

Sound WAVES

LOW IMPACT DEVELOPMENT PRACTICES— NEW TOOLS TO MANAGE STORMWATER

Stormwater engineers are always on the lookout for better ways to manage stormwater. It may be a new storm drain insert, a high efficiency street sweeper, or a chemical flocculant to better control erosion at construction sites. An especially promising new set of practices is, as they say, as old as the hills. These practices allow nature to manage stormwater in its own way, as it's done for millennia. This issue of *Sound Waves* is dedicated to the innovative stormwater management techniques known as low impact development, or LID, practices.

The Puget Sound Water Quality Action Team is actively promoting the appropriate use of LID practices. The Action Team presented **Low Impact Development in Puget Sound**, a two-day conference in June where almost 400 elected officials and their staff, members of the development community, stormwater engineers and other professionals learned more about LID practices. Post-conference surveys indicate that the conference was a success, and today more communities and businesses around the Sound are adding LID to their toolbox of stormwater management techniques.

What is low impact development? In a nutshell, it's a back-to-nature approach that eschews traditional collection and conveyance structures in favor of natural areas that treat and infiltrate stormwater on the development site. Originally

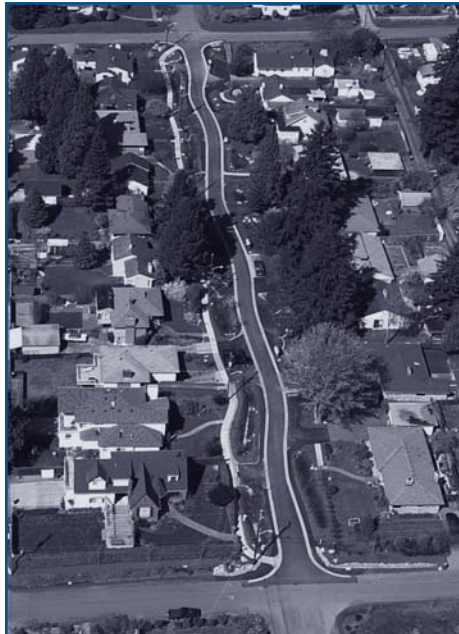


Photo courtesy of Seattle Public Utilities
*Growing greener and protecting area streams.
The Street Edge Alternatives Project on 2nd
Avenue NW in Seattle.*

developed by Prince Georges County, Maryland, the list of potential LID practices is long and includes landscaped rain gardens, permeable pavement, narrower roads and rain barrels. Turn to page 2 for the nuts and bolts of LID and why it's important for Puget Sound.

To illustrate how LID can be used in communities, we invited three professionals to share their current projects and ideas with us (pages 4-5). The City

of Olympia is looking at LID practices to help them protect their most environmentally sensitive watershed. Pierce County is revising its stormwater and development regulations to include LID. And the City of Seattle redesigned a neighborhood street to better protect an area stream and to make the neighborhood greener.

We showcase recent science in stormwater management on page 6. The Center for Urban Water Resources Management at the University of Washington recently completed a three-year study on the rehabilitation potential of urban streams in the region. The study focused on streams in King and Snohomish counties that have been altered by the effects of development. We read the study findings to be yet more evidence that development continues to degrade our region's streams, despite our use of conventional stormwater management practices. It is therefore critical that we use all available tools to protect our water resources, from innovative techniques such as LID to local land use planning.

The *Stormwater Management Manual for Western Washington*, which guides stormwater practices in Puget Sound, has been updated and now contains incentives to use LID practices. Turn to page 7 to find out more.

We hope you enjoy this issue of *Sound Waves*. Be sure to check out our web site for more information on LID.

The Puget Sound Water Quality Action Team and its advisory arm, the Puget Sound Council, were created by the Washington State Legislature to lead efforts to protect Puget Sound.

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LID: HELPING TO PROTECT OUR WATERS AS WE GROW

By Bruce Wulkan,
Stormwater Program lead

What is Low Impact Development?

Low impact development, or LID, is an eco-friendly approach to land development and stormwater management designed to reduce impacts on watershed hydrology and aquatic resources. (Watershed hydrology is the relationship between rainfall, evaporation, groundwater infiltration and flow of surface water.)

LID is based on the premise that nature knows best. Forests and other natural areas are extremely effective groundwater recharge areas. For example, there is very little runoff in a forested area—most rainfall infiltrates to the ground, is taken up by vegetation, or evaporates to the atmosphere. So rather than collecting and conveying stormwater off site through pipes and other conveyance systems, LID-designed sites use vegetation and small-scale hydrologic controls to capture, treat and infiltrate stormwater on site. This helps maintain the natural hydrology as it undergoes development.

To design using LID, a developer maps the site's natural runoff patterns and sets aside all sensitive areas and natural drainages, such as streams and wetlands. A portion of the site's trees and other native vegetation is also set aside. The remainder of the site is the development envelope. Specially designed landscaped areas (called bioretention cells, or rain gardens) capture, filter and infiltrate stormwater. Developers design narrower roads and use permeable pavement for parking lots, driveways and other impervious surfaces. Runoff is directed from remaining impervious surfaces—such as rooftops—onto vegetated areas with porous soils. Rooftop design can also include roof gardens, which

further retain and slowly release stormwater. Soils compacted during construction are amended with compost or other organic material to restore their capacity to infiltrate runoff and grow healthy plants.

When combined with effective local land use planning (see article on page 7) and watershed or basin planning, LID can help protect watershed hydrology and aquatic resources as we grow. (Note: Because infiltration rates vary among development sites, depending on soils, topography and other factors, each site should be assessed to determine which LID practices are most appropriate. Given the wide range of practices available, every site should include at least a few of the practices.)

► Why is LID important?

Studies show that our efforts to mitigate the effects of development through traditional stormwater management practices have not proven entirely successful. (See page 6 for the results of one such study.) Collection and conveyance systems, stormwater ponds and other traditional stormwater facilities do not replicate natural systems, which greatly slow water before it reaches streams, wetlands and other waters. The loss of trees and other vegetation, the compaction of soils by heavy equipment, the creation of vast stretches of connected impervious areas—all these factors combined are extremely difficult to compensate for using traditional practices.

The result? Stormwater runoff has significantly degraded many streams in Puget Sound. Habitat loss is documented as one of the factors limiting our ability to recover salmon under the Endangered Species Act. A multi-year study in King

County showed that amphibians and birds in wetlands are threatened more by excessive fluctuations in water levels (due to stormwater) than by water pollution. Stormwater alters the hydrology of Puget Sound's watersheds, which affects our region's streams and wetlands (and potentially our drinking water supplies).

► Other benefits of LID

In addition to better protecting the environment, low impact development also provides economic and community benefits. Developers using LID practices potentially increase developable land by reducing size requirements for stormwater ponds. Reduced stormwater drainage facilities can result in lower infrastructure costs. And stormwater utility fees may be lower due to the reduced amount of impervious areas.

Local governments and communities benefit by better protecting streams and habitat for endangered salmon, shellfish growing areas, and other natural resources. As neighborhoods, homes and businesses grow greener, they become more attractive and property values can increase. Stormwater facilities can be easier to oversee and less costly to maintain. Drinking water supplies can be better maintained. And low impact development provides new tools for cost-effective retrofit as well—something that concerns many communities.

► Community action on LID

Many communities around Puget Sound and around the nation are using low impact development. We highlight three jurisdictions' activities in a Q&A section on pages 4 and 5. The Puget Sound Water Quality Action Team encourages all cities and counties in Puget Sound to learn more about and use these innovative practices.

NEWS FROM AROUND PUGET SOUND

LOW IMPACT DEVELOPMENT AROUND THE SOUND

Whatcom County

When **Boundary Bay Brewery** in Bellingham made plans to rebuild their gravel parking lot, they did it with their business plan and the environment in mind. The brewery called on 2020 ENGINEERING (www.2020engineering.com) to design a surface that would accommodate employee parking in the winter (most employees ride their bikes during the summer) and outdoor events in the summer. Using GRASSY PAVERS™ (<http://www.rkmfg.com/grassy-pavers.html>), the engineering firm designed a functional and attractive surface that supports vehicular loading while helping to infiltrate and treat surface runoff at the site. Although initial costs are higher than traditional approaches, the return on investment will be positive because of the site's multi-use features and anticipated savings in the business's stormwater fees. Contact: Janet Lightner, Manager, Boundary Bay Brewery, (360) 647-5593, bbaybrewery@uswest.net, or Chris Webb, PE, 2020 ENGINEERING, (360) 671-2020, chris@2020engineering.com.



Photo courtesy of Chris Webb

Installing GRASSY PAVERS™ at Boundary Bay Brewery parking lot.

Thurston County

Every jurisdiction in Western Washington has to manage its stormwater. What each one chooses to do—and how it funds planning and implementation—varies with its size, location and circumstances. For **Yelm**, in rural Thurston County, major floods in 1996 and 1997 catalyzed this community to action. Faced with an array of water quality, habitat and flooding issues, the town turned to Washington State's Flood Control Assistance Account Program (FCAAP). Administered by the Department of Ecology, FCAAP assists jurisdictions with comprehensive planning and flood control maintenance (see <http://www.ecy.wa.gov/programs/sea/grants/fcaap/intro.html>). With FCAAP funds, Yelm hired a consultant to develop the Yelm Creek Comprehensive Flood Hazard Management Plan and to conduct public involvement activities and consulta-

tions with other agencies. The city council has adopted a draft plan, including a comprehensive stormwater program, and is preparing it for publication. For information, contact Cathie Carlson, Community Development Director, (360) 458-8408.

Pierce County

The Department of Ecology has awarded a Centennial grant to the **Tacoma Housing Authority** (THA) for a low impact development feasibility study for Salishan, a 200-acre public housing project in Tacoma, the largest public housing project in the country. The goal of the project is to show how stormwater runoff can be eliminated through land use design. Salishan's redevelopment would also demonstrate that watersheds and streams hard hit by urban runoff can be restored. Swan Creek, the receiving waters, has suffered destruction of habitat because of stormwater. Salishan could be the first step in Swan Creek restoration. The Tacoma Housing Authority will show how site and structure design can eliminate stormwater ponds and outfalls. THA will consider means to disconnect impervious surfaces from the stream including narrow, curbsless roads, under-structure parking, and roof runoff collection systems or garden roofs. THA will also study pervious pavement systems for roads and parking areas. Restored forested areas will absorb runoff wherever possible. Contact: Tess Colby, THA, (253) 207-4433 or Tom Holz, SCA Consulting Group, (360) 493-6002.

Island County

Island County encourages builders and developers to use low impact development techniques in a number of ways. For example, the county offers a menu of adopted stormwater management manuals from which to choose, including that of Maryland's Prince Georges County, which emphasizes the use of LID. The county also has adopted the Department of Ecology's stormwater management manual (see page 7) and Kitsap County's manual. Builders and developers also have a number of financial incentives to use LID. For example, if a developer intends to use LID for a commercial development, he or she needs only to provide the county with a narrative description of the plans to obtain project approval. No surveying, engineering, or pre-planning design work is required at that preliminary stage. The developer commits to not disturb the site until full plans are submitted and approved, so engineering costs are deferred until a later phase. Contact Phil Cohen, Surface Water Manager, (360) 679-7331.



Puget Sound Water Quality Action Team Local Liaisons:

Island and Snohomish counties:

Joan Drinkwin, (360) 848-0924

Thurston County:

Tim Ransom, (360) 407-7323

Mason, Whatcom, and Skagit counties:

Stuart Glasoe, (360) 407-7319

San Juan County:

Ginny Broadhurst, (360) 738-6122

Clallam, Kitsap and Jefferson counties:

Harriet Beale, (360) 379-4441

Pierce and King counties:

Kathy Taylor, (206) 263-6344

Kitsap County

Kitsap County is developing a plan for the Chico Creek watershed using an **Alternative Futures** approach. This approach first assesses watershed conditions and develops models for the impacts of development on natural resources, then involves the community in developing and selecting preferred land use alternatives. Low impact development techniques are considered as methods to reduce impacts to natural resources. The Chico project, funded in part by the Action Team with EPA funding and technical support from University of Washington scientists, is currently conducting a watershed assessment. In addition, an Education Work Group will educate and prepare the community for the planning process. When the assessment is complete, community residents will help develop alternative futures scenarios and make recommendations to the Kitsap County and City of Bremerton Planning Commissions. The recommendations will look at land uses that are compatible with resource protection, as well as low impact development techniques suitable for local conditions. Contact Paul Nelson, Kitsap County, (360) 337-4653 or pnelson@co.kitsap.wa.us

Q&A ~ Stormwater and LID

Two case studies conducted by Prince Georges County, Maryland, and the Southwest Florida Water Management District demonstrate the potential to use low impact development practices in either new development or as part of a retrofit project.

The first study, in **Largo, Maryland**, documented the efficiency of a bioretention cell (or rain garden) in removing pollutants from a 5-acre outdoor parking lot. A landscaped island measuring 38-foot long and 12-foot wide was constructed using a combination of sand, topsoil and compost. The island was then landscaped with assorted plants. A smaller rain garden was also constructed in a laboratory to confirm the results.

Summary and Benefits: The rain garden performed well, reducing pollutants from a one-half acre of impervious parking lot. Metals such as lead and zinc, phosphorous and ammonia/organic nitrogen were reduced by at least 67 percent. Dissolved copper was cut in half. In addition, the bioretention retrofit proved extremely cost-effective, costing only \$4,500. This compares very favorably to proprietary devices that cost significantly more. The rain garden also made the parking lot more attractive.

Study site in Largo, Maryland.

Photo courtesy of Larry Coffman



For this issue of *Sound Waves* on stormwater and low impact development, we asked three professionals in the region who work with LID to share their current activities and ideas.

- **John Arnesen** is a project manager with Seattle Public Utilities.
- **Andy Haub** is a project manager with the City of Olympia's Water Resources Program.
- **Curtis Hinman** is an Extension faculty member with Washington State University and a Puget Sound Water Quality field agent.

Sound Waves: What activities related to low impact development are you involved in?

John Arnesen. My work is related to the Street Edge Alternatives project on 2nd avenue NW and NW 117th street (see photo on cover). Seattle is looking at alternatives for providing street and drainage improvements to residential areas. Our intention is to design a more natural street and drainage system to lessen the impact of stormwater runoff to the surrounding area and to creeks downstream. We set the typical design guidelines aside and, working with residents, created a street design that met their needs. We designed the street as an inviting pedestrian environment while calming traffic. We reduced pavement area to create a more natural drainage system and landscaped the entire space with more than 100 trees and 1,000 shrubs (two-and-a-half times a typical street improvement). More information can be found at <http://cityofseattle.net/util/urbancreeks/SEAstreets>.

Andy Haub. Olympia is requiring the use of low impact development techniques in Green Cove basin, our highest-value aquatic habitat. Nearing conclusion, the 18-month effort investigated the feasibility of requiring the techniques in residential developments. We now understand the environmental, technical, financial, legal and social implications of low impact techniques. As a result, we are better able to explain the many competing community issues associated with the techniques.

Olympia established a residential low impact zoning district with allowable housing densities of two to four units per acre and maximum impervious coverage for lots of 2,500 square feet. Aside from zoning requirements, most of the regulations apply to publicly owned areas of a development rather than individual lots. For example, dedicated tree tracts will encompass 55 percent of a subdivision. Street widths of 18 feet will provide limited on-street parking. Stormwater will infiltrate in roadside rock and pipe galleries before discharging to stormwater ponds. Overall, we will reduce impervious surface coverage of new subdivisions by

50 percent. The regulations are enacted through changes to Olympia's comprehensive plan, *Unified Development Code, Development Guidelines and Public Works Standards*, and drainage manual.

Curtis Hinman. WSU Cooperative Extension and Pierce County are collaborating to incorporate low impact development into the county development process. Efforts are focused on four areas:

- Incorporate a low impact development chapter into the Pierce County stormwater manual.
- Develop an LID guidance manual applicable to the Puget Sound region and targeted at planners, engineers, landscape architects, developers, and builders.
- Develop incentives to encourage LID projects (possibly including a streamlined permit review process and reduced permit fees).
- Design and implement LID projects to demonstrate site planning, stormwater management practices, hydrologic performance, costs and benefits, and marketability.

I am also doing presentations around Puget Sound to educate local governments, the development community and citizens on LID principles and applications, and I'm working with WSU researchers and others to evaluate the hydrologic and pollutant reduction performance of bioretention designs.

SW: Why are you using low impact development?

Arnesen. Developing and experimenting with low impact development options is necessary at this time for many reasons. The way we have done things in the past is not working; we are seeing now that the long-term cumulative impacts are more than the natural environment can accommodate. It makes sense at this time to create systems that use the natural processes that have been created over eons to help manage human impacts to ecosystems. Because we have failed in the past to protect our environment, regulations now say that we have to change our ways and design improvements to avoid additional impacts.

Haub. We hope to maintain a viable biological community in Green Cove creek while accommodating urban-scale development. It's an ambi-

tious goal. We know that low impact techniques are the essential first step in the effort. With our regulations, we are making a meaningful, incremental step toward minimizing environmental impacts while maintaining urban services and public safety. Additional efforts are necessary if we want to ensure protection of the creek system. Homeowner education, stormwater retrofits, and technology advancements are also critical needs.

Hinman. Research shows that current stormwater management strategies (conveyance and pond technologies) often do not protect streams and wetlands from increased water volumes discharged from urban landscapes. Maintaining predevelopment stormwater volumes, flow frequencies and durations will be difficult at best and impractical at worst with the excessive loss of native vegetation and soils under current development standards. New design standards will require larger ponds and therefore large percentages of land designated for stormwater management within the development. To better manage stormwater we need additional tools. LID principles and strategies set a higher standard of protection than current regulations and focus on maintaining more natural hydrologic pathways through small-scale (less expensive) stormwater controls to meet those standards.

SW: What benefits do you hope to achieve using low impact development?

Arnesen. We hope to show that we can have cities and preserve our natural environment at the same time. By designing the street and drainage improvements to meet multiple needs, instead of just one, we work toward a more sustainable environment while providing needed infrastructure. We will reduce the impact of stormwater to Pipers Creek by reducing impervious surfaces, detaining the larger storm events on site and slowing discharges to the creek. Water quality will be improved by filtering stormwater through vegetation and soil. The idea that the enhanced street serves a higher purpose—to save salmon—will protect the public welfare directly and indirectly.

Haub. Our work is directly tied to urban stream research by the University of Washington. We hope to protect overall aquatic habitat rather than a single endangered species. We also anticipate more appealing subdivision designs.

Hinman. In Pierce County we hope to better protect streams, lakes and wetlands for fish and wildlife, domestic water supplies, and recreation. Low impact development can and should address other livability issues such as:

- Road design that promotes walking and biking as alternative transportation methods and reduces traffic speeds.
- Development that meets state Growth Management Act requirements and public

transportation use goals.

- Subdivision layout and building design that promotes interaction between neighbors and connection to open space and recreation.

Maintaining aquatic habitat, water quality, species of special concern and healthy aquatic systems requires protection or restoration of processes (i.e. movement of energy and materials) at the watershed scale. Accordingly, LID must be integrated with watershed and regional planning to effectively protect water quality and aquatic habitat.

SW: Is low impact development cost-effective?

Arnesen. It is definitely cost-effective. We have constructed a system that meets multiple needs with an aesthetically inviting product. The final evaluation of the benefits of a more natural system will not be known for several years. If the objective is environmental balance, it's hard to improve upon nature, and it would be a mistake to overlook what nature has designed over eons of evolution.

Haub. Although more costly, these techniques are effective. Without proven methods or biological models for restoring degraded urban habitats, low impact techniques are the only means available to better protect our community's habitat. And protection is more cost-effective than attempts at restoration.

Our engineering and market analyses conclude that low impact techniques are more costly than conventional development. The increased costs reflect infrastructure costs (roads, stormwater, sewer and water) as well as the larger lot sizes and tree tracts requirements. Using additional techniques (e.g. porous pavements, water reuse systems) entail substantial costs, but further increase environmental protection.

Hinman. The cost-effectiveness of any stormwater management strategy depends on the physical setting and goals. Low impact development can reduce development infrastructure and, therefore, development costs in many settings. Where soil conditions, topography and zoning densities are particularly difficult for stormwater management, LID costs may increase over standard stormwater controls given the higher standard of protection. However, costs for LID and standard management practices will likely equalize on the difficult sites when new state stormwater regulations are implemented in Western Washington.

LID AT WORK

The second study, at the **Florida Aquarium in Tampa, Florida**, compared the pollutant removal efficiency of LID practices to conventional stormwater practices in an 11.5-acre outdoor parking lot. LID practices included bioretention cells, perimeter bioretention swales and permeable pavement. A total of 30 storm events were monitored for one year during 1998-99. Samples were taken at the LID and conventional practice portions of the site and analyzed for peak runoff rate, runoff volume and water quality.

Summary and Benefits:

The parking areas controlled by LID practices showed a significant reduction in runoff volume, peak runoff rate and pollutants. The most significant reduction in pollutants came from porous pavement used in conjunction with bioretention swales located around the parking lot perimeter. Pollutants such as ammonia, suspended solids, copper, iron, lead, manganese and zinc, were all reduced by at least 75 percent.

For a copy of a fact sheet on these studies visit the Action Team's web site at www.wa.gov/puget_sound. Follow the link to Low Impact Development.

For the printed version, call Gigi Williams at (360) 407-7311.





PUGET SOUND'S HEALTH

The Puget Sound Ambient Monitoring Program (PSAMP) is a coordinated effort among state and federal agencies to measure the health of Puget Sound's waters and resources. The program complements monitoring by local governments and citizen volunteers.



URBAN STREAM REHABILITATION IN THE PACIFIC NORTHWEST— PHYSICAL, BIOLOGICAL AND SOCIAL CONSIDERATIONS

By Derek Booth, Director,
Center for Urban Water Resources
Management, University of Washington

► INTRODUCTION

Most urban streams in the Pacific Northwest have been altered and no longer resemble their natural state. Efforts to restore urban streams and waterways are well-meaning, but the process for selecting rehabilitation sites often lacks critical information necessary to ensure that the most appropriate sites are chosen, that rehabilitation approaches are appropriate, and that project objectives will actually be met. A recently completed study by the Center for Urban Water Resources Management at the University of Washington offers a strategy for more effective stream rehabilitation.

The goal of the study, which began in the spring of 1997, was to identify the factors that degrade urban streams and to assess how well rehabilitation efforts could improve stream conditions in an urban landscape. The study blended knowledge from the physical, biological, and social sciences by:

- Documenting the effects of urban development on urban streams.
- Understanding the causes of ecological degradation.
- Using that understanding to evaluate rehabilitation strategies and techniques.

► METHODS

Forty-five sites from 16 Puget Sound lowland streams were selected that share the following characteristics:

- Watershed area between 10 and 40 square kilometers.
- Channel gradient (i.e., slope) between 0.5 and 2.0 percent.
- Soils, elevation, and climate typical of the central Puget Lowland.
- Major source of human disturbance is urban development.

We used methods that explore the nature and causes of change to aquatic-

system health across a range of human activity, from nearly undisturbed to highly urbanized. We used a traditional measure of land cover (total impervious surface) but explored its limitations in detail. We conducted hydrologic analyses at 11 sites. To measure aquatic-system health, we used a recognized measure of instream biology, the Benthic Index of Biotic Integrity (B-IBI). We also conducted a detailed assessment of citizen attitudes toward their neighborhood streams.

► FINDINGS

Causes and Assessment of Degradation

Any human action that alters critical components of a stream system has the potential to harm the conditions within the stream. Thus streams can become unhealthy in many different ways. One consequence is that ambient stream conditions must be assessed directly, especially in biological terms. Biological information must be integrated with surveys designed to identify site-specific stressors. Our focus in this study on one aspect of the aquatic system—stream flow—demonstrated the importance of this element, but this emphasis does not diminish the need for broad, comprehensive assessment.

Any given level of watershed urbanization will influence the flow of different streams differently, due to the unique characteristics of that watershed (e.g., geology, soils, topography, channel network) and because of interactions of flow with other stream features.

No single assessment (such as the amount of impervious area in the watershed) can adequately predict stream flow or the effects of changes in flow on stream conditions.

Rehabilitation, even with the best analysis and effort, will not produce the same biological results in every stream, because even a "rehabilitated" stream will not be the same in every watershed or interact with other environmental fac-

tors in the same way. Every stream cannot be made equally healthy.

A Strategy for Successful Rehabilitation

The multiple effects of urban development on stream systems make rehabilitation progressively more difficult in more urban watersheds. Because of this, rehabilitation projects are most likely to be successful in watersheds with relatively low levels of development that display paradoxically poor biological and/or physical conditions.

Rehabilitation is least likely to produce improvements in highly developed watersheds. This is based on the fact that neither this study nor other previous studies in the Pacific Northwest (or elsewhere in the country) have found very good biological/physical conditions in highly urbanized watersheds.

Furthermore, streamside residents have a greater direct influence than governments on whether healthy stream conditions are maintained, because most of the riparian corridor is not under public ownership or control.

Based on these observations, the center offers the following strategy and recommendations for effective stream rehabilitation:

- Recognize and preserve high-quality, low-development watershed areas.
- Systematically and comprehensively evaluate stream conditions in areas of low to moderate development. Aggressively rehabilitate streams in these areas, where recovery of ecosystem elements and processes is possible and sources of degradation are easier to identify and correct.
- Rehabilitate selected areas of mid-range urban watersheds, where complete recovery is not feasible but where well-selected efforts may yield direct improvement, particularly on public lands. Improve the most degraded streams by first analyzing the acute cause(s) of degradation,

Continued on next page

NEW ECOLOGY STORMWATER MANUAL PROMOTES LID

By Ed O'Brien and Tony Barrett,
Department of Ecology

The Washington State Department of Ecology has just published the *Stormwater Management Manual for Western Washington*. The manual offers a guide for communities and businesses in western Washington to meet federal and state requirements. The new manual uses technically current information to provide better protection of water resources.

For more information on the manual, visit Ecology's Stormwater Web site:

<http://www.ecy.wa.gov/programs/wq/stormwater>

The new manual promotes low impact development (LID) techniques in several ways:

► **New flow control standard is a disincentive to standard development practice.** Depending upon the soil

conditions and whether the site historically was forested or prairie, a detention pond to serve a standard residential development of four homes per acre can be from 1.4 to 4 times larger than required by the old standard. That translates into loss of building lots if the developer uses standard development practices.

► **Size thresholds and drainage analysis procedures encourage reduction in impervious surfaces and landscaped areas.** The manual will include a new set of size thresholds and use of a new drainage analysis procedure for determining whether construction of engineered structures for flow control and treatment are necessary. The approach should encourage retention of natural drainage features. It will allow even the largest projects to apply sim-

ple, lower cost on-site best management practices to manage stormwater from small areas of the project that have their own natural drainage away from the project site.

► **Hydrologic modeling program has incentives to encourage LID.** To comply with the new flow control standard requires the use of continuous simulation runoff modeling. Knowing that we need the aggressive application of LID techniques to protect western Washington streams, the model gives credit for using certain types of LID techniques. Ecology hopes that more developers will use LID techniques when they see how much smaller their detention ponds can be.

LID techniques that reduce the size of flow control facilities include:

- Undisturbed and protected

natural vegetation and soil topography and profile.

- Reduced road widths and lengths, smaller driveways, and homes with smaller footprints.
- Roof runoff infiltration or dispersion through > 50 feet of vegetation.
- Use of porous pavers and permeable interlocking concrete.

For residential developments preserving 65 percent of a site in forest and having less than 10 percent impervious area, whose runoff is routed into that forest, no flow control is necessary.

For more information contact Ed O'Brien at eobr461@ecy.wa.gov; (360) 407-6438 or Tony Barrett at tbar@ecy.wa.gov; (360) 407-6467.

URBAN STREAM REHABILITATION

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recognizing that the potential for full biological restoration is minimal.

- In the most highly developed watersheds, education and/or community outreach is crucial.

Other recommendations that are already part of stream-enhancement strategies in many areas are well-supported by our data:

- Develop a long-term goal of mimicking the full range of natural hydrology and processes rather than simply addressing peak flows and low in-stream flows. The hydrologic consequences of urban development cannot be reversed without extensive re-development of urban areas.
- Localized patches of healthy riparian corridor are effective in maintaining biological integrity, but that effectiveness varies with basin-wide urbanization. Where overall basin development is low to moderate, natural riparian corridors can maintain or improve biological conditions, but in highly urban watersheds healthy riparian corridors alone cannot protect stream biology.
- Develop approaches to address the unanticipated consequences of human actions on streams in the name of backyard improvements. Regional and national efforts now fall short in this regard.

► MORE INFORMATION

For more information, including a copy of the study's final report, visit the Center for Urban Water Resources Management's web page at: <http://depts.washington.edu/cuwrn>.

LIMITATIONS OF LID AND THE IMPORTANCE OF EFFECTIVE LOCAL LAND USE PLANNING

Low impact development practices alone cannot fully protect our water quality and biological resources. Local land use planning is just as important. First we must choose where to grow and where to protect. Then we can use practices that have a lower impact on Puget Sound. To be most effective, local land use planning should include:

- Designating urban growth areas with appropriate densities and capital facilities to reduce sprawl.
- Providing adequate vegetative buffers and development setbacks in critical areas ordinances to protect sensitive areas.
- Assessing how full build-out according to the comprehensive plan will alter aquatic resources.
- Using measures to protect natural hydrology and processes, such as setting goals for limiting impervious surfaces and preserving open spaces.

~ Stormwater and Combined Sewer Overflows Program,
Puget Sound Water Quality Management Plan

Want to learn more about LID?

To find out more about low impact development, stormwater, smart growth and other issues pertaining to sound development, visit the Action Team's website at:

http://www.wa.gov/puget_sound

You can also contact Bruce Wulkan, the Action Team's technical and policy specialist on stormwater, at (360) 407-7332 or bwulkan@psat.wa.gov.

Return Service Requested

Read Sound Waves on the Web!

If you'd like to receive an e-mail reminder when *Sound Waves* is posted on our website, send an e-mail to gwilliams@psat.wa.gov.

Sound Waves is produced quarterly by the Puget Sound Water Quality Action Team.

If you need this document in an alternate format, call (360) 407-7300, (800) 54_SOUND, or the TDD number: (800) 833-6388.

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Sound Waves is run on an alcohol-free press using vegetable-based inks.



CALENDAR

Oct. 20, 27, 28 and Nov. 3
Cedar River Salmon Journey

11 a.m. to 4 p.m.

Learn about spawning salmon and the Cedar River. Volunteer naturalists will be stationed at Renton Library, Riverview Park, Cavanaugh Road and Landsburg Dam on the above dates. Carpool if you can—these sites have limited parking.

For more information, call (206) 205-6132.

Sponsors: King County, the City of Seattle, the US Army Corps of Engineers, the City of Redmond and the Washington Sea Grant Program.

Nov. 13
6:30 p.m.

Puyallup and Clover-Chambers Watershed Review

All water quality monitors on streams in the Puyallup and Clover-Chambers

Creek Watersheds are invited to attend this workshop to review the data you have collected over the years and assess the status of your stream. Contact the Pierce County Stream Team at (253) 845-2973, streamteam@piercecountycd.org, or <http://www.piercecountycd.org/streamtm.htm>.

Nov. 15

The Tale of Two Whales
7:15 a.m.

Bell Harbor International Conference Center, Seattle
You're invited to attend the Puget Soundkeeper Alliance Annual Breakfast. Program includes talks about orcas and gray whales. Learn how science, politics and conservation can work together to save orcas from extinction. RSVP at (206) 286-1309.

Fall is planting time!

October through November
Help Releaf the Sammamish River

Plant native plants, remove invasives and maintain previous plantings. Sponsored by King County and the cities of Bothell, Woodinville and Redmond. The details:

• Oct. 27; Nov. 3, 10
10 a.m. to 2 p.m.
Contact: Polly Freeman,
King County, (206) 296-8359
polly.freeman@metrokc.gov

Oct. 20
10 a.m. to 2 p.m.

Planting project on Snoqualmie River

Plant native trees and shrubs at Tolt-McDonald Park to protect habitat for salmon and other wildlife, improve water quality and reduce erosion. Contact Polly Freeman (King County) at (206) 296-8359, polly.freeman@metrokc.gov.

Oct. 20 and Nov. 3
9 a.m.

Plantings on Hylebos Creek and Nisqually River

Join Pierce County Stream Team and Friends of the Hylebos to plant native plants. Contact the Pierce County Stream Team at (253) 845-2973, streamteam@piercecountycd.org, or <http://www.piercecountycd.org/streamtm.htm>.

Nov. 3
9 a.m.

Riparian Planting

Nisqually River
Help re-plant an area disturbed by construction of an off-channel rearing pond for fish in the Nisqually River. Contact the Pierce County Stream Team at (253) 845-2973, streamteam@piercecountycd.org, or <http://www.piercecountycd.org/streamtm.htm>.



More volunteer activities are listed on the Action Team's website. Go to www.wa.gov.puget_sound and select the link to **Events** from the top of the page.