

# Technical Report 13

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*Stormwater*

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## What is Stormwater?

Stormwater is rainfall that runs off of buildings, pavement, yards, and fields. It picks up pollutants like sediment, oil, and fertilizer and carries them to streams, lakes, and wetlands. Stormwater can degrade streams by causing erosion from increased water volume and by carrying pollutants into them. Other problems related to poor stormwater management include flooding, decreased groundwater recharge, and decreased water to streams during dry months (called base flow). As stormwater runoff travels across the land surface, it picks up a number of pollutants that can pose serious health risks to humans and can disrupt and/or seriously damage water ecosystems.

## Background

The U.S. Environmental Protection Agency (EPA) identified stormwater as a major component of “nonpoint” source pollution and as one of the most serious threats to water quality in the country. Nonpoint source pollution is pollution that has no specific source, but is caused by a variety of pollutants that are present in stormwater runoff. The pollutants include the following:

- **Nutrients** include nitrogen and phosphorus that are needed for plant growth. However, high levels can cause a health hazard in drinking water. They also stimulate excessive aquatic plant growth and lower dissolved oxygen levels in the water, causing fish and other aquatic life to be smothered. Algae blooms are examples of how excess nutrients pollute. Sources of excess nutrients include animal waste, fertilizers, septic systems, and auto emissions.
- **Pathogens** are disease-causing bacteria and viruses associated with the presence of fecal matter. They affect human health directly through water contact and through consumption of shellfish. Sources include failing sewer or septic systems or animal waste.
- **Sediment** is made up of fine particles of eroded soil or sand. Sediment smothers aquatic life, carries pollutants like heavy metals that are bound to soil particles, and makes water cloudy. Common origins are sites cleared of vegetation for construction, timber harvest and farming.
- **Toxic Contaminants** include such substances as heavy metals and pesticides. Because they resist breakdown and accumulate in organisms, they threaten the food chain. Sources include industrial, commercial, household and agricultural chemicals and toxics from auto emissions.
- **Debris** consists of trash such as old tires, shopping carts and plastics. It comes from illegal dumping and street litter. It threatens aquatic life and detracts from recreational and aesthetic values.
- **Thermal Stress** or elevated water temperature reduces survival rates and disease resistance of valued native species and allows the spread of non-native (exotic) species negatively impacting biologic diversity. Causes include increased pavement near streams and loss of vegetated stream buffers.

In early 1987, the Federal Clean Water Act instituted a National Pollutant Discharge Elimination System (NPDES) permitting system to reduce harm to the nation's waterways from factories, public sewers, and other major waste sources. To comply with federal law, the Washington State Department of Ecology began issuing permits to regulate stormwater discharges from city and county drainage systems. NPDES permits regulated by the State Department of Ecology were issued in two phases. Phase I permits were issued to large municipalities and county governments with populations over 100,000 (as of the 1990 census). Phase II permits were issued in 2007 to smaller governmental entities with populations under 100,000.

Clark County is considered a large municipality and is required to have stormwater and water quality ordinances under Phase I permits. Identical permits were also issued for the cities of Seattle and Tacoma, and King, Pierce and Snohomish counties. The current permit issued in 2007, replaces a permit originally issued in 1999 and allows for stormwater system discharge. The permit requires the county to implement programs to protect water quality by reducing the discharge of pollutants to the maximum extent practicable; satisfy all known and reasonable methods of prevention control; and treatment prior to discharge.

### **Stormwater Management Program (SWMP)**

The county's existing stormwater ordinance does not meet the newest NPDES permit requirements to follow state guidelines for controlling stormwater and erosion on development and construction sites. The new guidelines are more protective of our streams and lakes. The water quality ordinance must be updated to adopt more recent state standards for preventing pollutants from business and government operations from reaching the storm sewer.

Clark County is updating the Stormwater Management Program (SWMP) which outlines what actions will be taken to meet requirements of a NPDES phase 1 municipal stormwater permit issued in February 2007. The SWMP should be completed in 2008 and include the following components:

- Public education and outreach program;
- A process for involving the public in the development of a stormwater management program;
- Develop an illicit discharge detection and elimination program to identify and remove discharges into the MS4 system;
- Adoption of ordinances to control runoff from new development, redevelopment and construction activities; and
- Operation and maintenance program to reduce pollutants from municipal operations.

The new Ecology NPDES permit limits the ability of permittees to tailor their programs to local needs and priorities. Input from the public will help identifying priority activities that go beyond permit requirements or additional tools to meet permit requirements. Clark County, along with other jurisdictions, has appealed certain portions of the Ecology permit. However, work to meet all compliance requirements must continue during the appeal process.

### **How will the new regulations affect infill and redevelopment projects in the Highway 99 sub-area?**

Traditionally, storm water management has been primarily a function of development activity. Clark County code requires treatment and detention of runoff from existing and

proposed impervious areas within project limits. The Stormwater Management Manual for Western Washington is used to establish the criteria and methods of treatment and detention.

Like the current ordinance, the revised stormwater ordinance will only affect proposals to develop or redevelop property, or increase the amount of hard surfaces on it. Many projects will require erosion control during construction. Larger projects also will be required to use more effective best management practices (BMPs) to control and treat stormwater on the property for the long term.

The existing stormwater system in the Highway 99 Sub-Area intercepts a significant amount of off-site flow from both the north and south sides of the planning area. Within the planning area, there are five creeks that cross Highway 99: Salmon Creek, NE 114th Street Tributary, Tenny Creek, Cougar Canyon Creek, and Cold Creek. Lalonde Creek flows into Salmon Creek in the northeast section of the study area. These five creeks, in most cases, are considered fish habitat. Stormwater management in the sub-area will require extensive research and utilize a variety of options in order to comply with the county code.

A critical policy decision for the stormwater code update is how redevelopment will be treated. Public Works compared a development site within the Highway 99 area and completed a cost comparison based on current and proposed new stormwater codes. (see Appendix A) In other cases, the proposed draft of the stormwater ordinance, targeted for completion in 2008, could reduce the detention requirements for some redevelopment projects compared to current code. Also, the new ordinance will allow Low Impact Development (LID) methods such as pervious pavement that can reduce the cost to manage stormwater. The City of Vancouver and Clark County are in the process of reviewing all development and building codes to identify barriers in existing regulations that would prevent a successful LID project. Although these changes could help many sites, some sites will remain difficult to develop or redevelop. The proposed update includes the following:

- Flow Control standards
- Increased infiltration;
- LID techniques;
- Use of Right-of-way for underground facilities;
- Credits for retaining natural areas;
- Review and update of other associated ordinances, e.g. Transportation;
- Developing regional facilities; and
- Providing flexibility to develop stormwater facilities as amenities and multi-purpose use.

The update of the stormwater ordinance may create substantial challenges for the redevelopment of properties in the Highway 99 sub-area. However, one of the mitigation measures the county is pursuing is the creation of regional stormwater facilities. If the County were to pursue development of regional stormwater facilities in the sub-area it could act as a development incentive for redevelopment projects in the Highway 99 sub-area. The Highway 99 sub-area would be an ideal location for a pilot project to determine the effectiveness of pursuing regional stormwater facilities countywide.

Examples of LID Techniques



Figure 1 | Rain Barrel



Figure 2 | Rooftop Garden



**Figure 3 | Bio Retention**



**Figure 4 | Rain Barrel**



Figure 5 | Pervious Pavement

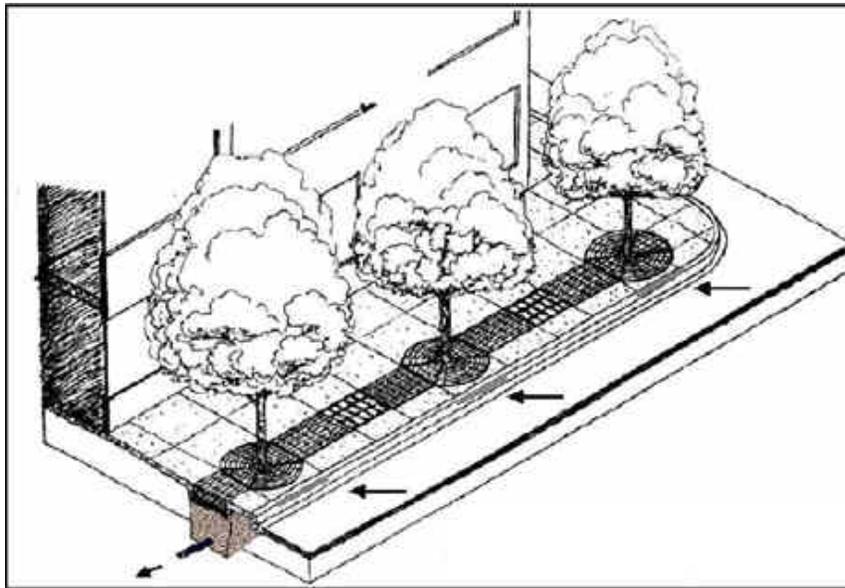


Figure 7 | Tree box filters are mini bioretention areas installed beneath trees that can be very effective at controlling runoff, especially when distributed throughout the site.



Figure 6 | Permeable

## **APPENDIX A Sample Redevelopment Project**

# Sample Redevelopment Project



- 2.5 acre redevelopment site
- Site was paved in 1955
- Enhanced treatment required

## Cost Comparison

Condition	Detention	Cost1
Current Code	275 cf	\$20,600
Draft Code 1955	None	\$40,500
Draft Code Forested	7,220 cf	\$216,500
Porous Pavement2	NA	\$54,400

1. Cost includes water quality and detention facilities.
2. Cost is in addition to standard asphalt.

**APPENDIX B      More Reading**

## Selected Sources for Further Reading

**American City and County-** A magazine devoted to local government news and issues. <http://www.americancityandcounty.com>

**American Planning Association-** A professional association of planners. Planners Press publishes books concerning planning issues, Planning Magazine and the Journal of the American Planners Association (JAPA). <http://www.planning.org>

**American Public Works Association-** A professional and education association of organizations and individuals involved in the provision of public works goods and services. Publishes the APWA Reporter. <http://www.apwa.net>

**American Society of Civil Engineers-** A professional organization for civil engineers. Publishes Civil Engineering, and the Journals of Environmental Engineering, Irrigation and Drainage Engineering, Water Resources Planning and Management, and Urban Planning and Development. <http://www.asce.org>

**American Water Works Association-** An organization for water supply professionals. Publishes four periodicals concerning drinking water and has conference proceedings available online. <http://www.awwa.org>

**Center for Watershed Protection-** A non-profit organization that disseminates information on watershed protection to community leaders and watershed managers. Conducts training seminars and publishes Watershed Protection Techniques. <http://www.cwp.org>

**Emerald Library-** Access to several professional journals including the International Journal of Public Sector Management online through a 30-day free trial. <http://www.emerald-library.com/EMR/EMRguest.html>

**Financing Alternatives for Stormwater Management: with an Emphasis on User Pay-** This is a fact sheet describing financing options available to municipal stormwater managers and finance officers, with an emphasis on the user pay approach. <http://www.on.ec.gc.ca/water/greatlakes/data/stormwater-management/intro.html>

**Government Finance Officers Association-** An association of public finance professionals. Publishes the Government Finance Review and books related to public-sector finance issues. <http://www.gfoa.org>

**International City/County Management Association-** A professional organization for local government administrators. Publishes materials about issues concerning local governments. <http://www.icma.org>

**Municipal Code Corporation-** This company publishes the municipal codes of hundreds of communities online in a searchable library. <http://www.municode.com>

**Municipal Research and Services Center-** An organization that conducts research on government for communities in Washington state. The organization has written guides concerning impact fees and stormwater utilities that are partially available online. <http://www.mrsc.org>

**National Association of Home Builders-** A federation of state and local builders associations. Publishes materials concerning development issues, smart growth, best development practices, and governmental relations. <http://www.nahb.com>

**Natural Resources Defense Council-** Promotes sustainability and protects our natural resources. Publishes the Amicus Journal and books about environmental issues. <http://www.nrdc.org>

**Stormwater-** A journal for stormwater management professionals. <http://www.forester.net/sw.html>

**The Stormwater Manager's Resource Center-** A Web site developed by the Center for Watershed Protection that contains technical information concerning stormwater. The site includes a library of over 600 resources concerning stormwater, slide shows, pollution prevention and resource protection techniques, examples of stormwater-related local ordinances, and a page that helps communities design their own stormwater manuals. <http://www.stormwatercenter.net>

**Storm Water Resources Site-** Lots of links to stormwater-related Web sites. <http://www.stormwater-resources.com>

#### **United States Environmental Protection Agency**

**Environmental Finance Center Network Guidebook of Financial Tools**-A guide to available financial tools that can be used for environmental management. <http://www.epa.gov/efinpage/guidbk98/index.htm>

**Office of Wastewater Management Financial Assistance Page-** This is the home page of the EPA's Clean Water State Revolving Loan Fund (CWSRF) program. The page contains links to fact sheets in PDF and HTML format that outline how revolving loan funds can be used to address stormwater concerns. <http://www.epa.gov/owm/finan.htm>

**Post-Construction Stormwater Management in New Development & Redevelopment-** [http://cfpub.epa.gov/npdes/stormwater/menuofbmeps/post\\_7.cfm](http://cfpub.epa.gov/npdes/stormwater/menuofbmeps/post_7.cfm)

**National Menu of Best Management Practices for Stormwater Phase II-** <http://cfpub.epa.gov/npdes/stormwater/menuofbmeps/menu.cfm>

**State and Local Government Guide to Environmental Program Funding Alternatives**- Discusses traditional funding methods and some innovative funding methods that can be used by communities to fund environmental programs. <http://www.epa.gov/OWOW/NPS/MMGI/funding.html>

**Office of Wetlands, Oceans, and Watersheds Nonpoint Source Pollution Site-** This site describes nonpoint source pollution, discusses different categories of nonpoint sources, and provides information for the public, students, and educators about nonpoint sources. It also includes information about funding opportunities, Section 319 of the Clean Water Act, and Section 6217 of the Coastal Zone Act Reauthorization Amendments. <http://www.epa.gov/OWOW/nps>

**Urban Land Institute-** An institute devoted to land use research. Publishes useful materials concerning land use issues and two monthly journals, Urban Land and Land Use Digest. <http://www.uli.org>

## **Climate Change**

EWRI 2005: Impacts of Global Climate Change Conference:  
<http://www.pubs.asce.org/WWWdisplaybn.cgi?0784407924>

NOAA National Climatic Data Center: <http://www.ncdc.noaa.gov/oa/ncdc.html>

Real Climate: <http://www.realclimate.org/>

United Nations Intergovernmental Panel on Climate Change (IPCC): <http://www.ipcc.ch/>

United Nations Framework Convention on Climate Change: <http://unfccc.int/2860.php>

US Army Corps of Engineers: <http://www.usace.army.mil/>

USEPA Climate Change: <http://epa.gov/climatechange/index.html>

US Geological Survey Climate Change: <http://www.usgs.gov/science/science.php?term=168>

## **Local Efforts North America**

Boston CLIMB Project Climate's Long-Term Impacts on Metro Boston:  
<http://www.tufts.edu/tie/climb/>

P. Kirshen, M. Ruth, and W. Anderson, "Responding to Climate Change in Metropolitan Boston: The Role of Adaptation," *New England Journal of Public Policy*, Spring/Summer 2005

California Climate Action Team and Climate Action Initiative:  
[http://www.climatechange.ca.gov/climate\\_action\\_team/index.html](http://www.climatechange.ca.gov/climate_action_team/index.html)

Canada Climate Change: <http://www.climatechange.gc.ca/>

Oregon Governor's Initiative on Global Warming:  
<http://www.oregon.gov/ENERGY/GBLWRM/climhme.shtml>

Portland (OR) Portland/Multnomah County Local Action Plan on Global Warming:  
<http://www.portlandonline.com/osd/index.cfm?c=ebijg>

Seattle Mayor's Office Climate Protection Agreement:  
<http://www.seattle.gov/mayor/climate/>

Vancouver, Canada, Climate Change:  
<http://www.city.vancouver.bc.ca/sustainability/coolvancouver/>

Washington State Department of Ecology Climate Change:  
<http://www.ecy.wa.gov/climatechange/>

## **Local Efforts Europe**

London Mayor's Office Climate Change Agency:

<http://www.london.gov.uk/mayor/environment/energy/climate-change/index.jsp>

Netherlands Environmental Assessment Agency: <http://www.mnp.nl/en/index.html>

## **Low-Impact Development**

Center for Watershed Protection: <http://www.cwp.org/>

Low Impact Development Support Center: <http://www.lowimpactdevelopment.org/>

"Porous Pavements" by Bruce K. Ferguson

USEPA Low-Impact Development: <http://www.epa.gov/nps/lid/>

## **Micro Hydropower**

Home Power Microhydro Basics:

<http://www.homepower.com/files/beginner/MicrohydroBasics.pdf>

## **Rainwater Harvesting**

"Rainwater Harvesting for Drylands" by Brad Lancaster

Texas A&M University Rainwater Harvesting: <http://rainwaterharvesting.tamu.edu/>

## **Sustainable Infrastructure**

Engineers Without Borders: <http://www.ewb-usa.org/>

US Green Building Council: <http://www.usgbc.org/>

## **Urban Forestry**

Alliance for Community Trees: <http://actrees.org/site/index.php>

Sacramento Tree Foundation Green Print Program:

<http://www.sactree.com/aboutUs/programsServices/greenprint/greenprintOverview.html>

USDA Center for Urban Forest Research: <http://www.fs.fed.us/psw/programs/cufr/>