Stormwater and Wastewater Management

Workshop Participants Report

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Ecology Action Centre

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Ecology Action Centre
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Contents

Introduction

In order to raise awareness of issues associated with stormwater and wastewater management , the Ecology Action Centre (EAC), in partnership with Bay of Fundy Ecosystem Partnership (BoFEP), hosted two 'Stormwater and Wastewater Management' workshops in February 2012. The workshops were designed to help planners, municipal officials and other interested stakeholders effectively manage stormwater while also raising awareness on the impacts of pharmaceuticals in the marine environment.

Water quality in the Bay of Fundy can be impacted by contaminants found in both stormwater and wastewater. Stormwater, which is often untreated, can enter the natural environment directly through storm drains. In areas serviced by combined systems, both stormwater and wastewater are treated in sewage treatment plants before being released into the environment. In times of heavy rain fall events combined sewage overflows can result in the direct release of untreated stormwater and wastewater into the environment.

The impacts of stormwater runoff resulting from more severe and more frequent storm events are felt primarily in urban landscapes where the high area of impervious surface cover (roofs, roads, parking lots) prevents precipitation from being retained in the ground. In urbanized areas like many cities and towns around the Bay of Fundy, water instead moves quickly over the hardened landscape, collecting contaminants along the way, and flows directly into the drainage system which can lead to combined sewage overflows, infrastructure damage from flooding, erosion and degradation of water quality. Changes in the amounts and intensity of precipitation associated with climate change along with problems associated with aging infrastructure and an ever expanding area of impervious surfaces in most municipalities make managing stormwater a critical issue.

Sewage treatment plants use physical, biological and chemical processes to remove contaminants from wastewater before releasing it into the environment. Various levels of sewage treatment exist around the Bay of Fundy. An emerging issue in wastewater treatment is the discharge of pharmaceuticals and the impacts they are having on the aquatic environment. Pharmaceuticals are designed to be biologically active, which means they have the potential to impact organisms living in the aquatic environment once they are released into freshwater and marine systems, even at very low concentrations. The impacts of pharmaceuticals on the health of the aquatic environment may be of particularly significance in urban and industrial areas where organisms are already stressed by degraded water quality.

The workshops took place on February 22nd (Digby, Nova Scotia) and February 23rd (Saint John, New Brunswick). The workshop attendees represented a broad range of stakeholders interested in the health of the Bay of Fundy including municipal planners, councillors, public works officials, provincial government, consultants and non-government organizations. The purpose of the workshops was to increase capacity of municipalities to 1.) Select and implement tools to reduce the impacts of stormwater runoff through a range of innovative, cost-effective Best Management Practices (BMPs) in order to improve water quality in the Bay of Fundy and reduce infrastructure and property damage caused by heavy rainfall events, and 2.) Increase awareness of the emerging issue of pharmaceuticals in the marine environment. The workshop was an excellent opportunity to bring people from various backgrounds together to network, talk about issues, share information and discuss ways to move forward to improve the health of the Bay of Fundy. All workshop presentations are available online at: http://www.ecologyaction.ca/content/stormwater-workshop-presentations-march-2012

The Ecology Action Centre has worked towards sustainability for Nova Scotia's communities and environment for 40 years and is known for offering well–researched, cost-effective, solutions to environmental challenges facing Nova Scotia's communities. The EAC has been involved in many research and capacity building projects, both with community partners and in collaboration with government and academic institutions. We have considerable expertise in climate change adaptation research and education. The EAC recently created a stormwater management blog (www.stormwatercentral.com) to share innovative stormwater Best Management Practices and encourage dialogue on reducing the impacts of stormwater runoff.

BoFEP promotes the vitality, biodiversity and productivity of the Bay of Fundy ecosystem, as well as the social well-being and economic sustainability of its coastal communities. BoFEP facilitates communication and co-operation among individuals and organizations interested in the Bay of Fundy. The funding to develop these workshops and resource materials came from Environment Canada.

Workshop Overview

'Stormwater and Wastewater Management' workshops were held on February 22nd in Digby and February 23rd in Saint John. Twenty-two participants attended the Digby workshop from Annapolis Royal, Middleton, West Hants, Digby, Yarmouth. Representatives from local environmental organizations Tusket River Environmental Protection Association (TREPA) and Clean Annapolis River Association (CARP) were also in attendance. Forty-six participants attended the workshop in Saint John from Hampton, Quispamsis, Saint John, Saint Andrews, Sussex, Moncton, Dieppe, Woodstock, St Louis-de-Kent, and Fredericton. Environmental organizations represented included Fundy Baykeeper, Friends of Kouchibouguacis, Kennebecasis Watershed Restoration Committee, Petitcodiac Wastershed Alliance and Kings County Agri-Conservation Club (For full participants list see Appendix III and IV).

The morning portion of the workshop included presentations on issues associated with stormwater runoff and changing weather patterns, followed by presentations on innovative stormwater management including examples of local policies and projects and an interactive stormwater scenario exercise. (See Appendix I and II for workshop agendas). The afternoon session included a presentation on pharmaceuticals in municipal effluent and the impacts of these drugs on the marine environment. The final session of the workshop included a group discussion where participants recommended next steps and actions to improve stormwater and wastewater management around the Bay of Fundy. The following presentations were given at each workshop. All workshop presentations are available online at: http://www.ecologyaction.ca/content/stormwater-workshop-presentations-march-2012

Digby:

- Ashley Sprague, Restoration Coordinator – Ecology Action Centre - "Introduction to Stormwater Management"
- Amanda Dean, Manager, Government Relations – Insurance Bureau of Canada Atlantic - "The Costs and Impacts of Storm Events on Homeowners and Municipalities"
- Kevin McLean, Superintendent of Public Works – Town of Annapolis Royal – "Annapolis Royal Stormwater Management Initiatives"

- Joy Elliot, Landscape Architect - Joy Elliott Landscape Architectural – “Stormwater Best Management Practices”
- Jen Ings, Postdoctoral Fellow, University of New Brunswick – Saint John – “Pharmaceuticals in the Environment”

Saint John:

- Ashley Sprague, Restoration Coordinator – Ecology Action Centre - “Introduction to Stormwater Management”
- Steve Olmstead, Manager, Government Relations – Insurance Bureau of Canada Atlantic - “The Costs and Impacts of Storm Events on Homeowners and Municipalities”
- Darryl Bonhower, Project Engineer – City of Moncton – “Stormwater Management Initiatives: Preparing for the Inevitable”
- Hans Arizs, Associate Director - RV Anderson Associates Limited - “Stormwater Best Management Practices”
- Jen Ings, Postdoctoral Fellow, University of New Brunswick – Saint John – “Pharmaceuticals in the Environment”

Workshop participants also took part in a stormwater scenario exercise (Appendix V). The purpose of this exercise was to allow participants to practice selecting appropriate BMPs to improve stormwater management on an individual property and neighbourhood scale. The participants were divided into four groups and assigned to work on one of two different scenarios. The participants were encouraged to identify opportunities to reduce the velocity, volume and pollutant load of runoff on their site by reducing impervious surface area, selecting tools to allow water to infiltrate into the ground and promoting water capture and reuse. Each group was given a large map of their site, smaller additional site photos, a write-up describing the site and various water issues being impacting the area, a table describing of stormwater BMPs (Appendix VI) and tracing paper.

The groups each had 45 minutes to work through the exercise and select appropriate BMPs that could be implemented on their site. The groups drew their designs on the site map using tracing paper and then reported their design plans back to the larger group. A large group discussion was then held to compare results and explore alternative solutions. This presented an excellent opportunity for participants to learn from each other’s experience as well as receive feedback on their design plans from regional stormwater experts.

The final workshop session focused on the impacts of pharmaceuticals in the marine environment. An excellent resource person, Jen Ings, attended both workshops and presented an overview of the most common pharmaceuticals present in municipal effluent, potential impacts of pharmaceuticals on marine ecosystem health and approaches for treatment and mitigation of pharmaceuticals discharged to the marine environment.

Workshop Content

The following is a summary of key points from the workshop presentations. All workshop presentations are available online at:

Key Points on Issues Associated with Stormwater Management:
Summary from Amanda Dean and Steve Olmstead (Insurance Bureau of Canada) presentations:

- We are experiencing more intense and frequent precipitation events due to climate change Nova Scotia's coast and water resources (including residential, municipal, and industrial infrastructure) are increasingly vulnerable to extreme weather impacts.
- Development and land use patterns (increased impervious surface area coverage) are changing peak volume, speed and quality of runoff.
- Old infrastructure/past standards do not meet reality of today's weather
- Inadequate investment to upgrade infrastructure
- National municipal water supply, wastewater and stormwater system deficit stands at $31 billion for existing infrastructure, with new needs estimated at almost $57 billion ($88 billion total)
- Several different regulators are involved. Nova Scotia Environment regulates freshwater environments, Department of Fisheries and Oceans regulates marine environment
- Across Canada, extreme weather has replaced fire as the highest cost of insurance payouts. Water related damage (mostly basement flooding and sewage backups caused by increasingly intense and unpredictable precipitation) costs the insurance industry 1.2 billion dollars annually in insurance payouts.
- These costs are rising quickly. In Atlantic Canada, home insurance claims resulting from water damage, increased by 143% between 2005 and 2009**.**
- Consumer awareness is an issue. Do people know what their policy covers?
- Adaptation is local. Individuals can make a difference.

Local Stormwater Initiatives:
Summary from Kevin McLean (Town of Annapolis Royal) presentation

- Six years ago a developer proposed a new subdivision in Annapolis Royal.
- The current sewage treatment plant was already at capacity, so the Town knew a new system would be required.
- Extensive investigations were done to review personal properties and see if houses were directly connected to sanitary system. All problems were documented and an inventory identifying problem areas that will require future work was created.
- Homes were provided with storm drains to prevent stormwater entering sanitary system.
- The Town decided to separate storm and sewer systems, instead of building a new lagoon (treatment area).

- These efforts have reduced costs for the Town of Annapolis Royal (power bills, wear and tear of pumps)

Summary from Darryl Bonhower (*City of Moncton*) presentation

- Stormwater management initiatives can be quantitative (Flood Reduction Measures) or qualitative (Pollutant Reduction Measures)
- Important to understand the problem through local/regional climate change adaptation study
  - What is predicted increase in precipitation?
  - What is the predicted increase in sea level?
  - How will these changes impact stormwater and wastewater infrastructure?
- Identify and target vulnerabilities (i.e., inlet control devices can limit water entering storm sewer inlets, storm outlet flap gates/tide flex valves can help manage outfall submergence)
- City of Moncton stormwater initiatives include:
  - Homeowners Guide to Flood Protection: http://www.moncton.ca/Assets/Government+English/Publications+English/Flood+protection+manual.pdf
  - Main backwater valve by-law: *No person shall make any connections to the municipal sewage works without installing a backwater valve that is of a normally open design to the building drain*
  - Backwater valve incentive and grant program - $500 rebate towards installation of approved backwater valve, residence who are refused sewer backup insurance may qualify for installation of backwater valve at no cost.
  - Minimum Habitable Space Elevation Zoning By-law: *No development of any habitable space, occupied floor space or indoor parking area shall be permitted in any zone, unless the minimum geodetic elevation of any floor is at least 10.2 metres.*
  - Zero Net Increase Policy: *Stormwater runoff rates for land parcel for **developed condition** do not exceed existing condition runoff rates for the 2-year through the100-year design storms.*

Key Points on Innovative Stormwater Management Approaches:

Summary from Ashley Sprague (EAC), Joy Elliot (Joy Elliot Landscape Architectural) and Hans Arisz (RV Anderson) presentations

Key Concepts:

- Watersheds include land (forests, fields, urban/rural developed areas), not just streams, rivers and lakes. Any activity on land will impact how runoff through the environment and contaminants enter the water from many sources.
- Innovative stormwater management approaches aim to keep it simple. Look for opportunities for multiple gains and simple approaches rather than a giant solution. Favour passive, low energy solutions.
- stormwater management usually approached in an engineered way - but preference is to deal with it naturally
- Retrofit versus new development - stormwater management on-site is easier at the outset when the design of a new system is involved. The real challenge lies in a retrofit involving impermeable surfaces and the lack of space

Key Approaches:

- Stormwater management starts with good planning
- Reducing runoff volume commonly looks for opportunities to increase infiltration, increase storage and slow peak flows. (I.e., Slow it, spread it, sink it)
- Enhancing runoff quality commonly uses settling, filtration, vegetation measures, or a combination of practices where possible.
- Runoff can be viewed as either a resource (chronic events can be source of water to reuse)or hazard (catastrophic, intense rainfall events lead to flooding)
- Sites should be designed to have same pre and post peak flow and volume of runoff for the chronic storms
- Tree planting is a good stormwater management tool. Tree canopy intercepts rate of passage of water to the ground - lessens runoff
- 3 tiers of stormwater management - on-site, neighborhood level and watershed level
- On-site measures aim to:
    - Reduce directly connected impervious areas,
    - Divert runoff from impervious to pervious
    - Increase water storage and reuse.
- Neighbourhood measures aim to:
    - Reduce impervious surfaces, avoid curb & gutter street design
    - Compact stormwater treatment devices
    - Stormwater ponds and wetlands
    - Parking lots with pervious pavement
    - Source controls (street sweeping, reduce road salting, contaminants retention, restoration of contaminated areas)
- Watershed measures aim to:
    - Establish riparian buffer zones
    - Provide passive or active treatment for all stormwater
    - Designate and maintain temporal flood waters storage areas
    - Maintain natural stream channels
- Policy (non-structural) measures are an important component
- To sustain benefits, monitoring and maintenance are needed
- Education and incentives
- Importance of watershed planning – cumulative impacts

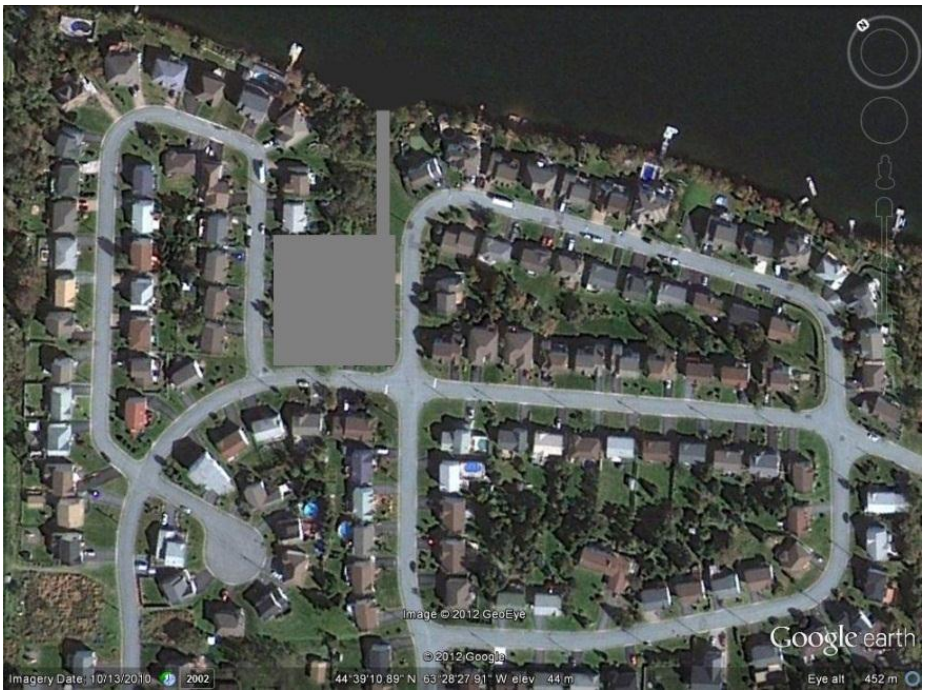
Considerations:

- Water Balance over different timescales
- New developments vs. retrofit developments: New developments have space for SW BMPs and costs can be covered by new homeowners. Retrofits have more space and financial constraints. Focus depends on rate of municipal growth. Managing stormwater in new developments is important in areas that are growing, retrofits important in areas that are shrinking.

- Residential features need to be dovetailed with education and consideration of practicality (climatic conditions, expense)
- Seasonal changes of rain events

Stormwater Scenario Exercise Summary

Scenario One: Cattail Lake



Site Description:

- Suburban lakeside development with many new homes, a school and a community centre recently constructed
- Untreated stormwater enters into the lake
- Algal blooms have been occurring over the past several years
- The large parking lot frequently floods
- A recently introduced 'Stormwater Surcharge' has motivated homeowners to reduce imperviousness and runoff in the neighbourhood

Options presented by groups to improve stormwater management on-site (Results are from both workshops):

To reduce runoff leaving homes/streets:

- Introduce a rain barrel program with over flow going to raingardens
- Encourage property owners to plant low height vegetation to serve as a buffer
- Construct a raingarden/vegetated island in the middle of the cul-de- sac

- lowering the sides of streets and deletion of curbing
- promote infiltration and filtration through re-landscaping and regarding
- Make streets one-way to reduce width

To reduce parking lot flooding:

- Use permeable pavement on large parking lot, or reduce size of parking lot
- Develop an underground retention pond
- capture of drainage in the parking lot
- reduce the outfall outlets and concentrate flows in the parking lot and promote infiltration

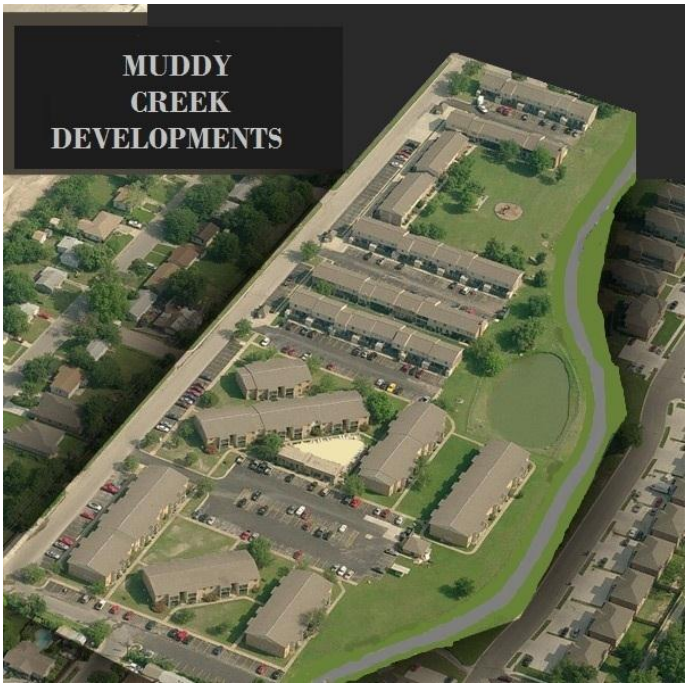
To improve water quality in lake:

- Engineered wetland between parking lot and lake
- Filtration of water through the drain and underground storage then discharge to a constructed wetland.
- Re-establishment of riparian vegetation along the lake

Non-structural BMPs:

- Municipality initiates public education program to focus on water quality in lakes involving the whole community
- Municipality enacts a municipal bylaw against pesticide use.
- Design a water quality monitoring program demonstrate improvements in water quality

Scenario Two: Muddy Creek Developments



Site Description:

- Muddy Creek Developments consists of rows of apartments and townhouses with ample parking, landscaped green space, paved bike trail and interest to plant a community garden
- Unfiltered stormwater enters the small pond and growing algal blooms are a concern for residence
- Water has been collecting between the rows of apartments and a few homes are experiencing basement flooding following heavy rain events

Options presented by groups to improve stormwater management on-site (Results are from both workshops):

To reduce flooding on site:

- Rain barrel for each downspout
- Bioswale between rows of houses Lot grading away from building and toward pond to reduce basement flooding
- Parking lots - separate the collection system and build another pond which can be used in winter as a hockey rink
- Reduce size of parking lots
- Treeline street scaping
- Add additional pond. Swale parking lots and direct runoff to first pond
- Put plants along the trail and a swale if plants don't do the job
- Ask residents if they want to get rid of pavement along the trail and build a skate park

To improve water quality of pond:

- Put a dye in the pond to kill the algae, or put in a solar aerator to get rid of the algae Plant vegetation along shore of pond (create riparian buffer) to increase nutrient uptake, improve habitat
- Add stormwater septor/ oil grit separator to treat runoff and ensure proper maintenance
- Plants around perimeter of pond

Other non-structural BMPs:

- Educate residence on reducing fertilizer use, composting policy

Pharmaceuticals in the Environment

Summary from presentation by Jen Ings (UNB-SJ)

- Pharmaceutical and personal care products (PPCPs) in municipal effluent is a new line of research
- Drugs in wastewater effluent come from the disposal unused to the toilet and through human excretion. Other groups of compounds (metabolites) are changed in the body excretable and are often more active than the parent compound
- We don't know the effects of pharmaceuticals on the ecosystem. We also don't know what the combined effect of multiple drugs is.

- Many studies have been done on the effects of pharmaceuticals on fish. Lab studies involve higher concentrations than would otherwise be found in the environment. We don't know what the long term effects are under natural conditions, i.e. continual exposure to low concentrations
- Most research has been done on freshwater systems. Little research on impacts to marine environments
- Studies have shown exposure to estrogen, one of the most studied drugs, can effect fish reproductive systems and lead to less egg production in the female spawning population, or egg production in male testes (intersex) Exposure also alters hormone levels and can decrease secondary sex characteristics in males reducing the capacity of males to attract females. These effects may impact reproductive success in the wild which could potentially impact population levels over time.
- The problem is that we don't know how to remove pharmaceuticals from waste effluent. Many pharmaceuticals go thru the treatment process without being removed while others change form depending on the process in the sewage treatment plant. Treatment only works for certain chemicals, i.e., Estrogens are broken down 60% by secondary sewer treatments, while other drugs are unchanged or may be converted into something different.
- Until more is known about removal of pharmaceuticals from municipal effluent the best we can do is encourage proper disposal (stop unused drugs going down the drain). Return unused pharmaceuticals to the pharmacy for proper disposal.
- Education, information and more research is needed.

Discussion on pharmaceuticals:

This was the first introduction to the issue of pharmaceuticals in the environment for many workshop participants. Several questions were asked to the presenter, Jen Ings, which focused primarily on the impacts of pharmaceuticals in the marine environment and current research on treatment methods.

Questions and answers:

- *What proportion of drugs is disposed down the drain versus from the body?* A: Can no say the relative proportion with certainty, however, we believe that the majority go through the body.
- *Is there a coordinated monitoring system along waterways in the East coast for pharmaceuticals?* A: No, not currently. Research involves individual research groups going out themselves. Monitoring is very expensive and you need a standard to measure each compound . If there is no standard, you can't measure the chemical. There is no formal monitoring program right now.
- *We know chemicals found in water bottles (BPA) mimicked estrogen. Can you tell if a fish is changing sex as the result of human estrogen, from a pharmaceutical or another chemical?* A: No you can't tell the source.
- *Is estrogen the most prominent pharmaceutical in the environment?* A: No, but it is the most studied. Researchers in the UK noticed intersex in fish (saw eggs in testes). Investigative work found that the effects were downstream of a sewage treatement plant. They started research by exposing fish to estrogen because a number of estrogens are found in effluents, including normal estrogens excreted by humans. Phenol A acts as an estrogen in fish and is a huge problem. Estrogen was and is so prevalent that it has become a focus of research.

Treatment:

- *What kinds of technologies are being suggested to remove estrogen from wastewaters?* A: Researchers are not sure how to remove estrogen. Current research suggests that a change in hydraulic retention time might help to remove estrogen. Nanowire technology to filter out pharmceuticals is also being researched, but this is highly technical. Important to know that all chemicals behave differently, so a system that removes estrogen may increase the proportion of another drug.
- *What is the effect of secondary treatment removal?* A: The effect depends on the drug - some drugs don't get broken down. Estrogens however, are broken down by 60%. Other drugs are broken down to something undetectable while others are converted to something different.
- *Is there any movement toward reducing the overall number and volume of pharmaceuticals being used?* A: This is a whole other issue. Source control is best. Reducing the pharmaceuticals you take is the best way to go.

Moving Forward:

Each workshop ended with a group discussion to identify ways to move forward on stormwater and wastewater issues facing municipalities around the Bay of Fundy. Participants suggested regulatory changes, partnerships and increased collaboration, homeowner and developer education and research were priorities.

	Saint John	**Digby**
Government/ Regulatory	• Stormwater surcharge is one of best ways to get action. We pay for treated water and by how much is used. Funding generated could pay for low impact development. • Need for standard regulations. However regulations come with a cost - If there are no resources to enforce regulations, they are ineffective	• If you want to effect change, you must work with municipalities and the province to develop regulations. Best Practices won't be implemented by homeowners, developers without enforced regulations • There needs to be a provincial Statement of Interest around stormwater management
Partnerships	• There are many opportunities for partnerships among provincial and municipal agencies and NGOs	• Opportunities must be created to collaborate at all levels (municipalities, province, NGOs, universities and among political jurisdictions) within a landscape on watershed protection. • Adjacent municipalities need to be consistent in views/perspectives. The closer municipalities agree, the less

		potential for pushback exists.
Best Management Practices	• A mixture of best management practices and practical approaches are needed (e.g. Annapolis Royal case study)	• Programs must find ways to reward success (eg. Financial incentives, rebates, free assessments/ risk evaluations) • There are concerns regarding the cost of change to senior citizens e.g. storm lines to everyone's property. People couldn't afford to do it themselves
Education/ Communication	• Education and buy-in of developers and residents is crucial. Developers don't want to do anything harmful but extra steps are equated to extra costs. The question is, who pays? • What is the cost of *not* implementing technology. Developers and the public could benefit from understanding the cost of doing nothing • The average homeowner is unaware of resources/events available to them through municipalities (i.e., rebate incentives). Municipalities need do a better job at making resources known and available.	• Municipalities, homeowners, developers, engineers need to be more aware of the issues, and stewardship must be encouraged • Education should be personalized i.e., brought down to an individual property level (impacts and solutions for individual property owners). • Interpretive signage can help educate public on municipal initiatives to protect the environment (stormwater treatment lagoon system and wetlands in Annapolis Royal) • Celebrate successful initiatives. Very few people in attendance at the Digby workshop were aware of the work that Annapolis Royal had undertaken around separating the stormwater and wastewater systems. • More local case studies on EAC blog to highlight innovative • Rather than having one huge project, have a phased approach to projects. Will lead to greater potential for success. • Encourage communication with NS municipalities through their website (Sustainability Office)

		• Education on proper disposal of pharmaceuticals is needed (stop flushing unused/old medications)
Research	• Research needed on housing and development prices that prove to developers that it won't cost more to develop a low impact dwelling/building. We need the proof that there is no additional cost, instead the costs lies with doing nothing.	• Research needed on relative water uptake by plant species • An assessment tool must be developed to identify where/how systems are stressed. The tool could then assess municipal infrastructure capacity to withstand flooding /overflow with the proviso that insurance won't be offered unless this assessment has been done.

Appendix I: Digby Workshop Agenda

Isaiah W.Wilson Memorial Library February 22nd, 2012		
Time	Activity	Speaker
8:30	Doors open	
8:45	Overview of day/workshop objectives	Jen Graham, EAC
9:00	Introduction to stormwater management	Ashley Sprague, EAC
9:30	Climate change and storm events: Costs and impacts to homeowners and municipalities	Amanda Dean, Insurance Bureau of Canada
10:00	BREAK	
10:15	Stormwater initiatives: Town of Annapolis Royal	Kevin McLean, Annapolis Royal
10:45	Stormwater Best Management Practices	Joy Elliot, Landscape Architect
11:15	Summary of morning Discussion/Questions	
11:30	Stormwater scenario exercise	Ashley Sprague, EAC
12:00	LUNCH	
12:45	Stormwater scenario exercise: Group work	All participants
1:15	Stormwater scenario exercise: Facilitated discussion	Feedback from speakers
2:00	Emerging Water Issues: Pharmaceuticals in Municipal Effluent	Jen Ings, UNBSJ
2:30	Group discussion How to address stormwater and wastewater issues : Opportunities and limitations	Jen Graham, EAC
3:00	Wrap up, Evaluation	
3:30	End	

Appendix II: Saint John Workshop Agenda

Market Square Public Library February 23rd, 2012		
Time	Activity	Speaker
10:00	Doors open	
10:10	Overview of day/Welcome	Jen Graham, EAC
10:30	Introduction to stormwater management	Ashley Sprague, EAC
10:50	Costs and impacts of storm events to homeowners and municipalities	Insurance Bureau of Canada
11:15	Stormwater initiatives: City of Moncton	Darryl Bonhower, City of Moncton
11:45	Stormwater Best Management Practices	Hans Arisz, RV Anderson
12:15	Lunch	
1:15	Stormwater scenario exercise: Explanation explain objectives, groups, scenario characteristics	Ashley Sprague, EAC
1:45	Stormwater scenario exercise: Group work	All participants
2:15	Stormwater scenario exercise: Facilitated discussion	Feedback from speakers
3:00	Break	
3:15	Emerging Water Issues: Pharmaceuticals in Municipal Effluent	Jen Ings, UNBSJ
3:45	Group discussion How to address stormwater and wastewater issues : Opportunities and limitations	Jen Graham, EAC
4:15	Wrap up, Evaluation	
4:30	End	

Appendix III: Digby Workshop Participants List

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Appendix V: Stormwater Scenario Exercise

Why a Stormwater Scenario Exercise*?*
The participants at this workshop represent many different types of expertise and experience about stormwater management. To maximize the opportunity to learn from each other, we will be spending some time today working in groups on stormwater scenario exercises.

We are using a scenario exercise format because it allows participants to apply the concepts presented in today's workshop, as well as their own expertise to hypothetical (yet realistic) urban stormwater management situations.

The purpose of this exercise is to practice selecting appropriate Best Management Practices (BMPs) to improve stormwater management on an individual property and neighbourhood scale. Try to identify opportunities to reduce the velocity, volume and pollutant load of runoff on your site by reducing impervious surface area, selecting tools to allow water to infiltrate into the ground and capturing and reusing rainwater.

How the activity works
Each group will work on one of two stormwater scenarios. Your scenario, along with a description of stormwater BMPs, are included in the workshop kit. The groups will work together to answer specific questions and prepare to report back to the larger group. Each group will find more photos of their site, flip chart paper and markers to help prepare to report back to the larger group. There will be a facilitated large group discussion after the small group session, to compare results and explore alternative solutions.

Getting started

- Introduce yourselves to each other. Find out about the background each member brings to the group.
- Read through your group's stormwater management scenario. Ask each other or the facilitators for clarification as needed.
- Lay the clear sheet provided on top of your site map and use a marker to draw changes to your site and selected BMPs.
- Assign a note taker to record highlights from the discussion for reporting back to the larger group.
- Figure out who will present your results to the larger group.

Answer these questions, keeping in mind the particular condition of your site, as well as the need to incorporate essential stormwater management concepts:

1. What are the opportunities and challenges for improving stormwater management on your site?
2. What are the on-site retrofit locations opportunities on your site? (rooftops, parking lots, underground, streets, parks, etc.)

3. What BMPs are the most appropriate to improve stormwater management on your site? Use a minimum of 3 different tools.
4. What additional benefits will your retrofit design plan create? (i.e., habitat, aesthetic value, water reuse, etc.)
5. What maintenance considerations apply to your design plan?

During the large group discussion you will have **5 minutes** to:

- Introduce your scenario
- Describe the on-site retrofit location opportunities on your site
- Present the various BMPs you have chosen to implement in your scenario
- Explain your reasoning behind the citing of various BMPs and how they will function to reduce velocity, volume and pollutant load of stormwater runoff.

Other tips

- It's your site! Feel free to add relevant information about existing land use, water use, habitat value, and human activities on the property. Also, you can make assumptions about your site if you feel the scenario is incomplete. For example: the size of stormwater outflows, drainage area, presence of bedrock.
- You can use additional BMPs that are not listed in the handout (i.e., tree planting, daylighting, education and awareness tools such as brochures for homeowners).
- If helpful, use sketches or additional drawings to explain your design plan when presenting back to the large group
- If time remains, feel free to discuss costs of your design plan based on your experience

Stormwater Scenario 1: Muddy Creek Apartment Development

Site Description:
Muddy Creek Developments is a spacious housing complex located only 20 km outside of the urban centre of Waterville, Nova Scotia. Land use has changed quickly in this area with several new housing developments, a school, community centre, and a shopping mall constructed in the past eight years. Only 10 years ago, the area was primarily forest with some land developed for agricultural purposes.

Muddy Creek Developments offers a range apartments, townhouses and condominiums at affordable prices. Ample parking space exists for residents and their guests. Rooftop rainwater is collected into downspouts which drain onto the site. The beautifully landscaped grounds consist of large grassed areas, a small water park and playground for kids, and a pond where you can relax and watch the resident ducks swim. A paved bike trail runs adjacent to the Development. Several youth in the area have recently decided to plant a community garden.

Stormwater Runoff Concerns:
The developer has recently started receiving complaints from tenants who are concerned about the health of the pond. Over the past two summers, the usually clear water has become covered with algal blooms. Families are no longer able to enjoy this space and the beloved ducks did not return to the pond this Spring. Storm drains collect runoff from the roofs and parking lots of the site, which drain into the pond unfiltered via one stormwater outlet. Wet areas have started to develop in between the rows of apartments and a few homeowners are also experiencing basement flooding following heavy rain events.

Additional Site information:
Soil type: Well-draining loam (60% sand, 30% silt, 10% clay)
Depth of water table: 4 m

Scenario #2: Cattail Lake

Site Description:
Development is rapidly growing around this suburban lake. The lake is very popular for recreation purposes, with canoeing, kayaking, swimming, fishing and bird watching all taking place during the spring and summer months. A large parking lot and paved road was built to provide public access to the lake. Many new homes, a school and a community centre have been constructed in the past 15 years.

Many of the lakefront homes have removed a high percentage of the existing vegetation in order to have an unobstructed view of the lake. The use of cosmetic pesticides is common practice for many homeowners. Untreated stormwater from the developments drains into the lake unfiltered via 10 different stormwater outlets.

Stormwater Runoff Concerns:
In the past 12 years, users of the lake have reported algal blooms and eutrophication, and for the past 5 years the local beach has had to be closed on days following heavy rain events. A local residents committee was formed to raise awareness about the health of the lake. The committee began testing the lake's water quality and found high levels of phosphorous.

The site slopes toward a depression where the parking lot was constructed to provide public access to the lake. Several large pools of water form in this area following heavy rain events and accelerated shoreline erosion has been reported in this area.

The municipality has recently introduced a 'Stormwater Surcharge' and rates are based on the area of impervious surfaces in a neighbourhood. The rates can be greatly reduced if the neighbourhood can demonstrate a reduction in runoff volume through of on-site retention and reuse or a reduction of impervious surface area.

In order to address these growing concerns, a community meeting was held and several homeowners committed to making changes on their individual properties. Residents also agreed to look for opportunities to help reduce the amount and pollutant load of runoff entering the lake in shared, public areas of the neighbourhood.

Additional Site information:
Soil type: Well-draining loam (60% sand, 30% silt, 10% clay)
Depth of water table: 4m

Appendix VI: Stormwater Retrofit Best Management Practices Handout

BMP	Description	Location possibilities	Pollutant Removal	Other benefits	Other Considerations
Detention (Dry) Ponds	- stores runoff after a rain event for some minimum amount of time (ex. 24 hours) - dry between rain events	- watershed or neighbourhood scale -existing ponds -roadway culverts -below outfalls -large parking lots	-fair removal of particulates -poor removal of soluble pollutants	-flood and erosion protection of downstream channel -groundwater recharge	-best used with other BMPs such as wetland or wet pond. -can be designed with pool at inlet and/or outlet -can be used with slopes up to 15% -most soil types appropriate -impermeable liner may be needed in sandy soils
Retention (Wet) Ponds	-permanent pool of standing water that temporarily holds stormwater - runoff from each new storm displaces water from previous storm	- watershed or neighbourhood scale -existing ponds -below outfalls -large parking lots	-moderate to high removal rate of all stormwater pollutants -both settling and biological uptake (i.e., algae) occur	-aesthetic value (community acceptance) -groundwater recharge	-need sufficient drainage area to maintain permanent pool -can be used with slopes up to 15% -most soil types appropriate
Constructed Wetlands	-shallow depressions that received stormwater inputs for treatment - runoff from each new storm displaces water from previous storm	- watershed or neighbourhood scale -existing ponds -roadway culverts -below outfalls -large parking lots -conveyance	- moderate to high removal of all stormwater pollutants -range of physical (settling), biological, chemical and microbial processes	-replicate natural wetland ecosystems -habitat value -aesthetic value (community acceptance)	-potential to take up a lot of space (not suitable for all urban areas) -need sufficient drainage area to maintain permanent pool -can be used with slopes up to 15% -most soil types appropriate

Filtration	-captures and temporarily stores runoff -runoff passed through an engineered filter media, collected in an underdrain and returned to storm drain system	-neighbourhood/ individual property -small parking lots -small, highly impervious sites	- moderate particulate pollutant removal -low soluble nutrient removal -mainly physical treatment (filtering, settling, straining)	-good for areas with limited space (use little surface land)	-several filter variations including surface sand filters, underground sand filters, organic media filters, multi-chamber treatment train - can have two chambers, one for settling and one serves as filter bed (i.e., sand) - Other engineered filtering systems exist (CDS separators, etc)
Infiltration (i.e., infiltration trenches, basins)	-shallow impoundment designed to capture and temporarily store runoff before infiltrating into soil -runoff initially passes through other treatment (i.e., swale) then is stored in rock filled chamber with no outlet before infiltrating into the ground	-neighbourhood/ individual property -small parking lots	-high pollutant removal -most pollutants trapped by soils	-increase groundwater recharge -reduce runoff volumes to prevent CSOs (runoff does not enter storm drain system)	-perforated pipe or other proprietary materials can be used instead of stone to increase storage capacity -effectively used in narrow, linear areas along property boundaries -soil requirements can limit applicability -bottom of basin must be completely flat to ensure infiltration throughout
Swales (bioswales, dry swales, grassed swales)	-linear vegetated open channel to slow and treat runoff -vegetation slows runoff allowing sedimentation -do not have underground rock-filled chamber, but may require fabricated soil bed to improve filtration	-neighbourhood/ individual property -small parking lots -individual streets	-moderate pollutant removal through settling, filtering, infiltration and plant uptake	-groundwater recharge	-improvement over conventional roadside ditch -most require widening, or deepening existing open channel -can be used for conveyance, or with other BMPs (i.e., rain garden) - best on slopes < 4% - not well suited for highly impervious soil types

Rain Garden	-small landscaped depressions that capture, filter and infiltrate rooftop runoff -sand/soil mix planted with grasses, shrubs, plants	-neighbourhood/ individual property -small parking lots -rooftop runoff	--moderate pollutant removal through settling, filtering, infiltration and plant uptake	-recharge groundwater -personal stewardship and increased watershed awareness -habitat value -aesthetic value	-allows at least 30% more water to infiltrate into the ground than conventional lawn (UWEO, 2002) -need proper maintenance -should be minimum of 10 ft. away from house to prevent basement flooding -well drained soils work best
Green Roofs	-layer of vegetation and soil installed on conventional roof designed to store and treat runoff	-neighbourhood/ individual property -commercial, industrial and residential buildings -rooftop runoff	-moderate removal of nitrogen and phosphorous due to soil microbial processes and plant uptake	-increased thermal insulation and energy efficiency - increased acoustic insulation -increased durability and lifespan compared to conventional roofs -habitat value	- extensive green roofs have < six inches of growing medium and usually have moss/grass cover (lower maintenance and cost) -intensive green roofs have > 6 inches of substrate and can support wide range of plants - flat roofs most common, but can be installed on 30% sloping roofs with special strapping -structural analysis of roof required to meet weight bearing requirements
Rain Barrel	-stormwater collection device to capture, store and reuse runoff from rooftop downspouts	-neighbourhood/ individual property -small parking lots -rooftop runoff	-low -designed for capture, not treatment	-water conservation through reuse (i.e., irrigation, car washing, etc.)	-should be drained and disconnected in winter months
Cisterns	- capture rooftop runoff from non-residential sites in aboveground or underground storage tanks	-neighbourhood/ individual property -small parking lots -rooftop runoff	- low -designed for capture, not for treatment	-water conservation through reuse (i.e., irrigation, grey water, etc.)	-generally much larger than rain barrels (typical capacity of over 40,000 L)
Stormwater Planters	-confined planters that store runoff and/or	-neighbourhood/ individual property	-low-moderate removal of nitrogen and phosphorous	-aesthetic landscaping feature	- infiltration planters allow runoff to pass through the planter and

	infiltrate runoff through soil bed -generally receive runoff from rooftop downspouts	-small parking lots -rooftop runoff	due to soil microbial processes and plant uptake	-useful in highly urban areas	into natural soil bed -filter boxes does not allow infiltration into natural soil bed -treat small drainage area
Permeable Pavers	-porous or semi-porous material used on driveways, parking lots and walkways to reduce and treat runoff -runoff infiltrates into soil or gravel bed	-neighbourhood/ individual property -small parking lots -rooftop runoff	-moderate pollutant removal	-groundwater recharge - aesthetic value	-can be porous asphalt or interlocking concrete blocks -maintenance required to ensure pores are not clogged
French Drains (Dry Wells)	-shallow underground trench with perforated pipe along bottom -runoff from rooftop leaders are directed to trench via swale or downspout	-neighbourhood/ individual property -small parking lots -rooftop runoff	-moderate removal of particles and soluble nutrients		-small drainage area -limited opportunities in very high density neighbourhoods -do not function in winter months - minimum of 10 ft. from house to prevent basement flooding - -regular maintenance required

Created by Ecology Action Centre (2012), based on:

Centre for Watershed Protection. 2007.Urban Subwatershed Restoration Manual No.3: Urban Stormwater Retrofit Practices Version 1.0. (Prepared by: Tom Schueler, Hirschman,D., Novotney, M., and Zielinski, J.)

U.S. Environmental Protection Agency. National Menu of Stormwater Best Management Practices. www.cfpub.epa.gov/npdes/stormwater/menuofbmps/

Appendix VII: Pharmaceutical Handout

Pharmaceuticals in the Marine Environment

Humans use a wide-range of pharmaceuticals to control disease and improve health conditions. After we take these drugs, they are used and then excreted by our bodies in either a modified form called a metabolite or in its original form, and enter the wastewater system. Drugs may also enter the wastewater system when unused medications are flushed down the toilet. Many pharmaceuticals and their metabolites have been detected in municipal wastewater, and most are only partially removed using current sewage treatment processes, leading to their presence in wastewater effluents entering rivers, lakes and coastal waters.

A nationwide study done in 1999 and 2000 by the United States Geological Survey (USGS) found low levels of drugs such as antibiotics, hormones, anti-depressants and beta-blockers in 80% of the rivers and streams tested [(1)], and a number of studies conducted in Canada have also found a high prevalence of these compounds in the aquatic environment[(2,3)].

Environmental Concerns

Pharmaceuticals are designed to be biologically active, which means they have the potential to impact organisms living in the aquatic environment once they are released into freshwater and marine systems, even at very low concentrations. The impacts of pharmaceuticals on the health of the aquatic environment may be of particularly significance in urban and industrial areas where organisms are already stressed by degraded water quality.

Studies have linked pharmaceutical and wastewater exposure to effects on reproduction, stress, bioenergetics and other endocrine system functions in fish. Of particular concern is the synthetic estrogen, ethinylestradiol, used in oral contraceptive medications. Studies on small minnow species, including those found in the estuaries of the Bay of Fundy, have shown that exposure to this estrogen causes a significant decrease in egg production and changes in hormone levels [(4,5)]. Recent studies are starting to identify other drugs, such as anti-depressants and beta-blockers, which have the potential to reduce fertility or affect spawning in certain aquatic organisms, as well as affect other parameters that may impact long-term health and survival. Often the greatest environmental impacts are seen near wastewater treatment plants.

What Can Municipalities Do?

The most important thing you can do to reduce the amount of drugs in our waterways is to encourage proper disposal by not flushing unused medications down the drain. The best option is to return unused pharmaceuticals to a pharmacy for proper disposal. Nova Scotia has a formal province-wide program for the disposal of household pharmaceutical waste. Administrated by the Pharmacy Association of Nova Scotia (PANS), the Medication Disposal

program allows consumers to return pharmaceuticals to provincial community pharmacies for safe disposal.
New Brunswick, does not have a formal province-wide program for the disposal of household pharmaceutical waste. However, the majority of the province's regional Solid Waste Commissions offer Household Hazardous Waste programs which allow the public to dispose of pharmaceuticals in a safe manner.

Upgrades to sewage treatment plants, such as biological or UV treatment, may be required to completely remove active pharmaceutical compounds. However, this may be an expensive option for municipalities and research is still underway to determine the best available treatment techniques. Therefore it is recommended that extensive infrastructure investments are not made until more knowledge exists.

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