

### Impervious Surfaces, Urban Expansion and Watersheds

Summary: Urban expansion and impervious surfaces coverage are a fundamental characteristics of urban and suburban areas. Rooftops, roadways, parking areas, and other impervious surfaces cover soils that, before development, allowed rainwater to infiltrate. By depriving the soil of its ability to infiltrate rainwater, a host of environmental consequences follow, such as stream degradation, wetlands loss, water supply reduction and water quality degradation. The below annotated bibliography defines the hydrological and water quality problems caused by expanding urban expansion and impervious surfaces in Southern California's coastal watersheds, and provides a range of alternative solutions.

Citation	Link	Annotation
<a href="#">Understanding Urban Expansion and Impervious Surfaces</a>		
Paul, Michael J. Meyer, Judy L. Streams In The Urban Landscape <i>Annual Review of Ecology &amp; Systematics</i> , 2001, Vol. 32 Issue 1, p333, 33p	Journal Article	Urbanization has brought landscape transformations that have a number of documented effects on stream ecosystems. The most consistent and pervasive effect is an increase in impervious surface cover within urban watersheds that alters the hydrology and geomorphology of streams. In addition to imperviousness, runoff from urbanized surfaces as well as municipal and industrial discharges result in increased loading of nutrients, metals, pesticides, and other contaminants to streams. These changes result in consistent declines in the biological diversity in urban streams. A comprehensive and detailed review of scientific literature.
Berke, Philip R.; MacDonald, Joe; White, Nancy; Holmes, Michael; Line, Dan; Oury, Kat; Ryznar, Rhonda . Greening Development to Protect Watersheds. <i>Journal of the American Planning Association</i> , Autumn2003, Vol. 69 Issue 4, p397.	Journal article	New urbanism has been touted as a more environmentally sustainable form of development than conventional low-density sprawl. To test this assertion, this study comparatively evaluates how well 50 matched pairs of new urban and conventional developments in the United States integrate watershed protection techniques. A comprehensive and thorough history and review of planning literature.
Dallman, Suzanne, and Thomas Piechota. 2000. <i>Stormwater: Asset Not Liability</i> . Los Angeles:	<a href="http://www.lasgrwc.org/publications.html">http://www.lasgrwc.org/publications.html</a>	Readable publication detailing the topic of impervious surfaces, stormwater and water quality in

<p>The Los Angeles and San Gabriel Rivers Watershed Council.</p>		<p>Los Angeles County. Applicable to Southern California's urbanized coastal watersheds. Details of model land use ordinances to reduce impervious surface coverage.</p>
<p>Bay Area Stormwater Management Agencies Association. BASMAA. 1999. <i>Start at the Source: Design Guidance Manual for Stormwater Quality Protection</i>. San Francisco, CA: BASMAA.</p>	<p><a href="http://www.scvurppp-w2k.com/basmaa_satsm.htm">http://www.scvurppp-w2k.com/basmaa_satsm.htm</a></p>	<p>Excellent primer on impervious surfaces and the hydrology alterations caused by impervious surfaces. Provides guidelines for planning and zoning, site design and landscaping.</p>
<p>United States Environmental Protection Agency. Water Web Page: <i>Urbanization and Streams: Studies of Hydrologic Impacts</i>. Last accessed: December 15, 2003.</p>	<p><a href="http://www.epa.gov/OWOW/NPS/urbanize/report.html">http://www.epa.gov/OWOW/NPS/urbanize/report.html</a></p>	<p>A short, useful introduction to understanding the potential hydrologic impacts of urbanization on streams.</p>
<p>U.S. Department of Interior. n.d. <i>Keeping Water on the Land Longer</i>. Denver, CO: U.S. Department of Interior, Bureau of Land Management.</p>	<p><a href="http://www.wy.blm.gov/rsfo/">http://www.wy.blm.gov/rsfo/</a> <a href="http://www.or.blm.gov/nrst">http://www.or.blm.gov/nrst</a></p>	<p>Brochure written by BLM National Riparian Service Team. Central thesis: "Surface water quality is maintained and improved when it passes through healthy soils and vegetation communities. These areas act like a combination sponge and filter that slows water's overland flow and help retain soil on the land where it is an asset." Details what persons and/or organizations can do to keep water on land longer. Easy to read for layperson.</p>
<p>Dissmeyer, George, 2000. ed. <i>Drinking Water from Forests and Grasslands. A Synthesis of Scientific Literature</i>. Ashville, NC: USDA Forest Service, Southern Research Station. Chapters: 6, 7, 9, 12 and 22</p>	<p><a href="http://www.srs.fs.usda.gov/pubs/gtr/gtr_srs039/">http://www.srs.fs.usda.gov/pubs/gtr/gtr_srs039/</a></p>	<p>A synthesis of peer reviewed scientific literature concerning land use management and water quality. An OUTSTANDING chapter discussing in detail the current science of evaluating post-fire (burn) water quality issues. Other chapters address impacts of impervious surfaces (i.e. changes in hydrology, fluvial geo-morphology, water quality, wetlands) due to roads, urbanization, and vegetation removal.</p>
<p>Natural Resources Conservation Service (NRCS). 2003. <i>Urbanization and Development of Rural Land</i>. July.</p>	<p><a href="http://www.nrcs.usda.gov/technical/land/urban.html">http://www.nrcs.usda.gov/technical/land/urban.html</a> <a href="http://www.nrcs.usda.gov/technic">http://www.nrcs.usda.gov/technic</a></p>	<p>Results from 2001 National Resources Inventory (NRI). The NRI provides spatial and numerical assessments of the</p>

	<p>al/land/nri01/ (click on "Urbanization and Development")</p>	<p>conversion of various rural lands into developed land. of these conversions. Central thesis: the impact of development on rural nonfederal land, "is an especially important consideration when the lands best suited to producing food and fiber come under development. Conversion of agricultural land to developed uses can also result in fragmentation of landscapes, leading to diminished values for wildlife, water management, open space, and aesthetic purposes, among others." Maps, bar charts and numerical data.</p>
<p>Calthorpe Peter and William Fulton. 2001. <i>The Regional City: Planning for the End of Sprawl</i>. Washington, D.C.: Island Press.</p>	<p><a href="http://www.islandpress.org">http://www.islandpress.org</a></p>	<p>Presents the evolution of metropolitan regions, agglomerations of central cities and suburbs that extend hundreds of miles in every direction. Introduces the reader to the problems of "sprawl" from a planning, environmental, and justice perspective. Weak on water resources literature. Central thesis: "Metropolitan regions that promote and manage growth, educate their populations, and maintain quality of life will succeed." Excellent intro to the topic for scientists and other persons not familiar with planning and urban geography literature on urban expansion.</p>
<p>2002. Beach Dana. <i>Coastal Sprawl: The Effects of Urban Design on Aquatic Ecosystems in the United States</i>. Arlington, Virginia: Pew Oceans Commission.</p>	<p><a href="http://www.pewoceans.org/oceanfacts/2002/04/12/fact_25649.asp">http://www.pewoceans.org/oceanfacts/2002/04/12/fact_25649.asp</a></p>	<p>Central thesis: "Runaway land consumption, dysfunctional suburban development patterns, and exponential growth in automobile use are the real engines of pollution and habitat degradation on the coast. When impervious surfaces cover more than ten percent of a watershed, the rivers, creeks, and estuaries they surround become biologically degraded." Provides bibliography on the topic. Little to no data or references from arid lands' or California rivers and</p>

		estuaries.
2003. Schueler, Tom. <i>Impacts of Impervious Cover on Aquatic Systems</i> . Elliot, MD: Center for Watershed Protection.	<a href="http://www.cwp.org/">http://www.cwp.org/</a>	Document not available for review.
<a href="#">Range of Solution Alternatives to the Problem of Increasing Urban Expansion and Impervious Surfaces</a>		
Bay Area Stormwater Management Agencies Association. BASMAA. 2003. <i>Using Site Design Techniques to Meet Development Standards for Stormwater Quality A Companion Document to Start at the Source</i> San Francisco, CA: BASMAA. May.	<a href="http://www.scvurppp-w2k.com/basmaa_satsm.htm">http://www.scvurppp-w2k.com/basmaa_satsm.htm</a>	Recent stormwater permits have evolved to include more specific <i>quantitative</i> requirements regarding development and redevelopment. This document demonstrates ways to utilize the techniques described in BASMAA's second edition of <i>Start at the Source</i> to help comply with these quantitative permit requirements. Provides an overview of current stormwater requirements, and examines concepts such as: zero discharge areas, self treating areas and runoff reduction areas.
Meyer, Judy L. et. al. 2003. <i>Where Rivers are Born: The Scientific Imperative for Defending Small Streams and Wetlands</i> . American Rivers and Sierra Club. September.	<a href="http://www.amrivers.org/amriverpublications/default.htm">http://www.amrivers.org/amriverpublications/default.htm</a>  <a href="http://www.epa.gov/OWOW/NPS/urbanize/report.html">http://www.epa.gov/OWOW/NPS/urbanize/report.html</a>	Headwater systems play a crucial role in ensuring a continual flow of water to downstream freshwater ecosystems. Land-use changes in the vicinity of small streams and wetlands can impair the natural functions of such headwater systems. Changes in surrounding vegetation, development that paves and hardens soil surfaces, and the total elimination of some small streams disrupts the quantity and availability of water in a stream and river system. In addition, downstream lakes and rivers have poorer water quality, less reliable water flows, and less diverse aquatic life. Peer reviewed by an extensive panel of scientists. Comprehensive bibliography. Resource to educate policy makers concerning the problems associated with urbanization in rural areas.
Lisa Lewis. 2000. <i>Soil Bioengineering: An Alternative</i>	<a href="http://www.or.blm.gov/nrst/Reference/Reference_Materials.htm">http://www.or.blm.gov/nrst/Reference/Reference_Materials.htm</a>	Provides "field personnel with the basic merits of soil bio-

<p><i>for Roadside Management. A Practical Guide.</i> National Riparian Service Team and USDA Forest Service. San Dimas Technology and Development Center, San Dimas CA.</p>		<p>engineering concepts and gives examples of several techniques especially effective in stabilizing and re-vegetating upland roadside environments. Soil bio-engineering is the use of live plant materials and flexible engineering techniques to alleviate environmental problems such as destabilized and eroding slopes. Resource for post-fire slope stabilization and revegetation.</p>
<p>Coffman, Larry. 2000. <i>Low-Impact Development Design Strategies. An Integrated Design Approach.</i> Largo, Maryland. Prince George's County Maryland Department of Environmental Resources, Programs and Planning Division. EPA-841-B-00-003</p>	<p><a href="http://www.lowimpactdevelopment.org/">http://www.lowimpactdevelopment.org/</a></p>	<p>The application of low-impact development techniques results in the creation of a hydrologically functional landscape, the use of distributed micro-management practices, impact minimization, and reduced effective imperviousness allowing stormwater infiltration and storage. Excellent resource for planners who wish to reduce imperviousness in highly urbanized regions. Provides design guidelines before development.</p>
<p>United States Environmental Protection Agency, Office of Water. Low Impact Development Center. 2000. <i>Low Impact Development (LID). A Literature Review.</i> Washington D.C.: USEPA. EPA-841-B-00-005. October.</p>	<p><a href="http://www.lowimpactdevelopment.org/">http://www.lowimpactdevelopment.org/</a></p>	<p>A literature review conducted to determine the availability and reliability of data to assess the effectiveness of low impact development (LID) practices for controlling stormwater runoff volume and reducing pollutant loadings to receiving waters.</p>
<p>Center for Watershed Protection. Website. Last accessed: December 15, 2003.</p>	<p><a href="http://www.cwp.org/">http://www.cwp.org/</a></p>	<p>Cited extensively in impervious surface literature. Developed techniques for protecting small watersheds from the detrimental effects of sprawling development and the accompanying impervious cover.</p>
<p>Low Impact Development Center. Website. Last accessed: December 15, 2003.</p>	<p><a href="http://www.lowimpactdevelopment.org/">http://www.lowimpactdevelopment.org/</a></p>	<p>Low Impact Development is a new comprehensive land planning and engineering design approach with a goal of maintaining and enhancing the pre-development hydrologic regime of urban and developing watersheds. Provides brochures to educate builders and</p>

		municipal leaders of low impact development concepts.
Puget Sound Action Team. Website. Last accessed: December 15, 2003.	<a href="http://www.psat.wa.gov/">http://www.psat.wa.gov/</a>	Population growth in Puget Sound has contributed significantly to the decline in water quality and biological resources over the past several decades. The Puget Sound Water Quality Management Plan incorporates growth issues into a number of programs, particularly the stormwater, shellfish, on-site sewage systems, and habitat programs.