

Municipality/Organization: Town of Grafton
EPA NPDES Permit Number: MAR04-1119
MassDEP Transmittal Number: (Form BRP WM 08A, 2003, W-035459)
Annual Report Number Year 14
& Reporting Period: May 1, 2016 – April 30, 2017

NPDES PII Small MS4 General Permit Annual Report (Due: May 1, 2017)

Part I. General Information: *Transmittal Number W 035459*

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Certification:

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 gather and evaluate 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.

Signature: 
Printed Name: Tim McNerney
Title: Town Administrator
Date: 4-26-17

Part II. Self-Assessment

The Town of Grafton has made significant progress towards meeting the requirements of the MS4 permit. In 2009, the Town of Grafton adopted stormwater and illicit discharge bylaws. The Town Conservation Commission (Con Com) and the Department of Public Works (DPW), respectively, have successfully integrated the bylaws (and implementation of the bylaws) into their operations.

Since 2003, the Town of Grafton has completed several significant housekeeping activities to reduce pollution from municipal sources including: connecting the DPW garage to the Town sewer, moving vehicle washing activities indoors, reducing pesticide applications, and controlling fertilizer applications. The roof of the salt storage shed was repaired; currently, the materials are stored under cover. In 2012 the underground fuel storage tank was removed. In 2013, it was replaced with an above-ground storage tank that meets the requirements of the Spill Prevention and Control Countermeasure (SPCC) regulations.

The Town has continued the street-sweeping program. During the spring, the Highway Department sweeps the entire town concentrating on industrial/commercial areas first and then moving out to the remaining roadways. The Town performs catch basin cleaning as needed, focusing on infrastructure adjacent to Flint Pond. In areas where road construction is scheduled, the street is swept once prior to construction and once following construction. Material collected as part of the street sweeping plan is disposed of in accordance with the Municipal O&M Plan.

During Year 11(2014), the Town of Grafton continued making strides on its stormwater mapping. The Town hired a subconsultant, Tata & Howard, to verify existing and map new outfalls and catch basin locations. As of Year 13 (2016), all outfalls, catch basins, storm drain manholes, and most of the storm drain piping system have been mapped. The progress made continues to exceed mapping requirements of the 2003 MS4 Permit. The stormwater infrastructure map is maintained through PeopleGIS and can be updated in real-time through their proprietary software.

The Town has also taken proactive steps to map stormwater infrastructure outside of its current MS4-regulated area. In the upcoming permit years, the Town will maintain the current map and add new structures to the geodatabase as needed. **(Attachment 1)**

Watershed groups continue to be active in organizing public events including town-wide clean-up days. The DPW supports clean-up activities by providing trash bags and removal services. On April 29, 2017 the Blackstone River Watershed Association scheduled a river clean up activity for the public. On Arbor Day, the Highway Department will, once again, sponsor a planting program involving children's groups. Documentation of public cleanup activities including hazardous waste collection activities is included as an attachment to this report. **(Attachment 2)**

During the 2015/2016 permit year, the Town implemented a systematic program to inspect outfalls and identify illicit discharges, and the Town entered into a contract with Tata & Howard to inspect outfalls for dry and wet-weather discharges. During the 2015/2016

permit year, all outfalls were inspected and tested. The test results are included as an attachment to last year's (year 13, 2016) annual report.

Ideas for funding and managing the illicit discharge detection and elimination (IDDE) program, proposed in 2012/2013, include implementing an application process and fee for accommodating Sump Pump Discharges. The program is still in the developmental phase.

The single outfall to the impaired TMDL waterbody, Flint Pond, was inspected and cleaned in April 2017. No illicit discharges were detected.

In 2015, the standard for replacement catch basin grates was updated to include an engraving to indicate that the catch basin drains to a waterway. In 2015, construction on an upgrade to the municipal wastewater treatment plant was underway. Construction on the plant is anticipated to be completed in 2017.

In 2012, the Town reached out to the Central Massachusetts Regional Stormwater Coalition (CMRSWC) to take advantage of state funding (the 2013 CIC Grant) to support NPDES MS4 compliance activities. During the Fiscal Years 2013, 2014, 2015, 2016 the Town of Grafton was an active participant in the CMRSWC. The Town is currently an active participant in the CMRSWC. The annual report on 2016/2017 CMRSWC activities is attached. **(Attachment 3)**

In 2015, the Town received a Technical Assistance Grant with the Central Mass Regional Planning Commission (CMRPC) to review the Town bylaws for consistency. The Town hosted a Low Impact Development (LID) workshop with the CMRPC and the Blackstone River Coalition. In 2015, the Town purchased a 5-acre parcel of conservation land (114 Marion Road) adjacent to the Great Meadow Conservation Area.

During the 2016/2017 reporting period:

- The Park Committee installed receptacles for pet waste in the park. (Community Preservation)
- The Planning Board received a quote from an engineer to create a Site Plan Review Checklist to integrate the requirements of the Zoning Bylaw and the Stormwater Bylaw.
- Three illicit discharges were detected, all three were acute emergent conditions and were remedied as soon as they were detected. Two were the result of a break in the sewer force main. The discharge was detected, reported to the local responders. Local responders identified and fixed the source of the problem. Follow-up testing was performed and results were satisfactory. The third discharge was a #2 diesel fuel oil spill. The discharge was detected, reported to local and state agencies, and cleaned up by a contractor licensed to perform such activities. Conservation Commission meeting minutes and follow up

sampling results for one of the sewer main breaks is attached. **(Attachment 4)**

- The Conservation Commission recorded and distributed a rain barrel educational program on the local public access cable channel. The rain barrel presentation aired on the local cable access show "Ask the Geezers" on 6-16-16. The show featured a discussion about what stormwater is, why it's a problem, and how rain barrels can be a part of the solution. The discussion also included information on installation and use of rain barrels and a brief overview of how residents can build their own.
- Blackstone Heritage Corridor, Inc., helped fund a project, "Creating a Teaching Landscape" that created an interpretive master plan for the Fisherville Mill Site, the Mill Villages Park, the Living Systems Laboratory (LSL), and historic and environmental resources; curriculum for local schools and universities; and constructed physical improvements to the LSL including the installation of a plant nursery to be irrigated by Blackstone River water. **(Attachment 5)**
<http://www.grafton-ma.gov/planning-department/pages/creating-teaching-landscape>
- The DPW consolidated the distribution of the NPDES Phase II public outreach information onto one webpage:
<http://www.grafton-ma.gov/departments-public-works-engineering/pages/stormwater-npdes-phase-ii-information>
- Representatives from the Town of Grafton attended two MS4 workshops to learn about the new (2017/2018) permit. **(Attachment 6)**
- The Blackstone River Coalition released a Water Quality Monitoring Report that included results at 7 sites in Grafton. **(Attachment 7)**
- The DPW published an educational article about pet-waste in the Grafton News (4/27/2017). **(Attachment 8)**

Part III. Summary of Minimum Control Measures

1. Public Education and Outreach

BMP ID #	BMP Description	Responsible Dept./Person Name	Measurable Goal(s)	Progress on Goal(s) – Permit Year 14 (Reliance on non-municipal partners indicated, if any)	Planned Activities
1A	Stormwater Flyer Residents	DPW & Cons Com	Year 1: distribute flyer to 75% of Town residents.	Flyers continued to be available on a self-service basis at the Town offices. Links to documents are on the Town website.	Links on the town website will be maintained. See self-assessment for link.
Revised			Ongoing program, one communication per year. Provide links to materials on the Town website.		
1B	Lesson Plan for 5 th Grade	DPW & SuAsCo	Year 2: Develop, distribute, and teach lessons at one or more 5 th grade classrooms in the community. Met goal.	A copy of the lesson plan is available at the DPW office. Outreach activities for youth groups included Boy Scouts' participation in town clean up days.	Links on the town website will be maintained. See self-assessment for link. Also see Attachment 5 , "Creating at Teaching Landscape" for ongoing local programs.
Revised					
1C	Stormwater Flyer Businesses	DPW & SuAsCo	Year 3: Distribute flyer to 50% of Town businesses.	Flyers continued to be available on a self-service basis at the Town offices. Links to documents are on the Town website.	Links on the town website will be maintained. See self-assessment for link.
Revised			Ongoing program, one communication per year. Provide links to materials on the Town website.		
1D	Stormwater Media Campaign	DPW & SuAsCo	Year 4 requirement Met goal.	Met one-time goal. Links to documents are on the Town website.	In June 2016, the Conservation Commission recorded and distributed a rain barrel educational program on the local public access cable channel.
Revised					
1E	Stormwater Video	DPW & SuAsCo	Year 5 requirement Met goal.	Met one-time goal. The educational PowerPoint presentation remains on file in the DPW office.	See response to 1D.
Revised	09/05 – Powerpoint Presentation	DPW & SuAsCo			

BMP ID #	BMP Description	Responsible Dept./Person Name	Measurable Goal(s)	Progress on Goal(s) – Permit Year 14 (Reliance on non-municipal partners indicated, if any)	Planned Activities
1F	Grafton-Specific Stormwater Flyers	DPW	Year 1, 3: Distribute Grafton-specific brochure along with SuAsCo brochures.	Older flyers continued to be available on a self-service basis at the Town offices. Links to documents are on the Town website.	Links on the town website will be maintained. See self-assessment for link.
Revised			Ongoing program, one communication per year. Provide links to materials on the Town website.		
1G	Coordinate with Businesses and Landscapers	DPW	Coordinate education and the use and sale of slow-release fertilizers.	The Town offices contain self-service educational materials for businesses and landscapers who enter the town offices pursuing support or permits. Links to educational materials developed by others are also available on the Town website.	Continue to provide self-service materials at the Town offices. Links on the town website will be maintained. See self-assessment for link.
Revised					
1H	Stormwater Flyer for Agriculture	DPW	Year 3: Distribute flyers to agricultural owners/properties	Links to the educational materials are available on the Town website.	The Agricultural Department is currently inactive. Links on the town website will be maintained. See self-assessment for link.
Revised			Provide links to educational materials on the Town website.		
1I	Newspaper Articles	DPW	At least 1 article per year.	Links to past articles are posted on the DPW website.	Publish an educational article in the local newspaper by June 1. See Attachment 8 , “Publications”
Revised					
1J	Stormwater Info on Town Website	DPW	Ongoing Program to distribute educational materials via the web.	The stormwater and illicit discharge bylaws and other assorted educational materials are available on the Town website.	Continue to update and expand the site with current educational materials as they become available. See self-assessment for link.
Revised					
1K	Trees and their use in stormwater management	DPW/Tree Warden	Ongoing Program	Grafton continues to participate in the Tree City program. The program includes purchasing seeds and saplings and recruiting schoolchildren to plant them as part of Arbor Day activities.	Continue to seek funding to continue this program.
Revised					

2. Public Involvement and Participation

BMP ID #	BMP Description	Responsible Dept./Person Name	Measurable Goal(s)	Progress on Goal(s) – Permit Year 14 (Reliance on non-municipal partners indicated, if any)	Planned Activities
2A	Stormwater Traveling Display	DPW & SuAsCo	Year 1-5: Stormwater display circulates around the community for a minimum of 3 months; Stormwater display is posted at a minimum of 3 different public locations in the community; Stormwater display is also used in future permit years for posting in public places or at stormwater events	Continued to display poster and flyers at the kiosk at the Town Offices.	Continue to display the educational materials at the Town Offices.
Revised					
2B	Poster Contest for 5 th Graders	DPW & SuAsCo	Year 2: Poster contest held and entries received, judged, and displayed.	One time event. Met goal.	Continue to encourage faculty to present stormwater matters in their lesson plans during the 2016/2017 school year. Also see Attachment 5 , “Creating at Teaching Landscape” for ongoing local programs.
Revised					
2C	Photo Contest for High Schoolers	DPW & SuAsCo	Year 3: Photo contest is held and entries are received, judged, and displayed.	One time event. Met goal.	Continue to encourage faculty to present stormwater matters in their lesson plans during the 2016/2017 school year. Also see Attachment 5 , “Creating at Teaching Landscape” for ongoing local programs.
Revised					
2D	Stormwater Summit Event	DPW & SuAsCo	Year 4 requirement. Met.	One-time event in 2006. Met goal.	None.
Revised					

BMP ID #	BMP Description	Responsible Dept./Person Name	Measurable Goal(s)	Progress on Goal(s) – Permit Year 14 (Reliance on non-municipal partners indicated, if any)	Planned Activities
2E Revised	Stormwater Super Summit Event	DPW & SuAsCo	Year 5 requirement. Met.	One-time event in 2007. Met goal.	None.
2F Revised	Annual Stormwater Public Meeting	DPW	Hold public hearing by February every year.	Met with FinCom to discuss upcoming financial obligations for the new permit (March 2017).	Present the requirements of the new permit at the Selectmen's meeting.
2G Revised	Watershed Group Involvement	DPW & Local Groups	Continue ongoing activities of local watershed groups such as cleanup and monitoring.	Several town organizations hold cleanup events in the Spring. The DPW provides trash bags and pickup services.	Continue the program to support activities with various watershed groups. The Blackstone River Watershed Association (BRWA) will host a public clean up activity on April 29, 2017.
2H Revised	Involve Local Children's Groups	DPW	Children's groups help distribute or display educational information once per year.	See public outreach item 1K, 2G including Arbor Day, Earth Day, and Tree City activities.	Continue the program for coordinated activities with children's groups. Also see Attachment 5 , "Creating at Teaching Landscape" for ongoing local programs.
2I Revised	Purchase Land for Conservation	DPW, various Town Agencies	Ongoing Program	No purchases this year (2016/2017).	Continue purchasing Chapter 61A land as properties and funds are available.

2a. Additions

3. Illicit Discharge Detection and Elimination

BMP ID #	BMP Description	Responsible Dept./Person Name	Measurable Goal(s)	Progress on Goal(s) – Permit Year 14 (Reliance on non-municipal partners indicated, if any)	Planned Activities
3A Revised	Illicit Discharge Bylaw	DPW	Develop/Implement Bylaw. Met Goal.	Article 37 adopted May 2009.	Continue to implement bylaw.
3B Revised	Storm Sewer Map	DPW	Map 100% of Outfalls in Urbanized Areas by Permit Year 5	Outfall and infrastructure mapping complete. Mapping is in a GIS-compatible format.	Calculate number of outfalls discharging to waterbodies listed in the original permit application. Initiate consultation with U.S. Fish and Wildlife to determine if the outfalls impact endangered species. Initiate consultation with the National Register of Historic Places to determine if the outfalls impact archaeological resources or Historic Properties of National Significance.
3C Revised	Detection & Elimination Plan	DPW	Year 1: Determine priority areas and discuss plan. Year 1-5: Visually screen 20% of outfalls. Year 4-5: Trace sources of illicit discharges (50% each year). Year 4-5: Remove all sources of illicit discharges (50% each year)	During normal operations, suspect observations are recorded and kept by the DPW. This reporting period, three acute illicit discharges were identified and remedied. See self-assessment and Attachment 4 for more information. In 2014, contracted with Tata & Howard to perform outfall monitoring and illicit discharge detection. Contract includes provisions for wet and dry-weather sampling.	Using equipment acquired through partnership with the CMRSWC, identify connections to stormwater infrastructure during the next cleaning cycle and test for possible illicit connections. Work with contractor to conduct program activities.
3D	Education for Public & Businesses	DPW	Year 1, 3: Include illicit discharge education in the community business and Grafton-specific flyers.	Flyers continued to be available on a self-service basis at the Town offices. Links to IDDE fact-sheet materials are available on the Town website.	Continue to provide IDDE fact sheet on the Town website. See self-assessment for link.

BMP ID #	BMP Description	Responsible Dept./Person Name	Measurable Goal(s)	Progress on Goal(s) – Permit Year 14 (Reliance on non-municipal partners indicated, if any)	Planned Activities
Revised			Provide links to materials on Town website.		
3E	Education for Municipal Employees	DPW	Year 2-5: Include illicit discharge education.	All current DPW employees are trained to identify illicit discharges.	Continue to train new staff as necessary.
Revised					
Revised					

3a. Additions

4. Construction Site Stormwater Runoff Control

BMP ID #	BMP Description	Responsible Dept./Person Name	Measurable Goal(s)	Progress on Goal(s) – Permit Year 14 (Reliance on non-municipal partners indicated, if any)	Planned Activities
4A Revised	Construction Site Runoff Bylaw	DPW, Planning, & Con Com	Develop & Implement Bylaw. Goal Met.	Article 36, adopted May 2009.	Continue to implement bylaw.
4B Revised	Erosion, Sediment, & Waste Controls	DPW, Planning, & Con Com	Develop & Implement Bylaw	Article 36, adopted May 2009. Refers to MassDEP Stormwater Management Standards and Guidance Documents.	Continue to implement bylaw.
4C Revised	Site Plan Review Procedures	DPW, Planning, & Con Com	Develop & Implement Bylaw	Article 36, adopted May 2009. Refers to MassDEP Stormwater Management Standards and Guidance Documents.	Continue to implement bylaw. Projects are currently reviewed for compliance with local and state bylaws and regulations.
4D Revised	Site Inspection & Enforcement	DPW, Planning, & Con Com	Develop & Implement Bylaw	Approximately 100 site inspections annually. Approximately 2 sites cited with enforcement actions.	Continue to implement bylaw.
4E Revised	Stormwater Hotline	DPW, Planning, & Con Com	Receipt of complaints at DPW	Residents call town emergency services, the Highway Department, and the DPW. Reports are referred to the DPW. Hundreds of calls are received and responded to annually. Grafton Subscribed to the SeeClickFix service at https://en.seeclickfix.com/us-ma-grafton	Continue the program.
Revised					

4a. Additions

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5. Post-Construction Stormwater Management in New Development and Redevelopment

BMP ID #	BMP Description	Responsible Dept./Person Name	Measurable Goal(s)	Progress on Goal(s) – Permit Year 14 (Reliance on non-municipal partners indicated, if any)	Planned Activities
5A Revised	Post-Construction Site Runoff Bylaw	DPW, Planning, & Con Com	Develop & Implement Bylaw	Article 36, adopted May 2009.	Continue to implement bylaw.
5B Revised	Structural & Non-Structural BMPs	DPW, Planning, & Con Com	Develop & Implement Bylaw	Article 36, adopted May 2009. Refers to MassDEP Stormwater Management Standards and Guidance Documents for BMP list. The DPW reviews plans prior to construction and then reviews the as-built condition before a project is accepted. Before a project is accepted, the DPW inspects sites to verify that the stormwater facilities function as designed.	Continue to enforce compliance with stormwater BMP requirements for projects in the Town.
5C Revised	Long-Term O&M	DPW, Planning, & Con Com	Develop & Implement Bylaw	Article 36, adopted May 2009. Refers to MassDEP Stormwater Management Standards and Guidance Documents.	Continue to implement bylaw.
5D Revised	Structural BMP Implementation Procedures	DPW, Planning, & Con Com	Develop & Implement Bylaw	Article 36, adopted May 2009. Refers to MassDEP Stormwater Management Standards and Guidance Documents.	Continue to implement bylaw.

5a. Additions

6. Pollution Prevention and Good Housekeeping in Municipal Operations

BMP ID #	BMP Description	Responsible Dept./Person Name	Measurable Goal(s)	Progress on Goal(s) – Permit Year 14 (Reliance on non-municipal partners indicated, if any)	Planned Activities
6A	Municipal Employee Training	DPW	Develop a comprehensive Municipal Operations and Maintenance Plan to include training protocols.	All DPW staff is currently trained in stormwater management.	Train new staff as needed.
Revised					
6B	Maintenance & Inspection Procedures	DPW	Develop a comprehensive Municipal Operations and Maintenance Plan to include activities, schedules and procedures.	Annual programs are in place to clean catch basins and sweep streets. The streets are swept in the spring and fall. Catch basins are cleaned at least once per year starting in the spring. Known problem areas are addressed more often. Records for these activities are kept with the Highway Superintendent.	Continue with the program.
Revised					
blank					

BMP ID #	BMP Description	Responsible Dept./Person Name	Measurable Goal(s)	Progress on Goal(s) – Permit Year 14 (Reliance on non-municipal partners indicated, if any)	Planned Activities
6C	Municipal Pollutant Source Reduction	DPW	Develop a comprehensive Municipal Operations and Maintenance Plan to include BMPs to reduce municipal pollution sources	In 2003, Grafton hired a consultant to assess the Municipal Operations in the Town with respect to Stormwater. The assessment recommended: - Connecting the DPW garage to the sewer. This task was accomplished in 2010. - Performing vehicle washing indoors. As of 2010, this is routine procedure. - BMPs for the sand/salt piles. The storage shed was rehabilitated; the materials are now completely covered. - The underground fuel storage tank was removed in 2012. The above ground storage tank will be constructed in 2013. - Assess pesticide and fertilizer operations. As of 2012, pesticide applications were limited to treatment of catch basin sump water. Fertilizer applications (where necessary) are limited to lawful mixes of organic applied at a rate of 3 pounds per 1000 SF. Note that all major tasks had been completed as of April 2013.	Continue to encouraging “Do not Dump” catch basin castings and drain covers. As of 2015, replacement grates are engraved with “Drains to Waterway” or similar language.
Revised					
6D	Waste Disposal Procedures	DPW	Develop a comprehensive Municipal Operations and Maintenance Plan to include BMPs to reduce municipal pollution sources	Materials are collected and properly disposed of by a licensed 3 rd party. See Attachment 2 for Hazardous Waste Disposal procedures.	Continue with the program.
Revised					

7. BMPs for Meeting Total Maximum Daily Load (TMDL) Waste Load Allocations (WLA) <<if applicable>>

BMP ID #	BMP Description	Responsible Dept./Person Name	Measurable Goal(s)	Progress on Goal(s) – Permit Year 14 (Reliance on non-municipal partners indicated, if any)	Planned Activities
7A	Residential and Commercial Education	DPW	Provide links to materials on the Town website.	Met goal, refer to items 1A, 1C.	Expand educational materials on Town website as they become available.
Revised					
7B	Outfall Inspection and Testing	DPW		Outfalls inspected in accordance with the municipal schedule and cleaned as-needed. The one municipal outfall identified at Flint Pond was inspected and contributing structures were cleaned out in April 2015 100% of all outfalls were inspected in 2015. Wet and dry weather sampling was conducted. Test results are attached to this annual report.	Continue to monitor the outfall to Flint Pond and the contributing infrastructure.
Revised					
7C	Illicit Discharge Elimination	DPW		No chronic illicit discharges identified. Began discussions with Town agencies to fund this program. Ideas for funding include applications and fees for Sump Pump Discharge hookups.	Continue to monitor the outfall to Flint Pond outfall and the contributing infrastructure.
Revised				Three acute illicit discharges were identified and remedied (and monitored) as soon as they were detected. See Attachment 4 and the self-assessment.	Continue reviewing methods to fund and implement this program.
7D	Municipal Operations Prioritized	DPW		Street sweeping and catch basin cleaning activities conducted in accordance with the municipal schedule. The schedule is kept at the Highway Superintendent's Office.	Continue ongoing maintenance activities.
Revised					
Revised					
Revised					

7b. WLA Assessment

The TMDL for Flint Pond indicates that the pond is impaired for turbidity as a result of excess phosphorus loading. The TMDL indicates that stormwater contributions of phosphorus must be reduced by 52 % to meet the waste load allocation (WLA) of the TMDL.

Regular street sweeping and catch basin cleaning provide a reduction in phosphorus loading. In 2016/2017 neither fertilizers nor pesticides were applied in any buffer to a resource area.

The Blackstone River Coalition performed a volunteer watershed-wide water quality monitoring program during the 2016 monitoring season. The Flint Pond Outlet was sampled and evaluated for aesthetics, temperature, DO, % saturation, and nutrients. The site received an excellent grade for temperature, a good grade for aesthetics (turbidity), % saturation (DO), and nutrients, and a fair grade for DO. See **Attachment 4**.

Part IV. Summary of Information Collected and Analyzed

In 2016, no outfalls were sampled and tested during dry or wet weather conditions.

Part V. Program Outputs & Accomplishments (OPTIONAL)

(Since beginning of permit coverage unless specified otherwise by a **, which indicates response is for period covering May 1, 2016 through April 30, 2017)

Programmatic

	(Preferred Units)	Response
Stormwater management position created/staffed	(y/n)	No
Annual program budget/expenditures **	(\$)	\$30,000+/-
Total program expenditures since beginning of permit coverage	(\$)	\$236,000+/-
Funding mechanism(s) (General Fund, Enterprise, Utility, etc)		General Fund

Education, Involvement, and Training

Estimated number of property owners reached by education program(s)	(# or %)	50%
Stormwater management committee established	(y/n)	No
Stream teams established or supported	(# or y/n)	No
Shoreline clean-up participation or quantity of shoreline miles cleaned **	(y/n or mi.)	Yes
Shoreline cleaned since beginning of permit coverage	(mi.)	1.25 (annually)
Household Hazardous Waste Collection Days		
▪ days sponsored **	(#)	4
▪ community participation **	(# or %)	10%
▪ material collected **	(tons or gal)	10 Tons (est.)
School curricula implemented	(y/n)	See Attachment 5

Legal/Regulatory

	In Place Prior to Phase II	Reviewing Existing Authorities	Drafted	Draft in Review	Adopted
Regulatory Mechanism Status (indicate with “X”)					
▪ Illicit Discharge Detection & Elimination					X
▪ Erosion & Sediment Control					X
▪ Post-Development Stormwater Management					X
Accompanying Regulation Status (indicate with “X”)					
▪ Illicit Discharge Detection & Elimination					X
▪ Erosion & Sediment Control					X
▪ Post-Development Stormwater Management					X

Mapping and Illicit Discharges

	(Preferred Units)	Response
Outfall mapping complete	(%)	100%
Estimated or actual number of outfalls	(#)	333
System-Wide mapping complete (complete storm sewer infrastructure)	(%)	100%
Mapping method(s)		
▪ Paper/Mylar	(%)	0%
▪ CADD	(%)	15%
▪ GIS	(%)	100%
Outfalls inspected/screened **	(# or %)	0%
Outfalls inspected/screened (Since beginning of permit coverage)	(# or %)	100% (qty 281)
Illicit discharges identified **	(#)	3 (accidental, acute)
Illicit discharges identified (Since beginning of permit coverage)	(#)	8 (acute)
Illicit connections removed **	(#); and (est. gpd)	0 (not applicable)
Illicit connections removed (Since beginning of permit coverage)	(#); and (est. gpd)	0 (not applicable)

100% of salt/chemical pile(s) covered in storage shed(s) by May 2013	(y/n)	Yes

Water Supply Protection

Storm water outfalls to public water supplies eliminated or relocated	# or y/n	None
Installed or planned treatment BMPs for public drinking water supplies and their protection areas	# or y/n	None
Treatment units induce infiltration within 500-feet of a wellhead protection area	# or y/n	1

% of population on sewer	(%)	61%
% of population on septic systems	(%)	39%

Construction

	(Preferred Units)	Response
Number of construction starts (>1-acre) **	(#)	6+/-
Estimated percentage of construction starts adequately regulated for erosion and sediment control **	(%)	100%
Site inspections completed **	(# or %)	>100
Tickets/Stop work orders issued **	(# or %)	2+/-
Fines collected **	(# and \$)	0
Complaints/concerns received from public **	(#)	100's

Post-Development Stormwater Management

Estimated percentage of development/redevelopment projects adequately regulated for post-construction stormwater control	(%)	100%
Site inspections (for proper BMP installation & operation) completed **	(# or %)	100+/-
BMP maintenance required through covenants, escrow, deed restrictions, etc.	(y/n)	Yes
Low-impact development (LID) practices permitted and encouraged	(y/n)	Yes

Operations and Maintenance

Average frequency of catch basin cleaning (non-commercial/non-arterial streets) **	(times/yr)	1x/yr
Average frequency of catch basin cleaning (commercial/arterial or other critical streets) **	(times/yr)	1-2x/yr
Qty of structures cleaned **	(#)	2400+/-
Qty. of storm drain cleaned **	(%, LF or mi.)	250 LF
Qty. of screenings/debris removed from storm sewer infrastructure **	(lbs. or tons)	200 Tons
Disposal or use of screenings (landfill, POTW, compost, beneficial use, etc.) **	(location)	Landfill

Basin Cleaning Costs		
• Annual budget/expenditure (labor & equipment)**	(\$)	see hourly rate
• Hourly or per basin contract rate **	(\$/hr or \$ per basin)	~ \$25/hr
• Disposal cost**	(\$)	~ \$9/ton ~ 200 tons every 2 or 3 years.
Cleaning Equipment		
• Clam shell truck(s) owned/leased	(#)	1
• Vacuum truck(s) owned/leased	(#)	0
• Vacuum trucks specified in contracts	(y/n)	No
• % Structures cleaned with clam shells **	(%)	100%
• % Structures cleaned with vacuor **	(%)	0%

	(Preferred Units)	Response
Average frequency of street sweeping (non-commercial/non-arterial streets) **	(times/yr)	1/yr
Average frequency of street sweeping (commercial/arterial or other critical streets) **	(times/yr)	1-2/yr
Qty. of sand/debris collected by sweeping **	(lbs. or tons)	700 Tons
Disposal of sweepings (landfill, POTW, compost, beneficial use, etc.) **	(location)	Landfill
Annual Sweeping Costs		
• Annual budget/expenditure (labor & equipment)**	(\$)	see hourly rate
• Hourly or lane mile contract rate **	(\$/hr. or ln mi.)	~\$25/hr
• Disposal cost**	(\$)	0
Sweeping Equipment		
• Rotary brush street sweepers owned/leased	(#)	1
• Vacuum street sweepers owned/leased	(#)	0
• Vacuum street sweepers specified in contracts	(y/n)	No
• % Roads swept with rotary brush sweepers **	%	100%
• % Roads swept with vacuum sweepers **	%	0%

Reduction (since beginning of permit coverage) in application on public land of: ("N/A" = never used; "100%" = elimination)		
▪ Fertilizers	(lbs. or %)	70%
▪ Herbicides	(lbs. or %)	N/A
▪ Pesticides	(lbs. or %)	90%
Integrated Pest Management (IPM) Practices Implemented	(y/n)	No

	(Preferred Units)	Response
Average Ratio of Anti-/De-Icing products used ** (also identify chemicals and ratios used in specific areas, e.g., water supply protection areas)	% NaCl % CaCl ₂ % MgCl ₂ % CMA % Kac % KCl % Sand	80% 20%
Pre-wetting techniques utilized **	(y/n or %)	Yes
Manual control spreaders used **	(y/n or %)	No
Zero-velocity spreaders used **	(y/n or %)	No
Estimated net reduction or increase in typical year salt/chemical application rate	(±lbs/ln mi. or %)	0% change
Estimated net reduction or increase in typical year sand application rate **	(±lbs/ln mi. or %)	No sand used
% of salt/chemical pile(s) covered in storage shed(s)	(%)	100%
Storage shed(s) in design or under construction	(y/n or #)	Construction complete

Town of Grafton
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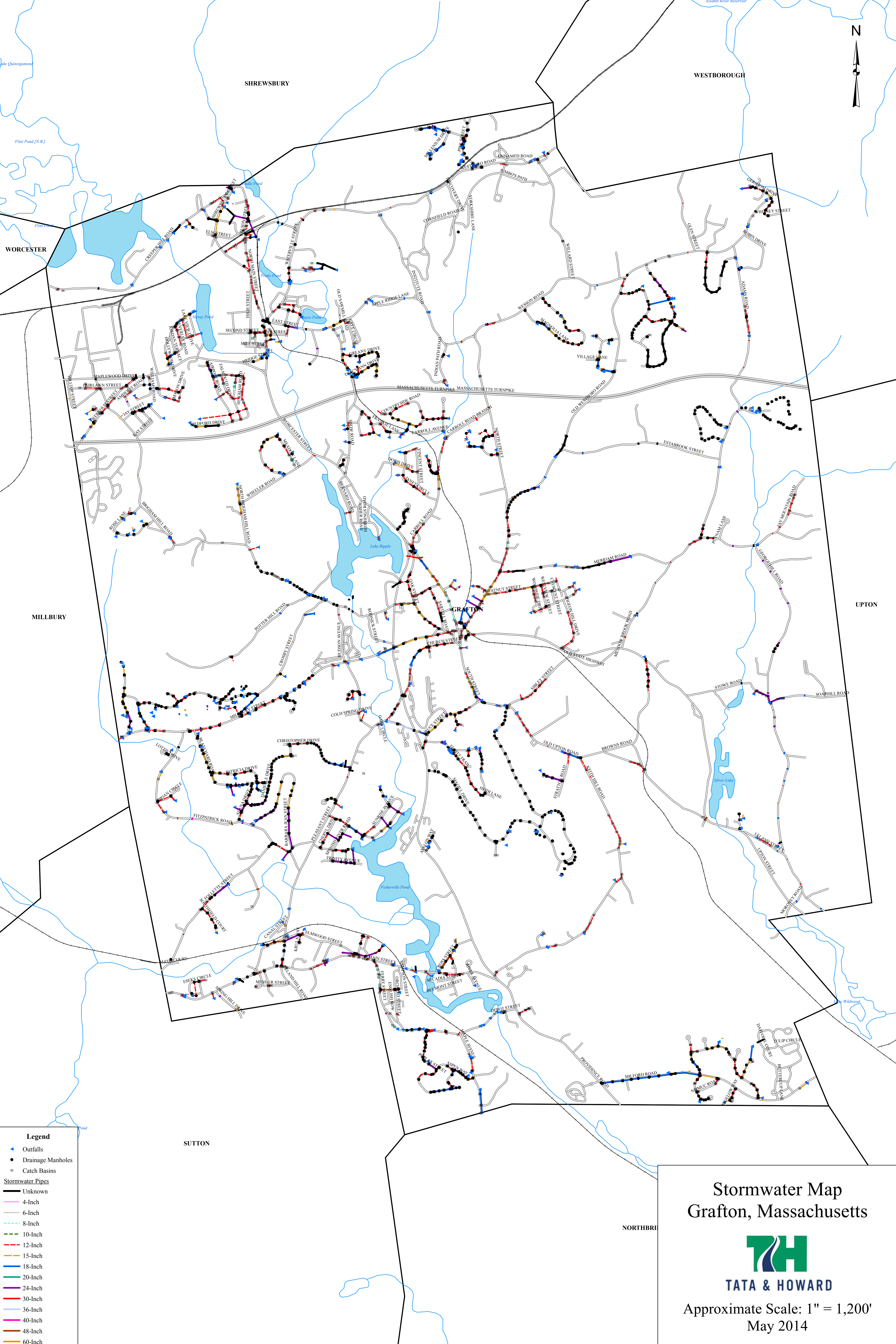
Attachments

1. Stormwater Map (Tata & Howard, May 2014)
2. Public Clean-up Activities and Hazardous Waste Collection Information
3. CMRSWC Annual Report
4. Illicit Discharge Detection and Follow-up
5. Creating a Teaching Landscape Educational Program
6. MS4 Workshops
7. Blackstone River Coalition Water Quality Monitoring Report
8. Publications

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Attachment 1

Stormwater Map (Tata & Howard, May 2014)



Legend

- Outfalls
- Drainage Manholes
- Catch Basins

Stormwater Pipes

- Unknown
- 4-Inch
- 6-Inch
- 8-Inch
- 10-Inch
- 12-Inch
- 15-Inch
- 18-Inch
- 20-Inch
- 24-Inch
- 30-Inch
- 36-Inch
- 40-Inch
- 48-Inch
- 60-Inch

Stormwater Map
Grafton, Massachusetts


TATA & HOWARD

Approximate Scale: 1" = 1,200'
May 2014



Friday, April 21, 2017

North Grafton MA

Rain



42°F

MENU

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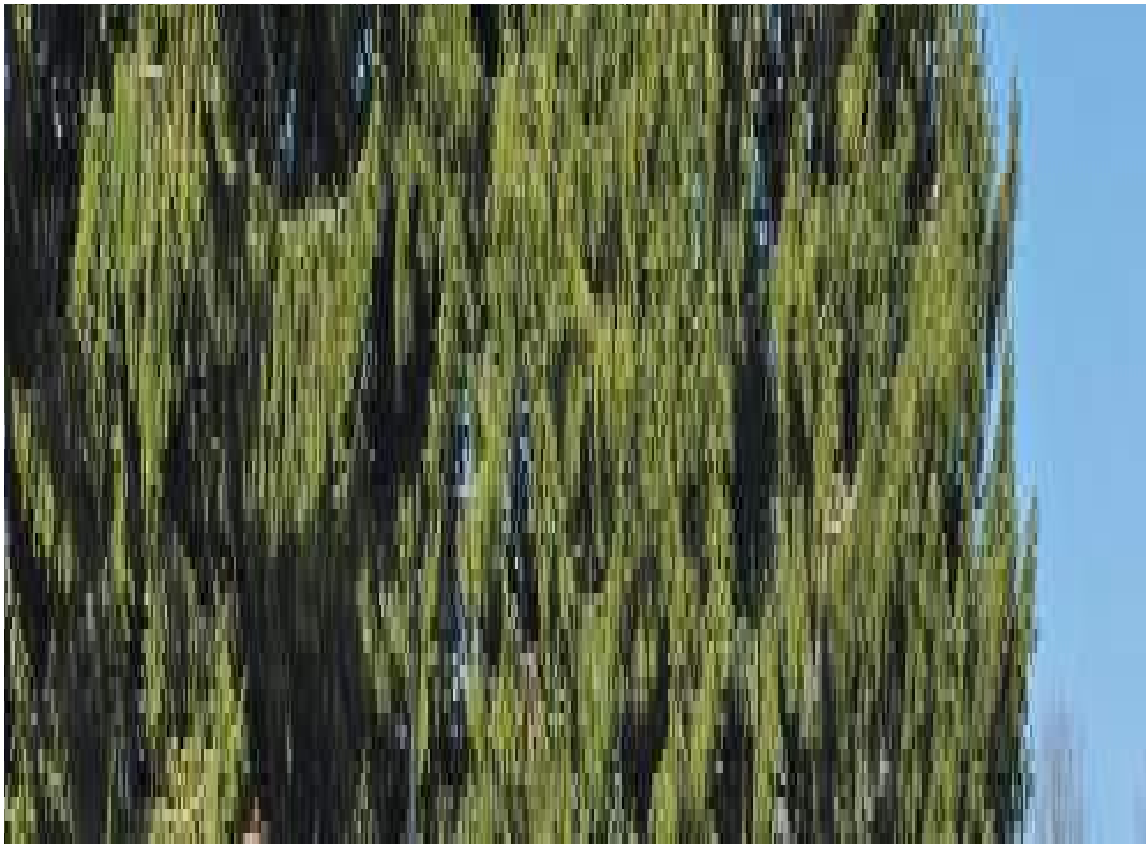


Volunteers needed for Earth Day cleanup

By [Grafton News](#) | on March 23, 2017

[SUBMITTED PHOTO](#)





2016 BRWA Earth Day Cleanup volunteers pose with some of the trash they pulled from waterways.

APRIL 29 IN GRAFTON

In celebration of [Earth Day](#), the Blackstone River [Watershed Association](#) is sponsoring its annual river cleanup on Saturday, April 29.

Local News *On The Go!*



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The Grafton [Garden Club](#) is organizing the local cleanup and volunteers will meet at the [Town Common](#) at 9 a.m. and clean until noon.

The BRWA plans to work with volunteers in and along waterways in other towns including [Auburn](#), [Millbury](#), Upton, [Sutton](#), [Northbridge](#), [Uxbridge](#), [Douglas](#), [Hopedale](#), [Mendon](#), [Millville](#), and Blackstone. Make a difference by volunteering just a few hours of your time to clean up trash and various debris that pollute our waterways. This project also meets community service requirements for many organizations.

In 2016, over 150 volunteers gathered 181 bags of trash and a collection of large items including tires, mattresses, stereos, microwaves, construction debris and toilets out of our rivers, streams, ponds, wetlands, and shorelines at over 40 sites in 12 towns from [Worcester](#) to Blackstone. Volunteers included Scout packs and troops, church groups, businesses, [Lions Clubs](#), school groups, individuals and families.

[advertisement]

	FREE Event: M.I.T. & Harvard Medical Trained Neuroscientist & Audiologist, Dr. Keith N. Darrow, Presents: <i>The Healthy Brain!</i> For Individuals Wishing To Avoid Cognitive Decline, Dementia and Social Isolation That Prevents Active-Aging. At the Worcester Historical Museum w/ FREE Valet Parking. CLICK HERE TO REGISTER!	April 26
---	--	---------------------------

Register online for the BRWA Annual Earth Day Cleanup at thebrwa.org.

After the cleanup, volunteers will meet at DCR's River Bend Farm [Visitor Center](#) at 287 Oak Street in Uxbridge at 3 p.m. for refreshments. [Alternatives Unlimited](#), Inc. is co-sponsoring the Annual Clean and [Green Fair](#) from 2:30 to 4 p.m. with environmental demonstrations and children's activities. Both events are rain or shine.

For additional information about the Blackstone River Watershed Association, call 508-278-5200 or email events@thebrwa.org.

More From News Updates

[Go To The News Updates Section](#)

[Vet school dean on
'Minute By Minute'](#)

[Art in the Valley](#)

[Grafton Garden Club
Plant Sale](#)

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Trash & Recycling

All Recycling must be in the EL Harvey Toter. Toters have been delivered to residents at no cost for the first toter. Toters must remain with the property.

Recycling Toters are available through EL Harvey and Sons, Inc. by calling 1-800-321-3002.

If you have recycling questions, you may call the Grafton Selectmen's Office at (508) 839-5335 ext. 1180.

Calendar

[2015-2017 Trash & Recycling Flyer](#)

[2015-2017 Recycling Schedule](#)

Hazardous Waste Information

[NEDT Household Hazardous Products Collection Center](#)

Brush Disposal

[Brush Disposal Area Schedule](#)

Town of Grafton
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Attachment 3

CMRSWC Annual Report

Central Massachusetts Regional Stormwater Coalition
2003-MS4 Permit
Coalition Activities in Year 14 (April 1, 2016-March 31, 2017)

Introduction

The Central Massachusetts Regional Stormwater Coalition (CMRSWC) is an MS4 resource for all member communities. In 2017, total membership reached 31 towns. In December 2016, CMRSWC created four standing sub-committees to allow members to focus efforts on specific issues important to the Coalition. These sub-committees are:

- Education Sub-Committee: responsible for developing and promoting outreach and educational materials for audiences targeted in the 2016-MS4 permit. The committee is the primary liaison to the WPI Project Centers and other university partnerships.
- Program Sub-Committee: responsible for planning and scheduling Annual Meeting, Steering Committee Meetings, educational workshops, and other forums for discussion of MS4 topics.
- Technical Sub-Committee: responsible for managing Coalition's website and shared equipment resources; advising members on relevant technical issues including GIS system maintenance and upgrades.
- Legislative Sub-Committee: serves as the liaison to the Massachusetts Statewide Stormwater Collaborative; responsible for tracking MS4 related legislation and regulations and keeping the legislature and regulatory agencies informed of the concerns of member communities.

The CMRSWC Steering Committee held four meetings during this 12 month reporting cycle. The CMRSWC Annual Meeting was held on September 20, 2016 in Holden. CMRSWC's Needham MS4 Technical Training Workshop and Stormwater Video were featured at the Annual Meeting of the Statewide Collaborative on September 27, 2016 at the Massachusetts Department of Environmental Protection central region office in Worcester. Members of CMRSWC attended and actively participated in the Massachusetts Statewide Stormwater Collaborative meetings.

MS4 Workshops and Technical Training (Minimum Control Measures 3, 4, 5, and 6)

Municipal Stormwater Technical Assistant Project

The CMRSWC was awarded a \$50,000 Municipal Stormwater Technical Assistance Contract Grant from the Massachusetts Department of Environmental Protection to provide technical assistance support and materials designed to help regulated communities in Massachusetts begin to cost-effectively comply with the requirements of the 2016 MS4 Permit. The grant funded the Needham MS4 training workshop, educational and training videos, and stormwater templates.

Needham Workshop

On June 29, 2016, CMRSWC and the Fuss & O'Neill project team held an MS4 training workshop at the Needham Public Services Administration Building. This site was selected because it contains several features that provided participants hands-on training and exposure to actual operations and conditions affected by the new MS4 permit requirements. These features include new SWPPP regulated activities, outfalls discharging to an on-site stream, vegetated swales, infiltration basins, catchbasin and manholes, gravel surface parking area, and more.

The program targeted new or inexperienced public works professionals, stormwater coordinators, and other municipal staff responsible for their community's NPDES Phase II Stormwater Permit Minimum Control Measures 3, 4, 5, and 6. The program included classroom presentation, site visits, and hands-on experience on the following MS4 topics:

- Outfall inspections and water quality sampling – safety, tools, protocols, hits
- Mapping stormwater system attributes – paper versus GIS
- Stormwater BMPs and LID – construction, operations, and maintenance
- SWPPPs – site characteristics

Millbury Workshop

CMRSWC held a second workshop for Coalition members on October 28, 2016 at the Millbury Public Works Facility. The program targeted public works professionals, stormwater coordinators, and other municipal staff responsible for the NPDES Phase II Stormwater Permit Minimum Control Measures 3, 4, 5, and 6.

The MS4 Training Workshop emphasized hands-on training on the following topics:

- IDDE – review of CMRSWC IDDE template and inspection form
- BMPs and LID–BMP retrofits; BMP & LID construction, O&M
- SWPPPs – using CMRSWC template to develop a facility-specific SWPPP

The Workshop included a Vendor Fair with products and services that support MS4 compliance. There were scheduled presentations by Environmental K9 Services, People GIS, and Civil View drone services.

Videos and Templates (Minimum Control Measures 1, 3, 4, 5, 6)

In addition to the Needham training workshop, the Municipal Stormwater Technical Assistance Contract Grant funded the following stormwater videos, new templates, updates of existing CMRSWC templates, and referenced additional online resources associated with various stormwater management topics to assist regulated communities.

Long-Format Stormwater Videos

- MS4 workshop from June 29, 2016
- Questions, concerns, and contributions from workshop participants
- Stormwater Utility options presented by municipal finance expert Mark Abrahams
- The success of Franklin, MA in considering stormwater BMPs and LID in their public works projects

Short-Format Classroom Videos

- Outfall inspections and water quality sampling – safety, tools, protocols, hits
- Mapping stormwater system attributes – paper versus GIS
- BMPs – construction, operations, and maintenance
- SWPPPs – site characteristics

Short-Format Videos Targeting Information on Specific MS4 Requirements

- Exterior salt and sand storage
- Proprietary systems for stormwater management
- Vegetated swales
- Outfall screening
- Tablet tools
- Stormwater infiltration basins
- Introduction to water quality testing procedures and tools
- Public works facility SWPPPs

Underscoring the value of the videos and templates developed by CMRSWC, in advance of the Millbury Technical Training Workshop participants were asked to review the MS4 training videos on CMRSWC's website. These videos provided background on the permit requirements, which facilitated the field training component of this workshop. CMRSWC MS4 templates were used and referenced for the SWPPP and IDDE program elements.

Worcester Polytech Institute Worcester Community Project Center (Minimum Control Measures 1 and 2)

From September 27, 2016 Statewide Stormwater Collaborative Minutes: Andrea Briggs of DEP provided a review of WPI Student projects, and an overview of the program. Andrea facilitates the program. In 2012 WPI and DEP approached the CMRSWC to pair students with communities who need assistance. Since that time WPI has created a new center called the Water Research Outreach Center (WROC), which is a Worcester Project Center. They also have a Boston Project Center. There are three ways through WPI that students can help cities and towns. WPI project timeline is structured in 4 quarters. A, B, C and D term. During the A term they prepare to work (e.g. learning the permit); during the B term the students are available full time to the communities. This past summer the student group looked at cost estimates for municipalities and created a permit summary. Andrea showed 5-minute educational video on stormwater and the connection to local resources, which is posted on the town of Holden webpage. WPI students in attendance introduced themselves and the projects they have been working on. Project #1 involves developing a methodology to help communities estimate cost and hopefully to compare to EPA's cost estimators. Project #2 involves developing an education and outreach campaign to educate municipalities and looking to conduct education and outreach to communities. Andrea described how the partnership between the state and WPI has been very beneficial. Holden has had at least 3 projects now.

WPI students developed a stormwater toolkit featuring an activity book and stickers for children. The activity book includes opportunities for parents to participate and ask questions. The students participated in a craft fair at Union Station in Worcester where they surveyed attendees on logo schemes for their stormwater project branding.

Member Needs Survey

In September 2016, CMRSWC developed a technical needs survey that measured the concerns of member communities with respect to the issuance of the 2016-MS4 General Permit for Stormwater Discharges. The survey also asked members to rank certain programs and tasks that CMRSWC could support to assist members in complying with the MS4 Permit.

Coalition members ranked their needs as follows:

1. Provide Comprehensive Training Programs
2. Continue Standardization of Templates and Forms
3. Provide Web-Based Tools That Support GIS Mapping

Coalition members ranked their compliance concerns as follows:

1. Funding
2. Preparation of NOI and SWMP
3. Designing and Constructing BMP Retrofits
4. Performing Outfall Inspections
5. Performing Outfall Inventory Ranking
6. Developing a Written IDDE Program
7. Meeting TMDL Requirements
8. Developing Written Catchment Investigation Procedures
9. Identifying and Removing Illicit/Illegal Discharges
10. Developing and Maintaining SWPPPs

Conclusion

More than 40 representatives, including CMRSWC members, from MS4 communities participated in the MS4 Workshop in Needham. More than 35 CMRSWC members participated in the Millbury Workshop. The production of 16 videos targeting specific MS4 topics and training opportunities expands the learning opportunities to anyone with access to the web.

The enhanced MS4 templates and information sources on developing IDDE plans, SWPPPs, bylaw review, and LID, which are accessible on the Coalition's website, provide relevant tools to communities implementing their MS4 program with local staff and resources. They are just as relevant to MS4 communities choosing to partner with associations or consultants in the implementation of their MS4 requirements.

CMRSWC members receive ongoing value from the Coalition's workshops, field training, video library, and templates. CMRSWC membership provides consistency to an MS4 constituency subject to routine staff changes, questionable access to funding, and ongoing regulatory demands.

Town of Grafton
NPDES Phase 2
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Year 14 (2017)

Attachment 4

Illicit Discharge Detection and Follow-up



Grafton Conservation Commission

GRAFTON MEMORIAL MUNICIPAL CENTER

30 PROVIDENCE ROAD

GRAFTON, MASSACHUSETTS 01519

Phone: (508) 839-5335 ext. 1138 • FAX: (508) 839-4602

www.grafton-ma.gov • concom@grafton-ma.gov

Minutes of the December 6, 2016 Meeting at 7:00 p.m.

A meeting of the Grafton Conservation Commission was held in Conference Room F of the Grafton Municipal Center on December 6, 2016. Present were: Chairperson Sandra Brock, Heather Trudell, Scott Conway, Nathan Jaffer, Conservation Agent Maria Mast, and Conservation Assistant Leah Cameron.

Chairperson Sandra Brock opened the public meeting at 7:03 p.m.

November 15, 2016 Meeting Minutes – Heather Trudell made a motion, seconded by Nathan Jaffer, to approve the November 15, 2016 meeting minutes as drafted. Chairperson Sandra Brock was in agreement. Being absent from that meeting, Scott Conway abstained.

Request for Certificate of Compliance - DEP #164-622 / WP #469 – 11 Meadowbrook Road – The Conservation Agent reported that the replication was successful and an as-built was on file. Heather Trudell made a motion, seconded by Scott Conway, to issue a Certificate of Compliance for 11 Meadowbrook Road. The motion carried unanimously.

Discussion Item: Update on Sewage Issue at Forest Hills & Lordvale Acres – The Conservation Agent reported that a pipe in the private sewage system at Forest Hills & Lordvale Acres broke and discharged raw sewage into the street. It then flowed into the storm inlet which leads to a stormwater basin on site which potentially discharges into a wetland. The owner has since repaired the broken pipe and is planning to do water testing and the Conservation Agent will find out the results. Chairperson Sandra Brock suggesting testing of the bottom sediments as well. The Conservation Agent will also consult with the Board of Health and provide an update at the next Conservation Commission meeting.

Notice of Intent # 164-926, Application for Grafton Wetlands Protection Bylaw Permit # 759, Application for Grafton Stormwater Management Bylaw Permit # 16-5 - 104 Creeper Hill Road (Assessor's Map 17, Lot 8A) (Russo Brothers, Inc.) – The applicant proposed the construction of a new 12,000 square foot building, subsurface sewage disposal system, stormwater management system, supporting utilities, and paved parking and storage areas within the buffer zone to resource areas. Andy Russo, the owner, and Brian Nelson of Metrowest Engineering, Inc. presented the project to the Commission. Resource areas on the site include: bank, bordering vegetated wetland, riverfront, and FEMA 100-year flood zone. There is no work proposed within the riverfront area. Relocation of the existing gravel access right of way is also proposed for access to the properties on the island and the future cell tower. Peer review comments from Graves Engineering, Inc. have been addressed via revised plans and they are awaiting a second letter from Graves Engineering, Inc. Chairperson Sandra Brock stated that they will need to meet DEP's salt shed requirements. Andy Russo confirmed that all vehicle maintenance will occur inside the building. Chairperson Sandra Brock requested that the peer reviewer review the mounding requirements for the stormwater system. She also suggested that the applicant explore the potential for low impact development (LID) features. The applicant proposed an alternate boundary for bordering land subject to flooding and requested a waiver from the requirement to maintain a 25-foot no-disturb zone around that boundary. The Commission requested written documentation to justify the request. Chairperson Sandra Brock stated that a special condition will be needed for management of any excess material from the storage bins. There were no comments from the audience. Heather Trudell made a motion, seconded by Scott Conway, to continue the public hearing for 104 Creeper Hill Road to December 20, 2016, at the applicant's request. The motion carried unanimously.

2016 Water Quality Report
Lordvale Acres Pond
Grafton, MA

January 18, 2017

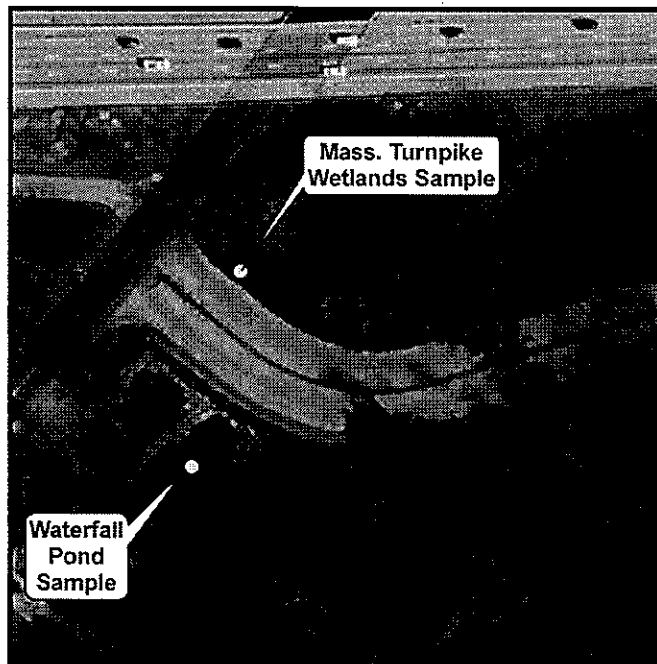
Prepared by: SOLitude Lake Management
590 Lake Street
Shrewsbury, MA 01545

Prepared for: Roy Blanchard
Pioneer Property Management
146 Forest Street
Franklin, MA 02038

This report summarizes the water quality sampling performed on December 1, 2016. It was performed in response to sewer system leakage potentially entering the pond.

Water Quality Results

Water samples were collected from two locations, the waterfall pond and at the outfall between the main entrance and the Massachusetts Turnpike (see below), on December 1st and analyzed for a number of



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common water quality parameters. The results of these tests are presented below, followed by a brief interpretation.

Parameter	Unit	Waterfall	Pike
Turbidity	NTU	2.1	3.1
True Color	A.P.C.U.	8	160
Apparent Color	A.P.C.U.	14	160
Total Alkalinity	CaCO ₃ mg /l	10.8	36.5
pH	S.U.	6.8	7.3
Ammonia Nitrogen	mg/l	ND	ND
Nitrate Nitrogen	mg/l	0.343	0.799
Total Kjeldahl Nitrogen	mg/l	0.412	0.791
Total Phosphorous	mg/l	0.017	0.061
Soluble Phosphorous	mg/l	0.012	0.056
Total Coliform	Col/100 ml	*Pos.	*Pos.
E. coli	Col/100 ml	*Pos.	*Pos.
Fecal Coliform	Col/100 ml	79	130

ND – the sample parameter was below the laboratory's Minimum Detection Level

*Pos. – the sample parameter was present (or positive) in the sample

Turbidity – Turbidity is a measure of the amount of suspended matter present in the water. Turbidity values can range from less than one to hundreds of units. Typically, in lakes, turbidity rarely rises above 5. The turbidity value from the Waterfall sample was 2.1 NTU and the value from the Pike sample was 3.1 NTU. These values indicate an average amount of suspended material in the water bodies.

True Color/Apparent Color - Apparent color is the color of the unfiltered water that is caused by suspended and dissolved matter. This value can change drastically depending on weather conditions: increase due to storm events, decrease due to drought. True color is the color of filtered water due to dissolved constituents only. There are four approximate categories for Color: 0-25 is clear, 25-40 is light tea-color, 40-80 is tea color, >80 is dark tea color. The Waterfall sampling showed an apparent color of 14 and a true color of 8 and in the Pike sample the apparent color was 160 and the true color was 160. Based on the values attained at Pike indicate a dark tea color, and at Waterfall the sample indicates clear water. The higher color from the Pike sample is mainly attributed to dissolved material and likely due to seepage from the organic soils in the surrounding emergent wetlands.

Total Alkalinity – Alkalinity is a measure of the buffering capacity of a waterbody against acidic additions such as acid rain and pollution, which can be detrimental to fish populations. Values below 20 mg/l are a signal that the pond may experience short-term fluctuations in pH. The Waterfall sample had an alkalinity of 10.8 mg/l and the Pike sample had an alkalinity of 36.5 mg/l. While both samples are low, regional alkalinity levels are naturally low in most waterbodies, and reflect the character of the surrounding soils and geology.

pH – The pH measurement scale is from 0 to 14, where 0 is extremely acidic, 7 is neutral, and 14 is the most basic. In general, a range of 5.5-8.0 is desirable for a healthy aquatic habitat. The pH of the Waterfall sample was 6.8 which is slightly below neutral, but desirable. The pH of the Pike sample was 7.3 which is

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slightly above neutral, but also still desirable. Both samples collected were within the desirable range for a healthy aquatic habitat.

Ammonia Nitrogen – Ammonia is an inorganic form of nitrogen, broken down by bacteria into other forms of inorganic nitrogen (nitrite and nitrate). Excessive concentrations of ammonia are toxic to aquatic organisms, often causing large fish-kills, at >0.03 mg/l. The EPA recommends a limit of 0.02 mg/l in freshwater systems. The levels of ammonia nitrogen in the Waterfall and Pike samples were less than the laboratory's minimum detection level of 0.01 mg/l. High levels of ammonia would be indicative of recent pollution, specifically pollution with high organic content like sewage, so the fact that concentrations were low in the ponds is a good sign.

Nitrate Nitrogen – Nitrogen is an essential nutrient for aquatic plant growth in freshwater systems, and is used with available phosphorus. Nitrates (Ammonia, Nitrate, and Nitrite) are a result of organic matter breakdown or indicative of external sources such as fertilizers or sewage. In low-oxygen environments, most nitrates remain unprocessed as ammonia or nitrite. Standards for nitrate have been set by the EPA and are human-safe at <10 mg/l. In reality, the desirable level of nitrate in freshwater systems is actually <0.3 mg/l but it's not uncommon to see concentrations up to 1 mg/l in some waterbodies. The level of nitrate nitrogen in the Waterfall sample was 0.343 mg/l, and in the Turnpike sample the value was 0.799 mg/l. The higher level of nitrate in the Pike sample is again likely due to the surrounding wetlands, but is still within a normal range.

Kjeldahl Nitrogen – Kjeldahl Nitrogen is a combination of organic nitrogen, ammonium, and ammonia. The Total Kjeldahl Nitrogen test resulted in a concentration of 0.412 mg/l in the Waterfall sample and 0.791 in the Turnpike sample. A concentration of 1.0 mg/l or below is considered desirable, which both were.

Total and Soluble Phosphorus – Phosphorus is generally considered to be the limiting nutrient for plant and algae growth, with concentrations of 0.030 mg/l or more being sufficient to stimulate algal blooms or excessive plant growth. Total Phosphorus is comprised of all forms of both organic and inorganic phosphorus within the water column, while Soluble Phosphorus is only the phosphates that are dissolved in the water. The value obtained for Total Phosphorous in the Waterfall sample was 0.017 mg/l and the value obtained from the Turnpike sample was 0.061 mg/l. The value obtained for Soluble phosphorous from the Waterfall sample was 0.012 mg/l and from the Turnpike sample the soluble phosphorous was 0.056 mg/l. Based upon these results, the Turnpike sample was well above the threshold for desirable conditions, while the Waterfall sample had desirably low phosphorus concentrations. Although elevated, the phosphorus concentrations in the Pike sample were not necessarily indicative of gross pollution and may be due to higher organic content in the sediments and surrounding soils.

Total/ Fecal Coliform and E. coli – Bacterial analysis is used to determine the probability of some type of fecal contamination. Total coliform is produced through soil or vegetation (environmental factors) and generally harmless, whereas E. coli and Fecal Coliform are present in the digestive tract of humans and animals, and therefore are a reliable indicator of fecal inputs. Typical standards for Fecal Coliform bacteria for the protection of human health in freshwater are <235 colonies/100 mL. In both the Waterfall and Turnpike samples, Total Coliform and E. coli were present and the level of Fecal Coliform in the Waterfall sample were 79 col/100ml and in the Turnpike sample Fecal Coliform were 130 col/100ml, both below the above threshold.

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Conclusions

These samples are only a snapshot of the water chemistry of the wetland and pond when they were collected; no prior data has been collected and no baseline to compare the results is available. The Turnpike sample did exhibit elevated nutrient levels from those reported in the Waterfall sample. This is likely attributable to them being different ecological systems, a wetland and pond, as well as the samples being collected in December from a stagnated system with limited processes to utilize the nutrients. In addition, although some results in the Turnpike sample were elevated above desirable thresholds, they were still within typical ranges for freshwater systems and not indicative of any gross pollution. Based on this sampling effort and the parameters tested, no obvious impacts to water quality were observed due to the sewage discharge. If you have any questions, please feel free to contact our office.

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Town of Grafton
NPDES Phase 2
Small MS4 General Permit
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Attachment 5

Creating a Teaching Landscape Educational Program

LIVING SYSTEMS FIELD TRIP CURRICULUM:

BIODIVERSITY

Grade Levels: Middle to High School

2016 Massachusetts Science and Technology/Engineering Standards Achieved:

Grade 7: ESS3. Earth and Human Activity

Grade 7: LS2. Ecosystems: Interactions, Energy, and Dynamics

Grade 8: ESS3. Earth and Human Activity

High School: LS2. Ecosystems: Interactions, Energy, and Dynamics

High School: ESS3 Earth and Human Activity

Topics covered: Biodiversity, ecosystem services, land use change, habitat degradation, protected areas management, pollution, ecological restoration, the Industrial Revolution, ecological design

ABOUT THE LIVING SYSTEMS LABORATORY

The Blackstone River Corridor Living Systems Laboratory (LSL) is a nonprofit organization that seeks to engage people in the socioecological history of the Blackstone River and create effective solutions to environmental contamination. The purpose of the LSL is to connect people with the River, help them to appreciate the benefits of a healthy ecosystem in society in the context of development, and be a part of the restoration of the Blackstone through education, research, and community outreach. The LSL especially hopes to engage students by offering them an experiential learning opportunity to engage with the past, present and future of the Blackstone River, better understand the complex relationship that humans have with nature. Biodiversity is a key theme in understanding this relationship, and the LSL provides a platform for interactive learning around this topic.

DURING THE TRIP, students will see firsthand the effects of human activity on ecosystems and consider the connection between nature and human society. Specifically, students will consider biodiversity and ecosystem services provided by the Blackstone River, and how industrial and urban contamination affects them. Students will then experience a novel restoration project that demonstrates how biodiversity can improve ecosystem resiliency and restore a damaged landscape.



AFTER THE TRIP, students will have an appreciation for the importance of biodiversity on healthy ecosystems and the threats to biodiversity and thus human well-being. Students will have considered an ecosystem approach to restoring a damaged landscape, having applied the principles of ecology and biodiversity to a real world contamination issue. They will understand the role of humans in the functioning of ecosystems and know how the Blackstone River has affected both the economy and ecology of the area. They will also consider possible solutions to anthropogenic threats to biodiversity.



BACKGROUND

The Blackstone River, birthplace of the American Industrial Revolution, is also assumed to be one of the largest sources of nutrient and pathogen pollution in the watershed. The long history of development along the river has left a legacy of antiquated infrastructure and development practices that continue to discharge nutrient laden stormwater and pathogens as well as inadequately treated sewage into the river and ultimately the Narragansett Bay. This area of the canal and river has been further degraded by oil and other toxins from the area's industrial past.

The Eco Machine and Canal Restorers were built in 2012 by John Todd Ecological Design, LLC in Grafton, MA, on the banks of the Blackstone Canal. They utilize the theories of ecological design and induced biodiversity to harness the abilities of native plants, animals, fungi and bacteria and other microorganisms to metabolize waterborne contaminants. By creating engineered microenvironments that induce biodiversity and amplify surface area, a diverse ecosystem of organisms metabolize nutrients and contaminants at higher rates than the compromised ecology of the canal and river.



BASIC PRINCIPLES OF BIODIVERSITY. Students will get the most out of a trip to the LSL if they have had exposure to the principles of the subject of Biodiversity prior to the excursion. Topics that they should be familiar with include:

What is Biodiversity?

The variety of life!

Genetic vs Ecological Biodiversity

The Importance of Biodiversity

Ecosystem and Species Resiliency- recovering from disturbances and disease

Medical discoveries- the uses of species not yet discovered

Ecosystem Services- high biodiversity supports ecosystem functions

Biodiversity creates the variety of life!

The Threats to Biodiversity

Habitat loss- land use change

Exploitation- over hunting and fishing

New and non-native disease

Humans can indirectly contribute to these threats through *climate change* and *pollution*

Protecting and Restoring Biodiversity

Ecological Restoration- The recovery of an ecosystem that has been degraded

Protected Areas- Preserve the natural habitat of species and protect them from threats

The difference between an engineered and natural ecosystems and implications for biodiversity.

NAVIGATING THE LEARNING LANDSCAPE. Now that students have a background in the principles of biodiversity, they can use the Blackstone River and Eco Machine as an example of how biodiversity can be threatened, the risks to humanity, and to see how degraded ecosystems can be repaired. The questions below are a tool for teachers and are meant to guide the learning of students before and during their tour of the LSL.

Before the Tour

Geography of the Blackstone River

Through what regions does the Blackstone River flow?

What communities have a connection to the Blackstone River?

Ecology of the Blackstone River

What kinds of organisms are supported by rivers?

What kinds of services do humans depend on rivers for?

During the Tour

History of the Blackstone River

How did the Blackstone River shape the economic history of the region?

How did industrialization and urbanization affect the river physically? Chemically? Ecologically?

The Effects of Pollution

How has the industrial and urban pollution affected the organisms living in and around the Canal? The River? Narragansett Bay?

How has the pollution affected humans living around the Canal? The River? Narragansett Bay?

What is Ecological Design?

How are the Eco Machine and Canal Restorers different from typical engineered ecosystems?

Protecting the Blackstone

With the previous discussion of biodiversity in mind, how could we begin to protect the biodiversity and ecosystems of the Blackstone River as an industry? As a community? As an individual?

How does the Eco Machine and Canal Restorers create protected areas? What are they and how do they protect biodiversity?

After the Tour/Reflection

Restoring the Blackstone

With the previous discussion of biodiversity in mind, how could we begin to restore the biodiversity of the Blackstone River as an industry? As a community? As an individual?

How does the Eco Machine and Canal Restorers remediate canal water?

What is the role of bacteria? Fungi? Plants?

Why is it important to include all of them inside the Eco Machine?

Why is it important to have different types of plants, fungi and bacteria inside of the Eco Machine?

What is the role of animals?

What part can we play in the protection and restoration of biodiversity?

RESOURCES ON BIODIVERSITY:

National Wildlife Federation: <http://nwf.org/Wildlife/Wildlife-Conservation/Biodiversity.aspx>

Convention on Biological Diversity: <https://www.cbd.int/protected/overview/>

Society for Ecological Restoration: <http://www.ser.org/resources/resources-detail-view/ecological-restoration-a-means-of-conserving-biodiversity-and-sustaining-livelihoods>

RESOURCES ON THE BLACKSTONE RIVER:

Map of the Blackstone Watershed: <http://www.thebrwa.org/map.htm>

River History: <http://www.nps.gov/blac/index.htm>

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LIVING SYSTEMS FIELD TRIP CURRICULUM:

FOOD WEBS AND

ENERGY TRANSFER

Grade Levels: Middle School, High School

2016 Massachusetts Science and Technology/Engineering Standards Achieved:

Grade 7: LS2. Ecosystems: Interactions, Energy, and Dynamics

Grade 8: LS1. From Molecules to Organisms: Structures and Processes

High School: LS2. Ecosystems: Interactions, Energy, and Dynamics

Topics covered: Trophic levels, biomass and the building blocks of organisms, nutrient and energy flow, decomposers, herbivores, carnivores, autotrophs, pollution, food web dynamics and perturbations

ABOUT THE LIVING SYSTEMS LABORATORY

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DURING THE TRIP, students will experience an engineered ecosystem in which various strands of the food web are showcased and their function explained. The Eco Machine effectively shows the role of fungi, bacteria and plants in the recycling and of nutrients and energy transfer, allowing student to visualize how these elements are stored and transferred. Students will consider the methods of energy transfer and see firsthand how the different components of an ecosystem contribute to healthy ecosystem function, and how humans can foster healthy ecosystem development in order to promote public health.

AFTER THE TRIP, students will have a better understanding of the role of different organisms in the healthy functioning of ecosystems, and how healthy ecosystems benefit humanity. They will visualize the way nitrogen and carbon flow through ecosystems, and make up organisms. Students will be able to understand how energy is transferred through these ecosystems and begin to consider the role that humans play and potential solutions in the maintenance of ecological balance.





BACKGROUND

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BASIC PRINCIPLES OF FOOD WEBS.

Students will get the most out of a trip to the LSL if they have had exposure to the tenants of the subject of Food Webs and Energy Transfer prior to the excursion. Topics that they should be familiar with include:

What is an Ecosystem?

Food Chains and Food Webs

Producers, Consumers, Predators, Prey
Decomposers

Energy Sources and Transfer

Photosynthesis
Cellular Respiration
Transfer and loss among producers, primary, secondary, and tertiary consumers, and decomposers.

The Nitrogen and Carbon Cycle

The role of fungi, bacteria, plants
How humans alter the N and C cycle



NAVIGATING THE LEARNING LANDSCAPE. Now that students have a background in the tenants of food webs, they can use the Blackstone River and Eco Machine as an example of how biodiversity can be threatened, the risks to humanity, and to see how degraded ecosystems can be repaired. The questions below are a tool for teachers and are meant to guide the learning of students before and during their tour of the LSL.

Before the Tour

The Ecology of the Blackstone River

Where will you most likely find a producer in the natural ecosystem? What characteristics does it have and on what resources does it rely?

What trophic levels can be seen around the River, Pond and Canal?

Where do nutrients enter the ecosystem?

What part do humans play in this ecosystem?

Energy at the Fisherville Mill

What forms of energy can be seen at the site?

What forms of are humans using, and how is it returning to the ecosystem?

During the Tour

Nutrients and Energy in the Blackstone Canal

Why are the nutrients that humans add to the ecosystem good for some organisms by bad for others?

How are petroleum hydrocarbons affecting the Food Web? What does it mean for humans?

The Eco Machine

Where is photosynthesis occurring in the system? Cellular Respiration? Decomposition?

What do petroleum hydrocarbons resemble? Why are they not toxic to the fungi in the Eco Machine?

What happens to the energy during decomposition?

What is the fate of the nitrogen in the Eco Machine? Of the hydrocarbons?

How would a disruption to one of these microcosms affect the system as a whole?

After the Tour/Reflection

The Role of different Ecological Groups

What groups are the most important in a food web?

What would happen if the producers were removed? The consumers? The decomposers?

The Role of the Abiotic Environment

How are the organisms outside the Eco Machine different from the ones inside of it, even though some are the same species?

Disruptions and Human Activity

What would happen to the river's ecosystem if there were a disruption such as a hurricane? A flood? A wildfire? An oil spill?

How can humans disrupt a food web?

What do humans stand to lose if a food web is disrupted?

What other things can humans do to protect ecosystems and food webs?

RESOURCES ON FOOD WEBS AND ENERGY:

Annenberg Learner: <https://www.learner.org/courses/envsci/unit/text.php?unit=4&secNum=3>

Study.com: <http://study.com/academy/lesson/cycles-of-matter-the-nitrogen-cycle-and-the-carbon-cycle.html>

RESOURCES ON THE BLACKSTONE RIVER:

Map of the Blackstone Watershed: <http://www.thebrwa.org/map.htm>

River History: <http://www.nps.gov/blac/index.htm>

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LIVING SYSTEMS FIELD TRIP CURRICULUM: NATURE AND HUMAN ACTIVITY

Grade Levels: Elementary School (Can be modified for Middle and High School)

2016 Massachusetts Science and Technology/Engineering Standards Achieved:

Grade 2, 4 & 5: ESS3. Earth and Human Activity

Grade 3 & 4: ETS1. Engineering Design

Grade 5: ESS2. Earth's Systems

Topics covered: Water and the water cycle, runoff, erosion, human energy resources and their extraction, land use change, biodiversity loss, climate change and engineered environmental solutions

ABOUT THE LIVING SYSTEMS LABORATORY

The Blackstone River Corridor Living Systems Laboratory (LSL) is a nonprofit organization that seeks to engage people in the socioecological history of the Blackstone River and create effective solutions to environmental contamination. The purpose of the LSL is to connect people with the River, help them to appreciate the benefits of a healthy ecosystem on society in the context of development, and be a part of the restoration of the Blackstone through education, research, and community outreach. The LSL hopes to engage students by offering them an experiential learning opportunity to engage with the past, present and future of the Blackstone River, and to better understand the complex relationship that humans have with nature. The LSL provides an opportunity for students to see natural cycles up close, and invites students to explore the intersection of human activity with these cycles. As some present human practices are at odds with the cycles upon which we depend, the LSL encourages students to consider ecological engineering solutions to some of our most pressing environmental problems.



DURING THE TRIP, students review the water cycle in an outdoor environment, using the Fisherville Mill site to help identify how different factors will affect how water flows through the ecosystem. They will see the legacy of an industry that relied on both fossil fuels and renewable energy, and consider how these practices have affected the water cycle and other ecosystems in the area and globally. Finally, students will explore the Eco Machine and Canal Restorers and begin to consider how human engineered solutions may play a role in mitigating some of the water and weather related challenges that we face today.

AFTER THE TRIP, students will have a better understanding of how water moves through an ecosystem and how organisms (including humans) depend on the healthy cycling of water. They will consider how different energy uses, extraction processes and land uses affect the water cycle and, and explore ecological engineering solutions to address the effects of some of the problems caused by human activity.





BACKGROUND

The Blackstone River, birthplace of the American Industrial Revolution, is also assumed to be one of the largest sources of nutrient and pathogen pollution in the watershed. The long history of development along the river has left a legacy of antiquated infrastructure and development practices that continue to discharge nutrient laden stormwater and pathogens as well as inadequately treated sewage into the river and ultimately the Narragansett Bay. This area of the canal and river has been further degraded by oil and other toxins from the area's industrial past.

The Eco Machine and Canal Restorers were built in 2012 by John Todd Ecological Design, LLC in Grafton, MA, on the banks of the Blackstone Canal. They utilize the theories of ecological design and induced biodiversity to harness the abilities of native plants, animals, fungi and bacteria and other microorganisms to metabolize waterborne contaminants. By creating engineered microenvironments that induce biodiversity and amplify surface area, a diverse ecosystem of organisms metabolize nutrients and contaminants at higher rates than the compromised ecology of the canal and river.



BASIC PRINCIPLES OF CYCLES AND HUMAN ACTIVITY. Students will get the most out of a trip to the LSL if they have had exposure to the principles of the subject of Natural Cycles and Human Activity prior to the excursion. Topics that they should be familiar with include:

The Water Cycle

Steps: evaporation, precipitation, absorption, surface runoff, and condensation

Global water pools (salt and fresh): oceans, groundwater, glaciers etc

Factors affecting how water is cycled: temperature, groundcover



Fuel Use and Extraction

*What fuels are used for
Nonrenewable fuels and sources
How nonrenewable fuels pollute
Renewable energy sources*



NAVIGATING THE LEARNING LANDSCAPE. Now that students have a background in the tenants of the water cycle and human activity, they can use the Blackstone Canal, Eco Machine and Canal Restorers to evaluate these processes in motion. The questions below are a tool for teachers and are meant to guide the learning of students before and during their tour of the LSL.

Before the Tour

The Water Cycle

Where is water found in this landscape?

Can you identify where evaporation occurs? Infiltration? Runoff?

How do the different surfaces that you see affect runoff? Evaporation? Infiltration?

Energy and the Direct Effect of Human Activity

How has the use of hydropower affected the River? The Water Cycle?

How has the use of fossil fuels affected the River? The Water Cycle?

What other sources of fuels are there, and how would they affect the River and Water Cycle?

During the Tour

The Water Cycle and Ecosystem Health

What happens when more water precipitates than evaporates? Than infiltrates? What does that mean for organisms? For humans?

How does temperature affect precipitation, evaporation and infiltration?

Runoff and Erosion

What happens to water as it runs across the landscape? What happens to the surfaces? What does that mean for river organisms? For humans?

How did the Fisherville Mill affect the nature of runoff? How about Worcester?

What phenomenon are seen in the River and Canal because of this?

How do changing temperatures affect this phenomenon?

The Eco Machine

What natural processes are taking place in the Eco Machine?

Where in the Water Cycle would these processes happen?

After the Tour/Reflection

Nature and Human Activity

Why do plants and animals depend on a normally functioning Water Cycle? How about humans?

How has human activity directly affected the Water Cycle?

How do disruptions in the Water Cycle affect humans?

Using Ecological Engineering to Solve Problems

What problems is the Eco Machine solving? How?

How could we expand on the Eco Machine's success?

Is this addressing the root cause of the problem?

What are some other ways that we can address these root problems?

RESOURCES ON NATURE AND HUMAN ACTIVITY:

NASA's Precipitation Education Resources:

http://pmm.nasa.gov/education/browse?field_article_edu_and_tid=77

Humans and the Water Cycle: <http://sciencelearn.org.nz/Contexts/H2O-On-the-Go/Science-Ideas-and-Concepts/Humans-and-the-water-cycle>

PowerPoint on Humans and the Water Cycle:

http://westernreservepublicmedia.org/earthmotion3/images/Human_Impact_on_water.ppt

An activity to demonstrate runoff:

<http://watermonitoring.uwex.edu/pdf/level1/curriculum/WisStreamCurriculum-UrbanRunoffModel.pdf>

RESOURCES ON THE BLACKSTONE RIVER:

Map of the Blackstone Watershed: <http://www.thebrwa.org/map.htm>

River History: <http://www.nps.gov/blac/index.htm>

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Living Systems
Laboratory

Raised Boardwalk

Curriculum by: Jacquelyn Burmeister

LIVING SYSTEMS FIELD TRIP CURRICULUM: LIFE CYCLES AND STRUCTURES

Grade Levels: Elementary School

2016 Massachusetts Science and Technology/Engineering Standards Achieved:

Grade 1: LS1. From Molecules to Organisms: Structures and Processes

Grade 2: LS2. Ecosystems: Interactions, Energy, and Dynamics

Grade 3, 4 & 5: LS1. From Molecules to Organisms: Structures and Processes

Grade 5: LS2. Ecosystems: Interactions, Energy, and Dynamics

Topics covered: plant, bacterial and fungal lifecycles, resources needed for growth and development, how organisms interact with their environment to obtain resources

ABOUT THE LIVING SYSTEMS LABORATORY

The Blackstone River Corridor Living Systems Laboratory (LSL) is a nonprofit organization that seeks to engage people in the socioecological history of the Blackstone River and create effective solutions to environmental contamination. The purpose of the LSL is to connect people with the River, help them to appreciate the benefits of a healthy ecosystem on society in the context of development, and be a part of the restoration of the Blackstone through education, research, and community outreach. Understanding how humans and nature interact depends in part on understanding the resources needed for organisms to thrive and reproduce, and the ways that they obtain them. The LSL provides an opportunity for students to learn about the processes by which plants, fungi and bacteria interact with their environment to obtain these resources by creating microcosms in which the functioning of these organisms as part of an ecosystem is clearly seen. This novel perspective allows students an up close view of the structures and lifecycles of plants and animals, and allows them to consider how these organisms in turn help humans to survive

DURING THE TRIP, students will experience an engineered ecosystem in which various strands of the food web are showcased. Student will see up close the ways in which fungi, plants and bacteria interact with their environment, the structures they use to obtain resources, and how they reproduce. The unique setup of the Eco Machine allows students to identify various stages of organismal life cycle, and discern how different biotic and abiotic factors affect organismal growth and reproduction.



AFTER THE TRIP, students will have a better understanding of how organisms obtain resources to grow and reproduce, as well as identify their structures in nature. More so, they will see how excesses or a lack of these resources can affect an organism's ability to survive and prosper, and the resources that they provide for humans and each other. Finally they begin to think about how humans affect an organisms ability to obtain necessary resources.



BACKGROUND

The Blackstone River, birthplace of the American Industrial Revolution, is also assumed to be one of the largest sources of nutrient and pathogen pollution in the watershed. The long history of development along the river has left a legacy of antiquated infrastructure and development practices that continue to discharge nutrient laden stormwater and pathogens as well as inadequately treated sewage into the river and ultimately the Narragansett Bay. This area of the canal and river has been further degraded by oil and other toxins from the area's industrial past.

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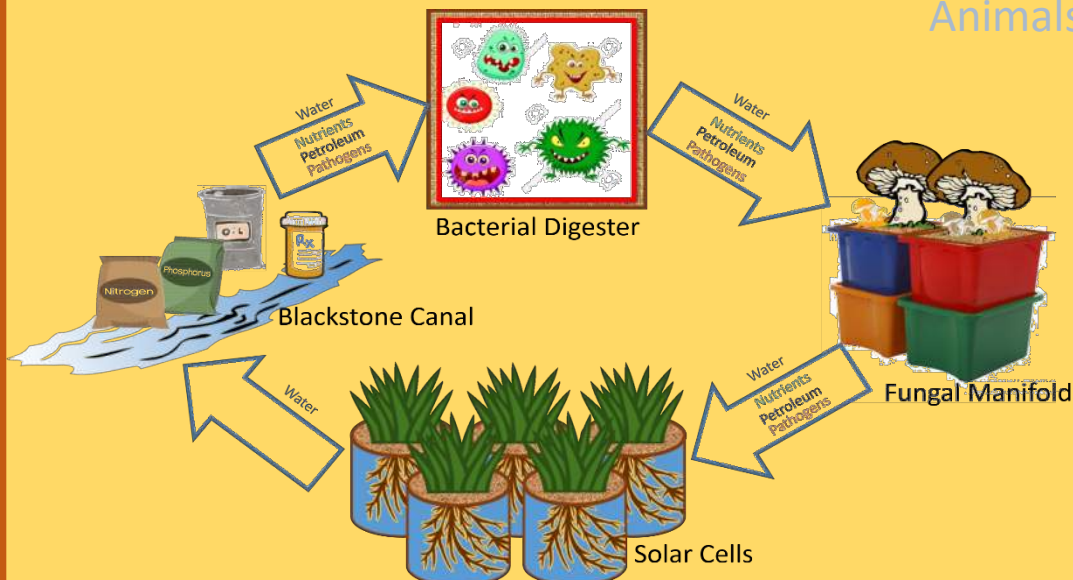


BASIC PRINCIPLES OF LIFE CYCLES AND STRUCTURES. Students will get the most out of a trip to the LSL if they have had exposure to the tenants of the subject of Lifecycles and body structures prior to the excursion. Topics that they should be familiar with include:

Resources that Organisms Depend On

- How plants, animals, bacteria and fungi obtain food, minerals, air and water
- How temperature can affect an organism's ability to survive
- The role of light

Life Cycles of Plants, Fungi, Animals and Bacteria



How organisms begin
(seeds, eggs)

How organisms grow
(increase in size, weight, grow new parts)

Reproduction
(develop seeds, root runners, mate, lay eggs)

Death (length of life)

NAVIGATING THE LEARNING LANDSCAPE. Now that students have a background in the principles of organismal structure and life cycles, they can use the Blackstone Canal, Eco Machine and nursery to evaluate these processes in motion. The questions below are a tool for teachers and are meant to guide the learning of students before and during their tour of the LSL.

Before the Tour

Ecology of the Blackstone River

What different kinds of organisms do you see?

What kinds of organisms are there below the water? Below the ground?

From where do these organisms obtain water? Food?

During the Tour

Bacteria

Why can't we see the bacteria in the digester?

If we had a microscope, what would the shapes of bacteria be?

How do bacteria move throughout the Eco Machine?

How and what are the bacteria eating?

How do bacteria reproduce?

What happens to the bacteria when the temperature gets really cold outside?

Fungi

Which parts of the fungi can you see in the bins? Can you name them?

What are the filaments for?

What is the fruiting body/mushroom for?

How do fungi reproduce?

Why can the fungi grow even when the covers are on the bins?

How do the fungi obtain energy? Water?

What happens after the fruiting body releases spores? How else do they reproduce?

Plants

Can you name the parts of the plants you see in the tanks?

How are the plants obtaining energy? How are they obtaining nutrients and minerals?

Where do the nutrients go after they are taken in from the environment?

How do the plants reproduce?

Why do the plants in the greenhouse have more leaves or are bigger than the same plants outside?

How do plants die?

After the Tour/Reflection

The role of Temperature

What happens to animals when it gets cold out? To plants? To fungi and bacteria?

How do hot temperatures affect an animal's ability to get water? How about plants and fungi?

Why is it worrying when we are told that the temperature keeps on rising?

Excess Resources

What happens to bacteria when there are lots of nutrients in the water?

What does that mean for animals? For humans?

Where do nutrients come from?

What happens to plants when there are lots of nutrients in the water?

What does that mean for humans?

RESOURCES ON LIFE CYCLES AND STRUCTURE:

Fungi: http://www.namyco.org/fungus_files.php

Plant Life Cycle Activity: http://www.pbslearningmedia.org/resource/tdc02.sci.life.colt.lp_plantcycle/plant-life-cycles/

Bacteria and Bioremediation: <http://www.nap.edu/read/2131/chapter/4>

RESOURCES ON THE BLACKSTONE RIVER:

Map of the Blackstone Watershed: <http://www.thebrwa.org/map.htm>

River History: <http://www.nps.gov/blac/index.htm>

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Town of Grafton
NPDES Phase 2
Small MS4 General Permit
Annual Report
Year 14 (2017)

Attachment 6

MS4 Workshops

Municipal Stormwater Technical Assistance Project

Workshop 1: MA MS4 Permit

Program

Date: June 29, 2016

Location: Needham Public Services Administration Building, 500 Dedham Ave.,
Needham, MA 02492

Attendees: maximum 40, ideally new or MS4 inexperienced

Presentation Team: Bill Guenther, Jenn Cavanaugh, Dan Delany, Mary Monahan, Fuss
& O'Neill; Kevin Flanders, People GIS; Brutus Cantoreggi, Franklin DPW; Fred Civian,
Massachusetts Department of Environmental Protection

8:00AM

Coffee, donuts, fruit

Welcome: Representatives from Central Mass Regional Stormwater Coalition and
Needham DPW

8:10AM

Program intro

Brief review of MS4 permit

Six Minimum Control Measures
Schedule

8:30AM

Intro to IDDE and municipal good housekeeping challenges and opportunities

Outfall inspections and water quality sampling – safety, tools, protocols, hits

Mapping SW system attributes: paper vs GIS

BMPs – construction, operations, and maintenance

SWPPPs – site characteristics

9:45AM

Site visits and hands on experience (4 teams of 10 – 4 staging areas) 20 minutes per site

11:15AM

Review results of field activities

12:00PM

Lunch (catered) and Networking

12:30PM

BMPs in public works operations

1:30PM

Final Discussions and conclusion

1:45PM

Dismissal

**Central Massachusetts Regional Stormwater Coalition
MS4 Training Workshop & Vendor Fair**

Date and time: October 28, 2016

Workshop: 8:00AM – 12:30PM with lunch

Vendor Fair: 12:00PM – 3:00PM

Location: Millbury Department of Public Works, 131 Providence Street, Millbury, MA

This program targets public works professionals, stormwater coordinators, and other municipal staff responsible for their community's NPDES Phase II Stormwater Permit Minimum Control Measures 3, 4, 5, and 6.

The MS4 Training Workshop emphasizes hands on training for the following:

- **IDDE** – review of CMRSWC IDDE inspection template and inspection form
- **BMPs and LID** –opportunities to identify BMP retrofits; BMP and LID construction, operations, and maintenance
- **SWPPPs** – using CMRSWC template to develop a SWPPP using Millbury's site characteristics

In advance of the day's program, participants are asked to review the classroom training videos from CMRSWC's previous workshop in Needham. These videos provide the permit requirements' background that will facilitate the field training for this workshop.

They can be found at the following link:

http://www.centralmastormwater.org/Pages/crsc_toolbox/videos

The **Vendor Fair** will include products and services that support MS4 compliance, including *Environmental K9 Services*.

Prior registration is required for attendance to the Workshop

Deadline to register: Tuesday October 25

Workshop registration is limited to the first 40 registrants.

Vendor Fair in the afternoon has no registration limit

RSVP - return the attached Program Registration to:

Jessica Montagna

jmontagna@fando.com

413-452-0445 x4400

For technical questions contact: Bill Guenther - WGuenther@fando.com

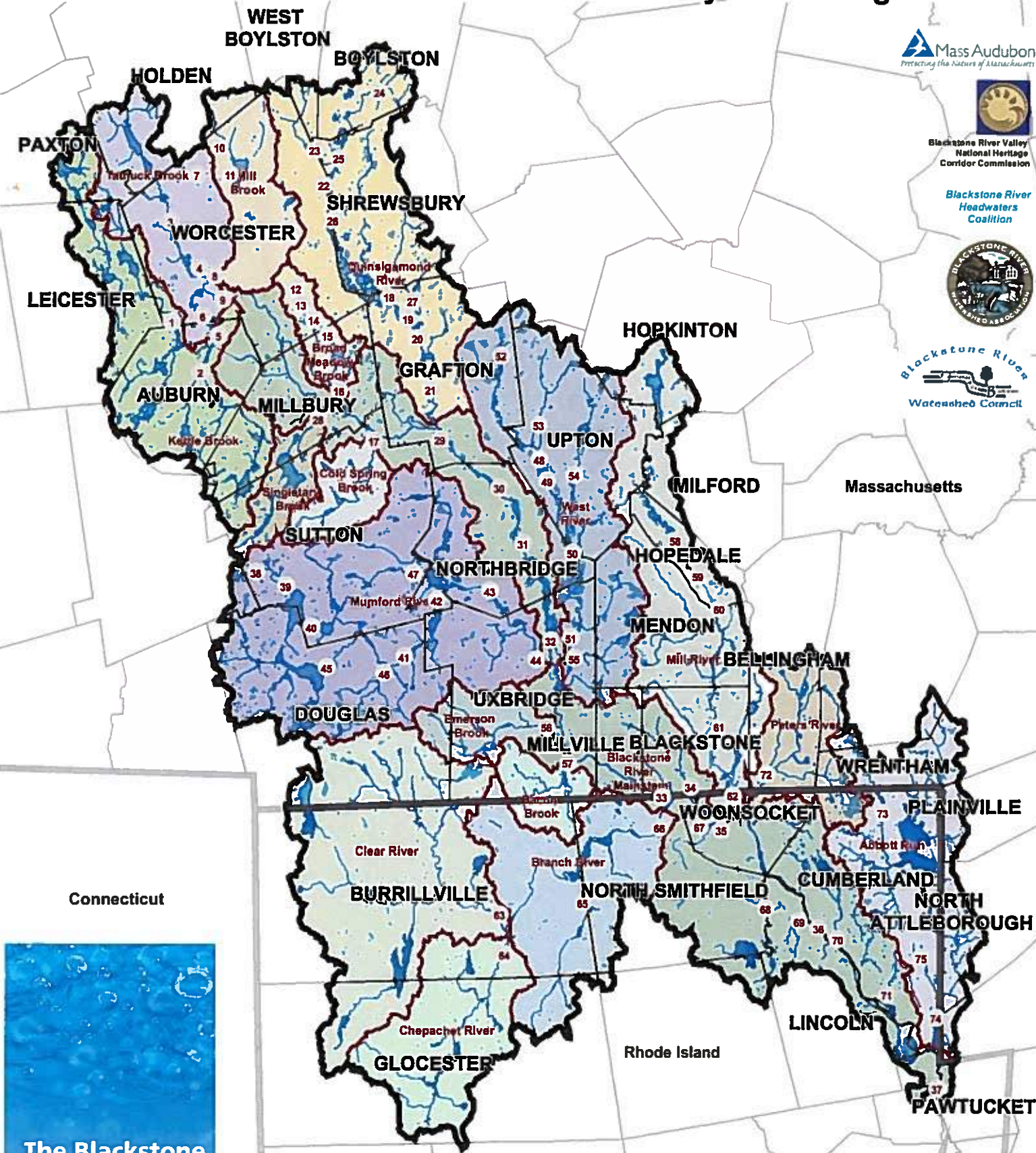
Funding for this program is provided by the **Central Massachusetts Regional Stormwater Coalition**.

Town of Grafton
NPDES Phase 2
Small MS4 General Permit
Annual Report
Year 14 (2017)

Attachment 7

Blackstone River Coalition Water Quality Monitoring Report

Blackstone River Watershed 2016 Water Quality Monitoring Sites



Mass Audubon
Protecting the Nature of Massachusetts



Blackstone River Valley
National Heritage
Corridor Commission

Blackstone River
Headwaters
Coalition



Blackstone River
Watershed Council

The Blackstone
River Coalition

For more information email
info@zaptheblackstone.org

www.zaptheblackstone.org

Funded in part by Mass Audubon and Blackstone Heritage Corridor, Inc.

LandVest®

This map was produced by
James DeNormandie, LandVest.

Blackstone River Coalition
Watershed-wide Volunteer Water Quality Monitoring Program
Report Card for 2016 Monitoring Season

map #	WaterBody	Site Location	Town	Aesthetics	Temp.	DO	% Sat.	Nutrients
HEADWATERS TRIBUTARIES								
1	Kettle Brook	Stafford Street	Worcester					
2	Dark Brook	Auburn High	Auburn					
3	Tatnuck Brook ^{cwf}	VFW-south	Worcester					
4	Tatnuck Brook ^{cwf}	Park Ave.	Worcester					
5	Leesville Pond	Leesville inflow	Auburn					
6	Leesville Pond	Leesville outflow	Worcester					
7	Beaver Brook	Jewish Community Center	Worcester					
8	Beaver Brook	Park Ave. Carwash	Worcester					
9	Middle River	St. John's Cemetery	Worcester					
10	Ararat Brook ^{cwf}	Ford Brook	Worcester					
11	Delaney Brook	Delaney Brook	Worcester					
12	Broad Meadow Brook	Dunkirk	Worcester					
13	Broad Meadow Brook	Dupuis	Worcester					
14	Broad Meadow Brook	Holdridge	Worcester					
15	Broad Meadow Brook	Knollwood	Millbury					
16	Broad Meadow Brook	Dosco	Millbury					
17	Cold Spring Brook ^{cwf}	Hatchery Road	Sutton					
18	Quinsigamond River	Flint Pond Outlet	Grafton					
19	Quinsigamond River	Rte 140	Grafton					
20	Quinsigamond River	Wheeler Road	Grafton					
21	Quinsigamond River	Pleasant Street	Grafton					
22	Coal Mine Brook ^{cwf}	Plantation Street	Worcester					
23	Poor Farm Brook ^{cwf}	Roberto Clemente	Worcester					
24	Sewall Brook ^{cwf}	School Street **	Boylston					
25	Sewall Brook ^{cwf}	Holden Street	Shrewsbury					
26	Tilly Brook	Vinny Testa's	Shrewsbury					
27	Bummitt Brook	Pratts Pond	Grafton					
28	Singletary Brook	Sycamore Circle	Millbury					

KEY TO COLOR CODES

Excellent
Good
Fair
Poor
Not Enough Data

Categories

(Each category is derived from the combination of the following factors)

Aesthetics -

turbidity, water appearance, water odor & visual assessments

Temp. - temperature

DO - dissolved

oxygen % saturation

Nutrients - nitrate & orthophosphate

April 2017

*cwf = designated cold water fishery

** = site experienced 1 or more no-flow conditions

= site experienced more than 2 missed sampling events

Funding provided by Blackstone Heritage Corridor, Inc. 

Blackstone River Coalition
Watershed-wide Volunteer Water Quality Monitoring Program
Report Card for 2016 Monitoring Season

map #	WaterBody	Site Location	Town	Aesthetics	Temp.	DO	% Sat.	Nutrients
BLACKSTONE RIVER								
29	Blackstone River	Fisherville Pond Outlet/122A	Grafton					
30	Blackstone River	Sutton St. USGS flow station	Northbridge					
31	Blackstone River	Plummer's Landing	Northbridge					
32	Blackstone River	Tow path / Stanley Woolen	Uxbridge					
33	Blackstone River	Upstream @Gorge/ Staples La	Blackstone					
34	Blackstone River	Main St. Blackstone/TKO	Blackstone					
35	Blackstone River	River Island Park	Woonsocket					
36	Blackstone River	Below Albion Dam	Lincoln					
37	Blackstone River	Slater Mill	Pawtucket					
TRIBUTARIES								
38	Mumford River	Hotel Pond Outlet	Sutton					
39	Mumford River	L. Manchaug Inlet	Sutton					
40	Mumford River	L. Manchaug Out./Parker Rd	Sutton					
41	Mumford River	Gilboa Street/above WWTP	Douglas					
42	Mumford River	Lackey Dam	Uxbridge					
43	Mumford River	Northbridge Middle School	Uxbridge					
44	Mumford River	Downstream @Depot Street	Uxbridge					
45	unnamed tributary	Whitin Reservoir Outlet	Douglas					
46	Centerville Brook ^{cwf}	West Street	Douglas					
47	Cook Allen Brook ^{cwf}	Upstream of bridge/Johnson R	Sutton					
48	West River ^{cwf}	Hartford Avenue	Upton					
49	West River ^{cwf}	Pleasant and Glen	Upton					
50	West River ^{cwf}	Mendon Road	Northbridge					
51	West River ^{cwf}	Under Rte. 16 bridge	Uxbridge					
52	Miscoe Brook ^{cwf}	Merriam Road	Grafton					
53	Warren Brook ^{cwf}	Fowler Road Bridge	Upton					
54	Center Brook ^{cwf}	Mendon Road	Upton					
55	Meadow Brook ^{cwf}	Blackstone St. Bridge**#	Uxbridge					
56	Emerson Brook ^{cwf}	Above Quaker Highway	Uxbridge					
57	Bacon Brook ^{cwf}	Balm of Life Springs Road	Uxbridge					

KEY TO COLOR CODES

Excellent
Good
Fair
Poor
Not Enough Data

Categories
(Each category is derived from the combination of the following factors)

Aesthetics - turbidity, water appearance, water odor & visual assessments
Temp. - temperature
DO - dissolved oxygen
% Sat. - dissolved oxygen % saturation
Nutrients - nitrate & orthophosphate

April 2017

*cwf = designated cold water fishery

** = site experienced 1 or more no-flow conditions

= site experienced more than 2 missed sampling events

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Blackstone River Coalition
Watershed-wide Volunteer Water Quality Monitoring Program
Report Card for 2016 Monitoring Season

map #	WaterBody	Site Location	Town	Aesthetics	Temp.	DO	% Sat.	Nutrient s
TRIBUTARIES continued								
58	Mill River	Fitzgerald Street	Hopedale					
59	Mill River	Mill Street	Hopedale					
60	Mill River	Hartford Avenue East	Hopedale					
61	Mill River	Park Street Valati Park	Blackstone					
62	Mill River	Privilege Street	Woonsocket					
63	Clear River ^{cwf}	RI 102	Burrillville					
64	Chepachet River ^{cwf}	Gazza Road	Burrillville					
65	Tarkiln Brook	Tarkiln Road	Burrillville					
66	Branch River	Rte. 146A/Great Road	N. Smithfield					
67	Cherry Brook	Olo Street	Woonsocket					
68	Crookfall Brook ^{cwf}	Sayles Hill Road	Lincoln					
69	Mussey Brook	New River Road	Lincoln					
70	Sneech Brook ^{cwf}	Albion Road	Cumberland					
71	Monastery Brook	Mendon Road**#	Cumberland					
72	Peters River ^{*cwf}	Paine Street	Bellingham					
73	Sylvys Brook	Grants Mill Road	Cumberland					
74	Robin Hollow Pond	Dexter Street	Cumberland					
75	Millers River ^{cwf}	Hines Road	Cumberland					

KEY TO COLOR CODES

Excellent
Good
Fair
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Not Enough Data

Categories

(Each category is derived from the combination of the following factors)

Aesthetics -

turbidity, water appearance, water odor & visual assessments

Temp. - temperature

DO - dissolved

% Sat. - dissolved oxygen % saturation

Nutrients - nitrate & orthophosphate

April 2017

*cwf = designated cold water fishery

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= site experienced more than 2 missed sampling events

Funding provided by Blackstone Heritage Corridor, Inc. 

Blackstone River Coalition
Watershed-wide Volunteer Water Quality Monitoring Program
Procedure for Developing 2016 Monitoring Season Report Card

1. Samples are collected and tested on the second Saturday of the month from April to November. Sites must be sampled at least 6 times out of 8 possible monitoring events. Monthly raw data is color coded by parameter according to guidance provided by MA DEP. See chart below.

Category/Indicator	Units	Excellent <i>green</i>	Good <i>yellow</i>	Fair <i>orange</i>	Poor <i>red</i>
AESTHETICS					
Turbidity	NTU	0-1	greater than 1, less than 5	5 - 50	>50
CHEMICAL					
Dissolved Oxygen	Cold water	≥8 mg/l	>6 – 7 mg/l	5 – 6 mg/l	<5 mg/l
	Warm water	≥6 mg/l	5 – < 6 mg/l	4 – <5 mg/l	<4 mg/l
	% Saturation	91 – 110 %	71 – 90 %	50 – 70 %	< 50%
Temperature	Cold water	< 15°C (<59°F)	15°C - <20°C (59°F - <68°F)	20°C – 24°C (68°F – 75.5°F)	>24°C (>75.2°F)
	Warm water	< 24°C (<75.2°F)	24°C - <27°C (75.2° - <80.6°F)	27°C – 28°C (80.6°F – 83°F)	>28°C (>83°F)
NUTRIENTS					
Orthophosphate as P	mg/l	<.025	.025 - <.05	.05 - .1	>.1
Nitrate as N	mg/l	<0.3	0.3 - <.6	0.6 – 0.9	>0.9

Adapted from: MA DEP's SMART Monitoring Watershed Report Card Criteria, Kimball, Warren.2005.unpublished. DEP, Worcester.

2. Parameters are grouped into the following categories: aesthetics, water temperature, dissolved oxygen (DO), DO % saturation, and nutrients
 - aesthetics includes the following measurements: turbidity, water appearance, water odor, nuisance aquatic vegetation, erosion, presence of trash a visual assessment of turbidity and knowledge of the site
 - water temperature
 - dissolved oxygen
 - water temperature
 - nutrients includes the following parameters: nitrate and orthophosphate

Blackstone River Coalition –4/11/2017

For more information please contact Susan Thomas, Program Coordinator, acadia94@zoho.com or visit our website zaptheblackstone.org

3. The report card includes an overall grade for each category (for each site monitored)
- aesthetics
 - using best professional judgment all measurements are assessed to determine an overall grade. This is the most subjective category.
 - water temperature
 - for sites designated as a cold water fishery the grade is determined by the lowest grade received even if it is a one time occurrence. For other sites if there is one outlier (low grade) the results are evaluated as a whole and best professional judgment is used to determine grade
 - dissolved oxygen
 - if one or more monitoring event includes a DO grade in the red (poor), the site receives a red (poor) overall grade
 - if one or more monitoring event includes a DO grade in the orange (fair), the site receives an orange (fair) overall grade
 - if one or more monitoring event includes a DO grade in the yellow (good), the site receives a yellow (good) overall grade
 - if every monitoring event results in a DO grade in the green (excellent), the site receives a green (excellent) overall grade
 - if the site experiences one or more no flow events it receives a red (poor) overall grade
 - DO % saturation
 - for sites designated as a cold water fishery the grade is determined by the lowest grade received even if it is a one time occurrence. For other sites if there is one outlier (low grade) the results are evaluated as a whole and best professional judgment is used to determine grade
 - nutrients
 - averages are calculated for both nitrate (as nitrogen) and orthophosphate (as phosphorous)
 - overall site grades are assigned primarily based on the phosphorous average, due to phosphorous being the limiting nutrient in fresh water.
 - if the average phosphorous grade falls into the orange (fair) or yellow (good) category, but more than one monitoring event has a phosphorous red (poor) rating (excluding wet weather events*), the site is given an overall grade of red (poor)

** April was considered a wet weather event for sites in Massachusetts. April, May, and August were considered wet weather events for sites in Rhode Island*

4. Report card includes the following notations
- *cwf indicates designated cold water fishery, which means cold water standards for DO and water temperature were used

Blackstone River Coalition –4/11/2017

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Town of Grafton
NPDES Phase 2
Small MS4 General Permit
Annual Report
Year 14 (2017)

Attachment 8

Publications



Monday, May 1, 2017

North Grafton MA

Fog



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CSR Financial Services, LLC
Peter F. Cardoza, CFP®, CLU®, CLTC.
Grafton Resident



'Pick up the poop' and protect Grafton's waterways

By [Grafton News](#) | on April 27, 2017

Submitted by the Grafton [Conservation Commission](#)





Why do you have to pick up after your dog? Won't it just degrade and wash away? Can't you just push it into the storm drain?

It is critical that you pick up and properly dispose of your pet's waste in the trash, toilet (without the bag), at pet waste disposal stations, if available or by burying it (at least 6-inches deep and away from gardens). Pet waste is a serious problem for our health and our waters. If pet waste is left on the sidewalk, the street, the lawn or placed in a catch basin it washes into the nearest water body, either directly or through storm drains. In [Grafton](#) that means directly into Cider Mill, [Fisherville](#), Flint, Hayes, Hovey, Pratts and Windle Ponds, or to [Silver Lake](#), [Lake Ripple](#), the [Blackstone River](#), [Quinsigamond River](#) or into all our local brooks, streams and wetlands.

Contrary to what some people think, water that goes down the storm drain does not enter a sewer treatment plant. With every rainfall, anything left on the lawn, street or in the storm drain goes out to the waterbodies. Pet waste that is left out during the winter will stay

frozen until it all melts and creates quite a mess and health hazard during the spring thaw.

Some of the problems that occur when pet waste is not picked up include the following:

Pet waste contains bacteria that can cause diseases in humans and threaten wildlife.

Pets, children, and adults who swim in local waters, play outside, or garden is at risk for infection from bacteria found in pet waste, with the kids having the highest risk.

Flies may spread diseases when stopping on waste and then onto uncovered food.

Diseases or parasites that can be carried from pet waste to humans include the following:

Campylobacteriosis, a bacterial infection carried by dogs and cats that cause diarrhea in humans.

Cryptosporidium, a protozoan parasite that can cause diarrhea, stomach cramps, nausea, and dehydration. May be fatal to people with deficient immune systems.

Toxocariasis, roundworms transmitted from dogs to humans, often without symptoms, but can cause vision loss, rash, fever or a cough.

Toxoplasmosis, a protozoan parasite carried by cats that can cause congenital disabilities such as blindness and mental retardation if a pregnant woman becomes infected. Also a problem for people with

depressed immune systems. Can cause headaches, muscle aches, and lymph node enlargement.

Nutrients in pet waste can cause algae and weed growth in lakes and rivers and ponds. Water may become cloudy and green and unattractive for boating, swimming or fishing.

As waste decays in water, it uses up the oxygen in the water threatening aquatic life and also releasing ammonia. Low oxygen levels combined with ammonia in warmer temperatures can cause fish kills.

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