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**December 21, 2011**

**TO: Metro SB+L Team**  
**FROM: Communitas-ECONW Team**  
**SUBJECT: TASK 1, DELIVERABLE 2: FINAL MEMO—LITERATURE REVIEW**

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## **INTRODUCTION AND SUMMARY**

Metro asked ECONorthwest, with assistance from Communitas, to conduct a literature review of best practices for implementing sustainability programs, to lay a foundation for further research about Metro's role in reducing the environmental and human health impact of construction, building, and landscaping activities. Through the literature review, we identified national and international programs designed to implement sustainability goals similar to those that Metro is considering. Where in-depth information was available, we analyzed key steps taken to implement the programs, and reviewed data describing the effectiveness of the programs. This memorandum summarizes our findings.

We began our review by developing a framework to more clearly define Metro's goals for reducing impacts related to construction, building, and landscaping activities. Jointly with Metro and Communitas, we defined four specific goals to capture potential avenues available to Metro to reduce impacts in these areas. We used these goals to guide and hone our review of programs and strategies:

1. Reduce the amount of solid waste generated in building and landscaping across all phases of development (building/redevelopment, maintenance, and deconstruction/demolition).
2. Reduce toxic exposure to people and wildlife from building and landscaping at all phases of development (building/redevelopment, maintenance, and deconstruction/demolition).
3. Preserve and enhance wildlife habitats at all phases of development (building/redevelopment, maintenance, and deconstruction/demolition).
4. Reduce "upstream" impacts of primary construction materials (e.g., roofing, framing, flooring, siding, plants) at all phases of development (building/redevelopment, maintenance, and deconstruction/demolition).

Our review of the literature, which included peer-reviewed journal articles; reports of government, non-governmental organizations (NGOs), and academic institutions; and websites of organizations, identified countless programs that promoted these goals. Across all programs, we found that the following three basic strategies were employed:

1. Regulatory requirements (non-voluntary strategies)
2. Market and social incentives (voluntary strategies)
3. Education, research and development, and technical assistance

There is no shortage of programs in the United States and around the world designed to accomplish goals similar to those Metro has articulated. The breadth of the literature is overwhelming, but its depth and rigor is often lacking. For some types of programs for some goals, we found studies that synthesized information about programs and strategies across jurisdictions and provided useful analysis of their strengths and weaknesses. Where syntheses were not available in the literature, we have highlighted individual programs that illustrate the type of strategies local, state, and national governments have pursued. In many cases, the literature on these examples is devoid of useful context and evaluation that would support more informative conclusions for Metro. As we investigated each goal, we found that the literature doesn't point clearly in one direction to the most effective strategies for accomplishing particular outcomes. Communities use all sorts of strategies, usually in combination and without robust data to indicate what's working well and how they could be doing better. We summarize the findings for each goal below, and conclude with some general findings that apply across goals.

- 1. Reduce the amount of solid waste generated in building and landscaping.** Programs designed to reduce the amount of solid waste generated in building and landscaping are among the most numerous, targeted, and developed across the four goals. We found well-established programs across the United States and in Europe, many of which have been extensively studied and evaluated. Several observations from the literature offer helpful direction in sorting through the different approaches communities have taken:
  - While most programs target both construction and demolition projects, there are important differences in the best-management practices and economics that guide waste reduction and recycling in new construction versus demolition.
  - There are also important differences in the economics and feasibility of recycling different types of C&D wastes, for example among wood, metal, and gypsum board. Successful C&D reduction programs recognize these differences and account for them by using a variety of different approaches to change practices.
  - Results from one study of different strategies indicates that regulation requiring deposits when building permits are issued and providing rebates for demonstrated C&D waste reduction had the lowest cost per ton of C&D waste recycled, and resulted in the highest increase in C&D debris recycling rates.
  - Many programs emphasize that “waste” is a product of inefficiency, and reducing C&D wastes that end up in the landfill can produce economic benefits. There are, however, many different causal factors affecting whether individuals and firms practice “waste prevention” behavior, and a program focusing on economic incentives alone, without addressing other barriers may not yield as much success as a more integrated approach.
  - The most interesting and innovative programs focused on developing local markets for construction and demolition waste to emphasize reuse opportunities. Earth Exchange, a private initiative developed in the United Kingdom to help businesses comply with strict disposal rules, uses the internet and map-based technology to connect potential suppliers with potential sources of demand for different types of construction and demolition materials.

**2. Reduce toxic exposure to people and wildlife from building and landscaping.** We found few programs specifically aimed at reducing the use of toxic materials, including within the construction and demolition sector. Programs focused on these sectors typically address exposure not by controlling the substances themselves, but by providing guidance on appropriate handling standards, application conditions, and ventilation requirements.

- The majority of programs addressing this goal arise from Toxic Use Reduction Acts (TURAs). TURAs have historically focused on reducing hazardous wastes rather than the more common and pervasive chemicals of concern found in construction and landscaping practices and released through demolition. Massachusetts and Ontario, Canada are regarded as models in this area.
- The most direct connection between this goal and landscaping practices was through programs designed to reduce pesticide application and increase adoption of integrated pest management practices (IPM). Canadian provinces, including Ontario, have implemented bans on applying certain pesticides for “cosmetic purposes” on public and private lawns and gardens.
- More focused attention on reducing chemicals used in construction and landscaping is emerging through green building certification programs, indoor air-quality initiatives, and green lawn-care programs, rather than from traditional programs focusing on toxics reduction.
- Local governments can effectively lead in this area by implementing policies to reduce the application of pesticides and herbicides in public places and switch to non-toxic building supplies for new and redeveloped public projects. In addition to demonstrating these goals can be accomplished, local governments can create demand for non-toxic products, increasing availability and reducing costs for private consumers.

**3. Preserve and enhance wildlife habitats.** The connections between development and effects on wildlife habitat are numerous and well-documented in the literature, so it was not surprising that we found a wide range of programs for reducing impacts on both aquatic and terrestrial habitats. The programs intended to achieve this goal, however, were generally less rigorously evaluated for measurable outcomes. Monitoring programs designed to provide measurable impacts on habitat indicators are limited and highly site-specific, so drawing broad conclusions about the achievements of these types of programs remains challenging.

- Regulations drive most of the action in this area. Countless illustrations of market-based strategies and education and technical assistance programs have emerged to help individuals and firms comply with the laws and regulations at lower cost, and comply in ways that maximize social and ecological benefits.
- EPA sums up the interaction between regulatory, market-based, and education strategies in this way: *No single policy or program will be a panacea for the challenge of how to integrate green infrastructure into the local landscape. Many of the policies work in tandem and fit within a context of several other complementary policies and programs. The greenest cities in terms of stormwater management use a wide range of policies and a number of approaches that focus on both public and private sectors (U.S EPA 2010, p. 5).*

- The Metro area is already considered a leader in this arena. Many strategies to accomplish this goal were illustrated through case studies from Portland.
  - Studies of barriers to adopting more LID and ecological landscaping identify a strong need for programs and strategies that provide education and technical assistance to engineers, design professionals, and permitting officials. These individuals make many of the decisions that lead to adoption, and are often unfamiliar with the latest science and have biased or outdated perceptions of these techniques. Bremerton, Washington has demonstrated success in this area by providing extensive education and support to its public engineers, resulting in cost-effective integration of LID in many capital and redevelopment projects in its downtown core, where LID is often considered too expensive or infeasible to implement.
  - One of the more innovative programs we found is Seattle’s Green Factor program, which is based on similar programs in Germany and Spain. It establishes a scoring system for landscaping design that encourages developers to install ecologically functional landscapes.
- 4. Reduce “upstream” impacts of primary construction materials.** This goal encompasses a huge sphere of issues and related programs, including climate change, energy efficiency, forest management practices, environmental justice concerns, and worker rights. Our review of the literature in this area found extensive overlap with the programs and strategies outlined in the other three goals. When designed well, strategies and programs aimed at reducing waste, exposure to toxics, and protecting and improving habitat also tend to reduce overall energy use, carbon emissions, and upstream air and water pollution.
- Programs that seek to further this goal typically accomplish it indirectly, by promoting already-existing building and materials certification programs, such as LEED, Sustainable Sites Initiative, FSC lumber, Fair Trade, and others. By promoting these certification efforts, jurisdictions are able to maximize a wide range of benefits while avoiding the costs of keeping up with constantly evolving research across a wide range of fields.

The results of our literature review underscore several themes Metro might consider as it develops and refines its strategy to achieve its goals:

- Draw from each of the strategies in adopting programs to achieve the goals. Metro’s structure and charter positions it well to employ all three strategies – regulatory, incentive-based, and technical assistance – in an integrated way that maximizes the potential for change.
- Leverage existing local programs and certification efforts. There is a great deal of work that is already happening in Oregon and the Northwest that can be leveraged through regional coordination and networking to achieve greater results. This is one of Metro’s strengths.
- Focus on measuring results. Design new programs and develop methods within existing programs to monitor existing conditions and program outcomes using metrics that effectively measure progress toward goals. Ideally, monitoring efforts would collect data for metrics at a fine enough level of detail (e.g., by type of job site, type of material) for

Metro staff to understand what's working well and develop solutions to target specific outcomes. Our findings suggest that many programs do not effectively accomplish this, suggesting that there might be an opportunity for Metro leadership in this area.

# METHODOLOGY

We designed the literature review to identify specific programs, strategies, and tools that local, regional, and national governments, and non-governmental organizations (NGOs) have implemented to achieve outcomes similar to the goals Metro, Communitas, and we identified. After defining goals, we developed a list of key words to use as search terms in the review. Based on our own experience and an initial screening of literature Metro provided to us, we identified two sets of key words: terms to describe Metro’s goals, and terms to describe the types of programs and strategies used to implement sustainability goals. Table 1 shows our complete set of key words.

In our search, we coupled key words describing sustainability goals (those in the first column of Table 1) with key words describing program strategies (those in the second column of Table 1) to identify programs intended to further specific sustainability goals. We revised these key-word lists as we conducted the literature review to capture additional terms used in the literature missing from our initial list (the terms in Table 1 reflect our final set of key words). This revision process was especially helpful to identify international programs, which tend to employ different vocabulary than we are familiar with in the U.S.

**Table 1. Key Words Used in the Literature Review**

Sustainability-Goal Terms	Program-Strategy Terms
Construction and demolition waste	Incentives
Building material recycling	Practices
Construction solid waste reduction	Strategies
Building toxic materials reduction	Behavior change
Green building	Policy
Toxic materials construction	Public communication
Construction chemicals reduction	Public education
Landscape fertilizers reduction	Requirements
Landscape pesticides reduction	Social marketing
Landscape life-cycle analysis	Adoption
Sustainable site practices	Technical assistance
Integrated pest management	Education
Low-impact development	Requirements
Habitat conservation	Change practices
Green infrastructure	Best management practices
Natural drainage systems	
Sustainable stormwater management	
Conservation development	
Life-cycle cost of development	
Upstream impacts	

Source: ECONorthwest

We began our literature review by searching peer-reviewed publications in professional and trade journals, identified in the first section of Table 2. After reviewing relevant peer-reviewed publications and following up on the references they contained, we expanded our search to

include sources shown in the second and third sections of Table 2. These categories capture the “gray literature,” which includes publications by government, NGOs, and academic researchers, which are usually scholarly but may not have undergone peer review or independent vetting. The last category, programs and websites, allowed us to capture primary information about programs, reported directly from implementing organizations, and secondary information from organizations reporting on or summarizing information about other organizations’ programs.

**Table 2. Databases and Search Engines Used in the Literature Review**

Database	Description
<b>Peer-Reviewed Journal Articles</b>	
Academic Search Premier	Index of over 8,000 academic journals in the social sciences, humanities, and general science, back to 1965.
Article First	Index of over 16,000 journal titles in business, humanities, popular culture, science, social science, and technology, back to 1990.
Google Scholar	Collection of articles from a wide variety of academic publishers, professional societies, preprint repositories and universities, as well as scholarly articles available across the web.
Web of Science	Index of science and social science journals, back to 1975.
<b>Government, NGO, and Academic Reports</b>	
Google Scholar	Collection of articles from a wide variety of academic publishers, professional societies, preprint repositories and universities, as well as scholarly articles available across the web.
WorldCat	Index of bibliographic records of books, journals, manuscripts, etc. archived in university, public and private library catalogs around the world.
Cascadia Green Building Council	Collection of scholarly articles and studies related to green building and related topics with a specific focus on the Pacific Northwest.
Internet search engines (Google, Bing)	Source for non-peer reviewed reports, articles, websites and other publications.
<b>Program Websites and Fact Sheets</b>	
Internet search engines (Google, Bing)	Source for non-peer reviewed reports, articles, websites and other publications.

Source: ECONorthwest

Although the peer-reviewed literature contained some useful information, the majority of the programs we identified came directly from our searches of the gray literature and websites containing both primary and secondary information.

As we searched the literature, we organized our search results using bibliography-organizing software. We read each article, flagged additional references for follow-up, and refined our key-word lists. In a few cases where specific information was referenced but not available on the Internet, we made phone calls to obtain additional information.

We report our findings in the next section. A complete list of references, annotated with summaries of the findings or utility of the source, is included at the end of this memorandum.

## FINDINGS

We organize our findings around the four goals Metro, Communitas, and we identified. Within each goal, we separate programs into three general strategies to engender change: 1) Regulatory requirements (non-voluntary strategies), 2) Market and behavioral incentives (voluntary strategies), and 3) Education, research and development, and technical assistance. Barron and Ng (1996) and Cochran et al. (2007) use a similar categorization to describe policy instruments intended to encourage the recycling of construction and demolition debris and other solid waste. While their research focused on topics related to the first goal in our review, we found their methodology an effective organizing structure for each of the goals.

### 1. Reduce the Amount of Solid Waste Generated in Building and Landscaping

Programs designed to reduce the amount of solid waste generated in building and landscaping are among the most numerous, targeted, and developed across the four goals we considered in the literature review. Estimates vary, but approximately 20 to 40 percent of the material disposed in landfills in the U.S. each year is construction and demolition (C&D) waste generated in the process of new construction, renovation, and redevelopment (Cunningham 2011, Leigh and Patterson 2005, U.S. Department of Defense 2002). Similar rates prevail worldwide (Nitivattananon and Borongan 2007). Because many local jurisdictions are faced with landfill capacity constraints and illegal dumping (NCTCG 2003a, Leigh and Patterson 2005), the motivations to reduce C&D wastes are strong. Moreover, because as much as 80 percent of waste generated during construction is reusable or recyclable (Cole 2001) and markets exist in many locations for many types of C&D materials, programs to require, incentivize, and recognize efforts to reduce C&D wastes are seen as low-hanging fruit among strategies to reduce the waste stream headed to the landfill.

Although regulation plays a role in many local jurisdictions in reducing C&D wastes, many researchers recognize that successful programs include a variety of strategies in meeting C&D reduction goals (Leigh and Patterson 2005, U.S. EPA 2000). While most programs target both construction and demolition projects, there are important differences in the best-management practices and economics that guide waste reduction and recycling in new construction versus demolition (U.S. Department of Housing and Urban Development 2001, U.S. Department of Defense 2002). There are also important differences in the economics and feasibility of recycling different types of C&D wastes, for example among wood, metal, and gypsum board. Successful C&D reduction programs recognize these differences and account for them by using a variety of different approaches to change practices.

#### A. Regulatory requirements (non-voluntary approaches)

In the United States, non-hazardous construction and demolition (C&D) waste is regulated at the state and local level, if it is regulated separately from solid waste at all. The Construction Industry Compliance Assistance Center provides a website for contractors to identify the local regulations and regulatory entities responsible for regulating C&D waste in each state (CICA 2011). In Oregon, as in other states, state agencies provide oversight and technical assistance to local governments, who may regulate C&D wastes through ordinances. This dispersed approach to regulation has led

to many different strategies and programs to reduce the amount of solid waste generated in building and landscaping arising at the local level.

**Table 3. Summary of Survey Results of Local C&D Waste Regulations**

Policy Type	Disposal Restriction	Green Building	Deposit / Rebate	Percent Recycling Requirement	Government Recycling Requirement
# of locations implemented	1	2	5	8	1
Avg. cost/ person / year	\$3.90	\$ -	\$(0.51)	\$0.38	\$0.75
Avg. cost / ton recycled	\$51.83	\$ -	\$(8.75)	\$0.16	\$ -
Avg. total recycling rate increase	23%	9%	10%	7%	9%
Avg. total lbs recycled / person / year	150	300	25,000	3,000	250
Avg. cost / construction building permit	\$400	\$ -	\$(7,300)	\$66	\$(1,400)
Avg. tons recycled / construction building permit	8	30	4,200	240	266

Source: Cochran et al. (2007)

Cochran et al. (2007) analyzed local regulations targeting C&D wastes and analyzed their effectiveness across several criteria, derived from similar studies of solid waste reduction strategies (Barron and Ng 1996). Table 3, adapted from Cochran et al. (2007), provides a summary of the results of a survey of 18 cities and counties that adopted regulatory initiatives for promoting C&D debris recycling. The types of regulatory initiatives studied include

- **Disposal restriction** prohibits certain materials from being disposed of in landfills.
- **Green building requirement** dictates city or county buildings must obtain green building certifications through the U.S. Green Building Council. Certification typically entails minimizing C&D debris overall and recycling what is produced.
- **Deposits/advanced disposal fees/rebates** entail that a permitting agency collect a fee when a building permit is issued and offers reimbursement of the fee if the permittee can show that a certain percentage of debris is recycled.

- **Percent recycling requirements** require contractors submit waste plans for developments and show they will recycle a certain percentage of the waste stream.
- **Government recycling requirements** require contractors working on the construction, renovation, or demolition of government buildings to develop plans to demonstrate that a percentage of the waste will be recycled.

Cochran et al.'s research found that the regulation requiring deposits when building permits are issued and providing rebates for demonstrated C&D waste reduction had the lowest cost per ton of C&D waste recycled, and resulted in the highest increase in C&D debris recycling rates.

Other regulations aimed at reducing construction waste, found in our review of the literature but not explicitly reviewed in Cochran et al. (2007), include:

- **Levy a tax on the disposal of C&D waste.** Local governments often use a landfill tax, disposal surcharge, or increase in tipping fee to raise the cost of disposal of C&D waste and then use the profits from these fees to support recycling. Leigh and Patterson (2005) identify such taxes in 22 states, ranging from \$0.25 to \$8.75 per ton. Although there are some unintended consequences to these taxes – as a result contractors sometimes participate in illegal dumping or will transport their waste to nearby untaxed landfills. Many jurisdictions minimize these practices with regional consensus and enforcement against illegal dumping (Leigh and Patterson 2005).
- **Require C&D Waste Management Planning.** Starting in 2008, all construction projects that cost over £300,000 (about \$470,000) in England are required to create Site Waste Management Plans (SWMP). The plans must set out how waste will be controlled at all stages of a construction project, including who is responsible for management, what types of waste will be generated, how it will be managed, which contractors will be used to ensure waste is correctly recycled or disposed of, and how the quantity of waste generated during a project will be measured (NetRegs 2011).
- **Require salvage notices.** Require demolition contractors to post notice of an impending demolition to allow anyone to salvage materials from the building (Cochran 2007).

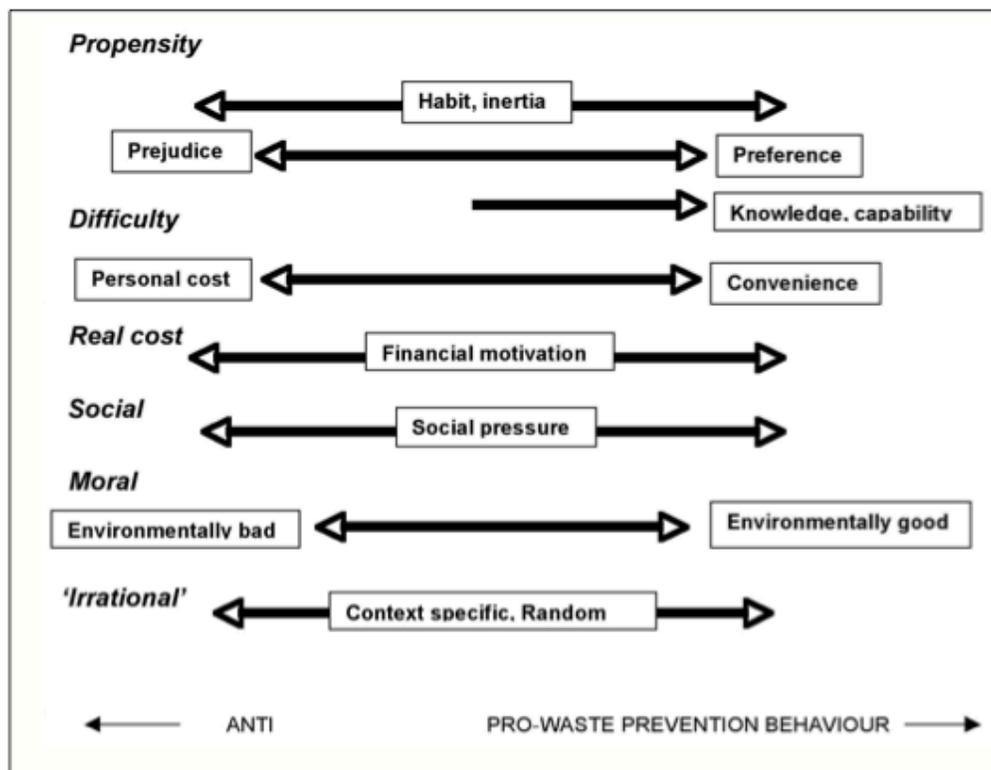
## **B. Market and social incentives (voluntary strategies)**

Incentives come in at least two forms. Market incentives work by providing monetary benefits to increase C&D recycling rates and waste reduction goals. Social incentives work by providing public recognition or tapping into moral motivations to change behavior. Municipalities use both types of strategies in C&D waste reduction programs. We illustrate some examples from the literature, below.

Markets for construction and demolition wastes exist in many locations. There are ample financial incentives in some areas for recycling some types of materials. Many resources for private developers and contractors highlight that “waste” is a product of inefficiency, and

reducing C&D wastes that end up in the landfill can produce economic benefits (CalRecycle 2009, Leigh and Patterson 2005, U.S. EPA 2000). Researchers point out that cost is just one factor among many that influence individuals' and firms' actions. There are many different causal factors affecting whether individuals practice "waste prevention" behavior. Tucker (2007) illustrates these factors in a framework, which we reproduce in Figure 1. Strategies that rely on market and social incentives to create change can leverage each of these causal factors. Unfortunately, Tucker's research has not, yet, applied this framework to identify successful strategies to increase waste-prevention behavior (Tucker 2007, pg. 5).

**Figure 1. Causal Factors for "Waste Prevention" Behavior**



Source: Tucker 2007

### Market Incentives

- **Phase out subsidies for landfilling.** The New Zealand Business Council for Sustainable Development (2003) notes that in many parts of the county, local governments subsidize local landfills, which limits contractors' incentives to reduce waste or recover resources from the waste stream. Texas also subsidizes landfill space, which the Texas Campaign for the Environment Fund (2011) notes contributes to the current condition where dumping trash in a landfill is up to ten times cheaper than recycling it.
- **Establish tradable credits to offset waste generation.** The New Zealand Business Council for Sustainable Development (2003) has proposed creating a transferable resource recovery certificate, an independently-certified credit which companies would earn by sustainably disposing of waste. Companies

would be required to purchase or create credits when disposing of waste in landfills, which would create a market for reducing, reusing, and recycling C&D wastes.

- **Create Markets for Materials.** C&D waste reuse becomes more economically feasible as companies with supply can efficiently and effectively find sources of demand for their materials. Local governments, NGOs, and increasingly private companies are creating the infrastructure to facilitate these market transactions. One common strategy many local governments provide are websites and clearinghouses that list the contact information for recycling companies that accept different types of waste. Stores that accept and sell reusable building materials are another example of this strategy. Habitat for Humanity, for example, runs the ReStore resale outlets for building materials and fixtures (Habitat for Humanity 2011). Their utility, however, is limited for larger amounts of materials and raw construction and demolition debris. Some regional organizations, such as the Northwest Building Salvage Network (NBSN) and The ReUse People (The ReUse People 2011) serve as intermediaries between suppliers and buyers and facilitate “exchanges” online that include a directory of building materials available and building materials wanted. In the United Kingdom, where regulation has mandated recycling and reuse of construction debris, private companies have stepped in to create the infrastructure required for more robust markets. Earth Exchange has created a web-based service to quickly match construction projects that have reusable materials with construction projects that need the materials, using a Google map interface. It allows members to register current and future projects, list the types of materials that will be available, and the dates when they will become available (Earth Exchange 2011). Members looking for particular materials can see if there are nearby sites that can supply the types of materials they will need at the times they will need them. The service provides automatic notification when suppliers match requests for materials.
- **Provide tax credits or low-interest loans for recycling plants, facilities, and equipment.** Many states provide tax credits for investing in recycling technologies, including those that are critical to ensuring that local markets exist for C&D recycling (U.S. EPA 2011). Sparks (1998) notes that states that “seem to have the most success with tax incentives are those that also provide a network of market development assistance. This can occur either as various financial assistance programs other than tax incentives (loans, grants) or as technical assistance.” Delaware, which provides a tax credit for recycling investment, is an example of such a success. It has established a system of financial tools, technical assistance, employee training, and expedited environmental permitting. Delaware also requires businesses to demonstrate a serious commitment to recycling and environmental issues before it will grant tax credits.
- **Provide grants or subsidies for green development projects and green innovation.** Government agencies often use grants and subsidies to fund the start-up costs or capital acquisition costs of new technologies and approaches that yield social net benefits. These public expenditures help offset higher costs and reduce the risk of adopting new technologies. For example, King County’s Built Green Incentive provides funding for single and multi-family residential

and community development projects to help offset the cost of certifying and designing innovative green projects. Eligible projects must recycle more than 75 percent of construction and demolition debris, and may receive up to \$20,000. (BuiltGreen 2011)

- **Provide incentives in the permitting process to reduce developers' costs.** Examples of these incentives include zoning upgrades, expedited permitting applications, and reduced stormwater requirements (Leigh and Patterson 2005). The Oakland/Berkeley Recycling Market Development Zone, for example, provides expedited permitting, referral of job applicants, low-interest loans, site location assistance, and employee training to encourage solid waste reduction (Leigh and Patterson 2005). These incentives can be particularly useful in targeted neighborhoods that will be undergoing large-scale redevelopment.

### Social Incentives

- **Provide awards and recognition.** Wisconsin awards the Governor's Waste Reduction and Recycling Award to businesses, individuals, and community groups to recognize innovation in recycling (Radke 1998). In 1994 Windsor Homes received the award in recognition for its waste reduction. The company wrote a recycling booklet to help educate its employees and customers, cut its own disposal costs by following a strict reuse and recycling policy, and required subcontractors to comply with all its own recycling specifications (Wisconsin Department of Natural Resources 1995).
- **Establish recognizable certification.** King County, Washington created the CleanBin program to recognize companies that use the best diversion and recycling practices at construction sites. All new construction, remodeling, and building removal projects are eligible. The certification requires contractors to meet two criteria: 1) have a garbage-only container on-site and 2) achieve a minimum 75 percent diversion rate for new construction and remodel projects and a 50 percent diversion rate for building removal projects. The program provides technical assistance for companies to quantify their diversion rates. Companies that receive the certification are promoted in local media and to other businesses (King County 2011). C&D waste reduction practices are required to qualify for green-building certifications, such as LEED (U.S. Green Building Council 2011).
- **Create friendly competition.** In 2002, the U.S. EPA launched its WasteWise Building Challenge, calling for corporations to pledge to reduce C&D waste and purchase recycled-content building products. Since 2002, 23 WasteWise partners have made the pledge. Participants are awarded and given a chance to share strategies at an annual meeting and awards ceremony (U.S. EPA 2011b)

### C. Education, Research and Development, and Technical Assistance

Governments and NGOs provide educational resources, workshops, and other types of technical assistance to reduce C&D wastes. Lack of education and awareness is one barrier to more widespread C&D waste reduction, reuse, and recycling (Leigh and Patterson 2005). MetroVancouver conducted survey of members of the Greater Vancouver Home Builders' Association, in which 76 percent of respondents agreed that contractors are not informed or "buying in" to recycling on the job site, and 59 percent

agreed that they did not know what can and can't be recycled in the region (MetroVancouver 2009). In general, few governments that provide educational resources and toolkits provide information about their effectiveness or whether they see increases in recycling after information becomes available. Metro itself is one exception: it conducted a survey to measure the effectiveness of a partnership with the local construction trade industry that helped disseminate a construction recycling toolkit and other educational materials. The survey showed that recycling rates increased among members of the partnership more than those not affiliated with the partnership (Metro 2004).

Despite the lack of empirical data to indicate how effective education and technical assistance programs are in improving C&D waste reduction and recycling rates, they remain one of the most common strategies employed. Table 4 lists a variety of educational resources both public and private organizations offer to developers to help them reduce waste generated during construction and demolition.

**Table 4. Training and Education Materials for Construction and Demolition Waste Recycling and Reuse**

<b>Agency or Organization</b>	<b>Management Guide</b>	<b>Brief Summary</b>
Associated General Contractors of America (AGC No Date)	Recycling Toolkit	This toolkit helps contractors who want to reduce, reuse, or recycle construction and demolition materials or who want to use recycled materials.
CalRecycle (2010)	Recycling Toolkit for Contractors	This toolkit provides C&D waste management specifications, planning tips, a database of debris recyclers, and other resources for contractors in California.
CalRecycle (2011)	Best Practices in Waste Reduction Video Series	This series of videos highlights the reasons why C&D waste reduction is economically and technically feasible.
National Association of Home Builders Research Center (1997-1999)	The Deconstruction Series	Four informational pamphlets on recycling related to: carpet and padding, deconstruction, asphalt, and construction waste.
National Association of Home Builders Research Center (1997)	Residential Construction Waste Management	A guide for builders on construction waste management, including discussion on cost, efficiency, resource conservation, liability, and marketing.
Massachusetts Department of Environmental Protection (Lennon 2005)	Recycling Construction and Demolition Wastes	A guide for architects, engineers, specification writers, and contractors who are interested in job site recycling, but are not familiar with the practicalities.

Source: ECONorthwest

In addition to distributed materials, some jurisdictions and organizations provide interactive training and education opportunities:

- **Conduct trainings and workshops.** The North Central Texas Council of Governments offers a workshop entitled “Construction and Demolition Recycling, Reduce and Reduction” to explain how contractors and developers can reduce solid waste associated with construction and demolition (Cunningham 2011).
- **Establish accreditation programs.** WasteCap Resource Solutions provides a day-long C&D Recycling Training Course at select locations nationwide. The course covers topics including developing, managing, monitoring, documenting, and promoting a successful recycling program for construction and demolition debris. After successfully completing the course, participants receive accreditation and can market C&D waste-management services to other contractors (WasteCap 2011).
- **Use social networking to increase awareness of waste reduction and recycling among homeowners.** The use of social networking is not widespread in C&D waste reduction strategies, but it is likely to increase as governments and organizations in the field integrate the technology into their programs. Early studies indicate they could be used effectively. Freeman and Skumantz (2010) designed a pilot program in the City of Broomfield, CO to document the costs and impacts of a social marketing campaign to increase awareness of recycling among local residents. Using three groups with various levels of social intervention, the authors found the cost per successful program participant was lowest for the group that received social marketing interventions and two in-person visits from a volunteer (Carlson Communications 2011). Harris et al. (2010) note that to successfully change behavior with this type of initiative, officials should apply social marketing tools that public health and other officials use successfully. These include commitment, goal-setting, prompts, and communication of social norms.

Another important role municipalities and organizations provide to promote C&D waste reduction is investing in research and development to improve the understanding and implementation of C&D waste reduction techniques.

- **Collect data on C&D recycling rates.** Information about the quantities and types of C&D materials being recycled and reused in a region can provide useful data to design and modify programs that seek to increase reuse and recycling rates. The U.S. EPA provides guidance on how to conduct these types of data collection efforts, and some municipalities regularly collect such data. The North Central Texas Council of Governments (NCTCG) initiated a detailed data collection effort to inform its development of C&D waste reduction strategies, and continues to collect information on recycling rates in the region (NCTCG 2003a). NCTCG has found that repeat efforts to collect information increases survey participation and improves the quality of data over time (NCTCG 2007).
- **Subsidize demonstration projects.** When municipalities replace aging buildings and infrastructure, they can use the projects as demonstrations for the public in how to effectively recycle demolition debris and reduce construction waste. The

Hartford Housing Authority in Connecticut, for example, used a demonstration project to train nine public housing residents to deconstruct, an alternative to demolition, six public housing units. Through the project, workers recovered 50% of the materials from the building. Marion County, Oregon advertised the recycling results of its demolition of a public building on television and radio, and posted banners around the construction site illustrating the recycling rates of different materials (U.S. EPA 2000).

- **Push the boundaries and innovate.** In some cases, public agencies are best positioned to develop and implement new techniques that stretch the boundaries of what is considered economically feasible or technically possible. In one example of innovation, the City of Seattle, King County, WA, partnered with Resource Venture, Inc., the Hamer Center for Community Design, and the Pennsylvania State University to develop a guide titled Design for Disassembly (Guy and Ciarimboli 2006). The guide outlines the principles for constructing buildings in a way that gives consideration to the impacts of building construction techniques throughout the lifecycle of a building, including facilitating its demolition and disposal. It provides strategies consistent with reduced lifecycle costs, outlines the design process, and illustrates the principles through case studies. The guide encourages contractors to think beyond recycling C&D wastes of traditional buildings, to fundamentally rethinking building processes to reduce future impacts.

## 2. Reduce Toxic Exposure from Building and Landscaping

In many cases, chemicals commonly used in construction, landscape maintenance, and released during demolition activities are not well controlled or widely recognized as toxic. Government bodies continue to study these chemicals and substances, which include formaldehyde, chlorinated plastics (e.g., PVC), fire retardants, heavy metals, volatile and semi-volatile organic compounds (VOCs and SVOCs), and poly-aromatic hydrocarbons (PAHs) found in sealants, adhesives, cleaners and other materials, to better-understand their effects on human and animal health. Often, regulatory agencies address exposure not by controlling the substances themselves, but by providing guidance on appropriate handling standards, application conditions, and ventilation requirements (U.S. EPA 2010a). Cole (2001) notes health risks as a result of the release of toxic substance on construction sites can be minimized by selecting materials that are safe to handle; avoiding caustics, heavy metals, hazardous solvents, and hazardous fibers; and selecting construction products and methods that minimize long-term release of volatiles and trapped dust.

### A. Regulatory requirements (non-voluntary approaches)

Federal and state laws are the primary mechanisms for regulating human and wildlife exposure to toxic substances in the United States. The federal government regulates toxic substances through the Toxic Substance Control Act (TSCA) and the Resource Conservation and Recovery Act (RCRA). The Environmental Protection Agency and the Occupational Safety and Health Administration each have responsibility for managing toxic substances related to construction, building maintenance, and demolition. The Oregon Department of Environmental Quality is in the process of adopting an agency-wide toxics reduction strategy with four focuses: 1) optimize agency resources by focusing on high-priority pollutants; 2) implement regulatory actions that reduce toxins

at the source; 3) establish partnerships with other agencies and organizations to increase the effective use of resources; and 4) use environmental outcome metrics to measure the effectiveness of the strategy. The strategy is still under development and preliminary information should be released sometime in 2012 (Personal communication with staff Oregon DEQ).

Given the federal and state regulatory frameworks already in place, regulatory approaches to reducing toxic exposure in construction, maintenance, and demolition are not widespread at the local level. Most regulatory programs focus on hazardous waste and pesticide management, rather than the suite of chemicals widely used in construction and property maintenance practices. Legislation related to brownfield reclamation has also developed over the last few decades, but again is more focused on reducing exposure to hazardous waste, rather than the chemicals more commonly targeted for reduction by green building and sustainable building practices. Here are a few examples of regulatory strategies that governments have implemented targeted at hazardous waste and toxic substances.

- **Pass Right-to-Know (RTK) and Worker Right-to-Know laws.** RTK laws are designed to give workers and consumers information about the presence and identities of chemicals in products they may be in contact with (Stenzel 1992). Philadelphia passed a RTK law that covered both workers and the local community in 1981. After several other cities passed similar laws in subsequent years, the federal government enacted community RTK legislation in the Emergency Planning and Community Right-to-Know Act (EPCRA), also known as Title III. Stenzel (1992) indicates that response to RTK laws varies, with some citizens showing no interest, and others using the information to leverage “good neighbor agreements” with polluting companies and campaign for toxic use reduction laws. Researchers at Tufts University’s Center for Environmental Management found that ten years after the passage of EPCRA, industrial practices and attitudes toward chemical risk management are changing. At the same time, citizens interested in using the information are limited by barriers to data acquisition and interpretation (Stenzel 1992). The Tufts researchers suggest that local governments are not providing sufficient technical assistance to citizens interested in interpreting and using the data. Weil et al. (2006), investigating the degree to which information-disclosure policies affect decision-making processes of individuals, suggest that disclosure of workplace hazards and toxic releases both have low level of influence over day-to-day decisions because data are difficult to obtain, complex, and require specialized knowledge to interpret. As a result, these types of programs have not been particularly effective in changing people’s activities and behaviors.
- **Pass Toxic Use Reduction laws and policies.** Massachusetts has one of the oldest and most widely studied Toxic Use Reduction acts (TRUAs), the Toxic Use Reduction Act of 1989 (Ellenbecker and Geiser 2010). Oregon followed Massachusetts’ lead in 1989 by enacting the Toxic Use and Hazardous Reduction Act, which was revised in 2005 (Oregon Department of Environmental Quality 2011). It requires certain generators of hazardous wastes regulated under U.S. EPA’s Toxic Release Inventory program to develop management plans for

limiting the use of toxics and addressing the risks associated with the chemicals of concern.

- **Restrict or ban specific types of toxic substances.** Some jurisdictions ban certain materials to ensure the health and safety of construction workers and occupants. For example, in 1997, France banned the use of asbestos in all materials, including asbestos-cement. Likewise, in 2003, the United States banned manufacturers from treating wood with Copper Chromate Arsenate (CCA) preservative in all new residential buildings. (Kua 2006) More recently, bans of emerging toxic substances, such as Bisphenol-A (BPA) in certain applications, have been considered by local and national governments (NRDC 2010). While the ban on BPA will have no consequences for exposure through construction and building practices, it may foreshadow potential future actions against other chemicals of emerging concern.
- **Pass local ordinances and state laws specifying toxic reduction practices for public spaces and contractors.** The City of San Francisco has implemented toxic reductions on city property and city development projects. One of its most successful efforts is its Integrated Pest Management Program, which requires by ordinances that all City departments and City contractors who apply pesticides to City property eliminate or reduce pesticide applications to the maximum extent feasible. It does not apply to private property, but does extend to private contractors working on City property. The City's Integrated Pest Management Program Manager releases annual reports of the City's progress toward meeting the maximum extent feasible provision. Since the beginning of the program, San Francisco has reduced the application of pesticides by 88 percent of volume and 85 percent of active ingredient (City of San Francisco 2009). Oregon Toxics Alliance is campaigning for Oregon to adopt a similar effort statewide through the Safe Public Places Campaign. The project calls for a 70 percent reduction in the amount of pesticides used in public parks, around public buildings, and on public roads. Oregon Toxics Alliance points out that in 1991 Oregon became one of the first states to reduce the amount of pesticide used by public agencies, an effort that ceased in 2001 when the law expired (Oregon Toxics Alliance 2010).
- **Levy a tax on specific types of toxic substances.** Washington State levies a tax of .007% of the wholesale value of the first possession of hazardous substances. The tax applies over 8,000 different hazardous substances, including petroleum products, pesticides, and other chemicals (Washington Department of Revenue 2010).

## **B. Market and social incentives (voluntary strategies)**

Legislative efforts in Ontario, Massachusetts, and other jurisdictions are effectively coupled with market and social incentives to promote greater toxic reduction achievements. These incentives aren't specifically targeted at the construction industry, but companies that supply materials and perform construction work likely benefit from these strategies.

- **Frame toxic reduction as an economic efficiency program.** Jurisdictions that have implemented comprehensive toxic reduction strategies have realized economic benefits by reducing the amount of toxic substances they use. In

Massachusetts, both the public and private sector realized economic benefits. In a program evaluation of the Toxic Use Reduction Act (TURA), 67 percent of business survey respondents reported experiencing a direct cost savings on materials use and waste disposal fees. Overall, a benefit-cost evaluation of the law indicated firms saved \$88.2 million in benefits from reduced operating costs (Massachusetts Toxics Use Reduction Program 1997). In 2008, the Toxic Use Reduction Institute conducted a follow-up survey, which revealed that TURA continues to provide economic benefits to firms: 40 percent reported achieving financial savings from implementing TURA during 2000-2006 period, almost 30 percent reported achieving improvements in production efficiency, and one-third of respondents reported experiencing benefits related to lower compliance costs with other state and federal regulations (Massey et al. 2009).

- **Provide tax credits or reimbursements to homeowners and contractors for toxic substance reduction.** The Toronto Region Sustainability Program provides a 50 percent funding cost share (up to \$7,000) to cover expenses related to Pollution Prevention Assessments. The regional program also links consultants trained in Pollution Prevention assessment (P2) to interested businesses (TRSP).
- **Provide awards, recognition, and social goodwill to contractors engaged in toxic substance reductions.** Starting in 1994, Massachusetts gave out the Governor's Awards for Outstanding Achievement in Toxics Use Reduction Program. The awards for 1998 recognized Boston Retail Products, a global manufacturer of custom retail fixtures sold in home centers. The firm reduced toxic substances by implementing a program to reduce VOC emissions from spray-paint coating operations by using alternative paint formulations. The program ultimately reduced VOC emissions by 86 percent and resulted in a savings of about \$150,000 per year in reduced hazardous waste costs, reduced worker down time, and increased process efficiency (Toxic Use Reduction Institute 2010).
- **Provide grants for programs that provide toxic reductions.** The Community Grants program of the Toxics Use Reduction Institute (TURI) has demonstrated success using this tool. Launched in 1995, the mission of this program is to promote "reductions in the use of toxic chemicals or the generation of toxic byproducts" in Massachusetts. TURI provides seed money on an annual, competitive basis to community groups and municipalities with application objectives that best reflect the group's mission statement (Blackman 2001). Blackman (2001) notes that "the successful project were those that had strong cross-sector partnerships as well as...a team that a leader could lead."

### **C. Education, Research and Development, and Technical Assistance**

Many studies note that increasing information and awareness of these issues is not sufficient to effectively change behavior, particularly when examined on the household level. Freeman and Skumantz (2010), Harris et al (2010), and Werner (2003) all emphasize the importance of two-way communications – both between officials and their audience and peer groups. Other studies, including Simon (2010) and Tucker and Douglas (2006), note that peer pressure is a powerful influencer on household behavior that can drive behavior change, particularly when applied in different, subtle ways.

- **Publish documents and studies to promote toxic reductions among homeowners and contractors.** The Scottish Ecological Design Association funded a guide on design and detailing for reducing toxic chemicals in buildings during construction. The guide seeks to minimize the toxic loads in construction, projects, and the built environment to create a safer and healthier environment for workers and occupants (Liddell Gilbert and Halliday 2008).
- **Provide technical assistance to homeowners and contractors pursuing toxic substance reductions.** With support from strong regulatory requirements, the Ontario Toxics Reduction Strategy provides programs and technical assistance to replace and reduce toxic chemicals with other less polluting substances and introduce new innovative technologies is a comprehensive program (Ontario Ministry of the Environment 2008). These programs include: (1) a forthcoming industry assistance program that includes support for facilities undertaking toxic reduction accounting and (2) training and accreditation for toxic substance reduction planners whose certification of plans is required under the regulation. Likewise, the city of San Francisco provides technical assistance and general resources for private property managers and homeowners to implement IPM programs and reduce pesticide applications (City of San Francisco 2011).
- **Use social networking to increase awareness of toxic reductions among homeowners.** Shultz and Tabanico (2010) apply the principals of Community-Based Social Marketing to household hazardous waste (Carlson Communications 2011). To effectively change behavior with CBSM, they recommend that officials: 1) focus interventions on a single, specific behavior; 2) tell people what *to do* not what *not to do*; and 3) use personal contact to increase the likelihood that people will change behavior. Moreover, Harris et al (2010) note that to successfully change behavior with this type of initiative, officials should apply social marketing tools that have public health and other officials have used successfully. These include commitment, goal-setting, prompts, and communication of social norms (Carlson Communications 2011).

### 3. Preserve and Enhance Habitat through Building and Landscaping

Development practices inevitably produce effects on wildlife habitat, many of them adverse. Development that occurs on open space, often called greenfield development, permanently alters the landscape and has lasting effects on aquatic and terrestrial habitat. The degree of impact depends on the type of development, and is typically proportional to the amount of land converted from pervious to impervious surface (Niemi and Lee 2008). Development that occurs in already urbanized areas, as infill or redevelopment, provides opportunities to increase habitat and improve water quality in urban waterways. Low-impact development practices, which emphasize maintaining infiltration capacity and integrating green infrastructure and functional landscapes into designs, are being refined and are gaining widespread acceptance in many regions of the country (U.S. EPA 2010b).

In 2010, the U.S. EPA released a report that described common approaches local governments have used across the U.S. to promote the adoption of habitat-friendly development and increase the use of green-infrastructure to manage stormwater. The nine approaches reach across the three categories we describe below. In its report, the EPA breaks the approaches into those that public agencies can initiate internally, while private

sector policies apply to private development and property. Table 5 shows the common policy approaches EPA identified through its case studies. In the report, EPA emphasizes that a collection of approaches may be most effective in creating change:

*No single policy or program will be a panacea for the challenge of how to integrate green infrastructure into the local landscape. Many of the policies work in tandem and fit within a context of several other complementary policies and programs. The greenest cities in terms of stormwater management use a wide range of policies and a number of approaches that focus on both public and private sectors. (U.S. EPA 2010b, pg. 5)*

**Table 5. Common Policy Approaches for Supporting Green Infrastructure**

City	Public					Private			
	Demonstration Projects	Street Retrofits	Capital Projects	Local Code Review	Education & Outreach	Stormwater Regulation	Stormwater Fee	Fee-based incentives	Other Incentives
Alachua Co., FL	X		X			X			
Philadelphia, PA	X	X	X	X	X	X	X	X	
Portland, OR	X	X	X	X	X	X	X	X	X
Seattle, WA	X	X	X	X	X	X	X	X	X
San Jose, CA	X	X		X		X			
Santa Monica, CA		X	X	X	X	X	X		X
Stafford Co., VA	X			X		X			
Wilsonville, OR	X	X	X	X		X			
Olympia, WA	X	X		X	X	X	X		
Chicago, IL	X	X	X	X	X	X			X
Emeryville, CA	X	X		X		X	X		
Lenexa, KS	X	X	X		X	X	X		
Total	11	10	8	10	7	12	7	3	4

Source: U.S. EPA 2010 (pg. 5)

#### **A. Regulatory requirements (non-voluntary approaches)**

Habitat protection is accomplished through a variety of regulatory strategies at the local, state, and federal levels in the United States. Legislation, foremost through the Clean Water Act, requires private property owners to comply with a host of permitting requirements that seek to protect wetlands and the quality of navigable waterways. The Endangered Species Act and the National Environmental Policy Act add additional layers of protection for sensitive resources. States and local jurisdictions are charged with implementing these federal statutes, and often add additional protections of their own. Regulatory programs to protect sensitive species, water quality, and other natural resources abound. One difficulty in relying on regulation to promote improvements in habitat quality is that regulations often, for legal or practical reasons, apply to new development, but much of the impact arises from existing development. Tailoring regulation to require existing developments to integrate green infrastructure through retrofits may yield considerable improvements in environmental quality in urban areas. These regulatory provisions may, however, be more controversial than those that impose requirements on new projects (Low Impact Development Center 2007).

Here we identified a few of the more innovative regulatory approaches local governments have used to increase the use of green infrastructure and protect and improve habitat in urban and suburban areas.

- **Require developers to use certain green infrastructure techniques to manage stormwater.** Maryland for example, requires all new development and redevelopment to use low impact development techniques to the maximum extent practical (Low Impact Development Center 2007). The City of Seattle similarly requires green stormwater infrastructure (GSI) to the maximum extent feasible (MEF) through its stormwater code (Tackett 2010). Seattle enforces the MEF standard unless developers can prove that physical site limitations, adverse environmental impacts, or unreasonable financial costs would prevent GSI from being used. To help developers integrate GSI into sites and determine whether they comply with the stormwater code, Seattle has developed a set of worksheets and an extensive stormwater manual (Tackett 2010). The City of Chicago requires a minimum reflectance for low and medium sloped roofs to mitigate the urban heat island effect, but allows developers to meet this requirement with green roofs (Spangler 2007).
- **Require developers to meet certain landscaping requirements.** Seattle’s Green Factor is a regulatory approach to promote environmentally-functional landscapes in urban areas, without actually dictating which practices, plants, and hardscapes must be used. Instead, it awards points for incorporating into new development projects larger plants, permeable paving, green roofs, vegetated walls, protection of existing vegetation, layered vegetation, food cultivation, native and drought-tolerant plants, and rainwater harvesting. Each practice is weighted by its environmental value (or “green factor”) and practices are scored based on square foot or equivalent metric devoted to the practice. Green Factor requires developments in some zoning districts to achieve a minimum score equivalent to about 30 percent of the site devoted to sustainable landscaping. A worksheet allows developers to experiment with different combinations of landscaping choices and to ensure they achieve the minimum number of points necessary to comply with the regulation (Seattle Department of Planning and Development 2011 and Low Impact Development Center 2007). Green Factor is modeled on similar programs in Berlin, Germany and Malmo, Sweden, and is the first such program in the United States (Hirst et al. 2008).

## **B. Market and social incentives (voluntary strategies)**

Increasingly, jurisdictions are turning to market incentives to achieve greater improvements in habitat quality than regulations alone are able to create. Market and social incentives may induce existing property owners to improve the environmental function of their land when they otherwise aren’t required to do so through regulation. As we point out above, encouraging these incremental improvements to already-developed land may be critical in mitigating existing natural-resource degradation in urban and suburban areas. (Low Impact Development Center 2007).

### **Market Incentives**

- **Tie stormwater and development fees to a development’s level of impact.** Many local governments have established stormwater utilities that levy fees to

manage stormwater runoff (U.S. EPA 2010, Doll, Scodari, and Lindsey 1998). When these fees are tied to functional indicators of a property's impact, such as area of impervious surface contributing to runoff into the stormwater system, the fee can serve as an incentive for the property owner to develop in a way that reduces environmental impacts and increases the land's ability to provide ecosystem services (Parikh et al. 2005). The City of Bellingham, WA, for example, provides up to a 50 percent reduction in stormwater development charges if the property meets certain criteria and charges lower annual stormwater utility fees based on reductions in impervious surfaces on the project (City of Bellingham).

There is considerable discussion in the literature about the promise of stormwater fee programs, as long as the fees are set high enough to account for the environmental damage they are intended to mitigate and to induce changes in behavior (Doll, Scodari, and Lindsey 1998, Parikh et al. 2005, Low Impact Development Center 2007). In 2010, Philadelphia implemented a new parcel-based fee and crediting program that, according to some sources, is the first program in the nation to set its fees high enough and offer a credit large enough to influence the behavior of large-scale developers (Szalay 2011). To encourage commercial property owners to invest in LID practices and reduce their stormwater fee, Philadelphia offers free design assistance to identify retrofits that will work on their property. In the last year, owners of 35 properties covering over 1,000 acres of land have taken advantage of the free assistance and several have moved forward with projects. Philadelphia has also created a "walk-in" design assistance program to assist smaller property owners. Nearly a year into the new program, managers have initiated a full review to determine what is working and what needs adjusting. Results of the evaluation are forthcoming.

Szalay (2011) contrasts Philadelphia's credit program with Portland's well-established Clean River Rewards crediting program, which has not produced similarly compelling results, largely because the credit is not large enough to induce property owners to invest in stormwater systems they wouldn't otherwise have installed. By contrasting the Philadelphia and Portland experiences, Szalay underscores a central reality of fee and credit programs: crediting the fee reduces the amount of revenue the City otherwise would collect. If the fee induces developers to make changes that ultimately reduce the City's costs to manage stormwater, it may make sense; if not, credits may destabilize the City's ability to provide services in the long run. As Szalay and others (Doll, Scodari, and Lindsey 1998) emphasize, careful planning must precede the adoption of any credit/fee program.

- **Provide tax credits or rebates for homeowners and developers who implement LID techniques on their properties.** The RainScapes Rewards Program in Montgomery County provides rebates for the cost of materials property owners who implement LID techniques on their properties incur (Montgomery County Department of Environmental Protection 2011). The program provides a maximum rebate of \$1,200 for projects constructed on residential property and \$5,000 for projects on commercial, multi-family, and institutional property. The rebates are funded through annual charges assessed on a property's impervious surface and collected through property taxes. As part of the rebate program, the property owner must agree to be part of public outreach activities, place signage

near their project, and allow the Montgomery County Department of Environmental Protection to conduct evaluation and monitoring activities. Bitting (2009) notes that tax credits and rebates are an appropriate strategy to encourage green redevelopment efforts and argues officials can justify the reductions in revenue from this type of policy by the decreased demand on municipal services provided by the green infrastructure.

The City of Chicago's Sustainable Backyard Program is another example of a program that provides rebates for property owners who adopt sustainable practices on their property. Property owners receive rebates for purchasing rain barrels, compost bins, trees, and native plants (City of Chicago 2011). A study of the rain barrel rebate portion of Chicago's program identifies several factors local governments can influence to increase property owners' willingness to adopt such practices. In a draft working paper, Ando and Freitas (2009) found that distance from distribution points is an important determinant of adoption: program managers may be able to increase total adoption by providing home delivery or provide more distribution sites across a region. They also suggest increasing distribution sites in areas that have higher impacts from stormwater runoff, to maximize the value of environmental benefits per rebate offered.

- **Provide incentives that reduce permitting costs to developers that use LID.** In 2010, the City of Philadelphia commissioned a study to review and streamline its notorious permitting process for development. The study included a review of best practices that other cities (with populations over 500,000) have adopted to increase the efficiency of obtaining a development permit. In many cases, these practices are only triggered for projects that include sustainable components, such as LID or LEED certification (Hsueh 2010). Chicago and Washington D.C., for example, both offer expedited permit review at no added cost for projects that produce social or community benefits, such as green buildings. Philadelphia also offers a 5-day accelerated review time for projects that implement green stormwater controls. King County provides a dedicated "green track" for green building and low-impact development projects, in which staff with expertise in alternative green design and construction practices conduct reviews as part of a "green team" (King County 2009).
- **Provide incentives that increase private benefits to developers that use LID.** These incentives typically provide exceptions to certain zoning provisions, such as density and height requirements and the amount of land dedicated to public rights-of-way, in exchange for using green building or LID techniques for managing stormwater. Exceptions are also provided for establishing interconnecting greenways, protecting highest quality natural areas, and protecting sensitive habitat (Minnesota Department of Natural Resource 2001). These types of incentives typically result in increased profits or revenues for the developer, which can help offset any increased cost for implementing sustainable practices. It can be particularly helpful for increasing the adoption of higher-cost LID strategies, such as green roofs. In Portland and Chicago, for example, developers of buildings in the central city can receive bonus floor-area ratio depending on the level of green-roof coverage (Water Environment Research Foundation 2009).

- **Provides grants or funding for LID projects and LID innovation.** The Washington State Department of Ecology provides grants for LID Standards Implementation Project to help cities and counties draft LID standards with the help of a consultant and a technical team. This program has helped Poulsbo, WA overcome obstacles – including limited time, resources and technical knowledge – to drafting LID standards (North Kitsap Herald). The Washington Department of Ecology also provides grants to local governments for stormwater construction projects that use low impact development techniques.
- **Establish tradable credits to offset water quality degradation.** For example, companies in Pennsylvania may use offsets and tradable credits to reduce the impact of pollution activities and protect and maintain water quality in the Chesapeake Bay (The Commonwealth of Pennsylvania).

### Social Incentives

- **Provide awards, recognition, and social goodwill for contractors implementing low impact development techniques.** Provide marketing opportunities and in some cases monetary awards for implementing LID and other green building techniques (EPA 2009). The Leadership in Low Impact Development Recognition Program provides awards to recognize LID projects and serve as a leadership model for LID programs across the country. Award areas include contractors and builders (Low Impact Development Center).

### C. Education, Research and Development, and Technical Assistance

This is one of the largest categories of programs local governments provide to promote sustainable stormwater and habitat-friendly development practices. Education and outreach is a required component of EPA’s regulatory program for stormwater management, so every local government that must comply has developed strategies for providing public education. These strategies are usually coupled with and intended to further compliance with regulatory requirements. There is a wide body of literature suggesting strategies to craft a successful outreach and education effort. Neiswender and Shepart (2003), for example, offer several elements based on their review of stormwater education programs in the upper Midwest:

1. Use outcomes-based education principles, focusing on specific audiences with specific action-oriented messages.
2. Target specific audiences with specific messages based on their responsibilities and ability to act.
3. Partner education with technical expertise to communicate complex concepts in understandable but technically correct ways.
4. Coordinate multi-jurisdictional and multi-agency efforts to enhance messages, gain efficiencies in communication, and pool educational dollars.
5. Evaluate programs to measure effectiveness.

Neiswender and Shepard’s (2003) final recommendation is important, but the lack of rigorous evaluations we uncovered during our review suggests this element is often ignored. Other researchers have noted similar shortcomings (Galvin 2005). Education

programs typically are not evaluated to measure their effectiveness at changing behaviors, but a few studies suggest that education can produce measurable benefits (Dietz, Clausen, and Filchak 2004).

Education strategies often target the general public and households. An even more important target of education and technical assistance may be the professionals involved in designing and engineering development and redevelopment projects. In a series of interviews with developers, engineers, and permitting officials in three local jurisdictions with progressive stormwater regulations, the primary recommendation that emerged for increasing the adoption and improving the efficiency of implementing sustainable stormwater practices was to increase education and technical assistance opportunities for engineers responsible for stormwater infrastructure (Reich and MacMullan 2011). Other studies have drawn similar conclusions regarding the adoption of LID and ecological designs in landscape architecture (Matel 2010, Calkins 2005).

- **Provide technical assistance and resources related to low impact development and green building practices.** The Washington Stormwater Center (or WSC, a joint program of the Washington State University and University of Washington) provides technical assistance and resources in four primary program areas: municipal resources, business resources, low-impact development and TAPE (emerging technologies). In each of these areas, WSC provides workshops and trainings, assistance through the permitting process, database of relevant publications, and index of best management practices. In addition, the TAPE program develops, tests and approves best management practices and new stormwater technologies.
- **Use social networking to increase awareness of habitat enhancement techniques through building and landscaping.** Clean Water Services, a water resource management utility in the Tualatin River Watershed, initiated a public awareness campaign to encourage local residents to plant native plants in their yards. Kyle and DeBaker (2011) caution that campaigns that rely solely on providing information often have little or no effect on behavior. To effectively change behavior, officials must move from public information campaigns to action-based communication that has identified the local barriers to implementation. Water Environment Services in Clackamas County asks the local community to “take the pledge for watershed health” and commit to protecting local rivers and streams.
- **Subsidize a demonstration project.** The City of Olympia, Washington reconstructed two blocks of Decatur Street with permeable pavement as an LID demonstration site (WA Department of Ecology). The project uses traditional pavement materials and infiltrates runoff under the roadway. The City of Chicago also encourages the use of green roofs by sponsoring installations and demonstration sites. For example, in 2006 the City offered two hour windows in a variety of locations around the city for residents to buy discounted rain barrels, which officials demonstrated on-site so buyers could ask questions (Spangler 2007).
- **Encourage or provide training programs to help homeowners enhance habitat through building and landscaping.** The East Multnomah Soil and Water

Conservation District provides free workshops to help local residents landscape their own yards with native plants, natural landscapes, and water-friendly gardening practices (EMSWCD). In Washington, DC the Department of Health provided rain barrels for free at public training sessions, where officials explained the benefits of rain barrels, gave tips on installation and maintenance. Spangler (2007) notes this program distributed less than 100 barrels because many residents did not have the capacity to transport the barrels back to their homes.

#### 4. Reduce Upstream Impacts of Building and Landscaping

This goal addresses the impacts of building and landscaping more holistically. It provides an avenue to create programs and strategies that address energy use, carbon emissions, and air and water pollution from extraction of raw materials and manufacture of goods used in construction and landscaping activities. Our review of the literature in this area found extensive overlap with the programs and strategies outlined in the other three goals. When designed well, strategies and programs aimed at reducing waste, exposure to toxics, and protecting and improving habitat also tend to reduce overall energy use, carbon emissions, and upstream air and water pollution. Planners often design those other strategies well-aware of the larger beneficial effects—the positive externalities—they have on upstream systems.

##### A. Regulatory requirements (non-voluntary approaches)

- **Adopt energy efficiency requirements in building codes.** Contractors can use strategies like proper siting and airtight construction, and can install energy-efficient equipment and appliances to reduce the amount of energy a building needs to operate. Such strategies can significantly reduce overall energy consumption.
- **Ban specific types of construction materials.** A municipality could ban the importation of certain types of topsoils and soil blends. This follows from the Sustainable Sites Initiative recommendation that contractors never use topsoil or soil blends from prime farmland, unique farmland, farmland of statewide importance, or other greenfield sites, unless those soils are a byproduct of a construction process. (Sustainable Sites Initiative 2009)
- **Levy a tax on certain natural resources.** Tax products that create pollution when manufactured, consumed, or destroyed. For example, some jurisdictions have levied a virgin material tax in the wood industry by collecting a severance tax for the felling of trees. Other jurisdictions use a resource rental, which is a competitive bidding and area-based tax (e.g. for purchasing rights to logging) (Kua 2006).
- **Require some private development to conform to green building standards.** The city of Boulder, CO requires some level of green building measures for all housing constructed within the city limits and enforces this requirement through the building permitting process (Kibert 2002). Similarly, Boston and Washington, DC require buildings above a certain size to meet minimum green building requirements (Pollard 2009). The City of West Hollywood, CA adopted a zoning

provision that imposes minimum green building standards on all new construction projects.

- **Require government buildings to conform to green building standards.** The city of Seattle requires all municipal buildings conform to the LEED Standard.
- **Overhaul local laws and regulations that promote sprawling development.** Pollard (2009) notes that municipalities should replace zoning codes that require “separation of uses, large minimum lot sizes, and minimum setbacks” with “provisions that facilitate compact, mixed use development and a diversity of housing types in more areas.”

## **B. Market and social incentives (voluntary strategies)**

- **Award project grants and other awards and prizes through an application or a competitive process.** King County, WA provides grants and programs for whole building and component energy-efficiency approaches. The county offers up to 70 percent of the incremental costs for many high-efficiency electric and natural gas applications. The County will grant developers between \$0.60 and \$1.80 per square foot for large, complex buildings that achieve 10 to 30 percent energy efficiency improvements compared to the energy code (King County 2010).
- **Provide subsidies, reduced building permit fees, or tax credits for companies purchasing sustainable materials.** Governments can lower barriers to investment in green projects by providing incentives that lower project costs. New Mexico, for example, provides an escalating tax credit for green buildings, depending on level of LEED certification (Pollard 2009). Washington State offers incentives ranging between \$0.12/kWh and \$1.08/kWh for businesses that produce electricity using solar thermal, photovoltaics, wind, or anaerobic digestion to produce power (King County 2010). Likewise, municipalities can encourage homeowners to invest in green development by providing property tax credits for homeowners or property owners.
- **Provide subsidies, reduced building permit fees, or tax credits for buildings with energy efficiency measures on home improvement and new residential construction.** The U.S. Federal Energy Policy Tax Credits give a tax deduction of up to \$1.80 per square foot to owners and designers who save at least 50% of the heating and cooling energy of a new or existing commercial building. The program also offers a Residential Energy Efficiency Property Tax Credit of up to 30% for primary residence homes (<http://www.energytaxincentives.org/>).
- **Provide awards, recognition, and social goodwill for companies engaged in reducing upstream impacts.** The Business in the Community, a UK consortium of sustainably-minded companies, launched the Corporate Responsibility Index which benchmarks the corporate social responsibility performance of companies and rates company management practices that impact the community, environment, and workplace.
- **Provide financial and process incentives for developers pursuing green building projects.** Pollard (2009) notes that some of these include: revolving loan funds, funding the certification of green buildings, and providing an increased

mortgage deduction for green, location-efficient buildings near public transportation.

- **Reduce subsidies that work against green communities.** For example, some transportation funding is biased toward new highway construction and against alternatives to driving.

### C. Education, Research and Development, and Technical Assistance

- **Facilitate or encourage participation in a performance-based standards or benchmarking scheme.** In this option, a jurisdiction would publish a standardized scheme that assesses the entire life-cycle sustainability performance of a material or system of products (Kua 2006). In the UK the BRE Environmental Assessment Method publishes the Green Guide, an accredited environmental rating scheme for buildings. BRE bases its environmental rankings of nine different elements<sup>1</sup> on life-cycle assessments of each of the products. They assign a rank between A+ and E for those materials based on a variety of environmental indicators.<sup>2</sup> Likewise, the National Fenestration Rating Council (NFRC) developed a voluntary, national rating system for windows and doors to allow builders and consumers to compare the efficiency of various products. Kibert (2002) recommends policy makers couple this incentive with an information campaign to explain certification and labeling schemes to consumers.
- **Form new partnerships with a variety of stakeholders.** Some communities use private and non profit organizations to help them modify their building codes and standards and others work with private industries to develop workshops on building design or best environmental practices for home building (Augenbroe 1998).
- **Encourage the adoption of ISO 14000 or ISO 9000.** These are quality management systems that are required by law in the construction industry in some countries, like Singapore, but are voluntary in most of the world.
- **Subsidize a demonstration project.** Often an integral part of an R&D program, officials use demonstration projects to demonstrate and assess the feasibility and viability of innovative projects and techniques. For example, the state government of Texas subsidized the construction and operation of the Eco-industrial Park in Brownsville, TX to demonstrate the concept of industrial ecology and industrial symbiosis. Researchers and government officials also used the project to collect data on the generation and reuse of industrial waste. Similarly, other communities use low-income weatherization programs to fund energy efficiency improvements or build green affordable housing near transit (Pollard 2009).
- **Conduct outreach programs.** The American Forest & Paper Association promotes its Sustainable Forest Initiative (SFI) through a series of industrial

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<sup>1</sup> These elements are external walls, internal walls and partitions, roofs, ground floors, upper floors, windows, insulation, landscaping, and floor finishes.

<sup>2</sup> These include climate change, water extraction, mineral resource extraction, stratospheric ozone depletion, human toxicity, ecotoxicity to freshwater, nuclear waste, ecotoxicity to land, waste disposal, fossil fuel depletion, eutrophication, photochemical ozone creation, and acidification.

outreach projects that introduce firms and forest owners to the objectives and initiatives of the SFI. Likewise, the EPA's Landfill Methane Outreach Program is an example of a public outreach program that promotes the use of landfill gas as a renewable, green energy source (Kua 2006).

- **Fund an R&D program.** Agenda2020 is a government-backed R&D program that partners industry participants with government and academia to accelerate U.S. forest products industry innovation in process, materials, and markets. Kua (2006) points out that many of these programs neglect the social aspects of sustainability, including employment related factors. He recommends policymakers integrate job creation programs like the Jobs-Through-Recycling Program into R&D programs like Agenda2020 to foster closer ties between these objectives.
- **Encourage or provide training programs and technical assistance to increase understanding of the upstream impacts of landscape and development and facilitate adoption among contractors and homeowners.** The City of Bellingham, WA provides free technical assistance and free green building program technical assistance to encourage the use of sustainable development and building practices.
- **Publish documents and studies to promote awareness of the upstream impacts of construction among homeowners and contractors.** The New Zealand Business Council for Sustainable Development publishes a variety of documents/studies that both promote sustainability and suggest actions public and private parties can take to achieve sustainability goals.

## REFERENCES AND ANNOTATED BIBLIOGRAPHY

Ando, A.W. and L.P.C. Freitas. 2009. *Consumer Demand for Green Technology in an Urban Setting: The Case of Chicago Rain Barrels*. Retrieved October 16, 2011, from <http://ssrn.com/abstract=1440877>

**Summary.** This preliminary working paper describes the results of a study that investigated the consumer participation in Chicago's rain barrel rebate program. The study used data on the spatial distribution of rain barrel rebates across the city to identify factors that influenced adoption, including income levels, political persuasion, environmental factors including incidence of flooding, type of housing, and distance to distribution centers. The study provides insights for program managers on strategies to increase participation levels and maximize the benefits of the rebate program.

Associated General Contractors of America (AGC). No Date. *Recycling Toolkit: The Contractor Toolkit for Recycling and Using Recycled Industrial Materials*. Retrieved October 9, 2011, from [http://www.agc.org/cs/recycling\\_toolkit](http://www.agc.org/cs/recycling_toolkit).

**Summary.** AGC developed this tool in cooperation with U.S. EPA to provide resources – including references and links to other websites – for contractors who are looking to reduce, reuse, or recycle (R3) construction and demolition (C&D) materials generated at their job sites and contractors who want to use recycled materials in the construction or renovation of a building. The resources also include “how to” guides and relevant case studies.

Augenbroe, G., A.R. Pearce, B. Guy, and C.J. Kibert. 1998. *Sustainable Construction in the United States of America: A Perspective to the Year 2010*. Georgia Institute of Technology, College of Architecture, Construction Research Center. Report No. CIB-W82.

**Summary.** This article presents a variety of concerns, constraints, and issues currently facing the sustainable building industry in the United States and introduces a variety of national initiatives and programs that public organizations have put into place to address these barriers.

Barron, W.F. and G.T.L. Ng. 1996. “An Assessment Methodology for Environmental Policy Instruments: An Illustrative Application to Solid Wastes in Hong Kong.” *Journal of Environmental Management* 48: 283-298.

**Summary.** Using solid waste management in Hong Kong as a case study, this paper outlines a methodology for the systematic assessment of policy instruments government officials use for environmental management. The paper develops a set of evaluation criteria, selects the relevant combination of potential policy instruments, and ranks each set of policy instruments on the basis of the prior-established criteria.

Blackman, A. 2001. *Encouraging Reductions in Households' Use of Toxic Products Through Local Partnerships: Lessons for Sustainable Consumption Initiatives*. Massachusetts Toxics Use Reduction Institute. Paper presented at the Organization for Economic Cooperation and Development's “Experts Workshop on Information and Consumer Decision-Making for Sustainable Consumption.” Paris, France: January 16-17.

**Summary.** This paper summarizes the University of Massachusetts' Toxic Use Reduction Institute and its Community Grants program, including the key lessons officials have learned during implementation of the program and reviews some of the program's successes. The paper also presents some sample projects, including the Springfield Toxics Awareness and Reduction program.

BuiltGreen. 2011. *2010 Built Green Incentives Guidelines & Application, 2<sup>nd</sup> Round*. Retrieved October 9, 2011, from <http://www.builtgreen.net/incentive.html>.

**Summary.** This website provides information on the application process for the Built Green program. In this program King County provides funds to builders and contractors to offset the cost of certifying and designing innovative green residential remodel projects. The website includes information on how to submit an application, relevant performance requirements, selection criteria, and eligibility.

Calkins, M. 2005. "Strategy Use and Challenges of Ecological Design in Landscape Architecture." *Landscape and Urban Planning* 73: 29-48.

**Summary.** This peer-reviewed article reports the results of a survey of landscape architects to determine the frequency of use of common ecological design landscape strategies and the obstacles and challenges that result in non-use. The study found that lack of information, perceptions of cost, time available for research, and resistance among permitting officials and clients combined to present barriers to wider adoption. The author concludes that the study's results highlight a strong need for informational forums for practitioners and education efforts directed at all stakeholders.

CalRecycle. 2009. "Chapter 4: C&D – The Law and Monetary Incentives." *Best Practices in Waste Reduction Videos*. Retrieved October 9, 2011, from <http://www.calrecycle.ca.gov/Video/2009/20090826BestPracChap4.aspx>.

**Summary.** This video is part of a series that shows contractors a variety of options for recycling, reducing, and reusing solid waste products. The video overviews several types of waste materials and gives information on best practices for contractors to reduce their waste streams.

CalRecycle. 2010. *C&D Recycling Toolkit for Contractors*. Retrieved October 9, 2011, from <http://www.calrecycle.ca.gov/ConDemo/Toolkit/default.htm>.

**Summary.** This website presents a resource for builders looking to understand what materials their projects will generate and to plan for and increase C&D reuse and recycling. They also provide fact sheets with general background information on markets for recycling.

Carlson Communications. 2011. *Sustainable Behavior Change Marketing and Communications: Annotated Bibliography*. Prepared for Metro. 8 April.

**Summary.** This document reviews a number of papers and articles which studied the effectiveness of social media and communication in changing household behavior,

particularly in the areas of sustainability. The document summarizes several studies of note and presents key findings from a number of data sources.

Guroi, K. 2006. "Low Impact Development Ordinance and 2005 King County Surface Water Design Manual Background Summary." Prepared for City of Sammamish Planning Commission. 1 November.

**Summary.** This memo outlines the variety of ways the City of Sammamish, Washington has addressed the impact of potential development in areas sensitive to increased surface water volumes. It reviews the King County Surface Water Design Manual update and lists incentives and techniques compiled from a number of sources, including the surrounding 10 cities, that have implemented LID ordinances.

City of Bellingham. *City of Bellingham Municipal Code*. 15.16.030 – Storm and Surface Water Service Rates. Retrieved 10 October 2011, from <http://www.cob.org/web/bmcode.nsf/33da36e7d5c2d55188256eb7006cb803/C317D1BE39B851128825615D007038C1>.

**Summary.** This is the portion of the City of Bellingham's Municipal Code that addresses storm and surface water service rates.

City of Portland. 2008. *Downspout Disconnection Program: Administrative Rules*. Environmental Services. November.

**Summary.** This document outlines the program history, policy goals, guiding principals, reimbursement policies, mandatory program areas, and policies and procedures associated with the City of Portland's Downspout Disconnection Program.

City of San Francisco. 2009. *San Francisco Department of the Environment, Integrated Pest Management Program, Annual Report 2008-2009*. Retrieved October 9, 2011 from [http://www.sfenvironment.org/downloads/library/final\\_ipm\\_rpt\\_200809\\_final\\_submitted.pdf](http://www.sfenvironment.org/downloads/library/final_ipm_rpt_200809_final_submitted.pdf).

**Summary.** This report describes the progress made by the City of San Francisco's Integrated Pest Management Program to the Board of Supervisors. It summarizes the program's achievements, analyzes data on current use of pesticides within the City, and summarizes specific information on the City's departments that conduct the majority of the pest control on City property.

City of San Francisco. 2011. *Pest Management (IPM)*. Retrieved October 9, 2011, from [http://www.sfenvironment.org/our\\_programs/topics.html?ssi=2&ti=1](http://www.sfenvironment.org/our_programs/topics.html?ssi=2&ti=1).

**Summary.** This document reports on San Francisco's approach to non-toxic pest management called Integrated Pest Management. This program controls pests using regular monitoring, various tactics to keep pest numbers low enough to prevent intolerable damage or annoyance, and least-toxic chemical controls as a last resort.

Cochran, K., et al. 2007. *Government Policies for Increasing the Recycling of Construction and Demolition Debris*. Clay County Solid Waste Division. September 1. Retrieved October 9, 2011,

from [http://www.dep.state.fl.us/waste/quick\\_topics/publications/shw/recycling/InnovativeGrants/IGYear7/finalreports/ClayIRGRecyclingFinalDeliverable\\_10\\_23\\_2007.pdf](http://www.dep.state.fl.us/waste/quick_topics/publications/shw/recycling/InnovativeGrants/IGYear7/finalreports/ClayIRGRecyclingFinalDeliverable_10_23_2007.pdf).

**Summary.** This paper describes regulatory initiatives that promote C&D debris recycling, defines policies that governments can use to encourage C&D debris recycling, identifies locations in the U.S. that have implemented these policies, and discusses the lessons learned from these experiences. Using a literature review and a survey, the paper also identifies and evaluates categories of programs based on their potential for increasing the recycling rate, potential costs, and cost-effectiveness.

Cole, R.J. 2001. "Building Environmental Assessment Methods: Assessing Construction Practices." *Construction Management and Economics* 18(8): 949-957.

**Summary.** This paper describes the environmental problems posed by the building construction process and identifies the practical and methodological reasons for the limited inclusion of environmental assessment methods in building construction practices. The paper also offers potential solutions to this problem.

Commonwealth of Pennsylvania. 2010. *The Pennsylvania Code Online*. §96.8 Use of offsets and tradable credits from pollution reduction activities in the Chesapeake Bay Watershed. Effective on October 9, 2010. Retrieved 5 October, from: <http://www.pacode.com/secure/data/025/chapter96/s96.8.html>.

**Summary.** This is the portion of the Commonwealth of Pennsylvania's Code that addresses the use of offsets and tradable credits from pollution reduction activities in the Chesapeake Bay Watershed.

Construction Industry Compliance Assistance (CICA). 2011. *The Construction Industry Compliance Assistance Center*. Retrieved October 9, 2011, from <http://www.cicacenter.org/solidregs.html>.

**Summary.** This tool compiles state and local regulations on C&D debris disposal, other compliance assistance, and P2 resources by state.

Cunningham, S. and S. Pasternak. 2011. *Construction and Demolition Recycling, Reuse, and Reduction Workshop*. North Central Texas Council of Governments. March. Retrieved October 9, 2011, from [http://www.nctcog.org/envir/SEELT/reduction/CD\\_Workshop\\_Presentation\\_03-09-11\\_final.pdf](http://www.nctcog.org/envir/SEELT/reduction/CD_Workshop_Presentation_03-09-11_final.pdf).

**Summary.** This presentation defines C&D and its impact on North Central Texas; presents some barriers to increasing recycling, reusing, and reducing of C&D waste; and describes long term building strategies, market development, and the role of public sector and private companies in C&D waste.

Dietz, M.E., J.C. Clausen, and K.K. Filchak. 2004. "Education and Changes in Residential Nonpoint Source Pollution." *Environmental Management* 34 (5):684-690.

**Summary.** This peer-reviewed article reports the results of a study the objective of which was to determine if education efforts that targeted homeowners in a suburban

neighborhood could improve water quality outcomes. The study paired two watersheds: water-quality was measured in each as an intensive resident education program was administered in one. Water-quality measurements showed marked improvements in several water-quality indicators during and after education efforts, which, the authors suggest, indicates local, state, and federal education efforts aimed at pollution prevention and BMP adoption might be successful.

Doll, A., P.F. Scodari, and G. Lindsey. 1998. *Credits as Economic Incentives for On-Site Stormwater Management: Issues and Examples*. Presented at the EPA National Conference on Retrofit Opportunities for Water Resource Protection in Urban Environments in Chicago, Illinois, February 9-12. Pages 113- 117. Retrieved October 16, 2011, from <http://stormwaterfinance.urbancenter.iupui.edu/PDFs/DollScodari.pdf>

**Summary.** This conference paper provides an overview of stormwater utilities as an economic mechanism to create incentives for property owners to manage stormwater onsite through green infrastructure and LID techniques. The paper presents examples of stormwater utilities' fee programs.

Earth Exchange. 2011. *Construction Waste Minimization and Exchange Site*. Retrieved October 16, 2011, from <http://www.earthexchange.com/Earth%20Exchange%20Brochure.pdf>

**Summary.** Earth Exchange is a UK construction waste minimization service that uses technology and mapping to help contractors and builders resolve soil, aggregate and building material issues. This service also matches builders and sites with companies that buy recycling materials.

Ellenbecker, M. and K. Geiser. 2011. "At the Source: the Origins of the Massachusetts Toxic Use Reduction Program and An Overview of this Special Issue." *Journal of Cleaner Production* 19: 389-396.

**Summary.** This paper reviews the Massachusetts Toxic Use Reduction Program, including the background and development of the program, the reasons Massachusetts adopted the law, the evolution of the idea after the law's implementation, and a brief history of the development of the concept of toxic use reduction.

East Multnomah Soil and Water Conservation District. *Free Workshops*. Retrieved 5 October 2011, from <http://www.emswcd.org/naturescaping/naturescaping-workshops>.

**Summary.** This website provides information on the East Multnomah Soil and Water Conservation District and its free workshops that assist people landscape their own yards in more sustainable ways.

Environmental Protection Agency. 2009. *Managing Wet Weather with Green Infrastructure: Municipal Handbook*. EPA-833-F-09-001. June.

**Summary.** This document lists incentive mechanisms municipalities around the United States currently use to promote green infrastructure. The document defines five primary

types of incentives for green infrastructure: stormwater fee discounts, development incentives, grants, rebates & installation financing, and awards & recognition programs.

Freeman, J. and L. Skumantz. 2010. *The Broadlands Project: Measuring the Effectiveness of Social Marketing*. Resource Recycling: 38-42. Quoted in Carlson Communications. "Sustainable Behavior Change Marketing and Communications: Annotated Bibliography." Metro. 8 April 2011.

**Summary.** This article reviews the literature on social marketing and reports the results of a pilot project in Broomfield, CO that sought to document the actual costs and impacts of a social marketing campaign to increase recycling.

Galvin, D. 2005. "Measuring Benefits from Outreach and Education Programs: Can We See Improvements Downstream?" *Proceedings of the 4<sup>th</sup> National Conference of Nonpoint Source and Stormwater Pollution Education Programs*. Chicago, IL. October 17-20. Retrieved October 17, 2011, from [http://water.epa.gov/polwaste/nps/upload/2006\\_11\\_21\\_NPS\\_2005\\_nps\\_outreach\\_proceedings-2.pdf](http://water.epa.gov/polwaste/nps/upload/2006_11_21_NPS_2005_nps_outreach_proceedings-2.pdf)

**Summary.** This conference paper highlights the lack of information available to determine whether education and outreach programs achieve water-quality improvements. The author emphasizes that a lack of information does not necessarily mean that education and awareness programs are ineffective, just that we have very little data to show a direct link between these efforts and improvements in water quality.

Guy, B. and N. Ciarimboli. 2006. *Design for Disassembly*. Hamer Center for Community Design, Pennsylvania State University, City of Seattle, King County, WA, and Resource Venture, Inc. Retrieved October 9, 2011, from [http://your.kingcounty.gov/solidwaste/greenbuilding/documents/Design\\_for\\_Disassembly-guide.pdf](http://your.kingcounty.gov/solidwaste/greenbuilding/documents/Design_for_Disassembly-guide.pdf).

**Summary.** This paper describes design for disassembly (DfD), including background information on what is involved in DfD, the problems in current design, ten key principals for DfD, and other relevant information.

Harris, J., J. Hummer, K. Cooney, and P. Thompson. 2010. *Evaluation of Consumer Behavioral Research*. Summit Blue Consulting and Navigant Consulting. Prepared for the Northwest Energy Efficiency Alliance. Quoted in Carlson Communications. "Sustainable Behavior Change Marketing and Communications: Annotated Bibliography." Metro. 8 April 2011.

**Summary.** This report reviews the existing research on best practices in behavior change strategies in energy and utility industries as the first of a three-stage process to develop a regional marketing effort. The report also identifies five core elements of successful behavior change initiatives.

Hirst, J., J. Morley, and K. Bang. 2008. *Functional Landscapes: Assessing Elements of Seattle Green Factor*. The Berger Partnership PS. Retrieved October 16, 2011, from [http://www.seattle.gov/dpd/cms/groups/pan/@pan/@permits/documents/web\\_informational/dpdp016505.pdf](http://www.seattle.gov/dpd/cms/groups/pan/@pan/@permits/documents/web_informational/dpdp016505.pdf)

**Summary.** This report describes Seattle's Green Factor program, how it developed, how its scoring criteria works, and provides analysis on the cost versus point value of different landscape elements developers might use to comply.

Hsueh, N. 2010. *Philadelphia's Development Permit Review Process: Recommendations for Reform*. May. Retrieved October 17, 2011, from <http://www.philaplanning.org/pubinfo/devprocess050510.pdf>

**Summary.** This report provides an overview of best practices for improving the efficiency of the development permitting process, and how these improvements can be used as incentives for the adoption of LID and green infrastructure practices.

Kibert, C.J. 2002. "Policy Instruments for a Sustainable Built Environment." *Journal of Land Use and Environmental Law* 17(2): 379-394.

**Summary.** This paper presents the policy drivers that encourage construction and demolition industries to adopt sustainable practices. The paper also explores the main categories of the policy instruments that improve the performance of the various stages of the construction and demolition industries, including: the supply chain, building creation and disposal, and building operations.

King County, Washington. 2009. *Green Building & Low Impact Development*. Department of Development and Environmental Services (DDES) Customer Information Bulletin # 55. Retrieved October 17, 2011, from <http://your.kingcounty.gov/ddes/acrobat/cib/55.pdf>

**Summary.** This bulletin outlines the programs and incentives available for individuals and businesses implementing green building and low-impact development practices in building projects in King County.

King County, Washington. 2010. *Puget Sound Energy, State, and Federal Energy Efficiency Incentives: Commercial New Construction*. Department of Development and Environmental Services. 11 November.

**Summary.** This document covers the following incentives for commercial new construction: PSE energy-efficiency grant incentives, federal tax deductions and credits, and state solar incentives. It also reviews a variety of incentives, grants, and rebates many local jurisdictions offer.

King County, Washington. 2011. "Clean Bin." *Green Tools: Construction and Demolition Recycling*. Retrieved October 9, 2011, from <http://your.kingcounty.gov/solidwaste/greenbuilding/cleanbin.asp>.

**Summary.** This website helps companies use best diversion and recycling practices at their job sites. The website includes information on why companies should apply to this program, who is eligible, and other application submittal information.

Kua, H.W. 2006. *The Design of Effective Policies for the Promotion of Sustainable Construction Materials*. Dissertation. Massachusetts Institute of Technology. September.

**Summary.** This paper explores the effects of policy tools employed to promote sustainable building materials based on seven detailed case studies. The paper also apply this concept to seven case studies and proposed a series of innovative policy strategies to address negative, unanticipated outcomes the paper observed.

Leigh, N.G. and L.M. Patterson. 2005. *Construction and Demolition Debris Recycling for Environmental Protection and Economic Development*. Practice Guide #7. Fall. U.S. Environmental Protection Agency, Region 4, Southeast Regional Environmental Finance Center and University of Louisville. April 19. Retrieved October 9, 2011, from [http://cepm.louisville.edu/Pubs\\_WPapers/practiceguides/PG7.pdf](http://cepm.louisville.edu/Pubs_WPapers/practiceguides/PG7.pdf).

**Summary.** This guide provides information for local governments and community groups interested in developing a comprehensive construction and demolition recycling program. The guide defines C&D wastes, identifies barriers and opportunities for C&D debris recycling, provides information for assessing existing C&D waste streams, current trends in reuse and recycling of C&D waste, and innovations in the field regarding recycled products with resultant potential markets for recycled materials.

Lennon, M. 2005. *Recycling Construction and Demolition Wastes: A Guide for Architects and Contractors*. Boston Society of Architects, Associated General Contractors of Massachusetts and the Massachusetts Department of Environmental Protection. April. Retrieved October 9, 2011, from <http://www.mass.gov/dep/recycle/reduce/cdrguide.pdf>.

**Summary.** This document introduces the practicalities of job site recycling to architects, engineers, specification writers, and contractors who are interested in this idea. The document also provides information to help these parties understand and address objections to job site recycling and lay the foundation for successful recycling from any new construction, renovation or demolition project.

Liddell, H, J. Gilbert, and S. Halliday. 2008. *Design and Detailing for Toxic Chemical Reduction in Buildings*. SEDA Design Guides for Scotland: No. 3.

**Summary.** This guide addresses design and detailing for more sustainable construction. It specifically discusses the use of chemicals in our built environment and offers guidance on designing and detailing to reduce toxic loads in buildings. The guide seeks to help contractors, builders, and other industry individuals to minimize toxic loads in construction, products, buildings and the built environment and to create sustainable buildings.

Low Impact Development Center. 2007. *A Review of Low Impact Development Policies: Removing Institutional Barriers to Adoption*. California State Water Resources Control Board Stormwater Program and the Water Board Academy. December. [http://pepi.ucdavis.edu/mapinfo/pdf/CA\\_LID\\_Policy\\_Review\\_Final.pdf](http://pepi.ucdavis.edu/mapinfo/pdf/CA_LID_Policy_Review_Final.pdf)

**Summary.** This analysis focused on regulatory approaches used in California to manage stormwater runoff and investigate whether LID approaches might be used for compliance. To provide recommendations for California's local governments, it reviewed other policies adopted throughout the U.S.

Low Impact Development Center. "Leadership in Low Impact Development Recognition Program." Retrieved on 5 October 2011, from: [http://www.lowimpactdevelopment.org/lid\\_awards.htm](http://www.lowimpactdevelopment.org/lid_awards.htm).

**Summary.** This website overviews the project goal and outcomes, review panel, candidate LID projects, and selection criteria of the Leadership in Low Impact Development Program.

Massachusetts Toxics Use Reduction Program. 1997. *Evaluating Progress: A Report on the Findings of the Massachusetts Toxics Use Reduction Program Evaluation*. March. Retrieved October 9, 2011, from <http://www.p2pays.org/ref/34/33460.pdf>.

**Summary.** This report presents the findings of the Massachusetts Toxics Use Reduction Act program evaluation, including three significant studies conducted by independent contractors, an inventory and assessment of the program undertaken by the TUR agencies, and an analysis of the TURA data.

Massey, R. P. Eliason, E. Harriman, et al. 2009. *Massachusetts Toxics Use Reduction Act Program Assessment*. June. Massachusetts Toxics Use Reduction Institute. June. Retrieved October 9, 2011, from [http://www.turi.org/content/download/5795/61560/file/methodspolicy26\\_exec.pdf](http://www.turi.org/content/download/5795/61560/file/methodspolicy26_exec.pdf).

**Summary.** This report is a program assessment of the Massachusetts Toxic Use Reduction Act (TURA). It describes the program by grouping program activities into eight categories, reviewing existing studies of the TURA program, and presents survey findings.

Matel, L.J. 2010. "An Urban Approach to LID." *Civil Engineering*. September. Retrieved October 17, 2011, from [http://www.asce.org/uploadedFiles/Sustainability\\_-\\_New/Resources/An%20Urban%20Approach%20to%20LID.pdf](http://www.asce.org/uploadedFiles/Sustainability_-_New/Resources/An%20Urban%20Approach%20to%20LID.pdf)

**Summary.** This article presents a case study of successfully integrating LID practices into the ultra-urban landscape of Bremerton, Washington's downtown through redevelopment and large-scale capital improvement projects. The author concludes that Bremerton has met with success by vigorously promoting education among and providing technical support to its engineers.

Metro. 2004. "Innovative partnership helps contractors increase recycling." *Metro News Release*. Retrieved October 9, 2011, from <http://www.oregonmetro.gov/index.cfm/go/by.web/id=16221>.

**Summary.** This article discusses a recent survey of participating firms in a three-year partnership between Metro and the local construction trade industry.

Montgomery County Department of Environmental Protection. 2011. *RainScapes Rewards Rebates Program*. Retrieved October 16, 2011, from <http://www.montgomerycountymd.gov/dectmpl.asp?url=/content/dep/water/rainrebate.asp>

**Summary.** This website describes the RainScapes Rewards program in Montgomery County, Maryland. It outlines the eligibility requirements and rebate amounts for different types of projects. It also allows property owners to apply for rebates online.

National Association of Home Builders (NAHB) Research Center. 1997–1999. *The Deconstruction Series*. Retrieved October 9, 2011, from <http://www.nahbrc.com/bookstore/cw0703w.aspx>.

**Summary.** This series of reports presents opportunities for builders and contractors to reuse and recycle during the deconstruction process. It includes information on carpet and padding, building disassembly and material salvage, recycling asphalt roof shingles into paving materials, and construction waste.

National Association of Home Builders (NAHB) Research Center. 1997. *Residential Construction Waste Management: A Builder's Field Guide*. Retrieved October 9, 2011, from <http://www.nahbrc.com/bookstore/cw0503w.aspx>.

**Summary.** This guide for residential construction builders explains how construction waste management can positively affect a builder's operations. The guide discusses issues related to cost, efficiency, resource conservation, liability, and marketing.

Natural Resources Defense Council (NRDC). 2010. *BPA Ban in California Passes, Despite Industry Spin*. July 2. Retrieved October 9, 2011, from [http://switchboard.nrdc.org/blogs/sjanssen/bpa\\_ban\\_in\\_california\\_passes\\_1.html](http://switchboard.nrdc.org/blogs/sjanssen/bpa_ban_in_california_passes_1.html).

**Summary.** This article discusses a California bill that bans the use of BPA products for children younger than three years and addresses some of the arguments the chemical industry uses to support the safety of BPA.

Neiswender, C. and R. Shepard. 2003. *Elements of successful stormwater outreach and education*. EPA National Conference on Urban Stormwater. February. Retrieved October 17, 2011 from <http://www.epa.gov/nps/natlstormwater03/25Neiswender.pdf>

**Summary.** This conference paper highlights the outreach strategies employed in EPA Region 5 through University Cooperative Extensive programs to increase public education about stormwater. It outlines important elements to include in stormwater education programs and outreach efforts.

NetRegs. 2011. *Site Waste—It's Criminal: A Simple Guide to Site Waste Management Plans*. February. Retrieved October 9, 2011, from [http://www.environment-agency.gov.uk/static/documents/NetRegs/SWMP\\_Simple\\_Guide\\_Feb\\_2011.pdf](http://www.environment-agency.gov.uk/static/documents/NetRegs/SWMP_Simple_Guide_Feb_2011.pdf).

**Summary.** This paper presents information on Site Waste Management Plans (SWMPs), including how builders can create a SWMP, a SWMP checklist, and guidance and information. SWMPs are a legal requirement in England for all construction projects started after April 6<sup>th</sup>, 2008.

New Zealand Business Council for Sustainable Development. 2003. *How Economic Incentives Motivate Sustainable Development: An Introduction*. November. Retrieved October 9, 2011, from <http://www.nzbcscd.org.nz/economicincentives>.

**Summary.** This booklet presents and discusses economic incentives public authorities use to achieve sustainable development. It argues these incentives are valuable for businesses. The

Council has provided these resources to encourage progress toward sustainable development among the business leadership in New Zealand.

Niemi, E. and K. Lee. 2008. *Residential Development Patterns and the Effects on Stormwater and Wastewater*. National Association of Homebuilders. June 27.

**Summary:** This technical report to the National Association of Homebuilders provides a literature review to outline the current understanding of the relationship between development and effects on stormwater and wastewater.

Nittivattananon, V. and G. Borongan. 2007. "Construction and Demolition Waste Management: Current Practices in Asia." *Proceedings of the International Conference on Sustainable Solid Waste Management*. Chennai, India. 5-7 September.

**Summary.** This study reviews the current C&D waste management programs in Asian countries, including the corresponding instruments these countries develop and implement. The paper aims to develop findings to assist policy makers in formulating interventions including policies for improving C&D waste management in the region.

North Central Texas Council of Governments. 2003a. *Regional Construction and Demolition Debris (C&D) Reduce/Reuse/Recycle (R3) Study*. TRC Environmental Corporation and Texas Commission on Environmental Quality. August. Retrieved October 9, 2011, from [http://www.nctcog.org/envir/SEELT/documents/C\\_and\\_D\\_FinalCDReport.pdf](http://www.nctcog.org/envir/SEELT/documents/C_and_D_FinalCDReport.pdf).

**Summary.** This study presents data regarding C&D debris generators and recycling companies in the sixteen member counties of the North Central Texas Council of Governments; assesses the quantities of C&D debris these NCTCOG companies are generating and recycling; quantifies the financial benefits of R3 to businesses involved; compares regional findings with studies elsewhere; identifies obstacles to C&D debris R3; and develops media to encourage R3 participation.

North Central Texas Council of Governments. 2003b. *Regional Construction and Demolition (C&D) Debris Reduce/Reuse/Recycle Study: 3-Year Action Plan*. August. Retrieved October 9, 2011, from [http://www.nctcog.org/envir/SEELT/documents/C\\_and\\_D\\_Final\\_Action\\_Plan\\_08-20-03.pdf](http://www.nctcog.org/envir/SEELT/documents/C_and_D_Final_Action_Plan_08-20-03.pdf).

**Summary.** Based on previous research, this paper determines obstacles that impede progress in increasing C&D debris R3; compares these obstacles with information from other parts of the nation; and develops an action plan that describes the necessary activities to increase C&D debris R3 participation over the next 3 years.

North Central Texas Council of Governments. 2007. *Regional Recycling Rate Benchmarking Study*. Final Report. R.W. Beck. October. Retrieved October 9, 2011, from [http://www.timetorecycle.com/documents/NCTCOG\\_Benchmarking\\_Final\\_Report\\_Oct2007.pdf](http://www.timetorecycle.com/documents/NCTCOG_Benchmarking_Final_Report_Oct2007.pdf).

**Summary.** This study develops recycling rates for the 16-county North Central Texas region. For the paper, the authors developed residential, ICI (industrial, commercial, and institutional) and overall recycling rates to serve as a benchmark to measure the success of future recycling initiatives.

North Kitsap Herald. 2005. "LID grant money rains down on City of Poulsbo." Retrieved 5 October, from: <http://www.pnwlocalnews.com/kitsap/nkh/news/19748819.html>.

**Summary.** This article reviews information on the recent grant money the City of Poulsbo received to take part in a project to draft municipal low impact development standards.

Parikh, P., M.A. Taylor, T. Hoagland, H. Thurston, W. Shuster. 2005. "Application of Market Mechanisms and Incentives to Reduce Stormwater Runoff: An Integrated Hydrologic, Economic and Legal Approach." *Environmental Science & Policy* 8: 133-144.

**Summary.** This peer-reviewed journal article explores the different types of market-based approaches that might be effective in reducing stormwater runoff. The authors describe the hydrologic and legal factors that underpin stormwater regulation and why market-based incentives might provide cost-effective avenues for local governments to increase the adoption of small-scale on-site best-management practices for controlling stormwater. Based on their analysis of the available market-based strategies, the authors describe the opportunities they offer and their limitations.

Pollard, T. 2009. "Building Greener Communities: Smarter Growth and Green Building." *Virginia Environmental Law Journal* 27(125): 125-146.

**Summary.** This law-review article explores the impacts of current building strategies and makes a case for the need to fundamentally reconceive the built environment, including a more comprehensive concept of green building and advocates policy makers shift their focus from creating more green buildings to encouraging green communities. The article also identifies some policy changes and projects that could promote green communities.

Radke, L. 1998. "Wisconsin's War on Waste." *Wisconsin Natural Resources Magazine*. June. Retrieved October 9, 2011, from <http://dnr.wi.gov/wnrmag/html/stories/1998/jun98/waste.htm>.

**Summary.** This article summarizes the history of Wisconsin's innovative approach to solid waste. Until 1965 no state had formal agencies to manage solid waste. Wisconsin was the first to establish such an office and the first to use rules to regulate solid waste dumps. The website also states that the program has been a success and outlines the reasons for this.

Seattle Department of Planning and Development. 2011. *Seattle Green Factor*. Retrieved October 16, 2011, from <http://www.seattle.gov/dpd/Permits/GreenFactor/Overview/default.asp>

**Summary.** This website is the official information portal for the Seattle Green Factor program. It provides an overview of the program, including the zoning districts where compliance with the program is required and minimum points required for each type of development. Scoring sheets, regulatory documents, and reports, workshop materials, and case studies are available for download.

Simon, S. 2010. "The Secret to Turning Consumers Green." *Wall Street Journal*. Retrieved October 4, 2011, from <http://online.wsj.com/article/SB10001424052748704575304575296243891721972.html>.

**Summary.** This news article summarizes information on recent public efforts to nudge consumers to make sustainable consumer choices. The article concludes the most effective way to encourage responsible behavior is with peer pressure. To support this claim, it cites two peer-reviewed papers both of which studied placards in hotel bathrooms encouraging guests to reuse their towels.

Spangler, B.R. 2007. *Public Funding Incentives for Private Residential and Commercial Watershed Protection Projects*. Prepared for the Montgomery County Department of Environmental Protection Division of Environmental Policy and Planning. March.

**Summary.** This paper addresses the strategies public agencies have adopted to provide funding incentives for private residential and commercial watershed protection projects. The paper presents three case studies on proven approaches, including: Portland, OR, Burnsville, MN, Maplewood, MN. The paper also presents two case studies on funding approaches which are in progress, these include Chicago, IL and Washington, DC and several examples of approaches to rain barrel programs.

Sparks, K. 1998. "Tax Credits: An Incentive for Recycling?" *Resource Recycling*. July.

**Summary.** The author gathered information on states that have sales, property, or income tax exemptions that are specifically geared toward increasing recycling by telephone and used state market development information provided by the National Recycling Coalition to provide a comprehensive resource on state recycling incentive programs. The author also sought to answer the following questions: what do these programs offer and in what direction are they moving?

Stenzel, P.L. 1991. "Toxic Use Reduction Legislation: An Important "Next Step" After Right to Know." *Utah Law Review* 707-748.

**Summary.** This law-review article analyzes and explains the theoretical and practical basis for legislation encouraging and mandating toxic use reductions. The article presents the history, provision, and purposes of "right-to-know" laws, demonstrates why more regulation is needed and discusses toxic use reduction legislation, including its purposes, public policies supporting it, and its feasibility. The article concludes with a discussion of issues that legislators have confronted when drafting toxic use reduction legislation and makes recommendations for a model law.

Szalay, S. 2011. "Stormwater Crediting: Leveraging Private Investment to Fund Urban Stormwater Retrofits in Philadelphia and Beyond." *Stormwater*. July-August. Retrieved October 17, 2011, from <http://www.stormh2o.com/july-august-2011/stormwater-crediting-philadelphia-1.aspx>

**Summary.** This article summarizes a stormwater fee and credit program in Philadelphia that is influencing developers' decisions about adopting LID and green infrastructure practices. The author contrasts Philadelphia's program with Portland's longer-established but less ambitious Clean River Rewards.

Tackett, T. 2010. *Green Stormwater Infrastructure to the Maximum Extent Feasible*. Seattle Public Utilities. Retrieved October 16, 2011, from <http://www.ecy.wa.gov/programs/wq/stormwater/municipal/LID/May12SPUppLIDcommittees.pdf>

**Summary:** This presentation outlines the City of Seattle's regulatory efforts to increase the use of green stormwater infrastructure by enacting a "maximum extent feasible" (MEF) provision in its stormwater code. It outlines how Seattle has implemented its MEF standard, and how it has developed resources for developers and property owners to understand and work through compliance with the provisions.

Texas Campaign for the Environment Fund. 2011. "Landfills are No Accident." *Landfills and Recycling*. Retrieved October 9, 2011, from [http://www.texasenvironment.org/fund/landfills\\_new\\_mountain\\_ranges.cfm](http://www.texasenvironment.org/fund/landfills_new_mountain_ranges.cfm).

**Summary.** This website summarizes Texas' growing problem with landfills and summarizes ways in which policy, environmental standards, and enforcement can improve the problem. The Fund advocates for the goal of eliminating waste altogether.

Toronto Region Sustainability Program. *Cleaner and Greener Manufacturing*. Retrieved 6 October 2011, from <http://www.trsp.ca/>.

**Summary.** This website gives information on the Toronto Region Sustainability Program, which gives technical assistance to business looking to adopt practices that prevent pollution, reduce toxics, and improve energy efficiency. The website also explains how the program works, what the eligibility is, and how participation can improve business.

Toxic Use Reduction Institute. 2010. *Governor's Awards*. Retrieved October 9, 2011, from <http://turadata.turi.org/Success/GovernorsAwards.html>.

**Summary.** This website summarizes the history of the *Governor's Awards for Outstanding Achievement in Toxic Use Reduction Program*. Massachusetts established the award in 1994 to recognize outstanding achievement in toxic use reductions to industrial or commercial businesses, private or public institutions, nonprofits, and community organizations who have demonstrated leadership and outstanding results. The Program also educates consumers about personal purchasing practices which lead to the use of toxic materials in manufacturing operations.

Tucker, P. and P. Douglas. 2006. *Understanding Household Waste Prevention Behavior: Results of a Household Attitude/Behavior Study*. Report prepared for the UK Department for Environment, Food and Rural Affairs (Defra)'s Waste and Resources Evidence Program. Scotland: University of Paisley Environmental Initiatives Research Group. Technical Report No. 2. December.

**Summary.** This paper seeks to establish a reference framework for understanding household waste prevention behaviors. To this end, it reviews relevant academic research and other documented case studies, collects new data with a questionnaire survey, and creates conceptual and predictive models of the impacts of alternative policies and management strategies.

Tucker, P. 2007. *Waste Prevention: Understanding the Drivers and Barriers*. Technical Session 1. June 13. Retrieved October 16, 2011, from <http://www.carbonbaseddesign.co.uk/ciwm/papers/TS1PeterTucker.pdf>

**Summary.** This paper summarizes the findings of a study into household waste prevention behaviors, for the United Kingdom's Department of Environment, Food, and Rural Affairs. It identifies behavioral drivers for waste prevention and describes challenges in tapping them to create change.

The ReUse People. 2011. *About the ReUse People of America*. Retrieved October 9, 2011, from <http://thereusepeople.org/AboutTRP>.

**Summary.** This website summarizes the members and history of the ReUse People of America, who help connect reusable building materials with general building contractors, building owners, and government agencies. Humanitarians founded ReUse People of America in San Diego to help flood victims in Tijuana, Mexico.

U.S. Department of Housing and Urban Development (HUD). 2001. *Report on the Feasibility of Deconstruction: An Investigation of Deconstruction Activity in Four Cities*. NAHB Research Center, Inc. January. Retrieved from: <http://www.huduser.org/publications/pdf/deconstruct.pdf>.

**Summary.** This report qualitatively describes deconstruction activities in four case study cities: Miami, El Paso, Milwaukee, and Nashville, which provide a broad picture of the conditions and patterns in deconstruction activity in cities in the nation. The report also discusses barriers to deconstruction and reviews successes and failures of each of the cities' programs.

U.S. Environmental Protection Agency (EPA). 2000. *Building Savings: Strategies for Waste Reduction of Construction and Demolition Debris from Buildings*. Report No. EPA-530-F-00-001. June. <http://www.epa.gov/osw/nonhaz/municipal/pubs/combined.pdf>.

**Summary.** This fact sheet packet summarizes successful waste reduction programs that local governments can use as models to implement their own programs to reduce disposal. The document is in particular geared toward "building-related construction and demolition debris recovery, building owners and developers interested in green building design, and building contractors seeking a competitive edge."

U.S. Environmental Protection Agency (EPA). 2010a. *Construction Site Chemical Control*. Retrieved October 9, 2011, from <http://www.epa.gov/owow/NPS/MMGI/Chapter4/ch4-3b.html>.

**Summary.** This website summarizes information on all of the available state recycling tax incentive programs. For each state with such a program, it includes a description of the program and eligible applicants.

U.S. Environmental Protection Agency (EPA), Office of Wetlands, Oceans, and Watersheds. 2010b. *Green Infrastructure Case Studies: Municipal Policies for Managing Stormwater with Green Infrastructure*. Report No. EPA-841-F-10-004. Retrieved October 9, 2011, from [http://www.epa.gov/owow/NPS/lid/gi\\_case\\_studies\\_2010.pdf](http://www.epa.gov/owow/NPS/lid/gi_case_studies_2010.pdf).

**Summary.** This report presents common strategies for developing and implementing stormwater policies to support green infrastructure. It highlights 12 local governments through case studies to illustrate how each has constructed its stormwater-management program to increase the adoption of low-impact development and other green-infrastructure approaches.

U.S. Environmental Protection Agency (EPA). 2011. *Building Challenge*. Retrieved October 9, 2011, from <http://www.epa.gov/epawaste/partnerships/wastewise/challenge/building.htm>.

**Summary.** This website summarizes information on the WasteWise Building Challenge, which encourages its Partners to reduce, reuse, and recycle construction and demolition materials. The website provides information on how construction site can reduce C&D debris and benefits of that reduction.

U.S. Green Building Council. 2011. *LEED 2009 for New Construction and Major Renovations*. October. Retrieved October 9, 2011, from <http://www.usgbc.org/ShowFile.aspx?DocumentID=8868>.

**Summary.** This guide provides information for builders, contractors, government officials, and other interested parties on the LEED Green Building Rating System. The guide includes: a checklist for new and major renovation projects, an overview of the LEED process, minimum program requirements, and examples of exemplary performance standards.

Washington Department of Ecology. 2009. *City of Olympia – Decatur Street LID Demonstration Program*. Retrieved 4 October 2011, from: <http://www.ecy.wa.gov/biblio/0910022.html>.

**Summary.** This website summarizes key background information the City of Olympia’s Decatur Street LID Demonstration Program. It includes a brief description, a link to a relevant publication, and the subject water bodies.

Washington Department of Revenue. 2010. *Hazardous Substance Tax*. Retrieved October 9, 2011, from [http://dor.wa.gov/content/findtaxesandrates/othertaxes/tax\\_hazard.aspx](http://dor.wa.gov/content/findtaxesandrates/othertaxes/tax_hazard.aspx).

**Summary.** This website presents a brief summary of information on the State of Washington’s hazardous substance tax. It details what the tax is, how the tax is paid, what rate is paid, and what the funds of the tax are used for.

WasteCap Resource Solutions. 2011. *C&D Recycling Training: Construction and Demolition Recycling Training and Accreditation Course*. Retrieved on October 8, 2011, from: <http://www.wastecap.org/services/training>.

**Summary.** This website summarizes the training program offered by WasteCap. Participants receive a three year Accreditation in Construction Waste Recycling, a toolkit, and criteria for meeting Leadership in Energy and Environmental Design’s Materials and Resources Credits.

Water Environment Research Foundation. 2009. “Using Incentive Programs to Promote Stormwater BMPs.” *Using Rainwater to Grow Livable Communities: Sustainable Stormwater Best*

*Management Practices*. Retrieved October 17, 2011, from <http://www.werf.org/livablecommunities/toolbox/incentives.htm>

**Summary.** This website provides information for different audiences and stakeholders to integrate sustainable stormwater BMPs into local projects. It provides a “toolbox” of different approaches cities across the United States have used to encourage wider adoption of sustainable stormwater management.

Werner, C. 2003. *Changing Homeowners' Use of Toxic Household Products: A Transactional Approach*. *Journal of Environmental Psychology* 23: 33-45.

**Summary.** This peer-reviewed article reports the results of a study that investigated using guided discussion groups to influence people’s perceptions of social norms regarding the use of non-toxic chemicals in landscaping and home maintenance.

Wisconsin Department of Natural Resources. 1995. *Rethinking Debris: The Industry: Construction and Demolition Waste Reduction and Recycling Tips*. Report No. PUBL-IE-211-95. Retrieved October 9, 2011 from <http://dnr.wi.gov/org/caer/cea/publications/pubs/section3/ie211.pdf>.

**Summary.** This document helps construction and demolition contractors in Wisconsin to better understand how effectively to reuse and recycle C&D materials. It explains Wisconsin’s Waste Reduction and Recycling Law and gives information on companies that are already recovering these materials for reuse or recycling and tips for other companies interested in trying these strategies.