CHAPTER 13: ROADS, HIGHWAYS & BRIDGES

Massachusetts Nonpoint Source
Pollution Management Manual

Introduction:

Roads, highways, and bridges are a significant source of nonpoint source pollution to Massachusetts waters. Contamination generated during road construction, maintenance and use is washed from roads and roadsides during periods of precipitation. A large amount of this runoff pollution is deposited into streams, rivers, lakes, and bays (USEPA, 1995). As runoff washes over roads, bridges, parking lots, and other impermeable surfaces, it picks up chemicals, fertilizers, automotive oils, litter, and other debris that can degrade water quality and harm aquatic life.

Nonpoint Source Pollution Management For Roads, Highways And Bridges

Primary NPS Pollutants and Issues

- Sediment
- Oil/grease
- Metals/Toxics
- Salt

Who Typically Gets Involved?

- Local Department of Public Works
- Massachusetts Highway Department

There are several methods to prevent nonpoint source pollution from roads, highways, and bridges. This chapter discusses best management practices to employ during phases of planning, construction, operation and maintenance. Included are methods controlling or reducing road salts, debris, and chemicals.

Massachusetts/EPA Resources for Roads, Highways & Bridges

The **MassHighway Storm Water Handbook** was developed to provide guidance on stormwater management practices that are applicable to highway and road projects, including BMP selection and design criteria. http://166.90.180.162/mhd/downloads/projDev/swbook.pdf

Massachusetts Guidelines on Deicing Chemical (Road Salt) Storage, MA-DEP Bureau of Resource Protection. http://www.state.ma.us/dep/brp/dws/files/saltgui.doc

MA DEP Snow Disposal Guidance: http://www.mass.gov/dep/water/laws/snowdisp.htm

The Massachusetts Unpaved Roads BMP Manual - Best Management Practices for construction and maintenance of unpaved roads, prepared for MA-DEP by the Berkshire Regional Planning Commission. http://www.state.ma.us/dep/brp/wm/files/dirtroad.pdf

Gravel Roads: Maintenance and Design Manual - This manual was developed with a major emphasis on the maintenance of gravel roads, including some basic design elements. http://www.epa.gov/owow/nps/gravelroads/

Recommended Practices Manual: A Guideline for Maintenance and Service of Unpaved Roads: Describes techniques to enhance stability and maintenance of unpaved roadways while reducing sedimentation and improving water quality. http://www.epa.gov/owow/nps/unpavedroads.html

Underlined bold blue indicates an active web link.
Bold purple indicates that a term is defined in the Glossary of Terms.

A discussion on the topic of **mosquito control** with regard to stormwater retention/detention facilities:
http://notes.tetratech-ffx.com/newsnotes.nsf/0/143f7fa99c3ea25485256d0100618bc9?OpenDocument

For more information on a variety of various topics for Roads, Highways and Bridges, see
http://www.epa.gov/owow/nps/roadshwys.html

Massachusetts River and Stream Crossing Standards: Technical Guidelines (Massachusetts River and Stream Continuity Steering Committee, 2004)
http://www.umass.edu/nrec/pdf_files/guidelines_river_stream_crossings.pdf

Massachusetts Stream Crossings Handbook (Massachusetts Riverways Program, 2005)
http://www.nae.usace.army.mil/reg/Riverways%20Program%20Stream%20Crossings%20Handbook.pdf

Permitting/Regulatory Considerations

Replacement or construction of bridges and other types of crossings than span rivers, streams, and wetlands are subject to review under the Massachusetts Wetlands Protection regulations, as well as new or repair work to roadways undertaken in wetland resource areas or buffer zones, including installation of outfalls draining roadway runoff into wetlands. These activities may also be subject to review pursuant to the Massachusetts Section 401 Water Quality Certification regulations, depending on the scale of the project. Bridge footprint replacements undertaken by the Massachusetts Highway Department (MHD) are typically exempt from review under the Wetlands Protection Act by bond legislation. However, they are subject to review pursuant to the Section 401 regulations. When MHD proposes to replace a bridge in the same or similar footprint crossing a waterway, under procedures established by the Massachusetts DEP, the municipal conservation commission should expect to receive a copy of the MHD 401 application containing a pre-set list of standard conditions designed specifically to avoid and minimize impacts to wetlands.

New and replacement stream crossings are required to comply with the Massachusetts Stream Crossing Standards (see link provided above), pursuant to the U.S. Army Corps of Engineers, New England District 404 programmatic general Permit. To prevent storm damage, new stream crossings must also be designed large enough to pass peak flows pursuant to the Wetland Protection Act regulations (310 CMR 10.57).

Construction phase BMPs should be employed during road, highway, and bridge construction, including routine repaving projects. Construction phase controls include erosion and sediment prevention measures, as well as measures to minimize contamination to wetlands, such as fueling vehicles away from waterways and utilizing appropriate dewatering controls. Construction of roads and bridges over stream channels or other wetlands impose particular constraints. Installation of temporary coffer dams, stream channel diversions and pump-arounds utilized in such situations must be accommodated in such a way so as to not increase turbidity, and impact flow to the downgradient portion of the stream or other wetland resource area.

Underlined bold blue indicates an active web link.
Bold purple indicates that a term is defined in the Glossary of Terms.

The Pollution Problem: Roads, Highways & Bridges

Sediment

Sedimentation is the redistribution of soil particles through the process of **erosion**. Sediment sources from roadways include road sanding, runoff from unpaved roads and areas where soil has been exposed during construction. In addition to physical problems associated with sediment deposition and buildup, sediment particles readily transport pollutants such as metals and **pathogens**. Sedimentation also contributes to increased **turbidity** (poor light penetration) in downgradient (receiving) water bodies. This reduces **photosynthesis** by phytoplankton and aquatic plants, and can contribute to anoxic (low oxygen) conditions that are harmful to aquatic organisms (USEPA, 1995).

Oil and Grease

Oil and grease pollution is caused by leaky car and truck engines, oil and grease spills at gas stations, or when oil and grease have not been disposed of properly. During periods of rain and snow-melt, these pollutants are transported directly into surface and **groundwater** (USEPA, 1995).

Road Deicers and Anti-icing Agents (Road Salt)

Road salts can be a major **pollutant** in both **urban** and rural areas. Rain and snow runoff tends to carry salt, which contains high concentrations of sodium and chloride, into ponds, lakes, bays and groundwater. These pollutants often result in adverse ecological responses as they negatively affect aquatic biogeochemistry (USEPA, 1995).

Debris

Debris pollution can result from a variety of litter sources such as food containers, household wastes, and grass and shrub clippings. Debris associated with infrastructure industries, such as construction materials, can contribute to the pollutant load from these types of practices (USEPA, 1995).

Fertilizers, Pesticides, and Herbicides

Fertilizers, **pesticides** and **herbicides** should be used with discretion and according to label specifications when conducting right-of-way and roadside maintenance. When applied improperly or excessively, these products can be carried by runoff and can contaminate water sources. These pollutants can be harmful to both human and aquatic life and contribute to **algal bloom**s, excessive plant growth, and **eutrophication** of rivers, streams, lakes, and bays.

Underlined bold blue indicates an active web link.
Bold purple indicates that a term is defined in the Glossary of Terms.

Best Management Practices for Roads, Highways and Bridges:

A summary of Best Management Practices (BMPs) commonly used during the construction and ongoing maintenance of roads, highways and bridges are provided below. Please note that this Manual describes general categories of BMPs, rather than the variety of proprietary products that are on the market. For example, a summary description and fact sheet is provided for Water Quality Inlets, rather than related proprietary products such as Vortechnics™ and StormTreat™.

Sagamore Bridge, Bourne, MA

For more information on the BMPS summarized below, use the links provided below to access fact sheets adapted for this manual from the MassHighway Storm Water Handbook for Highways and Bridges and the Massachusetts Erosion and Sediment Control Guidelines for Urban and Suburban Areas. These resource documents can be accessed via the web links provided on page 13-1.

In addition to the BMPs listed below, municipalities can play an important role in managing roadway NPS pollution by conducting an anti-litter campaign and through enforcement activities (fines, etc) related to illegal roadside dumping.

As discussed in Chapter 2, municipal policies and "housekeeping" practices also impact NPS pollution from roads, including road salt and sand applications, catch basin cleaning and the purchase and use of equipment such as street sweepers.

Summaries are provided on the following pages for the BMPs listed below:

Street Sweeping	Sediment Basin	Flow Splitter
Channel Systems 1. Conventional Channel 2. Water Quality Swales	Constructed Wetlands	Impoundment Structures
	Recharge Basin	Check Dams
Deep Sump Catch Basin	Leaching Catch Basin/Leaching Basin	Road Salt Management
Outlet Sediment Trap	Subsurface Recharge Systems	Unpaved Roads
Filter Strip (Vegetated)	Filter Systems	
Sediment Forebay	Water Quality Inlet	

Underlined bold blue indicates an active web link.
Bold purple indicates that a term is defined in the Glossary of Terms.

Street Sweeping: Street sweeping is a source reduction practice for controlling stormwater pollutants. It involves mechanical or vacuum pavement cleaning to remove particulates from pavement prior to wash-off by stormwater. (FACT SHEET LINK)

Channel Systems: Channel systems include open channels in two categories:

1. **Conventional drainage channels** with non-erosive surfaces designed primarily for storm water conveyance. Conventional drainage channels provide little or no water quality benefit, and for this reason are less desirable than a water quality swale (see below). (FACT SHEET LINK)

2. **Water Quality Swales**, designed primarily to provide storm water treatment, with the secondary function of conveying flows. They include Dry Swales, Bio-filter Swales, and Wet Swales. They are generally shallow, vegetated, earthen channels. Depending on site conditions, pollutant removal occurs by filtration through vegetation, infiltration into underlying soils, and physical settling (if residence time is sufficient). Check dams may enhance pollutant removal. (FACT SHEET LINK)

Deep Sump Catch Basin: Deep sump catch basins are modified versions of the inlet structures typically installed in a piped storm water conveyance system. Deep sumps provide capacity for sediment accumulation. Regular maintenance (removal of accumulated sediment) is critical to the function of these structures. Deep sump catch basins must be placed off-line. Off-line catch basins have only one inlet (capturing runoff directly from the road) and one outlet. An in-line catch basin has two or more inlets, one at street level and the other(s) from up-gradient catch basins. In-line or flow-through catch basins are more susceptible to sediment re-suspension. Deep sump catch basins can serve as sediment pretreatment for other structural BMPs. (FACT SHEET LINK)

Outlet Sediment Trap: An Outlet Sediment Trap is a small basin lined with riprap or other suitable non-erosive lining, and located at the end of an outlet pipe, paved waterway, or channel outlet. The Outlet Sediment Trap is designed similar to a plunge pool, to dissipate the energy of incoming runoff. It is also sized to detain the runoff for initial settling of coarse particulates. Outlet Sediment Traps may be used for pretreatment of runoff before it discharges to another BMP, or they may be used as a BMP at the outlet of a drain system without further downstream treatment. This device can be employed where insufficient space is available to install another type of BMP, and where the device can be inspected and cleaned on a regular basis. (FACT SHEET LINK)

Vegetated Filter Strip: Filter strips are vegetated areas of land that have gradual slopes and are designed to accept runoff as overland sheet flow. Vegetation slows runoff, allowing for some infiltration and promoting settling of particles. Runoff from an adjacent impervious area must be evenly distributed across the filter strip; a level spreader may be used to accomplish this. Filter strip vegetation may be grass, shrubs, or woods.
(FACT SHEET LINK)

Underlined bold blue indicates an active web link.
Bold purple indicates that a term is defined in the Glossary of Terms.

Sediment Forebay: A sediment forebay is an impoundment, basin, or other storage structure designed to dissipate the energy of incoming runoff, and detain the runoff for initial settling of coarse particulates. Although similar to a sediment basin (see below), forebays are usually used for pretreatment of runoff before it discharges to the primary water quantity and quality control BMP. Forebays are frequently integrated into the design of larger storm water management structures. (FACT SHEET LINK)

Sediment Basin: A sediment basin is a settling pond with a controlled storm water release structure used to collect and store sediment produced by construction activities. A sediment basin can be constructed by excavation or by placing an earthen embankment across a low area or drainage swale. Sediment basins can be designed to maintain a permanent pool or to drain completely dry. The basin detains sediment-laden runoff long enough to allow most of the sediment to settle out. (FACT SHEET LINK)

Constructed Stormwater Wetlands: Constructed stormwater wetlands are manmade shallow pools that create conditions suitable for the growth of wetland plants. These systems maximize pollutant removal through vegetative uptake, soil binding, bacterial decomposition, and enhanced settling of particulates. Created wetlands may be combined with wet ponds and/or extended detention, to enhance their performance. Created wetlands are suitable for on-line or off-line treatment (assuming adequate hydrology can be maintained with off-line systems). (FACT SHEET LINK)

Recharge Basin: Recharge basins temporarily store runoff, but release at least a portion of that runoff by infiltrating the water into the ground. The recharge volume is stored below the lowest outlet of the basin, and allowed to infiltrate into the underlying soils over a period of time following a storm event. The storage volume above this level may be released by an outlet structure designed to bypass all excess flows, or to control the release rates of discharge as for a conventional detention basin or extended detention basin. Recharge Basins may be designed on-line or off-line. (FACT SHEET LINK)

Leaching Catch Basin/Leaching Basin: A leaching catch basin is a catch basin fabricated of barrel and riser sections that permit the infiltration of runoff into the ground. A leaching basin is a similar device, installed adjacent to a deep sump catch basin that provides pretreatment. Because of this pretreatment, the catch basin/leaching basin combination is preferable to the leaching catch basin, where feasible. Leaching catch basins should be used as "off-line" devices (that is, they should not generally be piped in series as "flow-through" devices). (FACT SHEET LINK)

Subsurface Recharge Systems: Subsurface recharge systems may include trenches, beds, galleys, or dry wells. Such systems have sufficient storage capacity to permit gradual infiltration of runoff. Pollutant removal is provided by filtration through the soil matrix. Pre-treatment is required to prevent failure of infiltration systems due to sediment accumulation. Subsurface systems (other than leaching catch basins or leaching basins – see above) are rarely used in the highway setting. Subsurface systems (other than leaching catch basins - see above) are rarely used in the highway setting in Massachusetts due to the potential for pavement cracking due to cold climate issues. (FACT SHEET LINK)

Underlined bold blue indicates an active web link.
Bold purple indicates that a term is defined in the Glossary of Terms.

Filter Systems: Filter systems include both sand, organic, and other type of filtration structures. Filter beds are designed to receive the first flush of runoff, which is then strained through a filter media and collected in underdrains for discharge. The basic type of system is a **sand filter**, using specially graded **sand** for the filter media. These systems may be enhanced to include peat or other organic materials (**organic filters**) or iron shavings to enhance nutrient removal.
(FACT SHEET LINK)

Water Quality Inlet (Oil/Grit Separator): Water quality inlets are underground storage tanks with multiple chambers designed to remove heavy particulates, floating debris, and some hydrocarbons from storm water runoff. They are frequently used to pre-treat storm water discharged to other BMPs. Some proprietary products (e.g. Vortechnics, StormTreat) introduce other components or features for collecting sediment, trapping **floatables**, and controlling flows. Water Quality Inlets include American Petroleum Institute (API) and Coalescing Plate (CP) type separators, and are sometimes referred to as Wet Vaults. For Water Quality Inlets installed within parking garages, the design must meet the standards established in the Massachusetts Plumbing Code (248 CMR 1.00 to 10.00, see http://www.mass.gov/dpl/boards/pl/cmr.htm.
(FACT SHEET LINK)

Flow Splitter: A flow splitter is an engineered structure used to divide flow into two or more parts, and divert these parts to different places. The design of a flow splitter uses specifically designed structures, pipes, orifices, and weirs set at specific elevations to control the direction of flow. Flow splitters are typically used to direct initial storm water flows to an "off-line" BMP. The splitter is placed at an elevation coordinated with the elevation of the **treatment BMP**, so that the elevation of water in the BMP governs the elevation in the flow splitter. Once storm water reaches a pre-determined elevation, a weir (or other hydraulic feature) directs additional flow to an alternative outlet. (FACT SHEET LINK)

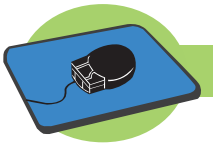
Impoundment Structures: The design of Storm Water Management BMPs frequently involves the development of containment basins to store runoff from the contributing watershed. In some instances, these basins can be constructed by excavation. More frequently, impoundments are required to develop the needed storage capacity. Impoundments are typically created by earthen embankments, with ancillary discharge control structures. (FACT SHEET LINK)

Check Dams: A check dam is a small dam constructed across a drainage ditch, swale, or channel to lower the speed of flow. Reduced runoff speed reduces erosion and gullying in the channel and allows **sediments** to settle out. A check dam may be built from stone, sandbags filled with pea gravel, or logs. (FACT SHEET LINK)

Road Salt Management: The application and storage of deicing materials, such as salts and sand, can lead to water quality problems. Historically, there have been incidents in Massachusetts where improperly stored road salt has polluted public and private drinking water supplies. mediate impacted water supplies and to protect water supplies from future contamination. As a result of properly designing storage sheds, new incidents are uncommon. The MA-DEP **Guidelines on Deicing Chemical (Road Salt) Storage** summarize salt storage prohibition standards around drinking water supplies and current salt storage practices. (FACT SHEET LINK)

Underlined bold blue indicates an active web link.
Bold purple indicates that a term is defined in the Glossary of Terms.

Unpaved Roads: For a thorough discussion of issues related to construction and maintenance of unpaved roads, please see the **Massachusetts Unpaved Roads BMP Manual**.
http://www.state.ma.us/dep/brp/wm/files/dirtroad.pdf



For information on additional BMPs, jump to the Interactive BMP Selection Menu

References:

MADEP. 2001. The Massachusetts Unpaved Roads BMP Manual. Project 98-06/319.

MADEP. 1997. Massachusetts Erosion and Sediment Control Guidelines for Urban and Suburban Areas: A Guide for Planners, Designers, and Municipal Officials.

USEPA. 1995. Polluted Runoff (Nonpoint Source Pollution): Planning Considerations for Roads, Highways, and Bridges. EPA-841-F-95-008b. Office of Water.

USEPA. 1995. Polluted Runoff (Nonpoint Source Pollution): Erosion, Sediment, and Runoff Control for Roads and Highways. EPA-841-F-95-008d. Office of Water.

USEPA. 1995. Polluted Runoff (Nonpoint Source Pollution): Pollution Control Programs for Roads, Highways, and Bridges. EPA-841-F-008c. Office of Water.

Underlined bold blue indicates an active web link.
Bold purple indicates that a term is defined in the Glossary of Terms.