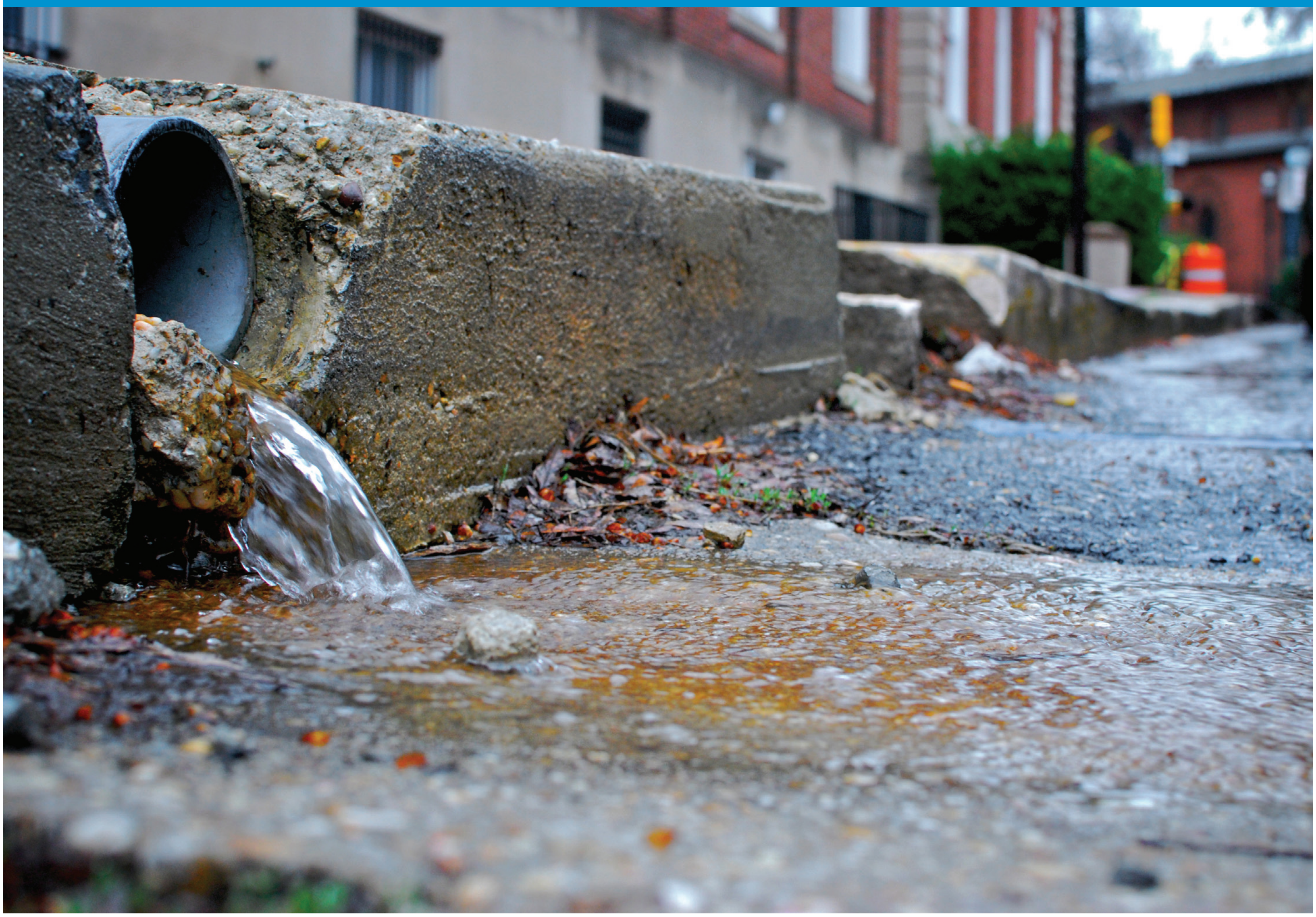
After the Storm:

How Green Infrastructure Can Effectively Manage Stormwater Runoff from Roads and Highways

September 2011



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TRANSPORTATION STORMWATER

Stormwater runoff from roads and highways pollutes and erodes our nation's water bodies, imposing health, financial, and environmental costs on local communities. These costs can be avoided or significantly reduced by ensuring that our roadways incorporate runoff controls that retain stormwater onsite. Green infrastructure, in particular, is an especially effective method for retaining stormwater that also generates a wide range of economic and social benefits beyond improved water quality. To ensure that these benefits are enjoyed by communities across the United States, legislative and administrative decision makers at the federal and state levels should provide incentives and requirements for these controls to be implemented at all road and highway facilities.

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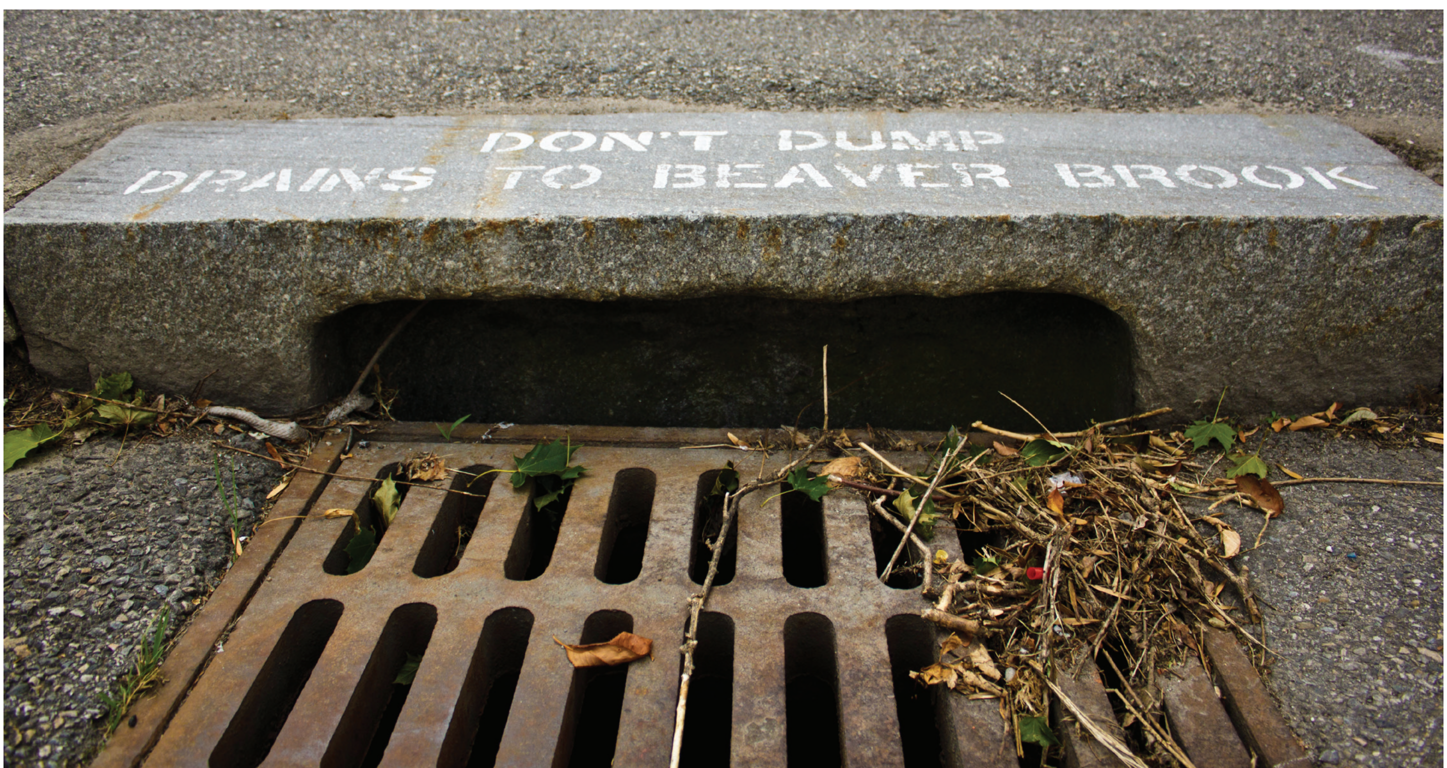

Stormwater Road Drain in Worcester, Massachusetts

POLLUTED RUNOFF FROM ROADS AND HIGHWAYS HAS COSTLY NEGATIVE IMPACTS ON WATER BODIES

When it rains, runoff from roads and highways frequently washes harmful pollutants into nearby rivers, streams, and lakes because the surface of roads is impervious, meaning that water cannot pass through it. Therefore, rain that falls on roadways is not able to soak into the ground as it would naturally. In fact, only 10 to 20 percent of rainwater runs off the land in its natural state, while the runoff from impervious surfaces approaches 100 percent. That runoff makes its way into local water bodies, carrying with it any substances that may be present on the road's surface.

The types and amounts of pollutants found on any one stretch of road can vary widely from place to place, and most commonly can include dirt, oil, grease, toxic chemicals, heavy metals, road salts, nitrogen and phosphorus, pathogens, and trash.[1] Many of these materials are deposited on roadways as a result of ordinary traffic activities, such as fluid leakage and the wear and tear of vehicle parts. For example, brake pad wear is a source of copper and zinc, which are the metals most commonly found in road and highway runoff. Wintertime salting and sanding practices may deposit chloride, sodium, and calcium onto roads, and application of fertilizers on median strips and rights-of-way is a source of nitrogen and phosphorus. Additionally, roads themselves may generate pollutants as their pavement degrades.

Traffic volume, roadway design, surrounding land use, regional climate, and accidental spills can also influence pollutant composition and quantity. For example, roadways carrying an average of 30,000 vehicles per day may produce runoff with two to five times the pollutant levels found in runoff from rural, less-traveled highways.[2] Or, roadways in arid areas, which experience long dry periods between storms, generate higher concentrations of runoff pollutants than areas with more frequent rainfall. When these factors combine in a particular location to create runoff with high concentrations of pollutants, the health of nearby water bodies may suffer.

POLLUTED ROAD AND HIGHWAY RUNOFF HAS A NEGATIVE IMPACT ON THE HEALTH OF WATER BODIES AND THE WILDLIFE THEY SUPPORT

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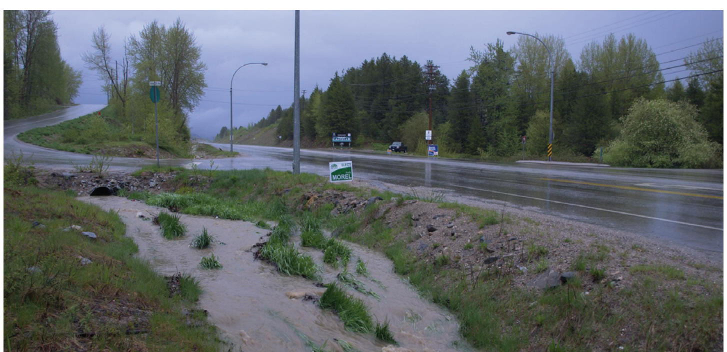

Road Runoff in Castlegar, British Columbia

Concentrations of pollutants in road and highway runoff often exceed numeric limits that are designed to protect the health of waterways.[3] For water bodies and their aquatic ecosystems, the consequences can be severe.[4] The effects of of pollutants commonly found in roadway runoff include:

- Suspended solids—small solid particles, like sediment, that remain in suspension in stormwater—cause problems like increased turbidity, decreased light penetration, and direct toxicity to aquatic organisms.
- Large quantities of chloride, found in deicing agents, can damage plants, harm freshwater life, and leave water unsafe to drink.
- Pathogens, including viruses and bacteria, cause public health impacts when they are discharged into water supplies or waters used for recreation.
- High levels of nitrogen and phosphorus pollution may stimulate excessive algae growth. As the algae die and decompose, dissolved oxygen concentrations in the water decrease to harmfully low levels. This process is called ‘eutrophication.
- Heavy metals are toxic to aquatic life and able to contaminate drinking water supplies. While eutrophication tends to be the most serious problem for lakes and bays, heavy metal toxicity typically threatens the health of streams.

In addition to the harmful effects of pollutants added to waterways, stormwater can also cause excessive stream bank erosion due to the sheer volumes of runoff. It does not take much impervious road surface to create massive quantities of runoff: one inch of rain that falls on one mile of a narrow two-lane road produces 55,000 gallons of stormwater.[5] Excessive erosion caused by these high volumes leads to a disproportionate sediment supply, stream channel instability, land loss, habitat loss, and many other adverse effects.

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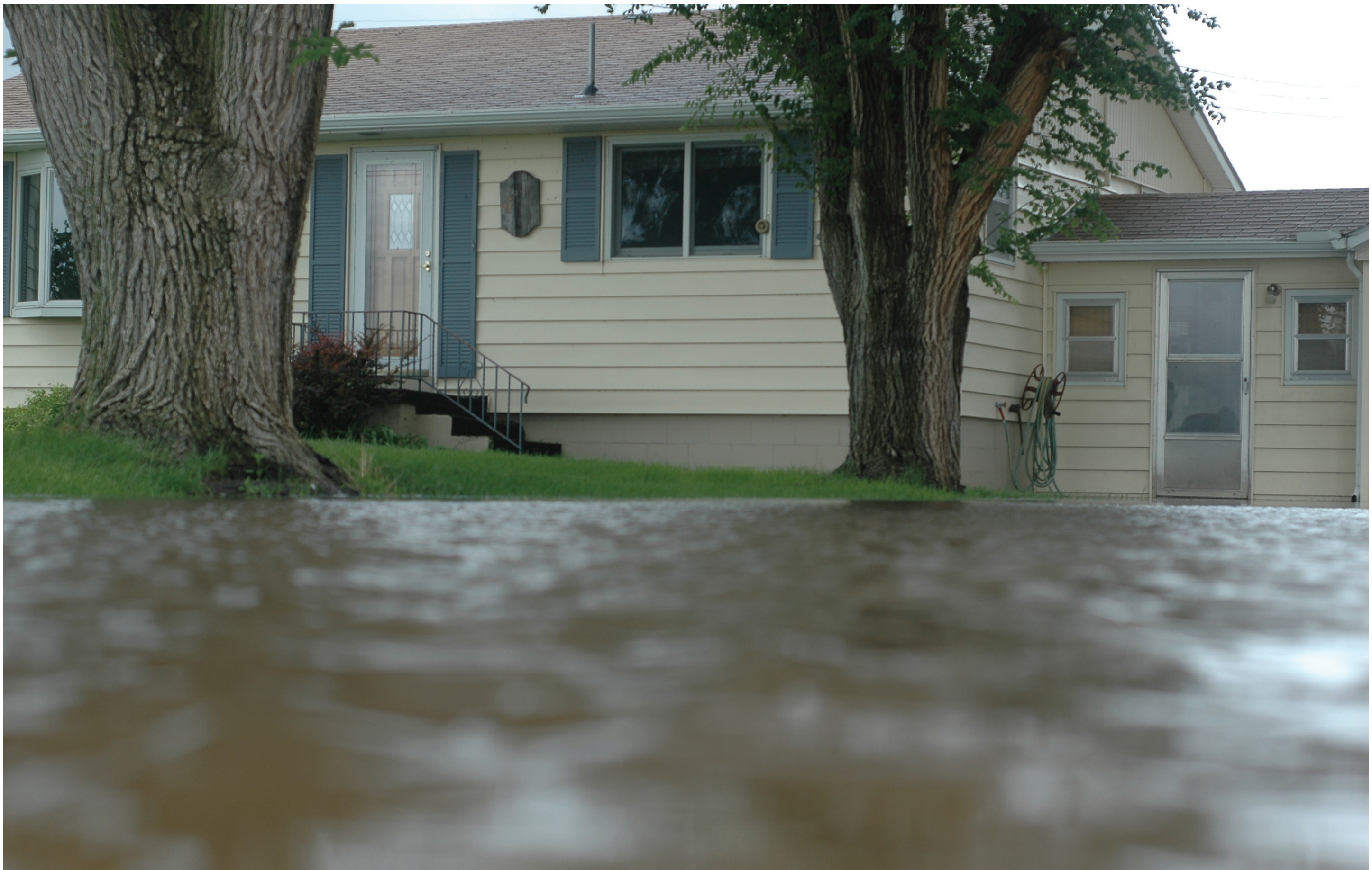

Flooding in Grand Island, Nebraska

NEGATIVE IMPACTS OF ROAD RUNOFF ON WATER QUALITY HAVE CONSIDERABLE ECONOMIC AND SOCIAL COSTS

When clean water and aquatic ecosystems are harmed by stormwater runoff, our communities suffer economic and social costs.[6] Some of these costs take the form of decreased revenues for companies that depend on healthy water bodies. For instance, when an ecosystem is damaged and fish and shellfish species are unable to thrive, commercial fishing and aquaculture may become less profitable. When water bodies become unsafe for human contact because of pathogens or toxic chemicals, recreational facilities may generate less income from boating and swimming. In fact, tourism revenues decrease when beaches are forced to close. In 2009, for example, there were 18,682 days of closings and advisory days at ocean, bay, and Great Lakes beaches around the country, due in large part to polluted stormwater runoff.[7] One study has estimated that economic losses associated with closing a Lake Michigan beach could be as high as $37,030 per day.[8]

Other costs directly affect individual members of the community. For example, high volumes of stormwater runoff can lead to flood–related property damage. The Federal Emergency Management Administration (FEMA) estimates that property damage from all types of flooding averages $2 billion per year.[9] Also, stormwater can cause costly health problems for people who get sick after coming into contact with it. One study found that the costs of lost wages and medical care for each case of gastrointestinal illness associated with polluted water is $36.58, and that each case of acute respiratory disease is $76.76.[10] These costs add up when many people become sick. It is estimated that between 627,800 and 1.47 million gastrointestinal illnesses occur at beaches in Los Angeles and Orange Counties each year, with a resulting annual economic loss of $21 to $51 million.[11]

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Stream Bank Erosion in Ballona Slough, California

Additionally, when runoff carries pollutants into water bodies that are used as drinking water sources, purification and treatment costs for municipalities may increase substantially. In one case, a Washington, D.C. area sanitary commission had to extend a drinking water intake pipe at a cost of $15 million because the previous shoreline intake was drawing water contaminated with pollutants and sediments flowing out of a tributary stream polluted by stormwater runoff.[12] Another study in Texas found that when surface waters are contaminated, the chemical cost of treating drinking water rises more than 25 percent.[13] When treatment costs rise, water rates for customers may rise as well.

Finally, some costs created by polluted stormwater runoff are more indirect and harder to quantify. Water pollution can pose a major threat to healthy and diverse aquatic communities that provide humans with free "ecosystem services" such as drinking and irrigation water, fish and shellfish for human consumption, and recreational activities. These natural roles are difficult and expensive to replicate if the environment can no longer provide them. For example, wetlands filter and store water supplies and provide protection against flooding; the total value of ecosystem services provided by healthy, functioning wetlands is estimated between $129,000 and $292,000 per acre.[14] Conserving biodiversity therefore delivers an economic benefit to people. Conversely, losses in biodiversity and associated ecosystem services, caused when roads and highways generate polluted runoff and excess stormwater volumes, impose costs on communities when they must replicate nature's services artificially.

CONTROLLING ROADWAY RUNOFF PROTECTS WATER QUALITY AND PROVIDES OTHER BENEFITS

Communities can avoid many of the costly impacts of water pollution by preventing road runoff through stormwater control measures. Sometimes called best management practices (BMPs), stormwater control measures refer to any technique—both structural (engineered devices) and nonstructural—used to manage the quantity and improve the quality of stormwater runoff. Often applied in combination, there are dozens of categories of stormwater control measures that can be used, such as:

Structural controls

- Treatment systems
- Erosion and sediment controls
- Vegetated volume reduction devices

Typical structural controls include grassy swales, infiltration trenches and basins, sand filters, bioretention cells, wet and dry retention ponds, constructed wetlands, and porous pavement.

Nonstructural controls

- Impervious cover minimization
- Land-use planning
- Conservation of natural areas

Overall, structural and nonstructural controls are relatively effective at removing pollutants from runoff. Road and highway BMPs can remove anywhere from 28 percent to 100 percent of various pollutants. Some BMPs, such as green infrastructure, however, are more effective than others, because those BMPs that are infiltration-based also help maintain or restore the natural hydrology of the watershed.[15]

GREEN INFRASTRUCTURE: A HIGHLY EFFECTIVE BEST MANAGEMENT PRACTICE

Sometimes referred to as low impact development (LID) techniques, green infrastructure replicates the natural functions of a landscape by integrating functions like storage, detention, infiltration, evaporation, and transpiration, or uptake by plants. These techniques reduce the volume of runoff by capturing and managing rainwater where it falls, and maintain as much of the site's natural hydrology as possible. These natural functions are often lost in transportation projects where impervious road surfaces prevent rainwater from soaking into the ground. Incorporating green infrastructure into road and highway design can reduce or eliminate impacts to water bodies, as the volume reduction has the double benefit of reducing pollutant loads and avoiding erosion and sedimentation.

Examples of green infrastructure for road projects include:

- Bioswales or grassed swales—grassy areas on the side of the road that convey drainage; they can be designed to promote pollutant removal and infiltration of runoff.
- Rain gardens—landscaping features planted with vegetation that collect, infiltrate, evaporate, and transpirate runoff.
- Wetlands—whether natural or engineered, wetlands perform many of these same functions. In fact, a single acre of wetland holding a foot of water stores up to 330,000 gallons of water and filters pollutants such as oil, sediments, and chemicals.[16]

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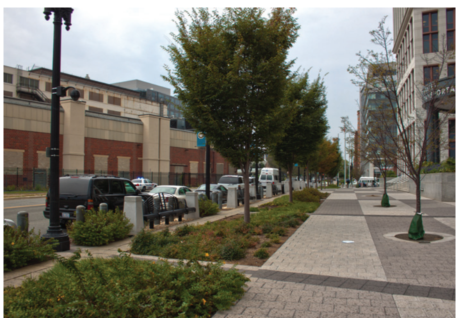

Bioswale in Washington, D.C.

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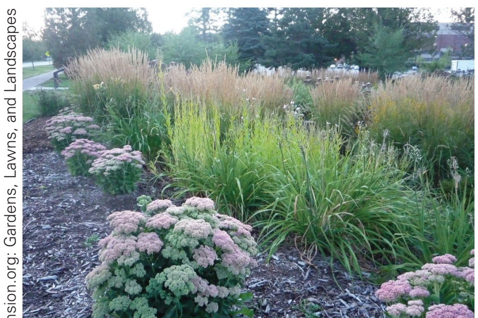

Rain Garden

© Gordon Joly

Barnes Wetland Centre in London, England

All of these practices are flexible in scale and can be designed to fit into small areas, allowing for incorporation into median strips and other areas close to roads and highways.

Green infrastructure can even be integrated into roads and highways themselves. In many instances, conventional asphalt or concrete can be replaced by permeable pavement, allowing stormwater to drain through its porous surface to a reservoir underneath, which temporarily stores the runoff before infiltrating it into the soil. While permeable pavement may not be suited for areas with high traffic volumes, it can be used in the construction of parking areas, emergency stopping areas, traffic islands, sidewalks, road shoulders, vehicle crossovers on divided highways, and low-traffic roads, and stormwater commonly can be directed to those areas.[17]

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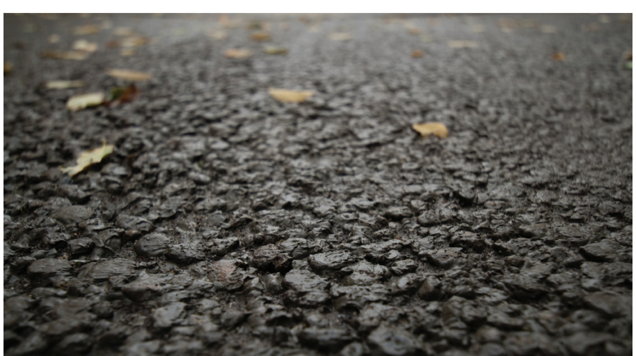

Porous Pavement

Studies have found that infiltration-based approaches reduce runoff volume by 73 percent to 99 percent.[18] Moreover, large reductions in runoff volume achieved through infiltration can dramatically reduce the pollutants carried to water bodies. In fact, infiltration basins and trenches provide the highest level of surface water quality protection of any BMP, as they infiltrate runoff directly into the ground and restore original hydrological conditions.[19] The California Department of Transportation assigns infiltration-based BMPs a pollutant removal rating of 100 percent because no water is discharged from them to surface waters.[20]

Additionally, many studies have demonstrated the effectiveness of grassed swales, which are one of the most common BMPs employed in the road and highway setting. Well-designed, well-

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Urban Heat Island Effect

The urban heat island effect is created when cities replace natural vegetated land cover, which has natural cooling effects, with pavement, buildings, and other surfaces that absorb and retain heat. As a result, cities are often a degree or two warmer than surrounding rural areas. By providing additional green space and vegetation, green infrastructure can help mitigate the effects of urban heat islands. Reducing these effects can create energy savings, reduce heat-related illnesses and mortalities, and decrease greenhouse gas emissions.

maintained swales may remove up to 70 percent of sediment, 30 percent of phosphorus, 25 percent of nitrogen, 50 percent to 90 percent of trace metals, and 67 percent to 93 percent of oil and grease.[21] One study found that concentrations of pollutants at a site without a grassed swale were substantially higher than at two sites where runoff passed through a swale before discharge.[22] Another study comparing 22 rainfall events over one and a half years found that grass swales achieve significant peak reduction, delay of peak flow, and reduction of total volume, along with statistically significant removals of various pollutants.[23]

In addition to effectively controlling the quality and quantity of stormwater runoff from roads and highways, green infrastructure provides a wide range of benefits that traditional stormwater controls cannot provide. Communities that use vegetation to infiltrate road runoff have found that bioretention offers ancillary benefits like improved aesthetics and urban heat island reduction. Swales can provide recharge to groundwater by infiltrating runoff, as well as creating or preserving wildlife habitat. Wetland systems also provide wildlife habitat while reducing peak runoff rates and stabilizing flow to receiving streams.

The U.S. Environmental Protection Agency (EPA) has found additional benefits from green infrastructure, such as improved air quality, as trees and vegetation absorb pollutants from the air; improved human health, as green space encourages physical activity and time spent outdoors; and increased property values for sites near green infrastructure.[24]

CONTROLLING POLLUTED ROADWAY RUNOFF IS TECHNOLOGICALLY AND ECONOMICALLY FEASIBLE

Thanks to the wide range of BMPs available for road and highway stormwater management, various controls can be combined cost-effectively to manage runoff in many different transportation settings. Some of the factors affecting the mix of controls suitable for use in a particular location include the type of proposed highway facility, the amount of land area available, local watershed conditions, soil characteristics, surrounding land use, storm frequency, and receiving stream characteristics.[25] When these factors make one type of BMP infeasible, other types can replace or supplement it in order to achieve full stormwater management on the site. For example, when Edmonston, Maryland developed a "green street" design for the town's main street, project managers evaluated the physical constraints of the street—including buried gas lines, narrow right-of-way, and high groundwater—when selecting BMPs. Where, for instance, street trees were impractical because of limited right-of-way space, permeable pavement was selected to control the remainder of the runoff.[26]

When an appropriate mix of BMPs is selected for a particular roadway, stormwater management practices can be installed without compromising the safety of the traveling public or of highway personnel.[27] Moreover, carefully selected BMPs can be put in place without causing any adverse effects to roadway function or pavement integrity.[28]

Managing stormwater runoff from roads and highways is not only technically feasible, but also economically feasible.[29] It is difficult to generalize regarding the precise cost of runoff controls, as stormwater treatment exhibits considerable site-specific variation resulting from different soil, topography, climatic conditions, local economic conditions, and regulatory requirements. Generally, though, the construction cost of any particular BMP will depend upon the volume of water the

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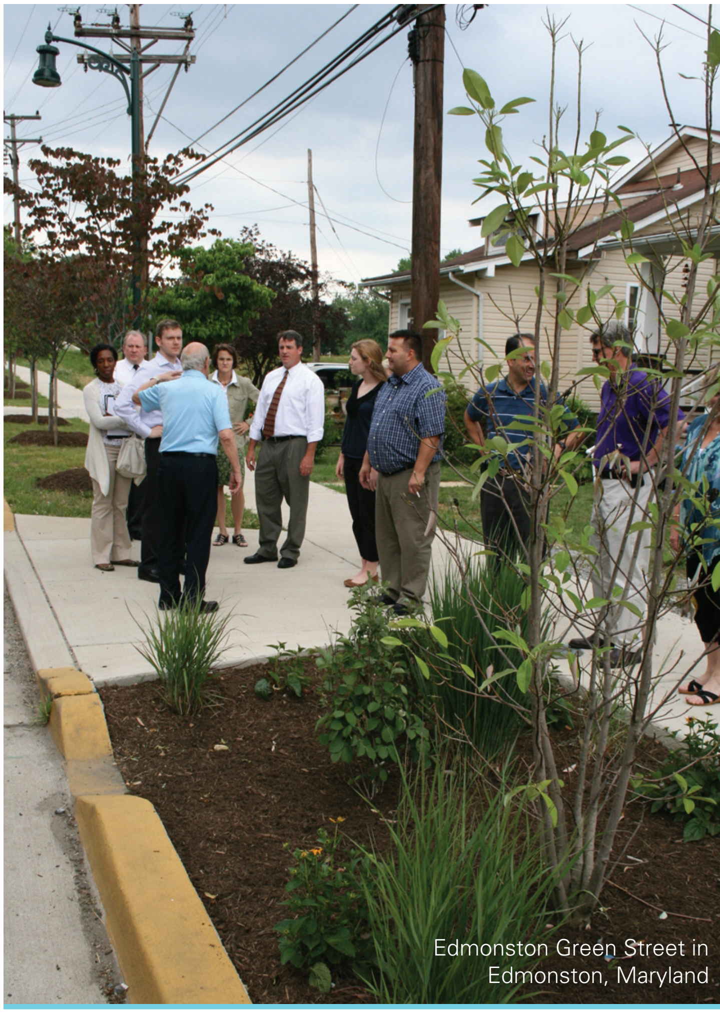

Edmonston Green Street in Edmonston, Maryland

Edmonston Green Street

The Edmonston, Maryland Green Street project, completed in 2010, transformed the small town's main residential street into a national model for roadway stormwater management. Prior to the project's completion, the town experienced years of devastating flooding due to poor stormwater management practices, and polluted runoff from the road fouled the neighboring Anacostia River. Now, Decatur Street features energy-efficient street lights, rain gardens of native plants, wider sidewalks, and bike paths, all while capturing and retaining the first 1.33 inches of rainfall from each storm. That means nearly 90 percent of all rainstorms in a typical year will be captured. Rain gardens treat 62 percent of the street's area, and the permeable pavement of the bike lanes treats an additional 28 percent.[a]

The project was completed in two and a half years and cost $1.3 million, funded through the American Recovery and Reinvestment Act.[b] The project provides many benefits beyond stormwater management to the town's 1,300 residents: a large tree canopy filters airborne pollutants and provides shade to decrease the urban heat island effect. The street also incorporates a "walking tour" of interpretative signs that describe the environmental features of the street to educate residents, students, and the public.

[a] Edmonston, Maryland Green Street website, http://www.edmonstonmd.gov/GoingGreen.html.

[b] Capital News Service, "Edmonston Goes Green with LED Lights, Rain Gardens" (Nov. 9, 2010), http://www.edmonstonmd.gov/GoingGreen-2.html.

practice is designed to treat. Construction costs may decrease for some, though not all, BMPs on a per-unit-of-volume basis as the overall size of the BMP increases. One Washington study found that stormwater management costs ranged from just 7.9 percent to 10.7 percent of total transportation project costs.[30]

The implementation of BMPs to treat stormwater runoff from highway infrastructure may be more expensive than the traditional "curb-gutter-sewer" approach, which does not aim to treat or manage runoff at all but rather simply transfers it from the roadway surface into receiving waters as quickly as possible. However, the use of stormwater BMPs provides additional benefits because of the removal of pollutants and protection of water quality, and therefore may have a net effect of being more cost-effective.[31] Cost-effectiveness of road and highway stormwater controls can be maximized by carefully selecting appropriate BMPs and by tailoring controls to specific water-quality goals.

Even "retrofit" BMPs—practices installed at existing roads and highways—are technically and economically feasible, especially when planned for in the early stages of reconstruction projects. Moreover, because the benefits of retrofit projects can be very high, as they are often designed to address specific pollution problems, the benefits may well exceed the costs.[32] This is particularly true in light of the fact that targeted improvements in water quality may reduce overall Clean Water Act compliance costs.

Overall, studies have shown a high degree of satisfaction with the function of highway stormwater BMPs and have not shown that their benefits are outweighed by costs.

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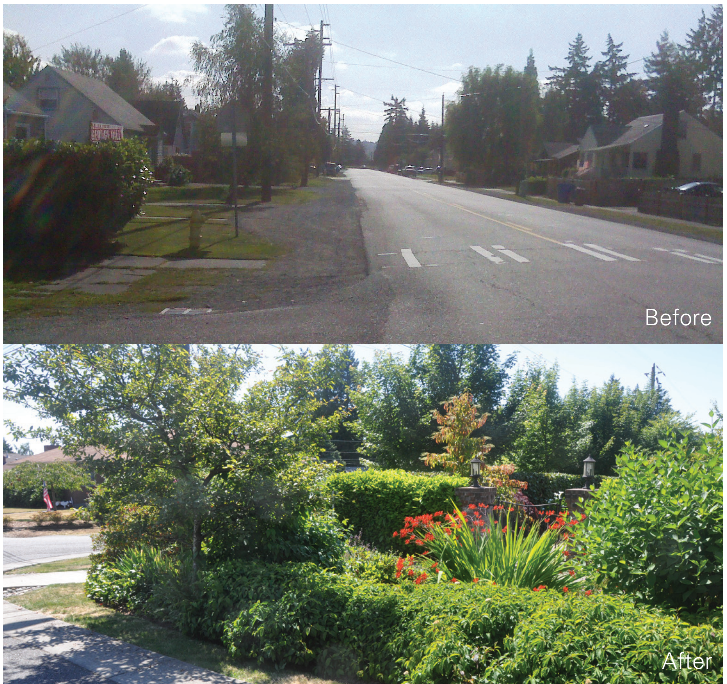

Seattle's SEA Street

Seattle's beautiful SEA project, completed in 2001, provides an amenity for neighborhood residents while also reducing runoff from the street by 99 percent.[a] Before the project's completion, stormwater poured off of roofs, driveways, and the street's surface, carrying polluted water into nearby Pipers Creek. To solve this problem and boost the street's retention capacity, Seattle retrofitted the residential block by reducing impervious surfaces to 11 percent less than a traditional street, installing swales to infiltrate stormwater, and planting more than 100 trees and 1,100 shrubs. Plant survival has been high in part because neighbors care for the plants within the right-of-way through weeding, mulching, and mowing.

The total project cost was $850,000, less than it would have cost to retrofit the street with conventional, non-green stormwater controls.[b] Moreover, the benefits of the street retrofit are numerous: local creeks and streams are protected from harmful stormwater runoff, and increased tree cover helps reduce summer heat and absorbs air pollutants. Residents also enjoy the more natural look of their surroundings, and pedestrians and cyclists enjoy safer conditions due to the traffic-calming effect of the new street design.

[a] Seattle Public Utilities, "Street Edge Alternatives," http://www.seattle.gov/util/About_SPU/Drainage_&_Sewer_System/GreenStormwaterInfrastructure/NaturalDrainageProjects/StreetEdgeAlternatives/.

[b] FEMA, "2nd Avenue SEA Street – Seattle, Washington," http://www.fema.gov/mitigationbp/briefPdfReport.do?mitssId=5246.

GREEN INFRASTRUCTURE CAN BE ESPECIALLY COST-EFFECTIVE AND TECHNICALLY FEASIBLE

Green infrastructure for roads and highways is both especially effective at managing the quantity and quality of runoff, and also a technically feasible alternative to traditional BMPs. Infiltration basins, infiltration trenches, and bioswales have all been found to be technically feasible depending on site-specific conditions.[33] Specifically, these techniques are all feasible as long as they are implemented at sites with appropriate soils, the impact on groundwater quality is considered, and the BMP design minimizes the risk of clogging. Swales are considered particularly feasible compared to other BMPs when limited space is available, as they can be easily sited in small spaces such as medians and shoulder areas. Moreover, swales and other vegetative surface controls have less rigorous maintenance requirements than traditional BMPs.

Using green infrastructure to manage stormwater runoff from roadways also has economic advantages. One study found infiltration devices to be among the most cost-effective BMPs because they provide significant pollution and volume control benefits with relatively low life-cycle costs. Similarly, that study found vegetated swales to be among the least expensive devices evaluated, yet among the best performers in reducing sediment and heavy metals in runoff.[34] Another study confirmed that swales are the least costly water quality BMP, with construction costs ranging from $5 to $15 per linear foot.[35]

On the whole, a comprehensive green infrastructure approach can make road and highway runoff control much more economical. One prominent project, the Seattle SEA (Street Edge Alternative) project, found that using green infrastructure to retrofit an existing street to control and infiltrate runoff saved 29 percent compared to retrofits using traditional BMPs.[36] Additionally, an overall "green" approach to meeting stormwater permit requirements in Los Angeles—including but not limited to controlling runoff from roads and highways—has been estimated to cost between $2.8 billion and $7.4 billion, as opposed to an estimate of $44 billion using conventional stormwater controls.[37] When these decreased costs are viewed in combination with the wide range of environmental, economic, and social benefits that green infrastructure offers, this approach becomes even more attractive.

LEGISLATORS AND EXECUTIVE BRANCH DECISION MAKERS SHOULD PROVIDE INCENTIVES TO CONTROL STORMWATER ROADWAY RUNOFF, PARTICULARLY BY USING GREEN INFRASTRUCTURE

Because controlling stormwater runoff from roads and highways provides so many benefits, government actors at the federal and state levels should invest in these controls and provide incentives and requirements for private parties to do so as well.

Congress should require new and rehabilitated roadways to meet a performance-based standard to reduce stormwater runoff pollution

Congress periodically passes bills that fund and authorize federal surface transportation projects. These projects include interstate highways, transit systems around the country, bicycling and pedestrian facilities, and freight rail operations. The most recent federal transportation bill, the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU), was signed into law in 2005 and is due to be renewed.[38] Congress is now preparing to debate a new multi-year bill that will authorize funding for new and ongoing projects, which provides a major opportunity to address runoff pollution from highways and roads.

The new transportation bill should contain provisions requiring all new and rehabilitated federally-funded roads to meet a performance-based standard to reduce stormwater runoff pollution. In other words, the bill should require roadway projects to retain a certain amount of the runoff that their impervious surfaces generate. As an example of such a performance standard, Congress previously required certain federal facilities to maintain the "predevelopment hydrology" of the site in conducting specified development projects.[39] That means that the project must maintain the combination of runoff, infiltration, and evapotranspiration rates and volumes that existed on the site before human-induced land disturbance occurred. This kind of approach could serve as a model for transportation legislation, and Congress should require any retention standard to be met using green infrastructure whenever feasible.

If Congress delays in passing a comprehensive transportation bill or if it acts on a bill lacking needed stormwater standards, it should pass stand-alone legislation requiring federally funded roads and highways to control runoff pollution to an objective retention standard. Senator Ben Cardin (D-Md.) has introduced such a bill, the STOPS Runoff Act (S. 898), which would require new highways and highway improvement projects to maintain or restore the predevelopment hydrology of the project site to the maximum extent technically feasible.

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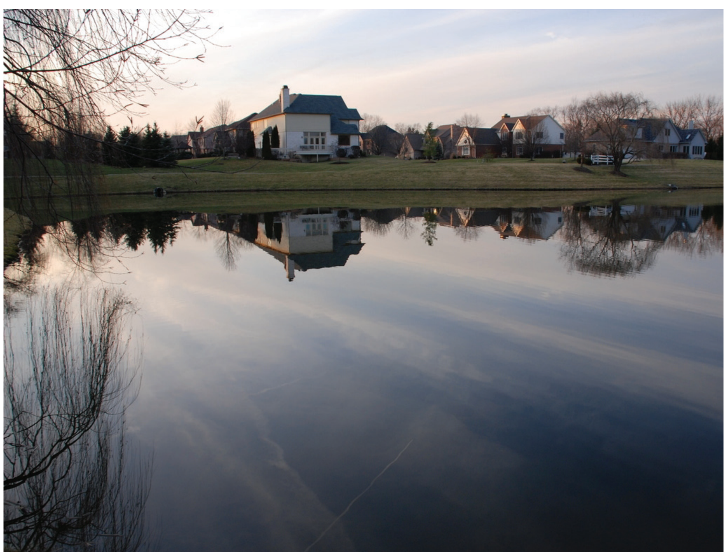
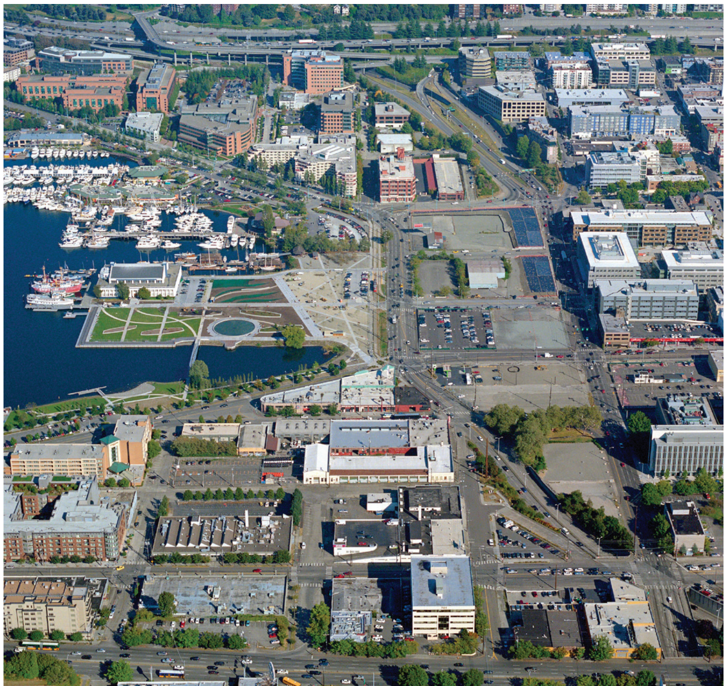


Retention Pond in Indiana

Federal agencies should create incentives and requirements for road and highway projects to control polluted runoff under current law

Federal agencies should exercise their current authority to require stormwater controls for roads and highways. The U.S. Department of Transportation (DOT), for example, should create funding incentives for projects that help to control polluted roadway runoff. The agency currently participates in several grant programs that fund transportation and infrastructure projects; those grants should be awarded to projects that control runoff using green infrastructure techniques that provide a wide array of benefits to communities.

For instance, the DOT participates in the Partnership for Sustainable Communities along with the EPA and the U.S. Department of Housing and Urban Development (HUD); that Partnership awards grants to support livable and sustainable communities. The Partnership's grants include DOT's Transportation Investment Generating Economic Recovery (TIGER)



Mercer Corridor Project in Seattle, Washington

grants, which are awarded on a competitive basis for capital investments in surface transportation projects that will have a significant impact on the nation, a metropolitan area, or a region. Since the TIGER grant program began, only a few projects have received funding to implement green infrastructure. One of those projects is the Mercer Corridor project in Seattle, which will use TIGER grant funds to reduce Mercer Street's impervious area by 0.7 acre, install natural drainage using a "wet median" and rain gardens, and increase the tree canopy along the corridor.[40] In the future, more TIGER grants should be directed to road and highway projects that propose to control their stormwater runoff pollution through green infrastructure.

Additionally, the EPA should include roads and highways within the scope of its new nationwide rulemaking addressing stormwater runoff from developed sites. This new rule, currently under development by the agency, will establish a program to reduce stormwater discharges from new development and redevelopment and make other regulatory improvements to strengthen the national stormwater program.[41] The rule should cover runoff from transportation projects, as roads, highways, and bridges are significant contributors of pollutants to our nation's waters. In the meantime, before the new rule is promulgated, EPA should require green infrastructure in Clean Water Act permits issued to state departments of transportation as a means of complying with their existing legal and regulatory obligations.

Some states' departments of transportation have expressed concerns to the EPA regarding their potential coverage under the new stormwater rule. Primarily, they argue that linear transportation projects are sufficiently dissimilar from other developed sites due to limited space in the right-of-way that they should not be subject to the same stormwater control requirements.[42] Depending on the particular location of the transportation project and local conditions, these may be valid concerns, but they can be effectively addressed by the rule without exempting transportation projects or weakening the performance standard for such facilities. For example, the EPA might allow stormwater control requirements to be met offsite within the same watershed in cases of technical infeasibility.

States should direct available resources toward projects that include stormwater controls to receive maximum environmental benefits from their investments

States spent $120 billion on transportation expenditures in 2009; federal contributions accounted for only 30 percent of that total.[43] With states spending billions of dollars in revenue on transportation projects, they should ensure that they receive the maximum benefit from their investments by ensuring that projects avoid generating costly stormwater pollution, and by encouraging the use of green infrastructure that improves communities' quality of life. This result can be accomplished by directing funds toward high quality projects that incorporate stormwater runoff controls, as well as by including requirements in state transportation agencies' stormwater permits to control runoff by using green infrastructure. The Washington State Department of Transportation has already recognized the benefits of green infrastructure: the state's highway runoff manual provides recommendations for integrating low impact development and other green approaches into the design of state highway projects.[44] Other states should follow Washington's lead in order to achieve maximum economic, environmental, and community benefits for their citizens.

ENDNOTES

1 For a discussion of road and highway pollutants and their sources, see generally American Association of State & Highway Transportation Officials (AASHTO), "State-of-the-Practice Report: Source Control" (2011); Washington State Department of Transportation (WSDOT), "Untreated Highway Runoff in Western Washington" (2007); East-West Gateway Coordinating Council (EWGCC), "Highway Runoff and Water Quality Impacts" (2000).

2 EWGCC, supra note 1, at 3.

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