Stormwater Management Program (SWMP)

Town of Middleton June 2020

195 North Main Street MA 01949

EPA NPDES Permit Number MA 041211

Certification

Authorized Representative (Optional): All reports, including SWPPPs, inspection reports, annual reports, monitoring reports, reports on training and other information required by this permit must be signed by a person described in Appendix B, Subsection 11.A or by a duly authorized representative of that person in accordance with Appendix B, Subsection 11.B. If there is an authorized representative to sign MS4 reports, there must be a signed and dated written authorization.
The authorization letter is:

☐ Attached to this document (document name listed below)

☐ Publicly available at the website below

"I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

Printed Name: Andrew Sheehan, Town Manager

Signature: _____ Date: 7/28/19

Revisions

Printed Name: Andrew Sheehan

Signature: _____ Date: 9/28/20

Click Here for Revisions

Background

Stormwater Regulation

The Stormwater Phase II Final Rule was promulgated in 1999 and was the next step after the 1987 Phase I Rule in EPA's effort to preserve, protect, and improve the Nation's water resources from polluted stormwater runoff. The Phase II program expands the Phase I program by requiring additional operators of MS4s in urbanized areas and operators of small construction sites, through the use of NPDES permits, to implement programs and practices to control polluted stormwater runoff. Phase II is intended to further reduce adverse impacts to water quality and aquatic habitat by instituting the use of controls on the unregulated sources of stormwater discharges that have the greatest likelihood of causing continued environmental degradation. Under the Phase II rule all MS4s with stormwater discharges from Census designated Urbanized Area are required to seek NPDES permit coverage for those stormwater discharges.

Permit Program Background

On May 1, 2003, EPA Region 1 issued its Final General Permit for Stormwater Discharges from Small Municipal Separate Storm Sewer Systems (2003 small MS4 permit) consistent with the Phase II rule. The 2003 small MS4 permit covered "traditional" (i.e., cities and towns) and "non-traditional" (i.e., Federal and state agencies) MS4 Operators located in the states of Massachusetts and New Hampshire. This permit expired on May 1, 2008 but remained in effect until operators were authorized under the 2016 MS4 general permit, which became effective on July 1, 2018.

Stormwater Management Program (SWMP)

The SWMP describes and details the activities and measures that will be implemented to meet the terms and conditions of the permit. The SWMP accurately describes the permittees plans and activities. The document should be updated and/or modified during the permit term as the permittee's activities are modified, changed or updated to meet permit conditions during the permit term. The main elements of the stormwater management program are (1) a public education program in order to affect public behavior causing stormwater pollution, (2) an opportunity for the public to participate and provide comments on the stormwater program (3) a program to effectively find and eliminate illicit discharges within the MS4 (4) a program to effectively control construction site stormwater discharges to the MS4 (5) a program to ensure that stormwater from development projects entering the MS4 is adequately controlled by the construction of stormwater controls, and (6) a good housekeeping program to ensure that stormwater pollution sources on municipal properties and from municipal operations are minimized.

Town Specific MS4 Background (optional)

The Town of Middleton's stormwater discharges were authorized under the 2003 MS4 Permit; consequently, the Town currently implements many BMPs to demonstrate compliance with the six minimum control measures. This SWMP identifies enhancements to existing BMPs as well as new BMPs to demonstrate compliance with the 2016 MS4 Permit. Existing mapping identifies outfalls identified during the 2003 permit term, and will be updated as needed to address 2016 MS4 Permit requirements.

Small MS4 Authorization

The NOI was submitted on 2018-10-01

The NOI can be found at the following (document name or web address):

https://www3.epa.gov/region1/npdes/stormwater/ma/tms4noi/middleton.pdf

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Authorization to Discharge was granted on 2019-04-05

The Authorization Letter can be found (document name or web address):

https://www3.epa.gov/region1/npdes/stormwater/ma/tms4noi/middleton-auth.pdf

Stormwater Management Program Team

SWMP Team Coordinator

Name	Kristin Kent	Title	Conservation Agent
Department	Conservation		
Phone Number	978-777-1869	Email	Kristin.Kent@middletonma.gov
Responsibilities	Lead for MS4 compliance tasks.		

SWMP Team

Name	Paul Goodwin	Title	Superintendent
Department	Department of Public Works		
Phone Number	978-774-0407	Email	Paul.goodwin@middletonma.gov
Responsibilities	Head of DPW and responsible for implementing repair work to MS4 system as needed.		

Name	Kenneth Gibbons	Title	Deputy Superintendent
Department	Department of Public Works		
Phone Number	978-777-0407	Email	ken.gibbons@middletonma.gov
Responsibilities	Assists with MS4 compliance tasks as needed.		

Add SWMP Member

Receiving Waters

The following table lists all receiving waters, impairments and number of outfalls discharging to each waterbody segment.

OR

The information can be found in the following document or at the following web address:

Waterbody segment that receives flow from the MS4	Number of outfalls into receiving water segment	Chloride	Chlorophyll-a	Dissolved Oxygen/ DO Saturation	Nitrogen	Oil & Grease/ PAH	Phosphorus	Solids/ TSS/Turbidity	E. coli	Enterococcus	C
Boston Brook (MA92-13)	26	☐	☐	☐	☐	☐	☐	☐	☐	☐	
Unnamed Tributary (MA92-12)	160	☐	☐	☐	☐	☐	☐	☐	☐	☐	F
Middleton Pond (MA92039)	9	☐	☐	☐	☐	☐	☐	☐	☐	☐	
Nichols Brook (MA92-25)	7	☐	☐	☐	☐	☐	☐	☐	☐	☐	
Upper Boston Brook Pond (MA92070)	3	☐	☐	☐	☐	☐	☐	☐	☐	☐	
Lower Boston Brook Pond (MA92031)	5	☐	☐	☐	☐	☐	☐	☐	☐	☐	
		☐	☐	☐	☐	☐	☐	☐	☐	☐	
		☐	☐	☐	☐	☐	☐	☐	☐	☐	
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Click here to lengthen table

Eligibility: Endangered Species and Historic Properties

*Reminder: The proper consultations and updates to the SWMP must be conducted for construction projects related to your permit compliance where Construction General Permit (CGP) coverage, which requires its own endangered species and history preservation determination, is NOT being obtained.

Attachments:

- [x] The results of Appendix C U.S. Fish and Wildlife Service endangered species screening determination
- [ ] The results of the Appendix D historic property screening investigations
- [ ] If applicable, any documents from the State Historic Preservation Officer (SHPO), Tribal Historic Preservation Officer (THPO), or other Tribal representative to mitigate effects

These attachments are required within one year of the permit effective date and are:

- [x] Attached to this document (document names listed below)

  Attachment A Threatened and Endangered Species List

- [x] Publicly available at the website listed below

  https://www3.epa.gov/region1/npdes/stormwater/ma/tms4noi/middleton.pdf

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Under what criterion did permittee determine eligibility for ESA?

☐ Criterion A ☐ Criterion B ☒ Criterion C

Under what criterion did permittee determine eligibility for Historic Properties?

☒ Criterion A ☐ Criterion B ☐ Criterion C

Below add any additional measures for structural controls that you're required to do through consultation with U.S. Fish and Wildlife Service (if applicable):

Middleton was not required to do any additional measures for structural controls as a result of consultation with USFWS.

Below add any additional measures taken to avoid or minimize adverse impacts on places listed, or eligible for listing, on the NRHP, including any conditions imposed by the SHPO or THPO (if applicable):

Note: Middleton's MS4 is covered under the 2003 Permit; therefore eligibility with the National Historic Preservation Act was previously determined. There is no expansion planned to the MS4 as part of the 2018 NOI MS4 Permit, therefore Middleton is covered under Criterion A.

MCM 1
Public Education and Outreach
Permit Part 2.3.2

Objective: The permittee shall implement an education program that includes educational goals based on stormwater issues of significance within the MS4 area. The ultimate objective of a public education program is to increase knowledge and change behavior of the public so that the pollutants in stormwater are reduced.

Examples and Templates:
EPA's Stormwater Education Toolbox
MassDEP's Stormwater Outreach Materials

Other templates relevant to MCM 1 can be found here:
https://www.epa.gov/npdes-permits/stormwater-tools-new-england#peo

BMP: Residential Brochures and Pamphlets

BMP Number (Optional) 1.1

Document Name and/or Web Address: See Appendix B

Description:

Stormwater related brochures and pamphlets on display at the Town Library. Flyers on display include brochures regarding proper management of pet waste and septic systems.

Targeted Audience: Residents

Responsible Department/Parties: Conservation Agent, Town Planner

Measurable Goal(s):

Observed decrease in pet waste and trash along roads and trails.

Message Date(s): Annually, beginning in 2018

BMP: Business/Institution/Commercial Information on Town Website

BMP Number (Optional) 1.2

Document Name and/or Web Address: https://middletonma.gov/212/Conservation-Commission

Description:

Provide links on the Town Stormwater webpage regarding stormwater information relevant to businesses. Use outreach materials and guidance from various sources (Think Blue Massachusetts, MassDEP, Cape Cod Stormwater) for posting online.
See: https://www.thinkbluemassachusetts.org/for-businesses.

Targeted Audience: Businesses, institutions and commercial facilities

Responsible Department/Parties: Conservation Agent, Town Webmaster

Measurable Goal(s):

Observed decrease in pet waste and trash along roads and trails.

Message Date(s): 2020

BMP: Local Public Service Announcements

BMP Number (Optional) 1.3

Document Name and/or Web Address:

Description:

Provide education on recommended stormwater and erosion control practices by providing fact sheets and diagrams when meeting with applicants and through announcements on community access TV.

Targeted Audience: Developers (construction)

Responsible Department/Parties: Conservation Agent, Town Planner, DPW, Building Department

Measurable Goal(s):

Improved use of sediment and erosion controls on construction sites and observed decrease in sedimentation in receiving waters.

Message Date(s): throughout 2020

BMP: Brochures/Pamphlets

BMP Number (Optional) 1.4

Document Name and/or Web Address: See Appendix B

Description:

Distribute EPA supplied stormwater brochures to Industrial Facilities in Town,with the annual recycling program mailing.

Targeted Audience: Industrial facilities

Responsible Department/Parties: Conservation Agent, Town Planner

Measurable Goal(s):

Observed increase in proper storage of industrial materials and decreased runoff of sediment-laden stormwater from industrial sites.

Message Date(s): 2020

BMP: Local Public Service Announcement

BMP Number (Optional) 1.5

Document Name and/or Web Address:

Description:

Broadcast stormwater related information on local public access TV.

Targeted Audience: Residents

Responsible Department/Parties: DPW, Public Health Director

Measurable Goal(s):

Observed decrease in trash in streams and ponds.

Message Date(s): 2020

BMP: Business/Commercial Brochures and Pamphlets

BMP Number (Optional) 1.6

Document Name and/or Web Address: To be provided once available

Description:

Provide stormwater related brochures and pamphlets to local businesses, institutions, and commercial facilties. Use Think Blue Massachusetts outreach materials and guidance, provided at: https://www.thinkbluemassachusetts.org/for-businesses.

Targeted Audience: Businesses, institutions and commercial facilities

Responsible Department/Parties: Conservation Agent, DPW

Measurable Goal(s):

Observed decrease in pet waste and trash along roads and trails.

Message Date(s): Target is 2021

BMP: Developer Stormwater Links on Town Webpage

BMP Number (Optional) 1.7

Document Name and/or Web Address: To be provided once available

Description:

Include a link on Townstormwater webpage marked as "Important Stormwater Management Information for Developers" – with a collection of links to relevant educational material.

Targeted Audience: Developers (construction)

Responsible Department/Parties: Conservation Agent, DPW, Town Webmaster

Measurable Goal(s):

Improved use of sediment and erosion controls on construction sites and observed decrease in sedimentation in receiving waters.

Message Date(s): Target is 2022

BMP: Industrial Stormwater Links on Town Webpage

BMP Number (Optional) 1.8

Document Name and/or Web Address: To be provided once available

Description:

Post web links and guidance from various sources (Think Blue Massachusetts, MassDEP, Cape Cod Stormwater, etc.) specific to industrial facilities on the Town stormwater webpage.

Targeted Audience: Industrial facilities

Responsible Department/Parties: Conservation Agent, Town Webmaster

Measurable Goal(s):

Observed increase in proper storage of industrial materials and decreased runoff of sediment-laden stormwater from industrial sites.

Message Date(s): Target is 2022

BMP: School Curricula/Programs

BMP Number (Optional) 1.9

Document Name and/or Web Address:

Description:
Implement Greenscapes North Shore Coalition's "Keeping Water Clean" program for 5th grade classes

Targeted Audience: Residents

Responsible Department/Parties: Conservation Agent

Measurable Goal(s):
Observed decrease in trash in streams and ponds.

Message Date(s): 2019

BMP: Pet Waste Information

BMP Number (Optional) 1.10

Document Name and/or Web Address:

Description:
Include information about proper pet waste management in mailings for dog license re-issuance.

Targeted Audience: Residents

Responsible Department/Parties: Conservation Agent, Board of Health

Measurable Goal(s):
Observed decrease in pet waste along roads and trails.

Message Date(s): Annually in spring

Add BMP

MCM 2
Public Involvement and Participation
Permit Part 2.3.3

Objective: The permittee shall provide opportunities to engage the public to participate in the review and implementation of the permittee's SWMP.

BMP: Public Review of Stormwater Management Program

BMP Number (Optional) 2.1

Location of Plan and/or Web Address: https://middletonma.gov/DocumentCenter/View/1688/Storm-Water-Management-Plan_June-2019

Responsible Department/Parties: Conservation Agent, Board of Selectmen's Office

Measurable Goal(s):

Stormwater Management Plan is publicly available on-line and comments can be reviewed by public.

BMP: Public Participation in Stormwater Management Program Development

BMP Number (Optional) 2.2

Description:

Hold annual hazardous waste collection day and continue used oil, battery, and tire collection program.

Responsible Department/Parties: DPW

Measurable Goal(s):

Increased public engagement in stormwater management efforts.

BMP: Shoreline/Waterbody Cleanups

BMP Number (Optional) 2.3

Document Name and/or Web Address: Not applicable

Description:

Continue annual cleanups in partnership with Middleton Stream Team.

Responsible Department/Parties: DPW, Stream Team

Measurable Goal(s):

Increased public engagement in stormwater management efforts and reduced trash along streams and ponds.

Add BMP

MCM 3
Illicit Discharge Detection and Elimination (IDDE) Program
Permit Part 2.3.4

Objective: The permittee shall implement an IDDE program to systematically find and eliminate illicit sources of non-stormwater discharges to its municipal separate storm sewer system and implement procedures to prevent such discharges.

Examples and Templates:
IDDE Program Template and SOPs

Other templates relevant to IDDE can be found here:
https://www.epa.gov/npdes-permits/stormwater-tools-new-england#idde

BMP: IDDE Legal Authority

BMP Number (Optional) _____ **Completed** (by May 1, 2008) ☒

Ordinances Link or Reference: https://middletonma.gov/DocumentCenter/View/337/Stormwater-and-Illicit-Discharge-Bylaw-PDF?bidId=

Department Responsible for Enforcement: Board of Health

BMP: Sanitary Sewer Overflow (SSO) Inventory

BMP Number (Optional) _____ **Completed** (by year 1) ☐

Document Name and/or Web Address:

Description:

This BMP is not applicable to Middleton, as they do not have sanitary sewers.

Responsible Department/Parties:

Measurable Goal(s):

Annually track and report the following SSO information: the location; a clear statement of whether the discharge entered a surface water directly or entered the MS4; date(s) and time(s) of each known SSO occurrence; estimated volume(s) of the occurrence; description of the occurrence indicating known or suspected cause(s); mitigation and corrective measures completed with dates implemented; and mitigation and corrective measures planned with implementation schedules. Update inventory as needed.

SSO Reporting:

In the event of an overflow or bypass, a notification must be reported within 24 hours by phone to MassDEP, EPA, and other relevant parties. Follow up the verbal notification with a written report following MassDEP's Sanitary Sewer Overflow (SSO)/Bypass notification form within 5 calendar days of the time you become aware of the overflow, bypass, or backup.

The MassDEP contacts are: Northeast Region (978) 694-3215 205B Lowell Street Wilmington, MA 01887 Central Region (508) 792-7650 8 New Bond Street Worcester, MA 01606 Southeast Region (508) 946-2750 20 Riverside Drive Lakeville, MA 02347 Western Region (413) 784-1100 436 Dwight Street Springfield, MA 01103 24-hour Emergency Line 1-888-304-1133	The EPA contacts are: EPA New England (617) 918-1510 5 Post Office Square Boston, MA 02109

BMP: Map of Storm Sewer

BMP Number (Optional) 3.1

Phase I Completed (by year 2) ☒ **Phase II Completed** (by year 10) ☐

Document Location and/or Web Address: see Appendix C

Description:

Outfall mapping was completed under the 2003 MS4 Permit and is located in Appendix C. The outfall map created under the 2003 permit was updated to reflect requirements of 2016 permit and is included in Appendix D.

Responsible Department/Parties: DPW, Consultant

Measurable Goal(s):

Map 100% of outfall spatial locations, pipes, manholes, catch basins, refined catchment delineations, municipal sanitary sewer system (if available), and municipal combined sewer system (if applicable) within 10 years of the permit's effective date (i.e., by June 30, 2028).

BMP: IDDE Program

BMP Number (Optional) 3.2 **Written Document Completed** (by year 1) ☒

Document Name and/or Web Address: Provided in Appendix D

Description:

Create a written Illicit Discharge Detection and Elimination Program. IDDE document shall include assessment and ranking (problem, high priority, low priority) of outfalls and interconnections, as well as written procedures describing sampling protocols. All outfalls discharging to the unnamed tributary (MA92-12) between Middleton Pond and the Ipswich River shall be ranked as high priority outfalls because this receiving water is listed as impaired for fecal coliform on the 2014 MassDEP 303(d) list.

Responsible Department/Parties: DPW, Consultant

Measurable Goal(s):

Document complete

The outfall/interconnection inventory and initial ranking and the dry weather outfall and interconnection screening and sampling results can be found:

This information will be referenced once available, in either hard copy or electronic format.

BMP: Employee Training

BMP Number (Optional) 3.3

Description:

Develop and implement program to train municipal employees involved in the IDDE program. Training shall include discussion of how to recognize illicit discharges. Frequency and type of training shall be reported in the annual report.

Responsible Department/Parties: DPW, Consultant

Measurable Goal(s):

Training will occur annually in the spring.

BMP: Implement Catchment Investigation portion of IDDE Program

BMP Number (Optional) 3.4 **Completed** ☒

Document Name and/or Web Address: Provided in Attachment D

Description:

Prepared a written catchment investigation procedure, included in IDDE Plan. Reviewed catchments for evidence of failing septic systems, which would indicate higher potential for illicit discharges to MS4 system. Catchments with failing septic systems shall be evaluated with wet weather sampling at the catchment outfall. For any illicit discharges identified during the catchment investigation procedure, identify the source of illicit discharge and eliminate the illicit source.

Responsible Department/Parties: DPW, Consultant

Measurable Goal(s):

Catchment investigations initiated and complete by 2027; and complete low and high priority catchment investigations by June 30, 2029, which is within 10 years after the permit effective date.

BMP: Conduct Dry Weather Screening

BMP Number (Optional) 3.5 **Completed** ☐

Document Name and/or Web Address: To be supplied once completed

Description:

Conduct dry weather screening of high and low priority outfalls using the procedures outlined in the written IDDE program. Conduct sampling after 24-hours of no more than 0.1 inches of rainfall or significant snow melt. Any flow observed should be sampled for: ammonia, chlorine, conductivity, salinity, E.coli, surfactants and temperature. In addition, outfalls discharging to the unnamed tributary (MA92-12) between Middleton Pond and the Ipswich River shall be sampled for fecal coliform.

Responsible Department/Parties: DPW, Consultant

Measurable Goal(s):

Complete 3 years after effective date of permit (i.e., by June 20, 2021).

BMP:

BMP Number (Optional) _____ **Completed** ☐

Document Name and/or Web Address:

Description:

Responsible Department/Parties:

Measurable Goal(s):

Add BMP

MCM 4

Construction Site Stormwater Runoff Control

Permit Part 2.3.5

Objective: The objective of an effective construction stormwater runoff control program is to minimize or eliminate erosion and maintain sediment on site so that it is not transported in stormwater and allowed to discharge to a water of the U.S. through the permittee's MS4.

Examples and Templates:
Examples and templates relevant to MCM 4, including model ordinances and site inspection templates, can be found here:
https://www.epa.gov/npdes-permits/stormwater-tools-new-england#csrc

BMP: Sediment and Erosion Control Ordinance

BMP Number (Optional) 4.1 **Completed** (by May 1, 2008) ☒

Ordinances Link or Reference: https://middletonma.gov/DocumentCenter/View/337/Stormwater-and-Illicit-Discharge-Bylaw-PDF?bidId=

Department Responsible for Enforcement: Planning, DPW, Conservation, Public Health , and Building Departments together make up the Stormwater Permitting

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BMP: Site Plan Review Procedures

BMP Number (Optional) 4.2 **Written procedures completed** (by year 1) ☒

Document Name and/or Web Address: https://middletonma.gov/DocumentCenter/View/337/Stormwater-and-Illicit-Discharge-Bylaw-PDF?bidId=

Description:

Site Plan review procedures are included in Middleton's stormwater management regulations, which is located at the location identified above.

Responsible Department/Parties: Conservation Agent, Building Inspector

Measurable Goal(s):

Conduct site plan review of 100% of projects according to the procedures outlined above.

BMP: Site Inspections and Enforcement of Sediment and Erosion Control Measures Procedures

BMP Number (Optional) 4.3 **Completed** (by year 1) ☒

Document Name and/or Web Address: https://middletonma.gov/DocumentCenter/View/337/Stormwater-and-Illicit-Discharge-Bylaw-PDF?bidId=

Description:

Requirements for construction operators to implement a sediment and erosion control program as well as enforcement have been adopted and completed, and are included in the Middleton stormwater management regulations, which are located at the location identified above. In addition, the stormwater permitting authority will exercise its option, as outlined in the regulations, to conduct site inspections during and after construction on all sites greater than one acre in size within the MS4 regulated area. Records will be kept of all site inspections and enforcement actions completed within the regulated area, and these will be reported in each annual report.

Responsible Department/Parties: Conservation Agent, Building Inspector

Measurable Goal(s):

Inspect 100% of construction sites as outlined in the above document and take enforcement actions as needed.

BMP: Erosion and Sediment Control

BMP Number (Optional) 4.4 **Completed** ☒

Document Name and/or Web Address: https://middletonma.gov/DocumentCenter/View/337/Stormwater-and-Illicit-Discharge-Bylaw-PDF?bidId=

Description:

Requirements for construction operators to implement a sediment and erosion control program are included in the the Middleton stormwater management regulations, which are located at the location identified above. This requirement is also enforced through the Middleton Conservation Commission's review of projects and issuance of Orders of Conditions under the Wetlands Protection Act.

Responsible Department/Parties: Conservation Agent, Building Inspector

Measurable Goal(s):

Achieve sediment and erosion controls on 100% of sites disturbing greater than one acre of area.

BMP: Waste Control

BMP Number (Optional) 4.5 **Completed** ☒

Document Name and/or Web Address: https://middletonma.gov/DocumentCenter/View/337/Stormwater-and-Illicit-Discharge-Bylaw-PDF?bidId=

Description:

Requirements for construction operators to control wastes on sites disturbing greater than one acre of area are included in the Middleton stormwater management regulations, which are located at the location identified above.

Responsible Department/Parties: Conservation Agent, Building Inspector

Measurable Goal(s):

Achieve control of wastes on 100% of sites disturbing greater than one acre of area.

Add BMP

MCM 5

Post Construction Stormwater Management in New Development and Redevelopment

Permit Part 2.3.6

Objective: The objective of an effective post construction stormwater management program is to reduce the discharge of pollutants found in stormwater to the MS4 through the retention or treatment of stormwater after construction on new or redeveloped sites and to ensure proper maintenance of installed stormwater controls.

Examples and Templates:
Examples and templates relevant to MCM 5, including model ordinances and bylaw review templates and guidance can be found here:
https://www.epa.gov/npdes-permits/stormwater-tools-new-england#pcsm

BMP: Post-Construction Ordinance

BMP Number (Optional) 5.1 **Completed** (by year 2) ☒

Town Ordinances Link or Reference: https://middletonma.gov/DocumentCenter/View/337/Stormwater-and-Illicit-Discharge-Bylaw-PDF?bidId=

Department Responsible for Enforcement: Planning, DPW, Conservation, Public Health , and Building Departments together make up the Stormwater Permitting

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BMP: Street Design and Parking Lot Guidelines Report

BMP Number (Optional) 5.2 **Completed** (by year 4) ☐

Document Name and/or Web Address: To be provided once available

Description:

Develop a report assessing requirements that affect the creation of impervious cover. The assessment will help determine if changes to design standards for streets and parking lots can be modified to support low impact design options

Responsible Department/Parties: Conservation Agent, DPW, Town Planner

Measurable Goal(s):

Recommendations are implemented as outlined in schedule of report with progress reported annually.

BMP: Green Infrastructure Report

BMP Number (Optional) **Completed** (by year 4) ☐

Document Name and/or Web Address: To be provided once complete

Description:

Develop a report assessing existing local regulations to determine feasibility of making green infrastructure practices allowable when appropriate site conditions exist.

Responsible Department/Parties: Conservation Agent, DPW, Town Planner

Measurable Goal(s):

Recommendations are implemented as outlined in the schedule of report with progress reported annually.

BMP: List of Municipal Retrofit Opportunities

BMP Number (Optional) 5.4 **Completed** (by year 4) ☐

Document Name and/or Web Address: To be provided once available

Description:

Identify at least 5 permittee-owned properties that could be modified or retrofitted with BMPs to reduce impervious areas. Update annually.

Responsible Department/Parties: Conservation Agent, DPW

Measurable Goal(s):

The list is completed by June 30, 2022 and updated as needed.

BMP: As-Built Plans for On-Site Stormwater Control

BMP Number (Optional) **Completed** ☒

Document Name and/or Web Address: https://middletonma.gov/DocumentCenter/View/337/Stormwater-and-Illicit-Discharge-Bylaw-PDF?bidId=

Description:

Requirements for submission of as-built drawings on sites disturbing greater than one acre of area are included in the Middleton stormwater mangaement regulations, which are located at the location identified above.

Responsible Department/Parties: Conservation Agent, DPW

Measurable Goal(s):

Create and adopt procedures regarding as-built plans for stormwater control measures, implement for 100% of completed projects after adoption.

Add BMP

MCM 6
Good Housekeeping and Pollution Prevention for Permittee Owned Operations
Permit Part 2.3.7

Objective: The permittee shall implement an operations and maintenance program for permittee-owned operations that has a goal of preventing or reducing pollutant runoff and protecting water quality from all permittee-owned operations.

Examples and Templates:
Examples and templates relevant to MCM 6, including SOP templates for catch basin cleaning, street sweeping, vehicle maintenance, parks and open space management, winter deicing, and Stormwater Pollutoin Prevention Plans can be found here:
https://www.epa.gov/npdes-permits/stormwater-tools-new-england#gh

PERMITTEE OWNED FACILITIES

BMP: Parks and Open Spaces Operations and Maintenance Procedures

BMP Number (Optional) 6.1 **Written Document Completed** (by year 2) ☒

Document Name and/or Web Address: https://middletonma.gov/DocumentCenter/View/2457/Middleton-Standard-Operating-Procedures

Description:

Developed an inventory of all permittee owned parks and open spaces within the MS4 regulated area. Created written O&M procedures including all requirements contained in 2.3.7.a.ii of the permit, including pet waste handling and signage.

Responsible Department/Parties: DPW, Parks and Recreation, Conservation Agent

Measurable Goal(s):

Implement the SOP listed above on 100% of the parks and open spaces.

Properties List (Optional)

BMP: Buildings and Facilities Operations and Maintenance Procedures

BMP Number (Optional) 6.2 **Written Document Completed** (by year 2) ☒

Document Name and/or Web Address: https://middletonma.gov/DocumentCenter/View/2457/Middleton-Standard-Operating-Procedures

Description:

Developed inventory of all permittee owned buildings and facilities. Created written O&M procedures for these buildings and facilities, including all requirements contained in 2.3.7.a.ii of the permit. Implement the written procedures.

Responsible Department/Parties: DPW, Schools, Conservation Agent

Measurable Goal(s):

Implement the SOP listed above on 100% of buildings and facilities.

Properties List (Optional)

BMP: Vehicles and Equipment Operations and Maintenance Procedures

BMP Number (Optional) 6.3 **Written Document Completed** (by year 2) ☒

Document Name and/or Web Address: https://middletonma.gov/DocumentCenter/View/2457/Middleton-Standard-Operating-Procedures

Description:

Developed an inventory of all permittee owned vehicles and equipment. Created written O&M procedures for vehicles and equipment including all requirements contained in 2.3.7.a.ii of the permit. Implement the written procedures. Procedures should address leaks, fueling, washing, etc.

Responsible Department/Parties: DPW, Conservation Agent

Measurable Goal(s):

Implement the SOP listed above for 100% of vehicles and equipment according to the above document.

Properties List (Optional)

INFRASTRUCTURE

BMP: Infrastructure Operations and Maintenance Procedures

BMP Number (Optional) 6.4 **Written Procedure Completed** (by year 2) ☒

Document Name and/or Web Address: Attachment H

Description:

Established and implement a program for repair and rehabilitation of MS4 infrastructure in accordance with permit requirements, Section 2.3.7.iii. Procedures should include include frequency of inspections, prioritization, etc.

Responsible Department/Parties: DPW

Measurable Goal(s):

100% of infrastructure is maintained to ensure proper function in accordance with the procedures above.

BMP: Catch Basin Cleaning Program

BMP Number (Optional) 6.5 **Written Procedure Completed** (by year 1) ☒

Document Name and/or Web Address: Appendix E

Description:

Establish schedule for catch basin cleaning such that each catch basin is no more than 50% full, and clean catch basins on that schedule. See Appendix E for schedule guidance and sample log. Schedule includes the party responsible for cleaning, blackout dates, equipment used, etc.

Responsible Department/Parties: DPW

Measurable Goal(s):

All catch basins are cleaned in accordance to the document above such that no catch basin is more than 50% full at any given time.

BMP: Street Sweeping Program

BMP Number (Optional) 6.6 **Written Procedure Completed** (by year 1) ☒

Document Name and/or Web Address: Appendix F

Description:

Establish and implement street sweeping procedures. Roads should generally be swept once per year, except for rural uncurbed roads or limited access highways. See Appendix F for schedule.

Responsible Department/Parties: DPW

Measurable Goal(s):

Annually sweep 100% of all streets and 50% of all municipal parking lots in accordance with the schedule listed above.

BMP: Winter Road Maintenance Program

BMP Number (Optional) 6.7 **Written Procedure Completed** (by year 1) ☒

Document Name and/or Web Address: Appendix G

Description:

Establish and implement procedures for winter road maintenance, including use and storage of sand and salt, disposal, and minimization of chloride containing materials. See Appendix G for further guidance.

Responsible Department/Parties:

Measurable Goal(s):

Evaluate at least one salt/chloride alternative for use in the municipality.

BMP: Stormwater Treatment Structures Inspection and Maintenance Procedures

BMP Number (Optional) 6.8 **Completed** (by year 1)☒

Document Name and/or Web Address: Appendix H

Description:

Appendix H describes inspection and maintenance protocols and frequencies. Inspect permitee-owned structural BMPs annually at minimum.

Responsible Department/Parties: DPW

Measurable Goal(s):

Inspect and maintain 100% of treatment structures to ensure proper function.

BMP: SWPPP

BMP Number (Optional) **Completed** (by year 2)☒

Document Name and/or Web Address:

Description:

Not Applicable - Middleton does not have a maintenance facility or any waste-handling facilities within the MS4 regulated area.

Responsible Department/Parties:

Measurable Goal(s):

Develop and implement SWPPPs for 100% of facilities.

BMP:

BMP Number (Optional) _____ **Completed** ☐

Document Name and/or Web Address:

Description:

Responsible Department/Parties:

Measurable Goal(s):

Add BMP

Annual Evaluation

Year 1 Annual Report

Document Name and/or Web Address:

https://middletonma.gov/574/4344/MS4-Annual-Reports?activeLiveTab=widgets

Year 2 Annual Report

Document Name and/or Web Address:

Year 3 Annual Report

Document Name and/or Web Address:

Year 4 Annual Report

Document Name and/or Web Address:

Year 5 Annual Report

Document Name and/or Web Address:

Year X Annual Report

Document Name and/or Web Address:

Add a Year

TMDLs and Water Quality Limited Waters

Select the applicable Impairment(s) and/or TMDL(s).

Impairment(s)

☒ Bacteria/Pathogens ☐ Chloride ☐ Nitrogen ☐ Phosphorus

☐ Solids/oil/grease (hydrocarbons)/metals

TMDL(s)

In State:

☐ Assabet River Phosphorus ☐ Bacteria and Pathogen ☐ Cape Cod Nitrogen

☐ Charles River Watershed Phosphorus ☐ Lake and Pond Phosphorus

Out of State:

☐ Bacteria and Pathogen ☐ Metals ☐ Nitrogen ☐ Phosphorus

Clear Impairments and TMDLs

Bacteria/Pathogens

Combination of Impaired Waters Requirements and TMDL Requirements as Applicable

Applicable Receiving Waterbody(ies)	TMDL Name (if applicable)	Add/Delete Row
Unnamed Tributary (MA92-12)	fecal coliform	+ -

Annual Requirements Beginning Year 1

Rank outfalls to these receiving waters as high priority for IDDE implementation in the initial outfall ranking

The relevant BMP number(s) listed above in the Stormwater Management

Outfalls discharging to the Unnamed Tributary (MA92-12) will be ranked as high priority for IDDE implementation, pursuant to BMPs.

Public Education and Outreach

(Public education messages can be combined with other public education requirements as applicable (see Appendix H and F for more information))

Annual message encouraging

The relevant BMP number(s) listed above in the Stormwater Management

BMP 1.1

Permittee or its agents disseminate educational material to dog owners at the time of issuance or renewal of dog license, or other appropriate time

The relevant BMP number(s) listed above in the Stormwater Management

BMP 1.10

Provide information to owners of septic systems about proper maintenance in any catchment that discharges to a water body impaired for bacteria

The relevant BMP number(s) listed above in the Stormwater Management

BMP 1.1

Nitrogen

Combination of Impaired Waters Requirements and TMDL Requirements as Applicable

Applicable Receiving Waterbody(ies)	TMDL Name (if applicable)	Add/Delete Row
		+ -

Annual Requirements Beginning Year 1

Public Education and Outreach

(Public education messages can be combined with other public education requirements as applicable (see Appendix H and F for more information))

Distribute an annual message in the spring (April/May) that encourages the proper use and disposal of grass clippings and encourages the proper use of slow-release fertilizers

The relevant BMP number(s) listed above in the Stormwater Management

---

Distribute an annual message in the summer (June/July) encouraging the proper management of pet waste, including noting any existing ordinances where appropriate

The relevant BMP number(s) listed above in the Stormwater Management

---

Distribute an annual message in the fall (August/September/October) encouraging the proper disposal of leaf litter

The relevant BMP number(s) listed above in the Stormwater Management

Good Housekeeping and Pollution Prevention for Permittee Owned Operations

---

Establish requirements for the use of slow release fertilizers on permittee owned property currently using fertilizer, in addition to reducing and managing fertilizer use as provided in part 2.3.7.1

The relevant BMP number(s) listed above in the Stormwater Management

---

Establish procedures to properly manage grass cuttings and leaf litter on permittee property, including prohibiting blowing organic waste materials onto adjacent impervious surfaces

The relevant BMP number(s) listed above in the Stormwater Management

---

Increase street sweeping frequency of all municipal owned streets and parking lots subject to Permit part 2.3.7.a.iii.(c) to a minimum of two times per year (spring and fall)

The relevant BMP number(s) listed above in the Stormwater Management

Nitrogen Reduction Tracking BMP

Any structural BMPs listed in Table 3 of Attachment 1 to Appendix H already existing or installed in the regulated area by the permittee or its agents shall be tracked and the permittee shall estimate the nitrogen removal by the BMP consistent with Attachment 1 to Appendix H. .

The BMP type, total area treated by the BMP, the design storage volume of the BMP and the estimated nitrogen removed in mass per year by the BMP is found in the following document or website and is updated yearly at a minimum:

Requirements Due by Year 2

Stormwater Management in New Development and Redevelopment

The requirement for adoption/amendment of the permittee's ordinance or other regulatory mechanism shall include a requirement that new development and redevelopment stormwater management BMPs be optimized for nitrogen removal

The relevant BMP number(s) listed above in the Stormwater Management

Requirements Due by Year 4

Complete a Nitrogen Source Identification Report

The document name (if attached) and/or web address is/are:

Stormwater Management in New Development and Redevelopment

Retrofit inventory and priority ranking under 2.3.6.1.b. shall include consideration of BMPs to reduce nitrogen discharges

The relevant BMP number(s) listed above in the Stormwater Management

Requirements Due by Year 5

Potential Structural BMPs

Evaluate all permittee-owned properties identified as presenting retrofit opportunities or areas for structural BMP installation under Permit part 2.3.6.d.ii or identified in the Nitrogen Source Identification Report that are within the drainage area of the impaired water or its tributaries

The relevant BMP number(s) listed above in the Stormwater Management

---

Complete a listing of planned structural BMPs and a plan and schedule for implementation

The relevant BMP number(s) listed above in the Stormwater Management

Chloride

Applicable Receiving Waterbody(ies)	TMDL Name (if applicable)	Add/Delete Row
		+ -

Annual Requirements Beginning Year 1

Public Education and Outreach

(Public education messages can be combined with other public education requirements as applicable (see Appendix H and F for more information))

Include an annual message in November/December to private road salt applicators and commercial industrial site owners on the proper storage and application rates of winter deicing material, along with the steps that can be taken to minimize salt use and protect local waterbodies

The relevant BMP number(s) listed above in the Stormwater Management

Requirements Due by Year 3

Develop a Salt Reduction Plan

The document name (if attached) and/or web address is/are:

Requirements Due by Year 4

Continue implementation of the Salt Reduction Plan

Requirements Due by Year 5

Fully implement the Salt Reduction Plan

Solids, Oil and Grease (Hydrocarbons), or Metals

Combination of Impaired Requirements and TMDL Requirements as Applicable

Applicable Receiving Waterbody(ies)	TMDL Name (if applicable)	Add/Delete Row
		+ -

Annual Requirements Beginning Year 1

Rank outfalls to these receiving waters as high priority for IDDE implementation in the initial outfall ranking

The relevant BMP number(s) listed above in the Stormwater Management

Good Housekeeping and Pollution Prevention for Permittee Owned Operations

---

Increase street sweeping frequency of all municipal owned streets and parking lots to a schedule to target areas with potential for high pollutant loads

The relevant BMP number(s) listed above in the Stormwater Management

---

Prioritize inspection and maintenance for catch basins to ensure that no sump shall be more than 50 percent full; Clean catch basins more frequently if inspection and maintenance activities indicate excessive sediment or debris loadings

The relevant BMP number(s) listed above in the Stormwater Management

Requirements Due by Year 2

Stormwater Management in New Development and Redevelopment

Stormwater management systems designed on commercial and industrial land use area draining to the water quality limited water body shall incorporate designs that allow for shutdown and containment where appropriate to isolate the system in the event of an emergency spill or other unexpected event

The relevant BMP number(s) listed above in the Stormwater Management

Phosphorus

Combination of Impaired Waters Requirements and TMDL Requirements as Applicable

Applicable Receiving Waterbody(ies)	TMDL Name (if applicable)	Add/Delete Row
		+ -

_

Annual Requirements Beginning Year 1

Public Education and Outreach

(Public education messages can be combined with other public education requirements as applicable (see Appendix H and F for more information))

Distribute an annual message in the spring(April/May) that encourages the proper use and disposal of grass clippings and encourages the proper use of slow-release and phosphorus-free fertilizers

The relevant BMP number(s) listed above in the Stormwater Management

---

Distribute an annual message in the summer (June/July) encouraging the proper management of pet waste, including noting any existing ordinances where appropriate

The relevant BMP number(s) listed above in the Stormwater Management

---

Distribute an annual message in the fall (August/September/October) encouraging the proper disposal of leaf litter

The relevant BMP number(s) listed above in the Stormwater Management

Good Housekeeping and Pollution Prevention for Permittee Owned Operations

---

Increase street sweeping frequency of all municipal owned streets and parking lots subject to Permit part 2.3.7.a.iii.(c) to a minimum of two times per year (spring and fall)

The relevant BMP number(s) listed above in the Stormwater Management

---

Establish procedures to properly manage grass cuttings and leaf litter on permittee property, including prohibiting blowing organic waste materials onto adjacent impervious surfaces

The relevant BMP number(s) listed above in the Stormwater Management

Stormwater Management in New Development and Redevelopment

Retrofit inventory and priority ranking under 2.3.6.1.b. shall include consideration of BMPs to reduce phosphorus discharges

The relevant BMP number(s) listed above in the Stormwater Management

Phosphorus Reduction Tracking BMP

Any structural BMPs listed in Table 3 of Attachment 1 to Appendix H already existing or installed in the regulated area by the permittee or its agents shall be tracked and the permittee shall estimate the phosphorus removal by the BMP consistent with Attachment 1 to Appendix H.

The BMP type, total area treated by the BMP, the design storage volume of the BMP and the estimated phosphorus removed in pass per year by the BMP is found in the following document or website and is updated yearly at a minimum:

Requirements Due by Year 2

Stormwater Management in New Development and Redevelopment

The requirement for adoption/amendment of the permittee's ordinance or other regulatory mechanism shall include a requirement that new development and redevelopment stormwater management BMPs be optimized for phosphorus removal

The relevant BMP number(s) listed above in the Stormwater Management

Requirements Due by Year 4

Complete a Phosphorus Source Identification Report

The document name (if attached) and/or web address is/are:

Stormwater Management in New Development and Redevelopment

Retrofit inventory and priority ranking under 2.3.6.1.b. shall include consideration of BMPs that infiltrate stormwater where feasible

The relevant BMP number(s) listed above in the Stormwater Management

Requirements Due by Year 5

Potential Structural BMPs

Evaluate all permittee-owned properties identified as presenting retrofit opportunities or areas for structural BMP installation under Permit part 2.3.6.d.ii or identified in the Phosphorus Source Identification Report that are within the drainage area of the impaired water or its tributaries

The relevant BMP number(s) listed above in the Stormwater Management

---

Complete a listing of planned structural BMPs and a plan and schedule for implementation

The relevant BMP number(s) listed above in the Stormwater Management

Charles River Watershed Phosphorus TMDL

PCP Phase	Document Location
I (completed by year 5)	
II (completed by year 10)	
III (completed by year 15)	

Lake and Pond Phosphorus TMDL

Begin Phase 1 of the Lake Phosphorus Control Plan during year 1 and complete by year 5.

Applicable Receiving Waterbody(ies)	PCP Complete	Document Location	Add/Delete Row
	☐		+ -

Attachment A – Endangered Species Documentation

United States Department of the Interior

FISH AND WILDLIFE SERVICE
New England Ecological Services Field Office
70 Commercial Street, Suite 300
Concord, NH 03301-5094
Phone: (603) 223-2541 Fax: (603) 223-0104
http://www.fws.gov/newengland

In Reply Refer To:
Consultation Code: 05E1NE00-2018-SLI-3066
Event Code: 05E1NE00-2018-E-07225
Project Name: Middleton NOI

September 13, 2018

Subject: List of threatened and endangered species that may occur in your proposed project location, and/or may be affected by your proposed project

To Whom It May Concern:

The enclosed species list identifies threatened, endangered, proposed and candidate species, as well as proposed and final designated critical habitat, that may occur within the boundary of your proposed project and/or may be affected by your proposed project. The species list fulfills the requirements of the U.S. Fish and Wildlife Service (Service) under section 7(c) of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 *et seq.*).

New information based on updated surveys, changes in the abundance and distribution of species, changed habitat conditions, or other factors could change this list. Please feel free to contact us if you need more current information or assistance regarding the potential impacts to federally proposed, listed, and candidate species and federally designated and proposed critical habitat. Please note that under 50 CFR 402.12(e) of the regulations implementing section 7 of the Act, the accuracy of this species list should be verified after 90 days. This verification can be completed formally or informally as desired. The Service recommends that verification be completed by visiting the ECOS-IPaC website at regular intervals during project planning and implementation for updates to species lists and information. An updated list may be requested through the ECOS-IPaC system by completing the same process used to receive the enclosed list.

The purpose of the Act is to provide a means whereby threatened and endangered species and the ecosystems upon which they depend may be conserved. Under sections 7(a)(1) and 7(a)(2) of the Act and its implementing regulations (50 CFR 402 *et seq.*), Federal agencies are required to utilize their authorities to carry out programs for the conservation of threatened and endangered species and to determine whether projects may affect threatened and endangered species and/or designated critical habitat.

A Biological Assessment is required for construction projects (or other undertakings having similar physical impacts) that are major Federal actions significantly affecting the quality of the human environment as defined in the National Environmental Policy Act (42 U.S.C. 4332(2)(c)). For projects other than major construction activities, the Service suggests that a biological evaluation similar to a Biological Assessment be prepared to determine whether the project may affect listed or proposed species and/or designated or proposed critical habitat. Recommended contents of a Biological Assessment are described at 50 CFR 402.12.

If a Federal agency determines, based on the Biological Assessment or biological evaluation, that listed species and/or designated critical habitat may be affected by the proposed project, the agency is required to consult with the Service pursuant to 50 CFR 402. In addition, the Service recommends that candidate species, proposed species and proposed critical habitat be addressed within the consultation. More information on the regulations and procedures for section 7 consultation, including the role of permit or license applicants, can be found in the "Endangered Species Consultation Handbook" at:

http://www.fws.gov/endangered/esa-library/pdf/TOC-GLOS.PDF

Please be aware that bald and golden eagles are protected under the Bald and Golden Eagle Protection Act (16 U.S.C. 668 *et seq.*), and projects affecting these species may require development of an eagle conservation plan (http://www.fws.gov/windenergy/eagle_guidance.html). Additionally, wind energy projects should follow the wind energy guidelines (http://www.fws.gov/windenergy/) for minimizing impacts to migratory birds and bats.

Guidance for minimizing impacts to migratory birds for projects including communications towers (e.g., cellular, digital television, radio, and emergency broadcast) can be found at: http://www.fws.gov/migratorybirds/CurrentBirdIssues/Hazards/towers/towers.htm; http://www.towerkill.com; and http://www.fws.gov/migratorybirds/CurrentBirdIssues/Hazards/towers/comtow.html.

We appreciate your concern for threatened and endangered species. The Service encourages Federal agencies to include conservation of threatened and endangered species into their project planning to further the purposes of the Act. Please include the Consultation Tracking Number in the header of this letter with any request for consultation or correspondence about your project that you submit to our office.

Attachment(s):

- Official Species List

Official Species List

This list is provided pursuant to Section 7 of the Endangered Species Act, and fulfills the requirement for Federal agencies to "request of the Secretary of the Interior information whether any species which is listed or proposed to be listed may be present in the area of a proposed action".

This species list is provided by:

New England Ecological Services Field Office
70 Commercial Street, Suite 300
Concord, NH 03301-5094
(603) 223-2541

Project Summary

Consultation Code: 05E1NE00-2018-SLI-3066

Event Code: 05E1NE00-2018-E-07225

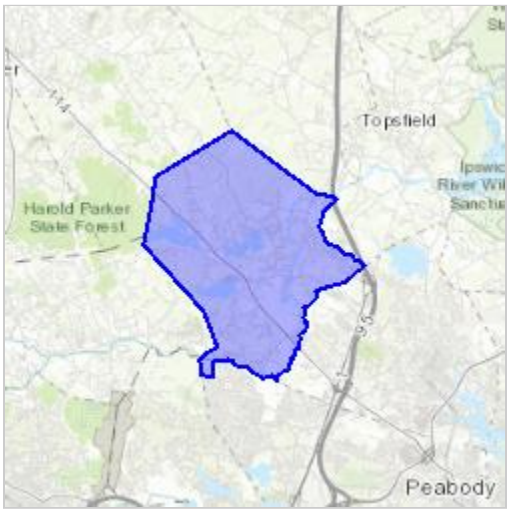
Project Name: Middleton NOI

Project Type: ** OTHER **

Project Description: Filling out the NOI MS4 permit form, which requires a review for endangered species.

Project Location:

Approximate location of the project can be viewed in Google Maps: https://www.google.com/maps/place/42.60252365702952N71.01231906975784W



Counties: Essex, MA | Middlesex, MA

Endangered Species Act Species

There is a total of 1 threatened, endangered, or candidate species on this species list.

Species on this list should be considered in an effects analysis for your project and could include species that exist in another geographic area. For example, certain fish may appear on the species list because a project could affect downstream species.

IPaC does not display listed species or critical habitats under the sole jurisdiction of NOAA Fisheries[1], as USFWS does not have the authority to speak on behalf of NOAA and the Department of Commerce.

See the "Critical habitats" section below for those critical habitats that lie wholly or partially within your project area under this office's jurisdiction. Please contact the designated FWS office if you have questions.

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1. NOAA Fisheries, also known as the National Marine Fisheries Service (NMFS), is an office of the National Oceanic and Atmospheric Administration within the Department of Commerce.

Mammals

NAME	STATUS
Northern Long-eared Bat *Myotis septentrionalis* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/9045	Threatened

Critical habitats

THERE ARE NO CRITICAL HABITATS WITHIN YOUR PROJECT AREA UNDER THIS OFFICE'S JURISDICTION.

Attachment B – Public Education Stormwater Brochures

Rain and snow are clean...

...right?

Until they hit the ground.

Polluted stormwater is the #1 threat to our water.

MS4, a federal-state permit program, requires cities and towns to reduce polluted stormwater runoff by:

- Educating residents, businesses and developers
- Testing water exiting pipes
- Controlling construction site discharge
- Retaining or treating runoff from development
- Ensuring that streets and catch basins are clean
- Developing a stormwater management plan to improve operation and maintenance

What will MS4 accomplish?

- Leaks and illegal sewer and stormwater connections fixed
- Cleaner water for our rivers, ponds and their wildlife inhabitants
- Healthier places for swimming, boating and fishing

What can I do?

- Support spending on stormwater and sewer systems
- Pick up pet waste; ask for more pet waste stations
- Eliminate chemical pesticides and fertilizers
- Don't dump dirty water or oil into storm drains—ever
- Install rain barrels; use water before it reaches the ground
- Learn where rainwater goes after it hits the street
- Learn about low-impact development and green infrastructure—check out ***Greenscapes.org***

GREENSCAPES

Produced by Greenscapes North Shore Coalition

Ipswich River Watershed Association, Merrimack River Watershed Council, MVPC/8 Towns and the Great Marsh, Salem Sound Coastwatch

Providing cost savings by bringing regional public education and outreach to your community

Stormwater might as well be called HYDROFILTH. Here's why...

- Pathogens, heavy metals, pesticides, salts, oil, common litter end up in our water.
- The "first flush" - the first inch - of rainfall washes 90% of the pollutants off the land into our waterbodies.
- Parking lots, roads, buildings (impervious surfaces) keep water from soaking into the soil and drastically affect water quality - 12-20% impervious surface coverage can threaten water quality.
- Lawns can generate up to 90% as much runoff as pavement when soils are compacted by lawn equipment or lawn chemicals which can deplete the microbial activity in the soil.

So how can I help prevent stormwater runoff (HYDROFILTH)?

In your yard:

- Add compost to your soil and aerate to reduce soil compaction.
- Add trees, shrubs and 'natural' areas to your property - the roots are efficient water recyclers.
- Plant a raingarden to capture water so it soaks into the soil.
- Use permeable pavers and porous asphalt to build walks and driveways.

In your town:

- Support open space protection especially near waterbodies.
- Advocate zoning/building regulations that encourage less pavement and other impervious surfaces.
- Support your town's efforts to clean storm drains, sweep the streets and build an effective stormwater infrastructure.

Visit greenscapes.org to learn more...

Stormwater is the #1 source of water pollution in Massachusetts - Reducing impervious surfaces is the best solution!

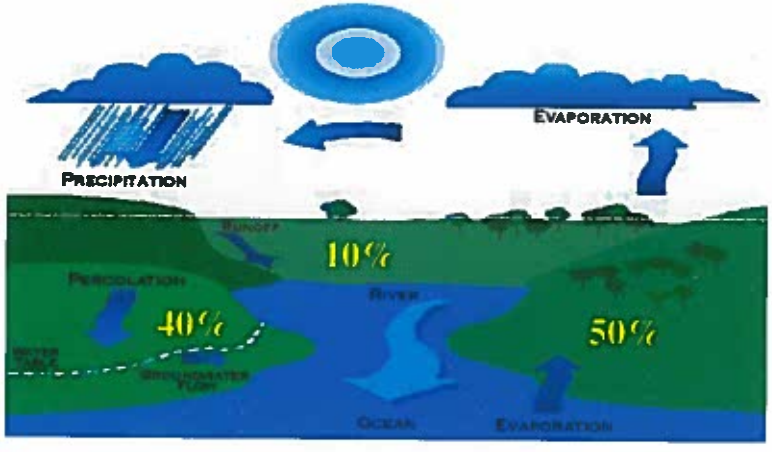
storm wa·ter: noun

Def: Rain and snow, not absorbed by plants and soil, that travels across land to the nearest waterbody

Question: It has always rained. Why do I keep hearing stormwater is such a problem now?

Answer: As we build more to accommodate a growing population and cover the soil with impervious surfaces (parking lots, roads, buildings, etc.) a great deal of rain water can no longer be absorbed into the soil the way it once was. Water that used to soak into the soil was actually cleansed by plant roots filtering pollutants. Now most of the rain and snow runs off, ending up in our lakes, streams and ocean. In short, we have been dramatically altering the water cycle as we change the landscape. ***Where once only 10% of the rain ran off the land, now 60-90% does - carrying toxic pollutants on the land with it!***

NATURAL WATER CYCLE



MAN-MADE WATER CYCLE

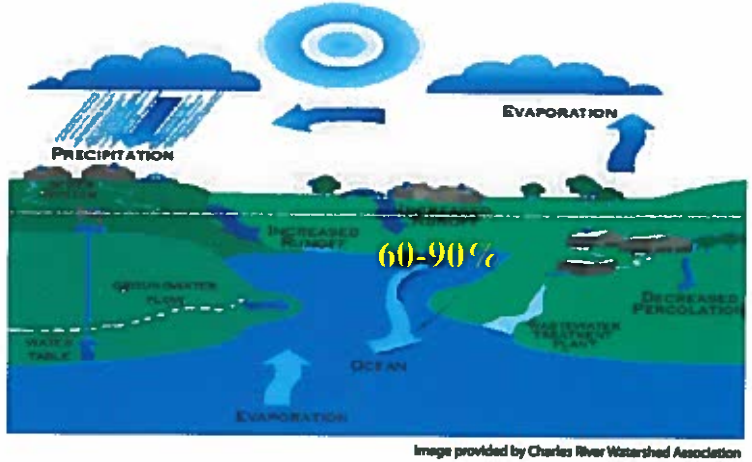


Image provided by Charles River Watershed Association

Question: Is stormwater runoff harmful?

Answer: Yes! Just about anything that has been deposited on the land, such as pet waste, cigarette butts, fertilizers, pesticides, plastic, automobile oil and gas can wash into our drinking water supply, favorite swimming hole or beach. The reason beaches have to close so often after a big rain storm is that stormwater runoff is often full of bacteria.

Question: Doesn't stormwater go to the sewage treatment plant via street storm drains and get treatment there ?

Answer: No. Water goes to the nearest waterbody. Storm drains can offer some degree of treatment, but they are often not maintained or cleaned properly.

www.Greenscapes.org
This information is brought to you by the Massachusetts Greenscapes™ Coalition and your town

WHAT IS A RAIN GARDEN?

A rain garden is a selection of plants growing in a shallow depression, generally formed on an existing slope. It is designed to temporarily hold and soak up rain water that flows off of roofs, driveways, patios or lawns. They are a simple, cost-effective tool that homeowners, municipalities or others can use to:

- **Create Beautiful, New Outdoor Space**
- **Enhance Habitat for Native Plants and Animals**
- **Reduce Flooding in Streets and Basements**
- **Recharge Essential Groundwater Resources**
  The water held in a rain garden should infiltrate within 48 hours, preventing the garden from becoming home to mosquitoes.
- **Trap, Filter and Remove Pollutants**
  Things such as oil, grease, pet waste and fertilizer that get swept from paved areas into storm drains, and eventually our rivers, streams and oceans.

Installing a rain garden can be a rewarding project!

TOOL LIST

- ☐ Shovels
- ☐ Rakes
- ☐ Gloves
- ☐ Wheelbarrow
- ☐ Measuring Tape
- ☐ Level
- ☐ Hammers
- ☐ Stakes
- ☐ String
- ☐ Calculator
- ☐ Gravel
- ☐ Compost
- ☐ Mulch

CHOOSE YOUR PLANTS

The following list is just a handful of plants, native to New England that could thrive in your garden.

Butterfly Milkweed *Asclepias Tuberosa*
Perennial
Prefers dry to damp soil (slope/berm)
Prefers full sun

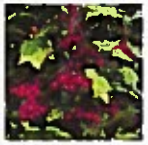
Moonbeam Coreopsis *Coreopsis Verticillata*
Perennial
Prefers wet soil (base/center)
Prefers partial sun or full shade

Wild Geranium *Geranium Maculatum*
Perennial
Prefers damp to wet soil (slope)
Prefers partial sun or full shade

Scarlet Bee Balm *Monarda Didyma*
Perennial
Tolerates most soil moisture levels
Prefers partial to full sun

Purple Coneflower *Echinacea Purpurea*
Perennial
Prefers dry to damp soil (slope/berm)
Prefers partial to full sun

Tall Switchgrass *Panicum Virgatum*
Grass
Tolerates most soil moisture levels
Prefers partial to full sun

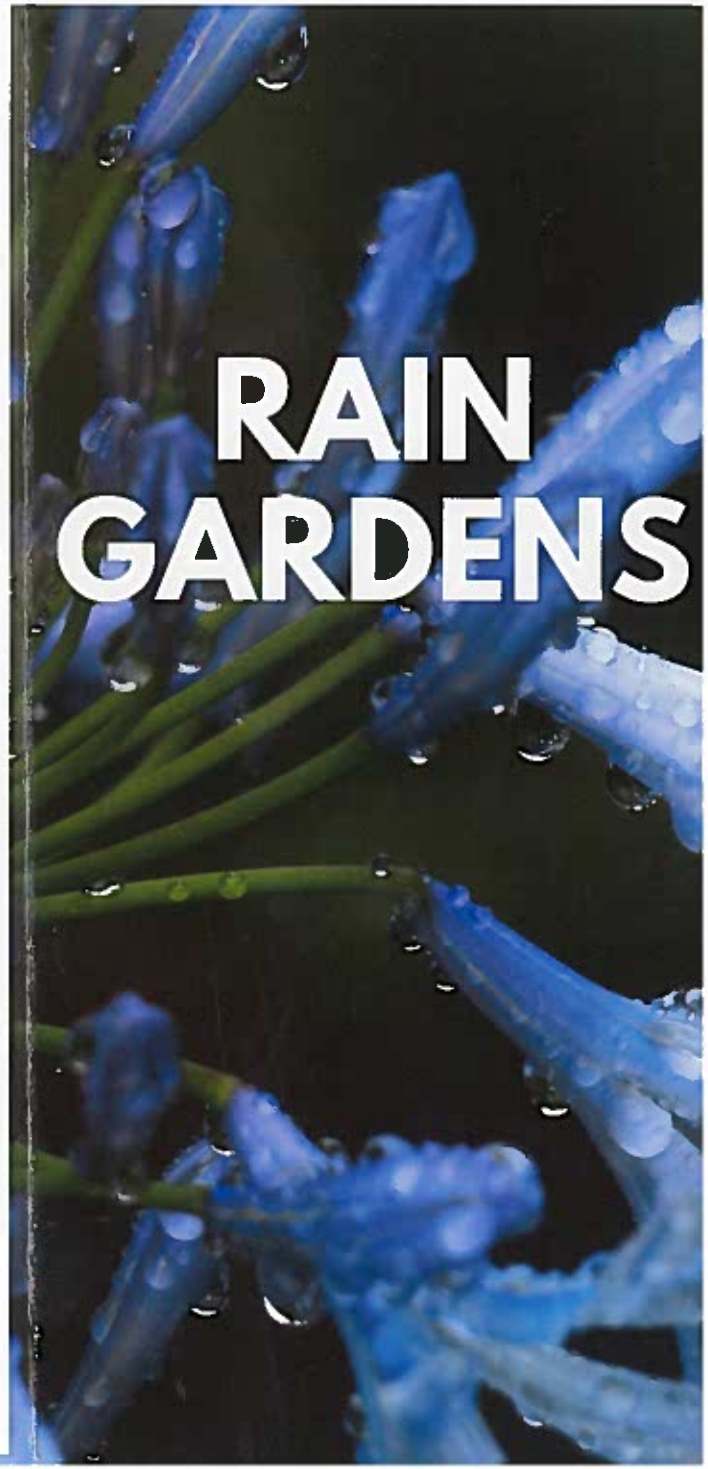


American Cranberry *Viburnum Trilobum*
Shrub
Tolerates most soil moisture levels
Prefers partial to full sun

Bayberry Bush
Shrub
Prefers damp to dry soil (slope/berm)
Prefers partial to full sun

For more information and resources visit www.greenscapes.org

GREENSCAPES



RAIN GARDENS

LET'S GET STARTED...

1. SELECT YOUR SITE

Explore your yard. Where does water naturally flow or collect? Avoid soggy areas, and instead try to capture the water before it reaches the wettest places in your yard. Keep the site at least 10 feet from building foundations and downspouts, and 3 feet from sidewalks or driveways.** Refer to START DIGGING Step for other yard obstacles you'll need to avoid **

2. CHECK YOUR SOIL

To ensure that your garden will drain well enough to provide a healthy habitat for your plants, you need to know more about your soil.

Dig a hole about 6" deep, 3-4" wide, and fill it with water. After a few hours, come back and fill it up again. After one hour, determine how much lower the water level is. If it has gone down 1.5" or more, the soil is sandy - you're good to go! If it has gone down less than 1.5", the soil is rich in clay or silt. In this case, there are several things you can do to prepare your site :

- Add a layer of gravel to the bottom of your site
- Add sand or coarser soils to your soil mixture
- All gardens will benefit from adding some compost to the mixture; the boost of nutrients will help your plants get established.

3. DETERMINE GARDEN SIZE

Time for a little math. To find the ideal size for your garden, you need to determine how much water will be flowing into it.

- **DRAINAGE AREA** Identify the impervious upstream areas that will drain into your garden. These include driveways, parking lots, sidewalks and roofs. Calculate the surface area (length x width) of each and add them together.
- **GARDEN AREA** Divide the total surface area by the garden depth of 8 - 10 inches. This will capture more than 90% of the runoff produced by an inch of rain.

Area = [Surface 1 + Surface 2 + . . .] ÷ Depth

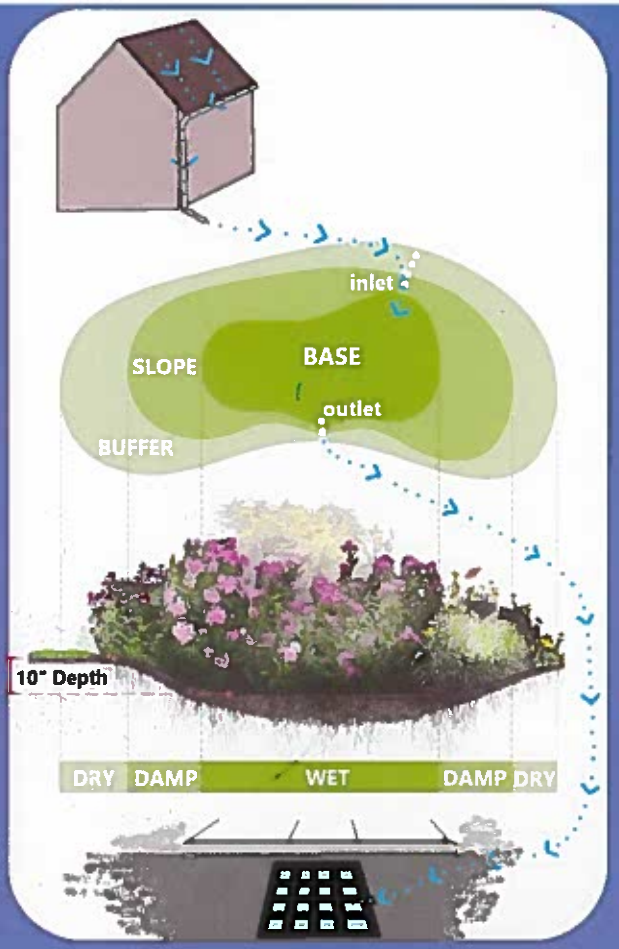
Example = [(ROOF) + (DRIVEWAY)] ÷ 10 inches

= [(20 ft x 20 ft) + (20 ft x 10 ft)] ÷ 10 in

Rain Garden Area = 60 square feet!

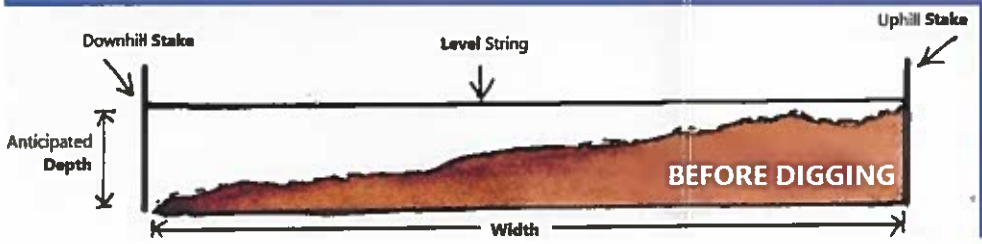
4. START DIGGING

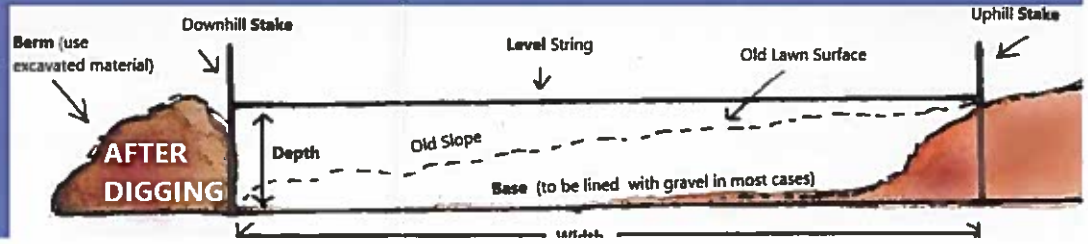
Now that you know how big your garden needs to be, you're ready to start digging.
You'll need to avoid the root zones of trees, and to stay clear of your septic tank and any other utility lines buried in your yard. Call dig-safe at:
(888) 344-7233 for help locating your utilities.
Is your home in close proximity to a wetland? If so, contact your Conservation Commission for advice on how to safely proceed.



5. TIME TO PLANT!

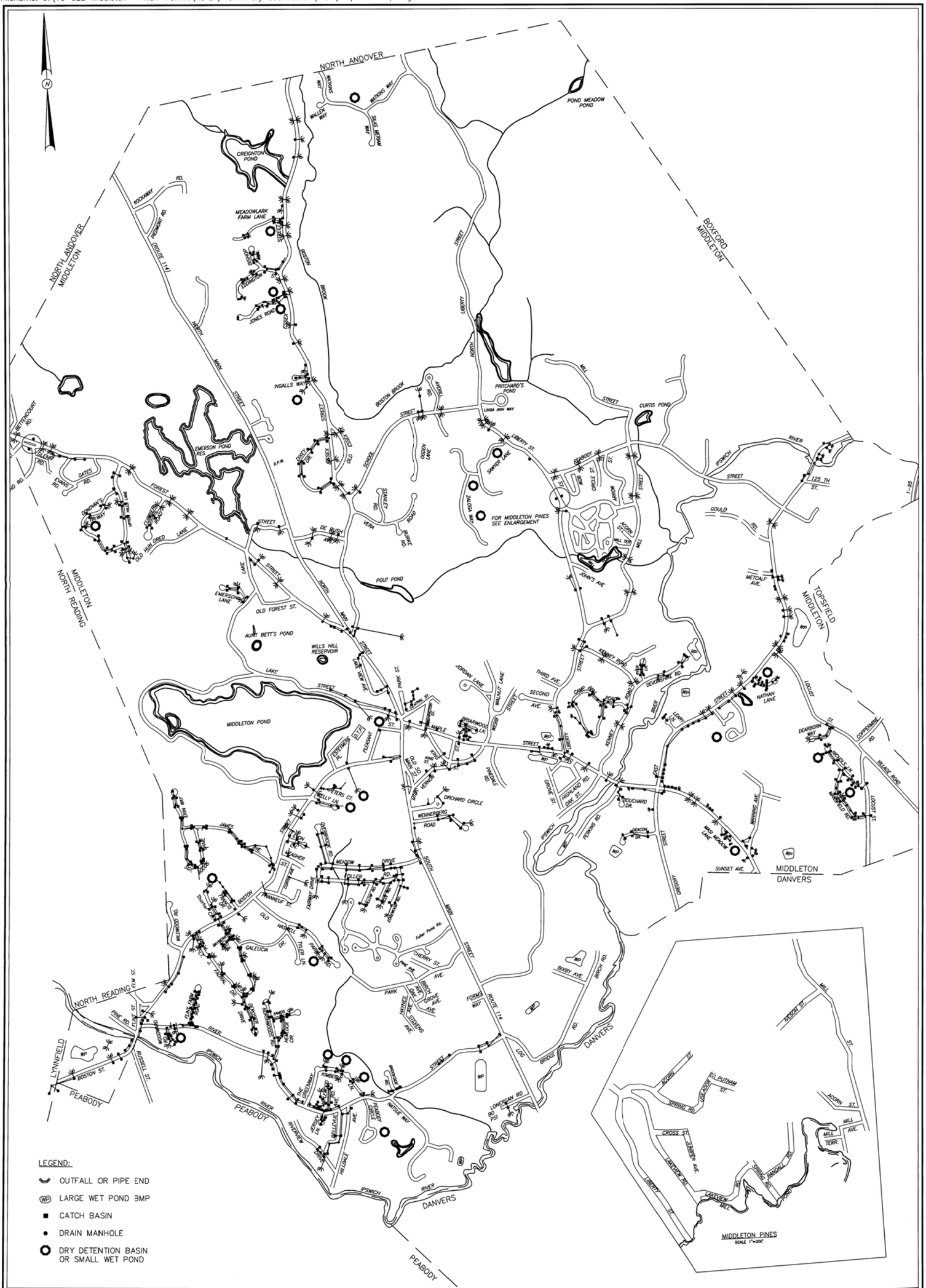
When preparing your garden, try not to walk on the mixed soil, to avoid compaction. After planting, give your garden a generous drink of water. Once established, native plants require little maintenance. Their root systems thrive under local soil conditions. Check the back of this brochure and www.greenscapes.org for suggested plants.





Attachment C – 2004 Outfall Map

Filename: J:\10-022 Middleton - MS4 Permit\ACAD\Preliminary Submission\Xref\Proposed Map.dwg



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WORLDTECH ENGINEERING

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FAX: 781.933.4801

No.	DATE	REVISION	BY

Town Of
Middleton, Massachusetts
Stormwater Drainage System

SCALE
1 inch = 1000 ft.
1000 0 500 1000 2000

04/25/2011

Attachment D – IDDE Plan

Illicit Discharge Detection and Elimination (IDDE) Plan

Town of Middleton, Massachusetts

June, 2020

Prepared by:

AECOM

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Figures

Tables

Appendices

1. Introduction

1.1 MS4 Program

This Illicit Discharge Detection and Elimination (IDDE) Plan has been developed 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 "2016 Massachusetts MS4 Permit" or "MS4 Permit." This IDDE Plan is based on a 2016 template provided by US EPA on their MS4 website for use by permittees; the template was prepared for US EPA by the Central Massachusetts Regional Stormwater Coalition.

The 2016 Massachusetts MS4 Permit requires that each permittee, or 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 permittee is required to implement an IDDE program to systematically find and eliminate sources of non-stormwater discharges to its municipal separate storm sewer 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 drainage system that is not composed entirely of stormwater, except for 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 drainage system through direct or indirect connections. Direct connections may be relatively obvious, such as cross-connections of sewer services to the storm drain 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 storm drainpipe 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 drainage system. Sump pumps legally connected to the storm drain 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 disposal 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-storm water discharges are allowed under the MS4 Permit unless the permittee, 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 the Town’s regulated area based on the 2016 Massachusetts Integrated List of Waters produced by MassDEP every two years. 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[1]	Impairment(s)	Associated Approved TMDL
Unnamed Tributary	MA92-12	5	Fecal Coliform	N/A

[1]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.

1.5 IDDE Program Goals, Framework, and Timeline

The goals of the IDDE program are to find and eliminate illicit discharges to municipal separate storm sewer 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;
- Storm system mapping;
- Inventory and ranking of outfalls;
- Dry weather outfall screening;
- Catchment investigations;
- Identification/confirmation of illicit sources;
- Illicit discharge removal;
- Follow-up screening; and
- 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

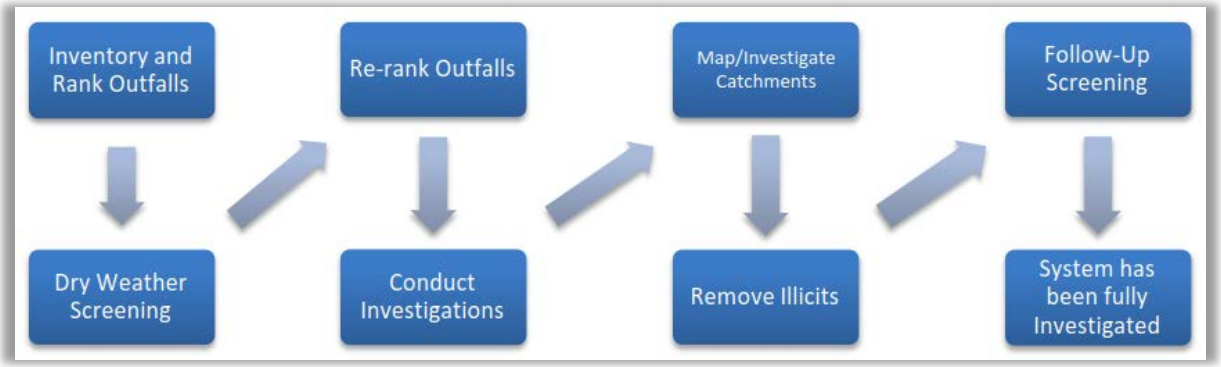

Table 1-2: IDDE Program Implementation Timeline

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					
Written Catchment Investigation Procedure		X				
Phase I Mapping			X			
Phase II Mapping						X
IDDE Regulatory Mechanism or By-Law (if not 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 storm system mapping and creating and enforcing regulatory mechanisms to prohibit illicit discharges. Each MS4 community was also required to define how confirmed discharges would be eliminated and how the removal would be documented.

The Town has completed the following IDDE program activities consistent with the 2003 MS4 Permit requirements:

- Developed a map of outfalls and receiving waters
- Adopted an IDDE bylaw or regulatory mechanism

2. Authority and Statement of IDDE Responsibilities

2.1 Legal Authority

The Town has adopted an Illicit Discharge Detection and Elimination Authority on September 17th, 2014. A copy of the Authority is provided in **Appendix A**. The Authority provides the Town with adequate legal authority to:

- Prevent pollutants from entering municipal separate storm sewer system;
- Prohibit illicit discharges;
- Require the removal of illicit connections;
- 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; and
- Implement appropriate enforcement procedures and actions.

The Town has reviewed its current Illicit Discharge Detection and Elimination Authority and related land use regulations and policies for consistency with the 2016 MS4 Permit.

2.2 Statement of Responsibilities

The Department of Public Works is the lead municipal agency responsible for implementing and administering the IDDE program pursuant to the provisions of the Illicit Discharge Detection and Elimination Authority, which includes enforcing any regulations, violation notices, or enforcement orders, and may pursue all civil and criminal remedies for such violations. The Department of Public Works is supported in implementing the IDDE by the Board of Health.

3. Stormwater System Mapping

The Town originally developed mapping of its stormwater system to meet the mapping requirements of the 2003 MS4 Permit. The 2016 MS4 Permit requires a more detailed storm 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 storm system map to be updated in two phases as outlined below. The Department of Public Works is responsible for updating the stormwater system mapping pursuant to the 2016 MS4 Permit. The Town will report on the progress towards completion of the storm system map in each annual report. The Town's current map is 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 (July 1, 2020) 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 storm sewer 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; and
- Initial catchment delineations. Topographic contours and drainage system information may be used to produce initial catchment delineations.

The Town has updated its stormwater mapping 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 (July 1, 2028) 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 (if available); and
- Municipal combined sewer system (if applicable).

The Town will update its stormwater mapping by July 1, 2028 to include the remaining following Phase II information.

4. Sanitary Sewer Overflows (SSOs)

The 2016 MS4 Permit requires municipalities to prohibit illicit discharges, including sanitary sewer overflows (SSOs), to the separate storm sewer 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, sewer defects that allow stormwater and groundwater to overload the system, power failures, improper sewer design, and vandalism.

The Town's only sanitary sewers at this time are located in the eastern portion of Town on the border with Danvers, and this sanitary flow is directed to Danvers system. The remainder of the Town disposes sewage through the use of private septic systems. There are no potential SSOs in Middleton, so there is no SSO inventory needed.

5. Assessment and Priority Ranking of Outfalls

The 2016 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 delineated to define contributing areas for investigation of potential sources of illicit discharges. Catchments are typically delineated based on topographic contours and mapped drainage infrastructure, where available. As described in **Section 3**, initial catchment delineations have been completed as part of the Phase I

[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 permittee 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 permittee'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.

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

The Department of Public Works has completed an initial outfall and interconnection inventory and priority ranking to assess illicit discharge potential based on existing information. An updated inventory and ranking will be provided in each annual report. 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. **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 permittee as high priority based on the characteristics listed below or other available information.

3. **Low Priority Outfalls**: Outfalls/interconnections determined by the permittee 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 drainage in undeveloped areas with no dwellings and no sanitary sewers; drainage for athletic fields, parks or undeveloped green space and associated parking without services; cross-country drainage 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.

- **Past discharge complaints and reports.**

- **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; and industrial manufacturing areas.

- **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.

- **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.

- **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** that receive a discharge from the MS4 or waters with approved TMDLs applicable to the permittee, where illicit discharges have the potential to contain the pollutant identified as the cause of the water quality impairment.

Table 5-1 is the outfall inventory and priority ranking matrix.

Table 5-1: Outfall Inventory and Priority Ranking Matrix – The Town of Middleton, Massachusetts – Revision Date: 06/30/20

Outfall ID	Receiving Water	Previous Screening Results Indicate Likely Sewer Input?[1]	Discharging to Area of Concern to Public Health?[2]	Frequency of Past Discharge Complaints	Receiving Water Quality[3]	Density of Generating Sites[4]	Age of Development/ Infrastructure[5]	Aging Septic?[6]	Culverted Streams?[7]	Additional Characteristics	Score	Priority Ranking
Information Source		Outfall Inspections and Sample Results	GIS Maps	Town Staff	Impaired Waters List	Land Use/GIS Maps, Aerial Photography	Land Use Information, Visual Observation	Land Use, Town Staff	GIS and Storm System Maps	Are There Other Factors of Concern?[9,10,11]		
Scoring Criteria		Yes = 15 (Problem Outfall) No = 0	Yes = 3 No = 0	Frequent = 3 Occasional = 2 None = 0	Poor = 3 Fair = 2 Good = 0	High = 3 Medium =2 Low = 1	High = 3 Medium = 2 Low = 1	Yes = 3 No = 0	Yes = 3 No = 0	Yes = 3 No = 0		
2-1	Unnamed Wetland	0	0	0	0	1	2	3	0	0	6	High Priority
9-1	Unnamed Wetland	0	0	0	0	1	0	0	0	0	1	Low Priority
13-1	Unnamed Wetland	0	0	0	0	1	0	0	0	0	1	Low Priority
14-1	Unnamed Wetland	0	0	0	0	1	0	0	0	0	1	Low Priority
17-1	Unnamed Wetland	0	3	0	0	1	2	3	0	0	9	High Priority
17-2	Unnamed Wetland	0	3	0	0	1	2	3	0	0	9	High Priority
17-3	Unnamed Wetland	0	3	0	0	1	2	3	0	0	9	High Priority
18-1	Unnamed Stream/Wetland	0	3	0	0	1	2	3	0	0	9	High Priority
18-2	Unnamed Stream/Wetland	0	3	0	0	1	2	3	0	0	9	High Priority
18-3	Unnamed Stream/Wetland	0	3	0	0	1	2	3	0	0	9	High Priority
24-1	Unnamed Stream/Wetland	0	3	0	0	1	2	0	0	0	6	High Priority
24-2	Unnamed Wetland	0	3	0	0	1	2	0	0	0	6	High Priority
25-1	Unnamed Stream	0	0	0	0	2	0	0	0	0	2	Low Priority
25-2	Unnamed Wetland	0	0	0	0	2	0	0	0	0	2	Low Priority
30-1	Unnamed Wetland	0	0	0	0	1	0	0	0	0	1	Low Priority
41-1	Unnamed Stream	0	0	0	0	1	0	0	0	0	1	Low Priority
42-1	Unnamed Stream/Wetland	0	0	0	0	1	0	0	0	3[9]	4	Low Priority
42-2	Unnamed Stream/Wetland	0	0	0	0	1	0	0	0	3[9]	4	Low Priority
42-3	Unnamed Stream/Wetland	0	0	0	0	1	0	0	0	3[9]	4	Low Priority
42-4	Unnamed Stream/Wetland	0	0	0	0	1	0	0	0	3	4	Low Priority
42-5	Unnamed Stream/Wetland	0	0	0	0	1	0	0	0	3[9]	4	Low Priority
43-`1	Ipswich River MA92-06	0	0	0	2	2	2	3	0	3[9]	12	High Priority
44-1	Unnamed Wetland	0	0	0	0	1	0	0	0	0	1	Low Priority
45-1	Unnamed Stream	0	0	0	0	1	0	0	0	0	1	Low Priority
45-2	Unnamed Stream	0	0	0	0	1	0	0	0	0	1	Low Priority
46-1	Unnamed Stream/Wetland	0	0	0	0	1	1	0	0	3[11]	5	High Priority
46-2	Unnamed Stream/Wetland	0	0	0	0	1	1	0	0	3[11]	5	High Priority
47-1	Unnamed Wetland	0	0	0	0	1	1	0	0	3[11]	5	Low Priority
48-1	Unnamed Tributary MA 92-12	0	3	0	3	2	0	0	0	3[10]	11	High Priority
48-2	Unnamed Tributary MA 92-12	0	3	0	3	2	0	0	0	3[10]	11	High Priority
49-1	Unnamed Tributary MA 92-12	0	3	0	3	1	0	0	0	3[10]	10	High Priority
56-2	Unnamed Stream	0	3	0	0	1	0	0	0	0	4	Low Priority

58-1	Unnamed Stream	0	0	0	0	1	2	3	0	0	6	High Priority
58-2	Unnamed Stream	0	0	0	0	1	2	3	0	3[11]	9	High Priority
61-1	Unnamed Wetland	0	0	0	0	1	1	0	0	0	2	Low Priority
62-1	Unnamed Wetland	0	0	0	0	1	2	0	0	0	3	Low Priority
62-2	Unnamed Wetland	0	0	0	0	1	2	0	0	0	3	Low Priority
62-3	Unnamed Wetland	0	0	0	0	1	2	0	0	0	3	Low Priority
63-1	Unnamed Wetland	0	0	0	0	1	2	0	0	0	3	Low Priority
63-2	Unnamed Wetland	0	0	0	0	1	2	0	0	0	3	Low Priority
63-3	Unnamed Wetland	0	0	0	0	1	2	0	0	0	3	Low Priority
63-4	Unnamed Wetland	0	0	0	0	1	2	0	0	0	3	Low Priority
63-5	Unnamed Wetland	0	0	0	0	1	2	0	0	0	3	Low Priority
66-1	Unnamed Wetland	0	0	0	0	1	2	0	0	0	3	Low Priority
68-1	Unnamed Wetland adjacent to Ipswich River MA 92-06	0	3	0	0	2	0	0	0	3[9]	5	High Priority
78-1	Unnamed Wetland	0	0	0	2	2	0	0	0	0	4	Low Priority
78-2	Unnamed Conveyance discharging to unnamed wetland	0	0	0	2	2	0	0	0	0	4	Low Priority

[1] Previous screening results indicate likely sewer input if any of the following are true:

- 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

[2] Outfalls/interconnections that discharge to or in the vicinity of any of the following areas: public beaches, recreational areas, drinking water supplies

[3] Receiving water quality based on latest version of MassDEP Integrated List of Waters.

- Poor = Waters with approved TMDLs (Category 4a Waters) where illicit discharges have the potential to contain the pollutant identified as the cause of the impairment
- Fair = Water quality limited waterbodies that receive a discharge from the MS4 (Category 5 Waters)
- Good = No water quality impairments
- Outfalls that discharge to impaired waters were automatically given a High Priority ranking.

[4] Generating sites are institutional, municipal, commercial, or industrial sites with a potential to contribute to illicit discharges (e.g., car dealers, car washes, gas stations, garden centers, industrial manufacturing, etc.)

[5] Age of development and infrastructure:0

- High = Industrial areas greater than 40 years old and areas where the sanitary sewer system is more than 40 years old
- Medium = Developments 20-40 years old
- Low = Developments less than 20 years old

[6]Aging septic systems are septic systems 30 years or older in residential areas.

[7]Any river or stream that is culverted for distance greater than a simple roadway crossing.

[9] The outfall is near the impaired Ipswich River

[10] The outfall is near the impaired tributary

[11] The outfall is near a sanitary discharge

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 within three years of the 2018 permit effective date, which means that all outfalls should be screened by June 30, 2021. The Department of Public Works is responsible for conducting dry weather outfall screening, starting with High Priority outfalls, followed by Low Priority outfalls, based on the initial priority rankings described in the previous section. Middleton does not have any outfalls identified as “Problem” outfalls.

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 Middleton’s weather station (Station ID: KMAMIDDL12). If the ‘Middleton Weather’ weather station is not available or not reporting current weather data, then either Falcon Ridge (KMAMIDDL26) or Upton Hills (KMAMIDDL23) 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 outfall(s) 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 potential field equipment).
3. Conduct the outfall inspection during dry weather:
    a. Mark and photograph the outfall.
    b. Record the inspection information and outfall characteristics (using paper forms or digital form using a tablet or similar device) (see form in **Appendix C**).
    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). Also 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. Other techniques can be used to detect intermittent or transitory flows including conducting inspections during evenings or weekends and using optical brighteners.
6. Input results from screening and sampling into spreadsheet/database. Include pertinent information in the outfall/interconnection inventory and priority ranking.
7. Include all screening data in the annual report.

6.2.2 Field Equipment

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

Table 6-1: Field Equipment – Dry Weather Outfall Screening and Sampling

Equipment	Use/Notes
Clipboard	For organization of field sheets and writing surface
Field Sheets	Field sheets for both dry weather inspection and Dry weather sampling should be available with extras
Chain of Custody Forms	To ensure proper handling of all samples
Pens/Pencils/Permanent Markers	For proper labeling
Nitrile Gloves	To protect the sampler as well as the sample from contamination
Flashlight/headlamp w/batteries	For looking in outfalls or manholes, helpful in early mornings as well
Cooler with Ice	For transporting samples to the laboratory
Digital Camera	For documenting field conditions at time of inspection
Personal Protective Equipment (PPE)	Reflective vest, Safety glasses and boots at a minimum
GPS Receiver	For taking spatial location data
Water Quality Sonde	If needed, for sampling conductivity, temperature, pH
Water Quality Meter	~~Hand held~~Handheld meter, if available, for testing for various water quality parameters such as ammonia, surfactants and chlorine
Test Kits	Have extra kits on hand to sample more outfalls than are anticipated to be screened in a single day
Label Tape	For labeling sample containers
Sample Containers	Make sure all sample containers are clean. Keep extra sample containers on hand at all times. Make sure there are proper sample containers for what is being sampled for (i.e., bacteria requires sterile containers).
Pry Bar or Pick	For opening catch basins and manholes when necessary
Sandbags	For damming low flows to take samples
Small Mallet or Hammer	Helping to free stuck manhole and catch basin covers
Utility Knife	Multiple uses
Measuring Tape	Measuring distances and depth of flow
Safety Cones	Safety
Hand Sanitizer	Disinfectant/decontaminant
Zip Ties/Duct Tape	For making field repairs
Rubber Boots/Waders	For accessing shallow streams/areas
Sampling Pole/Dipper/Sampling Cage	For accessing hard to reach outfalls and manholes

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

1. Fill out all sample information on sample bottles and field sheets (see **Appendix C** for Field Sheets).
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).

[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).

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 for laboratory samples.
8. Deliver samples to Northeast Environmental Laboratory, Inc. of Danvers, Massachusetts.
9. Dispose of used test strips and test kit ampules properly.
10. Decontaminate all testing personnel and equipment.

If 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. Middleton's receiving waters are not impaired for any pollutants of concern other than fecal coliform. Analytic procedures and user's manuals for field test kits and field instrumentation are provided in **Appendix D**.

Table 6-2: 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	NA
Conductivity	CHEMetrics™ I-1200 YSI Pro30 YSI EC300A Oakton 450	NA
Temperature	YSI Pro30 YSI EC300A Oakton 450	NA
Analyte or Parameter	**Instrumentation (Portable Meter)**	**Field Test Kit**
Salinity	YSI Pro30 YSI EC300A Oakton 450	NA
Temperature	YSI Pro30 YSI EC300A Oakton 450	NA
Indicator Bacteria: *E. coli* (freshwater)	EPA certified laboratory procedure (40 CFR § 136)	NA
Pollutants of Concern[1] - Fecal Coliform is listed above	NA	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.

Testing for indicator bacteria 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 6-3: Analytical Methods for Laboratory Analysis of Dry Weather Sampling Parameters

Analyte or Parameter	Analytical Method	Detection Limit	Max. Hold Time	Preservative
Ammonia	**EPA**: 350.2 **SM**[1]: 4500-NH3C	0.05 mg/L	28 days	Cool ≤6°C, H_2SO_4 to pH <2, No preservative required if analyzed immediately.
Surfactants	**SM**: 5540-C	0.01 mg/L	48 hours	Cool ≤6°C
Chlorine	**SM**: 4500-Cl G	0.02 mg/L	Analyze within 15 minutes	None Required
Temperature	**SM**: 2550B	*NA*	Immediate	None Required
Specific Conductance	**EPA**: 120.1 **SM**: 2510B	0.2 µs/cm	28 days	Cool ≤6°C
Salinity	**SM**: 2520		28 days	Cool ≤6°C
Indicator Bacteria: *E. coli* Enterococcus	*E. coli* **EPA**: 1603 **SM**: 9221B, 9221F, 9223 B **Other**: Colilert®, Colilert-18® *Enterococcus* **EPA**: 1600 **SM**: 9230 C **Other**: Enterolert®	*E. coli* **EPA**: 1 cfu/100mL **SM**: 2 MPN/100mL **Other**: 1 MPN/100mL *Enterococcus* **EPA**: 1 cfu/100mL **SM**: 1 MPN/100mL **Other**: 1 MPN/100mL	8 hours	Cool ≤10°C, 0.0008% $Na_2S_2O_3$
Analyte or Parameter	**Analytical Method**	**Detection Limit**	**Max. Hold Time**	**Preservative**
Total Nitrogen[2]	**EPA**: Cadmium reduction (automated)-353.2 Rev. 2.0, **SM**: 4500-NO_3 E-F	**EPA**: 0.05 mg/L **SM**: 0.05 mg/L	28 days	Cool ≤6°C, H_2SO_4 to pH <2

[1] SM = Standard Method

[2] Ammonia + Nitrate/Nitrate methods are for Nitrate-Nitrate and need to be combined with Ammonia listed above.

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

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

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 6-4: Benchmark Values for Sampling Parameters

Analyte or Parameter	Benchmark
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 periodically as dry weather screening information becomes available but will be completed within three (3) years of the effective date of the permit (July 1, 2021).

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 at the top of the High Priority Outfalls category for investigation. Other outfalls and interconnections may be re-ranked based on any new information from the dry weather screening.

7. Catchment Investigations

If 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.

The guidelines below list the order in which the catchments for outfalls and interconnections must be investigated based on the initial outfall ranking results:

- Catchment investigations where dry weather indicates sewer input or other illicit connection are to be completed within seven years of the permit effective date (i.e. completed by June 30, 2025). Middleton does not currently have any “Problem” outfalls.
- Investigations of all High and Low Priority outfalls must be completed within 10 years of the permit effective date (i.e., by June 30, 2028) and should follow the order as listed in the ranking table

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

7.1 System Vulnerability Factors

As explained above, most of Middleton does not have sanitary sewers. Therefore, there is limited opportunity for System Vulnerability Factors (SVF) to be present in the Town. None of the following SVFs are currently present in the Town:

- 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 storm and sanitary sewer alignments;
- Common trench construction serving both storm and sanitary sewer alignments;
- Crossings of storm and sanitary sewer alignments where the sanitary system is shallower than the storm 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 storm drain 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;
- Widespread code-required septic system upgrades required at property transfers (indicative of inadequate soils, water table separation, or other physical constraints of the area rather that poor owner maintenance); or
- History of multiple Board of Health actions addressing widespread septic system failures (indicative of inadequate soils, water table separation, or other physical constraints of the area rather that poor owner maintenance).

If any SVFs are identified during the catchment investigations, these will be documented for the catchment that includes the portion of Town including sanitary sewers (which is on maps 46 and 47 in Appendix B), retained as part of this IDDE Plan, and included in the annual report.

7.2 Dry Weather Manhole Inspections

The Department of Public Works will implement a dry weather storm drain 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.

The Department of Public Works will be responsible for implementing the dry weather manhole inspection program and making updates as necessary. Infrastructure information will be incorporated into the storm 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 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.

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 storm drain 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 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.

Inspection of key junction manholes will proceed as follows:

1. Manholes will be opened and inspected for visual and olfactory evidence of illicit connections. A sample field inspection form is provided in **Appendix C**.

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, 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 can be isolated to a pipe segment between two manholes.

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 (1) System Vulnerability Factor (SVF) is identified based on previous information or the catchment investigation, a wet weather investigation must also be conducted at the associated outfall. As indicated above in Section 7.1, Middleton does not currently have sanitary sewers. Therefore, there are no SVFs currently present in the Town and wet weather sampling is not required.

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 E**.

Public notification is an important aspect of a detailed source investigation program. Prior to smoke testing, dye testing, or TV inspections, the Town will notify property owners in the affected area. Smoke testing notification will include phone calls, hanging door tags, or emails 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 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 place in areas where there are suspected illegal connections or cracks/leaks, noting any escape of smoke (indicating an illicit connection or damaged storm drain 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.

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 storm drains and manholes as well as stormwater outfalls for the presence of the dye. Like smoke testing, it is important to inform 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 storm sewer 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 storm sewer and sanitary sewer, 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 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.

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 later 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 expensive 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 now, 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, 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. 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; and
- 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 certain personnel and their function within the framework of the IDDE program. Training records will be maintained in **Appendix F**. 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 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; and
- 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)

ARTICLE II

ILLICIT DISCHARGES TO STORM DRAIN SYSTEM

§ 204-9. PURPOSE

The purpose of this section is to eliminate non-stormwater discharges to the Town of Middleton's Municipal Storm Drain System. Non-stormwater discharges contain contaminants and supply additional flows to the Town's storm drain system. Increased and contaminated stormwater runoff is a major cause of:

(1) impairment of water quality and flow in lakes, ponds, streams, rivers, wetlands and groundwater;
(2) contamination of drinking water supplies;
(3) contamination of clam flats and other coastal areas;
(4) alteration or destruction of aquatic and wildlife habitat; and flooding.

Regulation of illicit connections and discharges to the municipal storm drain system is necessary for the protection of the Town of Middleton's natural resources, municipal facilities, and to safeguard the public health, safety, welfare and the environment.

§ 204-10. OBJECTIVES

The objectives of this section are:

(1) To prevent pollutants from entering the Town's municipal separate storm sewer system (MS4);
(2) To prohibit illicit connections and unauthorized discharges to the MS4;
(3) To require the removal of all such existing illicit connections, regardless of whether such connections were permitted or otherwise acknowledged prior to the implementation of this by-law;
(4) To comply with state and federal statutes and regulations relating to stormwater discharges; and
(5) To establish the legal authority to ensure compliance with the provisions of this by-law through inspection, monitoring, and enforcement.

§ 204-11. DEFINITIONS

Unless a different definition is indicated in other sections of Section 204, the following definitions and provisions shall apply throughout Section 204, also referred to as this by-law or Section.

AUTHORIZED ENFORCEMENT AGENCY: The Middleton Board of Health (hereafter "the BOH"), its employees or agents designated to enforce this by-law.

AUTHORIZED ADMINISTERING AGENCY: The Middleton Department of Public Works (hereafter "the Department" or "DPW"), its employees or agents designated to administer and implement this by-law.

BEST MANAGEMENT PRACTICE (BMP): An activity, procedure, restraint, or structural improvement that helps to reduce the quantity or improve the quality of stormwater runoff.

CLEAN WATER ACT: The Federal Water Pollution Control Act (33 U.S.C. § 1251 et seq.) as hereafter amended.

DISCHARGE OF POLLUTANTS: The addition from any source of any pollutant or combination of pollutants into the municipal storm drain system or into the waters of the United States or Commonwealth from any source.

GROUNDWATER: Water beneath the surface of the ground.

ILLICIT CONNECTION: A surface or subsurface drain or conveyance, which allows an illicit discharge into the municipal storm drain system, including without limitation sewage, process wastewater, or wash water and any connections from indoor drains, sinks, or toilets, regardless of whether said connection was previously allowed, permitted, or approved before the effective date of this by-law.

ILLICIT DISCHARGE: Direct or indirect discharge to the municipal storm drain system that is not composed entirely of stormwater, except as exempted in Section 204-16.4.

IMPERVIOUS SURFACE: Any material or structure on or above the ground that prevents water infiltrating the underlying soil. Impervious surface includes without limitation roads, paved parking lots, sidewalks, and roof tops.

MUNICIPAL SEPARATE STORM SEWER SYSTEM (MS4) or MUNICIPAL STORM DRAIN SYSTEM: The system of conveyances designed or used for collecting or conveying stormwater, including any road with a drainage system, street, gutter, curb, inlet, piped storm drain, pumping facility, retention or detention basin, natural or manmade or altered drainage channel, reservoir, and other drainage structure that together comprise the storm drainage system owned or operated by the Town of Middleton.

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES) STORM WATER DISCHARGE PERMIT: A permit issued by United States Environmental Protection Agency or jointly with the Commonwealth of Massachusetts that authorizes the discharge of pollutants to waters of the United States.

NON-STORMWATER DISCHARGE: Discharge to the municipal storm drain system not composed entirely of stormwater.

PERSON: An individual, partnership, association, firm, company, trust, corporation, agency, authority, department or political subdivision of the Commonwealth or the federal government, to the extent permitted by law, and any officer, employee, or agent of such person.

POLLUTANT: Any element or property of sewage, agricultural, industrial or commercial waste, runoff, leachate, heated effluent, or other matter whether originating at a point or nonpoint source, that is or may be introduced into any sewage treatment works or waters of the Commonwealth. Pollutants shall include without limitation:

(1) paints, varnishes, and solvents;
(2) oil and other automotive fluids;
(3) non-hazardous liquid and solid wastes and yard wastes;
(4) refuse, rubbish, garbage, litter, or other discarded or abandoned objects,
(5) ordnances, accumulations and floatables;
(5) pesticides, herbicides, and fertilizers;
(6) hazardous materials and wastes; sewage, fecal coliform and pathogens;
(7) dissolved and particulate metals;
(8) animal wastes;
(9) rock; sand; salt, soils;
(10) construction wastes and residues;
(11) and noxious or offensive matter of any kind.

PROCESS WASTEWATER: Water which, during manufacturing or processing, comes into direct contact with or results from the production or use of any material, intermediate product, finished product, or waste product.

RECHARGE: The process by which groundwater is replenished by precipitation through the percolation of runoff and surface water through the soil.

STORMWATER: Runoff from precipitation or snow melt.

TOXIC OR HAZARDOUS MATERIAL or WASTE: Any material, which because of its quantity, concentration, chemical, corrosive, flammable, reactive, toxic, infectious or radioactive characteristics, either separately or in combination with any substance or substances, constitutes a present or potential threat to human health, safety, welfare, or to the environment. Toxic or hazardous materials include any synthetic organic chemical, petroleum product, heavy metal, radioactive or infectious waste, acid and alkali, and any substance defined as Toxic or Hazardous under G.L. Ch.21C and Ch.21E, and the regulations at 310 CMR 30.000 and 310 CMR 40.0000.

WATERCOURSE: A natural or man-made channel through which water flows or a stream of water, including a river, brook or underground stream.

WATERS OF THE COMMONWEALTH: all waters within the jurisdiction of the Commonwealth, including, without limitation, rivers, streams, lakes, ponds, springs, impoundments, estuaries, wetlands, coastal waters, and groundwater.

WASTEWATER: any sanitary waste, sludge, or septic tank or cesspool overflow, and water that during manufacturing, cleaning or processing, comes into direct contact with or results from the production or use of any raw material, intermediate product, finished product, byproduct or waste product.

§ 204-12. APPLICABILITY
This section shall apply to flows entering the municipally owned storm drainage system.

§ 204-13. AUTHORITY
This Article is adopted under authority granted by the Home Rule Amendment of the Massachusetts Constitution, the Home Rule statutes, and the regulations of the federal Clean Water Act found at 40 CFR 122.34.

§ 204-14. RESPONSIBILITY FOR ADMINISTRATION
The BOH shall enforce this by-law. The BOH will work with the Department of Public Works ("DPW") to administer and implement this by-law. Any powers granted to or duties imposed upon the BOH may be delegated in writing by the BOH to employees or agents of the BOH and/or the DPW. References to the BOH, Department or DPW within this by-law are understood to denote either or both of these agencies.

§ 204-15. REGULATIONS
The Department may promulgate rules and regulations to effectuate the purposes of this by-law. Failure by the Department to promulgate such rules and regulations shall not have the effect of suspending or invalidating this by-law.

§ 204-16. PROHIBITED ACTIVITIES
(1) Illicit Discharges. No person shall dump, discharge, cause or allow to be discharged any pollutant or non-stormwater discharge into the municipal separate storm sewer system (MS4), into a watercourse, or into the waters of the Commonwealth.

(2) Illicit Connections. No person shall construct, use, allow, maintain or continue any illicit connection to the municipal storm drain system, regardless of whether the connection was permissible under applicable law, regulation or custom at the time of connection.

(3) Obstruction of Municipal Storm Drain System. No person shall obstruct or interfere with the normal flow of stormwater into or out of the municipal storm drain system without prior consent from the Department. No person shall dump or dispose of yard waste (leaves, grass clippings, etc.) into the open watercourses (swales, brooks and streams) that make up the stormwater system.

(4) Exemptions

A. Discharge or flow resulting from fire fighting activities;

B. The following non-stormwater discharges or flows are exempt from the prohibition of non-stormwaters provided that the source is not a significant contributor of a pollutant to the municipal storm drain system:

1. Waterline flushing;
2. Flow from potable water sources;
3. Springs;
4. Natural flow from riparian habitats and wetlands;
5. Diverted stream flow;
6. Rising groundwater;
7. Uncontaminated groundwater infiltration as defined in 40 CFR 35.2005(20), or uncontaminated pumped groundwater (e.g. sump pump), provided that where a pump intake exists inside a structure, the operator seeks a permit from the Department prior to discharge, and thereafter discharges in accordance with the requirements of the permit and applicable laws and regulations to be issued by the Department;
8. Water from exterior foundation drains, footing drains (not including active groundwater dewatering systems), crawl space pumps, or air conditioning condensation;
9. Discharge from landscape irrigation or lawn watering;
10. Water from individual residential car washing;
11. Discharge from dechlorinated swimming pool water (less than one ppm chlorine) provided the water is allowed to stand for one week prior to draining and the pool is drained in such a way as not to cause a nuisance;
12. Discharge from street sweeping;
13. Dye testing, provided verbal notification is given to the Department prior to the time of the test;
14. Non-stormwater discharge permitted under an NPDES permit, waiver, or waste discharge order administered under the authority of the United States Environmental Protection Agency, provided that the discharge is in full compliance with the requirements of the permit, waiver, or order and applicable laws and regulations; and

15. Discharge for which advanced written approval is received from the Department as necessary to protect public health, safety, welfare or the environment.

(5) Other Prohibited Activities

No person shall discharge, or cause to be discharged, water or any other liquid, on to the streets, sidewalks or ways of the Town in such a manner as to cause an obstruction of traffic or to endanger travel by freezing or otherwise.

Drains – No one shall tie any pump, cellar, yard, roof or area drain directly into the storm water drainage system, or add any new ties to an already permitted system, without a permit from the Department of Public Works.

Catch Basins – No person shall directly or indirectly dump, discharge or cause or allow to be discharged into any catchbasin, any solid waste, construction debris, paint or paint product, antifreeze, hazardous waste, oil, gasoline, grease and all other automotive and petroleum products, solvents and degreasers, drain cleaners, commercial and household cleaners, soap, detergent, ammonia, food and food waste, grease or yard waste, animal feces, dirt, sand gravel or other pollutant. Any person determined by the DPW to be responsible for the discharge of any of the above substances to a catchbasin may be held responsible for cleaning the catchbasin and any other portions of the storm water system impacted, paying the cost for such cleaning or for paying any penalties assessed by the Town.

Septage – No person shall discharge or cause or allow to be discharged any septage, or septage tank or cesspool overflow into the Town's storm water drainage system.

Storage & Disposal of Hazardous Material – No one shall dispose of anything other than clear water into the Town's storm drainage system. The disposal of waste, gasoline or any other hazardous material into the storm drainage system is strictly prohibited and is in violation of various state and federal pollution laws.

Private drainage systems – It is prohibited for anyone with a private drainage system from tying into the public storm water disposal system without a permit from the Department of Public Works. The maintenance of any and all private drainage systems shall be the responsibility of the owners.

§ 204-17. EMERGENCY SUSPENSION OF STORM DRAINAGE SYSTEM ACCESS

The Department may suspend municipal storm drain system access to any person or property without prior written notice when such suspension is necessary to stop an actual or threatened discharge of pollutants that presents imminent risk of harm to the public health, safety, welfare or the environment. In the event any person fails to comply with an emergency suspension order, the Authorized Enforcement Agency may take all reasonable steps to prevent or minimize harm to the public health, safety, welfare or the environment.

§ 204-18. INDUSTRIAL OR CONSTRUCTION ACTIVITY DISCHARGES

Any person subject to an industrial or construction activity NPDES storm water discharge permit shall comply with all provisions of such permit. Proof of compliance with said permit may be required in a form acceptable to the Department of Public Works prior to the allowing of discharges to the MS4.

§ 204-19. MONITORING OF DISCHARGES

This Section applies to all facilities that have storm water discharges associated with industrial activity, including construction activity.

(1) Access to Facilities – The BOH and DPW (or other enforcement agency/delegated enforcement partner) shall be permitted to enter and inspect facilities subject to regulation under this by-law as often as may be necessary to determine compliance with this by-law, subject to applicable law. If a discharger has security measures in force which require proper identification and clearance before entry into its premises, the discharger shall make the necessary arrangements to allow access to representatives of the authorized enforcement agency.

(2) Facility operators shall allow the BOH and DPW ready access to all parts of the premises for the purposes of inspection, sampling, examination and copying of records that must be kept under the conditions of an NPDES permit to discharge storm water, and the performance of any additional duties as defined by state and federal laws.

(3) The BOH and DPW shall have the right to set up on any permitted facility such devices as are necessary in the opinion of the authorized enforcement agency to conduct monitoring and/or sampling of the facility's storm water discharge.

(4) The BOH and DPW have the right to require the discharger to install monitoring equipment as necessary. The facility's sampling and monitoring equipment shall be maintained at all times in a safe and proper operating

condition by the discharger at its own expense. All devices used to measure storm water flow and quality shall be calibrated to ensure they are accurate.

(5) Any temporary or permanent obstruction to safe and easy access to the facility to be inspected and/or sampled shall be promptly removed by the operator at the written or oral request of the BOH and DPW and shall not be replaced. The costs of clearing such access shall be borne by the operator.

(6) Unreasonable delay in allowing the BOH or DPW access to a permitted facility constitutes a violation of a storm water discharge permit and of this by-law. A person who is the operator of a facility with a NPDES permit to discharge storm water associated with industrial activity violates this Section. if the person denies the authorized enforcement agency reasonable access to the permitted facility for the purpose of conducting any activity authorized or required by this by-law.

(7) If the BOH or DPW has been refused access to any part of the premises from which storm water is discharged, and he/she is able to demonstrate probable cause to believe that there may be a violation of this by-law, or that there is a need to inspect and/or sample as part of a routine inspection and sampling program designed to verify compliance with this by-law or any order issued hereunder, or to protect the overall public health, safety, and welfare of the community, then the authorized enforcement agency may seek issuance of a search warrant from any court of competent jurisdiction.

§ 204-20. WATERCOURSE PROTECTION

Every person owning property through which a watercourse passes, or such person's lessee, shall keep and maintain that part of the watercourse within the property free of trash, debris, excessive vegetation, and other obstacles that would pollute, contaminate, or significantly retard the flow of water through the watercourse. In addition, the owner or lessee shall maintain existing privately owned structures within or adjacent to a watercourse so that such structures will not become a hazard to the use, function, or physical integrity of the watercourse. Compliance with this by-law does not waive the responsibility of the property owner or lessee for applying for and receiving any other required Town, State or Federal permits associated with activities or uses otherwise regulated under other regulatory jurisdiction (e.g. Wetlands Protection Act).

§ 204-21. NOTIFICATION OF SPILLS

Notwithstanding other requirements of local, state or federal law, as soon as a person responsible for a facility or operation, or responsible for emergency response for a facility or operation has information of or suspects a release of materials at that facility or operation resulting in or which may result in discharge of pollutants to the municipal drainage system or waters of the Commonwealth, the person shall take all necessary steps to ensure containment, and cleanup of the release. In the event of a release of oil or hazardous materials, the person shall immediately notify the municipal fire and police departments. In the event of a release of non-hazardous material, the reporting person shall notify the Authorized Enforcement Agency no later than the next business day. The reporting person shall provide to the Authorized Enforcement Agency written confirmation of all telephone, facsimile or in-person notifications within three business days thereafter. If the discharge of prohibited materials is from a commercial or industrial facility, the facility owner or operator of the facility shall retain on-site a written record of the discharge and the actions taken to prevent its recurrence. Such records shall be retained for at least three years.

§ 204-22. ENFORCEMENT

The BOH or an authorized agent of the BOH shall enforce this by-law, regulations, orders, violation notices, and enforcement orders, and may pursue all civil and criminal remedies for such violations.

1. Civil Relief

If a person violates the provisions of this Section, regulations, permit, notice, or order issued thereunder, the BOH may seek injunctive relief in a court of competent jurisdiction restraining the person from activities which would create further violations or compelling the person to perform abatement or remediation of the violation.

2. Orders

The BOH or an authorized agent of the BOH may issue a written order to enforce the provisions of this section or the regulations thereunder, which may include: (a) elimination of illicit connections or discharges to the MS4; (b) performance of monitoring, analyses, and reporting; (c) that unlawful discharges, practices, or operations shall cease and desist; and (d) remediation of contamination in connection therewith.

A. If the enforcing person determines that abatement or remediation of contamination is required, the order shall set forth a deadline by which such abatement or remediation must be completed. Said order shall further advise that, should the violator or property owner fail to abate or perform remediation within the

specified deadline, the Town may, at its option undertake such work, and expenses thereof shall be charged to the violator.

B. Within thirty (30) days after completing all measures necessary to abate the violation or to perform remediation, the violator and the property owner will be notified of the costs incurred by the Town, including administrative costs. The violator or property owner may file a written protest objecting to the amount or basis of costs with the Department within thirty (30) days of receipt of the notification of the costs incurred. If the amount due is not received by the expiration of the time in which to file a protest or within thirty (30) days following a decision of the Department affirming or reducing the costs, or from a final decision of a court of competent jurisdiction, the costs shall become a special assessment against the property owner and shall constitute a lien on the owner's property for the amount of said costs pursuant to M.G.L. Ch. 40, §58. Interest shall begin to accrue on any unpaid costs at the statutory rate provided in G.L. Ch. 59, § 57 after the thirty-first day at which the costs first become due.

3. Non-Criminal Disposition
As an alternative to criminal prosecution or civil action, the Town may elect to utilize the non-criminal disposition procedure set forth in G.L. Ch. 40, §21D and in which case the Health Director and DPW Director of the Town shall be the enforcing person. The penalty for the 1st and all subsequent violations shall be $300.00. Each day or part thereof that such violation occurs or continues shall constitute a separate offense.

4. Criminal Penalty
Any person who violates any provision of this by-law, regulation, order or permit issued thereunder, shall be punished by a fine of $300.00. Each day or part thereof that such violation occurs or continues shall constitute a separate offense.

5. Entry to Perform Duties Under this Section
To the extent permitted by applicable law, or if authorized by the owner or other party in control of the property, the BOH and DPW, its agents, officers, and employees may enter upon privately owned property for the purpose of performing their duties under this by-law and regulations and may make or cause to be made such examinations, surveys or sampling as the BOH and DPW deems reasonably necessary.

6. Appeals
The decisions or orders of the BOH and DPW shall be final. Further relief shall be to a court of competent jurisdiction.

7. Remedies Not Exclusive
The remedies listed in this section are not exclusive of any other remedies available under any applicable federal, state or local law.

§ 204-23. SEVERABILITY
The provisions of this section are hereby declared to be severable. If any provision, paragraph, sentence, or clause, of this section or the application thereof to any person, establishment, or circumstances shall be held invalid, such invalidity shall not affect the other provisions or application of this section or by-law.

Appendix B

Storm System Mapping

GRID INDEX

Legend

Stormwater Outfall
- Field-Confirmed
- Field-Likely
- Likely

BMP-Infiltration Basin
- Field-Confirmed
- Field-Likely
- Likely
- Grid
- 2010 Census Urban Area
- Old Roads

Protected/Recreational
- Conservation
- Recreation
- Recreation and Conservation
- Agriculture
- Historical/Cultural
- Water Supply
- Surface Water Protection ZONE A
- Surface Water Protection ZONE B
- Surface Water Protection ZONE C

NORTH ANDOVER
TOPSFIELD
NORTH READING
DANVERS
LYNNFIELD
PEABODY
Brigadoon Village
Middleton Country Club

2 7 8 9 11 12 13 14 17 18 20 24 25 29 30 32 33 34 35 38 41 42 43 44 45 46 47 48 49 50 53 56 58 59 61 62 63 66 68 71 77 78 79 80 81 82 83 84 85

Service Layer Credits: Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community

1 inch = 2,000 feet

0 1,000 2,000 Feet

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GRID MAP

2

Legend

- Stormwater Outfall

2014 Impaired Waters 303d

- 2 - Attaining some uses
- Approximate Drainage Area

DEP Wetlands

- Hydrologic Connection
- Wetland Limit
- Closure Line
- Marsh/Bog
- Wooded Marsh

2-ft Contours

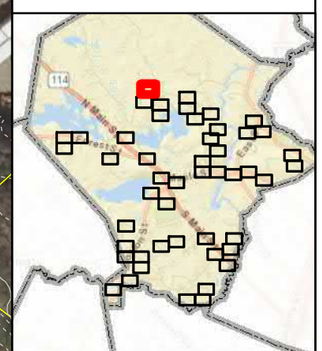
- Index
- Intermediate

Protected/Recreational

- Conservation
- Older Residential Street

1 inch = 100 feet

0 50 100 Feet



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GRID MAP

7

Legend

- BMP - Infiltration Basin

DEP Wetlands

- Hydrologic Connection
- Wetland Limit
- Marsh/Bog
- Wooded Marsh

2-ft Contours

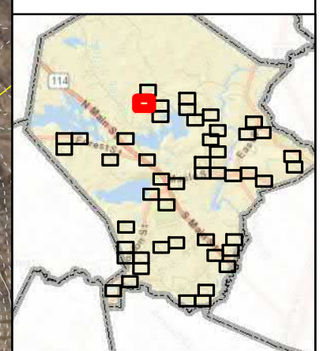
- Index
- Intermediate

Protected/Recreational

- Conservation
- Older Residential Street

1 inch = 100 feet

0 50 100 Feet



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GRID MAP

8

Legend

- BMP - Infiltration Basin

DEP Wetlands

- Shoreline
- Hydrologic Connection
- Wetland Limit
- Wooded Marsh
- Open Water

2-ft Contours

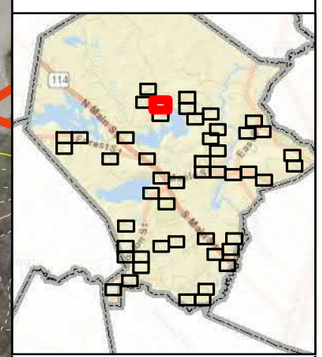
- Index
- Intermediate

Protected/Recreational

- Conservation
- Older Residential Street

1 inch = 100 feet

0 50 100 Feet



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GRID MAP

9

Legend

- Stormwater Outfall
- Approximate Drainage Area

DEP Wetlands

- Hydrologic Connection
- Wetland Limit
- Marsh/Bog
- Wooded Marsh

2-ft Contours

- Index
- Intermediate

9-1

CIRCLE STREET

PEABODY STREET

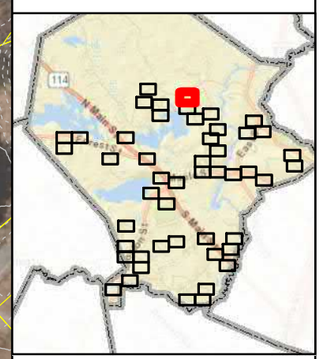
BOW STREET

LIBERTY STREET

ACORN STREET

1 inch = 100 feet

0 50 100 Feet



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GRID MAP

11

Legend

- BMP - Infiltration Basin

DEP Wetlands

- Shoreline
- Hydrologic Connection
- Wetland Limit
- Closure Line
- Wooded Marsh
- Open Water

2-ft Contours

- Index
- Intermediate

Protected/Recreational

- Conservation
- Older Residential Street

1 inch = 100 feet

0 50 100 Feet

Nichols Putnam Preserve

Nichols Putnam Preserve

ZALOGA WAY

11-1

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GRID MAP

12

Legend

BMP - Infiltration Basin

DEP Wetlands

Hydrologic Connection

Wetland Limit

Closure Line

Marsh/Bog

Wooded Marsh

2-ft Contours

Index

Intermediate

Protected/Recreational

Conservation

12-1

WOODBURY LANE

LAKEVIEW AVENUE

ACORN STREET

SPRING ROAD

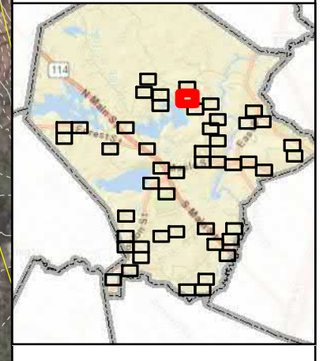
CROSS STREET

LAKEVIEW ROAD

LIBERTY STREET

1 inch = 100 feet

0 50 100 Feet



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GRID MAP

13

Legend

- Stormwater Outfall
- Approximate Drainage Area

DEP Wetlands

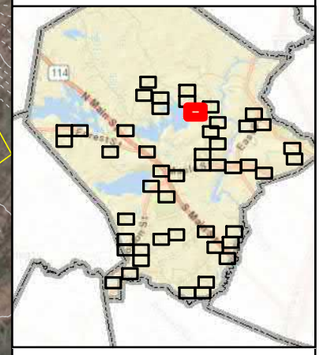
- Shoreline
- Hydrologic Connection
- Wetland Limit
- Closure Line
- Marsh/Bog
- Wooded Marsh
- Open Water

2-ft Contours

- Index
- Intermediate

1 inch = 100 feet

0 50 100 Feet



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GRID MAP

14

Legend

- Stormwater Outfall
- Approximate Drainage Area

DEP Wetlands

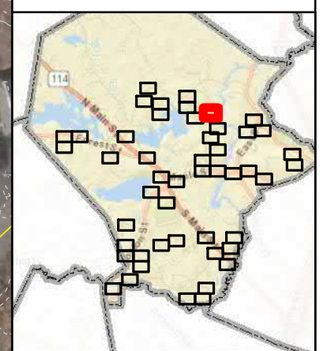
- Shoreline
- Hydrologic Connection
- Wetland Limit
- Closure Line
- Marsh/Bog
- Wooded Marsh
- Open Water

2-ft Contours

- Index
- Intermediate

1 inch = 100 feet

0 50 100 Feet



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GRID MAP

17

Legend

- Stormwater Outfall
- Approximate Drainage Area

DEP Wetlands

- Hydrologic Connection
- Wetland Limit
- Wooded Marsh

2-ft Contours

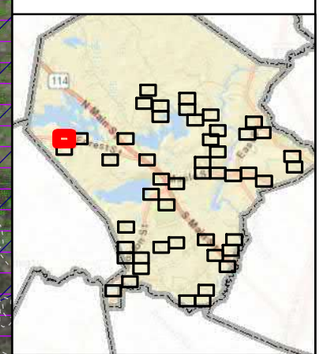
- Index
- Intermediate

Protected/Recreational

- Water Supply
- Surface Water ZONE A
- Surface Water ZONE B
- Older Residential Street

1 inch = 100 feet

0 50 100 Feet



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GRID MAP

18

Legend

- Stormwater Outfall
- Approximate Drainage Area

DEP Wetlands

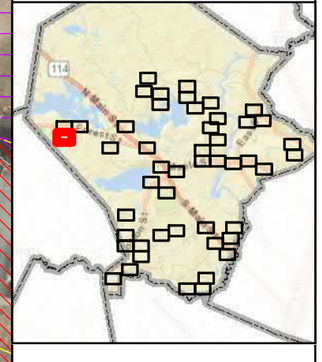
- Hydrologic Connection
- Wetland Limit
- Wooded Marsh

2-ft Contours

- Index
- Intermediate
- Surface Water ZONE A
- Surface Water ZONE B
- Surface Water ZONE C
- Older Residential Street

1 inch = 100 feet

0 50 100 Feet



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GRID MAP

20

Legend

- Stormwater Outfall
- Approximate Drainage Area

DEP Wetlands

- Shoreline
- Hydrologic Connection
- Wetland Limit
- Closure Line
- Marsh/Bog
- Wooded Marsh
- Open Water

2-ft Contours

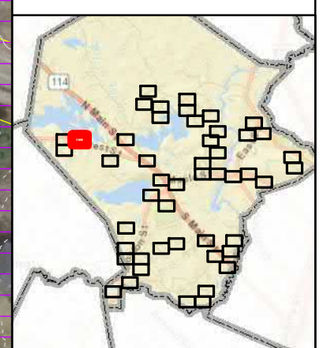
- Index
- Intermediate

Protected/Recreational

- Water Supply
- Surface Water ZONE A
- Surface Water ZONE B
- Older Residential Street

1 inch = 100 feet

0 50 100 Feet



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GRID MAP

24

Legend

- Stormwater Outfall
- Approximate Drainage Area

DEP Wetlands

- Hydrologic Connection
- Wetland Limit
- Closure Line
- Wooded Marsh

2-ft Contours

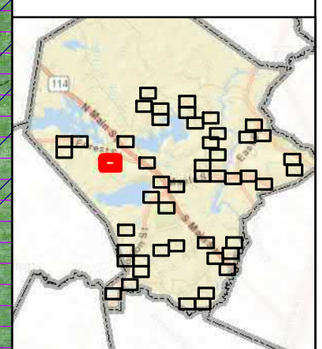
- Index
- Intermediate

Protected/Recreational

- Conservation
- Surface Water ZONE A
- Surface Water ZONE B
- Surface Water ZONE C
- Older Residential Street

1 inch = 100 feet

0 50 100 Feet



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GRID MAP

25

Legend

- BMP - Infiltration Basin
- Stormwater Outfall
- Approximate Drainage Area

DEP Wetlands

- Hydrologic Connection
- Wetland Limit
- Closure Line
- Marsh/Bog
- Wooded Marsh

2-ft Contours

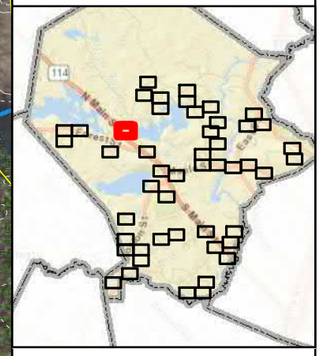
- Index
- Intermediate

25-1a
25-1
25-2
25-3

DEBUSH AVENUE
NORTH MAIN STREET
ESSEX STREET

1 inch = 100 feet

0 50 100 Feet



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GRID MAP

29

Legend

BMP - Infiltration Basin

2014 Impaired Waters 303d

5 - Impaired TMDL req'd

DEP Wetlands

Shoreline

Hydrologic Connection

Wetland Limit

Wooded Marsh

Open Water

2-ft Contours

Index

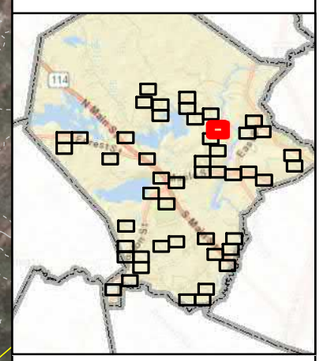
Intermediate

Protected/Recreational

Conservation

1 inch = 100 feet

0 50 100 Feet



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GRID MAP

30

Legend

- BMP - Infiltration Basin
- Stormwater Outfall
- Approximate Drainage Area

DEP Wetlands

- Hydrologic Connection
- Wetland Limit
- Marsh/Bog
- Wooded Marsh

2-ft Contours

- Index
- Intermediate

29-1

30-1

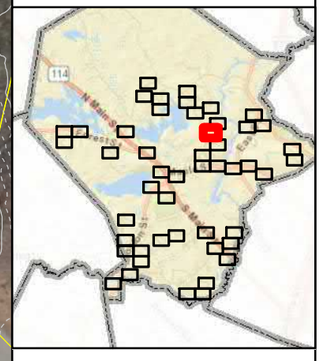
MILL STREET

LIBERTY STREET

KENNEY ROAD

1 inch = 100 feet

0 50 100 Feet



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GRID MAP

32

Legend

- BMP - Infiltration Basin

DEP Wetlands

- Shoreline
- Hydrologic Connection
- Wetland Limit
- Marsh/Bog
- Wooded Marsh
- Open Water

2-ft Contours

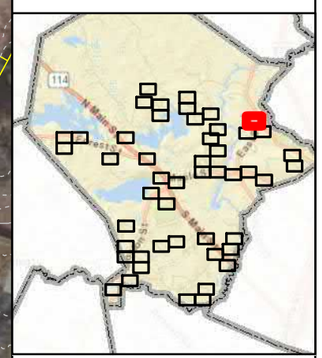
- Index
- Intermediate

32-1

SIMCHA ROAD
TOWNE ROAD
BUTLER DRIVE
NORMA WAY
EAST STREET
LOCUST STREET

1 inch = 100 feet

0 50 100 Feet



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GRID MAP

33

Legend

BMP - Infiltration Basin

2014 Impaired Waters 303d

5 - Impaired TMDL req'd

DEP Wetlands

Shoreline

Hydrologic Connection

Wetland Limit

Closure Line

Marsh/Bog

Wooded Marsh

Open Water

2-ft Contours

Index

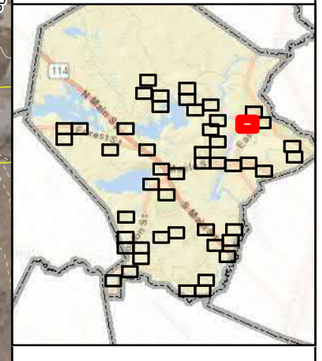
Intermediate

Protected/Recreational

Conservation

1 inch = 100 feet

0 50 100 Feet



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GRID MAP

34

Legend

- BMP - Infiltration Basin

DEP Wetlands

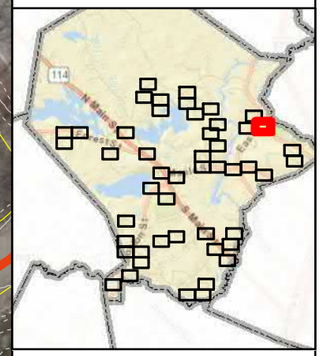
- Hydrologic Connection
- Wetland Limit
- Closure Line
- Marsh/Bog
- Wooded Marsh

2-ft Contours

- Index
- Intermediate
- Older Residential Street

1 inch = 100 feet

0 50 100 Feet



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GRID MAP

35

Legend

- BMP - Infiltration Basin

DEP Wetlands

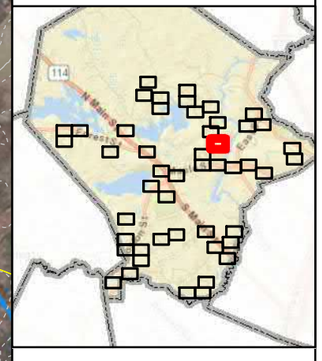
- Hydrologic Connection
- Wetland Limit
- Marsh/Bog
- Wooded Marsh

2-ft Contours

- Index
- Intermediate
- Older Residential Street

1 inch = 100 feet

0 50 100 Feet



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GRID MAP

38

Legend

- BMP - Infiltration Basin
- Approximate Drainage Area

DEP Wetlands

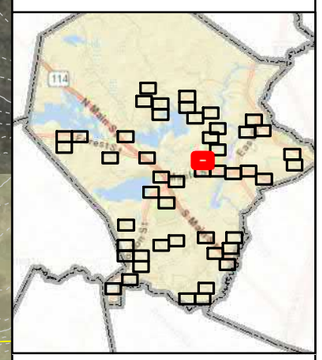
- Shoreline
- Hydrologic Connection
- Wetland Limit
- Closure Line
- Wooded Marsh
- Open Water

2-ft Contours

- Index
- Intermediate
- Older Residential Street

1 inch = 100 feet

0 50 100 Feet



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GRID MAP

41

Legend

- Stormwater Outfall
- Approximate Drainage Area

DEP Wetlands

- Shoreline
- Hydrologic Connection
- Wetland Limit
- Closure Line
- Wooded Marsh
- Open Water

2-ft Contours

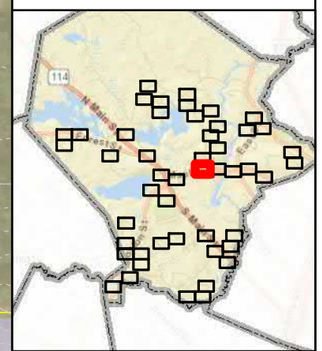
- Index
- Intermediate

Protected/Recreational

- Historical/Cultural

1 inch = 100 feet

0 50 100 Feet



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GRID MAP

42

Legend

- Stormwater Outfall

2014 Impaired Waters 303d

- 5 - Impaired TMDL req'd
- Approximate Drainage Area

DEP Wetlands

- Shoreline
- Hydrologic Connection
- Wetland Limit
- Marsh/Bog
- Wooded Marsh
- Open Water

2-ft Contours

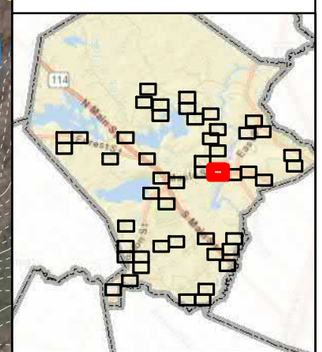
- Index
- Intermediate

Protected/Recreational

- Agriculture
- Historical/Cultural

1 inch = 100 feet

0 50 100 Feet



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GRID MAP

43

Legend

- Stormwater Outfall
- DEP BWP Major Facilities

2014 Impaired Waters 303d

- 5 - Impaired TMDL req'd
- Approximate Drainage Area

DEP Wetlands

- Shoreline
- Wetland Limit
- Closure Line
- Marsh/Bog
- Wooded Marsh
- Open Water

2-ft Contours

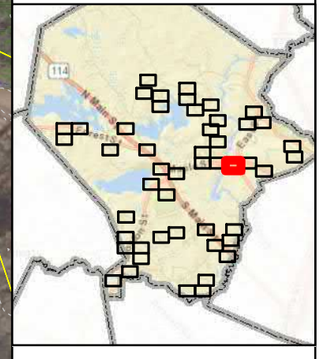
- Index
- Intermediate

Protected/Recreational

- Agriculture
- Older Residential Street

1 inch = 100 feet

0 50 100 Feet



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GRID MAP

44

Legend

- Stormwater Outfall
- Approximate Drainage Area

DEP Wetlands

- Wetland Limit
- Closure Line
- Marsh/Bog
- Wooded Marsh

2-ft Contours

- Index
- Intermediate

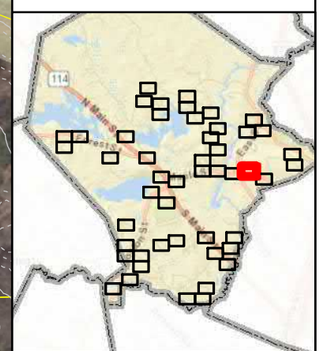
44-1

MAPLE STREET

GREGORY STREET

1 inch = 100 feet

0 50 100 Feet



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GRID MAP

45

Legend

- Stormwater Outfall
- Approximate Drainage Area

DEP Wetlands

- Hydrologic Connection
- Wetland Limit
- Marsh/Bog
- Wooded Marsh

2-ft Contours

- Index
- Intermediate

MAPLE STREET

MANNING AVENUE

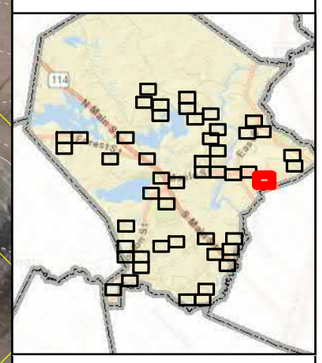
MASI MEADOW LANE

45-1

45-2

1 inch = 100 feet

0 50 100 Feet



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DANVERS

GRID MAP

46

Legend

- BMP - Infiltration Basin
- Stormwater Outfall
- Approximate Drainage Area

DEP Wetlands

- Hydrologic Connection
- Wetland Limit
- Wooded Marsh

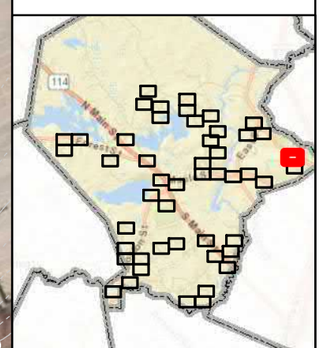
2-ft Contours

- Index
- Intermediate
- Older Residential Street

46-1
46-2
46-3
VILLAGE ROAD
VILLAGE ROAD
IRON WOOD
COUNTRY CLUB LANE
NICHOLS LANE
MANSFIELD ROAD
LOCUST STREET

1 inch = 100 feet

0 50 100 Feet



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GRID MAP

47

Legend

- Stormwater Outfall
- Approximate Drainage Area

DEP Wetlands

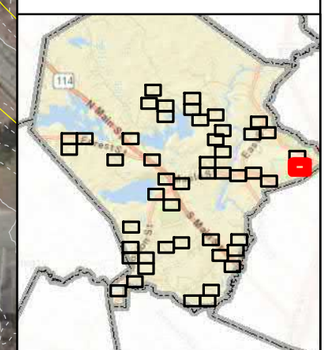
- Hydrologic Connection
- Wetland Limit
- Wooded Marsh

2-ft Contours

- Index
- Intermediate
- Older Residential Street

1 inch = 100 feet

0 50 100 Feet



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GRID MAP

48

Legend

- Stormwater Outfall

2014 Impaired Waters 303d

- 5 - Impaired TMDL req'd
- Approximate Drainage Area

DEP Wetlands

- Hydrologic Connection
- Wetland Limit
- Wooded Marsh

2-ft Contours

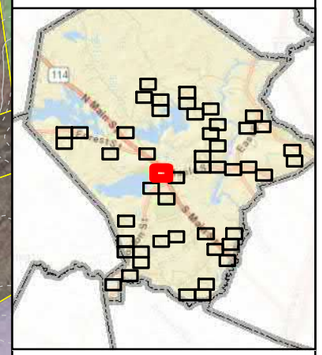
- Index
- Intermediate

Protected/Recreational

- Conservation
- Historical/Cultural
- Surface Water ZONE A
- Surface Water ZONE B

1 inch = 100 feet

0 50 100 Feet



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GRID MAP

49

Legend

- Stormwater Outfall

2014 Impaired Waters 303d

- 5 - Impaired TMDL req'd
- Approximate Drainage Area

DEP Wetlands

- Hydrologic Connection
- Wetland Limit
- Closure Line
- Marsh/Bog
- Wooded Marsh

2-ft Contours

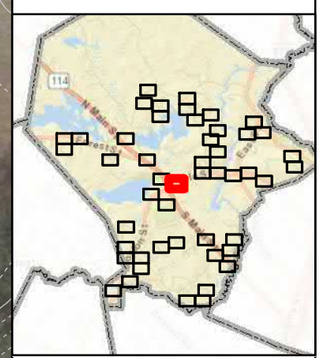
- Index
- Intermediate

Protected/Recreational

- Conservation
- Recreation
- Historical/Cultural
- Older Residential Street

1 inch = 100 feet

0 50 100 Feet



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GRID MAP

50

Legend

- BMP - Infiltration Basin

DEP Wetlands

- Shoreline
- Hydrologic Connection
- Wetland Limit
- Wooded Marsh
- Open Water

2-ft Contours

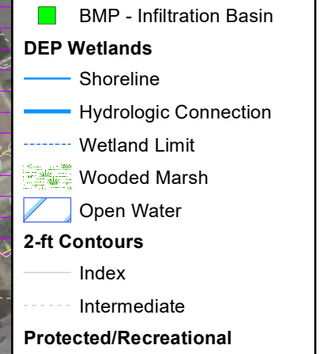
- Index
- Intermediate

Protected/Recreational

- Conservation
- Surface Water ZONE A
- Surface Water ZONE B

1 inch = 100 feet

0 50 100 Feet



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GRID MAP

53

Legend

- BMP - Infiltration Basin

DEP Wetlands

- Shoreline
- Wetland Limit
- Wooded Marsh
- Open Water

2-ft Contours

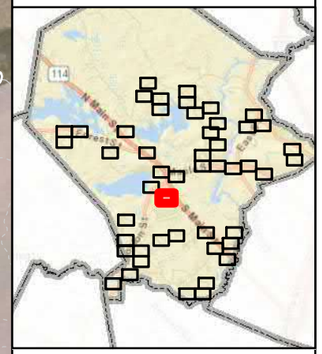
- Index
- Intermediate

Protected/Recreational

- Recreation

1 inch = 100 feet

0 50 100 Feet



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GRID MAP

56

Legend

- BMP - Infiltration Basin
- Stormwater Outfall
- Approximate Drainage Area

DEP Wetlands

- Wetland Limit
- Wooded Marsh

2-ft Contours

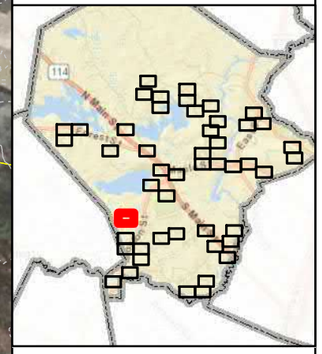
- Index
- Intermediate

Protected/Recreational

- Conservation
- Surface Water ZONE B
- Older Residential Street

1 inch = 100 feet

0 50 100 Feet



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GRID MAP

58

Legend

- Stormwater Outfall
- Sanitary Discharge
- Approximate Drainage Area

DEP Wetlands

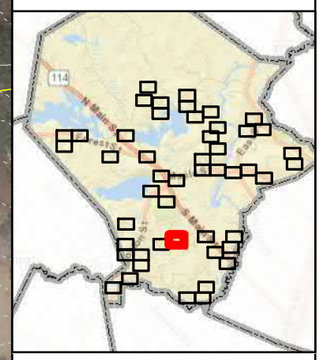
- Shoreline
- Hydrologic Connection
- Wetland Limit
- Wooded Marsh
- Open Water

2-ft Contours

- Index
- Intermediate
- Older Residential Street

1 inch = 100 feet

0 50 100 Feet



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GRID MAP

59

Legend

- BMP - Infiltration Basin
- Stormwater Outfall
- Approximate Drainage Area

DEP Wetlands

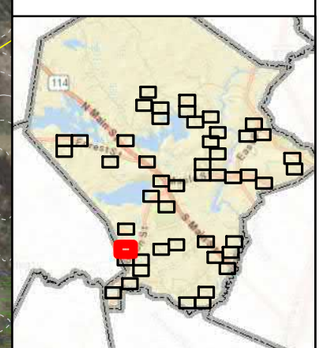
- Shoreline
- Hydrologic Connection
- Wetland Limit
- Closure Line
- Marsh/Bog
- Wooded Marsh
- Open Water

2-ft Contours

- Index
- Intermediate
- Older Residential Street

1 inch = 100 feet

0 50 100 Feet



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GRID MAP

61

Legend

- Stormwater Outfall
- Approximate Drainage Area

DEP Wetlands

- Hydrologic Connection
- Wetland Limit
- Wooded Marsh

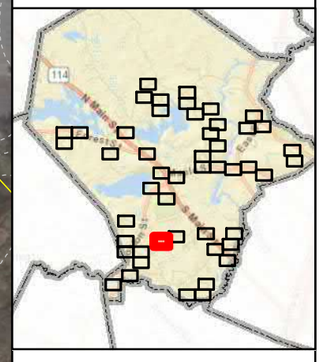
2-ft Contours

- Index
- Intermediate
- Older Residential Street

GALEUCIA ROAD
TYLER LANE
STONEY BROOK LANE
OLD HASWELL PARK ROAD
61-1

1 inch = 100 feet

0 50 100 Feet



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GRID MAP

62

62-3

62-2

62-1

CABRAL DRIVE

WILDWOOD ROAD

BOSTON STREET

NORTH READING

Greenmeadow Drive Conservation Area

Greenmeadow Drive Conservation Area

Legend

- Stormwater Outfall
- Approximate Drainage Area

DEP Wetlands

- Shoreline
- Wetland Limit
- Marsh/Bog
- Wooded Marsh
- Open Water

2-ft Contours

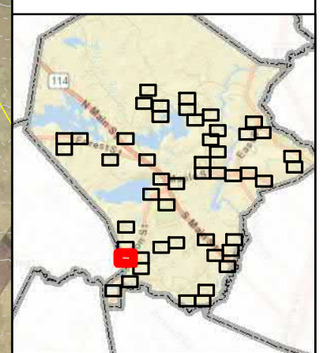
- Index
- Intermediate

Protected/Recreational

- Conservation
- Older Residential Street

1 inch = 100 feet

0 50 100 Feet



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GRID MAP

63

Legend

- Stormwater Outfall
- Approximate Drainage Area

DEP Wetlands

- Hydrologic Connection
- Wetland Limit
- Wooded Marsh

2-ft Contours

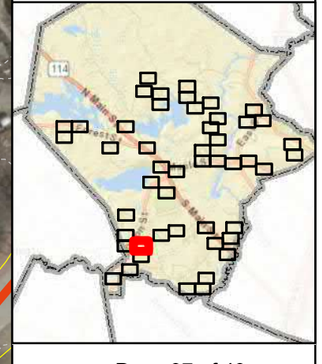
- Index
- Intermediate

- Older Residential Street

62-1
63-1
63-2
63-3
63-4
63-5
66-1
CABRAL DRIVE

1 inch = 100 feet

0 50 100 Feet



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GRID MAP

66

63-3

66-1

CABRAL DRIVE

DEROSIER DRIVE

FLINT FARM ROAD

150

170

160

190

180

90

130

100

110

120

140

Legend

- Stormwater Outfall
- Approximate Drainage Area

DEP Wetlands

- Wetland Limit
- Wooded Marsh

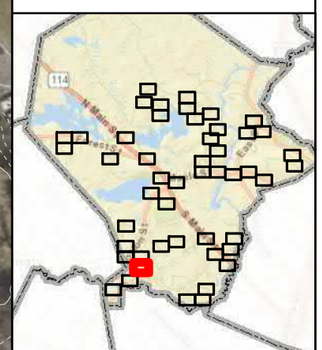
2-ft Contours

- Index
- Intermediate

- Older Residential Street

1 inch = 100 feet

0 50 100 Feet



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GRID MAP

68

Legend

- Stormwater Outfall

2014 Impaired Waters 303d

- 5 - Impaired TMDL req'd
- Approximate Drainage Area

DEP Wetlands

- Shoreline
- Hydrologic Connection
- Wetland Limit
- Closure Line
- Marsh/Bog
- Wooded Marsh
- Open Water

2-ft Contours

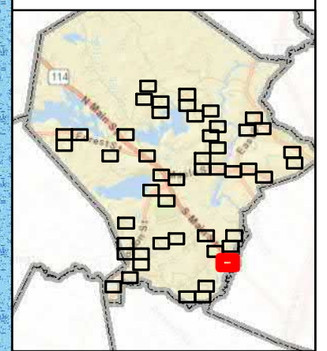
- Index
- Intermediate

Protected/Recreational

- Conservation
- Recreation
- Water Supply

1 inch = 100 feet

0 50 100 Feet



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GRID MAP

71

Legend

- BMP - Infiltration Basin

2014 Impaired Waters 303d

- 5 - Impaired TMDL req'd

DEP Wetlands

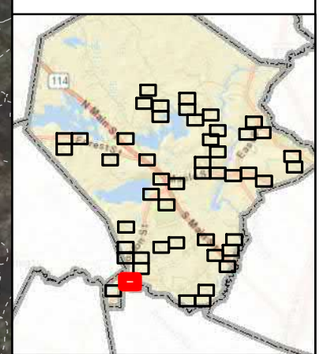
- Shoreline
- Hydrologic Connection
- Wetland Limit
- Wooded Marsh
- Open Water

2-ft Contours

- Index
- Intermediate
- Older Residential Street

1 inch = 100 feet

0 50 100 Feet



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GRID MAP

77

Legend

- BMP - Infiltration Basin
- Stormwater Conveyances
- Registered Compost Sites
- Landfills

2014 Impaired Waters 303d

- 5 - Impaired TMDL req'd
- Approximate Drainage Area

DEP Wetlands

- Shoreline
- Wetland Limit
- Closure Line
- Wooded Marsh
- Open Water

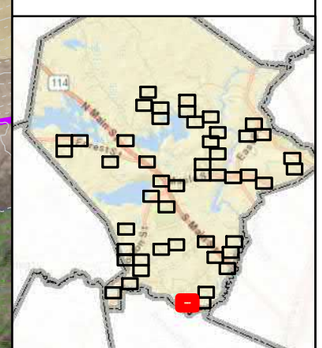
2-ft Contours

- Index
- Intermediate

Older Residential Street

1 inch = 100 feet

0 50 100 Feet



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GRID MAP

78

Legend

- BMP - Infiltration Basin
- Stormwater Outfall
- Stormwater Conveyances
- Registered Compost Sites
- Small Transfer Stations
- Landfills

2014 Impaired Waters 303d

- 5 - Impaired TMDL req'd
- Approximate Drainage Area

DEP Wetlands

- Shoreline
- Wetland Limit
- Marsh/Bog
- Wooded Marsh
- Open Water

2-ft Contours

- Index
- Intermediate

Protected/Recreational

- Conservation

1 inch = 100 feet

0 50 100 Feet

Natsue Way Conservation Area

78-1

78-2

77-1

77-2

MIDDLETON COMPOST SITE

MIDDLETON LANDFILL

MIDDLETON TRANSFER STATION

Buxton Rd Land

DANVERS

PEABODY

C:\Work\60632631MID\Maps\Grid.mxd

GRID MAP

79

Legend

DEP Wetlands

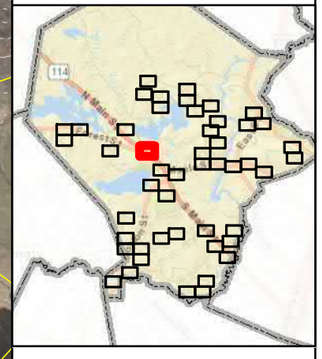
- Hydrologic Connection
- Wetland Limit
- Wooded Marsh

2-ft Contours

- Index
- Intermediate

1 inch = 100 feet

0 50 100 Feet



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GRID MAP

80

Legend

- DEP BWP Major Facilities

DEP Wetlands

- Wetland Limit
- Closure Line
- Marsh/Bog
- Wooded Marsh

2-ft Contours

- Index
- Intermediate

MIDDLETON AEROSPACE CORPORATION

CAR WASH

SOUTH MAIN STREET

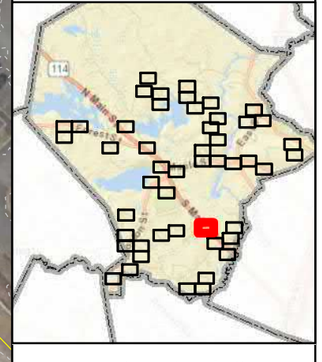
PARK AVENUE

FORMS WAY

RUNDLETT WAY

1 inch = 100 feet

0 50 100 Feet



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GRID MAP

81

Legend

- Landfills
- Approximate Drainage Area

DEP Wetlands

- Shoreline
- Hydrologic Connection
- Wetland Limit
- Marsh/Bog
- Wooded Marsh
- Open Water

2-ft Contours

- Index
- Intermediate

Protected/Recreational

- Conservation

1 inch = 100 feet

0 50 100 Feet

NATSUE WAY

AJOOTIAN WAY

INDUSTRIAL AREA

MIDDLETON LANDFILL

Natsue Way Conservation Area

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GRID MAP

82

Legend

DEP BWP Major Facilities

2014 Impaired Waters 303d

5 - Impaired TMDL req'd

DEP Wetlands

Shoreline

Hydrologic Connection

Wetland Limit

Marsh/Bog

Wooded Marsh

Open Water

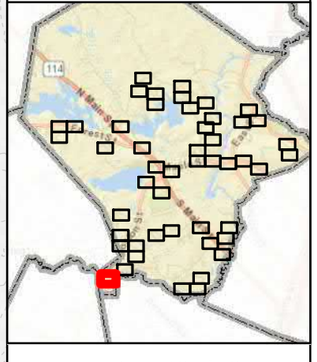
2-ft Contours

Index

Intermediate

1 inch = 100 feet

0 50 100 Feet



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GRID MAP

83

Legend

DEP Wetlands

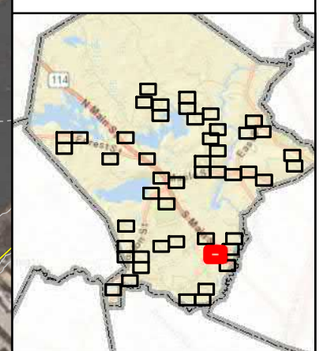
- Shoreline
- Hydrologic Connection
- Open Water

2-ft Contours

- Index
- Intermediate

1 inch = 100 feet

0 50 100 Feet



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GRID MAP

84

Legend

2014 Impaired Waters 303d

5 - Impaired TMDL req'd

DEP Wetlands

Shoreline

Wetland Limit

Closure Line

Marsh/Bog

Wooded Marsh

Open Water

2-ft Contours

Index

Intermediate

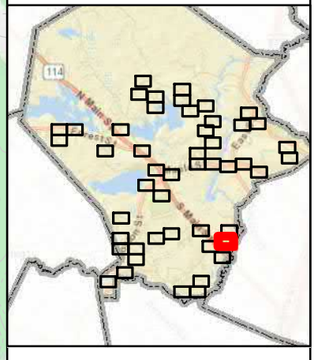
Protected/Recreational

Conservation

Recreation

1 inch = 100 feet

0 50 100 Feet



INDUSTRIAL AREA

Bruley Conservation Area

DANVERS

Bruleys Corner

LOG BRIDGE ROAD

Ipswich River MA92-06

SOUTH MAIN STREET

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GRID MAP

85

Danvers Fish and Game Club

Danvers Fish and Game Club

Danvers Fish and Game Club

West Street Conservation Area

BIRCH ROAD

INDUSTRIAL AREA

BIXBY AVENUE

LOG BRIDGE ROAD

Legend

2014 Impaired Waters 303d

- 5 - Impaired TMDL req'd

DEP Wetlands

- Shoreline
- Hydrologic Connection
- Wetland Limit
- Closure Line
- Marsh/Bog
- Wooded Marsh
- Open Water

2-ft Contours

- Index
- Intermediate

Protected/Recreational

- Conservation
- Recreation

1 inch = 100 feet

0 50 100 Feet

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Appendix C

Field Forms and Inspection SOPs

SOP 1: DRY WEATHER OUTFALL INSPECTION

Introduction

Outfalls from an engineered storm drain system can be in the form of pipes or ditches. Under current and pending regulations, it is important to inspect and document water quality from these outfalls under both dry weather and wet weather conditions. SOP 2, "Wet Weather Outfall Inspection", covers the objectives of that type of inspection. This SOP discusses the dry weather inspection objectives, and how they differ from wet weather inspection objectives.

During a dry weather period, it is anticipated that minimal flow from stormwater outfalls will be observed. Therefore, dry weather inspections aim to characterize any/all flow observed during a dry weather period and identify potential source(s) of an illicit discharge through qualitative testing; further described in SOP 13, "Water Quality Screening in the Field".

Objectives of Dry Weather Inspections

A dry weather period is a time interval during which less than 0.1 inch of rain is observed across a minimum of 72 hours. Unlike wet weather sampling, dry weather inspections are not intended to capture a "first flush" of stormwater discharge, rather they are intended to identify any/all discharges from a stormwater outfall during a period without recorded rainfall. The objective of inspections during a dry weather period is to characterize observed discharges and facilitate detection of illicit discharges.

Visual Condition Assessment

The attached Dry Weather Outfall Inspection Survey is a tool to assist in documenting observations related to the both quantitative and qualitative characteristics of any/all flows conveyed by the structure during a dry period.

For any visual observation of pollution in a stormwater outfall discharge, an investigation into the pollution source should occur, but the following are often true:

1. Foam: indicator of upstream vehicle washing activities, or an illicit discharge.
2. Oil sheen: result of a leak or spill.
3. Cloudiness: indicator of suspended solids such as dust, ash, powdered chemicals and ground up materials.
4. Color or odor: Indicator of raw materials, chemicals, or sewage.
5. Excessive sediment: indicator or disturbed earth of other unpaved areas lacking adequate erosion control measures.
6. Sanitary waste and optical enhancers (fluorescent dyes added to laundry detergent and some toilet paper): indicators of illicit discharge.
7. Orange staining: indicator of high mineral concentrations.

Many of these observations are indicators of an illicit discharge. Examples of illicit discharges include: cross-connections of sewer services to engineered storm drain systems; leaking septic systems; intentional discharge of pollutants to catch basins; combined sewer overflows; connected floor drains; and sump pumps connected to the system (under some circumstances). Additional guidelines for illicit discharge investigations are included in SOP 10, "Locating Illicit Discharges".

The Wet Weather Outfall Inspection Survey includes fields where these and other specific observations can be noted. The inspector shall indicate the presence of a specific water quality indicator or parameter by marking "Yes". If "Yes" is marked, provide additional details in the comments section. If the indictor in question is not present mark "No".

Within the comments section, provide additional information with regard to recorded precipitation totals, or more detailed descriptions of observations made during the inspection and corrective actions taken.

Conditional and Qualitative Considerations

Although many of the parameters listed above are considered to be indicators of illicit discharge, the presence of a parameter is not absolute evidence of an illicit discharge.

Some of these indicators may occur naturally. Orange staining may be the result of naturally occurring iron, and therefore unrelated to pollution. Foam can be formed when the physical characteristics of water are altered by the presence of organic materials. Foam is typically found in waters with high organic content such as bog lakes, streams that originate from bog lakes, productive lakes, wetlands, or woody areas. To determine the difference between natural foam and foam cause by pollution, consider the following:

1. Wind direction or turbulence: natural foam occurrences on the beach coincide with onshore winds. Often, foam can be found along a shoreline and/or on open waters during windy days. Natural occurrences in rivers can be found downstream of a turbulent site.
2. Proximity to a potential pollution source: some entities including the textile industry, paper production facilities, oil industries, and fire fighting activities work with materials that cause foaming in water. If these materials are released to a water body in large quantities, they can cause foaming. Also, the presence of silt in water, such as from a construction site can cause foam.
3. Feeling: natural foam is typically persistent, light, not slimy to the touch.
4. Presence of decomposing plants or organic material in the water.

Some of the indicators can have multiple causes or sources. For example, both bacteria and petroleum can create a sheen on the water surface. The source of the sheen can be differentiated by disturbing it, such as with a pole. A sheen caused by oil will remain intact and move in a swirl pattern; a sheen caused by bacteria will separate and appear "blocky". Bacterial or naturally occurring sheens are usually silver or relatively dull in color and will break up into a number of small patches of sheen. The cause may be

presence of iron, decomposition of organic material or presence of certain bacteria. Bacterial sheen is not a pollutant but should be noted.

Optical enhancers at high concentrations are sometimes visible to the naked eye as a bluish-purple haze in the water. However, due to physiological variation of the human eye, not all inspectors may be able to identify the presence of these materials, and quantitative testing is the preferred method to confirm the presence of these compounds. Optical enhancers are typically detected through the use of clean, white cotton pads placed within the discharge for several days, dried, and viewed under a fluorometer. If the cotton pad fluoresces, optical enhancers are assumed to be present. The magnitude of the fluorescence, as measured in fluorescent units, can be used to correlate the concentration of optical enhancers in water to other samples collected locally.

Measuring Water Quality

Based on the results of the Visual Condition Assessment, it may be necessary to collect additional data about water quality. Water quality samples can be in the form of screening using field test kits and instrumentation, or by discrete analytical samples processed by a laboratory.

Information on selecting and using field test kits and instrumentation is included in SOP 13, "Water Quality Screening in the Field." The Inspection Survey also provides values for what can be considered an appropriate benchmark for a variety of parameters that can be evaluated in the field.

If the results of screening using field test kits indicate that the outfall's water quality exceeds the benchmarks provided, collection of discrete analytical samples should be considered.

Analytical Sample Collection

Sample collection methods may vary based on specific outfall limitations, but shall follow test procedures outlined in 40 CFR 136. A discrete manual or grab sample can classify water at a distinct point in time. These samples are easily collected and used primarily when the water quality of the discharge is expected to be homogeneous, or unchanging, in nature. A flow-weighted composite sample will classify water quality over a measured period of time. These samples are used when the water quality of the discharge is expected to be heterogeneous, or fluctuating, in nature. Grab samples are more common for dry weather outfall inspections due to the time-sensitive nature of the process.

Protocols for collecting a grab sample shall include the following:

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. Always wear clean, powder-free nitrile gloves when handling sample containers and lids.
5. Never touch the inside surface of a sample container or lid, even with gloved hands.

6. Never allow the inner surface of a sample container or lid to be contacted by any material other than the sample water.
7. Collect samples while facing upstream and so as not to disturb water or sediments in the outfall pipe or ditch.
8. 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.
9. Slowly lower the bottle into the water to avoid bottom disturbance and stirring up sediment.
10. Do not allow any object or material to fall into or contact the collected water sample.
11. Do not allow rainwater to drip from rain gear or other surfaces into sample containers.
12. Replace and tighten sample container lids immediately after sample collection.
13. Accurately label the sample with the time and location.
14. Document on the Wet Weather Outfall Inspection Survey that analytical samples were collected, specify parameters, and note the sample time on the Inspection Survey. This creates a reference point for samples.

Analytical Sample Quality Control and Assurance

Upon completion of successful sample collection, the samples must be sent or delivered to a MassDEP-approved laboratory for analytical testing. Quality control and assurance are important to ensuring accurate analytical test results.

Sample preservation is required to prevent contaminate degradation between sampling and analysis, and should be completed in accordance with 40 CFR 136.3.

Maximum acceptable holding times are also specified for each analytical method in 40 CFR 136.3. Holding time is defined as the period of time between sample collection and extraction for analysis of the sample at the laboratory. Holding time is important because prompt laboratory analysis allows the laboratory to review the data and if analytical problems are found, re-analyze the affected samples within the holding times.

Chain of custody forms are designed to provide sample submittal information and document transfers of sample custody. The forms are typically provided by the laboratory and must be completed by the field sampling personnel for each sample submitted to the lab for analysis. The document must be signed by both the person releasing the sample and the person receiving the sample every time the sample changes hands. The sampling personnel shall keep one copy of the form and send the remaining copies to the laboratory with the samples. Custody seals, which are dated, signed and affixed to the sample container, may be used if the samples are shipped in a cooler via courier or commercial overnight shipping.

Attachments

1. Dry Weather Outfall Inspection Survey

Related Standard Operating Procedures

1. SOP 2, Wet Weather Outfall Inspection
2. SOP 10, Locating Illicit Discharges
3. SOP 13, Water Quality Screening in the Field

Outfall ID: _____ **Town:** _____

Inspector: _____ **Date:** _____

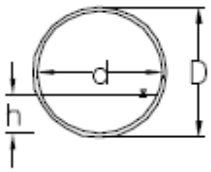
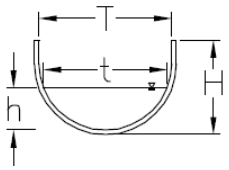
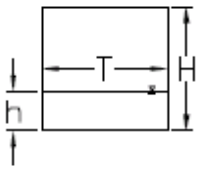
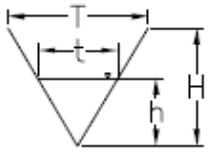
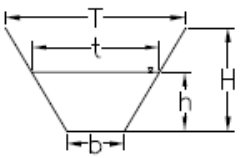
Street Name _____

Last rainfall event _____

DRY WEATHER OUTFALL INSPECTION SURVEY

Type of Outfall (check one):		**Pipe Outfall** ☐	**Open Swale Outfall** ☐
Outfall Label:	**Stencil** ☐ **Ground Inset** ☐ **Sign** ☐ **None** ☐ **Other**_____		
Pipe Material:	Concrete ☐ Corrugated metal ☐ Clay Tile ☐ Plastic ☐ Other: _____ ☐	**Pipe Condition:**	Good ☐ Poor ☐ Fair ☐ Crumbling ☐
Swale Material:	Paved (asphalt) ☐ Concrete ☐ Earthen ☐ Stone ☐ Other: _____ ☐	**Swale Condition:**	Good ☐ Poor ☐ Fair ☐ Crumbling ☐

Shape of Pipe/Swale (check one)

 ☐  ☐	 ☐	 ☐	 ☐
Rounded Pipe/Swale	**Rectangular Pipe/Swale**	**Triangular Swale**	**Trapezoidal Swale**

Pipe Measurements: Inner Dia. (in): d= _____ Outer Dia. (in): D= _____ Pipe Width (in): T= _____ Pipe Height (in): H= _____ Flow Width (in): h= _____*	**Swale Measurements:** Swale Width (in): T= _____ Flow Width (in): t = _____ Swale Height (in): H= _____ Flow Height (in): h= _____* Bottom Width (in): b=_____	**Is there a headwall?** Yes ☐ No ☐ **Condition:** Good ☐ Poor ☐ Fair ☐ Crumbling ☐	**Location Sketch**

Description of Flow: Heavy ☐ Moderate ☐ Trickling ☐ Dry ☐

If the outlet is submerged check yes and indicate approximate height of water above the outlet invert. h above invert (in):	**Circle All Materials Present:**
Odor: Yes ☐ No ☐ **Optical enhancers suspected?** Yes ☐ No ☐ **Has channelization occurred?** Yes ☐ No ☐ **Has scouring occurred below the outlet?** Yes ☐ No ☐	Rip rap Excessive sediment Foam Sanitary Waste Orange Staining Sheen: Bacterial Sheen: Petroleum Floatables Algae Excessive Vegetation
Required Maintenance: Tree Work ☐ Remove Trash/Debris ☐ Ditch Work ☐ Blocked Pipe ☐ Structural Corrosion ☐ Erosion at Structure ☐ N/A ☐ Other ☐	
Comments:	

OUTFALL INSPECTION FORM

OUTFALL RECONNAISSANCE INVENTORY/ SAMPLE COLLECTION FIELD SHEET

Section 1: Background Data

Subwatershed:		Outfall ID:	
Today's date:		Time (Military):	
Investigators:		Form completed by:	
Temperature (°F):	Rainfall (in.): Last 24 hours:	Last 48 hours:	
Latitude:	Longitude:	GPS Unit:	GPS LMK #:
Camera:		Photo #s:	

Land Use in Drainage Area (Check all that apply):

☐ Industrial ☐ Ultra-Urban Residential ☐ Commercial ☐ Open Space ☐ Suburban Residential ☐ Institutional

Other: _____ Known Industries: _____

Notes (e.g., origin of outfall, if known):

Section 2: Outfall Description

LOCATION	MATERIAL	SHAPE	DIMENSIONS (IN.)	SUBMERGED
	☐ RCP ☐ CMP	☐ Circular ☐ Single	Diameter, circular: _____	In Water: ☐ No ☐ Partially* ☐ Fully*
☐ Closed Pipe	☐ PVC ☐ HDPE	☐ Elliptical ☐ Double	Box: h - _____ w - _____	
☐ Manhole	☐ Steel	☐ Box ☐ Triple	Elliptical: h - _____ w - _____	With Sediment: ☐ No ☐ Partially ☐ Fully
	☐ Other: _____	☐ Other: _____ ☐ Other: _____		
	☐ Concrete ☐ rip-rap ☐ Earthen	☐ Trapezoid ☐ Other: _____	Depth: _____	Bottom Width: _____
☐ Open drainage	☐ Other: _____	☐ Parabolic	Top Width: _____	
☐ In-Stream	Complete Stream Discharge form			

Flow Present? ☐ Yes ☐ No *If No, Skip to Section 5* Flow Description ☐ Trickle ☐ Moderate ☐ Substantial

*Tidal? ☐ Yes ☐ No If yes, *stage* ☐ Flood ☐ Ebb Time:

Section 3: Quantitative Characterization

FIELD DATA FOR FLOWING OUTFALLS				
PARAMETER		RESULT	UNIT	EQUIPMENT
☐Flow #1	Volume		Liter	Bottle
	Time to fill		Sec	Stopwatch
☐Flow #2	Flow depth		In	Tape measure
(only for free-flowing outfalls)	Wetted width		ft	Tape measure
☐Flow #3	Flow width	_____' _____"	Ft, In	Tape measure
	Flow depth		In	Tape measure
	Time of travel (avg)	1._____ 2._____ 3._____	Sec	Stop watch
	Measured length	_____' _____"	Ft, In	Tape measure
Ammonia			mg/L	Specific ion probe Type:

Outfall Reconnaissance Inventory Field Sheet

Section 4: Physical Indicators for Flowing Outfalls Only

Are Any Physical Indicators Present in the flow? ☐ Yes ☐ No *(If No, Skip to Section 5)*

INDICATOR	CHECK if Present	DESCRIPTION	RELATIVE SEVERITY INDEX (1-3)		
Odor	☐	☐ Sewage ☐ Rancid/sour ☐ Petroleum/gas ☐ Sulfide ☐ Other:	☐ 1 – Faint	☐ 2 – Easily detected	☐ 3 – Noticeable from a distance
Color	☐	☐ Clear ☐ Brown ☐ Gray ☐ Yellow ☐ Green ☐ Orange ☐ Red ☐ Other:	☐ 1 – Faint colors in sample bottle	☐ 2 – Clearly visible in sample bottle	☐ 3 – Clearly visible in outfall flow
Turbidity	☐	See severity	☐ 1 – Slight cloudiness	☐ 2 – Cloudy	☐ 3 – Opaque
Floatables -Does Not Include Trash!!	☐	☐ Sewage (Toilet Paper, etc.) ☐ Suds ☐ Petroleum (oil sheen) ☐ Other:	☐ 1 – Few/slight; origin not obvious	☐ 2 – Some; indications of origin (e.g., possible suds or oil sheen)	☐ 3 - Some; origin clear (e.g., obvious oil sheen, suds, or floating sanitary materials)

Section 5: Physical Indicators for Both Flowing and Non-Flowing Outfalls

Are physical indicators that are not related to flow present? ☐ Yes ☐ No *(If No, Skip to Section 6)*

INDICATOR	CHECK if Present	DESCRIPTION	COMMENTS
Outfall Damage	☐	☐ Spalling, Cracking or Chipping ☐ Peeling Paint ☐ Corrosion	
Deposits/Stains	☐	☐ Oily ☐ Flow Line ☐ Paint ☐ Other:	
Abnormal Vegetation	☐	☐ Excessive ☐ Inhibited	
Poor pool quality	☐	☐ Odors ☐ Colors ☐ Floatables ☐ Oil Sheen ☐ Suds ☐ Excessive Algae ☐ Other:	
Pipe benthic growth	☐	☐ Brown ☐ Orange ☐ Green ☐ Other:	

Section 6: Overall Outfall Characterization

☐ Unlikely ☐ Potential (presence of two or more indicators) ☐ Suspect (one or more indicators with a severity of 3) ☐ Obvious

Section 7: Data Collection

1.	Sample for external lab?	☐ Yes	☐ No	2.	Sample for CWP?	☐ Yes	☐ No	3.	Sterile sample for bacteria analysis?	☐ Yes ☐ No
4.	Sample(s) collected from:	☐ Flow	☐ Pool							
5.	Duplicate collected?	☐ Yes	☐ No	*If yes, check appropriate:*		☐ External lab	☐ CWP	☐ Sterile		

Section 8: Any Non-Illicit Discharge Concerns (e.g., trash or needed infrastructure repairs) or other Notes?

SOP 2: WET WEATHER OUTFALL INSPECTION

Introduction

Outfalls from an engineered storm drain system can be in the form of pipes or ditches. Under current and pending regulations, it is important to inspect and document water quality from these outfalls under both dry weather and wet weather conditions. SOP 1, "Dry Weather Outfall Inspection", covers the objectives of that type of inspection. This SOP discusses wet weather inspection objectives and how they differ from dry weather inspection objectives. The primary difference is that wet weather inspection aims to describe and evaluate the first flush of stormwater discharged from an outfall during a storm, representing the maximum pollutant load managed by receiving water.

Definition of Wet Weather

A storm is considered a representative wet weather event if greater than 0.1 inch of rain falls and occurs at least 72 hours after the previously measurable (greater than 0.1 inch of rainfall) storm event. In some watersheds, based on the amount of impervious surface present, increased discharge from an outfall may not result from 0.1 inch of rain. An understanding of how outfalls respond to different events will develop as the inspection process proceeds over several months, allowing the inspectors to refine an approach for inspections.

Ideally, the evaluation and any samples collected should occur within the first 30 minutes of discharge to reflect the first flush or maximum pollutant load.

Typical practice is to prepare for a wet weather inspection event when weather forecasts show a 40% chance of rain or greater. If the inspector intends to collect analytical samples, coordination with the laboratory for bottleware and for sample drop-off needs to occur in advance.

Visual Condition Assessment

The attached Wet Weather Outfall Inspection Survey should be used to document observations related to the quality of stormwater conveyed by the structure. Observations such as the following can indicate sources of pollution within the storm drain system:

- Oil sheen
- Discoloration
- Trash and debris

For any visual observation of pollution in a stormwater outfall discharge, an investigation into the pollution source should occur, but the following are often true:

1. Foam: indicator of upstream vehicle washing activities, or an illicit discharge.
2. Oil sheen: result of a leak or spill.

3. Cloudiness: indicator of suspended solids such as dust, ash, powdered chemicals and ground up materials.
4. Color or odor: Indicator of raw materials, chemicals, or sewage.
5. Excessive sediment: indicator or disturbed earth of other unpaved areas lacking adequate erosion control measures.
6. Sanitary waste and optical enhancers (fluorescent dyes added to laundry detergent and some toilet paper): indicators of illicit discharge.
7. Orange staining: indicator of high mineral concentrations.

Many of these observations are indicators of an illicit discharge. Examples of illicit discharges include: cross-connections of sewer services to engineered storm drain systems; leaking septic systems; intentional discharge of pollutants to catch basins; combined sewer overflows; connected floor drains; and sump pumps connected to the system (under some circumstances). Additional guidelines for illicit discharge investigations are included in SOP 10, "Locating Illicit Discharges".

The Wet Weather Outfall Inspection Survey includes fields where these and other specific observations can be noted. The inspector shall indicate the presence of a specific water quality indicator or parameter by marking "Yes". If "Yes" is marked, provide additional details in the comments section. If the indictor in question is not present mark "No".

Within the comments section, provide additional information with regard to recorded precipitation totals, or more detailed descriptions of observations made during the inspection and corrective actions taken.

Conditional and Qualitative Considerations

Although many of the parameters listed above are considered to be indicators of illicit discharge, the presence of a parameter is not absolute evidence of an illicit discharge.

Some of these indicators may occur naturally. Orange staining may be the result of naturally occurring iron, and therefore unrelated to pollution. Foam can be formed when the physical characteristics of water are altered by the presence of organic materials. Foam is typically found in waters with high organic content such as bog lakes, streams that originate from bog lakes, productive lakes, wetlands, or woody areas. To determine the difference between natural foam and foam cause by pollution, consider the following:

1. Wind direction or turbulence: natural foam occurrences on the beach coincide with onshore winds. Often, foam can be found along a shoreline and/or on open waters during windy days. Natural occurrences in rivers can be found downstream of a turbulent site.
2. Proximity to a potential pollution source: some entities including the textile industry, paper production facilities, oil industries, and fire fighting activities work with materials that cause foaming in water. If these materials are released to a water body in large quantities, they can cause foaming. Also, the presence of silt in water, such as from a construction site can cause foam.
3. Feeling: natural foam is typically persistent, light, not slimy to the touch.

4. Presence of decomposing plants or organic material in the water.

Some of the indicators can have multiple causes or sources. For example, both bacteria and petroleum can create a sheen on the water surface. The source of the sheen can be differentiated by disturbing it, such as with a pole. A sheen caused by oil will remain intact and move in a swirl pattern; a sheen caused by bacteria will separate and appear "blocky". Bacterial or naturally occurring sheens are usually silver or relatively dull in color and will break up into a number of small patches of sheen. The cause may be presence of iron, decomposition of organic material or presence of certain bacteria. Bacterial sheen is not a pollutant but should be noted.

Optical enhancers at high concentrations are sometimes visible to the naked eye as a bluish-purple haze in the water. However, due to physiological variation of the human eye, not all inspectors may be able to identify the presence of these materials, and quantitative testing is the preferred method to confirm the presence of these compounds. Optical enhancers are typically detected through the use of clean, white cotton pads placed within the discharge for several days, dried, and viewed under a fluorometer. If the cotton pad fluoresces, optical enhancers are assumed to be present. The magnitude of the fluorescence, as measured in fluorescent units, can be used to correlate the concentration of optical enhancers in water to other samples collected locally.

Measuring Water Quality

Based on the results of the Visual Condition Assessment, it may be necessary to collect additional data about water quality. Water quality samples can be in the form of screening using field test kits or by discrete analytical samples processed by a laboratory.

Information on how to use field test kits is included in SOP 13, "Water Quality Screening with Field Test Kits", and the Wet Weather Outfall Inspection Survey includes fields to document the results of such screening. The Inspection Survey also provides values for what can be considered an appropriate benchmark for a variety of parameters that can be evaluated with field test kits.

If the results of screening using field test kits indicate that the outfall's water quality exceeds the benchmarks provided, collection of discrete analytical samples should be considered.

Analytical Sample Collection

Sample collection methods may vary based on specific outfall limitations but shall follow test procedures outlined in 40 CFR 136. A discrete manual or grab sample can classify water at a distinct point in time. These samples are easily collected and used primarily when the water quality of the discharge is expected to be homogeneous, or unchanging, in nature. A flow-weighted composite sample will classify water quality over a measured period of time. These samples are used when the water quality of the discharge is expected to be heterogeneous, or fluctuating, in nature. Grab samples are more common for wet weather outfall inspections due to the time-sensitive nature of the process.

Protocols for collecting a grab sample shall include the following:

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. Always wear clean, powder-free nitrile gloves when handling sample containers and lids.
5. Never touch the inside surface of a sample container or lid, even with gloved hands.
6. Never allow the inner surface of a sample container or lid to be contacted by any material other than the sample water.
7. Collect samples while facing upstream and so as not to disturb water or sediments in the outfall pipe or ditch.
8. 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.
9. Slowly lower the bottle into the water to avoid bottom disturbance and stirring up sediment.
10. Do not allow any object or material to fall into or contact the collected water sample.
11. Do not allow rainwater to drip from rain gear or other surfaces into sample containers.
12. Replace and tighten sample container lids immediately after sample collection.
13. Accurately label the sample with the time and location.
14. Document on the Wet Weather Outfall Inspection Survey that analytical samples were collected, specify parameters, and note the sample time on the Inspection Survey. This creates a reference point for samples.

Analytical Sample Quality Control and Assurance

Upon completion of successful sample collection, the samples must be sent or delivered to a MassDEP-approved laboratory for analytical testing. Quality control and assurance are important to ensuring accurate analytical test results.

Sample preservation is required to prevent contaminant degradation between sampling and analysis and should be completed in accordance with 40 CFR 136.3.

Maximum acceptable holding times are also specified for each analytical method in 40 CFR 136.3. Holding time is defined as the period of time between sample collection and extraction for analysis of the sample at the laboratory. Holding time is important because prompt laboratory analysis allows the laboratory to review the data and if analytical problems are found, re-analyze the affected samples within the holding times.

Chain of custody forms are designed to provide sample submittal information and document transfers of sample custody. The forms are typically provided by the laboratory and must be completed by the field sampling personnel for each sample submitted to the lab for analysis. The document must be signed by both the person releasing the sample and the person receiving the sample every time the sample changes hands. The sampling personnel shall keep one copy of the form and send the remaining copies to the

laboratory with the samples. Custody seals, which are dated, signed and affixed to the sample container, may be used if the samples are shipped in a cooler via courier or commercial overnight shipping.

Attachments

1. Wet Weather Outfall Inspection Survey

Related Standard Operating Procedures

1. SOP 1, Dry Weather Outfall Inspection
2. SOP 10, Locating Illicit Discharges
3. SOP 13, Water Quality Screening in the Field

Outfall I.D.: _____ **Date:** _____

Inspector: _____

Time of Inspection: _____

Street Name _____

Last rainfall event _____

WET WEATHER OUTFALL INSPECTION SURVEY

Visual Inspection:	**Yes**	**No**	**Comments (Include probable source of observed contamination):**
Color	☐	☐	
Odor	☐	☐	
Turbidity	☐	☐	
Excessive Sediment	☐	☐	
Sanitary Waste	☐	☐	
Pet Waste	☐	☐	
Floatable Solids	☐	☐	
Oil Sheen	☐	☐	
Bacterial Sheen	☐	☐	
Foam	☐	☐	
Algae	☐	☐	
Orange Staining	☐	☐	
Excessive Vegetation	☐	☐	
Optical Enhancers	☐	☐	
Other _____			

WET WEATHER OUTFALL INSPECTION SURVEY

Sample Parameters	Analytical Test Method	Benchmark	Field Screening Result	Full Analytical?
Ammonia[1]	EPA 350.2/SM4500-NH3C	>0.5 mg/L		☐ Yes ☐ No
Boron[1]	EPA 212.3	>35.0 mg/L		☐ Yes ☐ No
Chloride[2]	EPA 300.0	230 mg/L		☐ Yes ☐ No
Color[1]	EPA 110.1/110.2	>500 units		☐ Yes ☐ No
Detergents & Surfactants[3]	EPA 425.1/SM5540C	>0.25 mg/L		☐ Yes ☐ No
Fluoride[3]	EPA 300.0	>0.25 mg/L		☐ Yes ☐ No
Hardness[1]	EPA 130.2	<10 mg/L or >2,000 mg/L		☐ Yes ☐ No
pH[1]	EPA 150.1/SM 4500H	<5		☐ Yes ☐ No
Potassium[1]	EPA 200.7	>20 mg/L		☐ Yes ☐ No
Specific Conductance[1]	SM 2510B	>2,000 µS/cm		☐ Yes ☐ No
Turbidity[1]	EPA 180.1	>1,000 NTU		☐ Yes ☐ No
Comments:				

[1] – *Illicit Discharge Detection and Elimination: A Guidance Manual for Program Development and Technical Assessments*, Center for Watershed Protection and Robert Pitt of University of Alabama, 2004, p. 134, Table 45.

[2] – *Env –Ws 1703.21Water Quality Criteria for Toxic Substances,* State of New Hampshire Department of Surface Water Quality Regulations.

[2] – *Appendix I – Field Measurements, Benchmarks and Instrumentation*, Draft Massachusetts North Coastal Small MS4 General Permit, 2009.

Outfall Reconnaissance Inventory/ Sample Collection Lab Sheet

Subwatershed:	Outfall ID:
Today's date:	Duplicate? (yes/no):
Analysis Technician:	Form completed by:

LAB DATA FOR FLOWING OUTFALLS

PARAMETER	**RESULT**		**UNIT**	**EQUIPMENT**
Ammonia QC check (10% of samples)			mg/L	Colorimeter
Fluoride			mg/L	Specific ion probe
Potassium			ppm	Compact Ion Meter
Conductivity			µs	Conductivity Meter
Bacteria	***Count***	***Dilution (1:1 or 1:100)***		
Red w/ gas			CFUs	Petrifilm plate
Blue w/ gas			CFUs	Petrifilm plate

MANHOLE INSPECTION LOG

Manhole ID No. _____

Inspection Date: _____ Tributary Area:_____

Street: _____ Manhole Type:

Inspection: Not Found ____ Surface ____ Internal ____ Storm Drain _____

Follow Up Inspection _____ High Outlet _____ Lovejoy _____

Time Since Last Rain:

Inspector: _____ < 48 hours _____ 48 – 72 hours _____ > 72 hours _____

Observations:

Standing Water in Manhole: Yes ____ No ____ Color of Water: Clear ____ Cloudy ____ Other _____

Flow in Manhole: Yes _____ No _____ Velocity: Slow _____ Medium _____ Fast _____ Depth of Flow: _____ in.

Color of Flow: No Flow: _____ Clear _____ Cloudy _____ Suspended Solids _____ Other _____

Blockages: Yes _____ No _____ Sediment in Manhole: Yes ____ No____ If Yes: Percent of Pipe Filled: _____ %

Floatables: None _____ Sewage _____ Oily Sheen _____ Foam _____ Other _____

Odor: None _____ Sewage _____ Oil _____ Soap _____Other _____

Field Testing:

pH _____ Temp _____ Spec. Cond. _____ Surfactants: Yes _____ No __ Ammonia: Yes _____ No __

Contamination:

Found During Inspection Yes __ Check one: __Observation __Positive Test Kit Result

No __ Sandbagged Placed No __ Yes ____ Give Date _____

Sandbag Checked (Date): _____ and Flow was __ Captured __ Not Captured:

If Flow Captured, Check one: Visual Evidence Test Kit Positive Test Kit Negative (Not Contaminated)

Condition of Manhole:

Grade: At _____ Above_____ Below _____

Common Manholes:

High Outlet: Blocked Yes ___ No ___ NA ___

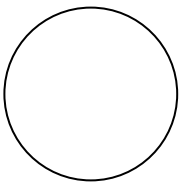
Lovejoy: Cover Plate in Place Yes ___ No ___ NA ___

	Good	Fair	Poor	Comments
Pavement	_____	_____	_____	_____
Cover	_____	_____	_____	_____
Frame	_____	_____	_____	_____
Corbel	_____	_____	_____	_____
Walls	_____	_____	_____	_____
Floor	_____	_____	_____	_____

Construction Material:

	Brick	Precast	Other
Corbel	____	_____	_____
Walls	____	_____	_____
Floor	____	_____	_____

Comments: Manhole Correct as Mapped Yes _____ No _____ **N↑**



Plan of Manhole

Continue on back if necessary

SOP 3: CATCH BASIN INSPECTION AND CLEANING

Introduction

Catch basins help minimize flooding and protect water quality by removing trash, sediment, decaying debris, and other solids from stormwater runoff. These materials are retained in a sump below the invert of the outlet pipe. Catch basin cleaning reduces foul odors, prevents clogs in the storm drain system, and reduces the loading of suspended solids, nutrients, and bacteria to receiving waters.

During regular cleaning and inspection procedures, data can be gathered related to the condition of the physical basin structure and its frame and grate and the quality of stormwater conveyed by the structure. Observations such as the following can indicate sources of pollution within the storm drain system:

- Oil sheen
- Discoloration
- Trash and debris

Both bacteria and petroleum can create a sheen on the water surface. The source of the sheen can be differentiated by disturbing it, such as with a pole. A sheen caused by a oil will remain intact and move in a swirl pattern; a sheen caused by bacteria will separate and appear "blocky". Bacterial sheen is not a pollutant but should be noted.

Observations such as the following can indicate a potential connection of a sanitary sewer to the storm drain system, which is an illicit discharge.

- Indications of sanitary sewage, including fecal matter or sewage odors
- Foaming, such as from detergent
- Optical enhancers, fluorescent dye added to laundry detergent

Each catch basin should be cleaned and inspected at least annually. Catch basins in high-use areas may require more frequent cleaning. Performing street sweeping on an appropriate schedule will reduce the amount of sediment, debris, and organic matter entering the catch basins, which will in turn reduce the frequency with which structures need to be cleaned.

Cleaning Procedure

Catch basin inspection cleaning procedures should address both the grate opening and the basin's sump. Document any and all observations about the condition of the catch basin structure and water quality on the Catch Basin Inspection Form (attached).

Catch basin inspection and cleaning procedures include the following:

1. Work upstream to downstream.
2. Clean sediment and trash off grate.
3. Visually inspect the outside of the grate.

4. Visually inspect the inside of the catch basin to determine cleaning needs.
5. Inspect catch basin for structural integrity.
6. Determine the most appropriate equipment and method for cleaning each catch basin.
    a. Manually use a shovel to remove accumulated sediments, or
    b. Use a bucket loader to remove accumulated sediments, or
    c. Use a high pressure washer to clean any remaining material out of catch basin while capturing the slurry with a vacuum.
    d. If necessary, after the catch basin is clean, use the rodder of the vacuum truck to clean downstream pipe and pull back sediment that might have entered downstream pipe.
7. If contamination is suspected, chemical analysis will be required to determine if the materials comply with the Massachusetts DEP Hazardous Waste Regulations, 310 CMR 30.000 (http://www.mass.gov/dep/service/regulations/310cmr30.pdf). Chemical analysis required will depend on suspected contaminants. Note the identification number of the catch basin on the sample label, and note sample collection on the Catch Basin Inspection Form.
8. Properly dispose of collected sediments. See following section for guidance.
9. If fluids collected during catch basin cleaning are not being handled and disposed of by a third party, dispose of these fluids to a sanitary sewer system, with permission of the system operator.
10. If illicit discharges are observed or suspected, notify the appropriate Department (see "SOP 10: Addressing Illicit Discharges").
11. At the end of each day, document location and number of catch basins cleaned, amount of waste collected, and disposal method for all screenings.
12. Report additional maintenance or repair needs to the appropriate Department.

Disposal of Screenings

Catch basin cleanings from storm water-only drainage systems may be disposed at any landfill that is permitted by MassDEP to accept solid waste. MassDEP does not routinely require stormwater-only catch basin cleanings to be tested before disposal, unless there is evidence that they have been contaminated by a spill or some other means.

Screenings may need to be placed in a drying bed to allow water to evaporate before proper disposal. In this case, ensure that the screenings are managed to prevent pollution.

Attachments

1. Catch Basin Inspection Form

Related Standard Operating Procedures

1. SOP 10, Addressing Illicit Discharges
2. SOP 13, Water Quality Screening in the Field

Job No.: _____ **Town:** _____

Inspector: _____ **Date:** _____

CATCH BASIN INSPECTION FORM

Catch Basin I.D.	_____	**Final Discharge from Structure?** Yes ☐ No ☐ **If Yes, Discharge to Outfall No:**_____	
Catch Basin Label:	**Stencil** ☐ **Ground Inset** ☐ **Sign** ☐ **None** ☐ **Other**_____		
Basin Material:	Concrete ☐ Corrugated metal ☐ Stone ☐ Brick ☐ Other: _____ ☐	**Catch Basin Condition:**	Good ☐ Poor ☐ Fair ☐ Crumbling ☐
Pipe Material:	Concrete ☐ HDPE ☐ PVC ☐ Clay Tile ☐ Other:_____	**Pipe Measurements:**	Inlet Dia. (in): d= ____ Outlet Dia. (in): D= ____

Required Maintenance/ Problems (check all that apply):

- ☐ Tree Work Required
- ☐ New Grate is Required
- ☐ Pipe is Blocked
- ☐ Frame Maintenance is Required
- ☐ Remove Accumulated Sediment
- ☐ Pipe Maintenance is Required
- ☐ Basin Undermined or Bypassed
- ☐ Cannot Remove Cover
- ☐ Ditch Work
- ☐ Corrosion at Structure
- ☐ Erosion Around Structure
- ☐ Remove Trash & Debris
- ☐ Need Cement Around Grate

Other: _____

Catch Basin Grate Type :	**Sediment Buildup Depth :**	**Description of Flow:**	**Street Name/ Structure Location:**
Bar: ☐ Cascade: ☐ Other:_____ Properly Aligned: Yes ☐ No ☐	0-6 (in): ____ 6-12(in): ____ 12-18 (in): ____ 18-24 (in): ____ 24 + (in): ____	Heavy ☐ Moderate ☐ Slight ☐ Trickling ☐	

***If the outlet is submerged check yes and indicate approximate height of water above the outlet invert.** h above invert (in):___ Yes ☐ No ☐

☐ **Flow**
☐ **Standing Water**
(check one or both)

Observations:

Color:	
Odor:	

Weather Conditions : Dry > 24 hours ☐ Wet ☐

Sample of Screenings Collected for Analysis? Yes ☐ No ☐

Comments:

Circle those present:

Foam	Oil Sheen
Sanitary Waste	Bacterial Sheen
Orange Staining	Floatables
Excessive sediment	Pet Waste
Other:_____	Optical Enhancers

Appendix D

Water Quality Analysis Instructions, User's Manuals, and Standard Operating Procedures

SOP 13: WATER QUALITY SCREENING IN THE FIELD

Introduction

Outfalls from an engineered storm drain system can be in the form of pipes or ditches. Under current and pending regulations, it is important to inspect and document water quality within the MS4 system under both dry weather and wet weather conditions. SOP 1, "Dry Weather Outfall Inspection" and SOP 2, "Wet Weather Outfall Inspection", cover the objectives of these activities and how water quality parameters can be collected during both types of inspections. SOP 3, "Catch Basin Inspection and Cleaning", describes how this operations and maintenance activity can serve as an additional opportunity to collect water quality data.

SOP 2 included detailed information on how to collect discrete analytical samples to be processed by a laboratory. In contrast, this SOP addresses screening-level measurements than can be collected at outfalls, catch basins, receiving waters, or other water bodies. The measurements can be collected with field test kits or with portable meters.

Water quality screening data collected in this manner can feed into an illicit discharge detection and elimination investigation, like the process described in SOP 10, "Locating Illicit Discharges".

Visual Condition Assessment

SOP 1, SOP 2, and SOP 3 describe a Visual Condition Assessment to collect observations related to the quality of stormwater conveyed by an engineered storm drain system. These observations may include such visual evidence and/or potential pollutants as:

- Foaming (detergents)
- Discoloration
- Evidence of sanitary waste
- Optical enhancers (fluorescent dyes added to laundry detergent); and
- Turbidity

If a Visual Condition Assessment indicates the presence of these pollutants, it may be necessary to quantify the extent of each, and gather data on other parameters that cannot be visually observed but can be measured using field kits or meters. These parameters include:

- Ammonia
- Chloride (present in treated drinking water but not groundwater)
- Conductivity
- Fluoride
- Hardness
- pH
- Potassium

Field Kits and Sampling Methods Available

In recent drafts of new MS4 Permits, U.S. EPA Region 1 has identified several test kits that are acceptable for use in the field, and other regulatory agencies have also completed similar reviews. The following table shows field test kits and portable meters that can be used for screening parameters.

Table SOP 13-1
Field Measurements, Test Kits, and Instrumentation

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
Bacteria	Bacteria field test kits require 24-hour window	
Boron	N/A	Hanna™ HI 38074 Taylor™ K-1541
Chloride	CHEMetrics™ V-2000 Colorimeter Hach™ Pocket Colorimeter™ II LaMotte™ DC1200 Colorimeter	CHEMetrics™ K-2002 through K-2070 Hach™ CDS-DT Hach™ Chloride QuanTab® Test Strips
Color		Hach™ ColorDisc
Conductivity	CHEMetrics™ I-1200	N/A
Detergents (Surfactants)	CHEMetrics™ I-2017	CHEMetrics™ K-9400 and K-9404 Hach™ DE-2
Fluoride	CHEMetrics™ V-2000 Colorimeter Hach™ Pocket Colorimeter™ II	N/A
Hardness	N/A	CHEMetrics™ K-1705 and K-1710 CHEMetrics™ K-4502 through K-4530 Hach™ HA-DT Hach™ Hardness Test Strips
Optical enhancers	Field tests still under development	
pH	CHEMetrics™ I-1000	Hach™ 17J through 17N Hach™ pH Test Strips
Potassium	Horiba™ Cardy C-131	LaMotte™ 3138 KIW
Turbidity	CHEMetrics™ I-1300	N/A

Each field test kit will include instructions specific to that test kit, and most kits are available in configurations that detect different ranges of the parameter. For example, the CHEMetrics™ detergents kit K-9400 shown above detects concentrations of 0 to 3 milligrams per liter (mg/L) while the K-9404 kit detects concentrations of 0 to 1,400 mg/L.

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 SOP 13-2
Benchmark Field Measurements for Select Parameters

Analyte or Parameter	Benchmark
Ammonia	>0.5 mg/L
Conductivity	>2,000
Detergents (Surfactants)	> 0.25 mg/L
Fluoride	>0.25 mg/L
pH	<5
Potassium	>20 mg/L

If and when water quality screening samples, whether using field test kits or portable meters, exceed these benchmark concentrations, the inspector should consider collecting analytical samples for laboratory analysis.

Advantages and Disadvantages of Field Testing

Field test kits can be convenient for use as a screening tool, initial purchase costs are low (typically $0.50 to $5.00 for the kits included in Table SOP 13-1), and the costs are far less than full analyses at a laboratory. However, some disadvantages of this screening method include:

- Limited shelf life
- Labor cost associated with inspector's time
- Generation of wastes, including glass vials and used reagent
- Steps and processes for each kit can vary widely, resulting in errors
- Trained staff are required in order to effectively utilize kits
- Not all kits are accepted by all regulatory agencies
- Limited useful detection range

Portable instrumentation such as the colorimeters shown in Table SOP 13-1 have the benefit of providing accurate readings, measure to low detection limits, and can be purchased pre-programmed to measure concentrations of most parameters required. Disadvantages of portable instrumentation include:

- High initial purchase cost
- Requirement for ongoing calibration and maintenance
- Individual probes require periodic replacement
- Specific storage requirements to maintain calibration
- Trained staff are required in order to effectively utilize meters

Related Standard Operating Procedures

1. SOP 1, Dry Weather Outfall Inspection
2. SOP 2, Wet Weather Outfall Inspection
3. SOP 3, Catch Basin Cleaning and Inspection
4. SOP 10, Locating Illicit Discharges

WATER QUALITY SCREENING FORM

Outfall I.D.			
Outfall Location			
Inspector's Name			
Date of Inspection		Date of Last Inspection	
Start Time		End Time	
Type of Inspection: Regular ☐ Pre-Storm Event ☐ During Storm Event ☐ Post-Storm Event ☐			
Most Recent Storm Event			

FIELD WATER QUALITY SCREENING RESULTS

Sample Parameter	Field Test Kit or Portable Instrument Meter	Benchmark	Field Screening Result	Full Analytical Required?
Ammonia[1]		> 0.5 mg/L		☐ Yes ☐ No
Boron[1]		> 0.35 mg/L		☐ Yes ☐ No
Chloride[2]		230 mg/L		☐ Yes ☐ No
Color[1]		> 500 units		☐ Yes ☐ No
Specific Conductance[1]		> 2,000 µS/cm		☐ Yes ☐ No
Detergents & Surfactants[3]		> 0.25 mg/L		☐ Yes ☐ No
Fluoride[3]		> 0.25 mg/L		☐ Yes ☐ No
Hardness[1]		< 10 mg/L or > 2,000 mg/L		☐ Yes ☐ No
pH[1]		< 5		☐ Yes ☐ No
Potassium[1]		> 20 mg/L		☐ Yes ☐ No
Turbidity[1]		> 1,000 NTU		☐ Yes ☐ No

[1] – *Illicit Discharge Detection and Elimination: A Guidance Manual for Program Development and Technical Assessments*, Center for Watershed Protection and Robert Pitt of University of Alabama, 2004, p. 134, Table 45.

[2] –*Env-Ws 1703.21 Water Quality Criteria for Toxic Substances*, State of New Hampshire Department Surface Water Quality Regulations.

[3] – *Appendix I – Field Measurements, Benchmarks and Instrumentation*, Draft Massachusetts North Coastal Small MS4 General Permit, 2009.

CMRSWC

FULL ANALYTICAL TESTING WATER QUALITY RESULTS

Sample Parameter	Analytical Test Method	Sample Collection (Time/Date)	Testing Lab	Analytical Testing Result
Ammonia	EPA 350.2/SM4500-NH3C			
Bacteria	E coli: 1103.1; 1603 Enterococcus: 1106.1; 1600			
Boron	EPA 212.3			
Chloride	EPA 9251			
Color	EPA 110.2			
Specific Conductance	SM 2510B			
Detergents & Surfactants	EPA 425.1/SM5540C			
Fluoride	EPA 300.0			
Hardness	EPA 130.1/SM 2340B			
Optical Enhancers	N/A*			
pH	EPA 150.1/SM 4500H			
Potassium	EPA 200.7			
Turbidity	SM 2130B			

*- There is presently no USEPA Standard Method for analysis of optical enhancers. Typically, sample pads are described as with "Present" or "Not Present" for fluorescing dye when exposed to UV light or a fluorometer.

User Manual
DOCUMENT #606042REF

EcoSense® ECx300A
EcoSense® ECx300M
Portable Conductivity, Salinity and Temperature Instruments

USER MANUAL
English

The EcoSense® EC300A/EC300M Instrument is warranted for one year from date of purchase by the end user against defects in materials and workmanship. EC300A/EC300M probes and cables are warranted for one year from date of purchase by the end user against defects in material and workmanship. Within the warranty period, YSI will repair or replace, at its sole discretion, free of charge, any product that YSI determines to be covered by this warranty.

To exercise this warranty, write or call your local YSI representative, or contact YSI Customer Service in Yellow Springs, Ohio. Send the product and proof of purchase, transportation prepaid, to the Authorized Service Center selected by YSI. Repair or replacement will be made and the product returned, transportation prepaid. Repaired or replaced products are warranted for the balance of the original warranty period, or at least 90 days from date of repair or replacement.

Limitation of Warranty

This Warranty does not apply to any YSI product damage or failure caused by: (i) failure to install, operate or use the product in accordance with YSI's written instructions; (ii) abuse or misuse of the product; (iii) failure to maintain the product in accordance with YSI's written instructions or standard industry procedure; (iv) any improper repairs to the product; (v) use by you of defective or improper components or parts in servicing or repairing the product; or (vi) modification of the product in any way not expressly authorized by YSI.

THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. YSI's LIABILITY UNDER THIS WARRANTY IS LIMITED TO REPAIR OR REPLACEMENT OF THE PRODUCT, AND THIS SHALL BE YOUR SOLE AND EXCLUSIVE REMEDY FOR ANY DEFECTIVE PRODUCT COVERED BY THIS WARRANTY. IN NO EVENT SHALL YSI BE LIABLE FOR ANY SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES RESULTING FROM ANY DEFECTIVE PRODUCT COVERED BY THIS WARRANTY

Contact Information

YSI
1725 Brannum Lane
Yellow Springs OH, 45387, USA
Tel: 800-897-4151 • 937-767-7241; Fax: 937-767-1058
E-mail: info@ysi.com
Web: ysi.com

CONTENTS

SAFETY INFORMATION

Please follow the guidelines below, and read this manual in its entirety to ensure safe operation of the unit.

⚠ Avoiding Damage to the Instrument - Precautions

The Instrument Case

Though the instrument is housed in a water-proof IP67 case, DO NOT use it underwater. The cable connector is not waterproof unless the cap is installed. In case of submersion without the cap connected, follow these steps immediately:

1. Remove the battery and reinstall the battery cover.
2. Dry the connector if necessary, and replace the conductivity probe. Rinse unit carefully with distilled water. After rinsing and drying, inspect and clean connectors to remove all contaminants that may affect probe connections.
3. Wait for unit and all connections to dry before reinstalling the battery and resuming operation.
4. If the unit does not function correctly after step 3, contact YSI for possible repair or replacement.

PACKAGE CONTENTS

Item #	Contents
606079	EC300A meter, manual, and 9V battery
606068	EC300A meter, manual, 9V battery, transport case, probe with 1 meter cable
606069	EC300A meter, manual, 9V battery, transport case, probe with 4 meter cable
606047	EC300A meter, manual, 9V battery, transport case, probe with 10 meter cable
601034	EC300M meter, manual, USB cable, and 9V battery
601035	EC300M meter, manual, USB cable, 9V battery, transport case, probe with 1 meter cable
601036	EC300M meter, manual, USB cable, 9V battery, transport case, probe with 4 meter cable

Item #	Contents
601037	EC300M meter, manual, USB cable, 9V battery, transport case, probe with 10 meter cable

UNPACKING

Carefully unpack the unit and accessories, and inspect for shipping damages. Compare received parts with materials listed in the Package Contents section. Notify YSI immediately of any damage or missing parts. Save all packing materials until satisfactory operation is confirmed.

INSTALLATION

Battery Installation

An initial display of "BAT" on the LCD indicates approximately one hour of battery life for unit operation within specifications. Replace battery when "BAT" appears on the LCD.

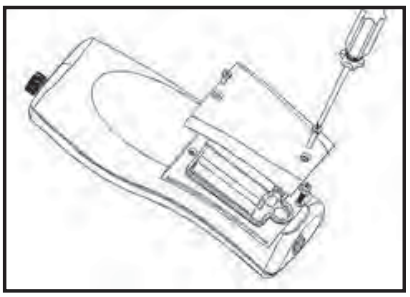


Figure 1

To replace battery, remove the two battery cover screws and the battery cover and o-ring (Figure 1). Replace the 9V battery. Replace the battery cover and o-ring (be sure to align the o-ring correctly to prevent a bad seal) and fasten the two battery cover screws.

Battery Disposal

This instrument is powered by a 9 volt battery, which the user must remove and dispose of when the batteries no longer power the instrument. Disposal requirements vary by country and region, and users are expected to understand and follow the battery disposal requirements for their specific locale.

INTENDED USE AND GENERAL OVERVIEW

The YSI model EC300A/EC300M is a precise instrument that measures conductivity, salinity and temperature. A built-in microprocessor calculates and compensates for all parameters related to conductivity and temperature determinations.

This instrument is waterproof (IP67) when the connector cap is installed. The mechanical touch keys are highly reliable with tactile and audio feedback. This instrument uses one 9V battery. Recalibration is not required when power is restored.

The front of the instrument has a large LCD that displays temperature and either temperature compensated or non-temperature compensated conductivity, salinity or TDS simultaneously along with user prompts and mode indicators. The unit prompts users through calibration and measurement procedures.

The model EC300A/EC300M is available with a single four-electrode cell. Other features include automatic conductivity ranging, automatic temperature compensation, long battery life, and 50/60 Hz AC noise rejection. This meter is universal and user-friendly for field, industrial and laboratory applications.

Key differences between the YSI EC300A and EC300M include:

- EC300A can store 50 data sets, while the EC300M can store 250 data sets.
- A real-time clock is included on the EC300M for date/time stamp of saved data.
- The EC300M features a waterproof USB port with cover that will allow customers to download stored measurement data to a PC.
- A recal prompt on the EC300M allows users to select a recalibration interval.

DISPLAY DESCRIPTION

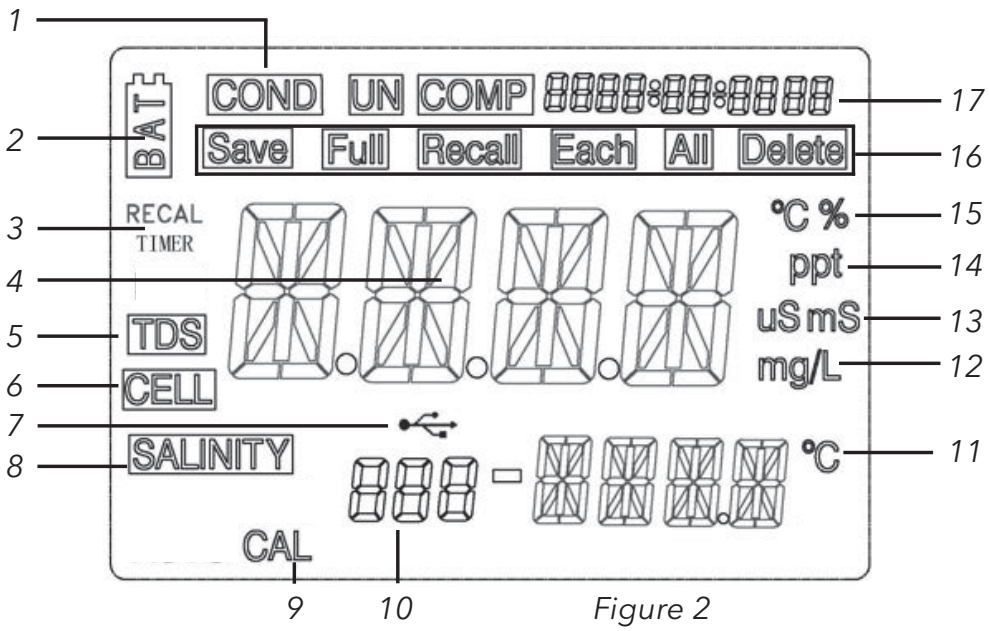


Figure 2

Number	*Description*
1	Displays when measuring conductivity.
2	Low battery indicator
3	Recal Timer indicator (EC300M only)
4	Main display for compensated and uncompensated conductivity, salinity and TDS values.
5	Displays when measuring total dissolved solids.
6	Indicates conductivity cell constant value.
7	USB/PC connection indicator (EC300M only)
8	Displays when measuring salinity.
9	Calibration mode indicator
10	Data set number
11	Temperature display
12	Indicates TDS measurement
13	Indicates conductivity measurement
14	Indicates salinity measurement
15	°C: Flashes during temperature compensated conductivity measurement. During calibration, indicates temperature reference unit. %: Displays during calibration; indicates temperature coefficient unit.

Number	*Description*
16	Save, Full, Recall, Each, All, Delete: Instrument's data storage indicators.
17	Date/Time display (EC300M only)

OPERATIONAL KEYS DESCRIPTION

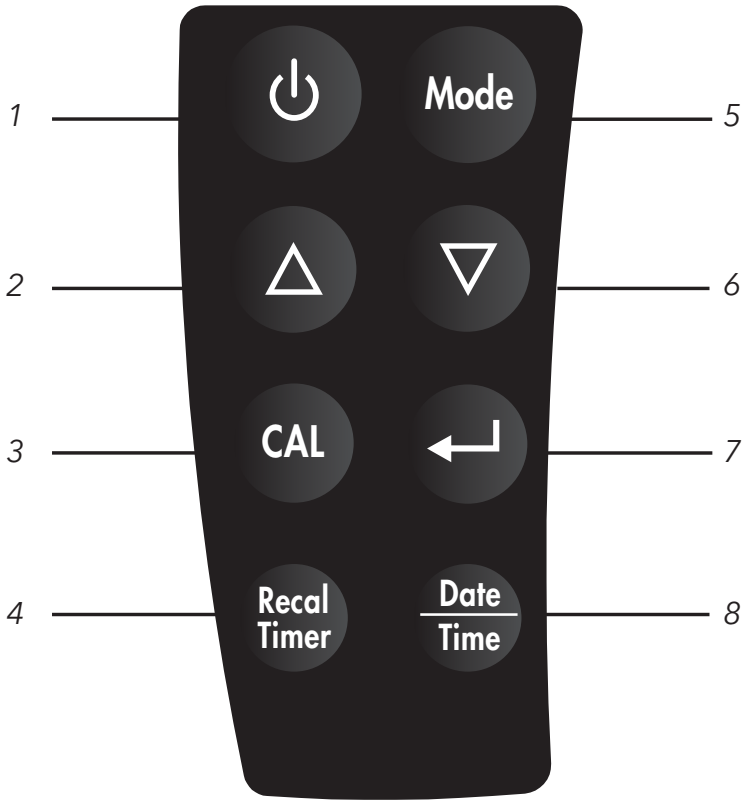
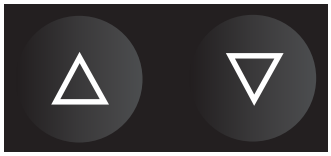
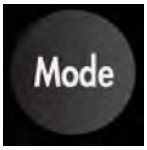


Figure 3

Number	*Key*	*Description*
1		**Power** key. Turns the unit on or off.
2, 6		**Up and down arrow** keys. Increases or decreases the display value as desired.
3		**Calibration** key. Press to enter the calibration mode.

4		**Recal Timer** key (EC300M only). Press to enter the Recal Timer input display.
5		**Mode** key. Selects display mode. In Normal operation, press Mode to switch the display between uncompensated conductivity, temperature compensated conductivity, salinity, total dissolved solids (TDS), Recall and Delete. In calibration mode, this key exits the current calibration and displays the next calibration parameter.
7		**Enter** key. Pressing Enter saves the current measurement into memory, confirms mode selection (rcl/delete), confirms calibration steps, and confirms data deletion. On the EC300M, this key confirms recal timer entry and date/time selections.
8		**Date/Time** key (EC300M only). A short press (i.e. key is not held) of the Date/Time key changes the display in the upper right corner to be either Date or Time. Pressing and holding for 3 seconds will allow date and time information to be updated. Pressing and holding for 6 seconds will allow for the date (e.g. MM/DD/YYYY) and time format (12 or 24 hour) settings to be changed.

OPERATIONAL PROCEDURES

Measurement Modes

1. Temperature - Current solution temperature continually displays.
2. Temperature Compensated Conductivity - Measurement of conductivity, compensated to 25°C or another specified value between 15 and 25°C. Expressed as uS/cm or mS/cm with a flashing "°C".

3. Uncompensated Conductivity – Direct measurement of conductivity, not compensated to a specific temperature. Expressed as uS/cm or mS/cm.
4. Salinity – Measurement of salinity; expressed in parts per thousand (ppt).
5. TDS – Measurement of total dissolved solids (TDS); expressed in milligrams per liter (mg/L)

Carefully observe the units displayed at the far side of the LCD to determine the desired mode.

Calibration

Calibration setup contains five sections: TDS, Cell, Temperature Coefficient, Temperature reference, and Conductivity Calibration. To access these sections:

1. Connect the conductivity probe and cable assembly to the unit and turn the unit on. The screen will display CELL and the cell constant of the conductivity probe.
2. Allow temperature readings to stabilize, then press **CAL** to enter the calibration mode; CAL appears on the LCD. Press **MODE** to sequentially display the following sections:

   Note: *Press* ***Enter*** ↵ *to accept any values changes in each section and automatically advance to the next section. If there are no changes, the unit accepts the current value and proceeds to the next section.*

TDS

TDS is determined by multiplying conductivity (mS) by a TDS factor. The default factor value is 0.65. To change the TDS factor, use the up and down keys to adjust the value between 0.30 and 1.00. Press **Enter** ↵ to save the new value, or press **MODE** to cancel the change and display the CELL screen.

CELL

The second screen will display CELL and the current cell value. The default cell value is 5.00 and is displayed in the lower right of the screen. The unit allows a variance of ±0.50 before displaying an error message. The cell value cannot be adjusted at this screen; calibrating conductivity is the only way to adjust the cell constant. Press **Enter** ↵ to reset the cell constant to 5.00 and display the Temperature Coefficient screen.

Note: *Be certain to press* ***Enter*** ↵ *to reset the cell constant to 5.00. If* ***MODE*** *is pressed, the unit retains the previous cell constant and calibrates from a value that is already offset.*

Temperature Coefficient

The unit uses the temperature coefficient to calculate temperature compensated conductivity. The default value is 1.91%. To change the temperature coefficient, use the up and down keys to adjust the value between 0 and 4.00%. Press **Enter** ↵ to save the new value, or press **MODE** to cancel the change and display the Temperature Reference screen.

Temperature Reference

The unit uses the temperature reference value to calculate temperature compensated conductivity. The default value is 25°C. To change the temperature coefficient, use the up and down keys to adjust the value between 15 and 25°C. Press **Enter** ↵ to save the new value, or press **MODE** to cancel the change and display the Conductivity Calibration screen.

Conductivity Calibration

1. Immerse the probe in a standard of known conductivity, preferably a standard in the middle range of the solutions to be measured. Completely submerge the probe without touching the sides of the calibration container. Shake the probe lightly to remove any air bubbles trapped in the conductivity cell.
2. Allow temperature to stabilize. The message 'rAng' (range) may display briefly to indicate unit auto-ranging; this is normal. After temperature stabilization, use the up and down keys to adjust the conductivity value to that of the conductivity standard at 25°C. Press **Enter** ↵ to calibrate. The unit beeps twice to indicate a successful calibration, then automatically switches to normal operation mode.

Conductivity Measurements

1. Turn the unit on. Place the probe in the solution to be measured. Completely submerge the probe. Shake the probe lightly to remove any trapped air bubbles in the conductivity cell.
2. Press **MODE** to enter the desired measurement mode. The message 'rAng' (range) may appear briefly on the display indicate auto-ranging; this is normal. Allow temperature to stabilize before taking measurements.

Saving, Viewing and Deleting Data

The EC300A can save 50 data records, while the EC300M can save 250 data records. When in measurement mode, press Enter ↵ to save a record. The instrument will confirm saving the data by displaying "Save" and the data record number for one second. "Full" is displayed when trying to save data and memory is full.

To view saved data, press Mode until "Recall" is displayed and then press Enter ↵. Use the Up or Down arrow keys to review different saved records. Press Mode to escape back to measurement mode.

To delete data records, press Mode while in measurement mode until "Delete" is displayed. Press Enter ↵. "All" will be displayed and blinking. Press the Up or Down arrow key to switch between delete 'All' or 'Each' options. Select either 'All' or 'Each' by pressing Enter ↵ while that option is displayed.

If 'All' is selected, all records will be deleted from memory and 'None' will be displayed. Press Mode twice to return to the measurement mode.

If 'Each' is selected, the Up and Down arrow keys will allow you to scroll through the saved data records. Press Enter to delete the selected record. All records after the deleted record will shift up to keep the records in sequential order. For example, if record 3 is deleted, record 4 will become record 3 and record 5 will become record 4. Press Mode twice to return to the measurement mode.

Downloading Data to a Computer - EC300M Only

The EC300M features a micro USB connection that allows the instrument to be connected to a computer with Windows 7 or Windows 10 as the operating system. Once connected, data saved to the meter can be downloaded to the computer.

1. A USB cable is included with all EC300M instruments. Plug the micro USB connector into the EC300M instrument and the USB connector into a computer.
2. Turn the EC300M instrument on. A driver will install from the instrument to the computer.
3. Open Windows Explorer. The PC will recognize the instrument as a removable drive.

Windows Explorer Icon

4. Copy and paste the .csv file from the instrument to a location on the computer. This file can be opened in Excel®.

   Note: *The original .csv file should be left on the EC300M instrument. Do not try to modify this file.*

   Note*: If the .csv file is opened with Excel® and the data is not formatted correctly (e.g. a temperature reading is interpreted as a date), please refer to the Troubleshooting section.*

5. The instrument can be disconnected from the computer. The original .csv file should still be located on the EC300M instrument.

Recal Timer - EC300M Only

The Recal Timer feature provides a reminder to recalibrate the DO probe. If enabled, 'Recal' will be displayed when the user-defined interval has elapsed.

After pressing the **Recal Timer** key, use the Up and Down arrow keys to adjust the value for the recal prompt in number of days. Press **Enter** ↵ to confirm. The instrument will return to the run screen.

Any value between 0 and 60 days can be selected. Set the value to 0 to disable the Recal Timer.

Date/Time Settings - EC300M Only

A short press (i.e. key is not held) of the **Date/Time** key changes the display in the upper right corner to be either Date or Time.

Press and hold the **Date/Time** key for 3 seconds to set date and time information. Use the up and down arrow keys to adjust Hour, Minute (Min) and Second (Sec). Press **Enter** ↵ to confirm each selection. After adjusting time, adjust date information by using the up and down arrow key to adjust the MM (month), DD (Day) and YYYY (Year) information. Press **Enter** ↵ to confirm each selection.

Press and hold the **Date/Time** key for 6 seconds to set the date/time format. Use the Up and Down arrow keys to display the desired Date format (MM/DD/YYYY, DD/MM/YYYY, or YYYY/MM/DD), followed by **Enter** ↵ to confirm the selection. Next, use the Up and Down arrow keys to display the desired Time format (12-hour or 24-hour), followed by Enter ↵ to confirm the selection.

TROUBLESHOOTING

Error Messages on Display

Main Display	*Problem*	*Possible Solution*
OvEr	• Conductivity is >200.0 mS • Salinity is > 70.00 ppt	• Completely submerge the probe. • Allow sufficient time for the electrode and Temp probe stabilization. • Recalibrate with correct value for the conductivity standard. • Replace conductivity standard. • Clean cell. • Return for service.
OvEr/Undr during calibration	• Cell Constant Calibration is out of range	

Main Display	*Secondary Display*	*Problem*	*Possible Solution*
OvEr/Undr	OvEr	Temperature >90.0 °C	• Decrease/ Increase the sample temperature. • Return for service.
	Undr	Temperature < -10.0 °C	

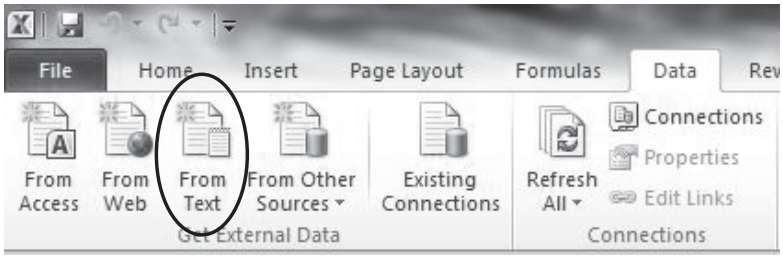
Opening the Data File with Excel®

Depending on the region and language setting of your PC, measurement data might be formatted incorrectly by Excel® when the data file is opened.

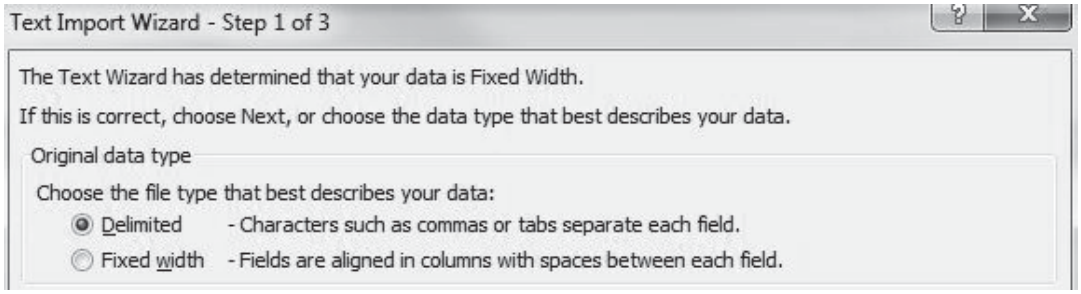
This is sometimes encountered with German set as the PC language, as a German date format typically utilizes a decimal (DD.MM.YYYY). The EC300M utilizes a decimal as the radix, so a temperature of **31.1** is sometimes interpreted by Excel® as **31. Jan** when German is set as the PC language.

If a data file is opened in Excel® and measurement data is incorrectly interpreted as something other than a number, please follow these steps:

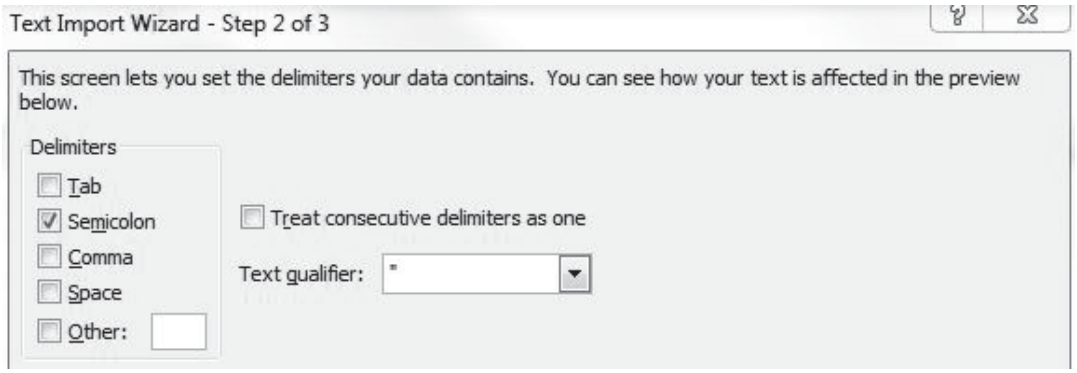
1. Open a blank Excel® spreadsheet.
2. Go to the **Data** tab and select **From Text**.



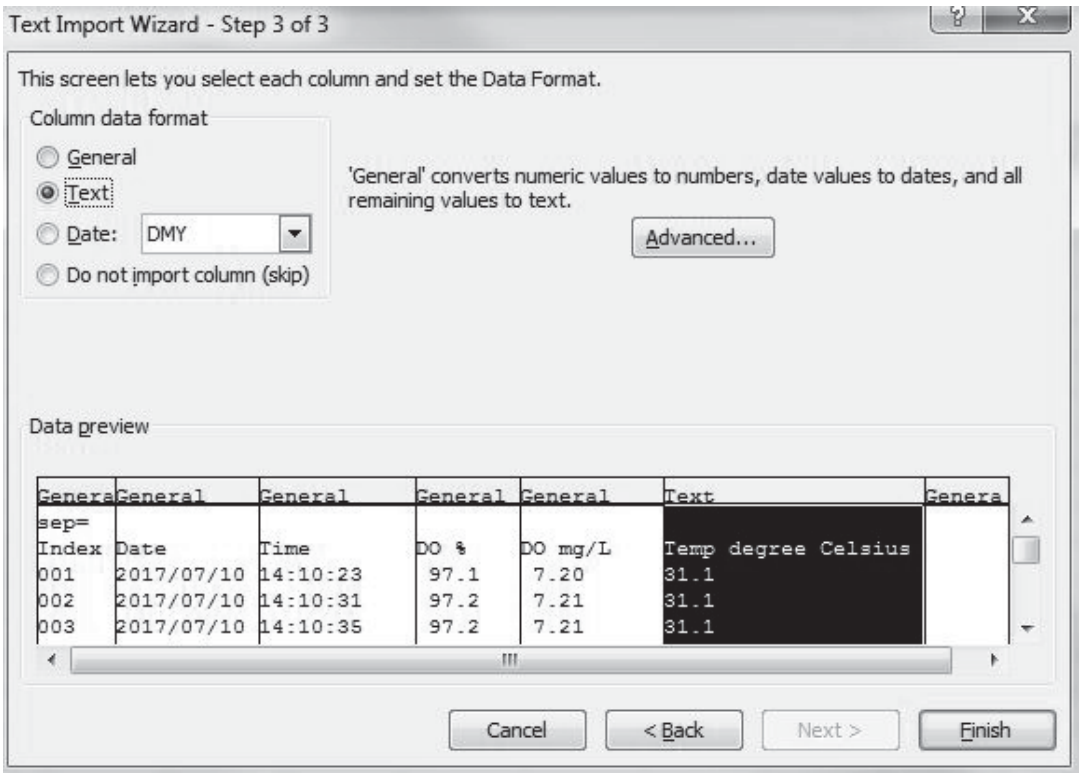
3. Choose to **Import** the data file you have copied to your PC. Don't select the original data file that is still on the instrument.
4. Under Step 1 of the Text Import Wizard, choose **Delimited**.



5. Under Step 2 of the Text Import Wizard, choose **Semicolon**.



6. Under Step 3, click on the column with the incorrectly formatted data. This column should be highlighted in black. Choose **Text** under **Column data format**. Do this for each column with incorrectly formatted data.



7. Select **Finish**, then choose where you want the data to be placed on your opened spreadsheet.

MAINTENANCE

The most important requirement for accurate and reproducible conductivity measurements is a clean cell. A dirty cell changes the conductivity of a solution through contamination. Clean the cell thoroughly before storing it. To clean the conductivity cell:

1. Dip the cell in cleaning solution and agitate for two to three minutes. Any foaming acid tile cleaner, such as Dow Chemical Bathroom Cleaner, should clean adequately. For a stronger cleaner, use a solution of 1:1 isopropyl alcohol and 1 N HCl. Remove the cell from the cleaning solution.
2. Use the nylon brush (supplied) to dislodge any contaminants from inside the electrode chamber.
3. Repeat steps one and two until the cell is completely clean. Rinse the cell thoroughly in deionized, or clean tap water.

ACCESSORIES / PART NUMBERS

Part Number	*Description*
606044	1 meter probe and cable assembly
605395	4 meter probe and cable assembly
605396	10 meter probe and cable assembly
606043	Carrying case, hard sided
605139	Carrying case, soft sided

TECHNICAL SERVICES

Telephone: 800 897 4151 (USA)
+1 937 767 2762 (Globally) Monday through Friday, 8 AM to 5 PM ET
Email: info@ysi.com
Mail: YSI Incorporated 1725 Brannum Lane Yellow Springs, OH 45387 USA
Internet: ysi.com.

SPECIFICATIONS

These specifications represent typical performance and are subject to change without notice. For the latest product specification information, please visit YSI's website at ysi.com or contact YSI Tech Support.

Parameter	*Range*	*Resolution*	*Accuracy*
Temperature	-10 to +90 °C (14 to 194 °F)	0.1 °C	±0.2 °C or ±0.4%, whichever is greater
Conductivity	0 to 499.9 µS/cm	0.1 µS/cm	± 1% of reading + 2 µS/cm
	500 to 4999 µS/cm	1 µS/cm	± 1% of reading + 5 µS/cm
	5.0 to 49.99 mS/cm	0.01 mS/cm	± 1% of reading + 0.05 mS/cm
	50 to 200 mS/cm	0.1 mS/cm	± 2.5% of reading + 0.5 mS/cm
Salinity	Calculated; 0.0 to 70.0 ppt	0.1 ppt	±0.2% FS

Reference Temperature (Input during calibration)	15.0 to 25.0°C (59 to 77°F)
Temperature Coefficient (Input during calibration)	0.0% to 4.0%
TDS Constant (Input during calibration)	0.3 to 1.00
Cell Constant Range	4.50 to 5.50
ATC Probe	Thermistor, 10KΩ, at 25 °C
Calibration Backup	Yes
Audio Feedback	Yes, on all keys
Power Source	One 9V battery (included with meter) Real time clock (RTC) on the EC300M also powered by CR2032 coin battery (3V)
Operating Range - Temperature	0 to 50 °C (32 to 122 °F)
Operating Range - Relative Humidity	Up to 95%
Instrument Casing	Waterproof IP-67 with cable connector cap installed
Weight (with battery)	272 grams (.6 lbs)
Dimensions (L x W x H)	18.7 cm x 7.6 cm x 3.8 cm (7.37 in x 3 in x 1.5 in)
Memory	50 data sets on the EC300A 250 data sets on the EC300M
Auto Shutoff	Automatically powers off after 30 minutes of inactivity
Recal Timer	EC300M only - Customer selects recalibration interval; from 0 to 60 days
Real-Time Clock (RTC) for Date/Time Stamp of Saved Data	EC300M only
Waterproof USB for Downloading Data to PC	EC300M only

Conforms to the following:	
Directives:	EMC 2014/30/EU RoHS 2011/65/EU WEEE 2012/19/EU
Harmonized Standards:	EN61326-1:2013 (IEC 61326-1:2012) IEC 61000-3-2:2005 IEC 61000-3-3:2008 IEC 61000-4-2:2008 IEC 61000-4-3:2006 IEC 61000-4-4:2004 IEC 61000-4-6:2008 IEC 61000-4-8:2009

AquaChek®

Water Quality Test Strips for

Ammonia

25 Test Strips

27553-25

HACH®

Total Ammonia (NH3–N) ppm

0 0.25 0.5 1.0 3.0 6.0

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.

5059LB R2/18 MADE IN USA OF US AND IMPORTED CONTENT.

USE BY DATE ON BOTTOM

HACH®
Hach Company, P.O. Box 389, Loveland, CO 80539 U.S.A.
(800) 227-4224 Outside U.S.A. (970) 669-3050. EU contact: HACH LANGE GmbH
Willstätterstrasse 11 40549, Düsseldorf, Germany +49-(0)211-52880

Chlorine, Free and Total, Low Range

DOC316.53.01450

USEPA DPD Method | **Method 8021 (free)[1] 8167 (total)[1,2]**

0.02 to 2.00 mg/L Cl_2 (LR) | **Powder Pillows or AccuVac® Ampuls**

Scope and application: For testing free chlorine (hypochlorous acid and hypochlorite ion) in water and treated waters. For testing total chlorine in water, treated waters and wastewater. USEPA accepted for reporting for drinking water analyses.

[1] USEPA accepted for drinking water reporting and equivalent to Standard Method 4500-Cl G for drinking water.
[2] USEPA accepted for wastewater reporting, USEPA method 330.5.

Test preparation

Before starting

Analyze the samples immediately. The samples cannot be preserved for later analysis.
Always do tests in sample cells or AccuVac© Ampuls. Do not put the instrument in the sample or pour the sample into the cell holder.
Make sure that the sample cells are clean and there are no scratches where the light passes through them.
Rinse the sample cell and cap with the sample three times before the sample cell is filled.
Make sure that there are no fingerprints or liquid on the external surface of the sample cells or AccuVac© Ampuls. Wipe with a lint-free cloth before measurement.
Cold waters can cause condensation on the sample cell or bubbles in the sample cell during color development. Examine the sample cell for condensation or bubbles. Remove condensation with a lint-free cloth. Invert the sample cell to remove bubbles.
Install the instrument cap over the cell holder before ZERO or READ is pushed.
After the test, immediately empty and rinse the sample cell. Rinse the sample cell and cap three times with deionized water.
Do not use the same sample cells for free and total chlorine. If trace iodide from the total chlorine reagent is carried over into the free chlorine determination, monochloramine will interfere. It is best to use separate, dedicated sample cells for free and total chlorine measurements.
If the test result is over-range, or if the sample temporarily turns yellow after the reagent addition, dilute the sample with a known volume of high quality, chlorine demand-free water and do the test again. Some loss of chlorine may occur due to the dilution. Multiply the result by the dilution factor. Additional methods are available to measure chlorine without dilution.
For the best results, measure the reagent blank value for each new lot of reagent. Replace the sample with deionized water in the test procedure to determine the reagent blank value. Subtract the reagent blank value from the sample results.
The AccuVac Ampul Snapper makes AccuVac Ampul tests easier to do. The AccuVac Ampul Snapper keeps the broken tip of the ampul, prevents exposure to the sample and provides controlled conditions for filling the ampule.
An AccuVac Ampul for Blanks can be used to zero the instrument in the AccuVac test procedure.
The SwifTest Dispenser for Free Chlorine or Total Chlorine can be used in place of the powder pillow in the test procedures. One dispensation equals one powder pillow for 10-mL samples.
Review the Safety Data Sheets (MSDS/SDS) for the chemicals that are used. Use the recommended personal protective equipment.
Dispose of reacted solutions according to local, state and federal regulations. Refer to the Safety Data Sheets for disposal information for unused reagents. Refer to the environmental, health and safety staff for your facility and/or local regulatory agencies for further disposal information.

Items to collect

Powder pillows

Description	Quantity
Chlorine, Free: DPD Free Chlorine Reagent Powder Pillows, 10-mL	1
Chlorine, Total: DPD Total Chlorine Reagent Powder Pillows, 10-mL	1
Sample cells, 25-mm (10 mL)	2

Refer to Consumables and replacement items on page 7 for order information.

AccuVac Ampuls

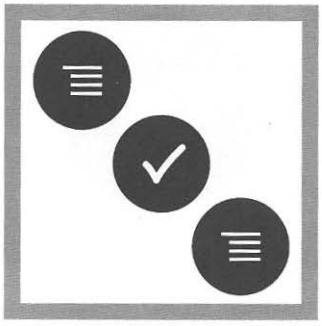
Description	Quantity
Chlorine, Free: DPD Free Chlorine Reagent AccuVac Ampuls	1
Chlorine, Total: DPD Total Chlorine Reagent AccuVac Ampuls	1
Beaker, 50-mL	1
Stopper for 18-mm tubes and AccuVac Ampuls	1
Sample cells, 25-mm (10 mL)	1

Refer to Consumables and replacement items on page 7 for order information.

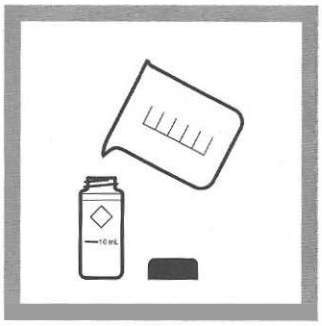
Sample collection

- Analyze the samples immediately. The samples cannot be preserved for later analysis.
- Chlorine is a strong oxidizing agent and is unstable in natural waters. Chlorine reacts quickly with various inorganic compounds and more slowly with organic compounds. Many factors, including reactant concentrations, sunlight, pH, temperature and salinity influence the decomposition of chlorine in water.
- Collect samples in clean glass bottles. Do not use plastic containers because these can have a large chlorine demand.
- Pretreat glass sample containers to remove chlorine demand. Soak the containers in a weak bleach solution (1 mL commercial bleach to 1 liter of deionized water) for at least 1 hour. Rinse fully with deionized or distilled water. If sample containers are rinsed fully with deionized or distilled water after use, only occasional pretreatment is necessary.
- Make sure to get a representative sample. If the sample is taken from a spigot or faucet, let the water flow for at least 5 minutes. Let the container overflow with the sample several times and then put the cap on the sample container so that there is no headspace (air) above the sample.

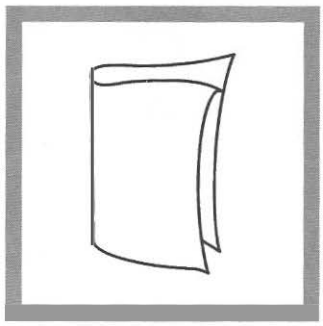
Powder pillow procedure



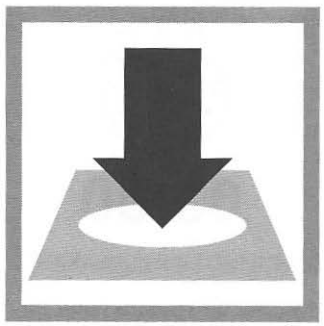
1. Set the instrument to low range (LR). Refer to the instrument documentation.



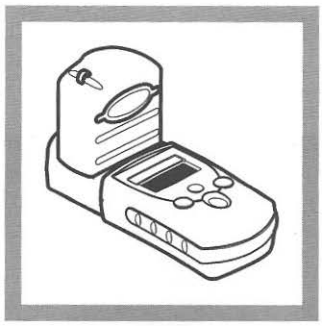
2. **Prepare the blank:** Fill a sample cell to the 10-mL mark with sample. Close the sample cell.



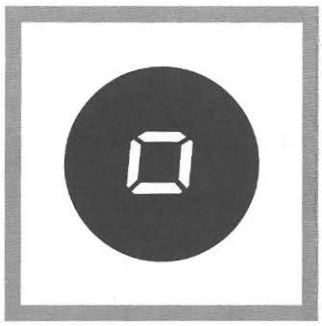
3. Clean the blank sample cell.



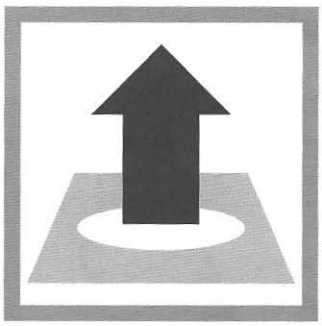
4. Insert the blank into the cell holder. Point the diamond mark on the sample cell toward the keypad.



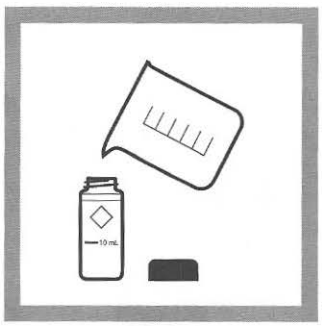
5. Install the instrument cap over the cell holder.



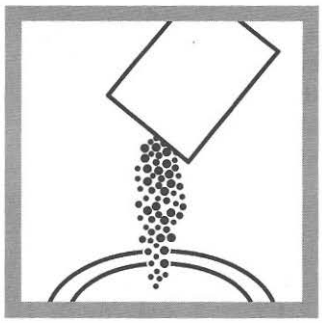
6. Push **ZERO**. The display shows "0.00".



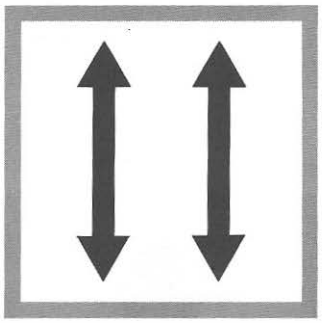
7. Remove the sample cell from the cell holder.



8. **Prepare the sample:** Fill a second sample cell to the 10-mL mark with sample.

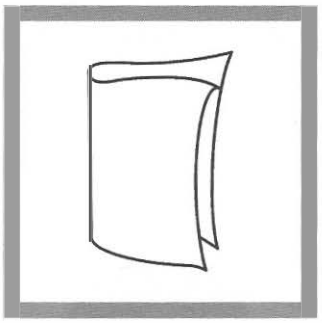


9. Add one 10-mL DPD Free Chlorine Reagent Powder Pillow or one 10-mL DPD Total Chlorine Reagent Powder Pillow to the second sample cell.

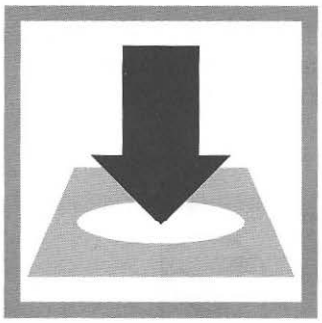


10. Close the sample cell. Shake the sample cell for about **20 seconds** to dissolve the reagent. Undissolved power will not affect accuracy.

A pink color will show if chlorine is in the sample.



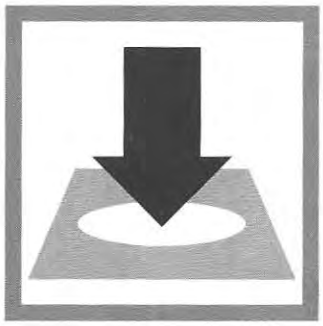
11. Clean the prepared sample cell.



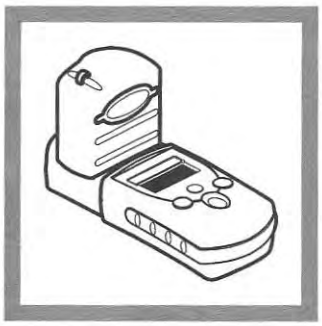
12. **Free chlorine measurement:** Within 1 minute of the reagent addition, insert the prepared sample into the cell holder. Point the diamond mark on the sample cell toward the keypad.

Go to step 15.

13. Set and start a timer for 3 minutes. A 3-minute reaction time starts.



14. Total chlorine measurement: After 3 minutes and within 6 minutes of the reagent addition, insert the prepared sample into the cell holder. Point the diamond mark on the sample cell toward the keypad.

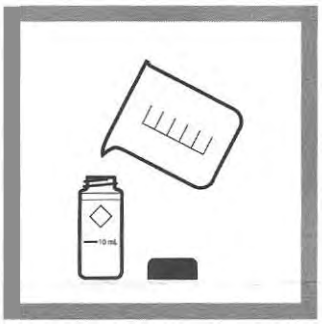


15. Install the instrument cap over the cell holder.

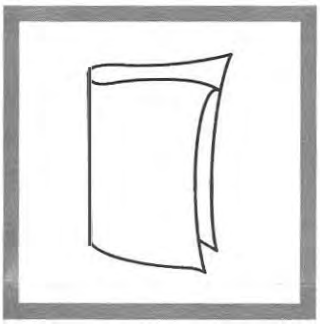
16. Push READ. Results show in mg/L Cl_2.

AccuVac® Ampul procedure

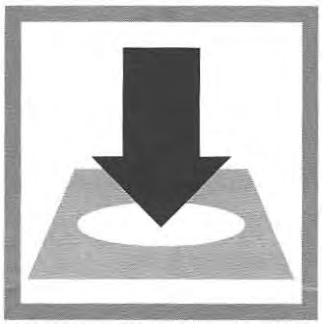
1. Set the instrument to low range (LR). Refer to the instrument documentation.



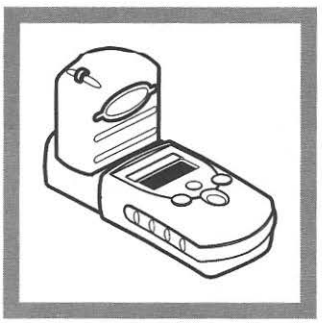
2. Prepare the blank: Fill a sample cell to the 10-mL mark with sample. Close the sample cell.



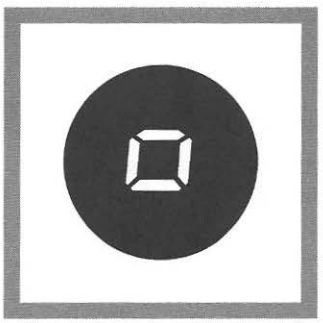
3. Clean the blank sample cell.



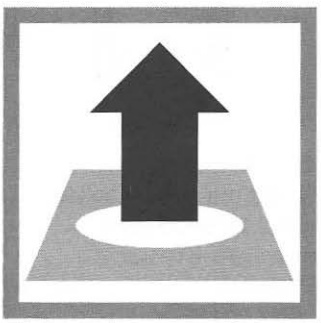
4. Insert the blank into the cell holder. Point the diamond mark on the sample cell toward the keypad.



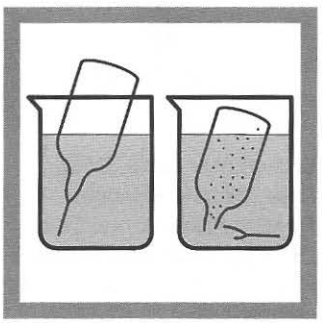
5. Install the instrument cap over the cell holder.



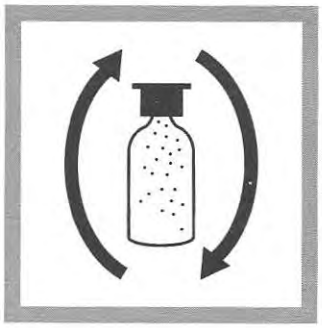
6. Push **ZERO**. The display shows "0.00".



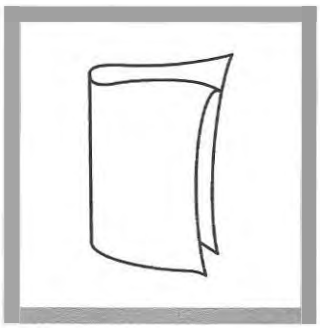
7. Remove the sample cell from the cell holder.



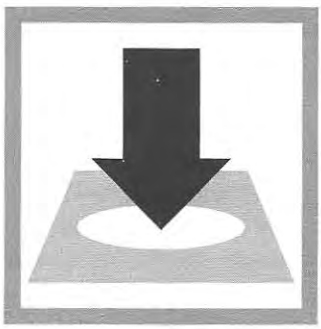
8. Prepare the sample: Collect at least 40 mL of sample in a 50-mL beaker. Fill a DPD Free Chlorine Reagent AccuVac Ampul or a DPD Total Chlorine Reagent AccuVac Ampul with sample. Keep the tip immersed while the AccuVac Ampul fills completely.



9. Quickly invert the AccuVac Ampul several times to mix.



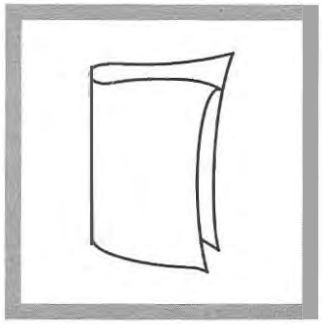
10. Clean the AccuVac Ampul.



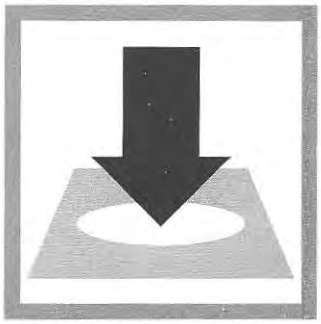
11. Free chlorine measurement: Within 1 minute of the reagent addition, insert the prepared sample AccuVac Ampul into the cell holder.

Go to step 15.

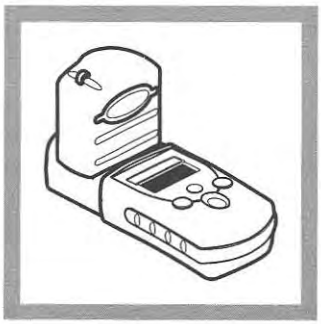
12. Set and start a timer for 3 minutes. A 3-minute reaction time starts.



13. When the timer expires, clean the prepared sample cell.



14. Total chlorine measurement: Within 6 minutes of the reagent addition, insert the prepared sample AccuVac Ampul into the cell holder.



15. Install the instrument cap over the cell holder.

16. Push READ. Results show in mg/L Cl_2.

Interferences

Interfering substance	Interference level
Acidity	More than 150 mg/L $CaCO_3$. The full color may not develop or the color may fade instantly. Adjust to pH 6–7 with 1 N Sodium Hydroxide. Measure the amount to add on a separate sample aliquot, then add the same amount to the sample that is tested. Correct the test result for the dilution from the volume addition.
Alkalinity	More than 250 mg/L $CaCO_3$. The full color may not develop or the color may fade instantly. Adjust to pH 6–7 with 1 N Sulfuric Acid. Measure the amount to add on a separate sample aliquot, then add the same amount to the sample that is tested. Correct the test result for the dilution from the volume addition.
Bromine, Br_2	Positive interference at all levels
Chlorine Dioxide, ClO_2	Positive interference at all levels
Inorganic chloramines	Positive interference at all levels
Chloramines, organic	May interfere
Hardness	No effect at less than 1000 mg/L as $CaCO_3$

Interfering substance	Interference level
Manganese, Oxidized (Mn^{4+}, Mn^{7+}) or Chromium, Oxidized (Cr^{6+})	Pre-treat the sample as follows: 1. Adjust the sample pH to 6–7. 2. Add 3 drops of Potassium Iodide (30-g/L) to 10 mL of sample. 3. Mix and wait 1 minute. 4. Add 3 drops of Sodium Arsenite (5-g/L) and mix. 5. Use the test procedure to measure the concentration of the treated sample. 6. Subtract this result from the result without the treatment to obtain the correct chlorine concentration.
Monochloramine	Causes a gradual drift to higher readings. When read within 1 minute after reagent addition, 3 mg/L monochloramine causes less than a 0.1 mg/L increase in the reading.
Ozone	Positive interference at all levels
Peroxides	May interfere
Highly buffered samples or extreme sample pH	Can prevent the correct pH adjustment (of the sample) by the reagents. Sample pretreatment may be necessary. Adjust to pH 6–7 with acid (Sulfuric Acid, 1 N) or base (Sodium Hydroxide, 1 N). Correct the test result for the dilution caused by the volume additions.

Pollution prevention and waste management

If sodium arsenite was added to the sample for manganese or chromium interferences, the reacted samples will contain arsenic and must be disposed of as a hazardous waste. Dispose of reacted solutions according to local, state and federal regulations. must be disposed of as a hazardous waste. Dispose of reacted solutions according to local, state and federal regulations.

Accuracy check

Standard additions method

Use the standard additions method to validate the test procedure, reagents and instrument and to find if there is an interference in the sample.

Items to collect:

- Chlorine Standard Solution, 2-mL PourRite® Ampule, 25–30 mg/L (use mg/L on label)
- Ampule breaker
- Pipet, TenSette®, 0.1–1.0 mL and tips

1. Prepare three spiked samples: use the TenSette pipet to add 0.1 mL, 0.2 mL and 0.3 mL of the standard solution, respectively, to three 10-mL portions of fresh sample. Mix well.

   Note: *For AccuVac® Ampuls, add 0.4 mL, 0.8 mL and 1.2 mL of the standard solution to three 50-mL portions of fresh sample.*
2. Use the test procedure to measure the concentration of each of the spiked samples. Start with the smallest sample spike. Measure each of the spiked samples in the instrument.
3. Compare the expected result to the actual result. The expected increase in the chlorine concentration is the Cl_2 mg/L concentration from the label of the standard solution multiplied by 0.1 mL for every 10 mL of standard solution added.

Standard solution method

If the Standard Calibration Adjust feature is used to adjust the calibration curve of the Pocket Colorimeter II, the concentration of the chlorine standard must be between 0.50 and 1.50 mg/L chlorine for the LR procedure.

Verification of on-line analyzers

This procedure can be used to meet the requirements of USEPA Method 334.0 - Determination of Residual Chlorine in Drinking Water Using an On-line Chlorine Analyzer.

The procedure and requirements for compliance with EPA Method 334.0 can be downloaded directly from **http://www.hach.com/method334**

Method performance

The method performance data that follows was derived from laboratory tests that were measured on a Pocket Colorimeter II during ideal test conditions. Users can get different results under different test conditions.

Precision (95% confidence interval)
1.00 ± 0.05 mg/L Cl_2

Summary of method

Chlorine can be in water as free chlorine and as combined chlorine. Both forms can be in the same solution and can be determined together as total chlorine. Free chlorine is in a solution as hypochlorous acid or hypochlorite ion. Combined chlorine represents a combination of chlorine-containing compounds, including monochloramine, dichloramine, nitrogen trichloride and other chloro derivatives. The combined chlorine oxidizes iodide (I^-) to iodine (I_2). The iodine and free chlorine reacts with DPD (N,N-diethyl-p-phenylenediamine) to form a red solution. The color intensity is proportional to the chlorine concentration. To determine the concentration of combined chlorine, complete a free chlorine test and a total chlorine test. Subtract the results of the free chlorine test from the total chlorine test to get the combined chlorine concentration.

Consumables and replacement items

Required reagents

Description	Quantity/test	Unit	Item no.
DPD Free Chlorine Reagent Powder Pillow, 10 mL	1	100/pkg	2105569
DPD Total Chlorine Reagent Powder Pillow, 10 mL	1	100/pkg	2105669
OR			
DPD Free Chlorine Reagent AccuVac® Ampul	1	25/pkg	2502025
DPD Total Chlorine Reagent AccuVac® Ampul	1	25/pkg	2503025

Required apparatus (powder pillows)

Description	Quantity/test	Unit	Item no.
Sample cells, 10-mL round, 25 mm x 60 mm	2	6/pkg	2427606

Required apparatus (AccuVac Ampul)

Description	Quantity/Test	Unit	Item no.
Sample cell, 10-mL round, 25 mm x 60 mm	1	6/pkg	2427606
Beaker, 50 mL	1	each	50041H
Stoppers for 18-mm tubes and AccuVac Ampuls	2	6/pkg	173106

Recommended standards and apparatus

Description	Unit	Item no.
Chlorine Standard Solution, 2-mL PourRite® Ampules, 25–30 mg/L	20/pkg	2630020
PourRite® Ampule Breaker, 2-mL	each	2484600

Optional reagents and apparatus

Description	Unit	Item no.
AccuVac® Ampul Snapper	each	2405200
Mixing cylinder, graduated, 25-mL	each	2088640
Potassium Iodide, 30-g/L	100 mL	34332
Sodium Arsenite, 5-g/L	100 mL	104732
Sodium Hydroxide Standard Solution, 1.0 N	100 mL MDB	104532
Sulfuric Acid Standard Solution, 1 N	100 mL MDB	127032
Pipet, TenSette®, 0.1–1.0 mL	each	1970001
Pipet tips for TenSette® Pipet, 0.1–1.0 mL	50/pkg	2185696
Pipet tips for TenSette® Pipet, 0.1–1.0 mL	1000/pkg	2185628
Paper, pH, 0–14 pH range	100/pkg	2601300
DPD Free Chlorine Reagent Powder Pillows, 10 mL	1000/pkg	2105528
DPD Total Chlorine Reagent Powder Pillows, 10 mL	1000/pkg	2105628
SwifTest™ dispenser for free chlorine[1]	each	2802300
SwifTest™ dispenser for total chlorine [2]	each	2802400
DPD Free Chlorine Reagent, 10-mL, SwifTest™ Dispenser refill vial	250 tests	2105560
DPD Total Chlorine Reagent, 10-mL, SwifTest™ Dispenser refill vial	250 tests	2105660
SpecCheck™ Secondary Standard Kit, Chlorine DPD, 0–2.0 mg/L Set	each	2635300
Water, organic-free	500 mL	2641549

[1] Includes one vial of 2105560 for 250 tests.
[2] Includes one vial of 2105660 for 250 tests.

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WORLD HEADQUARTERS
Telephone: (970) 669-3050
FAX: (970) 669-2932

06/2017, Edition 2

Detergents CHEMets Kit

K-9400/R-9400: 0 - 3 ppm

Test Procedure

1. Rinse the reaction tube with the sample to be tested, and then fill it to the 5 mL mark with the sample.
2. While holding the double-tipped ampoule in a vertical position, snap the upper tip using the tip breaking tool (fig. 1).
3. Invert the ampoule and position the open end over the reaction tube. Snap the upper tip and allow the contents to drain into the reaction tube (fig. 1).
4. Cap the reaction tube and shake it vigorously for **30 seconds**. Allow the tube to stand undisturbed for **1 minute**.
5. Make sure that the flexible tubing is firmly attached to the CHEMet ampoule tip.
6. Insert the CHEMet assembly (tubing first) into the reaction tube making sure that the end of the flexible tubing is at the bottom of the tube. Break the tip of the CHEMet ampoule by gently pressing it against the side of the reaction tube (fig. 2). The ampoule should draw in fluid only from the organic phase (bottom layer).
7. When filling is complete, remove the CHEMet assembly from the reaction tube.

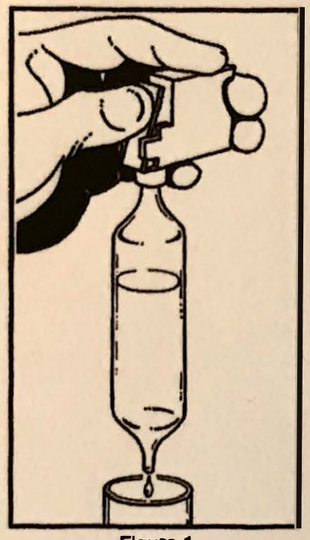

Figure 1

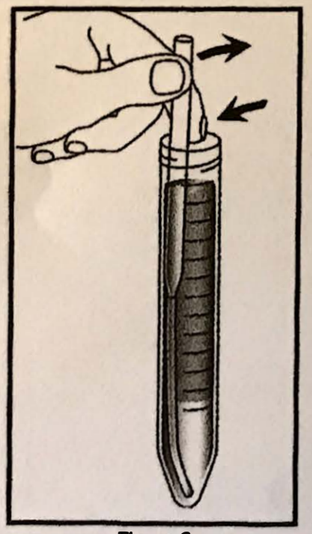

Figure 2

8. Remove the flexible tubing from the CHEMet ampoule and wipe all liquid from the exterior of the ampoule. Place an ampoule cap firmly onto the tip of the CHEMet ampoule. Invert the ampoule several times, allowing the bubble to travel from end to end.

Detergents CHEMets Kit

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6. Insert the CHEMet assembly (tubing first) into the reaction tube making sure that the end of the flexible tubing is at the bottom of the tube. Break the tip of the CHEMet ampoule by gently pressing it against the side of the reaction tube (fig. 2). The ampoule should draw in fluid only from the organic phase (bottom layer).
7. When filling is complete, remove the CHEMet assembly from the reaction tube.

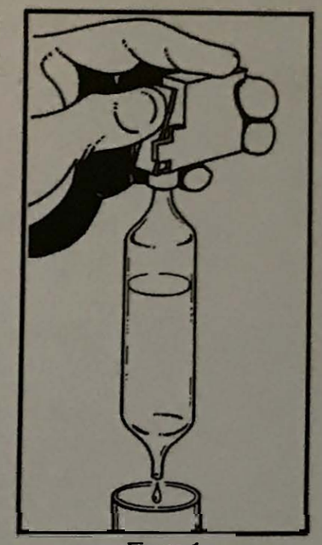

Figure 1

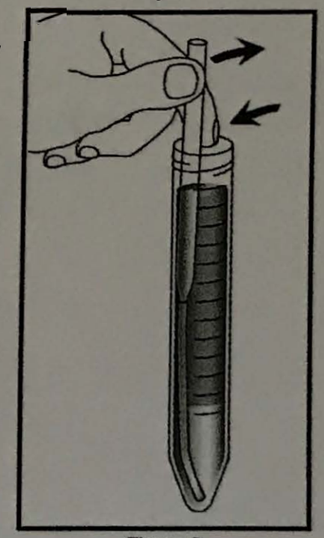

Figure 2

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Appendix E

Source Isolation and Confirmation Methods: Instructions and SOPs

SOP 10: LOCATING ILLICIT DISCHARGES

Introduction

An "illicit discharge" is any discharge to an engineered storm drain system that is not composed entirely of stormwater unless the discharge is defined as an allowable non-stormwater discharge under the 2003 Massachusetts MS4 Permit. Illicit discharges may enter the engineered storm drain system through direct or indirect connections, such as: cross-connections of sewer services to engineered storm drain systems; leaking septic systems; intentional discharge of pollutants to catch basins; combined sewer overflows; connected floor drains; and sump pumps connected to the system (under some circumstances). Illicit discharges can contribute high levels of pollutants, such as heavy metals, toxics, oil, grease, solvents, nutrients, and pathogens to receiving streams.

Illicit discharges can be located by several methods, including routine dry weather outfall inspections and catch basin inspections, which are described in detail in SOP 1, "Dry Weather Outfall Inspection" and SOP 3, "Catch Basin Inspection and Cleaning", respectively, as well as from citizen reports.

This SOP assumes that the municipality has legal authority (i.e., a bylaw or ordinance) in place, per the requirements of the 2003 Massachusetts MS4 Permit, to prohibit the connection of non-stormwater discharges into the storm drain system. The authority or department for addressing illicit discharge reports would be clearly identified in the municipality's legal authority. In Massachusetts, this is typically a combination of the Board of Health, the Department of Public Works (or Highway Department), and the local sanitary sewer department or commission. In some communities, the Conservation Commission may also play a role. This SOP refers to "appropriate authority" generically to reflect differences in how municipalities have identified these roles.

Identifying Illicit Discharges

The following are often indicators of an illicit discharge from stormwater outfall:

1. Foam: indicator of upstream vehicle washing activities, or an illicit discharge.
2. Oil sheen: result of a leak or spill.
3. Cloudiness: indicator of suspended solids such as dust, ash, powdered chemicals and ground up materials.
4. Color or odor: Indicator of raw materials, chemicals, or sewage.
5. Excessive sediment: indicator of disturbed earth of other unpaved areas lacking adequate erosion control measures.
6. Sanitary waste and optical enhancers (fluorescent dyes added to laundry detergent): indicator of the cross-connection of a sewer service.
7. Orange staining: indicator of high mineral concentrations.

Both bacteria and petroleum can create a sheen on the water surface. The source of the sheen can be differentiated by disturbing it, such as with a pole. A sheen caused by oil will remain intact and move in

a swirl pattern; a sheen caused by bacteria will separate and appear "blocky". Bacterial sheen is not a pollutant but should be noted.

Citizen Call in Reports

Reports by residents and other users of a water body can be effective tools in identifying the presence of illicit discharges. Many communities have set up phone hotlines for this purpose, or have provided guidance to local police departments and dispatch centers to manage data reported in this manner. Municipal employees and the general public should receive education to help identify the signs of illicit discharges and should be informed how to report such incidents.

When a call is received about a suspected illicit discharge, the attached IDDE Incident Tracking Sheet shall be used to document appropriate information. Subsequent steps for taking action to trace, document, and eliminate the illicit discharge are described in the following sections.

Potential illicit discharges reported by citizens should be reviewed on an annual basis to locate patterns of illicit discharges, identify high-priority catchments, and evaluate the call-in inspection program.

Tracing Illicit Discharges

Whenever an illicit discharge is suspected, regardless of how it was identified, the attached IDDE Incident Tracking Sheet should be utilized. The Incident Tracking Sheet shall be provided to the appropriate authority (i.e., Board of Health, Department of Public Works, etc.), which shall promptly investigate the reported incident.

If the presence of an illicit discharge is confirmed by the authority, but its source is unidentified, additional procedures to determine the source of the illicit discharge should be completed.

1. Review and consider information collected when illicit discharge was initially identified, for example, the time of day and the weather conditions for the previous 72 hours. Also consider and review past reports or investigations of similar illicit discharges in the area.
2. Obtain storm drain mapping for the area of the reported illicit discharge. If possible, use a tracking system that can be linked to your system map, such as GIS.
3. Document current conditions at the location of the observed illicit discharge point, including odors, water appearance, estimated flow, presence of floatables, and other pertinent information. Photograph relevant evidence.
4. If there continues to be evidence of the illicit discharge, collect water quality data using the methods described in SOP 13, "Water Quality Screening in the Field". This may include using field test kits or instrumentation, or collecting analytical samples for full laboratory analysis.
5. Move upstream from the point of observation to identify the source of the discharge, using the system mapping to determine infrastructure, tributary pipes, and drainage areas that contribute. At each point, survey the general area and surrounding properties to identify potential sources of the illicit discharge. Document observations at each point on the IDDE Incident Tracking Sheet as well as with photographs.
6. Continue this process until the illicit discharge is no longer observed, which will define the boundaries of the likely source. For example if the illicit discharge is present in catch basin 137

but not the next upstream catch basin, 138, the source of the illicit discharge is between these two structures.

If the source of the illicit discharge could not be determined by this survey, consider using dye testing, smoke testing, or closed-circuit television inspection (CCTV) to locate the illicit discharge.

Dye Testing

Dye testing is used to confirm a suspected illicit connection to a storm drain system. Prior to testing, permission to access the site should be obtained. Dye is discharged into the suspected fixture, and nearby storm drain structures and sanitary sewer manholes observed for presence of the dye. Each fixture, such as sinks, toilets, and sump pumps, should be tested separately. A third-party contractor may be required to perform this testing activity.

Smoke Testing

Smoke testing is a useful method of locating the source of illicit discharges when there is no obvious potential source. Smoke testing is an appropriate tracing technique for short sections of pipe and for pipes with small diameters. Smoke added to the storm drain system will emerge in connected locations. A third-party contractor may be required to perform this testing activity.

Closed Circuit Television Inspection (CCTV)

Televised video inspection can be used to locate illicit connections and infiltration from sanitary sewers. In CCTV, cameras are used to record the interior of the storm drain pipes. They can be manually pushed with a stiff cable or guided remotely on treads or wheels. A third-party contractor may be required to perform this testing activity.

If the source is located, follow steps for removing the illicit discharge. Document repairs, new sanitary sewer connections, and other corrective actions required to accomplish this objective. If the source still cannot be located, add the pipe segment to a future inspection program.

This process is demonstrated visually on the last page of this SOP.

Removing Illicit Discharges

Proper removal of an illicit discharge will ensure it does not recur. Refer to Table SOP 10-1, attached for, for examples of the notification process.

In any scenario, conduct a follow up inspection to confirm that the illicit discharge has been removed. Suspend access to the storm drain system if an "imminent and substantial danger" exists or if there is a threat of serious physical harm to humans or the environment.

Attachments

1. Illicit Discharge Incident Tracking Sheet

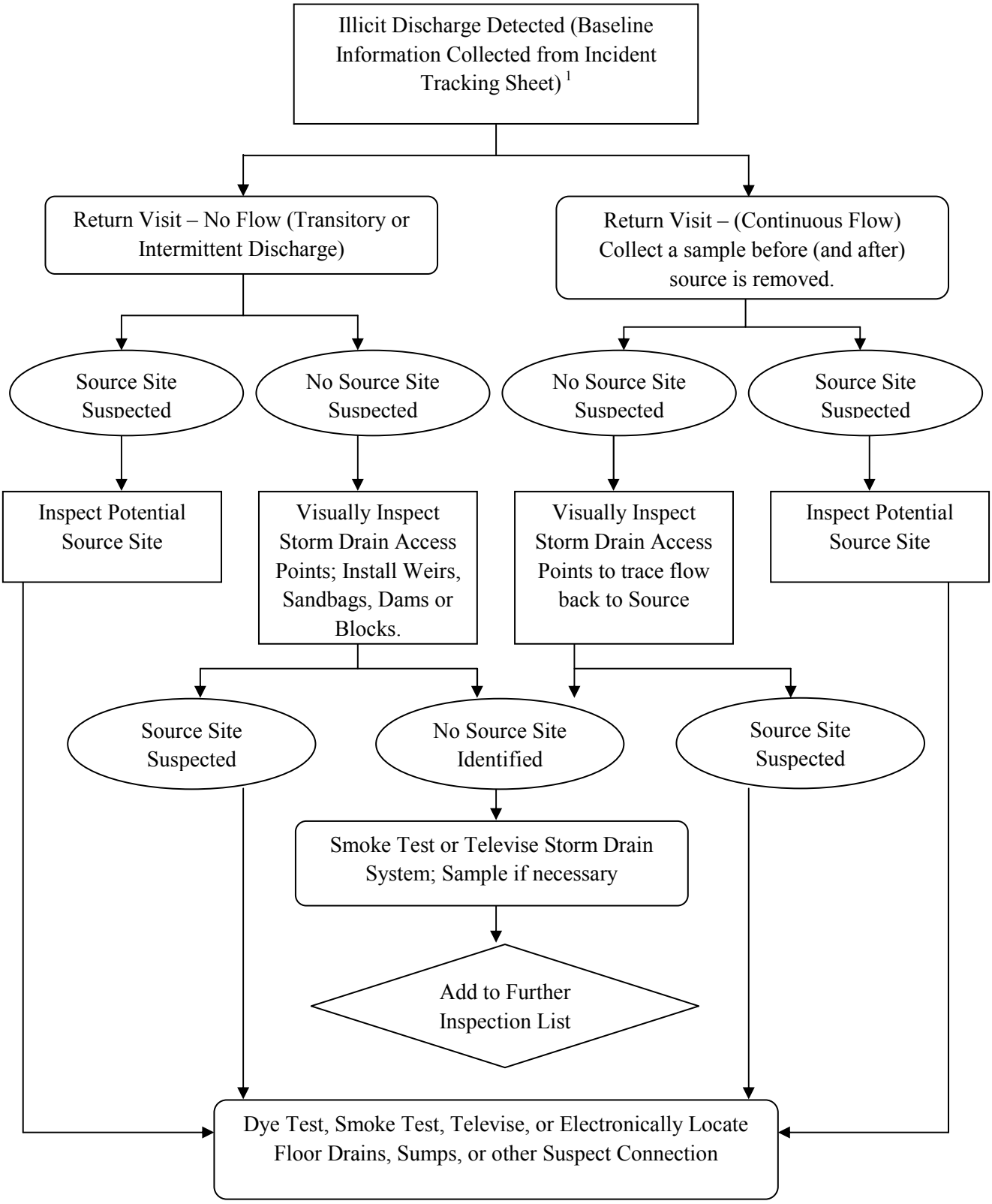
Related Standard Operating Procedures

1. SOP 1: Dry Weather Outfall Inspection
2. SOP 2: Wet Weather Outfall Inspection
3. SOP 3: Catch Basin Inspection
4. SOP 13: Using Field Test Kits For Outfall Screening
5. SOP 15: Private Drainage Connections

Table SOP 10-1

Notification and Removal Procedures for Illicit Discharges into the Municipal Separate Storm Sewer System

Financially Responsible	Source Identified	Enforcement Authority	Procedure to Follow
Private Property Owner	One-time illicit discharge (e.g. spill, dumping, etc.)	Ordinance enforcement authority (e.g. Code Enforcement Officer)	• Contact Owner • Issue Notice of Violation • Issue fine
Private Property Owner	Intermittent or continuous illicit discharge from legal connection	Ordinance enforcement authority (e.g. Code Enforcement Officer)	• Contact Owner • Issue Notice of Violation • Determine schedule for removal • Confirm removal
Private Property Owner	Intermittent or continuous illicit discharge from illegal connection or indirect (e.g. infiltration or failed septic)	Plumbing Inspector or ordinance enforcement authority	• Notify Plumbing Inspector or ordinance enforcement authority
Municipal	Intermittent or continuous illicit discharge from illegal connection or indirect (e.g. failed sewer line)	Ordinance enforcement authority (e.g. Code Enforcement Officer)	• Issue work order • Schedule removal • Remove connection • Confirm removal
Exempt 3rd Party	Any	USEPA	• Notify exempt third party and USEPA of illicit discharge


Illicit Discharge Detected (Baseline Information Collected from Incident Tracking Sheet) [1]
Return Visit – No Flow (Transitory or Intermittent Discharge)
Return Visit – (Continuous Flow) Collect a sample before (and after) source is removed.
Source Site Suspected
No Source Site Suspected
No Source Site Suspected
Source Site Suspected
Inspect Potential Source Site
Visually Inspect Storm Drain Access Points; Install Weirs, Sandbags, Dams or Blocks.
Visually Inspect Storm Drain Access Points to trace flow back to Source
Inspect Potential Source Site
Source Site Suspected
No Source Site Identified
Source Site Suspected
Smoke Test or Televise Storm Drain System; Sample if necessary
Add to Further Inspection List
Dye Test, Smoke Test, Televise, or Electronically Locate Floor Drains, Sumps, or other Suspect Connection

[1] – *Guidelines and Standard Operating Procedures: Illicit Discharge Detection and Elimination and Pollution Prevention/Good Housekeeping for Stormwater Phase II Communities in New Hampshire,* New Hampshire Estuary Project, 2006, p. 25, Figure 2-1.

Illicit Discharge Incident Tracking Sheet

Incident ID:				
Responder Information (for Citizen-Reported issues)				
Call Taken By:	Call Date:			
Call Time:	Precipitation (inches) in past 24-48 hours:			
Observer Information				
Date and Time of Observation:	Observed During Regular Maintenance or Inspections? ☐ Yes ☐ No			
Caller Contact Information (optional) or Municipal Employee Information:				
Observation Location: (complete one or more below)				
Latitude and Longitude:				
Stream Address or Outfall #:				
Closest Street Address:				
Nearby Landmark:				
Primary Location Description	**Secondary Location Description:**			
☐Stream Corridor (In or adjacent to stream)	☐Outfall	☐In-stream Flow	☐Along Banks	
☐Upland Area (Land not adjacent to stream)	☐Near Storm Drain	☐Near other water source (stormwater pond, wetland, ect.):		
Narrative description of location:				
Upland Problem Indicator Description				
☐Dumping	☐Oil/Solvents/Chemicals	☐Sewage		
☐Detergent, suds, etc.	☐Other:_____			
Stream Corridor Problem Indicator Description				
Odor	☐None	☐Sewage	☐Rancid/Sour	☐Petroleum (gas)
	☐Sulfide (rotten eggs); natural gas	☐Other: Describe in "Narrative" section		
Appearance	☐"Normal"	☐Oil Sheen	☐Cloudy	☐Foam
	☐Optical enhancers	☐ Discolored		
	☐Other: Describe in "Narrative" section			
Floatables	☐None	☐Sewage (toilet paper, etc)	☐Algae	☐Trash or debris
	☐Other: Describe in "Narrative" section			
Narrative description of problem indicators:				
Suspected Source (name, personal or vehicle description, license plate #, address, etc.):				

CMRSWC

Excepted from: Brown, E., Caraco, D., & Pitt, R. (2004). Illicit Discharge Detection and Elimination: a guidance manual for program development and technical assessments. Water Permits Division, Office of Water and Wastewater, US Environmental Protection Agency.

Chapter 13: Tracking Discharges To A Source

Once an illicit discharge is found, a combination of methods is used to isolate its specific source. This chapter describes the four investigation options that are introduced below.

Storm Drain Network Investigation

Field crews strategically inspect manholes within the storm drain network system to measure chemical or physical indicators that can isolate discharges to a specific segment of the network. Once the pipe segment has been identified, on-site investigations are used to find the specific discharge or improper connection.

Drainage Area Investigation

This method relies on an analysis of land use or other characteristics of the drainage area that is producing the illicit discharge. The investigation can be as simple as a "windshield" survey of the drainage area or a more complex mapping analysis of the storm drain network and potential generating sites. Drainage area investigations work best when prior indicator monitoring reveals strong clues as to the likely generating site producing the discharge.

On-site Investigation

On-site methods are used to trace the source of an illicit discharge in a pipe segment, and may involve dye, video or smoke testing within isolated segments of the storm drain network.

Septic System Investigation

Low-density residential watersheds may require special investigation methods if they are not served by sanitary sewers and/or storm water is conveyed in ditches or swales. The major illicit discharges found in low-density development are failing septic systems and illegal dumping. Homeowner surveys, surface inspections and infrared photography have all been effectively used to find failing septic systems in low-density watersheds.

13.1 Storm Drain Network Investigations

This method involves progressive sampling at manholes in the storm drain network to narrow the discharge to an isolated pipe segment between two manholes. Field crews need to make two key decisions when conducting a storm drain network investigation—where to start sampling in the network and what indicators will be used to determine whether a manhole is considered clean or dirty.

Where to Sample in the Storm Drain Network

The field crew should decide how to attack the pipe network that contributes to a problem outfall. Three options can be used:

- Crews can work progressively up the trunk from the outfall and test manholes along the way.
- Crews can split the trunk into equal segments and test manholes at strategic junctions in the storm drain system.
- Crews can work progressively down from the upper parts of the storm drain network toward the problem outfall.

The decision to move up, split, or move down the trunk depends on the nature and land use of the contributing drainage area. Some guidance for making this decision is provided in Table 53. Each option requires different levels of advance preparation. Moving up the trunk can begin immediately when an illicit discharge is detected at the outfall, and only requires a map of the storm drain system. Splitting the trunk and moving down the system require a little more preparation to analyze the storm drain map to find the critical branches to strategically sample manholes. Accurate storm drain maps are needed for all three options. If good mapping is not available, dye tracing can help identify manholes, pipes and junctions, and establish a new map of the storm drain network.

Option 1: Move up the Trunk

Moving up the trunk of the storm drain network is effective for illicit discharge problems in relatively small drainage areas. Field crews start with the manhole closest to the outfall, and progressively move up the network, inspecting manholes until indicators reveal that the discharge is no longer present (Figure 50). The goal is to isolate the discharge between two storm drain manholes.

Table 53: Methods to Attack the Storm Drain Network

Method	Nature of Investigation	Drainage System	Advance Prep Required
Follow the discharge up	Narrow source of an individual discharge	Small diameter outfall (< 36”) Simple drainage network	No
Split into segments	Narrow source of a discharge identified at outfall	Large diameter outfall (> 36”), Complex drainage Logistical or traffic issues may make sampling difficult.	Yes
Move down the storm drain	Multiple types of pollution, many suspected problems—possibly due to old plumbing practices or number of NPDES permits	Very large drainage area (> one square mile).	Yes

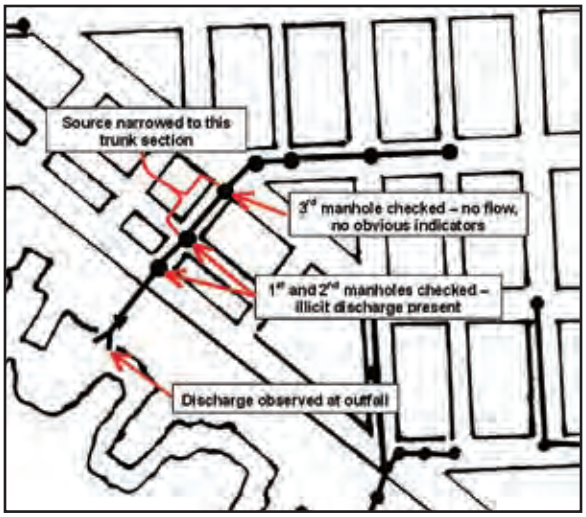


Figure 50: Example investigation following the source up the storm drain system

Option 2: Split the storm drain network

When splitting the storm drain network, field crews select strategic manholes at junctions in the storm drain network to isolate discharges. This option is particularly suited in larger and more complex drainage areas since it can limit the total number of manholes to inspect, and it can avoid locations where access and traffic are problematic.

The method for splitting the trunk is as follows:

1. Review a map of the storm drain network leading to the suspect outfall.
2. Identify major contributing branches to the trunk. The trunk is defined as the largest diameter pipe in the storm drain network that leads directly to the outfall. The "branches" are networks of smaller pipes that contribute to the trunk.
3. Identify manholes to inspect at the farthest downstream node of each contributing branch and one immediately upstream (Figure 51).
4. Working up the network, investigate manholes on each contributing branch and trunk, until the source is narrowed to a specific section of the trunk or contributing branch.
5. Once the discharge is narrowed to a specific section of trunk, select the appropriate on-site investigation method to trace the exact source.
6. If narrowed to a contributing branch, move up or split the branch until a specific pipe segment is isolated, and commence the appropriate on-site investigation to determine the source.

Option 3: Move down the storm drain network

In this option, crews start by inspecting manholes at the "headwaters" of the storm drain network, and progressively move down pipe. This approach works best in very large drainage areas that have many potential continuous and/or intermittent discharges. The Boston Water and Sewer Commission has employed the headwater option to investigate intermittent discharges in complex drainage areas up to three square miles (Jewell, 2001). Field crews certify that each upstream branch of the storm drain network has no contributing discharges before moving down pipe to a "junction manhole" (Figure 52). If discharges are found, the crew performs dye testing to pinpoint the discharge. The crew then confirms that the discharge is removed before moving farther down the pipe network. Figure 53 presents a detailed flow chart that describes this option for analyzing the storm drain network.

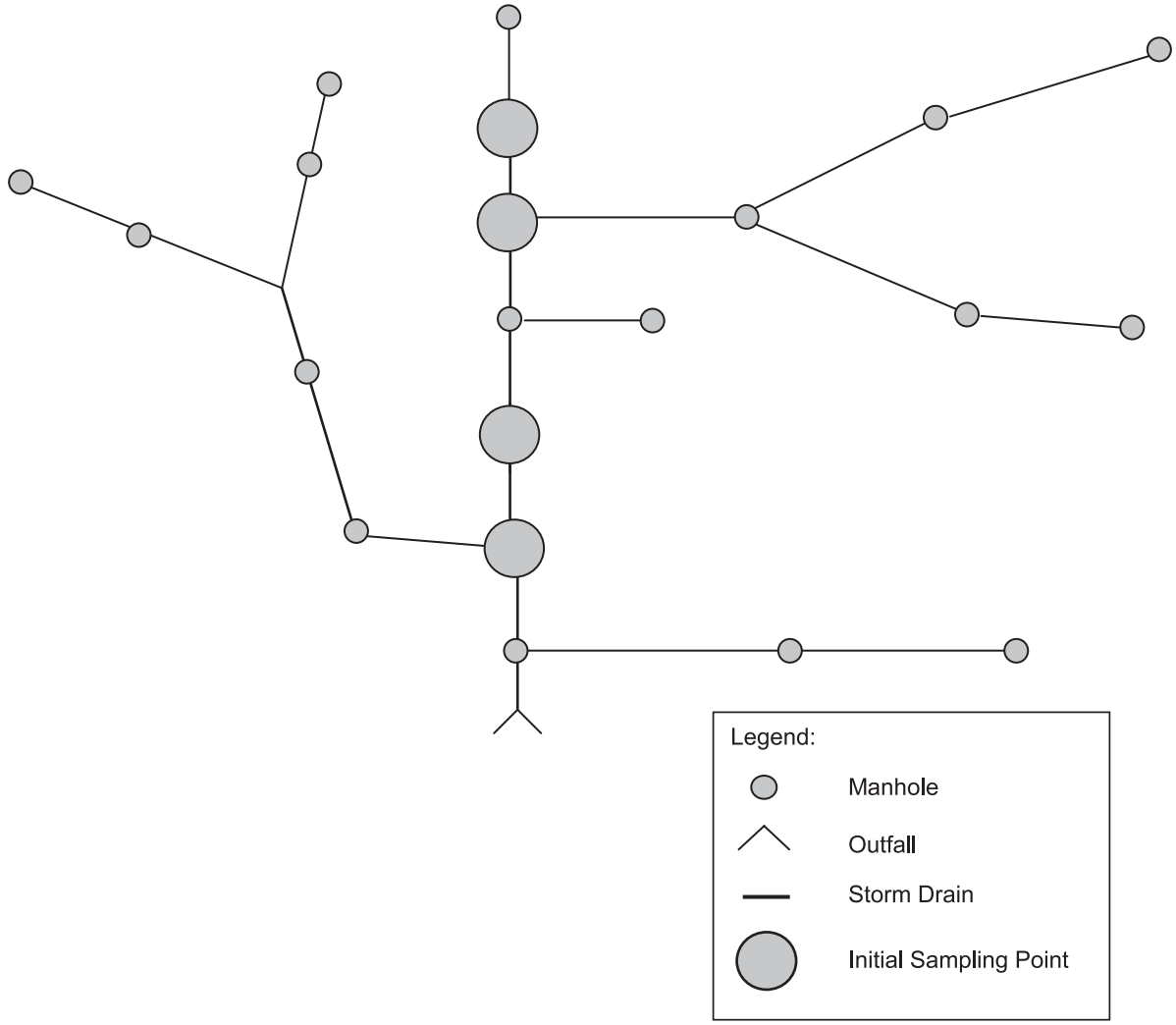


Figure 51: Key initial sampling points along the trunk of the storm drain

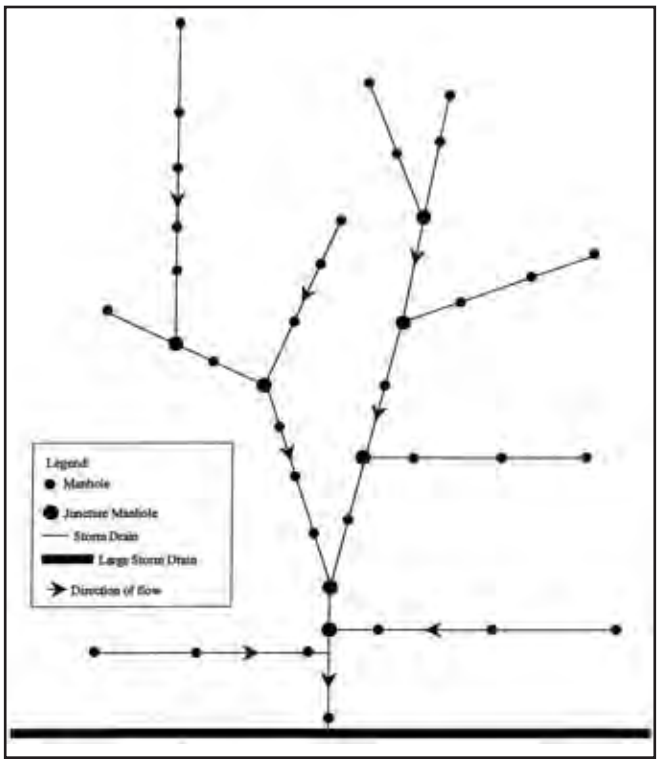


Figure 52: Storm Drain Schematic Identifying "Juncture Manholes" (Source: Jewell, 2001)

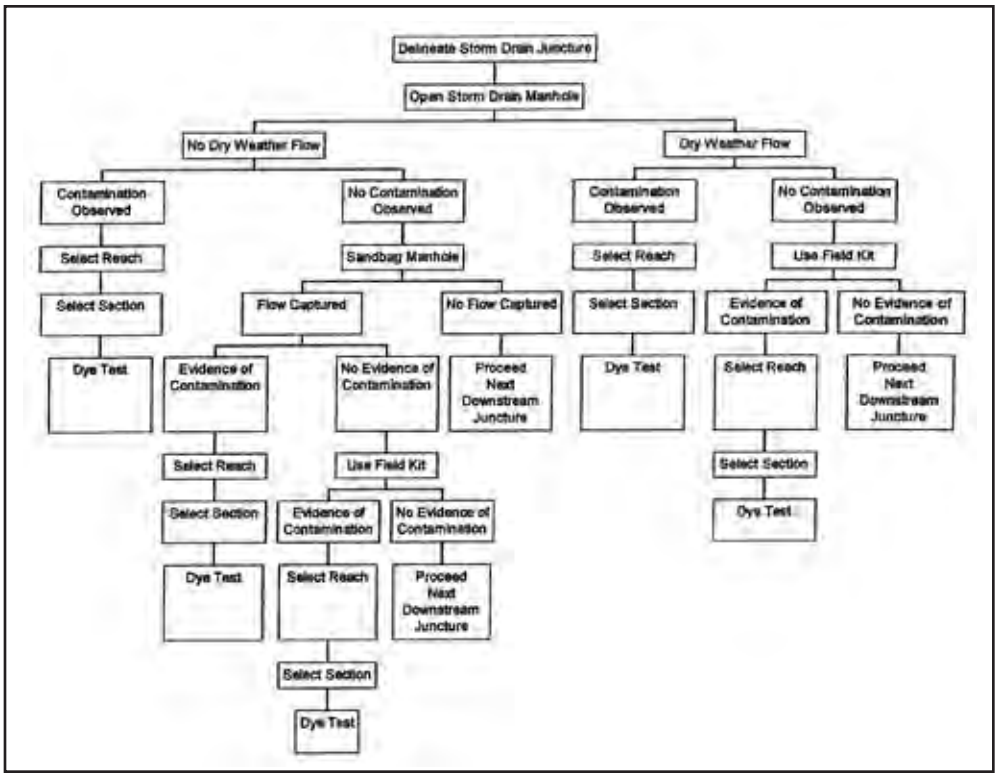


Figure 53: A Process for Following Discharges Down the Pipe (Source: Jewell, 2001)

Dye Testing to Create a Storm Drain Map

As noted earlier, storm drain network investigations are extremely difficult to perform if accurate storm drain maps are not available. In these situations, field crews may need to resort to dye testing to determine the flowpath within the storm drain network. Fluorescent dye is introduced into the storm drain network and suspected manholes are then inspected to trace the path of flow through the network (U.S. EPA, 1990). Two or three member crews are needed for dye testing. One person drops the dye into the trunk while the other(s) looks for evidence of the dye down pipe.

To conduct the investigation, a point of interest or down pipe "stopping point" is identified. Dye is then introduced into manholes upstream of the stopping point to determine if they are connected. The process continues in a systematic manner until an upstream manhole can no longer be determined, whereby a branch or trunk of the system can be defined, updated or corrected. More information on dye testing methods is provided in Section 13.3.

Manhole Inspection: Visual Observations and Indicator Sampling

Two primary methods are used to characterize discharges observed during manhole inspections—visual observations and indicator sampling. In both methods, field crews must first open the manhole to determine whether an illicit discharge is present. Manhole inspections require a crew of two and should be conducted during dry weather conditions.

Basic field equipment and safety procedures required for manhole inspections are outlined in Table 54. In particular, field crews need to be careful about how they will safely divert traffic (Figure 54). Other safety considerations include proper lifting of manhole covers to reduce the potential for back injuries, and testing whether any toxic or flammable fumes exist within the manhole before the cover is removed. Wayne County, MI has developed some useful operational procedures for inspecting manholes, which are summarized in Table 55.

Table 54: Basic Field Equipment Checklist

- Camera and film or digital camera
- Clipboards
- Field sheets
- Field vehicle
- First aid kit
- Flashlight or spotlight
- Gas monitor and probe
- Manhole hook/crow bar
- Mirror
- Storm drain, stream, and street maps
- Reflective safety vests
- Rubber / latex gloves
- Sledgehammer
- Spray paint
- Tape measures
- Traffic cones
- Two-way radios
- Waterproof marker/ pen
- Hand held global positioning satellite (GPS) system receiver (best resolution available within budget, at least 6' accuracy)

Figure 54: Traffic cones divert traffic from manhole inspection area

Table 55: Field Procedure for Removal of Manhole Covers
(Adapted from: Pomeroy et al., 1996)

Field Procedures:

1. Locate the manhole cover to be removed.
2. Divert road and foot traffic away from the manhole using traffic cones.
3. Use the tip of a crowbar to lift the manhole cover up high enough to insert the gas monitor probe. Take care to avoid creating a spark that could ignite explosive gases that may have accumulated under the lid. Follow procedures outlined for the gas monitor to test for accumulated gases.
4. If the gas monitor alarm sounds, close the manhole immediately. Do not attempt to open the manhole until some time is allowed for gases to dissipate.
5. If the gas monitor indicates the area is clear of hazards, remove the monitor probe and position the manhole hook under the flange. Remove the crowbar. Pull the lid off with the hook.
6. When testing is completed and the manhole is no longer needed, use the manhole hook to pull the cover back in place. Make sure the lid is settled in the flange securely.
7. Check the area to ensure that all equipment is removed from the area prior to leaving.

Safety Considerations:

1. Do not lift the manhole cover with your back muscles.
2. Wear steel-toed boots or safety shoes to protect feet from possible crushing injuries that could occur while handling manhole covers.
3. Do not move manhole covers with hands or fingers.
4. Wear safety vests or reflective clothing so that the field crew will be visible to traffic.
5. Manholes may only be entered by properly trained and equipped personnel and when all OSHA and local rules a.

Visual Observations During Manhole Inspection

Visual observations are used to observe conditions in the manhole and look for any signs of sewage or dry weather flow. Visual observations work best for obvious illicit discharges that are not masked by groundwater or other "clean" discharges, as shown in Figure 55. Typically, crews progressively inspect manholes in the storm drain network to look for contaminated flows. Key visual observations that are made during manhole inspections include:

- Presence of flow
- Colors
- Odors
- Floatable materials
- Deposits or stains (intermittent flows)

Figure 55: Manhole observation (left) indicates a sewage discharge. Source is identified at an adjacent sewer manhole that overflowed into the storm drain system (right).

Indicator Sampling

If dry weather flow is observed in the manhole, the field crew can collect a sample by attaching a bucket or bottle to a tape measure/rope and lowering it into the manhole (Figure 56). The sample is then immediately analyzed in the field using probes or other tests to get fast results as to whether the flow is clean or dirty. The most common indicator parameter is ammonia, although other potential indicators are described in Chapter 12.

Manhole indicator data is analyzed by looking for "hits," which are individual samples that exceed a benchmark concentration. In addition, trends in indicator concentrations are also examined throughout the storm drain network.

Figure 56: Techniques to sample from the storm drain

Figure 57 profiles a storm drain network investigation that used ammonia as the indicator parameter and a benchmark concentration of 1.0 mg/L. At both the outfall and the first manhole up the trunk, field crews recorded finding "hits" for ammonia of 2.2 mg/L and 2.3 mg/L, respectively. Subsequent manhole inspections further up the network revealed one manhole with no flow, and a second with a hit for ammonia (2.4 mg/L). The crew then tracked the discharge upstream of the second manhole, and found a third manhole with a low ammonia reading (0.05 mg/L) and a fourth with a much higher reading (4.3 mg/L). The crew then redirected its effort to sample above the fourth manhole with the 4.3 mg/L concentration, only to find another low reading. Based on this pattern, the crew concluded the discharge source was located between these two manholes, as nothing else could explain this sudden increase in concentration over this length of pipe.

The results of storm drain network investigations should be systematically documented to guide future discharge investigations, and describe any infrastructure maintenance problems encountered. An example of a sample manhole inspection field log is displayed in Figure 58.

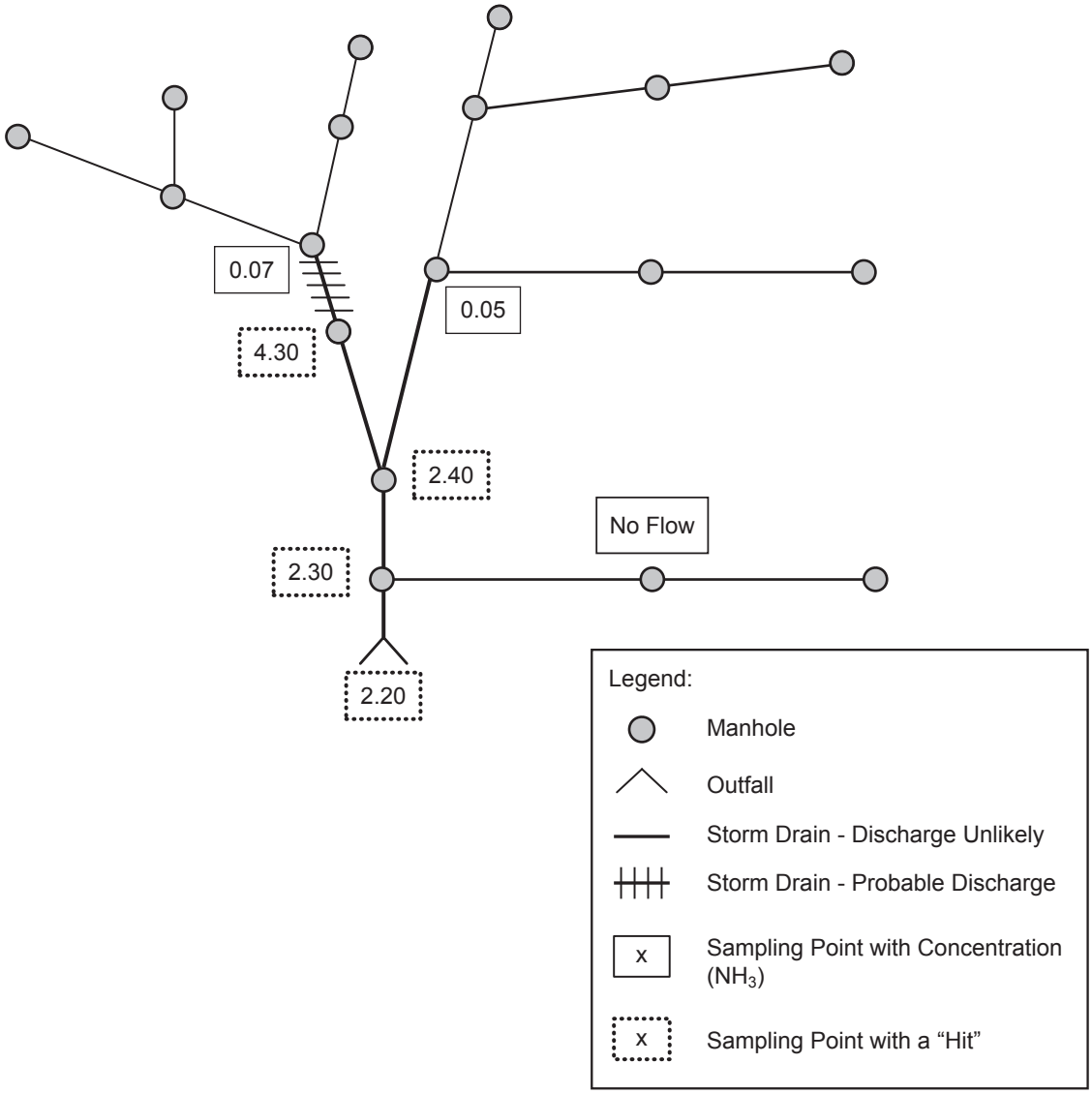
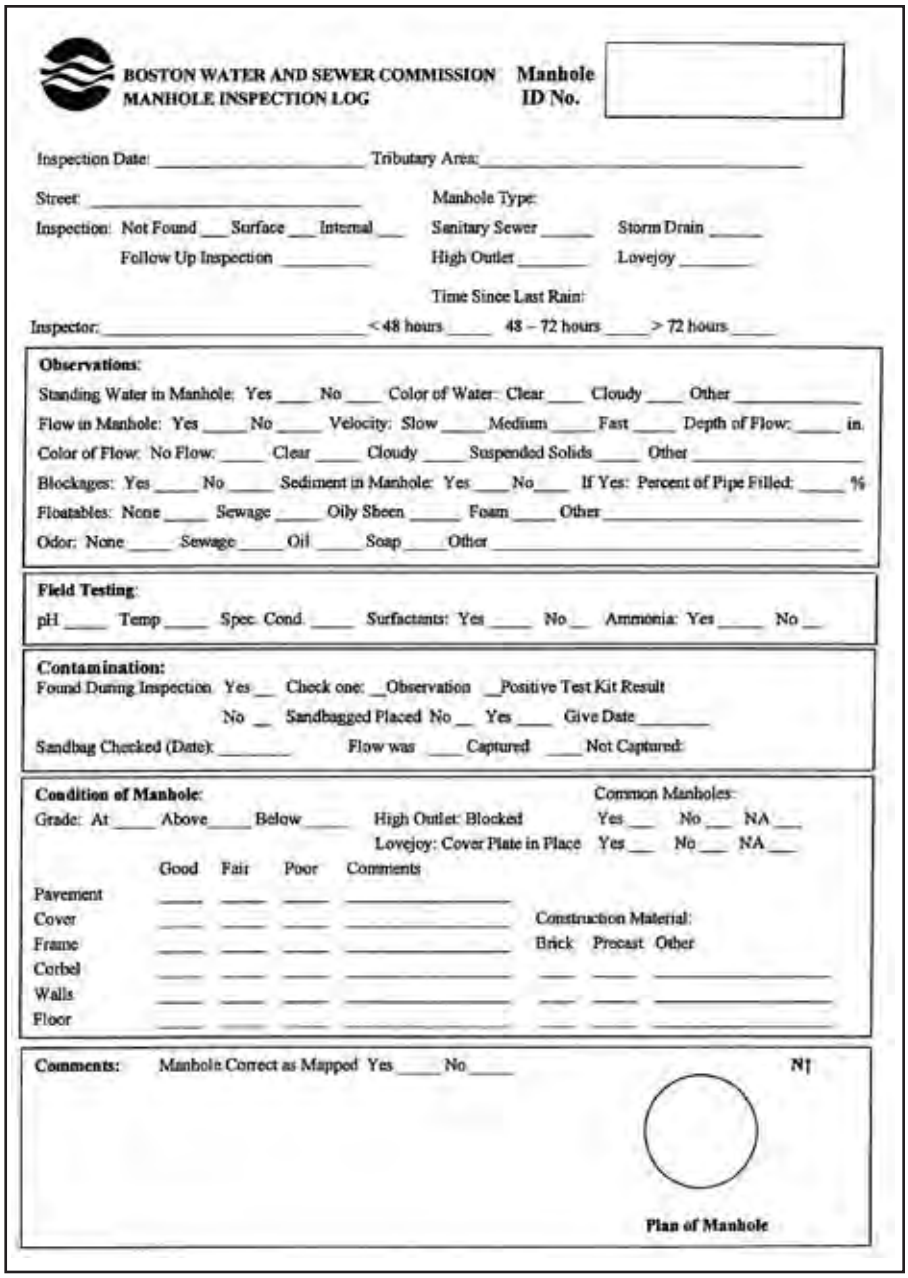


Figure 57: Use of ammonia as a trace parameter to identify illicit discharges



BOSTON WATER AND SEWER COMMISSION
MANHOLE INSPECTION LOG

Manhole ID No.

Inspection Date: _____ Tributary Area: _____

Street: _____ Manhole Type:

Inspection: Not Found ___ Surface ___ Internal ___ Sanitary Sewer _____ Storm Drain _____

Follow Up Inspection _____ High Outlet _____ Lovejoy _____

Time Since Last Rain:

Inspector: _____ < 48 hours _____ 48 – 72 hours _____ > 72 hours _____

Observations:

Standing Water in Manhole: Yes ____ No ____ Color of Water: Clear ____ Cloudy ____ Other _____

Flow in Manhole: Yes ____ No ____ Velocity: Slow ____ Medium ____ Fast ____ Depth of Flow: ____ in.

Color of Flow: No Flow: ____ Clear ____ Cloudy ____ Suspended Solids ____ Other _____

Blockages: Yes ____ No ____ Sediment in Manhole: Yes ____ No ____ If Yes: Percent of Pipe Filled: ____ %

Floatables: None ____ Sewage ____ Oily Sheen ____ Foam ____ Other _____

Odor: None ____ Sewage ____ Oil ____ Soap ____ Other _____

Field Testing:

pH ____ Temp ____ Spec. Cond. ____ Surfactants: Yes ____ No __ Ammonia: Yes ____ No __

Contamination:

Found During Inspection Yes __ Check one: __Observation __Positive Test Kit Result

No __ Sandbagged Placed No __ Yes ____ Give Date _____

Sandbag Checked (Date): _____ Flow was ____ Captured ____ Not Captured:

Condition of Manhole: Common Manholes:

Grade: At ____ Above ____ Below ____ High Outlet: Blocked Yes ___ No ___ NA ___

Lovejoy: Cover Plate in Place Yes ___ No ___ NA ___

	Good	Fair	Poor	Comments	Construction Material: Brick	Precast	Other
Pavement	____	____	____	_____			
Cover	____	____	____	_____			
Frame	____	____	____	_____			
Corbel	____	____	____	_____	___	___	_____
Walls	____	____	____	_____	___	___	_____
Floor	____	____	____	_____	___	___	_____

Comments: Manhole Correct as Mapped Yes ____ No ____

N↑

Plan of Manhole

Figure 58: Boston Water and Sewer Commission Manhole Inspection Log (Source: Jewell, 2001)

Methods to isolate intermittent discharges in the storm drain network

Intermittent discharges are often challenging to trace in the storm drain network, although four techniques have been used with some success.

Sandbags

This technique involves placement of sandbags or similar barriers within strategic manholes in the storm drain network to form a temporary dam that collects any intermittent flows that may occur. Any flow collected behind the sandbag is then assessed using visual observations or by indicator sampling. Sandbags are lowered on a rope through the manhole to form a dam along the bottom of the storm drain, taking care not to fully block the pipe (in case it rains before the sandbag is retrieved). Sandbags are typically installed at junctions in the network to eliminate contributing branches from further consideration (Figure 59). If no flow collects behind the sandbag, the upstream pipe network can be ruled out as a source of the intermittent discharge.

Sandbags are typically left in place for no more than 48 hours, and should only be installed when dry weather is forecast. Sandbags should not be left in place during a heavy rainstorm. They may cause a blockage in the storm drain, or, they may be washed downstream and lost. The biggest downside to sandbagging is that it requires at least two trips to each manhole.

Optical Brightener Monitoring (OBM) Traps

Optical brightener monitoring (OBM) traps, profiled in Chapter 12, can also be used to detect intermittent flows at manhole junctions. When these absorbent pads are anchored in the pipe to capture dry weather flows, they can be used to determine the presence of flow and/or detergents. These OBM traps are frequently installed by lowering them into an open-grate drop inlet or storm drain inlet, as shown in Figure 60. The pads are then retrieved after 48 hours and are observed under a fluorescent light (this method is most reliable for undiluted washwaters).

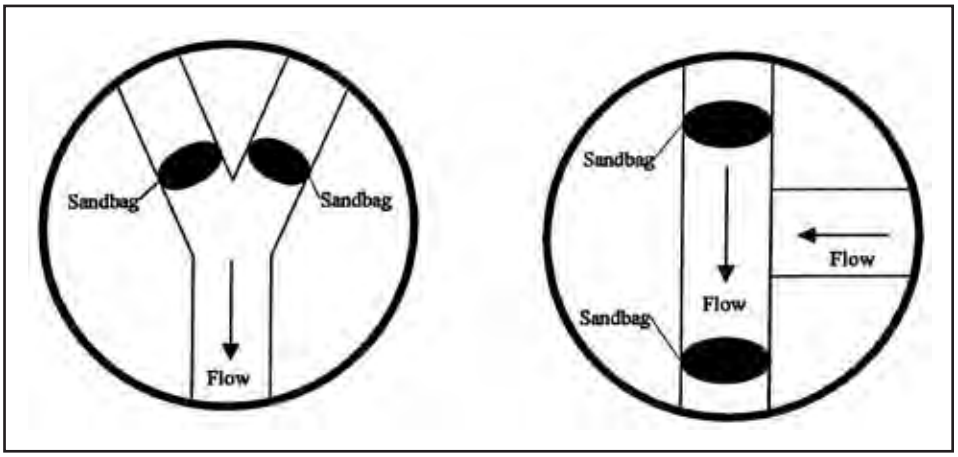


Figure 59: Example sandbag placement (Source: Jewell, 2001)

Figure 60: Optical Brightener Placement in the Storm Drain
(Source: Sargent and Castonguay, 1998)

Automatic Samplers

A few communities have installed automated samplers at strategic points within the storm drain network system that are triggered by small dry weather flows and collect water quality samples of intermittent discharges. Automated sampling can be extremely expensive, and is primarily used in very complex drainage areas that have severe intermittent discharge problems. Automated samplers can pinpoint the specific date and hours when discharges occur, and characterize its chemical composition, which can help crews fingerprint the generating source.

Observation of Deposits or Stains

Intermittent discharges often leave deposits or stains within the storm drain pipe or manhole after they have passed. Thus, crews should note whether any deposits or stains are present in the manhole, even if no dry weather flow is observed. In some cases, the origin of the discharge can be surmised by collecting indicator samples in the water ponded within the manhole sump. Stains and deposits, however, are not always a conclusive way to trace intermittent discharges in the storm drain network.

13.2 Drainage Area Investigations

The source of some illicit discharges can be determined through a survey or analysis of the drainage area of the problem outfall. The simplest approach is a rapid windshield survey of the drainage area to find the potential discharger or generating sites. A more sophisticated approach relies on an analysis of available GIS data and permit databases to identify industrial or other generating sites. In both cases, drainage area investigations are only effective if the discharge observed at an outfall has distinct or unique characteristics that allow crews to quickly ascertain the probable operation or business that is generating it. Often, discharges with a unique color, smell, or off-the-chart indicator sample reading may point to a specific industrial or commercial source. Drainage area investigations are not helpful in tracing sewage discharges, since they are often not always related to specific land uses or generating sites.

Rapid Windshield Survey

A rapid drive-by survey works well in small drainage areas, particularly if field crews are already familiar with its business operations. Field crews try to match the characteristics of the discharge to the most likely type of generating site, and then inspect all of the sites of the same type within the drainage area until the culprit is found. For example, if fuel is observed at an outfall, crews might quickly check every business operation in the catchment that stores or dispenses fuel. Another example is illustrated in Figure 61 where extremely dense algal growth was observed in a small stream during the winter. Field crews were aware of a fertilizer storage site in the drainage area, and a quick inspection identified it as the culprit.

Figure 61: Symptom (left): Discoloration of stream; Diagnosis: Extra hydroseed leftover from an upstream application (middle) was dumped into a storm drain by municipal officials (right).

A third example of the windshield survey approach is shown in Figure 62, where a very thick, sudsy and fragrant discharge was noted at a small outfall. The discharge appeared to consist of wash water, and the only commercial laundromat found upstream was confirmed to be the source. On-site testing may still be needed to identify the specific plumbing or connection generating the discharge.

Detailed Drainage Area Investigations

In larger or more complex drainage areas, GIS data can be analyzed to pinpoint the source of a discharge. If only general land use data exist, maps can at least highlight suspected industrial areas. If more detailed SIC code data are available digitally, the GIS can be used to pull up specific hotspot operations or generating sites that could be potential dischargers. Some of the key discharge indicators that are associated with hotspots and specific industries are reviewed in Appendix K.

13.3 On-site Investigations

On-site investigations are used to pinpoint the exact source or connection producing a discharge within the storm drain network. The three basic approaches are dye, video and smoke testing. While each approach can determine the actual source of a discharge, each needs to be applied under the right conditions and test limitations (see Table 56). It should be noted that on-site investigations are not particularly effective in finding *indirect* discharges to the storm drain network.

Figure 62: The sudsy, fragrant discharge (left) indicates that the laundromat is the more likely culprit than the florist (right).

Table 56: Techniques to Locate the Discharge		
Technique	**Best Applications**	**Limitations**
Dye Testing	• Discharge limited to a very small drainage area (<10 properties is ideal) • Discharge probably caused by a connection from an individual property • Commercial or industrial land use	• May be difficult to gain access to some properties
Video Testing	• Continuous discharges • Discharge limited to a single pipe segment • Communities who own equipment for other investigations	• Relatively expensive equipment • Cannot capture non-flowing discharges • Often cannot capture discharges from pipes submerged in the storm drain
Smoke Testing	• Cross-connection with the sanitary sewer • Identifying other underground sources (e.g., leaking storage techniques) caused by damage to the storm drain	• Poor notification to public can cause alarm • Cannot detect all illicit discharges

TIP

The Wayne County Department of the Environment provides excellent training materials on on-site investigations, as well as other illicit discharge techniques. More information about this training can be accessed from their website: http://www.wcdoe.org/Watershed/Programs___Srvcs_/IDEP/idep.htm.

Figure 63: Dye Testing Plumbing (NEIWPCC, 2003)

Dye Testing

Dye testing is an excellent indicator of illicit connections and is conducted by introducing non-toxic dye into toilets, sinks, shop drains and other plumbing fixtures (see Figure 63). The discovery of dye in the storm drain, rather than the sanitary sewer, conclusively determines that the illicit connection exists.

Before commencing dye tests, crews should review storm drain and sewer maps to identify lateral sewer connections and how they can be accessed. In addition, property owners must be notified to obtain entry permission. For industrial or commercial properties, crews should carry a letter to document their legal authority to gain access to the property. If time permits, the letter can be sent in advance of the dye testing. For residential properties, communication can be more challenging. Unlike commercial properties, crews are not guaranteed access to homes, and should call ahead to ensure that the owner will be home on the day of testing.

Communication with other local agencies is also important since any dye released to the storm drain could be mistaken for a spill or pollution episode. To avoid a costly and embarrassing response to a false alarm,

crews should contact key spill response agencies using a "quick fax" that describes when and where dye testing is occurring (Tuomari and Thomson, 2002). In addition, crews should carry a list of phone numbers to call spill response agencies in the event dye is released to a stream.

At least two staff are needed to conduct dye tests – one to flush dye down the plumbing fixtures and one to look for dye in the downstream manhole(s). In some cases, three staff may be preferred, with two staff entering the private residence or building for both safety and liability purposes.

The basic equipment to conduct dye tests is listed in Table 57 and is not highly specialized. Often, the key choice is the type of dye to use for testing. Several options are profiled in Table 58. In most cases, liquid dye is used, although solid dye tablets can also be placed in a mesh bag and lowered into the manhole on a rope (Figure 64). If a

Table 57: Key Field Equipment for Dye Testing
(Source: Wayne County, MI, 2000)

Maps, Documents
- Sewer and storm drain maps (sufficient detail to locate manholes)
- Site plan and building diagram
- Letter describing the investigation
- Identification (e.g., badge or ID card)
- Educational materials (to supplement pollution prevention efforts)
- List of agencies to contact if the dye discharges to a stream.
- Name of contact at the facility

Equipment to Find and Lift the Manhole Safely (small manhole often in a lawn)
- Probe
- Metal detector
- Crow bar
- Safety equipment (hard hats, eye protection, gloves, safety vests, steel-toed boots, traffic control equipment, protective clothing, gas monitor)

Equipment for Actual Dye Testing and Communications
- 2-way radio
- Dye (liquid or "test strips")
- High powered lamps or flashlights
- Water hoses
- Camera

Figure 64: Dye in a mesh bag is placed into an upstream manhole (left); Dye observed at a downstream manhole traces the path of the storm drain (right)

longer pipe network is being tested, and dye is not expected to appear for several hours, charcoal packets can be used to detect the dye (GCHD, 2002). Charcoal packets can be secured and left in place for a week or two, and then analyzed for the presence of dye. Instructions for using charcoal packets in dye testing can be accessed at the following website: http://bayinfo.tamug.tamu.edu/gbeppubs/ms4.pdf.

The basic drill for dye tests consists of three simple steps. First, flush or wash dye down the drain, fixture or manhole. Second, pop open downgradient sanitary sewer manholes and check to see if any dye appears. If none is detected in the sewer manhole after an hour or so, check downgradient storm drain manholes or outfalls for the presence of dye. Although dye testing is fairly straightforward, some tips to make testing go more smoothly are offered in Table 59.

Table 58: Dye Testing Options

Product	Applications
Dye Tablets	• Compressed powder, useful for releasing dye over time • Less messy than powder form • Easy to handle, no mess, quick dissolve • Flow mapping and tracing in storm and sewer drains • Plumbing system tracing • Septic system analysis • Leak detection
Liquid Concentrate	• Very concentrated, disperses quickly • Works well in all volumes of flow • Recommended when metering of input is required • Flow mapping and tracing in storm and sewer drains • Plumbing system tracing • Septic system analysis • Leak detection
Dye Strips	• Similar to liquid but less messy
Powder	• Can be very messy and must dissolve in liquid to reach full potential • Recommended for very small applications or for very large applications where liquid is undesirable • Leak detection
Dye Wax Cakes	• Recommended for moderate-sized bodies of water • Flow mapping and tracing in storm and sewer drains
Dye Wax Donuts	• Recommended for large sized bodies of water (lakes, rivers, ponds) • Flow mapping and tracing in storm and sewer drains • Leak detection

Table 59: Tips for Successful Dye Testing
(Adapted from Tuomari and Thompson, 2002)

Dye Selection
- Green and liquid dyes are the easiest to see.
- Dye test strips can be a good alternative for residential or some commercial applications. (Liquid can leave a permanent stain).
- Check the sanitary sewer before using dyes to get a "base color." In some cases, (e.g., a print shop with a permitted discharge to the sanitary sewer), the sewage may have an existing color that would mask a dye.
- Choose two dye colors, and alternate between them when testing multiple fixtures.

Selecting Fixtures to Test
- Check the plumbing plan for the site to isolate fixtures that are separately connected.
- For industrial facilities, check most floor drains (these are often misdirected).
- For plumbing fixtures, test a representative fixture (e.g., a bathroom sink).
- Test some locations separately (e.g., washing machines and floor drains), which may be misdirected.
- If conducting dye investigations on multiple floors, start from the basement and work your way up.
- At all fixtures, make sure to flush with plenty of water to ensure that the dye moves through the system.

Selecting a Sewer Manhole for Observations
- Pick the closest manhole possible to make observations (typically a sewer lateral).
- If this is not possible, choose the nearest downstream manhole.

Communications Between Crew Members
- The individual conducting the dye testing calls in to the field person to report the color dye used, and when it is dropped into the system.
- The field person then calls back when dye is observed in the manhole.
- If dye is not observed (e.g., after two separate flushes have occurred), dye testing is halted until the dye appears.

Locating Missing Dye
- The investigation is not complete until the dye is found. Some reasons for dye not appearing include:
- The building is actually hooked up to a septic system.
- The sewer line is clogged.
- There is a leak in the sewer line or lateral pipe.

Video Testing

Video testing works by guiding a mobile video camera through the storm drain pipe to locate the actual connection producing an illicit discharge. Video testing shows flows and leaks within the pipe that may indicate an illicit discharge, and can show cracks and other pipe damage that enable sewage or contaminated water to flow into the storm drain pipe.

Video testing is useful when access to properties is constrained, such as residential neighborhoods. Video testing can also be expensive, unless the community already owns and uses the equipment for sewer inspections. This technique will not detect all types of discharges, particularly when the illicit connection is not flowing at the time of the video survey.

Different types of video camera equipment are used, depending on the diameter and condition of the storm sewer being tested.

Field crews should review storm drain maps, and preferably visit the site before selecting the video equipment for the test. A field visit helps determine the camera size needed to fit into the pipe, and if the storm drain has standing water.

In addition to standard safety equipment required for all manhole inspections, video testing requires a Closed-Circuit Television (CCTV) and supporting items. Many commercially available camera systems are specifically adapted to televise storm sewers, ranging from large truck or van-mounted systems to much smaller portable cameras. Cameras can be self-propelled or towed. Some specifications to look for include:

- The camera should be capable of radial view for inspection of the top, bottom, and sides of the pipe and for looking up lateral connections.
- The camera should be color.
- Lighting should be supplied by a lamp on the camera that can light the entire periphery of the pipe.

When inspecting the storm sewer, the CCTV is oriented to keep the lens as close as possible to the center of the pipe. The camera can be self-propelled through the pipe using a tractor or crawler unit or it may be towed through on a skid unit (see Figures 65 and 66). If the storm drain has ponded water, the camera should be attached to a raft, which floats through the storm sewer from one manhole to the next. To see details of the sewer, the camera and lights should be able to swivel both horizontally and vertically. A video record of the inspection should be made for future reference and repairs (see Figure 67).

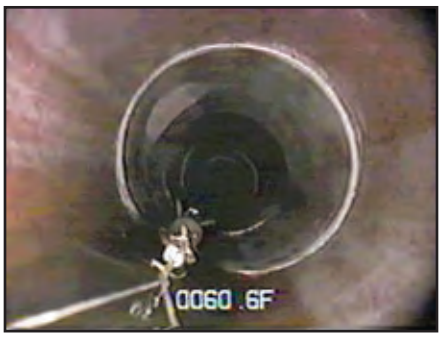


Figure 65: Camera being towed

Smoke Testing

Smoke testing is another "bottom up" approach to isolate illicit discharges. It works by introducing smoke into the storm drain system and observing where the smoke surfaces. The use of smoke testing to detect illicit discharges is a relatively new application, although many communities have used it to check for infiltration and inflow into their sanitary sewer network. Smoke testing can find improper

Figure 66: Tractor-mounted camera

Figure 67: Review of an inspection video

connections, or damage to the storm drain system (Figure 68). This technique works best when the discharge is confined to the upper reaches of the storm drain network, where pipe diameters are to small for video testing and gaining access to multiple properties renders dye testing infeasible.

Notifying the public about the date and purpose of smoke testing before starting is critical. The smoke used is non-toxic, but can cause respiratory irritation, which can be a problem for some residents. Residents should be notified at least two weeks prior to testing, and should be provided the following information (Hurco Technologies, Inc., 2003):

- Date testing will occur
- Reason for smoke testing
- Precautions they can take to prevent smoke from entering their homes or businesses
- What they need to do if smoke enters their home or business, and any health concerns associated with the smoke
- A number residents can call to relay any particular health concerns (e.g., chronic respiratory problems)

Program managers should also notify local media to get the word out if extensive smoke testing is planned (e.g., television, newspaper, and radio). On the actual day of testing, local fire, police departments and 911 call centers should be notified to handle any calls from the public (Hurco Technologies, Inc., 2003).

The basic equipment needed for smoke testing includes manhole safety equipment, a smoke source, smoke blower, and sewer plugs. Two smoke sources can be used for smoke testing. The first is a smoke "bomb," or "candle" that burns at a controlled rate and releases very white smoke visible at relatively low concentrations (Figure 69). Smoke bombs are suspended beneath a blower in a manhole. Candles are available in 30 second to three minute sizes. Once opened, smoke bombs should be kept in a dry location and should be used within one year.

The second smoke source is liquid smoke, which is a petroleum-based product that is injected into the hot exhaust of a blower where it is heated and vaporized (Figure 70). The length of smoke production can vary depending on the length of the pipe being

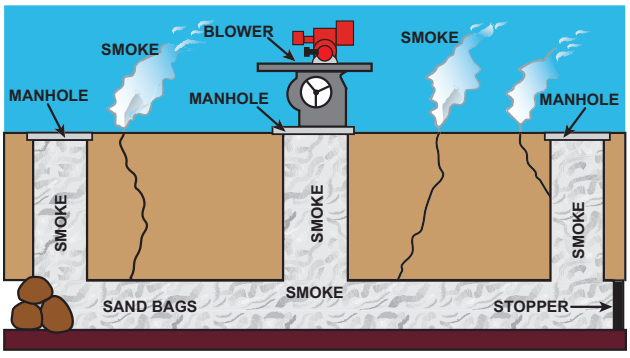


Figure 68: Smoke Testing System Schematic

Figure 69: Smoke Candles

Figure 70: Smoke blower

tested. In general, liquid smoke is not as consistently visible and does not travel as far as smoke from bombs (USA Blue Book).

Smoke blowers provide a high volume of air that forces smoke through the storm drain pipe. Two types of blowers are commonly used: "squirrel cage" blowers and direct-drive propeller blowers. Squirrel cage blowers are large and may weigh more than 100 pounds, but allow the operator to generate more controlled smoke output. Direct-drive propeller blowers are considerably lighter and more compact, which allows for easier transport and positioning.

Three basic steps are involved in smoke testing. First, the storm drain is sealed off by plugging storm drain inlets. Next, the smoke is released and forced by the blower through the storm drain system. Lastly, the crew looks for any escape of smoke above-ground to find potential leaks.

One of three methods can be used to seal off the storm drain. Sandbags can be lowered into place with a rope from the street surface. Alternatively, beach balls that have a diameter slightly larger than the drain can be inserted into the pipe. The beach ball is then placed in a mesh bag with a rope attached to it so it can be secured and retrieved. If the beach ball gets stuck in the pipe, it can simply be punctured, deflated and removed. Finally, expandable plugs are available, and may be inserted from the ground surface.

Blowers should be set up next to the open manhole after the smoke is started. Only one manhole is tested at a time. If smoke candles are used, crews simply light the candle, place it in a bucket, and lower it in the manhole. The crew then watches to see where smoke escapes from the pipe. The two most common situations that indicate an illicit discharge are when smoke is seen rising from internal plumbing fixtures (typically reported by residents) or from sewer vents. Sewer vents extend upward from the sewer lateral to release gas buildup, and are not supposed to be connected to the storm drain system.

13.4 Septic System Investigations

The techniques for tracing illicit discharges are different in rural or low-density residential watersheds. Often, these watersheds lack sanitary sewer service and storm water is conveyed through ditches or swales, rather than enclosed pipes. Consequently, many illicit discharges enter the stream as indirect discharges, through surface breakouts of septic fields or through straight pipe discharges from bypassed septic systems.

The two broad techniques used to find individual septic systems—on-site investigations and infrared imagery—are described in this section.

On-Site Septic Investigations

Three kinds of on-site investigations can be performed at individual properties to determine if the septic system is failing, including homeowner survey, surface condition analysis and a detailed system inspection. The first two investigations are rapid and relatively simple assessments typically conducted in targeted watershed areas. Detailed system inspections are a much more thorough investigation of the functioning of the septic system that is conducted by a certified professional. Detailed system inspections may occur at time of sale of a property, or be triggered by poor scores on the rapid homeowner survey or surface condition analysis.

Homeowner Survey

The homeowner survey consists of a brief interview with the property owner to determine the potential for current or future failure of the septic system, and is often done in conjunction with a surface condition analysis.

Table 60 highlights some common questions to ask in the survey, which inquire about resident behaviors, system performance and maintenance activity.

Surface Condition Analysis

The surface condition analysis is a rapid site assessment where field crews look for obvious indicators that point to current or potential production of illicit discharges by the septic system (Figure 71). Some of the key surface conditions to analyze have been described by Andrews *et al*., (1997) and are described below:

- Foul odors in the yard
- Wet, spongy ground; lush plant growth; or burnt grass near the drain field
- Algal blooms or excessive weed growth in adjacent ditches, ponds and streams
- Shrubs or trees with root damage within 10 feet of the system
- Cars, boats, or other heavy objects located over the field that could crush lateral pipes
- Storm water flowing over the drain field
- Cave-ins or exposed system components
- Visible liquid on the surface of the drain field (e.g., surface breakouts)
- Obvious system bypasses (e.g., straight pipe discharges)

Table 60: Septic System Homeowner Survey Questions
(Adapted from Andrews et al., 1997 and Holmes Inspection Services)

- How many people live in the house?[1]
- What is the septic tank capacity?[2]
- Do drains in the house empty slowly or not at all?
- When was the last time the system was inspected or maintained?
- Does sewage back up into the house through drain lines?
- Are there any wet, smelly spots in the yard?
- Is the septic tank effluent piped so it drains to a road ditch, a storm sewer, a stream, or is it connected to a farm drain tile?

[1] Water usage ranges from 50 to 100 gallons per day per person. This information can be used to estimate the wastewater load from the house (Andrews et. al, 1997).
[2] The septic tank should be large enough to hold two days' worth of wastewater (Andrews et. al, 1997).

a.  b. 

Figure 71: (a) Straight pipe discharge to nearby stream. (b) Algal bloom in a nearby pond.
(Sources: a- Snohomish County, WA, b- King County, WA)

Detailed System Inspection

The detailed system inspection is a much more thorough inspection of the performance and function of the septic system, and must be completed by a certified professional. The inspector certifies the structural integrity of all components of the system, and checks the depth of solids in the septic tank to determine if the system needs to be pumped out. The inspector also sketches the system, and estimates distance to groundwater, surface water, and drinking water sources. An example septic system inspection form from Massachusetts can be found at http://www.state.ma.us/dep/brp/wwm/soilsys.htm.

Although not always incorporated into the inspection, dye testing can sometimes point to leaks from broken pipes, or direct discharges through straight pipes that might be missed during routine inspection. Dye can be introduced into plumbing fixtures in the home, and flushed with sufficient running water. The inspector then watches the septic field, nearby ditches, watercourses and manholes for any signs of the dye. The dye may take several hours to appear, so crews may want to place charcoal packets in adjacent waters to capture dye until they can return later to retrieve them.

Infrared Imagery

Infrared imagery is a special type of photography with gray or color scales that represent differences in temperature and emissivity of objects in the image (www.stocktoninfrared.com), and can be used to locate sewage discharges. Several different infrared imagery techniques can be used to identify illicit discharges. The following discussion highlights two of these: aerial infrared thermography[13] and color infrared aerial photography.

Infrared Thermography

Infrared thermography is increasingly being used to detect illicit discharges and failing septic systems. The technique uses the temperature difference of sewage as a marker to locate these illicit discharges. Figure 72 illustrates the thermal difference

[13] Infrared thermography is also being used by communities such as Mecklenburg County and the City of Charlotte in NC to detect illicit discharges at outfalls.

between an outfall discharge (with a higher temperature) and a stream.

The equipment needed to conduct aerial infrared thermography includes an aircraft (plane or helicopter); a high-resolution, large format, infrared camera with appropriate mount; a GPS unit; and digital recording equipment. If a plane is used, a higher resolution camera is required since it must operate at higher altitudes. Pilots should be experienced since flights take place at night, slowly, and at a low altitude. The camera may be handheld, but a mounted camera will provide significantly clearer results for a larger area. The GPS can be combined with a mobile mapping program and a video encoder-decoder that encodes and displays the coordinates, date, and time (Stockton, 2000). The infrared data are analyzed after the flight by trained analysts to locate suspected discharges, and field crews then inspect the ground-truthed sites to confirm the presence of a failing septic system.

Late fall, winter, and early spring are typically the best times of year to conduct these investigations in most regions of the country. This allows for a bigger difference between receiving water and discharge temperatures, and interference from vegetation is minimized (Stockton, 2004b). In addition, flights should take place at night to minimize reflected and direct daylight solar radiation that may adversely affect the imagery (Stockton, 2004b).

Color Infrared Aerial Photography

Color infrared aerial photography looks for changes in plant growth, differences in soil moisture content, and the presence of standing water on the ground to primarily identify failing septic systems (Figure 73).

The Tennessee Valley Authority (TVA) uses color infrared aerial photography to detect failing septic systems in reservoir watersheds. Local health departments conduct follow-up ground-truthing surveys to determine if a system is actually failing (Sagona, 1986). Similar to thermography, it is recommended that flights take place at night, during leaf-off conditions, or when the water table is at a seasonal high (which is when most failures typically occur (U.S. EPA, 1999).

Figure 72: Aerial thermography showing sewage leak

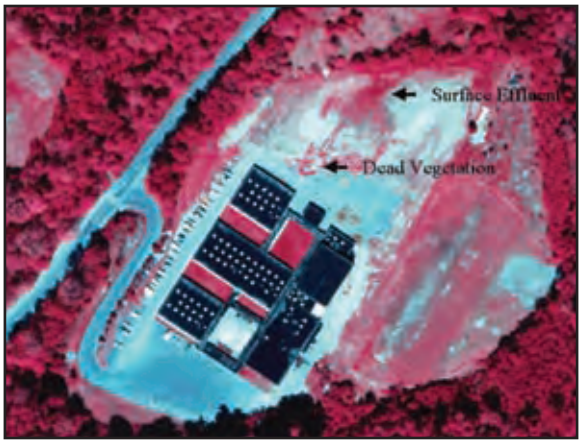


Figure 73: Dead vegetation and surface effluent are evidence of a septic system surface failure.
(Source: U.S. EPA, 1999)

13.5 The Cost to Trace Illicit Discharge Sources

Tracing illicit discharges to their source can be an elusive and complex process, and precise staffing and budget data are difficult to estimate. Experience of Phase I NPDES communities that have done these investigations in the past can shed some light on cost estimates. Some details on unit costs for common illicit discharge investigations are provided below.

Costs for Dye, Video, and Smoke Testing

The cost of smoke, dye, and video testing can be substantial and staff intensive, and often depend on investigation specific factors, such as the complexity of the drainage network, density and age of buildings, and complexity of land use. Wayne County, MI, has estimated the cost of dye testing at $900 per facility. Video testing costs range from $1.50 to $2.00 per foot, although this increases by $1.00 per foot if pipe cleaning is needed prior to testing.

Table 61 summarizes the costs of start-up equipment for basic manhole entry and inspection, which is needed regardless of which type of test is performed. Tables 62 through 64 provide specific equipment costs for dye, video and smoke testing, respectively.

Table 61: Common Field Equipment Needed for Dye, Video, and Smoke Testing

Item	Cost
1 Digital Camera	$200
Clipboards, Pens, Batteries	$25
1 Field vehicle	$15,000 - $35,000
1 First aid kit	$30
1 Spotlight	$40
1 Gas monitor and probe	$900 - $2,100
1 Hand-held GPS Unit	$150
2 Two-way radios	$250 - $750
1 Manhole hook	$80 - $130
1 Mirror	$70 - $130
2 Reflective safety vests	$40
Rubber/latex gloves (box of 100)	$25
1 Can of Spray Paint	$5
4 Traffic Cones	$50

Table 62: Equipment Costs for Dye Testing		
Product	**Water Volume**	**Cost**
Dye Strips	1 strip/500 gallons	$75 – $94 per 100 strips
Dye Tablets	0 – 50,000 gallons	$40 per 200 tablets
Liquid Concentrate (Rhodamine WT)	0 – 50,000 gallons	$80 – $90 per gallon $15 – $20 per pint
Powder	50,000 + gallons	$77 per lb
Dye Wax Cakes	20,000 – 50,000 gallons	$12 per one 1.25 ounce cake
Dye Wax Donuts	50,000 + gallons	$104 – $132 per 42 oz. donut
Price Sources: *Aquatic Eco-Systems http://www.aquaticeco.com/* *Cole Parmer http:/www.coleparmer.com* *USA Blue Book http:/www.usabluebook.com*		

Table 63: Equipment Costs for Video Testing	
Equipment	**Cost**
GEN-EYE 2™ B&W Sewer Camera with VCR & 200' Push Cable	$5,800
100' Push Rod and Reel Camera for 2" – 10" Pipes	$5,300
200' Push Rod and Reel Camera for 8" – 24" Pipes	$5,800
Custom Saturn III Inspection System 500' cable for 6-16" Lines	$32,000 ($33,000 with 1000 foot cable)
OUTPOST • Box with build-out • Generator • Washdown system	 $6,000 $2,000 $1,000
Video Inspection Trailer • 7'x10' trailer & build-out • Hardware and software package • Incidentals	 $18,500 $15,000 $5,000
Sprinter Chassis Inspection Vehicle • Van (with build-out for inspecting 6" – 24" pipes) • Crawler (needed to inspect pipes >24") • Software upgrade (optional but helpful for extensive pipe systems)	 $130,000 $18,000 $8,000
Sources: USA Blue Book and Envirotech	

Table 64: Equipment Costs for Smoke Testing	
Equipment	**Cost**
Smoke Blower	$1,000 to $2,000 each
Liquid Smoke	$38 to $45 per gallon
Smoke Candles, 30 second (4,000 cubic feet)	$27.50 per dozen
Smoke Candles, 60 Second (8,000 cubic feet)	$30.50 per dozen
Smoke Candles, 3 Minute (40,000 cubic feet)	$60.00 per dozen
Sources: Hurco Tech, 2003 and Cherne Industries, 2003	

Costs for Septic System Investigations

Most septic system investigations are relatively low cost, but factors such as private property access, notification, and the total number of sites investigated can increase costs. Unit costs for the three major septic system investigations are described below.

Homeowner Survey and Surface Condition Analysis

Both the homeowner survey and the surface condition analysis are relatively low cost investigation techniques. Assuming that a staff person can investigate one home per hour, the average cost per inspection is approximately $25. A substantial cost savings can be realized by using interns or volunteers to conduct these simple investigations.

Detailed System Inspection

Septic system inspections are more expensive, but a typical unit cost is about $250, and may also include an additional cost of pumping the system, at roughly $150, if pumping is required to complete the inspection (Wayne County, 2003). This cost is typically charged to the homeowner as part of a home inspection.

Aerial Infrared Thermography

The equipment needed to conduct aerial infrared thermography is expensive; cameras alone may range from $250,000 to $500,000 (Stockton, 2004a). However, private contractors provide this service. In general, the cost to contract an aerial infrared thermography investigation depends on the length of the flight (flights typically follow streams or rivers); how difficult it will be to fly the route; the number of heat anomalies expected to be encountered; the expected post-flight processing time (typically, four to five hours of analysis for every hour flown); and the distance of the site from the plane's "home" (Stockton, 2004a). The cost range is typically $150 to $400 per mile of stream or river flown, which includes the flight and post-flight analyses (Stockton, 2004a).

As an alternative, local police departments may already own an infrared imaging system that may be used. For instance, the Arkansas Department of Health used a state police helicopter with a Forward Looking Infrared (FLIR) imaging system, GPS, video equipment, and maps (Eddy, 2000). The disadvantage to this is that the equipment may not be available at optimal times to conduct the investigation. In addition, infrared imaging equipment used by police departments may not be sensitive enough to detect the narrow range of temperature difference (only a few degrees) often expected for sewage flows (Stockton, 2004a).

Appendix F

IDDE Employee Training Record

Illicit Discharge Detection and Elimination (IDDE)
Employee Training Record

Middleton, MA

Date of Training: _____

Duration of Training: _____

Name	Title	Signature

Attachment E – Catch Basin Inspection and Cleaning

ATTACHMENT E
CATCH BASIN INSPECTION AND CLEANING
STANDARD OPERATING PROCEDURE

This SOP and inspection form are based on a template that was created by the Central Massachusetts Regional Stormwater Coalition for use in municipalities across the state, as provided on the US EPA Region 1 Stormwater MS4 website.

Introduction

Catch basins help minimize flooding and protect water quality by removing trash, sediment, decaying debris, and other solids from stormwater runoff. These materials are retained in a sump below the invert of the outlet pipe. Catch basin cleaning reduces foul odors, prevents clogs in the storm drain system, and reduces the loading of suspended solids, nutrients, and bacteria to receiving waters.

During regular cleaning and inspection procedures, data can be gathered related to the condition of the physical basin structure and its frame and grate and the quality of stormwater conveyed by the structure. Observations such as the following can indicate sources of pollution within the storm drain system:

- Oil sheen
- Discoloration
- Trash and debris

Both bacteria and petroleum can create a sheen on the water surface. The source of the sheen can be differentiated by disturbing it, such as with a pole. A sheen caused by an oil will remain intact and move in a swirl pattern; a sheen caused by bacteria will separate and appear “blocky”. Bacterial sheen is not a pollutant, but should be noted.

Observations such as the following can indicate a potential connection of sanitary flow to the storm drain system, which is an illicit discharge.

- Indications of sanitary sewage, including fecal matter or sewage odors
- Foaming, such as from detergent
- Optical enhancers, fluorescent dye added to laundry detergent

Each catch basin should be cleaned and inspected at least annually. Catch basins in high-use areas may require more frequent cleaning. Performing street sweeping on an appropriate schedule will reduce the amount of sediment, debris, and organic matter entering the catch basins, which will in turn reduce the frequency with which structures need to be cleaned.

Cleaning Procedure

Catch basin inspection cleaning procedures should address both the grate opening and the basin’s sump. Document any and all observations about the condition of the catch basin structure and water quality on the Catch Basin Inspection Form (attached).

An excessive sediment or debris loading is assumed to be a catch basin sump more than 50 percent full. A catch basin sump is more than 50 percent full if the contents within the sump exceed one half of the distance between the bottom interior of the catch basin to the invert of the deepest outlet of the catch basin.

Catch basin inspection and cleaning procedures include the following:

1. Work upstream to downstream.
2. Clean sediment and trash off grate.
3. Visually inspect the outside of the grate.
4. Visually inspect the inside of the catch basin to determine cleaning needs.
5. Inspect catch basin for structural integrity.
6. Determine the most appropriate equipment and method for cleaning each catch basin.
    a. Manually use a shovel to remove accumulated sediments, or
    b. Use a bucket loader to remove accumulated sediments, or
    c. Use a high pressure washer to clean any remaining material out of catch basin while capturing the slurry with a vacuum.
    d. If necessary, after the catch basin is clean, use the rodder of the vacuum truck to clean downstream pipe and pull back sediment that might have entered downstream pipe.
7. If contamination is suspected, chemical analysis will be required to determine if the materials comply with the Massachusetts DEP Hazardous Waste Regulations, 310 CMR 30.000 (http://www.mass.gov/dep/service/regulations/310cmr30.pdf). Chemical analysis required will depend on suspected contaminants. Note the identification number of the catch basin on the sample label, and note sample collection on the Catch Basin Inspection Form.
8. Properly dispose of collected sediments. See the following section for guidance.
9. If fluids collected during catch basin cleaning are not being handled and disposed of by a third party, dispose of these fluids to a sanitary sewer system, with permission of the system operator.
10. If illicit discharges are observed or suspected, notify the appropriate Department (see the IDDE Plan for procedures).
11. At the end of each day, document location and number of catch basins cleaned, amount of waste collected, and disposal method for all screenings.
12. Report additional maintenance or repair needs to the appropriate department.

Disposal of Screenings

The discharge of decant wastewater and/or any other wastewater associated with catch basin maintenance to a watercourse or wetland, or returned to a catch basin or storm drain system, is prohibited. However, catch basin cleanings from storm water-only drainage systems may be disposed at any landfill that is permitted by MassDEP to accept solid waste. MassDEP usually does not require stormwater-only catch basin cleanings to be tested before disposal, unless there is evidence of contamination. Contaminated catch basin cleanings must be evaluated in accordance with the Hazardous Waste Regulations, 310 CMR 30.000, and handled as Hazardous Waste if appropriate. Any cleanings from combined sewers may be required to be tested before disposal

Screenings may need to be placed in a drying bed to allow water to evaporate before proper disposal. In this case, ensure that the screenings are managed to prevent pollution.

In Massachusetts, the only option for reuse of catch basin cleanings is at landfills. As discussed previously, catch basin cleanings must be sufficiently dry and free of decant liquid prior to re-use. Otherwise, the material will need to undergo a Paint Filter Liquids Test. This test consists of placing a predetermined amount of material in a paint filter, and if any material passes through the filter within a five minute period, the material is considered to contain free liquids (EPA, 2004). Once catch basin cleanings are sufficiently dry or have passed the Paint Filter Liquids Test, they may be used as grading and shaping material at landfills undergoing closure. Catch basin cleanings may also be used as a daily cover or grading material at active landfills, but only with specific MassDEP approval of the proposed use.

MassDEP 310 CMR19.130 (7) prohibits Massachusetts landfills from accepting materials with free draining liquids. The agency will generally be satisfied that the material is sufficiently dry if there is no free water in a truck used to transport the catch basin cleanings. Otherwise, the material will need to undergo a Paint Filter Liquids Test. However, catch basin cleanings can be used as grading and shaping material at landfills undergoing closure.

The cleanings may be used as a daily cover or grading material at active landfills only with specific MassDEP approval of the proposed use.

CATCH BASIN INSPECTION FORM

Catch Basin I.D.	_____	**Final Discharge from Structure?** Yes ☐ No ☐ **If Yes, Discharge to Outfall No:**_____	
Catch Basin Label:	**Stencil** ☐ **Ground Inset** ☐ **Sign** ☐ **None** ☐ **Other**_____		
Basin Material:	Concrete ☐ Corrugated metal ☐ Stone ☐ Brick ☐ Other: _____ ☐	**Catch Basin Condition:**	Good ☐ Poor ☐ Fair ☐ Crumbling ☐
Pipe Material:	Concrete ☐ HDPE ☐ PVC ☐ Clay Tile ☐ Other:_____	**Pipe Measurements:**	Inlet Dia. (in): d= ____ Outlet Dia. (in): D= ____

Required Maintenance/ Problems (check all that apply):

- ☐ Tree Work Required
- ☐ New Grate is Required
- ☐ Pipe is Blocked
- ☐ Frame Maintenance is Required
- ☐ Remove Accumulated Sediment
- ☐ Pipe Maintenance is Required
- ☐ Basin Undermined or Bypassed
- ☐ Cannot Remove Cover
- ☐ Ditch Work
- ☐ Corrosion at Structure
- ☐ Erosion Around Structure
- ☐ Remove Trash & Debris
- ☐ Need Cement Around Grate

Other: _____

Catch Basin Grate Type :	**Sediment Buildup Depth :**	**Description of Flow:**	**Street Name/ Structure Location:**
Bar: ☐ Cascade: ☐ Other:_____ Properly Aligned: Yes ☐ No ☐	0-6 (in): _____ 6-12(in): _____ 12-18 (in): _____ 18-24 (in): _____ 24 + (in): _____	Heavy ☐ Moderate ☐ Slight ☐ Trickling ☐	

***If the outlet is submerged check yes and indicate approximate height of water above the outlet invert.** h above invert (in):__	Yes ☐	No ☐

☐ **Flow**
☐ **Standing Water**
(check one or both)

Observations:	
Color:	
Odor:	

Weather Conditions : Dry > 24 hours ☐ Wet ☐

Sample of Screenings Collected for Analysis? Yes ☐ No ☐

Comments:

Circle those present:

Foam	Oil Sheen
Sanitary Waste	Bacterial Sheen
Orange Staining	Floatables
Excessive sediment	Pet Waste
Other:_____	Optical Enhancers

Attachment F – Street Sweeping Procedures

Standard Operating Procedures – Middleton SWMP Attachment F

Middleton Department of Public Works

Sweeping Streets and Parking Lots

Issue Date: 6/30/19

Approved by:

Kenneth Gibbons

_____

Superintendent of Public Works

Purpose of SOPs:

Procedures for the operation and maintenance of street sweepers, frequency of sweeping, disposal of debris, and recordkeeping to prevent pollution from entering the stormwater sewer systems.

MA Small MS4 General Permit Requirement Summary:

Part 2.3.7.a.iii.3.

The permittee shall establish and implement procedures for sweeping and/or cleaning streets, and permittee-owned parking lots. All streets with the exception of rural uncurbed roads with no catch basins or high speed limited access highways shall be swept and/or cleaned a minimum of once per year in the spring (following winter activities such as sanding). The procedures shall also include more frequent sweeping of targeted areas determined by the permittee on the basis of pollutant load reduction potential, based on inspections, pollutant loads, catch basin cleaning or inspection results, land use, water quality limited or TMDL waters or other relevant factors as determined by the permittee. The permittee shall report in each annual report the number of miles cleaned or the volume or mass of material removed.

For rural uncurbed roadways with no catch basins and limited access highways, the permittee shall either meet the minimum frequencies above, or develop and implement an inspection, documentation and targeted sweeping plan with two (2) years of the effective date of the permit, and submit such plan with its year one annual report.

Part 2.3.a.iii.4.

The permittee shall ensure proper storage of catch basin cleanings and street sweepings prior to disposal or reuse such that they do not discharge to receiving waters.

Equipment Inventory:

The following is a list of street sweeping equipment:

Equipment Number	Make	Description	Sweeper Speed (or other notes)
01	Bobcat	Bobcat Broom	
02	Contractor	American Sweeping	Tri-Town Consortium

[Expand table as necessary]

Standard Operating Procedures – Middleton SWMP Attachment F *Middleton Department of Public Works* **Sweeping Streets and Parking Lots**	**Issue Date: 6/30/19**

Operations

1. Operate all sweepers and equipment according to the manufacturer's recommended settings, standards, and procedures.

2. While sweeping, drive between the optimal sweeping speed limit, as recorded in the equipment list above.

3. Sweeping will not take place during rain events more substantial than a mist.

4. If spills occur or illegal discharges are seen, report to:
   Kenneth Gibbons, Superintendent of Public Works
   978-777-0407

Maintenance

1. Sweepers will be checked for leaks weekly. Immediately contain and properly clean up any spills.

2. Regular preventative maintenance to prolong equipment use (such as greasing moving parts and minor adjustments) occur seasonally.

3. Parts are replaced as-needed. Brushes are replaced when bristle length is less than eight inches.

4. Equipment is washed at the Public Works yard located at 195 North Main Street, Middleton, MA 01949 to trap grease, oils and sediment.

5. The left-over debris is scraped out from the hopper at the end of each day.

Schedule

1. Street sweeping will primarily take place between the months of April and May.

2. All streets with curbing and/or catch basins shall be swept a minimum of once per year in the spring (following winter activities such as sanding). Streets are swept according to the street list and schedule located at the DPW Office.

3. Priority roads and parking lots are identified on the basis of pollutant load reduction potential, based on inspections, pollutant loads, catch basin cleaning or inspection results, land use, impaired or TMDL waters or other relevant factors. These roads and parking lots are listed below and will be swept more frequently as indicated in the table.

Priority Road/ Parking Lot Name (or Category)	Frequency of Sweeping
Maple Street (Route 62)	Annually. Sweeping performed first
Boston Street (Route 62)	Annually. Sweeping performed first

The list of priority roads and parking lots will be reassessed annually.

4. The sweeping schedule is assessed annually and updated as necessary.

5. A map of town roads and parking lots is located at the DPW Office, located at 195 North Main Street, Middleton, MA 01949.

Storage and Disposal

1. Temporary storage of solid sweeping debris is on an impervious surface or in a truck/dumpster that is protected from runoff. The storage location is the DPW yard located at 195 North Main Street, Middleton, MA 01949.

2. Solid sweeping debris is brought to the Oakdale Cemetery for permanent disposal. If applicable, solid sweeping debris will be reused as fill in public ways and parking lots following the MassDEP Reuse and Disposal of Street Sweepings Policy. Debris is permanently disposed of annually.

3. Decant water is discharged to the DPW Building back lot.

4. Weighing process: The amount of solid sweeping debris is counted by load.

Training

1. Employees are trained annually on this procedure and the proper operation of equipment. Employees are also trained on stormwater pollution prevention, spill and response, and illicit discharge detection and elimination procedures.

Standard Operating Procedures – Middleton SWMP Attachment F *Middleton Department of Public Works* **Sweeping Streets and Parking Lots**	**Issue Date: 6/30/19**

Record Keeping

1. Records are kept electronically and at the Public Works Building located at 195 North Main Street, Middleton, MA 01949.

2. *The number of miles swept* are recorded after each sweeping.

3. The number of curb miles swept per *year* is calculated *annually*.

4. A list of employees implementing the SOPs and the completion of their training(s) can be found at the Middleton Public Works Office located at 195 North Main Street, Middleton, MA 01949.

Revising the SOPs

1. These procedures are reviewed annually and updated as needed.

Attachment G – Winter Road Maintenance

STANDARD OPERATING PROCEDURE – SWMP ATTACHMENT G **MIDDLETON DEPARTMENT OF PUBLIC WORKS** **PROGRAM:** Snow Removal and De-Icing	**SOP NUMBER:**	**ISSUE DATE:** 6/30/19

APPROVED BY:

Kenneth Gibbons

_____

Superintendent of Public Works

MA SMALL MS4 PERMIT REQUIREMENT SUMMARY:

Part 2.3.7.a.iii.5.
The permittee shall establish and implement procedures for winter road maintenance including the use and storage of salt and sand; minimize the use of sodium chloride and other salts, and evaluate opportunities for use of alternative materials; and ensure that snow disposal activities do not result in disposal of snow into waters of the United States. For purposes of this MS4 Permit, salt shall mean any chloride-containing material used to treat paved surfaces for deicing, including sodium chloride, calcium chloride, magnesium chloride, and brine solutions.

Personnel

The following personnel are responsible for snow and ice removal. Employees performing the procedures in this SOP shall attend yearly stormwater pollution prevention training.

TABLE 1

Name	Responsibility
Kenneth Gibbons	DPW Superintendent
Paul Goodwin	Deputy DPW Superintendent

Equipment

The municipality owns and maintains ice control and snow removal equipment listed in Table 2. Equipment maintenance shall be conducted consistent with the Vehicles and Equipment maintenance SOP maintained at the DPW Office**.** The wash bay/ area is located at the DPW yard located at 195 North Main Street, Middleton, MA 01949.

Plowing
When conditions warrant, plows are installed on the five larger trucks to move snow from the traveled roadway. Average time to install a plow is approximately 30 minutes. Six smaller trucks are available for plowing of residential streets and clearing public lots.

Sand Spreaders
When conditions warrant, sand spreaders are installed on the five larger trucks to spread sand on the traveled roadway. Each sand spreader is calibrated prior to the deicing season and every month thereafter. Sand spreaders are calibrated to dispense 250 pounds of sand per lane mile.

Salt Spreaders and Pre-Wetting Devices

When conditions warrant, salt spreaders are installed on the five larger trucks to spread salt on the traveled roadway. Each salt spreader is calibrated prior to the deicing season and every month thereafter. Salt application shall be calibrated to dispense rates of 250-300 pounds per lane mile (depending on conditions).

TABLE 2

Equipment Number	Make	Description	Additional Equipment	Primary Use
01	International	7400	Spreader, 11’ plow	General Salting & Plowing
02	International	7400	Spreader, 11’ plow	General Salting & Plowing
03	Freightliner	Business	Spreader, 11’ plow	General Salting & Plowing
04	Peterbilt	Conventional	Spreader, 11’ plow	General Salting & Plowing
05	Peterbilt	Conventional	Spreader, 11’ plow	General Salting & Plowing
06	Ford	F350	9’ plow	Plowing
07	Ford	F250	8’ Plow	Plowing
08	Ford	F550	10’ Plow	Plowing
09	Ford	F550	10’ Plow	Plowing
10	Ford	F550	10’ Plow	Plowing
11	Ford	F350	9’ Plow	Plowing

Other Equipment available from other divisions: Limited contractors used to supplement Town equipment.

Materials

The major materials used in snow and ice control are coarse sand, coarse salt, anti-icing agent. These materials are stockpiled in advance of an event and are immediately available when needed and stocks are replenished between events.

Sand

Sand is used as an abrasive for traction on slick roadways. Approximately 2000 cubic yards are anticipated to be used per year and are ordered from Tri-Town Consortium prior to each deicing season. Sand is stored in the covered facility located at 195 North Main Street, Middleton, MA 01949. Loading areas and yards are swept after each storm event to prevent sand build-up and run-off.

Salt

Salt is used to expedite the melting of snow and ice from the street surface and also to keep the ice from forming a bond to the street surface. Approximately 2000 tons of road salt are anticipated to be used per year and are ordered from Eastern Minerals prior to each deicing season. Salt is stored in the covered facility located at 195

North Main Street, Middleton, MA 01949. Loading areas and yards are swept after each storm event to prevent salt build-up and run-off.

Procedures

Anti-Icing

1. Whenever possible, the anti-icing product is applied to the roadway prior to the beginning of a storm to prevent snow from bonding to the roadway surface, and also used when heavy frost or black ice is expected to be an issue for commuters. Kenneth Gibbons will instruct staff when anti icing is appropriate. Anti-icing will not be done prior to freezing rain or when pavement temperatures are below 10 degrees F.
2. Prior to anti-icing application, equipment will be checked to ensure proper working order and ensure proper calibration of equipment. All fluid levels will be checked and filled to proper levels, all lights must be in working order. A visual walk-around inspection of the truck or equipment must be made. Any repairs must be made and reported to a supervisor or mechanic before leaving the yard.
3. Anti-icing chemical will only be applied to priority routes- Maple Street, Boston Street, River Street, Forest Street, Essex Street, School Street, Liberty Street, Peabody Street, Mill Street, East Street, Locust Street, Village Street, Gregory Street, Lakeview Avenue, and Lake Street.
4. Anti-Icing vehicle optimal speed is under 15 MPH.
5. Before parking any truck or equipment after use, all fluid levels will be checked and filled. All minor repairs will be done by the operator. Any repairs the operator cannot perform will be written up on the proper forms and turned in to Kenneth Gibbons. Kenneth Gibbons will determine importance and will assign the repairs according to schedule. All deicing chemical will be washed from equipment at the wash bay or designated wash area.

Salt Application

1. Whenever conditions warrant, salt is applied to the roadway prior to accumulation of snow to prevent compacted snow from bonding to the roadway surface. Kenneth Gibbons will instruct staff when salt application is appropriate. Salting will not be done when pavement temperatures are above 32 degrees F or below 15 degrees F.
2. Prior to salt application, equipment will be checked to ensure proper working order and ensure proper calibration of equipment. All fluid levels will be checked and filled to proper levels, all lights must be in working order. A visual walk-around inspection of the truck or equipment must be made. Any repairs must be made and reported to a supervisor or mechanic before leaving the yard.
3. The standard salt application speed is: 15 mph.
4. Follow the prioritized route or schedule. This schedule is located at the DPW Office.
5. Before parking any truck or equipment after use, all fluid levels will be checked and filled. All minor repairs will be done by the operator. Any repairs the operator cannot perform will be written up on the proper forms and turned in to Kenneth Gibbons**.** Kenneth Gibbons will determine importance and will assign the repairs according to schedule. All deicing chemical will be washed from equipment at the wash bay or designated wash area.

STANDARD OPERATING PROCEDURE – SWMP ATTACHMENT G **MIDDLETON DEPARTMENT OF PUBLIC WORKS** **PROGRAM:** Snow Removal and De-Icing	**SOP NUMBER:**	**ISSUE DATE:** 6/30/19

Snow Plowing

1. As the storm develops and one inch of snow has accumulated, all of the drivers and available equipment will begin to plow their assigned routes.
2. Prior to plowing operations, equipment will be checked to ensure proper working order. All fluid levels will be checked and filled to proper levels, all lights must be in working order. A visual walk-around inspection of the truck or equipment must be made. Any repairs must be made and reported to a supervisor or mechanic before leaving the yard.
3. Avoid plowing, pushing, blowing or storing excess snow, deicer, or other debris in or near creeks, watercourses or storm drainage systems.
4. Reduce plowing speed in sensitive areas (near creeks, wetlands or other water courses) to prevent snow and deicing materials from entering waterways.
5. The standard plowing speed is: 15 mph.
6. Follow the prioritized route or schedule. This schedule is located at the DPW Building.
7. Before parking any truck or equipment after use, all fluid levels will be checked and filled. Blades or bolts, which need replacing, will be taken care of unless told to do otherwise. Chains that need repairs will be repaired. All minor repairs will be done by the operator. Any repairs the operator cannot perform will be written up on the proper forms and turned in to Kenneth Gibbons. Kenneth Gibbons will determine importance and will assign the repairs according to schedule.

Sand Application

1. Whenever conditions warrant, sand is applied to the roadway to increase traction. Kenneth Gibbons will instruct staff when sand application is appropriate. Sanding will not be done when pavement temperatures are above 15 degrees F.
2. Prior to sand application, equipment will be checked to ensure proper working order and ensure proper calibration of equipment. All fluid levels will be checked and filled to proper levels, all lights must be in working order. A visual walk-around inspection of the truck or equipment must be made. Any repairs must be made and reported to a supervisor or mechanic before leaving the yard.
3. The standard sanding speed is: 15 mph.
4. Follow the prioritized route or schedule. This schedule is located at the DPW Office.
5. Before parking any truck or equipment after use, all fluid levels will be checked and filled. Blades or bolts, which need replacing, will be taken care of unless told to do otherwise. Chains that need repairs will be repaired. All minor repairs will be done by the operator. Any repairs the operator cannot perform will be written up on the proper forms and turned in to Kenneth Gibbons. Kenneth Gibbons will determine importance and will assign the repairs according to schedule.

Record Keeping and Documentation

The following documents and records will be maintained at the DPW Building, located at 195 North Main Street, Middleton, MA 01949.

1. Maintain a master schedule of prioritized snow and sanding routes and the miles or roads plowed or sanded.
2. Keep copies of manufacturer's recommendations for equipment calibration, plowing speed and salt/sand application rates.
3. Keep records of the amounts of salt, sand, liquid deicer, and salt alternatives applied per season.

4. Keep a list of all employees trained in the facility's Stormwater Pollution Prevention binder or computer file.

Attachment H – Stormwater BMP Inspection

MIDDLETON SWMP
ATTACHMENT H
STANDARD OPERATING PROCEDURE FOR INSPECTING CONSTRUCTED BEST MANAGEMENT PRACTICES

Best Management Practices (BMPs) are policies, procedures and structures designed to reduce stormwater pollution, prevent contaminant discharges to natural water bodies, and reduce stormwater facility maintenance costs. Constructed BMPs are permanent site features designed to treat stormwater before infiltrating it to the subsurface or discharging it to a surface water body.

This Standard Operating Procedure (SOP) provides a general summary of inspection procedures for eight common constructed BMPs, including:

1. Bioretention Areas and Rain Gardens
2. Constructed Stormwater Wetlands
3. Extended Dry Detention Basins
4. Proprietary Media Filters
5. Sand and Organic Filters
6. Wet Basins
7. Dry Wells
8. Infiltration Basins

This SOP and inspection forms provided at the end of this document are based on a template that was created by Central Massachusetts Regional Stormwater Coalition for use in municipalities across the state, and is provided on the US EPA Region 1 MS4 website for use by MS4 permittees. This SOP is based on the Massachusetts Stormwater Handbook and is not intended to replace that document. This SOP is also not intended to replace the Stormwater BMP Operation and Maintenance (O&M) Plan required by the Massachusetts Wetlands Protection Act, Order of Conditions.

Bioretention Areas and Rain Gardens

Bioretention areas and rain gardens are shallow depressions filled with sandy soil, topped with a thick layer of mulch and planted with dense native vegetation. There are two types of bioretention cells:

1. Filtering bioretention area: Areas that are designed solely as an organic filter; and
2. Exfiltration bioretention area: Areas that are configured to recharge groundwater in addition to acting as a filter.

Inspection & Maintenance

Regular inspection and maintenance are important to prevent against premature failure of bioretention areas or rain gardens. Regular inspection and maintenance of pretreatment devices and bioretention cells for sediment buildup, structural damage and standing water can extend the life of the soil media.

Maintenance Schedule: Bioretention Areas and Rain Gardens

Activity	Time of Year	Frequency
Inspect for soil erosion and repair	Year round	Monthly
Inspect for invasive species and remove if present	Year round	Monthly
Remove trash	Year round	Monthly
Mulch Void Areas	Spring	Annually
Remove dead vegetation	Fall and Spring	Bi-Annually
Replace dead vegetation	Spring	Annually
Prune	Spring or Fall	Annually
Replace all media and vegetation	Late Spring/Early Summer	As Needed

When failure is discovered, excavate the bioretention area, scarify the bottom and sides, replace the filter fabric and soil, replant vegetation and mulch the surface.

Never store snow within a bioretention area or rain garden. This would prevent required water quality treatment and the recharge of groundwater.

Constructed Stormwater Wetlands

Constructed stormwater wetlands maximize the pollutant removal from stormwater through the use of wetland vegetation uptake, retention and settling. Constructed storm water wetlands must be used in conjunction with other BMPs, such as sediment forebays.

Inspection & Maintenance

Regular inspection and maintenance are important to prevent against premature failure of bioretention areas or rain gardens. Regular inspection and maintenance of pretreatment devices and bioretention cells for sediment buildup, structural damage and standing water can extend the life of the soil media.

Maintenance Schedule, Constructed Stormwater Wetlands: Years 0-3

Activity	Time of Year	Frequency
Inspect for invasive species and remove if present	Year round	Monthly
Record and Map:	Year round	Annually
Types and distribution of dominant wetland plants	Year round	Bi-Annually
Presence and distribution of planted wetland species	Spring	Annually
Presence and distribution of invasive species	Fall and Spring	Bi-Annually
Indications other species are replacing planted wetland species	Spring	Annually
Percent of standing water that is not vegetated	Spring or Fall	Annually
Replace all media and vegetation	Late Spring/Early Summer	As Needed
Stability of original depth zones and micro-topographic features	Year round	Annually
Accumulation of sediment in the forebay and micropool and survival rate of plants	Spring/Summer	Annually

Maintenance Schedule, Constructed Stormwater Wetlands: Years 4-Lifetime

Activity	Time of Year	Frequency
Inspect for invasive species and remove if present	Year round	Monthly
Clean forebays	Year round	Annually
Clean sediment in basin/wetland system	Year round	Once every 10 years
Mulch Void Areas	Spring	Annually
Remove dead vegetation	Fall and Spring	Bi-Annually
Replace dead vegetation	Spring	Annually
Prune	Spring or Fall	Annually
Replace all media and vegetation	Late Spring/Early Summer	As Needed

When failure is discovered, excavate the bioretention area, scarify the bottom and sides, replace the filter fabric and soil, replant vegetation and mulch the surface.

Never store snow within a constructed stormwater wetland. This would prevent required water quality treatment and the recharge of groundwater.

Extended Dry Detention Basins

Extended dry detention basins are designed to control both stormwater quantity and quality. These BMPs are designed to hold stormwater for at least 24 hours, allowing solids to settle and to reduce local and downstream flooding. Pretreatment is required to reduce the potential for overflow clogging. The outflow may be designed as either fixed or adjustable. Additional nutrient removal may be achieved by a micropool or shallow marsh.

Inspection & Maintenance

Annual inspection of extended dry detention basins is required to ensure that the basins are operating properly. Potential problems include: erosion within the basin and banks, tree growth on the embankment, damage to the emergency spillway and sediment accumulation around the outlet. Should any of these problems be encountered, necessary repairs should be made immediately.

Maintenance Schedule: Extended Dry Detention Basins

Activity	Time of Year	Frequency
Inspect basins	Spring and Fall	Bi-Annually, and during and after major storms
Examine outlet structure for clogging or high outflow release velocities	Spring and Fall	Bi-Annually
Mow upper stage, side slopes, embankment and emergency spillway	Spring through Fall	Bi-Annually
Remove trash and debris	Spring	Bi-Annually
Remove sediment from basin	Year round	At least once every 5 years

Proprietary Media Filters

Media Filters are designed to reduce total suspended solids and other target pollutants, such as organics, heavy metals or nutrients, which are absorbed onto the filter media, which is contained in a concrete

structure. The substrate used as filter media depends on the target pollutants, and may consist of leaf compost, pleated fabric, activated charcoal, perlite, amended sand in combination with perlite, and zeolite. Two types of Media Filters are manufactured: Dry Media Filters, which are designed to dewater within 72 hours; and Wet Media Filters, which maintain a permanent pool of water as part of the treatment system.

Inspection & Maintenance

Maintenance in accordance with the manufacturer's requirements is necessary to ensure stormwater treatment. Inspection or maintenance of the concrete structure may require OSHA confined space training. Dry Media Filters are required to dewater in 72 hours, thus preventing mosquito and other insect breeding. Proper maintenance is essential to prevent clogging. Wet Media Filters require tight fitting seals to keep mosquitoes and other insects from entering and breeding in the permanent pools. Required maintenance includes routine inspection and treatment.

Maintenance Schedule: Proprietary Media Filters

Activity	Time of Year	Frequency
Inspect for standing water, trash, sediment and clogging	Per manufacturer's schedule	Bi-Annually (minimum)
Remove trash and debris	N/A	Each Inspection
Examine to determine if system drains in 72 hours	Spring, after large storm	Annually
Inspect filtering media for clogging	Per manufacturer's schedule	Per manufacturer's schedule

Sand and Organic Filters

Sand and organic filters, also known as filtration basins, are intended for quality control rather than quantity control. These filters improve water quality by removing pollutants through a filtering media and settling pollutants on top of the sand bed and/or in a pretreatment basin. Pretreatment is required to prevent filter media from clogging. Runoff from the filters is typically discharged to another BMP for additional treatment.

Inspection & Maintenance

If properly maintained, sand and organic filters have a long design life. Maintenance requirements include raking the sand and removing sediment, trash and debris from the surface of the BMP. Over time, fine sediments will penetrate deep into the sand requiring replacement of several inches or the entire sand layer. Discolored sand is an indicator of the presence of fine sediments, suggesting that replacement of the sand should be completed.

Maintenance Schedule: Proprietary Media Filters

Activity	Frequency
Inspect filters and remove debris	After every major storm for the first 3 months after construction completion. Every 6 months thereafter.

Wet Basins

Wet basins are intended to treat stormwater quality through the removal of sediments and soluble pollutants. A permanent pool of water allows sediments to settle and removes the soluble pollutants, including some metals and nutrients. Additional dry storage is required to control peak discharges during large storm events, and if properly designed and maintained wet basins can add fire protection, wildlife habitat and aesthetic values to a property.

Inspection & Maintenance

To ensure proper operation, wet basin outfalls should be inspected for evidence of clogging or excessive outfall releases. Potential problems to investigate include erosion within the basin and banks, damage to the emergency spillway, tree growth on the embankment, sediment accumulation around the outlet and the emergence of invasive species. Should any of these problems be encountered, perform repairs immediately. An on-site sediment disposal area will reduce sediment removal costs.

Maintenance Schedule: Wet Basins

Activity	Time of Year	Frequency
Inspect wet basins	Spring and/or Fall	Annually (Minimum)
Mow upper stage, side slopes, embankment and emergency spillway	Spring through Fall	Bi-Annually (Minimum)
Remove sediment, trash and debris	Spring through Fall	Bi-Annually (Minimum)
Remove sediment from basin	Year round	As required, but at least once every 10 years

Dry Wells

Dry wells are used to infiltrate uncontaminated runoff. These BMPs should never be used to infiltrate stormwater or runoff that has the potential to be contaminated with sediment and other pollutants. Dry wells provide groundwater recharge and can reduce the size and cost required of downstream BMPs or storm drains. However, they are only applicable in drainage areas of less than one acre and may experience high failure rates due to clogging.

Inspection & Maintenance

Proper dry well function depends on regular inspection. Clogging has the potential to cause high failure rates. The water depth in the observation well should be measured at 24 and 48 hour intervals after a storm and the clearance rate calculated. The clearance rate is calculated by dividing the drop in water level (inches) by the time elapsed (hours).

Maintenance Schedule: Dry Wells

Activity	Frequency
Inspect dry wells	After every major storm for the first 3 months after construction completion. Annually thereafter.

Infiltration Basins

Infiltration basins are designed to contain stormwater quantity and provide groundwater recharge. Pollution prevention and pretreatment are required to ensure that contaminated stormwater is not infiltrated. Infiltration basins reduce local flooding and preserve the natural water balance of the site, however high failure rates often occur due to improper siting, inadequate pretreatment, poor design and lack of maintenance.

Inspection & Maintenance

Regular maintenance is required to prevent clogging, which results in infiltration basin failure. Clogging may be due to upland sediment erosion, excessive soil compaction or low spots. Inspections should include signs of differential settlement, cracking, erosion, leakage in the embankments, tree growth on the embankments, riprap condition, sediment accumulation and turf health.

Maintenance Schedule: Infiltration Basins

Activity	Time of Year	Frequency
Preventative maintenance	Spring and Fall	Bi-Annually
Inspection	Spring and Fall	After every major storm for the first 3 months after construction completion. Bi-annually thereafter and discharges through the high outlet orifice.
Mow/rake buffer area, side slopes and basin bottom	Spring and Fall	Bi-Annually
Remove trash, debris and organic matter	Spring and Fall	Bi-Annually

INSPECTION OF BIORETENTION AREAS / RAIN GARDENS

General Information

BMP Description	Bioretention Area / Rain Garden		
BMP Location			
Inspector's Name			
Date of Inspection		Date of Last Inspection	
Start Time		End Time	
Type of Inspection: Regular ☐ Pre-Storm Event ☐ During Storm Event ☐ Post-Storm Event ☐			
Describe the weather conditions at time of inspection			

Specific Information

Maintenance Activity	Maintenance Frequency	Is Status of BMP Satisfactory?	Corrective Action Needed
Inspect for soil erosion and repair	Monthly	Yes ☐ No ☐	
Inspect for invasive species and remove if present	Monthly	Yes ☐ No ☐	
Remove trash	Monthly	Yes ☐ No ☐	
Mulch void areas	Annually	Yes ☐ No ☐	
Remove dead vegetation	Bi-Annually	Yes ☐ No ☐	
Replace dead vegetation	Annually	Yes ☐ No ☐	
Prune	Annually	Yes ☐ No ☐	
Replace all media and vegetation	As Needed	Yes ☐ No ☐	

INSPECTION OF CONSTRUCTED STORMWATER WETLANDS
Years 0-3 of Operation

General Information

BMP Description	Constructed Stormwater Wetland		
BMP Location			
Inspector's Name			
Date of Inspection		Date of Last Inspection	
Start Time		End Time	
Type of Inspection: Regular ☐ Pre-Storm Event ☐ During Storm Event ☐ Post-Storm Event ☐			
Describe the weather conditions at time of inspection			

Specific Information

Maintenance Activity	Maintenance Frequency	Is Status of BMP Satisfactory?	Corrective Action Needed
Inspect for invasive species and remove if present	Monthly	Yes ☐ No ☐	
Replace all media and vegetation	As Needed	Yes ☐ No ☐	

In addition, the following information should be recorded and mapped at least once per year:

- Types and distribution of dominant wetland plants
- Presence and distribution of planted wetland species
- Presence and distribution of invasive species
- Indications other species are replacing planted wetland species
- Percent of standing water that is not vegetated
- Replace all media and vegetation
- Stability of original depth zones and micro-topographic features
- Accumulation of sediment in the forebay and micropool and survival rate of plants

INSPECTION OF CONSTRUCTED STORMWATER WETLANDS
Year 4 - Lifetime of Operation

General Information

BMP Description	Constructed Stormwater Wetland		
BMP Location			
Inspector's Name			
Date of Inspection		Date of Last Inspection	
Start Time		End Time	
Type of Inspection: Regular ☐ Pre-Storm Event ☐ During Storm Event ☐ Post-Storm Event ☐			
Describe the weather conditions at time of inspection			

Specific Information

Maintenance Activity	Maintenance Frequency	Is Status of BMP Satisfactory?	Corrective Action Needed
Inspect for invasive species and remove if present	Monthly	Yes ☐ No ☐	
Clean forebays	Annually	Yes ☐ No ☐	
Clean sediment in basin/wetland system	Once every 10 years	Yes ☐ No ☐	
Mulch void areas	Annually	Yes ☐ No ☐	
Remove dead vegetation	Bi-Annually	Yes ☐ No ☐	
Replace dead vegetation	Annually	Yes ☐ No ☐	
Prune	Annually	Yes ☐ No ☐	
Replace all media and vegetation	As Needed	Yes ☐ No ☐	

INSPECTION OF EXTENDED DRY DETENTION BASINS

Inspections should be conducted bi-annually, and during and after major storm events.

General Information

BMP Description	Extended Dry Detention Basin		
BMP Location			
Inspector's Name			
Date of Inspection		Date of Last Inspection	
Start Time		End Time	
Type of Inspection: Regular ☐ Pre-Storm Event ☐ During Storm Event ☐ Post-Storm Event ☐			
Describe the weather conditions at time of inspection			

Specific Information

Maintenance Activity	Maintenance Frequency	Is Status of BMP Satisfactory?	Corrective Action Needed
Examine outlet structure for clogging or high outflow release velocities	Bi-Annually	Yes ☐ No ☐	
Mow upper stage, side slopes, embankment and emergency spillway	Bi-Annually	Yes ☐ No ☐	
Remove trash and debris	Bi-Annually	Yes ☐ No ☐	
Remove sediment from basin	At least once every 5 years	Yes ☐ No ☐	

INSPECTION OF PROPRIETARY MEDIA FILTERS

General Information

BMP Description	Media Filter		
BMP Location			
Media Type			
Inspector's Name			
Date of Inspection		Date of Last Inspection	
Start Time		End Time	
Type of Inspection: Regular ☐ Pre-Storm Event ☐ During Storm Event ☐ Post-Storm Event ☐			
Describe the weather conditions at time of inspection			

Specific Information

Maintenance Activity	Maintenance Frequency	Is Status of BMP Satisfactory?	Corrective Action Needed
Inspect for standing water, trash, sediment and clogging	Bi-Annually (minimum)	Yes ☐ No ☐	
Remove trash and debris	Each Inspection	Yes ☐ No ☐	
Examine to determine if system drains in 72 hours	Annually	Yes ☐ No ☐	
Inspect filtering media for clogging	Per manufacturer's schedule	Yes ☐ No ☐	

INSPECTION OF SAND AND ORGANIC FILTERS

Inspections should be conducted after every major storm event for the first 3 months following completion, then every 6 months thereafter.

General Information

BMP Description	Sand/Organic Filter		
BMP Location			
Media Type			
Inspector's Name			
Date of Inspection		Date of Last Inspection	
Start Time		End Time	
Type of Inspection: Regular ☐ Pre-Storm Event ☐ During Storm Event ☐ Post-Storm Event ☐			
Describe the weather conditions at time of inspection			

Specific Information

Maintenance Activity	Maintenance Frequency	Is Status of BMP Satisfactory?	Corrective Action Needed
Remove sediment, trash, and debris	Every 6 months	Yes ☐ No ☐	
Rake sand	Every 6 months	Yes ☐ No ☐	

INSPECTION OF DRY WELLS

Regular inspections should be conducted after every major storm event for the first 3 months following completion, then annually thereafter.

General Information

BMP Description	Dry Well		
BMP Location			
Inspector's Name			
Date of Inspection		Date of Last Inspection	
Start Time		End Time	
Type of Inspection: Regular ☐ Pre-Storm Event ☐ During Storm Event ☐ Post-Storm Event ☐			
Describe the weather conditions at time of inspection			
Describe condition of dry well at time of inspection			

After a major storm event, the water depth in the observation well should be measured at 24 and 48 hour intervals and the clearance rate calculated.

INSPECTION OF WET BASINS

Inspections should be conducted after every major storm event for the first 3 months following completion, then biannually thereafter.

General Information

BMP Description	Wet Basin		
BMP Location			
Inspector's Name			
Date of Inspection		Date of Last Inspection	
Start Time		End Time	
Type of Inspection: Regular ☐ Pre-Storm Event ☐ During Storm Event ☐ Post-Storm Event ☐			
Describe the weather conditions at time of inspection			
Describe condition of wet basin at time of inspection			

Specific Information

Maintenance Activity	Maintenance Frequency	Is Status of BMP Satisfactory?	Corrective Action Needed
Preventative maintenance	Bi-Annually	Yes ☐ No ☐	
Mow/rake buffer area, side slopes and basin bottom	Bi-Annually	Yes ☐ No ☐	
Remove trash, debris and organic matter	Bi-Annually	Yes ☐ No ☐	
Inspect and clean pretreatment devices	Every other month and after every major storm event	Yes ☐ No ☐	

INSPECTION OF OTHER BMP

General Information

BMP Description			
BMP Location			
Inspector's Name			
Date of Inspection		Date of Last Inspection	
Start Time		End Time	
Type of Inspection: Regular ☐ Pre-Storm Event ☐ During Storm Event ☐ Post-Storm Event ☐			
Describe the weather conditions at time of inspection			

Specific Information

Maintenance Activity	Maintenance Frequency	Is Status of BMP Satisfactory?	Corrective Action Needed
		Yes ☐ No ☐	
		Yes ☐ No ☐	
		Yes ☐ No ☐	
		Yes ☐ No ☐	
		Yes ☐ No ☐	
		Yes ☐ No ☐	
		Yes ☐ No ☐	