2			0	2	8	High
MRISFRDP-27A	INNER SIPPICAN HARBOR							No					Yes	No	No	1	2	2			0	2	8	High
MRISFRDP-27B	INNER SIPPICAN HARBOR							No					Yes	No	No	1	2	2			0	2	8	High
MRISFRDP-27C	INNER SIPPICAN HARBOR							No					Yes	Yes	Yes	2	2	2			0	2	9	High
MRISFRDP-29	INNER SIPPICAN HARBOR							No					Yes	No	No	1	2	2			0	2	9	High
MRISFRDP-31	INNER SIPPICAN HARBOR							No					Yes	Yes	Yes	2	2	2			0	2	10	High
MRISFRDP-46	INNER SIPPICAN HARBOR							No					Yes	Yes	Yes	1	2	2			0	2	9	High
MRISFRDP-49	INNER SIPPICAN HARBOR							No					Yes	Yes	Yes	2	2	2			0	2	10	High
MRISFRDP-55	INNER SIPPICAN HARBOR							No					Yes	Yes	Yes	2	2	2			0	2	10	High
MRISFRDP-63	INNER SIPPICAN HARBOR							No					Yes	Yes	Yes	1	2	2			0	2	9	High
MRISFRDP-67	INNER SIPPICAN HARBOR							No					Yes	No	No	1	2	2			0	2	9	High
MRISMADP-21	INNER SIPPICAN HARBOR							No					Yes	Yes	Yes	2	2	2			0	2	10	High
MRISMPDP-02	INNER SIPPICAN HARBOR							No					Yes	No	No	0	2	2			0	2	8	High
MRISPCDP-01	INNER SIPPICAN HARBOR							No					Yes	No	No	0	2	1			0	2	5	Low
MRISSPDP-10	INNER SIPPICAN HARBOR							No					Yes	No	No	0	2	2			0	2	8	High
MRISSPDP-33	INNER SIPPICAN HARBOR							No					Yes	No	No	1	2	2			0	2	9	High
MRISTADP-01	INNER SIPPICAN HARBOR							No					Yes	Yes	Yes	2	2	2			0	2	10	High
MRISTADP-05	INNER SIPPICAN HARBOR							No					Yes	Yes	Yes	2	2	2			0	2	10	High
MRISWADP-01	INNER SIPPICAN HARBOR							No					Yes	Yes	Yes	2	2	1			0	2	9	High
MRISWADP-07	INNER SIPPICAN HARBOR							No					Yes	Yes	Yes	2	2	1			0	2	9	High
MRISWADP-08	INNER SIPPICAN HARBOR							No					Yes	No	No	1	2	1			0	2	8	High
MRISWADP-10	INNER SIPPICAN HARBOR							No					Yes	Yes	Yes	2	2	1			0	2	7	High
MROSCODP-01	SIPPICAN HARBOR							No					Yes	No	No	0	2	2			1	2	9	High
MROSCVDP-01	SIPPICAN HARBOR							No					Yes	Yes	Yes	2	2	1			0	2	9	High
MROSOKDP-02	SIPPICAN HARBOR							No					Yes	No	No	0	2	1			0	2	6	Low
MROSSSDP-01	SIPPICAN HARBOR							No					Yes	Yes	Yes	2	2	1			0	2	9	High
MRISCUDP-03	SIPPICAN RIVER							No					Yes	No	No	0	2	1			0	2	7	Low
MRISPODP-02	SIPPICAN RIVER							Yes	roadway drainage only, contains no sewer pipes nor dwellings															
MRISPODP-07	SIPPICAN RIVER							No					Yes	No	No	0	2	1			0	2	7	Low
MRISPODP-09	SIPPICAN RIVER							No					Yes	No	No	0	2	1			0	2	7	Low
MRISPODP-10	SIPPICAN RIVER							Yes	roadway drainage only, contains no sewer pipes nor dwellings															
MRISPODP-11	SIPPICAN RIVER							No					Yes	No	No	0	2	1			0	2	7	Low
MRWEBLDP-01	SIPPICAN RIVER							No					Yes	No	No	0	2	1			0	2	7	Low
MRWEBRDP-01	SIPPICAN RIVER							No					Yes	No	No	1	2	1			0	2	8	High
MRWEBRDP-04	SIPPICAN RIVER							No					Yes	No	No	0	2	1			0	2	7	Low
MRWEBUDP-01	SIPPICAN RIVER							No					Yes	No	No	0	2	1			0	2	7	Low
MRWEBUDP-03	SIPPICAN RIVER							No					Yes	No	No	0	2	1			0	2	7	Low
MRWEBUDP-05	SIPPICAN RIVER							No					Yes	No	No	0	2	1			0	2	7	Low
MRWEBUDP-06	SIPPICAN RIVER							No					Yes	No	No	0	2	1			0	2	7	Low
MRWEBUDP-20	SIPPICAN RIVER							No					Yes	No	No	0	2	1			0	2	7	Low
MRWECUDP-04	SIPPICAN RIVER							No					Yes	No	No	0	2	1			0	2	7	Low
MRWECUDP-05	SIPPICAN RIVER							Yes	roadway drainage only, contains no sewer pipes nor dwellings															
MRWEICDP-06	SIPPICAN RIVER							No					Yes	No	No	1	2	1			0	2	8	High
MRWEPODP-01	SIPPICAN RIVER							No					Yes	No	No	0	2	1			0	2	7	Low
MRWEPPDP-01	SIPPICAN RIVER							No					Yes	Yes	Yes	2	2	1			0	2	9	High
MRWEPWDP-09	SIPPICAN RIVER							No					Yes	No	No	1	2	1			0	2	8	High
MRWERIDP-01	SIPPICAN RIVER							No					Yes	Yes	Yes	2	2	1			0	2	9	High
MRWERVDP-01	SIPPICAN RIVER							No					Yes	No	No	0	2	1			0	2	7	Low
MRWERVDP-02	SIPPICAN RIVER							No					Yes	No	No	0	2	0			0	2	6	Low
MRWEWEDP-02	SIPPICAN RIVER							No					Yes	No	No	1	2	1			0	2	8	High
MRISDEDP-05	WEWEANTIC RIVER							No					Yes	Yes	Yes	2	2	0			0	2	8	High
MRWE6DP-110	WEWEANTIC RIVER							Yes	roadway drainage only, contains no sewer pipes nor dwellings															
MRWECNDP-01	WEWEANTIC RIVER							No					Yes	No	No	0	2	0			0	2	6	Low
MRWEEDDP-02	WEWEANTIC RIVER							No					Yes	Yes	Yes	2	2	0			0	2	8	High
MRWESTDP-05	WEWEANTIC RIVER							No					Yes	No	No	0	2	0			0	2	6	Low
MRISDEDP-01	WINGS COVE							No					No	No	No	0	0	1			0	0	3	Low
MRISJODP-01	WINGS COVE							No					No	Yes	Yes	2	0	1			0	0	5	High

Town of Marion, Massachusetts
Priority Ranking of Outfalls/Interconnections

		Outfall General Inspection Results						Excluded Outfall Screening		Problem Outfall Screening			High Priority Screening			Discharge Screening Factor Scores								
Outfall or Interconnection ID	Receiving Water	Pipe Dimensions	Shape	Material	Latitude	Longitude	Physical Condition	Excluded Outfall	Reason for Exclusion	Most Recent Dry Weather Sampling Date	Was Evidence of Sewer Input Found?	Problem Outfall	Receiving Water Impaired for Bacteria?	Discharges to an Area of Concern?	High Priority Outfall	Area of Concern	Poor Receiving Water Quality	Density of Generating Sites	Previous Septic Systems	Existing Septic Systems	Culvereted Streams	Water Quality Limited Waterbodies	Total Score	Outfall Designation
MRWCJNDP-05	WINGS COVE							No					No	Yes	Yes	2	0	1			0	0	3	High
MRWCJODP-03	WINGS COVE							No					No	Yes	Yes	2	0	1			0	0	5	High
MRWCJODP-08	WINGS COVE							No					No	Yes	Yes	2	0	1			0	0	5	High
MRWCJODP-10	WINGS COVE							No					No	Yes	Yes	2	0	1			0	0	5	High

https://buzzardsbay.org/government/town-info/marion-info/marion-maps/#Drawer_R14:_Drainage
https://www.marionma.gov/open-space-acquisition-commission/pages/trailroad-maps
https://geo-massdot.opendata.arcgis.com/datasets/4d6f9262d380478a88873c00933411a6_0
https://www.mass.gov/service-details/massgis-data-layers

Appendix E

Sample Bottle Labels and Chain of Custody Forms

Example Laboratory Bottle Labels

Client: Town of Marion
Date Collected: July 17, 2019
Time Collected: 13:15
Sample ID: MRAC6DP-20
Analyses Required: Total Nitrogen
Preservative: Non-Preserved

Client: Town of Marion
Date Collected: July 17, 2019
Time Collected: 08:28
Sample ID: MRISJEDP-02
Analyses Required: E. coli
Preservative: Sterile

Client: Town of Marion
Date Collected: July 17, 2019
Time Collected: 15:32
Sample ID: MRIS6DP-78
Analyses Required: BOD5
Preservative: Sterile

Client: Town of Marion
Date Collected: July 17, 2019
Time Collected: 15:32
Sample ID: MRWEICDP-06
Analyses Required: Enterococci
Preservative: Sterile

R.I. ANALYTICAL
Specialists in Environmental Services

CHAIN OF CUSTODY RECORD

41 Illinois Avenue
Warwick, RI 02888-3007
800-937-2580 • Fax: 401-738-1970

131 Coolidge St., Suite 105
Hudson, MA 01749-1331
800-937-2580 • Fax: 978-568-0078

Date Collected	Time Collected	Field Sample Identification	Grab or Composite	# of Containers & Type C	Preservation Code P	Matrix Code M	* Enterococci	Oil & Grease	NO_2/NO_3	BOD_5
8/16/18	9:45	DP-201C	G	P/ST	S	SW	X	X		
8/16/18	8:33	DP-133	G	P/ST	—	SW	X		X	X
8/16/18	10:22	DP-122	G	P/ST	—	SW	X			

EXAMPLE

* Note: Enterococci & E.Coli dilution- 200-24,000

Client Information

Company Name: CDM Smith
Address: 260 West Exchange Street
City / State / Zip: Providence, RI 02903
Telephone: 401-751-5360 Fax:
Contact Person: Shannon Ruggieri

Project Information

Project Name: Marion MS4 Compliance
P.O. Number: Project Number:
Report To: Eilish Corey Phone: 401-457-0320 Fax
Sampled By:
Quote No:
Email report to these addresses: CoreyE@cdmsmith.com

Relinquished By Signatures	Date	Time	Received By Signatures	Date	Time

Turn Around Time

- [X] Normal [X] EMAIL Report
- [ ] 5 Business days. Possible surcharge
- [ ] Rush – Date Due: ___/___/___

Project Comments

Circle if applicable: GW-1, GW-2, GW-3, S-1, S-2, S-3 MCP Data Enhancement QC Package? Yes No

Temp. Upon Receipt °C

Lab Use Only

- [ ] Sample Pick-Up Only
- [ ] RIAL sampled; attach field hours
- [ ] Shipped on ice

Workorder No:

Containers: P=Poly, G=Glass, AG=Amber Glass, V=Vial, St=Sterile Preservatives: A=Ascorbic Acid, NH4=NH_4Cl, H=HCl, M=MeOH, N=HNO_3, NP=None, S=H_2SO_4, SB=$NaHSO_4$, SH=NaOH, T=$Na_2S_2O_3$, Z=ZnOAc

Appendix F

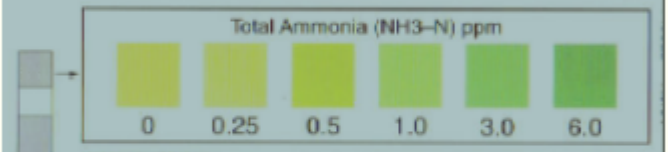
Water Quality Analysis Instructions and User's Manuals

AquaChek™

Water Quality Test Strips for

Ammonia

25 Test Strips
Cat. 27553-25



DIRECTIONS:

1. Fill sample vial to top line with water.
2. Dip the strip into water sample. Vigorously move the strip up and down in water sample for 30 seconds, making sure both pads are always submerged.
3. Remove the test strip and shake off excess water.
4. Hold the test strip level, with pad side up, for 30 seconds.
5. To read result, **turn test strip over** so that both pads are facing away from you.
6. Compare the color of the **small pad** to the color chart above. Read the result through the clear plastic of the test strip.
7. Rinse sample vial with tap water after each use.

IMPORTANT: KEEP CAP ON TIGHT BETWEEN USES. STORE AT ROOM TEMPERATURE. AVOID CONTACT WITH SKIN. IF CONTACT OCCURS, RINSE THOROUGHLY.

USE BY DATE ON BOTTOM

HACH® Hach Company, P.O. Box 389, Loveland, CO 80539 U.S.
(800) 227-4224 Outside U.S.A. (970) 669-3050

Detergents SAM

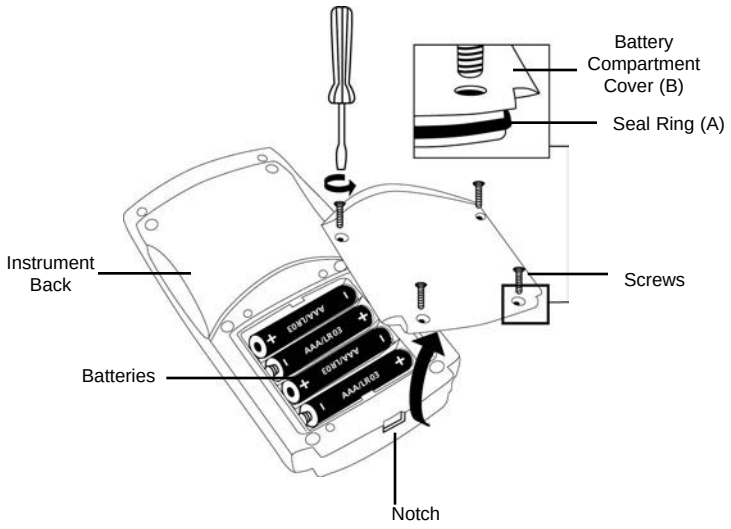
I-2017

0 to 2.50
PPM (mg/Liter)

CHEMetrics

Simplicity in Water Analysis

Battery Replacement



To ensure that the instrument is waterproof:

- seal ring (A) must be in position
- battery compartment cover (B) must be fixed with the four screws

To Set Zero

1. Press the Power key.
2. The display will show "**det**".
3. Insert the ZERO test tube (supplied in detergents test kit) filled with distilled or deionized water into the sample cell compartment (with mild downward pressure), making sure that it is fully seated.
4. Place the light shield over the ZERO test tube.
5. Press the Zero/Test key. The "**det**" symbol will flash for approximately 8 seconds, then the display will show "0.0.0".

To Make a Measurement

1. Follow the Test Procedure in the Instrumental Detergents Test (Cat. # R-9423).
2. Insert the resulting Detergents test tube into the sample cell compartment (with mild downward pressure), making sure that it is fully seated.
3. Place the light shield over the test tube.
4. Press the Zero/Test key. The "**det**" symbol will flash for approximately 3 seconds, then the sample test result will appear in the display as ppm (mg/Liter).

Operating Tips

- Upon startup, the photometer automatically proceeds to the zeroing process. Every time the photometer powers on, it must be re-zeroed.
- To re-zero the photometer, it must be turned off and back on again.
- A series of readings can be taken without re-zeroing, as long as the photometer stays on during the series.
- Protect photometer from extreme humidity, corrosive fumes and dusty areas. Store in a cool, dry place.
- Remove the batteries when photometer is not in use.
- Press the **!** key to turn the display back light on or off.
- When moving the photometer from one temperature extreme to another, wait at least 10 minutes before use to allow photometer to come to temperature equilibrium.
- Contamination of the optics in the sample chamber will result in incorrect measurements. The windows in the sample chamber should be checked at regular intervals and cleaned as necessary. Use a soft moist cloth or cotton swab for cleaning purposes.
- If the sample cell adapter has been removed, it must be replaced with proper orientation, aligning the triangle on the adapter with the triangle on the photometer.

Displays and Troubleshooting

E01: Light absorption too great (dirty optics)
E20/E21: Too much light reaching detector
E22 or Battery Icon: Battery should be replaced
E27/E28/E29: Instrument zeroed incorrectly, misaligned adapter, test tube not properly seated, dirty optics or failing light source.
Hi/E03: Measuring range exceeded or excessive turbidity
Lo: Test result has a negative value (less than 0 ppm)

Specifications

Auto Shutoff: After 15 minutes of non-use
Optics: 660 nm LED/interference filter and photosensor in transparent sample chamber
Operating Temp.: 5 to 40°C (41 to 104°F)
Battery: 4 AAA batteries (approx. 5,000 tests or 17 hours)
Waterproof: Floating, IP68 (1 hour at 0.1 meter)
Wavelength Accuracy: ± 1 nm
Photometric Accuracy: 3% full scale (T = 20 - 25° C / 68 - 77° F)
Photometric Resolution: 0.01 A
Ambient Conditions: Temperature 5 - 40° C / 41 - 104° F
Rel. humidity 30 - 90 % (non-condensing)
CE: Certificate of Declaration of CE-Conformity available upon request.

Menu Selection

Setting Date and Time

Upon initial start-up, the SAM will display "Set", "dAtE", and "YYYY", then a 4 digit number. Proceed to Step 4 in the procedure below to set the date and time, or power the instrument off and on again to bypass this process. At any time that the time and/or data need to be reset, follow steps 1-6 of the procedure below.

1. Press the Mode key and hold. Turn the instrument on by pressing and releasing the Power key. Once three decimal points appear in the display, release the Mode key. The display will show "di 5".
2. Press and release the ! key until the display shows arrows in the upper right and lower left corners of the display, pointing to "Time" and "Date".
3. Press the Mode key. "Set", "dAtE" will briefly appear in the display.
4. Date and time settings are displayed in the following order: Year ("YYYY"), Month ("MM"), Day ("dd"), Hour ("hh"), Minutes ("mm"). Increase the displayed value for each setting by pressing the Mode key or decrease the value by pressing the Zero/Test key until the desired value is displayed.
5. Press the ! key to save the displayed value and to proceed to the next setting.
6. After setting the minutes, press the ! key. The display will flash "iS" "SEt" and then will return to the measurement mode.

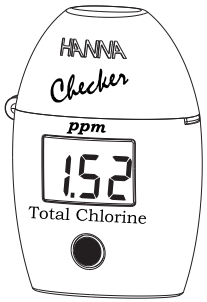
Recall of Stored Data

The SAM photometer automatically stores the last 15 data sets. To recall stored data:

1. Press the Mode key and hold. Turn the instrument on by pressing and releasing the Power key. Once three decimal points appear in the display, release the Mode key. The display will show "di 5".
   Note: If the instrument is already on, press and hold the ! key for at least 4 seconds and release to access the stored data.
2. Press the Mode key. The photometer will display the stored data sets in the following format:
   a. Sample Number: nXX (e.g. n15, n14, … n1)
   b. Year: XXXX (e.g. 2017)
   c. Date: mm.dd (e.g. 03.15)
   d. Time: hh.mm (e.g. 12:05)
   e. Analyte
   f. Result
3. Press the Zero/Test key to repeat the current data set.
4. Press the Mode key to proceed to the next data set.
5. Press the ! key to return to the measurement mode.

HI 711

Total Chlorine



HANNA instruments

www.hannainst.com

Dear Customer,

Thank you for choosing a Hanna Instruments Product.
Please read this instruction manual carefully before using the instrument. If you need additional technical information, do not hesitate to e-mail us at tech@hannainst.com or view our worldwide contact list at www.hannainst.com.

Preliminary examination:

Please examine this product carefully. Make sure that the instrument is not damaged. If any damage occurred during shipment, please notify your Dealer.
Each **HI 711** meter is supplied complete with:

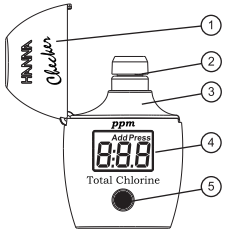
- Two Sample Cuvettes and Caps
- Six powder reagents for Total Chlorine
- 1 x 1.5V AAA Battery
- Instruction Manual

For more details about spare parts and accessories see "Accessories".

Technical specifications:

Range	0.00 to 3.50 ppm
Resolution	0.01 ppm
Accuracy	±0.03 ppm ±3% of reading @ 25 °C / 77 °F
Light Source	Light Emitting Diode @ 525 nm
Light Detector	Silicon Photocell
Method	Adaptation of USEPA method 330.5. The reaction between the chlorine and DPD reagent causes a pink tint in the sample.
Environment	0 to 50 °C (32 to 122 °F); max 95% RH non-condensing
Battery Type	1 x 1.5V AAA
Auto-Shut off	After 2 minutes of non-use
Dimensions	81.5 x 61 x 37.5 mm (3.2 x 2.4 x 1.5")
Weight	64 g (2.25 oz.)

Functional description:



1. Dust cover.
2. Cuvette with cap.
3. Cuvette holder.
4. Liquid Crystal Display.
5. Button.

Errors and warnings:

Light High: There is too much light to perform a measurement. Please check the preparation of the zero cuvette.

Light Low: There is not enough light to perform a measurement. Please check the preparation of the zero cuvette.

Inverted Cuvettes: The sample and the zero cuvette are inverted.

Under Range: A blinking **"0.00"** indicates that the sample absorbs less light than the zero reference. Check the procedure and make sure you use the same cuvette for reference (zero) and measurement.

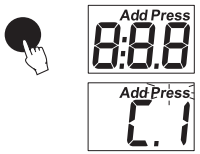
Over Range: A flashing value of the maximum concentration indicates the reading is over range. Dilute the sample and re-run the test.

Battery Low: The battery must be replaced soon.

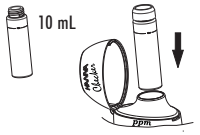
Dead Battery: This indicates that the battery is dead and must be replaced. Once this indication is displayed, normal operation of the instrument will be interrupted. Change the battery and restart the meter.

Measurement procedure:

- Turn the meter on by pressing the button. All segments will be displayed. When the display shows "**Add**", "**C.1**" with "**Press**" blinking, the meter is ready.

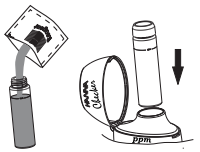


- Fill the cuvette with 10 mL of unreacted sample and replace the cap. Place the cuvette into the meter and close the meter's cap.



- Press the button. When the display shows "**Add**", "**C.2**" with "**Press**" blinking the meter is zeroed.

- Remove the cuvette from the meter and unscrew the cap. Add the content of one packet of **HI 711-25** reagent. Replace the cap and shake gently for 20 seconds. Place the cuvette back into the meter.



- Press and hold the button until the timer is displayed on the LCD (the display will show the countdown prior to the measurement) or, alternatively, wait for 2 minutes and 30 seconds and press the button.

- The instrument directly displays the concentration of total chlorine in ppm. The meter automatically turns off after 2 minutes.

Tips for an accurate measurement

- It is important that the sample does not contain any debris.
- Whenever the cuvette is placed into the measurement cell, it must be dry outside, and completely free of fingerprints, oil and dirt. Wipe it thoroughly with **HI 731318** or a lint-free cloth prior to insertion.
- Shaking the cuvette can generate bubbles, causing higher readings. To obtain accurate measurements, remove bubbles by swirling or by gently tapping the cuvette.
- Do not let the reacted sample stand for too long after reagent is added, as accuracy will be affected.
- After the reading it is important to immediately discard the sample, otherwise the glass might become permanently stained.

Battery management

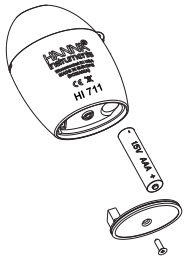
To save the battery, the instrument shuts down after 2 minutes of non-use.

One fresh battery lasts for a minimum of 5000 measurements. When the battery is dead the instrument will display "**bAd**" then "**bAt**" for 1 second and then turns off.

To restart the instrument, the battery must be replaced with a new one.

To replace the instrument's battery:

- Turn the instrument off by holding the button until the meter shuts off.
- Turn the instrument upside down and remove the battery cover with a screwdriver.



- Remove the battery from its location and replace it with a new one, inserting the negative end first.
- Insert the battery cover and replace the screw with a screwdriver.

Accessories:

REAGENT SETS	
HI 711-25	Reagents for 25 Total Chlorine tests
OTHER ACCESSORIES	
HI 711-11	Total Chlorine Certified Standard Kit
HI 731318	Cloth for wiping cuvettes (4 pcs.)
HI 731321	Glass cuvettes (4 pcs.)
HI 731225	Cuvette black cap for checker HC (4 pcs.)
HI 731353	Cuvette seal cap for checker HC (4 pcs.)
HI 740028	1.5V AAA batteries (4 pcs.)
HI 93703-50	Cuvette cleaning solution (230 mL)

Recommendations for Users

Before using these products, make sure that they are entirely suitable for your specific application and for the environment in which they are used.

Operation of these instruments may cause unacceptable interferences to other electronic equipments, thus requiring the operator to take all necessary steps to correct interferences.

Any variation introduced by the user to the supplied equipment may degrade the instrument's EMC performance.

To avoid damages or burns, do not put the instrument in microwave oven. For the safety of you and the instrument do not use or store the instrument in hazardous environments.

Hanna Instruments reserves the right to modify the design, construction or appearance of its products without advance notice.

For additional information, contact your dealer or the nearest Hanna Customer Service Center. To find a Hanna Office in your area, visit our web site:

www.hannainst.com

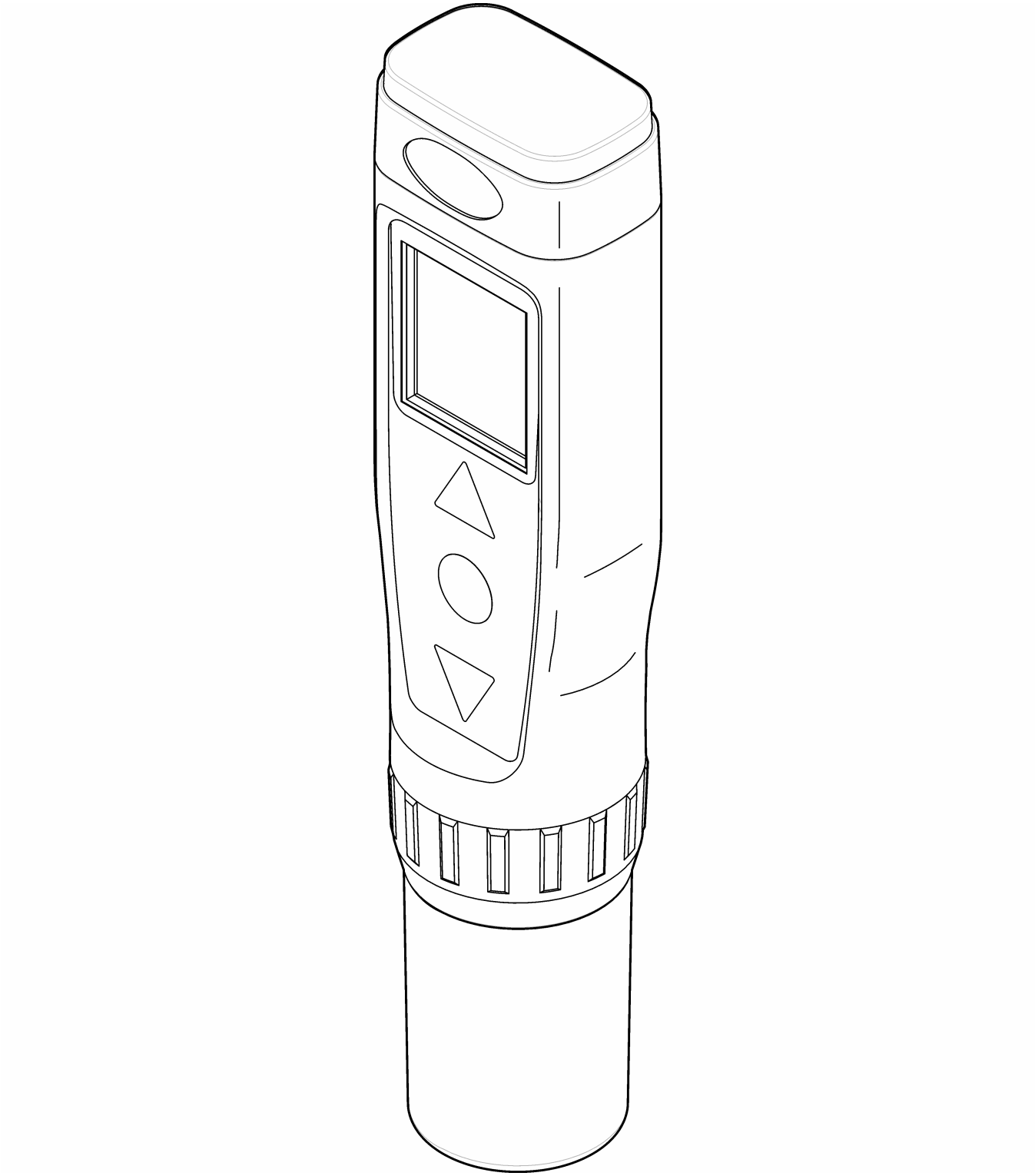
HANNA® instruments

IST711 03/13

User Manual

DOC022.53.80399

Pocket Pro™+ Multi 2



Specifications

Specifications are subject to change without notice.

Specification	Details
Dimensions (W x D x H)	37 x 30 x 170 mm (1.45 x 1.18 x 6.69 in.)
Enclosure rating	IP67
Weight	135 g (0.297 lb) with batteries
Power requirements (internal)	AAA alkaline batteries (4x)
Battery life	450 hours (200 hours with backlight on)
Operating temperature	0 to 50 °C (32 to 122 °F)
Storage temperature	–20 to 60 °C (–4 to 140 °F)
Operating humidity	80% (non-condensing)
Altitude	2000 m (6562 ft)
Instrument range	**pH:** 0.00 to 14.00 **Conductivity:** auto-ranging (0.0 to 199.9 µS/cm, 200 to 1999 µS/cm, 2.00 to 19.99 mS/cm) **TDS:** auto-ranging (0.0 to 99.9 ppm, 100 to 999 ppm, 1.00 to 10.00 ppt) **Salinity:** auto-ranging (0.00 to 99.9 ppm, 100 to 999 ppm, 1.0 to 10.00 ppt, 0.00 to 1.00%) **Temperature:** 0.0 to 50°C (32.0 to 122.0 °F)
Resolution	**pH**: 0.01 pH **Conductivity:** 0.1 µS/cm from 0.0 to 199.9 µS/cm, 1 µS/cm from 200 to 1999 µS/cm, 0.01 mS/cm from 2.00 to 20.00 mS/cm) **TDS:** 0.1 ppm from 0.0 to 99.9 ppm, 1 ppm from 100 to 999 ppm, 0.01 ppt from 1.00 to 10.00 ppt **Salinity:** 0.1 ppm from 0.0 to 99.9 ppm, 1 ppm from 100 to 999 ppm, 0.01 ppt from 1.0 to 10.00 ppt, 0.01% from 0.0 to 1.00% **Temperature:** 0.1°C (0.1 °F)
Accuracy[1], [2]	**pH:** ±0.02 pH **Conductivity:** ±1% **TDS:** ±1% **Salinity:** ±1% **Temperature:** ±0.5 °C (±0.9 °F)
Calibration points	**pH:** 3 points (auto), 2 points (custom) **Conductivity:** 3 points (auto), 1 point (custom) ***Note:*** *Temperature calibration is not available.*
Auto-recognition calibration standards	**pH:** USA: 4.01, 7.00, 10.01 pH, NIST: 4.01, 6.86, 9.18 pH **Conductivity:** 147 µS/cm, 1413 µS/cm and 12.88 mS/cm
Certifications	CE mark, FCC, Industry Canada, KC Mark, RCM, China RoHS
Warranty	1 year for tester and 6 months for replacement sensor for manufacturing faults only. Damage from use is not covered.

[1] For pH, the accuracy is based on a 3-point calibration and calibration standards at the same temperature as the samples measured. Also valid for 5.5 to 8.5 pH based on a 1-point calibration, 0.0 to 8.5 pH based on a 2-point calibration with pH 7 and pH 4 standards, or 5.5 to 14 pH based on a 2-point calibration with pH 7 and pH 10 standards.

[2] For conductivity, TDS and salinity, the accuracy is based on a 2-point calibration and the conductivity range of the calibration standards includes the conductivity value of the water sample.

General information

In no event will the manufacturer be liable for direct, indirect, special, incidental or consequential damages resulting from any defect or omission in this manual. The manufacturer reserves the right to make changes in this manual and the products it describes at any time, without notice or obligation. Revised editions are found on the manufacturer's website.

Safety information

NOTICE

The manufacturer is not responsible for any damages due to misapplication or misuse of this product including, without limitation, direct, incidental and consequential damages, and disclaims such damages to the full extent permitted under applicable law. The user is solely responsible to identify critical application risks and install appropriate mechanisms to protect processes during a possible equipment malfunction.

Please read this entire manual before unpacking, setting up or operating this equipment. Pay attention to all danger and caution statements. Failure to do so could result in serious injury to the operator or damage to the equipment.

Make sure that the protection provided by this equipment is not impaired. Do not use or install this equipment in any manner other than that specified in this manual.

Use of hazard information

⚠DANGER

Indicates a potentially or imminently hazardous situation which, if not avoided, will result in death or serious injury.

⚠WARNING

Indicates a potentially or imminently hazardous situation which, if not avoided, could result in death or serious injury.

⚠CAUTION

Indicates a potentially hazardous situation that may result in minor or moderate injury.

NOTICE

Indicates a situation which, if not avoided, may cause damage to the instrument. Information that requires special emphasis.

Precautionary labels

Read all labels and tags attached to the instrument. Personal injury or damage to the instrument could occur if not observed. A symbol on the instrument is referenced in the manual with a precautionary statement.

	This symbol, if noted on the instrument, references the instruction manual for operation and/or safety information.
	Electrical equipment marked with this symbol may not be disposed of in European public disposal systems after 12 August of 2005. In conformity with European local and national regulations (EU Directive 2002/96/EC), European electrical equipment users must now return old or end-of-life equipment to the Producer for disposal at no charge to the user. ***Note:*** *For return for recycling, please contact the equipment producer or supplier for instructions on how to return end-of-life equipment, producer-supplied electrical accessories, and all auxiliary items for proper disposal.*

Certification

Canadian Radio Interference-Causing Equipment Regulation, IECS-003, Class B:

Supporting test records reside with the manufacturer.

This Class B digital apparatus meets all requirements of the Canadian Interference-Causing Equipment Regulations.

Cet appareil numérique de classe B répond à toutes les exigences de la réglementation canadienne sur les équipements provoquant des interférences.

FCC Part 15, Class "B" Limits

Supporting test records reside with the manufacturer. The device complies with Part 15 of the FCC Rules. Operation is subject to the following conditions:

1. The equipment may not cause harmful interference.
2. The equipment must accept any interference received, including interference that may cause undesired operation.

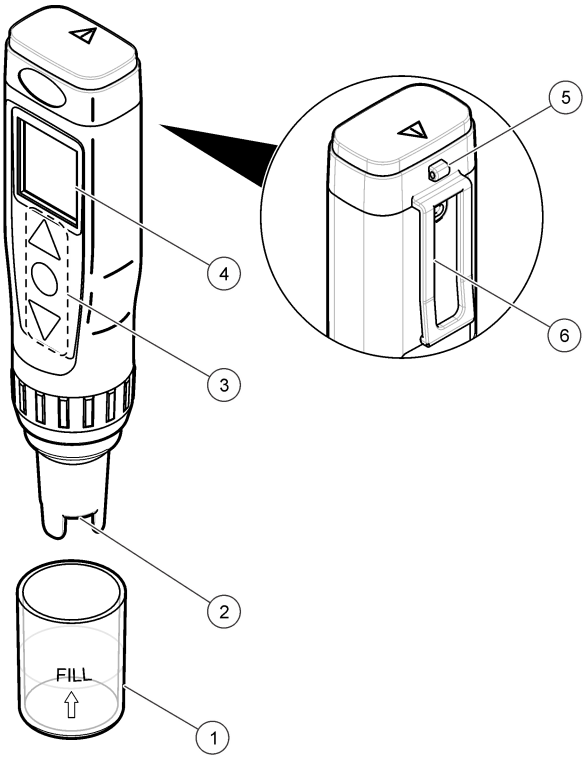
Changes or modifications to this equipment not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment. This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at their expense. The following techniques can be used to reduce interference problems:

1. Move the equipment away from the device receiving the interference.
2. Reposition the receiving antenna for the device receiving the interference.
3. Try combinations of the above.

Product overview

This Pocket Pro™+ tester measures the pH, conductivity, TDS (total dissolved solids) or salinity of general water samples. Refer to Figure 1. This tester is waterproof and floats.

Figure 1 Product features

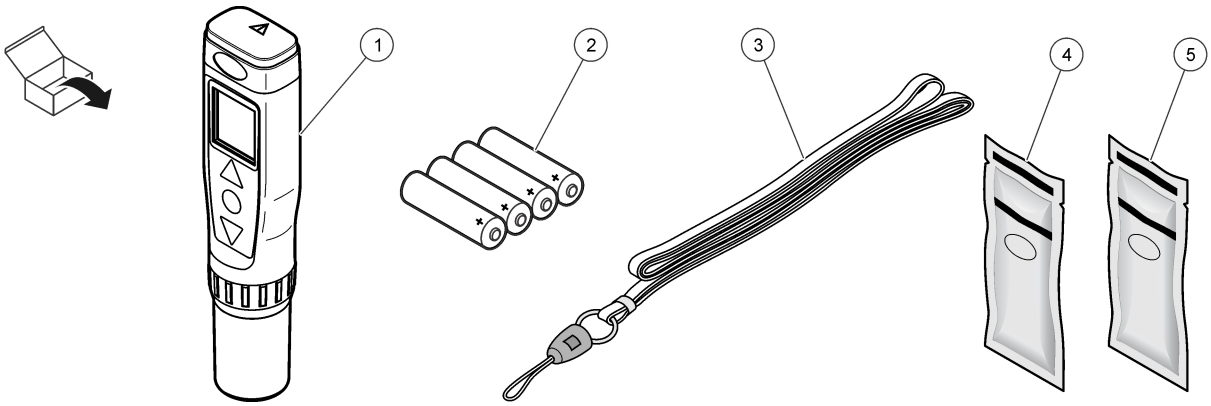


1 Sensor cap	**3** Keypad	**5** Lanyard attachment
2 Sensor	**4** Display	**6** Pocket clip

Product components

Make sure that all components have been received. Refer to Figure 2. If any items are missing or damaged, contact the manufacturer or a sales representative immediately.

Figure 2 Product components



1 Pocket Pro+ tester	**3** Lanyard	**5** SINGLET™ (1413 µS/cm)
2 AAA alkaline batteries (4x)	**4** SINGLET™ (7.00 pH)	

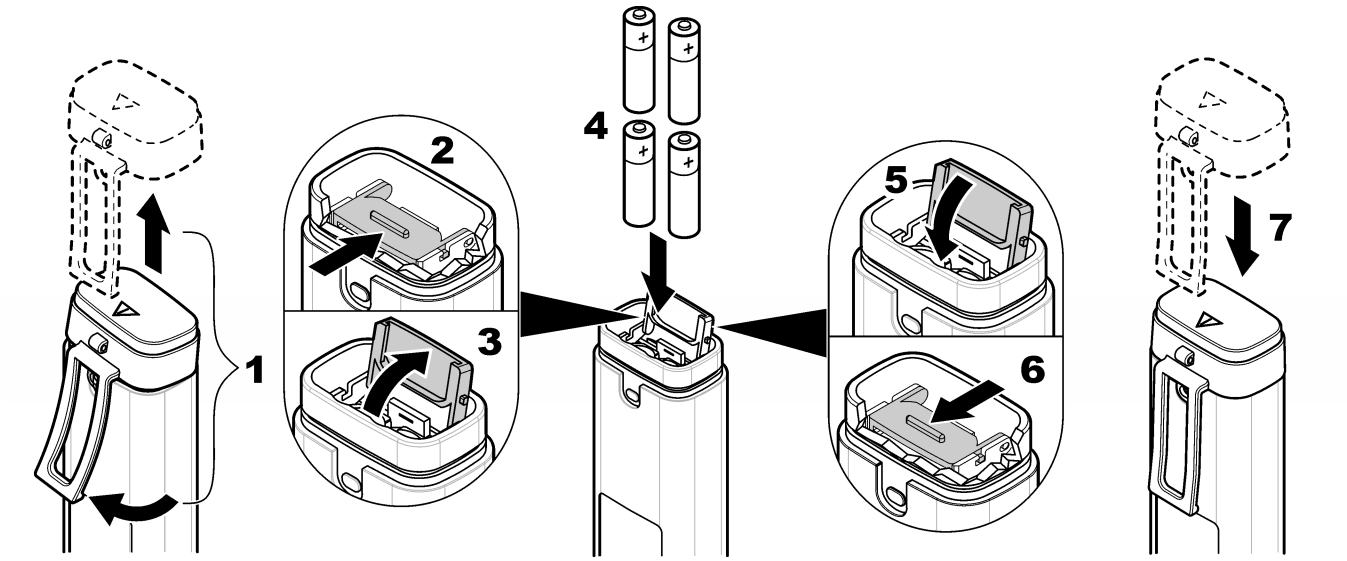
Install the batteries

⚠ CAUTION	
	Explosion hazard. Incorrect battery installation can cause the release of explosive gases. Be sure that the batteries are of the same approved chemical type and are inserted in the correct orientation. Do not mix new and used batteries.

⚠ WARNING	
	Fire hazard. Battery substitution is not permitted. Use only alkaline batteries.

Install the four AAA alkaline batteries in the tester. Refer to the illustrated steps in Figure 3.

Figure 3 Install the batteries

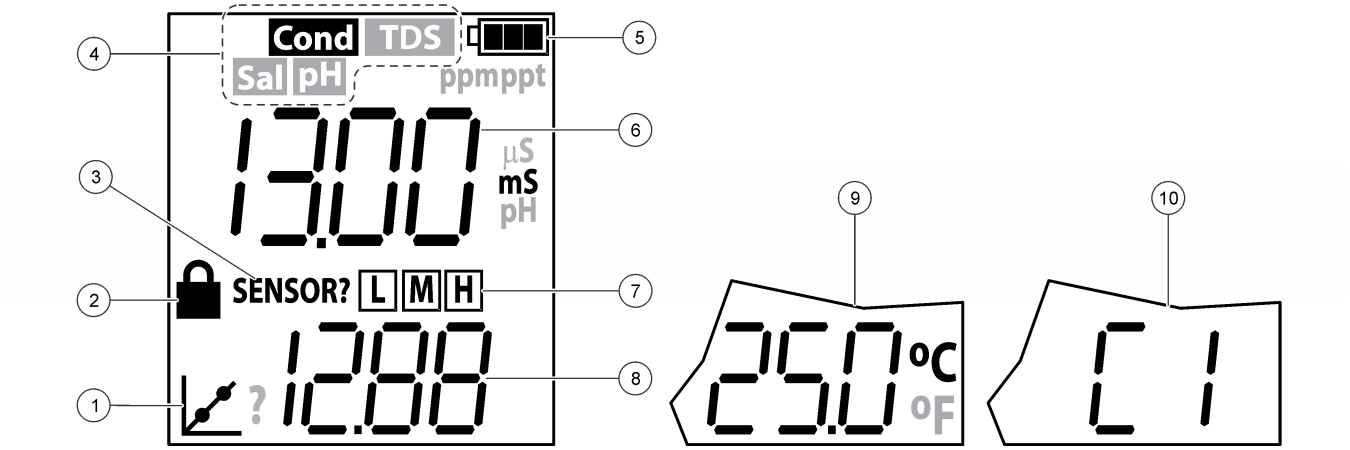


User interface and navigation

Display description

Figure 4 shows the measurements, calibration standard information and indicator icons shown on the display. Table 1 gives descriptions of the icons.

Figure 4 Display overview



1 Calibration icon	**5** Battery icon	**9** Temperature
2 Lock icon	**6** Parameter value	**10** Custom standard (C1, C2)[6]
3 Sensor? icon	**7** Calibration standard(s) measured for last calibration (low, medium, high)[4]	
4 Parameter[3]	**8** Calibration standard(s) expected[5]	

Table 1 Display icons

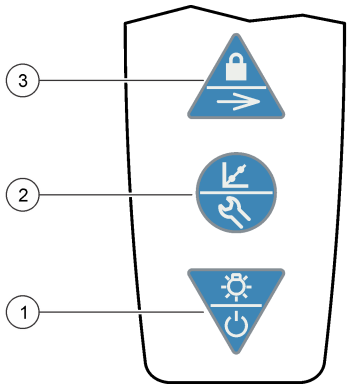
Icon	Description
	Shows the battery power level. Flashes when the battery power is less than 10%.
	Shows when the lock feature is on. When the lock feature is on, the parameter value on the display does not change. Push to set the lock feature to on or off.
Sensor?	Refer to Troubleshooting on page 12.
	Shows when the tester is in calibration mode or when a calibration is due. If "?" shows next to the calibration icon, the last calibration was not successful. When the ACAL setting is set to Yes (default), "?" shows next to the calibration icon on the pH screen when a pH calibration is due.

Keypad description

Figure 5 shows the keypad. Table 2 gives the key descriptions.

[3] Only one parameter shows at a time.
[4] Shows after auto calibration
[5] Shows during auto calibration
[6] Shows during pH custom calibration.

Figure 5 Keypad overview



1 Power/Backlight key	**2** Calibration/Settings key	**3** Lock/Parameter key

Table 2 Key functions

Key	Description
	Push and hold to set the power to on or off. Push to set the backlight to on or off. After 1 minute of no activity, the backlight switches off.
	Push to start a calibration of the parameter shown at the top of the display. To exit a calibration, push and hold. Push and hold until "SEt" shows on the display to go to the settings menu. To exit the settings menu, push and hold until "End" shows on the display. When in the settings menu, push to scroll through the settings. ***Note:*** *Power cannot be set to off while in settings or calibration mode.*
	Push and hold to scroll through the parameters measured. Push to set the lock feature to on or off. When the lock feature is on, the lock icon shows and the parameter value on the display does not change.

Calibration

⚠CAUTION

Chemical exposure hazard. Obey laboratory safety procedures and wear all of the personal protective equipment appropriate to the chemicals that are handled. Refer to the current safety data sheets (MSDS/SDS) for safety protocols.

Calibrate the tester before initial use and when:

- Results drift
- Results are not accurate
- "?" shows next to the calibration icon on the pH screen

Before initial calibration and after dry storage, soak the sensor for several minutes in the sample or a pH buffer.

Calibrate the parameters shown in Table 3 with the:

- Auto calibration procedure
- Custom calibration procedure

The number of calibration standards measured (calibration points) depends on the calibration procedure. Refer to Table 3.

Table 3 Number of calibration points

Parameter	Calibration procedure	Calibration points	Calibration standards
Conductivity	Auto	1–3	147 µS/cm, 1413 µS/cm, 12.88 mS/cm
	Custom	1	Any value
pH	Auto	1–3	USA: 4.01, 7.00, 10.01 NIST: 4.01, 6.86, 9.18
	Custom	1–2	Any value

Auto calibration – pH

Items to collect: One, two or three auto-recognition calibration standards

1. Set the power to on.
2. Remove the cap from the sensor.
3. Push and hold → until pH shows.
4. Push to go to calibration mode.
   The auto-recognition standard(s) to measure shows on the bottom line.
   Note: *If "C1" shows on the bottom line, do not continue. Set the tester to auto calibration mode. Refer to* Configure the settings *on page 11.*
5. Rinse the sensor and cap with deionized water and blot dry.
6. Pour the auto-recognition standard shown into the cap to the fill line.
7. Put the sensor fully into the cap.
8. When the measurement is stable, push to save the measurement.
   The measured value flashes three times.
9. Optional: To measure another calibration standard (maximum of 3), do steps 5–8 again.
10. Push and hold to go to continuous measurement mode. "END" shows on the display.
11. Rinse the sensor and cap with deionized water and blot dry.

Auto calibration – conductivity

Items to collect: One, two or three auto-recognition calibration standards

1. Set the power to on.
2. Remove the cap from the sensor.
3. Push and hold → until Conductivity shows.
4. Push to go to calibration mode.
   The auto-recognition standard(s) to measure shows on the bottom line.
   Note: *If "C1" shows on the bottom line, do not continue. Set the tester to auto calibration mode. Refer to* Configure the settings *on page 11.*
5. Rinse the sensor and cap with deionized water and blot dry.
6. Pour the auto-recognition standard shown into the cap to the fill line.
7. Put the sensor fully into the cap.
8. When the measurement is stable, push to save the calibration and go to continuous measurement mode. The measured value will flash 3 times and then stop. Then, "END" shows on the display.
9. Optional: To measure another calibration standard (maximum of 3), do steps 4–8 again.
10. Rinse the sensor and cap with deionized water and blot dry.

Custom calibration – pH

Items to collect: One or two calibration standards or samples of known pH value

1. Set the power to on.
2. Remove the cap from the sensor.
3. Push and hold → until "pH" shows.
4. Go to the settings menu. Make sure the bUFr setting is set to Cus (custom standard). Refer to Configure the settings on page 11.
5. Push CAL to go to calibration mode.
   "C1" shows on the bottom line.
6. Rinse the sensor and cap with deionized water and blot dry.
7. Pour the calibration standard or sample into the cap to the fill line.
8. Put the sensor fully into the cap.
9. When the measurement is stable, push ▲ and ▼ until the pH value of the calibration solution or sample shows on the display.
10. Optional: To measure a second pH calibration standard or sample of known value, push CAL, then do steps 6–9 again.
11. When the last measurement is stable, push and hold CAL to save the calibration and go to continuous measurement mode. "END" shows on the display.

    Note: *"ECAL" shows on the display if the calibration was not successful. Refer to* Troubleshooting *on page 12.*
12. Rinse the sensor and cap with deionized water and blot dry.

Custom calibration – conductivity

Item to collect: One calibration standard or sample of known value

1. Remove the cap from the sensor.
2. Set the power to on.
3. Push and hold → until "Cond" shows.
4. Go to the settings menu. Make sure that the Std setting in the conductivity settings menu is set to Cus (custom standard). Refer to Configure the settings on page 11.
5. Push CAL to go to calibration mode.
   "C1" shows on the bottom line.
6. Rinse the sensor and cap with deionized water and blot dry.
7. Pour the calibration standard or sample into the cap to the fill line.
8. Put the sensor fully into the cap.
9. When the measurement is stable, push ▲ and ▼ until the pH value of the calibration solution or sample shows on the display.
10. Push CAL. The entered value will flash 3 times and then stop. "END" shows on the display.
11. Rinse the sensor and cap with deionized water and blot dry.

Measurement

Note: *Air bubbles under the probe tip when submerged can cause slow stabilization or error in measurement. Shake the tester from side to side to remove air bubbles.*

1. Set the power to on.
2. Remove the cap from the sensor.
3. If the lock icon shows on the display, push 🔒 to go to continuous measurement mode.
4. Push and hold → to select the parameter to measure (i.e., Conductivity).

   Note: *Only one parameter can be measured at one time.*

5. Rinse the sensor and cap with deionized water and blot dry.
6. Pour the water sample into the cap to the fill line.
7. Put the sensor fully into the cap. The measured value shows on the top line.
8. To keep the measured value on the display when the sensor is removed from the sample, push .
   Note: *The lock icon shows on the display when the measurement is stable.*
9. To measure another sample, do steps 3–8.
10. When done with measurements:
    a. Rinse the sensor and cap with deionized water.
    b. Put the cap on the tester.
    c. Set the power to off.

Advanced operation

Configure the settings

1. Push and hold until "SEt" shows on the display.
2. Push to scroll through the settings. The current value of the setting shows on the bottom line.

Option	Description
Unit	Select the temperature unit that shows on the display—Celsius (default) or Fahrenheit.
bUFr	Select the pH buffers that are used for auto calibration—USA (4.01, 7.01, 10.01, default), NIST (4.01, 6.86, 9.18) or Cus (custom standard).
Std	Select the type of calibration standard to use for calibration—Aut (auto-recognition standard, default) or CUS (custom standard). This setting is not in the pH settings menu.
trEF	Enter the conductivity reference temperature for temperature correction—15.0 to 30.0 °C (default = 25.0 °C).
tC	Enter the conductivity temperature compensation factor (linear)—0.00% to 9.99% per °C (default = 2.00% per °C). The correction factor may need to be identified experimentally. For example, the factor for ultrapure water is 4.55% per °C and the factor for NaCl salt solution 2.125% per °C.
Fctr	Enter the TDS factor— 0.40 to 1.00 (default = 0.71)
Unit	Select the salinity unit that shows on the display— ppt or %.
AOFF	Set the auto-off feature to on (default) or off. When set to on, power is automatically set to off after 8 minutes of no activity.
ACAL	Enable or disable pH calibration reminder—Yes (enable, default) or No (disable). When set to Yes, "?" shows next to the calibration icon when a calibration is due.
rSEt	Change the settings to the factory defaults—Yes or No (default). When set to Yes, changes the settings for all the parameters to the factory settings and default values.

3. To change the value of the setting, push ▲ or ▼ .
4. When done with changes, push and hold until "End" shows to go to continuous measurement mode.

Maintenance

⚠ CAUTION

Multiple hazards. Only qualified personnel must conduct the tasks described in this section of the document.

Clean the sensor

Clean the sensor when:

- "SENSOR?" shows on the display
- Stabilization is slow
- Results drift or are not accurate
- Calibration failure occurs

1. Soak the sensor in the applicable cleaning agent. Refer to Table 4.
2. Rinse or soak the sensor in deionized water for 1 minute.

Table 4 Cleaning agents

Contaminant	Cleaning agent	Time
Grease, oils and fats	Electrode cleaning solution	2 hours maximum
Mineral buildup	10% hydrochloric acid (HCl) solution	5 minutes maximum

Replace the batteries

When the battery icon flashes or the tester will not come on, replace all four batteries. Refer to Install the batteries on page 6.

Replace the sensor

To replace the sensor, refer to the instructions supplied with the sensor.

Troubleshooting

Message	Possible cause	Solution
SENSOR?	The calibration slope is ±10–15%.	Gently clean the sensor. Refer to Clean the sensor on page 12.
ECAL	Calibration failure. The pH calibration slope is greater than ±15%.	Gently clean the sensor. Refer to Clean the sensor on page 12. Calibrate again. If calibration failure continues, replace the sensor.
"- - - -" (top line)	The parameter value is not within the measurement range of the tester. Refer to Specifications on page 2.	Make sure that the value of the sample is within the measurement range of the tester. Gently clean the sensor. Refer to Clean the sensor on page 12. Calibrate as necessary.
"- - - -" (bottom line)	The temperature value is not within the operating temperature range of the tester or a temperature sensor failure occurred. Refer to Specifications on page 2 for the operating temperature range.	Make sure that the sample temperature is within the operating temperature range of the tester. Contact technical support as necessary. ***Note:*** *The tester can still be used if a temperature sensor failure has occurred, but without automatic temperature compensation.*
Battery icon flashes	The batteries have less than 10% power remaining.	Replace all four batteries. Refer to Install the batteries on page 6.

Replacement parts and accessories

⚠ WARNING

Personal injury hazard. Use of non-approved parts may cause personal injury, damage to the instrument or equipment malfunction. The replacement parts in this section are approved by the manufacturer.

Note: *Product and Article numbers may vary for some selling regions. Contact the appropriate distributor or refer to the company website for contact information.*

Table 5 Replacement parts

Description	Quantity	Item no.
AAA alkaline batteries	4/pkg	4674300
Lanyard	1	201305
SINGLET, 1413 µS/cm	20/pkg	2771420
SINGLET, 7.00 pH	20/pkg	2770120
pH/Cond/TDS/Salinity sensor, replacement	1	9532801

Table 6 Accessories

Description	Quantity	Item no.
SINGLET, 4.01 pH	20/pkg	2770020
SINGLET, 10.01 pH	20/pkg	2770220
SINGLET, 147 µS/cm	20/pkg	2771320
SINGLET, 12.88 ms/cm	20/pkg	2771520
Electrode cleaning solution	500 mL	2965249
Hydrochloric Acid (HCl)	2.5 L	13406
Hydrochloric Acid (HCl)	500 mL	13449

HACH COMPANY World Headquarters
P.O. Box 389, Loveland, CO 80539-0389 U.S.A.
Tel. (970) 669-3050
(800) 227-4224 (U.S.A. only)
Fax (970) 669-2932
orders@hach.com
www.hach.com

HACH LANGE GMBH
Willstätterstraße 11
D-40549 Düsseldorf, Germany
Tel. +49 (0) 2 11 52 88-320
Fax +49 (0) 2 11 52 88-210
info@hach-lange.de
www.hach-lange.de

HACH LANGE Sàrl
6, route de Compois
1222 Vésenaz
SWITZERLAND
Tel. +41 22 594 6400
Fax +41 22 594 6499

© Hach Company/Hach Lange GmbH, 2014. All rights reserved.

12/2014, Edition 2

Appendix G

Outfall Inspection and Dry Weather Screening Standard Operating Procedures

Standard Operating Procedure

Outfall Inspection and Dry Weather Screening

PURPOSE AND APPLICABILITY

This standard operating procedure (SOP) is for the inspection of stormwater drainage outfalls and collection and analysis of samples during dry weather conditions as performed under an illicit discharge detection and elimination program. The objective of this inspection is to identify signs of sanitary sewer flow in drainage pipes. Refer to the Town of Marion Illicit Discharge Detection and Elimination (IDDE) Plan for additional details and information on the overall program.

SUMMARY OF THE METHOD

Inspect and take samples from stormwater outfalls to check for signs of illicit discharges.

ACRONYMS

CFU	*Colony Forming Units*
DPI	*Department of Public Works*
EPA	*Environmental Protection Agency*
GPS	*Global Positioning System*
IDDE	*Illicit Discharge Detection and Elimination*
mg/L	M*illigram/liter*
mL	*Milliliter*
MPN	*Most Probable Number*
PPE	*Personal Protection Equipment*
QA/QC	*Quality Assurance/Quality Control*
SOP	*Standard Operating Procedure*
SM	*Standard Method*

HEALTH AND SAFETY WARNINGS AND CAUTIONS

Special care should be taken throughout all sampling efforts, both to minimize inadvertent sample contamination and to maintain safe operating procedures at all times. Health and safety plans are developed for each project and should be referred to for proper health and safety protocol. Special consideration should be taken when performing the following:

- Take care when opening lab bottles, as some may contain a preservative crucial to achieving accurate results and that may be toxic to skin exposure. Carefully read the label of each lab bottle prior to opening.

- Take care when accessing outfalls or any open structures. Outfalls may be in heavily wooded areas, on steep slopes, or near environmental (poison ivy, stinging insects, biting animals, etc.) or manmade (fences, hostile dogs, etc.) hazards. Do not attempt to enter water if the flow depth exceeds three feet and never above ankle depth unless accompanied by another person. Do not enter a confined space without the correct preparation and permits.

EQUIPMENT AND SUPPLIES

Table G-1 lists typical field equipment used for dry weather outfall screening and sampling.

Table G-1. Field Equipment List

	Field Log Book		Form of Identification
	Ammonia Kit		Safety Vest
	Surfactant Kit		Steel Toed Boots
	Chlorine Kit or Test Strips		Safety Glasses
	Water Quality Sonde		Time Keeping Device
	Laboratory Sample Containers		Tablets/iPads
	Empty Plastic Jugs (for kit disposal)		GPS Receiver (if needed)
	IDDE Plan		Chain of Custody Forms
	Property Owner Notification Letter		Extra Sampling Kits & Lab Containers
	Cooler		Ice
	Pre-labeled sampling bottles		De-ionized water
	Plastic Bags (for temporary dams)		Dissolved Oxygen Meter
	Plumbers Putty		Coolers
	Hand-held Pump		First Aid Kits
	Measuring tape		Trash Bags
	Flashlight		Hand Sanitizer
	Sampling Rod		Zip Ties/Duct Tape
	Latex Gloves		Bucket (for carrying supplies)
	Hip Waders or Rubber Boots		Health & Safety Plan
	Shovel & Pickaxe or J-Hook		Safety Cones
	Small Mallet or Hammer		Pens & Sharpies
			Paper Towels

PROCEDURAL STEPS

When to Perform Inspections

Dry weather screening and sampling shall proceed only when no more than 0.1 inches of rainfall has occurred in the previous 24-hour period and no significant snow melt is occurring.

For purposes of determining dry weather conditions, program staff will use precipitation data from the following, listed in order of priority:

- New Bedford Regional Airport (KEWB): http://w1.weather.gov/data/obhistory/KEWB.html
- Plymouth Municipal Airport (KPYM): https://w1.weather.gov/data/obhistory/KPYM.html

General Procedure

The dry weather outfall inspection and sampling procedure consists of the following general steps:

1. Identify outfalls to be screened/sampled based on initial outfall inventory and priority ranking. Outfalls designated as High Priority should prioritized for investigation. Outfalls designated as Problem or Excluded are not included in the investigation and should not be visited. The most recent inventory and priority ranking is included in the IDDE Plan.

2. Acquire the necessary staff, mapping, and field equipment.

3. Conduct the outfall inspection during dry weather.

4. If flow is observed, sample and test the flow following the procedures described in subsequent sections.

5. If no flow is observed, but evidence of illicit flow exists (illicit discharges are often intermittent or transitory), revisit the outfall during dry weather, within one week of the initial observation if possible, to perform a second dry weather screening. Sample any observed flow.

Pre-Inspection Checklist

Prior to conducting outfall inspections and dry weather screening inspections, ensure the following is performed:

- Ensure all members of the field crew have read relevant Standard Operating Procedures and Health and Safety documents and are familiar with using sampling equipment.
- Obtain laboratory analysis sample bottles, labels, and chain of custody forms.
- Fill out chain of custody forms and sample labels with default information.
- Verify that adequate field test kit refills are available. Reorder in advance to maintain adequate stock.
- Verify the condition of sampling equipment and ensure calibration has been performed.
- Ensure equipment has been fully charged and backup chargers/batteries are available (e.g., water quality sondes, GPS unit (if using), tablet, flash light, cell phones).
- Compile and distribute sampling equipment to field crews at least one day before the sampling event.
- Coordinate with police department to arrange police details (if necessary).
- Notify analysis laboratory to arrange pickups or drop-offs of samples (if necessary).
- Buy perishables immediately prior to inspection (e.g., ice).

Outfall Inspection

The general procedure for outfall inspection is as follows:

1. Drive or walk to outfall location, using GPS on tablet as needed, until outfall is sighted. Obtain permission from owners prior to accessing outfalls through private property. If permission cannot be obtained, seek alternate routes to access the outfall.

2. Verify the mapped structure qualifies as an outfall or interconnection (See **Picture Guide**).

3. Photograph the outfall.

4. Record physical characteristics of outfall on tablet.

5. Look for and record visual/olfactory evidence of pollutants in flowing outfalls (See **Picture Guide**). Take pictures of all visual/olfactory evidence.

6. Look for and record surrounding land use and/or possible contributors to poor water quality (e.g., nearby construction, leaking dumpsters).

In the event an outfall is submerged, either partially or completely, or is inaccessible, field staff will proceed to the first accessible upstream manhole or structure for the observation and sampling and report the location with the screening results. Field staff will continue to the next upstream structure until there is no longer an influence from the receiving water on the visual inspection or sampling.

Re-visiting Outfalls

If no flow is observed, but evidence of illicit flow exists (illicit discharges are often intermittent or transitory), additional consideration of the outfall is warranted:

1. During first visit to outfall, note signs of illicit discharge and mark in field notebook that outfall requires follow up.

2. If practicable, create a dam within the outfall pipe using a plastic bag filled with soil or plumber's putty.

3. Revisit the outfall within 24 to 72 hours of dry weather.

4. If water has pooled behind the dam, take a sample and analyze as detailed in **Dry Weather Flow Sample Collection and Analysis** below.

5. If a dam cannot be created within the outfall pipe, revisit the outfall within one week of the initial inspection to check for signs of flow. If possible, visit the outfall during "odd hours" when illicit discharges are more likely: 1) early morning or late afternoon, 2) weekday evenings, or 3) weekend mornings and evenings.

Dry Weather Flow Sample Collection and Analysis

If flow is present during a dry weather outfall inspection, a sample will be collected and analyzed for the required permit parameters. The general procedure for collection of outfall samples is as follows:

General Procedure

1. Fill out all sample information on sample bottles and tablet.

2. Verify if the outfall has any "pollutants of concern" that require taking additional samples (See **Sampling Parameters and Analysis Methods**).

3. Put on protective gloves (nitrile/latex/other) before sampling.

4. If possible, collect water from the flow directly in the sample bottle. Use dipper if needed. Be careful not to disturb sediments.

5. If there is only a small amount of flow, set up a temporary dam using plumber's putty or plastic bags filled with sand/dirt. Once the pooled water has reached the necessary volume, use a hand pump to collect sample.

6. If using a dipper, hand pump or other device, triple rinse the device with distilled water and prior to putting in sample.

Water Quality Sonde Sampling

1. Fill a field container or bucket and perform field measurements using the water quality sonde, following the instructions provided by the manufacturer.

2. Record results reported by the water quality sonde on the tablet.

3. Decontaminate the field container and sonde thoroughly with distilled water after each sample.

Field Kit Sampling

1. Fill a field container or bucket and perform field measurements using the field kits following the instructions provided by the manufacturer.

2. Record results reported by the kits on the tablet.

3. Safely store any used glass products in an empty plastic bottle(s) for proper disposal.

Bacteria & Pollutants of Concern Sampling

1. If possible, each laboratory bottle should be filled from a single grab directly from the source.

2. Do not overfill sample containers, and do not dump out any liquids, as sample bottles may contain preservatives added by the laboratory.

3. Samples should be collected directly into the sample container, if possible. If not, use a dipper or hand pump as described previously. Sample bottles containing preservatives should always be filled using the dipper or hand pump.

4. Replace and tighten sample container lids immediately after sample collection.

5. Label sample bottles using a waterproof pen with the time and location.

6. Immediately place samples on ice in a designated cooler. Note that ice may need to be replaced throughout the day depending on weather and storage methods.

7. Fill out chain-of-custody form and deliver samples to laboratory.

8. Update the sampling database/tablet with results, once received from the laboratory.

Note: Bacteria samples must be delivered to the analysis laboratory within 6 hours of being taken, so be sure to allow for adequate travel time.

Measuring Flow

1. Use a time keeping device to record the time it takes to fill a container with a known volume (e.g., one liter).

2. Calculate an estimated velocity (Volume of flow captured per unit time).

3. Record results on the tablet.

During sampling the following protocols shall be followed:

1. Do not eat, drink or smoke during sample collection and processing.

2. Do not collect or process samples near a running vehicle.

3. Do not park vehicles in the immediate sample collection area, including both running and non-running vehicles.

4. Never touch the inside surface of a sample container or lid, even with gloved hands.

5. Never allow the inner surface of a sample container or lid to be contacted by any material other than the sample water.

6. Collect samples while facing upstream (for outfall samples within a waterbody) and so as not to disturb water or sediments in the outfall pipe or ditch.

7. Do not overfill sample containers, and do not dump out any liquid in them. Liquids are often added to sample containers intentionally by the analytical laboratory as a preservative or for pH adjustment.

8. Do not allow any object or material to fall into or contact the collected water sample.

9. Replace and tighten sample container lids immediately after sample collection.

Interpreting Results

Outfall analytical data from dry weather sampling can be used to help identify the major type or source of discharge. The table below shows values identified by the U.S. EPA and the Center for Watershed Protection as typical screening values for select parameters. These represent the typical concentration (or value) of each parameter expected to be found in stormwater. Screening values that exceed these benchmarks may be indicative of pollution and/or illicit discharges.

Benchmark Field Measurements for Select Parameters

Analyte or Parameter	Benchmark
Olfactory or Visual	Evidence of sanitary input
Ammonia	>0.5 mg/L
Conductivity	>600 µS/cm
Surfactants	>0.25 mg/L
Chlorine	>0.02 mg/L (detectable levels per the 2016 MS4 Permit)
Indicator Bacteria[1]: *E. coli* *Enterococcus*	*E. coli*: the geometric mean of the five most recent samples taken during the same bathing season shall not exceed 126 colonies per 100 ml and no single sample taken during the bathing season shall exceed 235 colonies per 100 ml. *Enterococcus:* the geometric mean of the five most recent samples taken during the same bathing season shall not exceed 33 colonies per 100 ml and no single sample taken during the bathing season shall exceed 61 colonies per 100 ml.

DATA AND RECORDS MANAGEMENT

All information shall be recorded on the forms available on hardcopy (i.e., paper) or an iPad or tablet. Additional information may be recorded in field notebooks, if needed.

[1] Massachusetts Water Quality Standards: http://www.mass.gov/eea/docs/dep/service/regulations/314cmr04.pdf

ANALYTICAL SAMPLE QUALITY CONTROL AND ASSURANCE

On occasion, quality assurance/quality control (QA/QC) samples may be collected in addition to the required samples. These samples include field duplicates, field blanks, and equipment blanks:

- A **field duplicate** is when two independent samples are taken from the same source and analyzed separately. Field duplicates will be taken at a minimum at least one out of every ten outfalls tested (10%). Field duplicates will be taken for both laboratory and field measurement samples. Field duplicate samples will be identified through a "-d" suffix in the sample ID.

- A **field blank and equipment blank** consists of deionized water. Sample bottles are filled with deionized water and sent to the laboratory or tested with field equipment in the exact manner as regular grab samples. Blanks will be taken at a minimum of at least one out of every ten outfalls tested (10%). Blanks will be taken for laboratory and field measurement samples. Field blank samples will be identified through a "-b" suffix in the sample ID.

Field measurement testing with the water quality sonde and field kits will take place immediately in-field. Testing for indicator bacteria and samples of concern must be conducted using analytical methods and procedures found in 40 CFR § 136. The table below lists analytical methods, detection limits, hold times, and preservatives for laboratory analysis of dry weather sampling parameters.

Required Analytical Methods, Detection Limits, Hold Times, and Preservatives

Analyte or Parameter	Pollutant Causing Impairment	Analytical Method	Detection Limit	Max. Hold Time	Preservative
BOD5	Dissolved Oxygen	**EPA**: SM 5210	2 mg/L	48 hours	Ice
Total Nitrogen (freshwater)	Total Nitrogen	**EPA**: 351.1/351.2 + 353.2 **SM**: 4500-N_{org}, 4500-NH_3	**EPA**: 0.01 mg/L **SM**: 0.01 mg/L	28 days	Ice + H_2SO_4 to pH <2
Indicator Bacteria: *E. coli* *Enterococci*		*E. coli* **EPA**: 1603 **SM**: 9221B, 9221F , 9223 B **Other**: Colilert®, Colilert-18® *Enterococci* **EPA**: 1603 **SM**: 1106.1, 1600 **Other**: Enterolert®	*E. coli* **EPA**: 1 cfu/100mL **SM**: 2 MPN/100mL **Other**: 1 MPN/100mL	6 hours (to lab) 6 hours (to lab)	Ice Ice

ATTACHMENTS / CHECKLISTS

1. Picture Guide

Picture Guide

Outfall Identification – Types of Outfalls to Record

Outfalls to Record	Outfalls to Skip
• Both large and small diameter pipes that appear to be part of the stormwater infrastructure • Outfalls that appear to be piped headwater streams • Submerged or partially submerged outfalls • Outfalls that are blocked with debris or sediment deposits • Pipes that appear to only drain roof downspouts but that are subsurface, preventing definitive confirmation	• Drop inlets from roads in culverts (unless evidence of illegal dumping, dumpster leaks, etc. • Cross-drainage culverts in transportation right-of-way (i.e., can see daylight at other end) • Weep holes • Flexible HDPE pipes that are known to serve as slope drains • Pipes that are clearly connected to roof downspouts via above-ground connections • Privately owned outfalls

Outfall Identification - Characterizing Flow

Submerged: More than ½ below water

Partially submerged: Bottom is below water

Fully submerged: Can't see outfall

Outfall fully submerged by debris

Fully submerged from downstream trees trapping debris

Partially submerged by leaf debris “back water”

Trickle Flow: Very narrow stream of water

Moderate Flow: Steady stream, but very shallow depth

Significant flow
(Source is a fire hydrant discharge)

Outfall Identification – Examples of Types of Outfalls to Record (cont.)

Ductile iron round pipe

4-6" HDPE; Check if roof leader connection (legal)

Field connection to inside of culvert; Always mark and record.

Small diameter (<2") HDPE; Often a sump pump (legal), or may be used to discharge laundry water (illicit).

Elliptical RCP; Measure both horizontal and vertical diameters.

Double RCP round pipes; Mark as separate outfalls unless known to connect immediately up-pipe

Culvert (can see to other side); Don't mark as an outfall

Open channel "chute" from commercial parking lot; Very unlikely illicit discharge. Mark, but do not return to sample (unless there is an obvious problem).

Small diameter PVC pipe; Mark, and look up-pipe to find the origin.

CMP outfall; Crews should also note upstream sewer crossing.

Box shaped outfall

CMP round pipe with two weep holes at bridge crossing. (Don't mark weep holes)

Pipe Materials


Reinforced Concrete (RCP)/Concrete


PVC


HDPE Pipe (Smooth or Corrugated Inner Wall)

Pipe Materials, cont.


Corrugated Metal (CMP)


Vitrified Clay (VCP) (also known as Clay Tile Pipe)


Orangeburg

Pipe Materials, cont.


Brick


Ductile Iron (DIP)


Fiberglass pipe (FRP)

Physical Observation Parameters and Likely Associated Flow Sources

(Olfactory & Visual Observations)

Parameter	Observations	Interpretation
Odor	Sewage	Stale sanitary wastewater, especially in pools near outfall
	Sulfur (rotten eggs)	Industries that discharge sulfide compounds or organics (meat packers, canneries, dairies, etc.) Also could be petroleum related "high-sulfur" fuels
	Rancid-sour	Food preparation facilities (restaurants, hotels, etc.)
	Oil and gas	Petroleum refineries or many facilities associated with vehicle maintenance or petroleum product storage
	Chlorine	Pool discharges, washing activities
	Sweet/Fruity	Washing activities
	Sharp, pungent (chemicals)	Hazardous waste
Color	Yellow	Chemical plants, textile and tanning plants
	Brown	Meat packers, printing plants, metal works, stone and concrete, fertilizers, petroleum refining facilities, construction sites, and glass cutting.
	Green	Chemical plants, textile facilities, algae/plankton bloom, antifreeze (fluorescent green), fertilizer
	Red	Meat packers, metal works, iron floc (bacterium)
	Gray	Dairies, flood processing, sewage, concrete wash-out
	Red, Purple, Blue, Black	Fabric dyes, inks from paper and cardboard manufacturers
Turbidity	Cloudy	Sanitary wastewater, concrete or stone operations, fertilizer facilities, automotive dealers
	Opaque	Food processors, lumber mills, metal operations, pigment plants
Floatable Matter	Oil sheen, grease	Petroleum refineries or storage facilities and vehicle service facilities, restaurants
	Sewage	Sanitary wastewater
	Suds	Sanitary wastewater, natural sources
Deposits & Stains	Sediment	Construction site erosion
	Oily	Sanitary wastewater
Vegetation	Excessive growth	Food product facilities, fertilizers, farming agricultural use
	Inhibited growth, stressed vegetation	High stormwater flows, beverage facilities, printing plants, metal product facilities, drug manufacturing, petroleum facilities, vehicle service facilities and automobile dealers
Pipe Benthic Growth	Brown	Elevated nutrient level, possibly from sewage or fertilizers
	Orange/Red	High iron and manganese concentration, not typically associated with illicit discharges
	Green	Elevated nutrient level, possibly from sewage or ferilizers
Damage to Outfall Structures	Concrete cracking	Industrial flows, chemicals
	Concrete spalling	
	Peeling paint	
	Metal corrosion	

.

Olfactory & Visual Observation Examples - Color & Turbidity

Color: Brown; Severity: 2
Turbidity Severity: 2

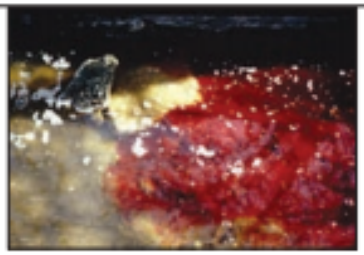
Color: Blue-green; Severity: 3
Turbidity Severity: 2

Highly Turbid Discharge
Color: Brown; Severity: 3
Turbidity Severity: 3

Sewage Discharge
Color: 3
Turbidity: 3

Paint
Color: White; Severity: 3
Turbidity: 3

Industrial Discharge
Color: Green; Severity: 3
Turbidity Severity: 3



Blood
Color: Red; Severity: 3
Turbidity Severity: None

Failing Septic System:
Turbidity Severity: 3

Turbidity in Downstream Plume
Turbidity Severity: 2
(also confirm with sample bottle)

High Turbidity in Pool
Turbidity Severity: 2
(Confirm with sample bottle)

Iron Floc
Color: Reddish Orange; Severity: 3
(Often associated with a natural source)

Slight Turbidity
Turbidity: 1
(Difficult to interpret this observation; May be natural or an illicit discharge)

Construction Site
Discharge
Turbidity Severity: 3

Discharge of Rinse from Floor Sanding
(Found during wet weather)
Turbidity Severity: 3

Olfactory & Visual Observation Examples - Floatables

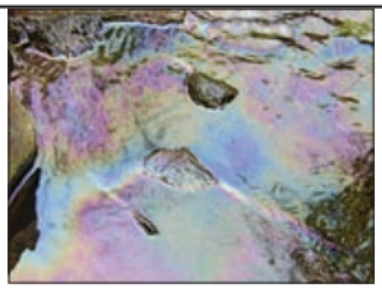
SUDS		
		
Natural Foam Note: Suds only associated with high flows at the "drop off" Do not record.	Low Severity Suds Rating: 1 Note: Suds do not appear to travel; very thin foam layer	High severity suds Rating: 3 Sewage
OIL SHEENS		
		
Low Severity Oil Sheen Rating: 1	Moderate Severity Oil Sheen Rating: 2	High Severity Oil Film Rating: 3

Figure 36: Synthetic versus Natural Sheen (a) Sheen from bacteria such as iron floc forms a sheet-like film that cracks if disturbed (b) Synthetic oil forms a swirling pattern

Olfactory & Visual Observation Examples - Pipe Benthic Growth

Bacterial growth at this outfall indicates nutrient enrichment and a likely sewage source.

This bright red bacterial growth often indicates high manganese and iron concentrations. Surprisingly, it is not typically associated with illicit discharges.

Sporalitis filamentous bacteria, also known as "sewage fungus" can be used to track down sanitary sewer leaks.

Algal mats on lakes indicate eutrophication. Several sources can cause this problem. Investigate potential illicit sources.

Illicit discharges or excessive nutrient application can lead to extreme algal growth on stream beds.

The drainage to this outfall most likely has a high nutrient concentration. The cause may be an illicit discharge, but may be excessive use of lawn chemicals.

This brownish algae indicates an elevated nutrient level.

Olfactory & Visual Observation Examples - Other Indicators

Reddish staining on the rocks below this outfall indicate high iron concentrations.

Toilet paper directly below the storm drain outlet.

Watershed Protection??

Trash is not an indicator of illicit discharges, but should be noted.

Staining at the base of the outfall may indicate a persistent, intermittent discharge.

Excessive vegetation may indicate enriched flows associated with sewage.

Brownish stain of unclear origin. May be from degradation of the brick infrastructure.

Cracked rock below the outfall may indicate an intermittent discharge.

Poor pool quality. Consider sampling from the pool to determine origin.

Keep an Eye Out for Example Discharge Sources

Example Discharges from:

Hazardous Waste Sources

Used oil under partial cover

Batteries outside without cover

Washing Activities Sources

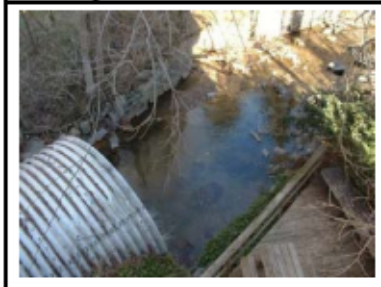
Washing side of building without soap

Unlabeled leaking barrels

Used, open oil container with spills

Fleet vehicle washing near stormwater drain

Example Sediment Observations and Sources



Sediment discharge at outfall

Sediment-laden runoff

Unprotected storm drain inlet

Sediment pile on the street

Failing silt fence

Construction site runoff

Example Waste/Trash Sources

Open grease containers

Dumping waste/trash

Appendix H

Wet Weather Sampling Standard Operating Procedure and System Vulnerability Factors

Standard Operating Procedure
Wet Weather Screening

PURPOSE AND APPLICABILITY

This standard operating procedure (SOP) is for the collection and analysis of samples during wet weather conditions as performed under an illicit discharge detection and elimination program. The objective of this inspection is to identify signs of sanitary sewer flow in drainage pipes. Refer to the Town of Marion Illicit Discharge Detection and Elimination Plan for additional details and information on the overall program.

SUMMARY OF THE METHOD

Inspect and take samples from stormwater outfalls to check for signs of illicit discharges.

ACRONYMS

CFU	*Colony Forming Units*
DPI	*Department of Public Works*
EPA	*Environmental Protection Agency*
GPS	*Global Positioning System*
IDDE	*Illicit Discharge Detection and Elimination*
mg/L	M*illigram/liter*
mL	*Milliliter*
MPN	*Most Probable Number*
PPE	*Personal Protection Equipment*
QA/QC	*Quality Assurance/Quality Control*
SOP	*Standard Operating Procedure*
SM	*Standard Method*
SVF	*System Vulnerability Factors*

HEALTH AND SAFETY WARNINGS AND CAUTIONS

Special care should be taken throughout all sampling efforts, both to minimize inadvertent sample contamination and to maintain safe operating procedures at all times. Health and safety plans are developed for each project and should be referred to for proper health and safety protocol. Special consideration should be taken when performing the following:

- Take care when opening lab bottles, as some may contain a preservative crucial to achieving accurate results and that may be toxic to skin exposure. Carefully read the label of each lab bottle prior to opening.
- Take care when accessing outfalls or any open structures. Outfalls may be in heavily wooded areas, on steep slopes, or near environmental (poison ivy, stinging insects, biting animals, etc.) or manmade (fences, hostile dogs, etc.) hazards. Do not attempt to enter water if the flow depth exceeds three feet and never above ankle depth unless accompanied by another person. Do not enter a confined space without the correct preparation and permits.

EQUIPMENT AND SUPPLIES

Table H-1 lists typical field equipment used for wet weather outfall screening and sampling.

Table H-1. Field Equipment List

	Field Log Book		Form of Identification
	Ammonia Kit		Safety Vest
	Surfactant Kit		Steel Toed Boots
	Chlorine Kit or Test Strips		Safety Glasses
	Water Quality Sonde		Time Keeping Device
	Laboratory Sample Containers		Tablets/iPads
	Empty Plastic Jugs (for kit disposal)		GPS Receiver (if needed)
	IDDE Plan		Chain of Custody Forms
	Property Owner Notification Letter		Extra Sampling Kits & Lab Containers
	Cooler		Ice
	Pre-labeled sampling bottles		De-ionized water
	Plastic Bags (for temporary dams)		Dissolved Oxygen Meter
	Plumbers Putty		Coolers
	Hand-held Pump		First Aid Kits
	Measuring tape		Trash Bags
	Flashlight		Hand Sanitizer
	Sampling Rod		Zip Ties/Duct Tape
	Latex Gloves		Bucket (for carrying supplies)
	Hip Waders or Rubber Boots		Health & Safety Plan
	Shovel & Pickaxe or J-Hook		Safety Cones
	Small Mallet or Hammer		Pens & Sharpies
			Paper Towels

PROCEDURAL STEPS

When to Perform Inspections

Wet weather screening and sampling shall proceed during or after a storm event of sufficient depth or intensity to produce a stormwater discharge. It is strongly recommended that sampling take place during the spring (March through June) when groundwater levels are relatively high; however, sampling may take place at any time of year. There is no minimum rainfall depth required prior to conducting prior to wet weather sampling, but the following should be taken in to consideration.

- Avoid sampling during the initial period of discharge, often referred to as the “first flush”. This is to avoid incidental pollutants to urban stormwater runoff that typically have the highest concentrations during the beginning of a storm event.
- Identify minimum storm event intensities that are likely to trigger sanitary sewer interconnections.
- Allow for at least 72 hours of dry weather after a previous storm event.
- To ensure runoff occurs, avoid storm events that are less than 0.1 inch of rain.

For purposes of determining weather conditions, program staff will use precipitation data from the following, listed in order of priority:

- New Bedford Regional Airport (KEWB): http://w1.weather.gov/data/obhistory/KEWB.html

- Plymouth Municipal Airport (KPYM): https://w1.weather.gov/data/obhistory/KPYM.html

General Procedure

The wet weather sampling procedure consists of the following general steps:

1. Identify outfalls to be screened/sampled based on results of the dry weather screening program and system vulnerability factors (SVF) assessment. Outfalls designated as Problem or High Priority should prioritized for sampling. Outfalls designated as Excluded are not included in the IDDE Program and should not be visited.
2. Acquire the necessary staff, mapping, and field equipment.
3. Monitor weather and alert staff members when a storm is approaching. Typical practice is to prepare for a wet weather investigation when the weather forecast shows a 40 percent chance of rain or greater.
4. If flow is observed at outfall, sample and test the flow following the procedures described in the following sections.
5. If no flow is observed, revisit the outfall at least one more time during a future storm event with which predicts larger rain intensities/volumes.

Pre-Inspection Checklist

Prior to conducting wet weather sampling, ensure the following is performed:

- Ensure all members of the field crew have read relevant Standard Operating Procedures and Health and Safety documents, and are familiar with using sampling equipment.
- Obtain laboratory analysis sample bottles, labels, and chain of custody forms.
- Fill out chain of custody forms and sample labels with default information.
- Verify that adequate field test kit refills are available. Reorder in advance to maintain adequate stock.
- Verify the condition of sampling equipment and ensure calibration has been performed.
- Ensure equipment has been fully charged and backup chargers/batteries are available (e.g., water quality sondes, GPS unit (if using), tablet, flash light, cell phones).
- Compile and distribute sampling equipment to field crews before the sampling event.
- Notify local police department daily on location of field crews.
- Coordinate with police department to arrange police details (if necessary).
- Notify analysis laboratory to arrange pickups or drop-offs of samples (if necessary).
- Buy perishables immediately prior inspection (e.g., ice).

Wet Weather Flow Sample Collection and Analysis

General Procedure

1. Drive or walk to outfall location, using GPS on tablet as needed, until outfall is sighted. Obtain permission from owners prior to accessing outfalls through private property. If permission cannot be obtained, seek alternate routes to access the outfall.

2. Verify the mapped structure matches the characteristics noted during previous outfall inspections and dry weather sampling.

3. Photograph the outfall.

4. Verify if the outfall has any "pollutants of concern" that require taking additional samples (See **Sampling Parameters and Analysis Methods**).

5. Fill out all sample information on sample bottles and tablet.

6. Put on protective gloves (nitrile/latex/other) before sampling.

7. If possible, collect water from the flow directly in the sample bottle. Use dipper if needed. Be careful not to disturb sediments.

8. If there is only a small amount of flow, set up a temporary dam using plumber's putty or plastic bags filled with sand/dirt. Once the pooled water has reached the necessary volume, use a hand pump to collect sample.

9. If using a dipper, hand pump or other device, triple rinse the device with distilled water and prior to putting in sample.

Water Quality Sonde Sampling

1. Fill a field container or bucket and perform field measurements using the water quality sonde, following the instructions provided by the manufacturer.

2. Record results reported by the water quality sonde on the tablet.

3. Decontaminate the field container and sonde thoroughly with distilled water after each sample.

Field Kit Sampling

1. Fill a field container or bucket and perform field measurements using the field kits following the instructions provided by the manufacturer.

2. Record results reported by the kits on the tablet.

3. Safely store any used glass products in an empty plastic bottle(s) for proper disposal.

Bacteria & Pollutants of Concern Sampling

1. If possible, each laboratory bottle should be filled from a single grab directly from the source.

2. Do not overfill sample containers, and do not dump out any liquids, as sample bottles may contain preservatives added by the laboratory.

3. Samples should be collected directly into the sample container, if possible. If not, use a dipper or hand pump as described previously.

4. Replace and tighten sample container lids immediately after sample collection.

5. Label sample bottles using a waterproof pen with the time and location.

6. Immediately place samples on ice in a designated cooler. Note that ice may need to be replaced throughout the day depending on weather and storage methods.

7. Fill out chain-of-custody form and deliver samples to laboratory.

8. Update the sampling database/tablet with results, once received from the laboratory.

Note: Bacteria samples must be delivered to the analysis laboratory within 6 hours of being taken, so be sure to allow for adequate travel time.

Measuring Flow

1. Use a time keeping device to record the time it takes to fill a container with a known volume (e.g., one liter).

2. Calculate an estimated veloTown (Volume of flow captured per unit time).

3. Record results on the tablet.

During sampling the following protocols shall be followed:

1. Do not eat, drink or smoke during sample collection and processing.

2. Do not collect or process samples near a running vehicle.

3. Do not park vehicles in the immediate sample collection area, including both running and non-running vehicles.

4. Never touch the inside surface of a sample container or lid, even with gloved hands.

5. Never allow the inner surface of a sample container or lid to be contacted by any material other than the sample water.

6. Collect samples while facing upstream (for outfall samples within a waterbody) and so as not to disturb water or sediments in the outfall pipe or ditch.

7. Do not overfill sample containers, and do not dump out any liquid in them. Liquids are often added to sample containers intentionally by the analytical laboratory as a preservative or for pH adjustment.

8. Do not allow any object or material to fall into or contact the collected water sample.

9. Replace and tighten sample container lids immediately after sample collection.

Interpreting Results

Outfall analytical data from wet weather sampling can be used to help identify the major type or source of discharge. The table below shows values identified by the U.S. EPA and the Center for Watershed Protection as typical screening values for select parameters. These represent the typical concentration (or value) of each parameter expected to be found in stormwater. Screening values that exceed these benchmarks may be indicative of pollution and/or illicit discharges.

Table 0-1. Benchmark Field Measurements for Select Parameters[1]

Analyte or Parameter	Benchmark
Olfactory or Visual	Evidence of sanitary input
Ammonia	>0.5 mg/L
Conductivity	>600 µS/cm
Surfactants	>0.25 mg/L
Chlorine	>0.02 mg/L (detectable levels per the 2016 MS4 Permit)
Indicator Bacteria[1]: *E. coli* *Enterococcus*	*E. coli*: the geometric mean of the five most recent samples taken during the same bathing season shall not exceed 126 colonies per 100 ml and no single sample taken during the bathing season shall exceed 235 colonies per 100 ml *Enterococcus:* the geometric mean of the five most recent samples taken during the same bathing season shall not exceed 33 colonies per 100 ml and no single sample taken during the bathing season shall exceed 61 colonies per 100 ml

DATA AND RECORDS MANAGEMENT

All information shall be recorded on forms available on hardcopy (i.e., paper) or an iPad or tablet. Additional information may be recorded in field notebooks, if needed.

ANALYTICAL SAMPLE QUALITY CONTROL AND ASSURANCE

On occasion, quality assurance/quality control (QA/QC) samples may be collected in addition to the required samples. These samples include field duplicates, field blanks, and equipment blanks:

- A **field duplicate** is when two independent samples are taken from the same source and analyzed separately. Field duplicates will be taken at a minimum at least one out of every ten outfalls tested (10%). Field duplicates will be taken for both laboratory and field measurement samples. Field duplicate samples will be identified through a "-d" suffix in the sample ID.

- A **field blank and equipment blank** consists of deionized water. Sample bottles are filled with deionized water and sent to the laboratory or tested with field equipment in the exact manner as regular grab samples. Blanks will be taken at a minimum of at least one out of every ten outfalls tested (10%). Blanks will be taken for laboratory and field measurement samples. Field blank samples will be identified through a "-b" suffix in the sample ID.

Field measurement testing with the water quality sonde and field kits will take place immediately in-field. Testing for indicator bacteria and samples of concern must be conducted using analytical methods and procedures found in 40 CFR § 136. The table below lists analytical methods, detection limits, hold times, and preservatives for laboratory analysis of wet weather sampling parameters.

[1] Massachusetts Water Quality Standards: http://www.mass.gov/eea/docs/dep/service/regulations/314cmr04.pdf

Required Analytical Methods, Detection Limits, Hold Times, and Preservatives

Analyte or Parameter	Pollutant Causing Impairment	Analytical Method	Detection Limit	Max. Hold Time	Preservative
BOD5	Dissolved Oxygen	**EPA**: SM 5210	2 mg/L	48 hours	Ice
Total Nitrogen (freshwater)	Total Nitrogen	**EPA**: 351.1/351.2 + 353.2 **SM**: 4500-N_{org}, 4500-NH_3	**EPA**: 0.01 mg/L **SM**: 0.01 mg/L	28 days	Ice + H_2SO_4 to pH <2
Indicator Bacteria: *E. coli* *Enterococci*		*E. coli* **EPA**: 1603 **SM**: 9221B, 9221F , 9223 B **Other**: Colilert®, Colilert-18® *Enterococci* **EPA**: 1603 **SM**: 1106.1, 1600 **Other**: Enterolert®	*E. coli* **EPA**: 1 cfu/100mL **SM**: 2 MPN/100mL **Other**: 1 MPN/100mL	6 hours (to lab) 6 hours (to lab)	Ice Ice

ATTACHMENTS / CHECKLISTS

1. System Vulnerability Factors Definitions
2. System Vulnerability Factor Table

Required Analytical Methods, Detection Limits, Hold Times, and Preservatives

Analyte or Parameter	Pollutant Causing Impairment	Analytical Method	Detection Limit	Max. Hold Time	Preservative
BOD5	Dissolved Oxygen	**EPA**: SM 5210	2 mg/L	48 hours	Ice
Total Nitrogen (freshwater)	Total Nitrogen	**EPA**: 351.1/351.2 + 353.2 **SM**: 4500-N_{org}, 4500-NH_3	**EPA**: 0.01 mg/L **SM**: 0.01 mg/L	28 days	Ice + H_2SO_4 to pH <2
Indicator Bacteria: *E. coli* *Enterococci*		*E. coli* **EPA**: 1603 **SM**: 9221B, 9221F , 9223 B **Other**: Colilert®, Colilert-18® *Enterococci* **EPA**: 1603 **SM**: 1106.1, 1600 **Other**: Enterolert®	*E. coli* **EPA**: 1 cfu/100mL **SM**: 2 MPN/100mL **Other**: 1 MPN/100mL	6 hours (to lab) 6 hours (to lab)	Ice Ice

ATTACHMENTS / CHECKLISTS

1. System Vulnerability Factors Definitions
2. System Vulnerability Factor Table

System Vulnerability Factors Definitions	
History of SSOs	History of SSOs, including, but not limited to, those resulting from wet weather, high water table, or fat/oil/grease blockages
Common or Twin-Invert Manholes	Common or twin-invert manholes serving storm and sanitary sewer alignments
Common Trench Construction	Common trench construction serving both storm and sanitary sewer alignments
Storm and Sanitary Sewer Crossings	Crossings of storm and sanitary sewer alignments where the sanitary system is shallower than the storm drain system
Known or Suspected Sanitary Sewer Underdrains	Sanitary sewer alignments known or suspected to have been constructed with an underdrain system
Inadquate Sanitary Sewer LOS	Inadequate sanitary sewer level of service (LOS) resulting in regular surcharging, customer back-ups, or frequent customer complaints
Former Combined Sewer areas	Areas formerly served by combined sewer systems
Sanitary Sewer Infrastructure Defects	Sanitary sewer infrastructure defects such as leaking service laterals, cracked, broken, or offset sanitary infrastructure, directly piped connections between storm drain and sanitary sewer infrastructure, or other vulnerability factors identified through Inflow/Infiltration Analyses, Sanitary Sewer Evaluation Surveys, or other infrastructure investigations.

Town of Marion, Massachusetts
Priority Ranking of Outfalls/Interconnections

Date Updated:

				Identified Sewer Input Indicators from Dry Weather Inspection					System Vulnerability Factors (SVFs)									
Outfall ID	Long.	Lat.	Receiving Waters	*Olfactory or visual evidence of sewage*	*Ammonia (>0.5 mg/L)*	*Surfactants (>0.25 mg/L)*	*Bateria (>Receiving Water Criteria)*	*Other*	History of SSOs	Common or Twin-Invert Manholes	Common Trench Construction	Storm and Sanitary Sewer Crossings	Known or Suspected Sanitary Sewer Underdrains	Inadquate Sanitary Sewer LOS	Former Combined Sewer areas	Sanitary Sewer Infrastructure Defects	Is a Minimum of One (1) SVF present?	Wet Weather Sampling Required?
																		NO
																		NO
																		NO
																		NO
																		NO
																		NO
																		NO
																		NO
																		NO
																		NO
																		NO
																		NO
																		NO
																		NO
																		NO
																		NO
																		NO
																		NO
																		NO
																		NO
																		NO
																		NO
																		NO
																		NO
																		NO
																		NO
																		NO
																		NO
																		NO

Appendix I

Source Isolation and Confirmation Methods: Instructions, Manuals, & SOPs

Standard Operating Procedure
Source Isolation

PURPOSE AND APPLICABILITY

The following standard operating procedures (SOPs) are for the varying techniques that could be used to confirm the location of illicit discharges between two manholes. Specifically, this includes the following inspection options:

- Dye Testing
- CCTV/Video Inspections
- Optical Brightener Monitoring
- IDDE Canines

Isolation and confirmation activities come after a dry weather manhole investigation, which isolates the location of a potential illicit discharge between two manholes. The objective of these investigations is to confirm the exact location of illicit sources so they may be eliminated. Refer to the Town of Marion Illicit Discharge Detection and Elimination Plan for additional details and information on the overall program.

SUMMARY OF THE METHODS

Use of a variety of inspection methods to narrow down the location of suspected illicit discharges.

ACRONYMS

CCTV	*Closed Caption Television*
DPI	*Department of Public Works*
EPA	*Environmental Protection Agency*
IDDE	*Illicit Discharge Detection and Elimination*
OBM	*Optical Brightener Monitoring*
PPE	*Personal Protection Equipment*
QA/QC	*Quality Assurance/Quality Control*
SOP	*Standard Operating Procedure*

HEALTH AND SAFETY WARNINGS AND CAUTIONS

Special care should be taken throughout all sampling efforts, both to minimize inadvertent sample contamination and to maintain safe operating procedures at all times. Health and safety plans are developed for each project and should be referred to for proper health and safety protocol. Special consideration should be taken when performing the following:

- Take care when accessing manholes. Drainage structures (manholes, catch basins, etc.) are typically located in or directly adjacent to roadways with varying vehicular traffic. Additionally, some structures may be in heavily wooded areas, on steep slopes, or near environmental (poison ivy, stinging insects, biting animals, etc.) or manmade (fences, hostile dogs, etc.) hazards. Do not access structures in the center of roadways during times of heavy vehicular traffic (if needed, a police escort will be utilized). Do not enter a confined space without the correct preparation and permits.

- Take care when opening manholes. Drainage structures (manholes, catch basins, etc.) covers and grates are typically extremely heavy, care, appropriate tools and personal protective equipment (described in health and safety procedures) should be utilized during opening of such structures. Once the cover or grate is

lifted pay close attention “openings” in the roadway or surface to avoid fall hazards. Do not leave open structures unattended. Do not open structures that would require more than ordinary effort.

EQUIPMENT AND SUPPLIES

Equipment and supplies will vary based on the source isolation technique used.

PROCEDURAL STEPS

When to Perform Inspections

Once a potential illicit discharge has been identified between two key junction manholes, follow-up investigations may be needed to further narrow down the source’s location. An example scenario is shown below on Figure 1. Key Junction Manholes 1 and 3 showed evidence of an illicit discharge. Since Key Junction Manhole 6 does not show evidence of illicit discharge, the source is most likely located between manholes 3 and 6. Therefore, manholes 4 and 5 should be investigated. The results of the investigation should narrow down the location to between two manholes. For example, if there is no evidence of illicit discharges in manhole 4, the source can be presumed to be within the pipe between manhole 4 and Key Junction 3.

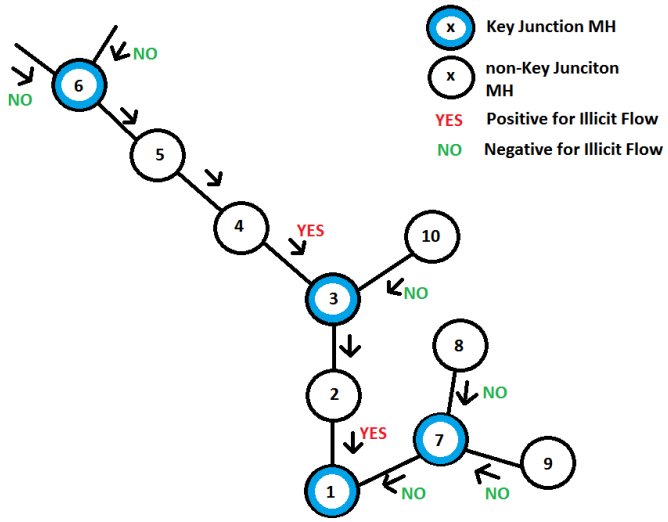


Figure 1 – Example Follow Up Dry Weather Manhole Investigation

The following provides the next step procedure for catchments that showed evidence of illicit connections in key junction manholes:

1. Identify key junction manholes that showed positive results for illicit flow.
2. Start the follow up investigation at the further upstream key junction manhole that tested positive for illicit flow.
3. Systematically investigate manholes between key junction manholes, looking for signs of illicit flow. Stop investigation once a potential source has been isolated between two manholes.
4. Conduct source isolation techniques (e.g., dye testing, CCTV) to identify the exact source location.

General Procedure

The inspection technique used and corresponding procedure consists of the following general steps:

1. Source isolation investigations will be performed based on the results of dry weather manhole inspections. However, if any information is received (e.g., from citizens, businesses, government agency) that indicates approximate locations of illicit sources, a source isolation investigation may be warranted.

2. Determine the appropriate source isolation method, based on descriptions provided in this SOP.

3. Acquire the necessary staff, mapping, and field equipment relevant for each inspection technique

Dye Testing

Dye testing involves flushing non-toxic dye into plumbing fixtures such as toilets, showers, and sinks and observing nearby storm drains and sewer manholes as well as stormwater outfalls for the presence of the dye. It is important to inform local residents and business owners. Police, fire, and local public health staff should also be notified prior to testing in preparation of responding to citizen phone calls concerning the dye and their presence in local surface waters.

The test can be relatively quick (about 30 minutes per test), effective (results are usually definitive), and inexpensive. Dye testing is best used when the likely source of an illicit discharge has been narrowed down to a few specific houses or businesses.

When to Perform Inspections

Dye testing shall only be performed when proper public notification (residents, businesses, police, and fire departments) is implemented in the area. Proper public notification for dye testing is designated as two business days. Additionally, due to the nature of the test, in most cases proper approval from the owner of the site being accessed is needed.

Pre-Inspection Checklist

Prior to conducting dye testing site inspections, ensure the following is performed:

- Ensure that public notices are issued two days in advance of dye testing to facilities that may need to be entered. The following information will be presented on each public notice.
    - Name, Department, Contact Information
    - Purpose of test
    - Place of test
    - Starting date of test
    - Expected length of test
- Ensure all members of the field crew have read relevant Standard Operating Procedures and Health and Safety documents, and are familiar with illicit source confirmation techniques.
- Verify all members understand the site inspection area (i.e., review site inspections maps and surrounding storm sewer and sewer infrastructure).
- Verify that adequate materials are present for the dye tests.
- Verify the condition of all inspection equipment.

General Procedure

The general procedure for dye testing is as follows:

1. Drive or walk to site inspection location. Obtain permission from owners prior to accessing inspection area through private property. If permission cannot be obtained, seek alternate routes to access the inspection site.

2. If access to a facility is needed, obtain permission to access possible areas where illicit connections may be connected to the storm drain (i.e., floor drains, toilet, sink, etc.) If access to a facility is refused, the team will continue to other scheduled investigations and note the refusal in a dye test form and to a supervisor.

3. Team member 1 shall remain at the facility, Team member 2 shall head to the downstream manhole.

4. If working in the middle of a busy roadway, ensure proper traffic controls are implemented.

5. Open the manhole. Pay special attention to roadway and environmental hazards.

6. Team member 2 will communicate via two-way radio that the Team Member 1 may discharge dye into to the system.

7. Flush dye according to the manufacturers specification for best results (i.e., how much, how long, etc.). If porcelain structures are dye tested ensure that tablets or charcoal are wrapped in tissue before depositing.

8. Team member 1 will notify Team member 2 when the dye is discharged. Team member 2 will observe flow in the downstream manhole and indicate whether dye is observed.

9. Give the dye at least one hour to flow to the downstream manhole.

10. If dye is observed, the area will be marked for illicit connection elimination.

11. In the event no dye is observed:

    a. Ensure that the manhole being observed is directly down gradient of the site.

    b. Check other storm drains in the area.

    c. If no other alternative, Closed Circuit Television (CCTV) inspection into the pipe segment may be warranted.

12. Regardless if dye is observed or not observed, all structures in all suspected facilities should be tested. Many times, a single utility may be incorrectly connected to a storm drain line. Actively inventory and "mark-off" structures as they are tested.

13. For each facility inspected, note results and comments on the tablet.

14. Once each facility has had all structures tested ensure that tested areas are left as they were when the team entered.

15. Close the manhole. Pay special attention to roadway and environmental hazards.

CCTV/ Video Inspections

Involves the use of mobile video cameras that are guided remotely through storm drain lines to observe possible illicit discharges. IDDE program staff can review the videos and note any visible illicit discharges. While this tool is both effective and usually definitive, it can be costly and time consuming when compared to other source isolation techniques.

It is recommended that CCTV inspections shall be carried according to the CCTV operator's standard operating procedures.

Optical Brightener Monitoring

Optical brighteners are fluorescent dyes that are used in detergents and paper products to enhance their appearance. The presence of optical brighteners in surface waters or dry weather discharges suggests there is a possible illicit discharge or insufficient removal through adsorption in nearby septic systems or wastewater treatment. It is recommended that that optical brightener monitoring (OBM) shall be carried out in accordance with the Center for Watershed Protection's Illicit Discharge Detection and Elimination Manual (October 2004).

OBM traps are another tool that crews can use to gain insight into the "history" of an outfall without being physically present. OBM traps can be fabricated and installed using a variety of techniques and materials. All configurations involve an absorbent, unbleached cotton pad or fabric swatch and a holding or anchoring device such as a wire mesh trap or a section of small diameter (e.g., 2-inch) PVC pipe. Traps are anchored to the inside of outfalls at the invert using wire or monofilament that is secured to the pipe itself or rocks used as temporary weights. Field crews retrieve the OBM traps after they have been deployed for 48 hours of dry weather, and place them under a long wave fluorescent ultraviolet light or "black light" that will indicate if they have been exposed to detergents.

Although OBM traps appear useful in detecting some intermittent discharges, research performed for the IDDE Manual found that OBM traps only pick up the most contaminated discharges, and the detergent level needed to produce a "hit" was roughly similar to pure washwater from a washing machine. Consequently, OBM traps may be best suited as a simple indicator of presence or absence of intermittent flow or to detect the most concentrated flows. OBM traps need to be retrieved before runoff occurs from the outfalls, which will contaminate the trap or wash it away.

IDDE Canines

IDDE canines are dogs that are specifically trained to smell human sewage. Each dog adopts a way to alert their human handler if there is a positive hit for sewage. The use of IDDE canines is not recommended as a standalone practice for source identification; rather it is recommended as a tool to supplement other conventional methods, such as dye testing, in order to fully verify sources of illicit discharges.

It is recommended that canine inspections are be carried according to the IDDE Canine vendor's standard operating procedures.

DATA AND RECORDS MANAGEMENT

All information shall be recorded on hardcopy (i.e., paper) or an iPad or tablet. Additional information may be recorded in field notebooks, if needed.

ATTACHMENTS / CHECKLISTS

1. N/A

Standard Operation Procedure

Catchment Investigations – Dry Weather Manhole Inspections

PURPOSE AND APPLICABILITY

The following standard operating procedure (SOP) is for dry weather manhole inspections that are included as part of the catchment investigations under the Illicit Discharge Detection Elimination (IDDE) program. The objective of this SOP is to determine the approximate location of suspected illicit discharges. For additional details and information on the overall program, refer to the Town of Marion's IDDE Plan.

SUMMARY OF THE METHOD

Inspect and take samples from manholes to narrow down the source of identified illicit discharges.

ACRONYMS

CFU	*Colony Forming Units*
DPI	*Department of Public Works*
EPA	*Environmental Protection Agency*
GPS	*Global Positioning System*
IDDE	*Illicit Discharge Detection and Elimination*
mg/L	M*illigram/liter*
mL	*Milliliter*
MPN	*Most Probable Number*
PPE	*Personal Protection Equipment*
QA/QC	*Quality Assurance/Quality Control*
SOP	*Standard Operating Procedure*
SM	*Standard Method*
SVF	*System Vulnerability Factors*

HEALTH AND SAFETY WARNINGS AND CAUTIONS

Special care should be taken throughout all sampling efforts, both to minimize inadvertent sample contamination and to maintain safe operating procedures at all times. Health and safety plans are developed for each project and should be referred to for proper health and safety protocol. Special consideration should be taken when performing the following:

- Take care when accessing manholes. Drainage structures (manholes, catch basins, etc.) are typically located in or directly adjacent to roadways with varying vehicular traffic. Additionally, some structures may be in heavily wooded areas, on steep slopes, or near environmental (poison ivy, stinging insects, biting animals, etc.) or manmade (fences, hostile dogs, etc.) hazards. Do not access structures in the center of roadways during times of heavy vehicular traffic. If needed, a police escort shall be utilized.

- Take care when opening manholes. Covers and grates to drainage structures (manholes, catch basins, etc.) are typically extremely heavy. Care, appropriate tools and personal protective equipment (described in the health and safety plans) should be utilized during opening of such structures. Once the cover or grate is lifted pay close attention to "openings" in the roadway or surface to avoid fall hazards. Do not leave open structures unattended. Do not open structures that would require more than ordinary effort.

- Take care when opening lab bottles, as some may contain a preservative that is crucial to achieving accurate results and that may be toxic to skin exposure. Carefully read the label of each lab bottle prior to opening.

EQUIPMENT AND SUPPLIES

Table I-1 lists typical field equipment used for dry weather outfall screening and sampling.

Table I-1. Field Equipment List

	Field Log Book		Form of Identification
	Ammonia Kit		Safety Vest
	Surfactant Kit		Steel Toed Boots
	Chlorine Kit or Test Strips		Safety Glasses
	Water Quality Sonde		Time Keeping Device
	Laboratory Sample Containers		Tablets/iPads
	Empty Plastic Jugs (for kit disposal)		GPS Receiver (if needed)
	IDDE Plan		Chain of Custody Forms
	Property Owner Notification Letter		Extra Sampling Kits & Lab Containers
	Cooler		Ice
	Pre-labeled sampling bottles		De-ionized water
	Plastic Bags (for temporary dams)		Dissolved Oxygen Meter
	Plumbers Putty		Coolers
	Hand-held Pump		First Aid Kits
	Measuring tape		Trash Bags
	Flashlight		Hand Sanitizer
	Sampling Rod		Zip Ties/Duct Tape
	Latex Gloves		Bucket (for carrying supplies)
	Hip Waders or Rubber Boots		Health & Safety Plan
	Shovel & Pickaxe or J-Hook		Safety Cones
	Small Mallet or Hammer		Pens & Sharpies
			Paper Towels

PROCEDURAL STEPS

When to Perform Inspections

Manhole inspections shall proceed only when no more than 0.1 inches of rainfall has occurred in the previous 24-hour period and no significant snow melt is occurring.

For purposes of determining dry weather conditions, program staff will use precipitation data from the following, listed in order of priority:

- New Bedford Regional Airport (KEWB): http://w1.weather.gov/data/obhistory/KEWB.html
- Plymouth Municipal Airport (KPYM): https://w1.weather.gov/data/obhistory/KPYM.html

Key Terms

- **Junction Manholes:** a manhole or structure with two or more inlets accepting flow from two or more MS4 alignments. Manholes with inlets solely from private storm drains, individual catch basins, or both are not considered junction manholes for these purposes.

- **Key Junction Manholes:** are those junction manholes that can represent one or more junction manholes without compromising adequate implementation of the illicit discharge program. Adequate implementation of the illicit discharge program would not be compromised if the exclusion of a particular junction manhole as a key junction manhole would not affect the permittee's ability to determine the possible presence of an upstream illicit discharge. A permittee may exclude a junction manhole located upstream from another located in the immediate vicinity or that is serving a drainage alignment with no potential for illicit connections.

General Procedure

The general procedure for dry weather manhole inspections is as follows:

1. Identify the delineated catchment area that will be investigated based on the outfall priority list.

2. Gather all relevant mapping and information pertinent to the catchment.

3. Identify key junction manholes within the catchment areas.

4. Decide if the inspection will start at the upstream or downstream end of the system. For most catchments, manhole inspections will proceed from the outfall moving up into the system. However, the decision to move up or down the system depends on the nature of the drainage system and the surrounding land use and the availability of information on the catchment and drainage system. Moving up the system can begin immediately when an illicit discharge is detected at an outfall, and only a map of the storm drain system is required. Moving down the system requires more advance preparation and reliable drainage system information on the upstream segments of the storm drain system, but may be more efficient if the sources of illicit discharges are believed to be located in the upstream portions of the catchment area. Once a manhole inspection methodology has been selected, investigations will continue systematically through the catchment.

5. Drive or walk to the first key junction manhole. Obtain permission from owners prior to accessing manholes through private property. If permission cannot be obtained, seek alternate routes to access the manhole. If working in the middle of a busy roadway, ensure proper traffic controls are implemented.

6. Open each key junction manhole. Pay special attention to roadway and environmental hazards.

7. Inspect the key junction manhole for visual and olfactory evidence of illicit connections.

8. If flow is observed, a sample will be collected and analyzed at a minimum for ammonia, chlorine, and surfactants (indicator sampling). Field kits can be used for these analyses. Sampling and analysis will be in accordance with procedures outlined in **Section 6** of the IDDE Plan and **Appendix G – Outfall Inspection and Dry Weather Sampling SOP**. Additional indicator sampling may assist in determining potential sources (e.g., bacteria for sanitary flows, conductivity to detect tidal backwater, etc.).

9. If no flow is observed at the time of inspection, there are two possible options for moving forward:

    a. **If visual or olfactory evidence of illicit connection was <u>not</u> observed** – Rule out the upstream network as a potential source of illicit discharge.

b. **If visual or olfactory evidence of illicit connection was observed** - Place sandbags in the inlet(s) of the manhole and revisit the site within 48 hours of dry weather. If present, take a water quality sample from flow that builds up behind sandbags. If no flow is observed, rule out the upstream network as a potential source of illicit discharge.

10. If sampling results, visual observations, and/or olfactory evidence indicate potential illicit discharges or SSOs, flag the area draining to the key junction manhole for further investigations and/or isolation and confirmation of sources.

11. Document all observations, notes, and sampling results in the tablet after each key junction manhole is inspected.

12. Visit each key junction manhole until all key junction manholes are inspected in the catchment.

13. If no evidence of an illicit discharge is found, catchment investigations will be considered complete upon completion of key junction manhole sampling.

DATA AND RECORDS MANAGEMENT

All information shall be recorded on forms available on hardcopy (i.e., paper) or an iPad or tablet. Additional information may be recorded in field notebooks, if needed.

ANALYTICAL SAMPLE QUALITY CONTROL AND ASSURANCE

On occasion, quality assurance/quality control (QA/QC) samples may be collected in addition to the required samples. These samples include field duplicates, field blanks, and equipment blanks:

- A **field duplicate** is when two independent samples are taken from the same source and analyzed separately. Field duplicates will be taken at a minimum at least one out of every ten outfalls tested (10%). Field duplicates will be taken for both laboratory and field measurement samples. Field duplicate samples will be identified through a "-d" suffix in the sample ID.
- A **field blank and equipment blank** consists of deionized water. Sample bottles are filled with deionized water and sent to the laboratory or tested with field equipment in the exact manner as regular grab samples. Blanks will be taken at a minimum of at least one out of every ten outfalls tested (10%). Blanks will be taken for laboratory and field measurement samples. Field blank samples will be identified through a "-b" suffix in the sample ID.

Field measurement testing with the water quality sonde and field kits will take place immediately in-field.

ATTACHMENTS / CHECKLISTS

1. N/A

Appendix J

IDDE Employee Materials and Training Record

ILLICIT DISCHARGE DETECTION AND ELIMINATION

Town of Marion

Annual Training

Presentation Overview

- Why Am I Taking this Training?
- What is an Illicit Discharge?
- Why is an Illicit Discharge Program Important?
- What Can I Do?
- Situational Review

Why Am I Taking This Training?

The EPA requires the Town do this under its National Pollution Discharge Elimination System (NPDES) Municipal Separate Storm Sewer System (MS4) Permit to conduct this training.

GENERAL PERMITS FOR STORMWATER DISCHARGES FROM SMALL MUNICIPAL SEPARATE STORM SEWER SYSTEMS IN MASSACHUSETTS

AUTHORIZATION TO DISCHARGE UNDER THE NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM

2.3.4.11 Training

The permittee shall, at a minimum, annually provide training to employees involved in IDDE program about the program, including how to recognize illicit discharges and SSOs. The permittee shall report on the frequency and type of employee training in the annual report.

What is an illicit discharge?

Any discharge to a municipal stormwater collection system that is **not composed entirely of stormwater** except discharges pursuant to a NPDES permit

Allowed discharges to a drain include:

- Water line flushing
- Landscape irrigation
- Diverted stream flows
- Rising ground water
- Uncontaminated ground water infiltration
- Uncontaminated pumped ground water
- Discharge from potable water sources
- Foundation drains
- Air conditioning condensation
- Irrigation water, springs
- Water from crawl space pumps
- Footing drains
- Lawn watering
- Individual resident car washing
- Flows from riparian habitats and wetlands
- De-chlorinated swimming pool discharges
- Street wash waters
- Residential building wash waters without detergents
- Fire fighting activities

Picture Credits: Georgetown County Stormwater Management, SPC Water Resource Center, Forester Magazines

Why is Removing Illicit Discharges Important?

Studies have shown that illicit discharges can contribute more pollutants than normal stormwater runoff

Benefits of Water Quality

Quality of Drinking Water

Health and Safety

Quality of Life

Economic Uses

Animal & Plant Habitat

Picture Credits: Central Florida Water Treatment, Inc., Today Outlook, XL Country, Sportige,

Recognizing Illicit Discharges

Direct Connection

Sewage, Industrial, Commercial Cross-Connection

Straight Pipe Connection

Indirect Connection

Spills

Dumping

Outdoor Washing

Cross-Contamination from Broken Sewer

Picture Credits: Town of Fayetteville,, Forsyth County News, , Water Encyclopedia, SEMSWA, Harris Water Main

Recognizing Illicit Discharges - Common Types of Discharges

Sewage

Looks like: Sanitary products, toilet paper, floatables, suds, oily, cloudy water

Smells like: Sewage

Other signs: Brown or green algae, excessive vegetation, trash

Caused by: Direct sewer pipe connection, indirect cross-connections between sewer and drain

Picture Credits: Livingston County Road Commission

Recognizing Illicit Discharges - Common Types of Discharges

Industrial/Commercial

Looks like: Oils/vehicle fluids, grease, soaps/detergents, unnatural colors

Smells like: Sulfur (rotten eggs), rancid-sour, oil and gas, sweet/fruity, sharp chemical smell

Other signs: Opaque/cloudy water, suds, excessive vegetation growth, chemical damage to drain pipe

Caused by: Direct pipe connections, spills, illegal dumping, washing vehicles

Picture Credits: Prince William County Government, Town of Durham, Clemson University, Town of Superior, WI

Recognizing Illicit Discharges - Common Types of Discharges

Construction

Looks like: Heavy sediment/turbidity, uncovered materials

Other signs: Brown or cloudy water, trash

Caused by: Improper construction controls

Picture Credits: Prince William County Government, Town of Durham, Clemson University, Town of Superior, WI

Recognizing Illicit Discharges - Common Types of Discharges

Residential

Looks like: Dog poop, lawn clippings, draining chlorinated swimming pools, fertilizers, wood/coal stove ash

Other signs: Trash, small amounts of hazardous materials

Caused by: Improper disposal by residents

Picture Credits: Town of Billings, MT, Alachua County

Recognizing Illicit Discharges – Sanitary Sewer Overflows

Sanitary Sewer Overflows

Definition: A discharge of untreated sanitary wastewater from a municipal sanitary sewer

Looks like: Sanitary flow exiting a Town sewer

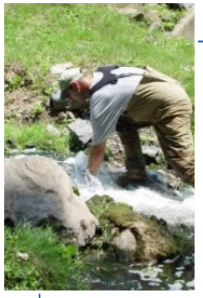
Caused by: Blockage of sewer lines, I/I during rainfall, malfunctioning pump station, broken sewer lines

Picture Credits: Town of Raleigh

What Can I Do?

Report Illicit Discharges

Talk to Residents



Participate in the IDDE Program

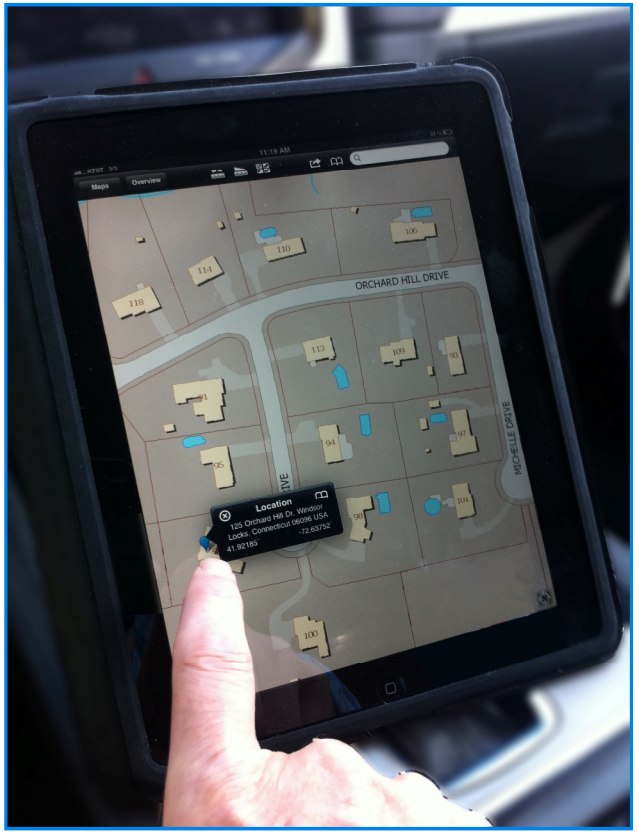
Educate Peers

Picture Credits: Philly Watersheds, Greatlakesecho,, Metropolitan Area Planning Council

What Can I do?

Additional Roles

- Department of Public Works Superintendent
  - Coordinates the MS4 Program
- Department of Public Works – All Workers
  - Report illicit discharges



Reporting Illicit Discharges

It is easy to report an illicit discharge!

- Take note of the discharge location
- Talk to your Supervisor
- Provide information including when, where, and what evidence there is of a discharge
- Take a picture

Report any concerns – it does not matter if you are not 100% sure if the discharge is illicit

Educate Peers/Talk to Residents

We all want clean water!

You and the citizens of the Town often have the best knowledge of the system

If you see something, say something! Encourage others to report illicit discharges by example

Spread education on illicit discharges, including how to recognize and report

IDDE Program

IDDE = **I**llicit **D**ischarge **D**etection and **E**limination

- An IDDE Program is required under the MS4 Permit
  - Outfalls are ranked based on potential to have illicit discharges
  - Each outfall is visited during dry weather and flow is tested for signs of illicit discharges
  - Where there are signs of illicit discharges, pipes and structures tributary to the outfall are investigated (wet weather sampling, dye testing, CCTV)
- More information is included in the Town of Marion IDDE Plan

The MS4 Permit includes six minimum control measures:

- Public Education and Outreach
- Public Involvement and Participation
- Illicit Discharge Detection and Elimination (IDDE)
- Construction Site Stormwater Runoff Control
- Post Construction Stormwater Management
- Good House Keeping and Pollution Prevention

What Happens When an Illicit Discharge is Identified?

Illicit Discharges

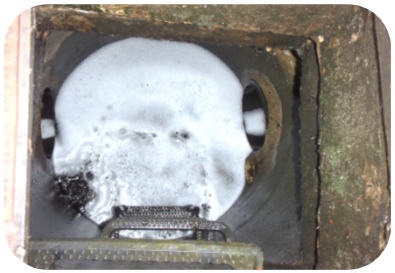
- Town works with property owner and exercises its authority as necessary to remove illicit discharge
- The illicit discharge is logged in an inventory
- EPA is notified in MS4 annual report
- Follow up screening is performed

Sanitary Sewer Overflows

- Mitigation measures are taken immediately per SSO Emergency Response Plan
- EPA and MassDEP are notified
  - Orally, within 24 hours
  - Written, within 5 days
- Local Groups are notified
- Annual Reporting

Example Situations

An uncovered dumpster is parked next to a catch basin



Suds/detergents are seen inside a catch basin during regular maintenance

A resident complains of a sewage smell in a nearby stream

A stream turns fluorescent green downstream of an industrial facility

Should it be reported as a potential illicit discharge?

Yes!

Yes!

Yes!

Yes!

Picture Credits: Scott McQuary, , Lori Lilly

IDDE – Employee Training Record

Marion, MA

Remember to sign the training record sheet!

Date of Training:_____

Duration of Training:_____

Name	Title	Signature

Questions?

Picture Credits: Scott McQuary, , Lori Lilly