

# THE GREEN INFRASTRUCTURE GUIDE



ISSUES,  
IMPLEMENTATION  
STRATEGIES AND  
SUCCESS STORIES



Susan Rutherford



West Coast  
Environmental  
Law

Copyright ©2007 West Coast Environmental Law Research Foundation

West Coast Environmental Law is BC's legal champion for the environment. West Coast empowers citizens and organizations to protect our environment and advocates for the innovative solutions that will build a just and sustainable world.

**ACKNOWLEDGEMENTS:** Generous funding for this project was provided by the Law Foundation of British Columbia, the Real Estate Foundation of British Columbia, the Walter and Duncan Gordon Foundation and the McLean Foundation:



THE REAL ESTATE  
FOUNDATION  
OF BRITISH COLUMBIA



The author extends gratitude and thanks to members of the project Advisory Committee, who generously gave up time from their busy schedules, and reviewed and provided helpful feedback on outlines and drafts: Cori Barraclough (Aqua-Tex Scientific Consulting Ltd.); Patrick Condon (UBC); Mark Holland (Holland Barrs Planning Group); Wm. Patrick Lucey (Aqua-Tex Scientific Consulting Ltd.); Kim Stephens, P.Eng.; John Turner (BFW Developments Ltd.); and Robyn Wark (City of Burnaby). The author is also very grateful and thankful to Joe VanBelleghem (Windmill Development Services) and Bud Fraser (Holland Barrs Planning Group), who both responded to requests for input at the last minute, reviewed a draft and offered thoughtful feedback; and to Michael Zbarsky (BC Ministry of Community Services), who provided helpful feedback on an outline and draft, and directed me to additional resources.

Special thanks are extended to Deborah Curran of Deborah Curran & Company for her careful review and feedback; and to Chris Johnston, P.Eng., of Kerr Wood Leidal Associates Ltd. – Consulting Engineers, for technical review and input, and for contributing the section on stormwater criteria.

The author is also extremely grateful to the following additional group of people who generously granted interviews, responded to email requests, shared information and documents, reviewed draft text and offered up their time, experience and insights, to the betterment of Guide content: Donavon Bishop (District of Saanich); Richard Boase (District of North Vancouver); Mike Bowen (Councillor, City of Port Coquitlam); Tess D'Aoust (Vernon Water Reclamation Centre); Richard Drdul (Drdul Community Transportation Planning); Liam Edwards (BC Ministry of Community Services); Raymond Fung (District of West Vancouver); Paul Ham (City of Surrey); Chris Hartman (Simon Fraser University Community Trust); David Hislop (City of Surrey); Judy McLeod (City of Surrey); Meggin Messenger (BC Ministry of Community Services); Ron Neufeld (City of Campbell River); David Reid (Lanarc Consultants Ltd.); Ross Rettie (Association of Professional Engineers and Geoscientists of BC); Rod Sanderson (City of Chilliwack); Hari Suvarna (City of Surrey); and all of the various people who granted us permission to feature their photographs. Finally, many thanks to the following West Coast staff: Andrea Wilkinson for thoughtful review and copy editing; Christopher Heald for meticulous design and layout; Joel Ornoy for speedy help locating photographs; and Ceciline Goh and Regi Bohringer for helpful administrative support.

The views expressed are those of the author and West Coast Environmental Law Research Foundation. Any errors or omissions are the sole responsibility of the author and West Coast Environmental Law.

**DISCLAIMER:** This report provides educational information only. It does not constitute legal or other professional advice. It is essential that local governments and others considering legal measures consult with legal professionals for advice.

**COVER PHOTOS:** from top to bottom – Vancouver Public Library green roof, Vancouver Public Library photo; Langley bike lanes, Township of Langley photo; Street and swale, City of Vancouver photo.

#### **National Library of Canada Cataloguing in Publication**

Rutherford, Susan, 1965-

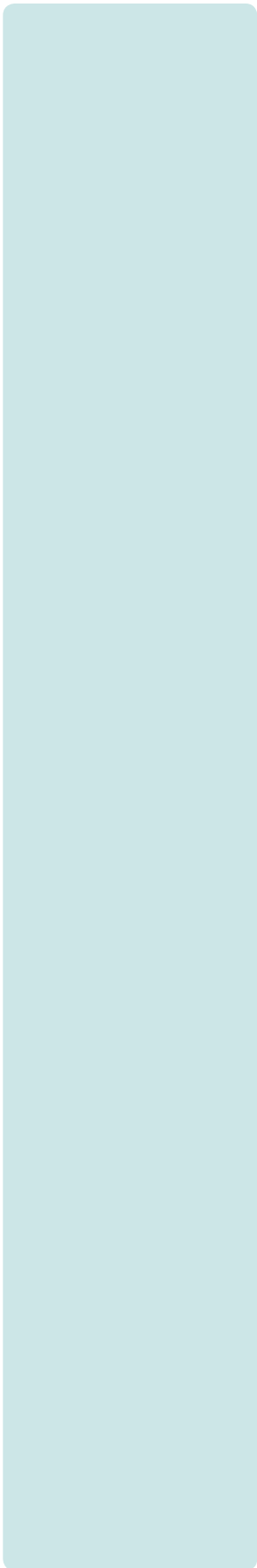
The Green Infrastructure Guide: Issues, Implementation Strategies and Success Stories / Susan Rutherford

Includes bibliographical references.

ISBN 978-0-919365-31-5

# Contents

- INTRODUCTION: LEGAL AND POLICY STRATEGIES TO SUPPORT GREEN INFRASTRUCTURE ..... 5**
  - What is Green Infrastructure Design? ..... 5
  - Why a Green Infrastructure Approach?..... 6
  - Distinguishing Natural from Engineered Green Infrastructure ..... 7
  - Guide Purpose and Structure ..... 7
- 1. BUILDING THE FRAMEWORKS TO SEED GREENER APPROACHES: GOVERNANCE, LEGAL PLANS AND EVALUATION TOOLS ..... 10**
  - 1.1 Governance..... 10
  - 1.2 Legislated Planning Frameworks ..... 12
    - 1.2.1 The Regional Growth Strategy ..... 12
    - 1.2.2 The Official Community Plan ..... 13
  - 1.3 Evaluation Tools – Sustainability Checklists ..... 17
    - Summary..... 18
- 2. REGULATING RAIN AND SUBDIVISION OF LAND ..... 19**
  - 2.1 Acceptance of Stormwater Control Criteria ..... 19
  - 2.2 Alternative Subdivision and Development Standards..... 21
  - 2.3 Development Permit Areas and Guidelines for Green Infrastructure..... 25
  - 2.4 Regulatory Bylaws – Green Infrastructure Requirements in Zoning, Landscaping, Runoff and Sediment Control, Parking and Comprehensive Rain Water Management Bylaws..... 27
    - 2.4.1 Zoning..... 27
    - 2.4.2 Landscaping..... 28
    - 2.4.3 Runoff Control – Green Roofs..... 28
    - 2.4.4 Runoff and Sediment Control – General ..... 30
    - 2.4.5 Parking ..... 31
    - 2.4.6 Comprehensive Rain Water Management Bylaw ..... 31
  - 2.5 Use of Development Cost Charges to Support Neighbourhood-Level Storm Water Management ..... 34
  - 2.6 Use of Site-Based Tools: Covenants ..... 35
  - 2.7 Stormwater Management Policy or Plan..... 38
- 3. METERING, REUSE AND RAINWATER HARVESTING ..... 39**
  - 3.1 Water Metering..... 39
  - 3.2 Water Reuse or Reclamation ..... 41
    - 3.2.1 Reclamation of Water for Building Use..... 44
  - 3.3 Residential Rainwater Harvesting..... 45



<b>4.</b>	<b>BECOMING ENERGY SMART – BUILDINGS, DISTRICT HEAT AND OTHER INNOVATIONS</b> .....	<b>46</b>
4.1	Implementing Energy-Saving Standards for Municipal Infrastructure.....	46
4.2	District Heat Energy Systems.....	47
4.3	Capturing and Benefiting from Municipal Waste Streams.....	49
4.3.1	Landfill Gas-to-Electricity Plants.....	49
4.3.2	Other Waste Recycling.....	50
4.3.3	Using Community Water System Flow to Generate Power .....	50
4.4	Resources .....	51
<b>5.</b>	<b>THE LIABILITY ELEPHANT</b> .....	<b>52</b>
5.1	Step One: Acknowledge the Risks .....	52
5.2	Understand the Risk Framework.....	54
5.2.1	Relevant Legislative Provisions.....	54
5.3	Reducing the Risk: Requirements to Over-Engineer.....	57
5.3.1	Pilots and Dual Systems.....	57
5.3.2	Overflow Systems .....	57
5.3.3	Over-Engineering.....	58
5.4	Other Strategies to Manage Risk: Legally Limiting or Shifting Risk .....	58
5.4.1	“True Policy Decisions” by Council .....	58
5.4.2	Reliance on Qualified Professionals and Private Insurance.....	60
5.4.3	Legal Agreements to Shift Risk .....	62
5.4.4	Bonding .....	63
5.4.5	Interim “No-Build” Covenants as a Security Mechanism .....	63
5.5	The Need for Public Debate on Risks and Choice.....	64
5.6	Financial Risks: Green Valuation .....	64
<b>6.</b>	<b>SUPPORTING INNOVATION WITH MONITORING AND ADAPTIVE MANAGEMENT</b> .....	<b>66</b>
6.1	The Importance of Monitoring.....	66
6.2	Instituting Monitoring Requirements.....	66
6.2.1	Bylaws for Ongoing Maintenance and Monitoring of Surface Runoff Systems .....	67
6.2.2	On-Site Rain Water Management Covenants.....	67
6.2.3	Comprehensive Development Agreements .....	67
6.2.4	Opportunities to Collaborate for Success.....	68
6.3	The Power of Results: Using Data to Monitor Performance and Build Success.....	68
6.4	Instituting Adaptive Management.....	72
<b>7.</b>	<b>CONCLUSION</b> .....	<b>74</b>
	<b>ENDNOTES</b> .....	<b>75</b>

# Introduction: Legal and Policy Strategies to Support Green Infrastructure

The *Green Infrastructure Guide* (the Guide) provides guidance on how local governments may, using legal and policy strategies, encourage or require more sustainable infrastructure designs. It refers readers to strategies, and highlights case studies of local governments that have already taken steps to incorporate a green infrastructure approach. The focus is on implementation mechanisms, issues and barriers, and on what lessons have been learned from experiences to date.

## What is Green Infrastructure Design?

Green infrastructure design is engineering design that takes a “design with nature” approach, to both mitigate the potential impacts of existing and future development and growth and to provide valuable services. This includes such designs as:

- disconnected roof leaders, grassy swales and rain gardens, which promote infiltration and groundwater recharge;
- roadside curb cuts that direct road runoff onto grassy swales and rain gardens;
- permeable pavement and green roofs, which reduce runoff;
- rock pits and other catch basins and detention ponds to detain rain water, slow it down and reduce/avoid the impact of peak flows;
- water conserving infrastructure such as low flow fixtures, metering systems and systems for water reclamation and redistribution;
- energy conserving systems such as district heat distribution, landfill gas recovery, sewer heat recovery and industrial process heat recovery; and
- green building features.<sup>1</sup>

The term “green infrastructure” is to a large degree concerned with softening the impacts of development on a community’s water resources, and mitigating against the impacts of climate change (e.g. higher magnitude and increased frequency of storm events). The term also connotes, however, infrastructure design that reduces waste and energy inefficiencies. The Guide’s primary focus is water issues; however, Chapter 4 briefly reviews some of the actions local governments are taking to reduce their energy footprint and take advantage of waste resources.

## Why a Green Infrastructure Approach?

Taking a greener approach to infrastructure development not only mitigates the potential environmental impacts of development (e.g. improving stream health and reducing energy use) but makes economic sense as well, when all of the impacts of conventional development on “natural capital” and the services rendered by natural capital are taken into account.<sup>2</sup> By softening the environmental footprint, avoiding waste and finding efficiencies, local governments can increase their long term sustainability.

The parking lot at the Intrust office building in North Vancouver, BC, features permeable parking pads, landscaping, and a seating/eating area.

PHOTO CREDIT: SUSAN RUTHERFORD



# Distinguishing Natural from Engineered Green Infrastructure

A distinction exists between *natural* green infrastructure – forests, grasslands, wetlands, creeks and other waterways which, in addition to providing habitat, serve some important environmental services for us, like cleaning our air and water – and *engineered* green infrastructure, i.e., human-designed devices that mimic nature in function, or strive to reduce their impact on ecological systems and function. Two complementary strategies can “green” a community and its infrastructure: first, preserving as much as possible of the natural green infrastructure; and secondly, promoting designs that soften the footprint of development.

## Guide Purpose and Structure

The *Green Infrastructure Guide* traces some of BC’s local government experience in implementing engineered green infrastructure designs. The Guide’s purpose is to encourage successful designs, by reporting on what the legal and policy strategies are, what some of the implementation hurdles (and solutions) have been, and how they have been effective in achieving sustainability goals. The intent is to support the efforts of local government officials and decision-makers to green their community’s infrastructure, by sharing the tools and the collective wisdom that have been gained as a result of implementation experiences from around the province.

This Guide is part of West Coast Environmental Law’s web-based Smart Bylaws Guide (<http://www.wcel.org/issues/urban/sbg>), a resource that provides local governments and citizens with information and strategies on how to build sustainable, smart growth communities. It builds on West Coast’s ongoing work to promote legal strategies for sustainability at the community level. West Coast’s other Smart Growth publications (all available on West Coast’s website) include:

- *The Smart Growth Guide to Local Government Law and Advocacy* (2001)
- *Do Development Cost Charges Encourage Smart Growth and High Performance Building Design?* (2003)

Maintaining natural green infrastructure and utilizing engineered green infrastructure to avoid or reduce impacts are both key elements of a “smart growth” approach that aims to create a more livable, sustainable community that realizes savings over time. Other smart growth elements include: planning for compact, complete communities; promoting urban revitalization and a healthy working land base; increasing transportation choices through land use decisions; creating inclusive neighbourhoods; supporting municipal goals through cost recovery; and reforming administrative processes and addressing liability issues to encourage smart growth.<sup>3</sup> Using all of these strategies together, community quality of life is enhanced, the natural environment is preserved, and over time, money will be saved.

- *A Case for Smart Growth* (2003)
- *Smart Bylaws – Summary* (2003)
- *Protecting the Working Landscape of Agriculture* (2005)
- *The Green Buildings Guide* (2006)

The Guide also builds on, and complements, the important work of other organizations to promote water and energy sustainability. For example, the province has been vigorously promoting an integrated storm water management approach since at least the 2002 publication of *Stormwater Planning: A Guidebook for British Columbia*.<sup>4</sup> Readers are further referred to the following resources:

- <http://www.waterbucket.ca>, a web-based communications portal for a number of “communities of interest” related to water sustainability, including the work of the Water Sustainability Committee<sup>5</sup> and the Green Infrastructure Partnership;<sup>6</sup>
- the Master Municipal Construction Documents Association’s *Green Design Supplement* (see page 22, below);
- publications describing the “soft path” to water governance, outlined by the POLIS Institute on Water Governance;<sup>7</sup>
- the partnerships involved in the Community Action on Energy Efficiency;<sup>8</sup> and
- the Template for Integrated Stormwater Management Planning (ISMP),<sup>9</sup> a template for use by municipalities in the Greater Vancouver Regional District to guide stormwater management at a watershed scale.

The Guide has been designed to complement, not duplicate, the *Green Infrastructure and Sensitive Ecosystems Bylaws Toolkit*,<sup>10</sup> being published by Ducks Unlimited Canada, Grasslands Conservation Council of British Columbia and The Wetland Stewardship Partnership. Whereas the focus of the *Toolkit* is on preserving the natural green infrastructure, the focus of this Guide is on implementing engineered approaches.

In summary, the *Green Infrastructure Guide* builds on a body of work that has preceded it, and is designed to be used in conjunction with the range of important resources available from various organizations and government to support a sustainable approach to community development of infrastructure. This Guide does not provide legal advice, as all situations call for tailored solutions that account for the particular circumstances and context. The Guide is, however, designed to serve as a useful backdrop for conversations to take place both within and



beyond the local government's planning department and legal advisors. Our hope is that the Guide will provide a useful resource for the many legal and engineering solutions that can be implemented to complement a community's project to become more sustainable.

Note that BC municipalities and regional districts do not always hold identical regulatory powers, due to distinctions made in the *Local Government Act* and the *Community Charter*. Guide terminology refers to "local governments" to include both municipalities and regional districts; otherwise, powers are addressed separately.

The Guide is organized as follows:

- **Chapter 1** addresses governance and planning structures, to provide overarching context, direction and support for more specific green infrastructure actions;
- **Chapter 2** discusses strategies for managing rainwater as a resource;
- **Chapter 3** focuses on implementation of water conservation strategies, such as metering and reuse;
- **Chapter 4** considers strategies to support energy efficiency and waste reuse and diversion;
- **Chapter 5** discusses liability concerns associated with implementation;
- **Chapter 6** encourages monitoring and adaptive management; and
- **Chapter 7** provides concluding remarks.

# 1. Building the Frameworks to Seed Greener Approaches: Governance, Legal Plans and Evaluation Tools

Key to building more sustainable infrastructure are the community's leadership and governance structures, and making sure that the rules governing decision-making reflect the prevailing ethos and support the use of best practices. This chapter focuses on strategies to put the frameworks in place that will seed more sustainable decision-making. We briefly outline some successful governance strategies, give an overview of the key legal plans, and look at some of the policy tools available to help communities evaluate whether proposed development fits with community goals.

## 1.1 Governance

Communities are to a large degree impacted by their governance patterns and structures, which can drive the shape of change. Case studies are included in the Guide to demonstrate some of the changes occurring on the ground, and to share the learning that has resulted from the profiled local government's experience with a particular legal or policy strategy that supported green infrastructure. In considering these case studies and other community successes in supporting sustainability, however, it is equally important to note some of the cross-cutting internal and external governance processes that support innovation. Some of the governance "change themes" that rise to the top include:

- visionary leadership and community champions, working to embed sustainability criteria into decision-making;
- integrated sustainability planning processes;<sup>11</sup>
- integrated decision-making processes for plan approvals;

- strategies that entail reviewing policy for consistency throughout the various layers of decision-making (e.g. region /watershed /municipality /neighbourhood /site) and identifying action opportunities;
- use of a partnership approach among the development community, the local, provincial and federal government regulators, providers of seed funding and community stakeholders, including non-governmental organizations;
- reliance on the expertise of experienced consultants; and
- a healthy use of pilot and demonstration projects, to build success incrementally.

No matter how good new ideas may be, they have a difficult time gaining momentum, as long as they remain isolated within an organization.<sup>12</sup> It is therefore important to gather and organize resources together, to ensure that processes are put into place to support, rather than create or reinforce, obstacles to progressive change. Refining internal processes is one means; working together in partnerships is another effective way to build trust and to build constructive learning together from experiences shared along the way.<sup>13</sup>

Local governments need to also maintain a dialogue with other levels of government, to communicate clearly which laws and processes are working to promote sustainability at the local level, and which are creating impediments and require reform. For example, there is currently a need to ensure that property tax and utility regimes do not discourage renewable energy innovations: e.g. adding photovoltaic features to assessed property value; or requiring developers who do tertiary on-site sewage treatment to become a public utility if they want to sell their treated water.

### Case Study:

The **City of Port Coquitlam** is notable for its Sustainability Initiative, which has its “roots” in the 2002 Corporate Strategic Plan and was endorsed again by the community in the City’s 2005 Official Community Plan. This strong vision is “leafing a community legacy”<sup>14</sup> through its activities, which include the following components:

- Official Community Plan
- Sustainability Checklist for Rezoning and Development Permit Applications
- Annual departmental business plans
- Triple Bottom Line Assessment matrix for annual budget decision package
- Potable water source control program
- Green building technology for City buildings
- Green roof regulation
- Green building and social housing incentive policy and social housing fund
- Social planning study
- Cash-in-lieu of parking variance
- City land sales project
- Tree bylaw.

## 1.2 Legislated Planning Frameworks

The planning frameworks established by the *Local Government Act* – regional growth strategies and official community plans - are key tools for providing direction for community action. This section outlines the role of legally authorized plans in making change.<sup>15</sup>

### 1.2.1 The Regional Growth Strategy

Regional growth strategies (RGSs) are authorized as a legal planning tool further to Part 25 of the *Local Government Act*. The purpose of an RGS is set out in section 849(1) of the *Act*:

849(1) The purpose of a regional growth strategy is to promote human settlement that is socially, economically and environmentally healthy and that makes efficient use of public facilities and services, land and other resources.

Sustainability goals are listed in greater detail (but without limitation) in section 849(2), covering such topics as: avoidance of sprawl; encouraging alternative transportation; protecting environmentally sensitive areas in land use planning; reducing and preventing air, land and water pollution; protecting the resource base; etc.

Section 850 prescribes mandatory content, stipulating that in guiding decisions on growth, change and development, an RGS must cover a period of at least twenty years; include a comprehensive statement of social, economic and environmental objectives of the board on the future of the region; and to the extent that such needs are regional, propose actions to provide for the needs of the population in relation to housing, transportation, regional district services, parks and natural areas, economic development, and any other regional matter.

Typical infrastructure concerns of RGSs are parks and greenways, transportation, water management, liquid wastewater and solid waste management (sewage), and solid waste disposal. To date, the greatest strength of RGSs has been in gaining commitment to region-wide approaches to better resource use, e.g. to urban containment, watershed based management, and regional transportation plans.

Regional growth strategies have less frequently encouraged site or neighbourhood level technologies; however, there is no reason why

a high level policy document like an RGS could not indicate the technologies that would support regional sustainability goals. In this way, an RGS might reference alternative development standards for drainage to support watershed needs; commit to introducing technology to capture and use “waste” methane gas produced by landfills; commit to universal metering; support land use designs (for clusters of density) that support the growth and development of efficient public transportation infrastructure; etc. There are a range of areas where regional sustainability objectives might be bolstered by the use and implementation of green infrastructure designs and technology.

## 1.2.2 The Official Community Plan

As the highest level plan at the local community level, an official community plan (OCP) sets out the community’s vision for itself, and how that vision is situated in the larger regional context. As stated in the Preface to Ucluelet’s OCP, an OCP not only sets out the broad objectives and policies, and establishes the foundation of policies, regulation and decisions pertaining to land use and development<sup>17</sup> but:

The Plan provides guidance for economic, environmental, physical design and development, and social considerations. It promotes the quality of life, future growth, community development, economic, environmental and social well-being, provision of amenities and services, and transportation systems. The OCP provides Council with the wishes and aspirations of individuals in Ucluelet.<sup>18</sup>

Where a regional growth strategy is in place for the municipal area, an OCP must have a regional context statement that sets out how municipal policies will be made consistent with the region’s strategy over time.<sup>19</sup> For example, the **City of North Vancouver’s** Regional Context Statement notes the GVRD’s Livable Region Strategic Plan goals of protecting the green zone, building complete communities, achieving a compact metropolitan region and increasing transportation choice, and highlights six pages of OCP policies that directly support these strategies. For example, identification of parkland and recreational spaces “protects the green zone” and adoption of integrated stormwater management plans on a watershed scale supports achievement of a compact metropolitan region that maintains utility capacity.<sup>20</sup>

Part 26, Division 2 of the *Local Government Act* stipulates the purposes, and the required and possible policy content of an OCP. The required content (set out in section 877 of the Act) to a large extent requires the

Unfortunately, RGSs are not currently mandatory and only eight of 27 regional districts in the province have an RGS either in place or in process to Guide regional development.<sup>16</sup>

local government to address infrastructure needs (roads, sewers, water, schools, parks and waste treatment and disposal) in addition to making decisions around land use planning.

In creating a plan, an OCP may also designate certain areas as Development Permit Areas, to achieve more specific objectives<sup>21</sup> in those areas, including protection of the natural environment. This tool and the kinds of guidelines that may be implemented are discussed in greater detail in Chapter 2, Regulating Rain and Subdivision of Land.

For achieving a green infrastructure approach, OCPs may include policies such as the following:

- integrated stormwater management
- xeriscaping [landscaping with native species, to reduce the need for irrigation]
- water metering
- reuse of water
- district heat
- diversion or reuse of waste streams
- alternative development standards

OCP policy should state the community's objectives vis-à-vis the infrastructure (e.g. to reduce watershed impacts, make best use of the rainwater resources or reduce energy consumption) and identify some of the regulatory vehicles that will support the infrastructure.

One of the potential vulnerabilities of an OCP is that it is a bylaw and therefore can be amended. Given that incremental changes can, over time, erode effectiveness, it is important for local governments to show leadership by adhering to OCP policy when granting development approvals. If the Council and planners permit OCP policy to be sidestepped or modified, its meaningfulness and utility as an effective planning tool will be seriously compromised - the risk being that the vision expressed in the OCP will not be realized. Councils and senior staff must therefore work together to create a culture that reinforces, rather than undermines or disregards, OCP policy – perhaps by instituting a rigorous OCP amendment process. Another way to seed such a culture is to ensure that the development community becomes familiar with the OCP and its ground rules. Knowledge is the first step toward winning support.

OCP policies are recommended to be specific and measurable so that they are enforceable. An example is a policy requiring 90 percent of rain water to be infiltrated into the ground.

## Case Studies:

The **District of Ucluelet** recently won several awards for its OCP and related community initiatives.<sup>22</sup> Ucluelet's OCP is strong, not only because it has many policies supporting sustainability practices, but also because it provides clear direction to decision-makers. For example, Ucluelet's OCP under Part III – The Plan (General Development Policies), endorses a number of policies, including Smart Growth principles. Under the same Part, Specific Development Policies (sub-topic – The Natural Environment) the OCP states the following goals and objectives:

**GOAL:** To identify, protect and, where possible, enhance environmentally sensitive aquatic and terrestrial natural resources for the long term benefit of fish and wildlife, natural ecosystems, and the enjoyment of present and future population and visitors to the municipality.

### OBJECTIVES:

1. To protect and enhance natural land forms and ecosystems.
2. To ensure the health and safety of the residents and visitors, and minimize the risk of damage to property and life resulting from hazardous natural conditions.
3. To harmonize existing development and the natural environment.

The following policies in Ucluelet's OCP elaborate on expectations vis-à-vis protection of the aquatic environment, by adoption of known, published, third party standards:<sup>23</sup>

10. Adopt the principle of minimal impact to the aquatic environment by adhering to the Land Development Guidelines for the Protection of Aquatic Habitat (Ministry of Environment, Lands and Parks) and Water Land and Air Protection stormwater management guidebook.
11. All storm water discharges should be designed based on Best Management Practices as recommended in the publication titled "Urban Runoff Quality Control Guidelines for B.C. (Ministry of Environment, Lands and Parks)".
12. Create a "green design" option or incentive for developers.



Connecting greenways benefits both people and wildlife.

PHOTO CREDIT: ANDREW GAGE

The **City of Dawson Creek's** OCP was substantially revised in 2004. Design Guidelines set out in Schedule "F" encourage sustainable design of the built environment, and also quite specifically endorse a green infrastructure approach to stormwater management. The latter is reproduced below:

### **5. Stormwater Management**

As a means to stagger stormwater run off, particularly from parking lots and large flat roof structures, every effort should be taken to detain this water on site. In order to reduce peak flow pressure on the City stormwater system, while retaining pollutants and suspended solids on site, in conjunction with reducing the over-reliance on soft landscape irrigation systems, this needs to be addressed through infiltration and natural soil groundwater recharge.

*[line drawing with accompanying hand text illustrates design details]*

Promotion of the use of bioswales as linear retention basins that move run-off as slowly as possible along a surface incline to raised drain inlets and utilizing native wetland plants further slowing this water while helping to biologically break down pollutants adds to the overall site integrity of community responsibility.

A number of OCPs around the province endorse xeriscaping. See e.g. the **City of Fort St. John**, the **City of Merritt**<sup>24</sup> and the **Town of Osoyoos**.<sup>25</sup>

For example, the City of Fort St. John's OCP<sup>26</sup> endorses a set of "Winter City Design Principles" and under the heading, Parks, Trails & the Natural Environment, provides:

8.2.3 **Winter City Landscaping** applies the principles of xeriscaping, is salt resistant, and is generally considered to be appropriate for winter cities.

A number of municipalities, such as the **District of North Vancouver**, **City of Burnaby**, **City of Surrey** and **District of Maple Ridge** now create detailed secondary plans (also known as "area", "neighbourhood" or "neighbourhood concept" plans) that form part of the official community plan but apply to specific neighbourhoods only and provide a greater level of detail and guidance on land use and design principles. They are developed in consultation with the area community.

A positive development is that in all of these municipalities, the detailed plans at this level are now considering watershed needs and considerations at the outset of the land use planning process. For example, Surrey's newest neighbourhood concept plans are being drafted to incorporate the watershed's Integrated Stormwater Management Plan design guidelines.<sup>27</sup> Burnaby's OCP for development of the university lands on Burnaby Mountain similarly referenced key elements that were to be addressed (and were ultimately addressed) in the watercourse and the integrated storm water management plan for the downstream Stoney Creek.<sup>28</sup>

The Silver Valley Area Plan<sup>29</sup> (District Bylaw 6067-2002) for the District of Maple Ridge incorporated four pages of detail on infrastructure and servicing, with two of these pages being devoted to design guidelines for stormwater management. Stipulations include the following general principles:



### 1.1.1 Principles

- (a) Observe current and anticipated best management practices, including, but not limited to:
  - a. retention of native top soil
  - b. minimal interception of ground water flow
  - c. maximizing storm water infiltration
  - d. minimizing impervious surfaces
  - e. watercourse base flow maintenance
  - f. utilization of storm water treatment ponds
  - g. development of storm water release rates through continuous simulation modeling of predevelopment flows
- (b) Develop an integrated storm water management plan.
- (c) Maintain predevelopment flow regimes and hydrology throughout the Silver Valley area in the management of storm water.
- (d) The objective is to limit impervious area to 15% of the total area for Silver Valley.

These principles are then elaborated upon with a further 1-1/2 pages of detail, including: the need to maintain riparian corridors using setbacks and minimizing road crossings; strategies for retention of stream habitat conditions and water quality; management of upland wildlife habitat; disconnection of roof leaders; implementation of sediment control ponds; and so on.<sup>30</sup> As a result, the “Silver Ridge Development” in Silver Valley incorporated some of the most advanced stormwater management practices available including road-side rain gardens to replace curbs and catchbasins, on-lot rock pits, and disconnected roof leaders. The development has won many awards including a 2005 Georgie award for the “Best Residential Development in BC” by the Canadian Home Builders Association of BC.

See also the District of North Vancouver’s Seymour Local Plan, a part of the District’s Official Community Plan, which stipulates support for reaching goals through a variety of means, including: the use of environmentally friendly design and construction methods; adherence to the Land Development Guidelines for the Protection of Aquatic Environments and relevant regulations, including the Streamside Protection Regulations (SPR); exploration of integrated stormwater management/low impact development approaches; development of watershed plans; use of public education programs; cooperation with, and workshops for, residents and developers; and cooperation with and support for work of community groups, including e.g. North Shore Streamkeepers and North Shore Black Bear Network.<sup>31</sup>

## 1.3 Evaluation Tools – Sustainability Checklists

Legal planning documents can be additionally supported by policy tools that support green infrastructure designs. Sustainability checklists or scorecards are an increasingly popular tool with which local govern-

ments may ask strategic questions about a proposed development, and clearly convey the community's priorities, evaluation preferences and expectations around development proposals. Checklists help to educate developers about what a local government expects from applications for development; in turn, staff using the tool learn how to integrate bylaws, planning approaches and technologies into development permits, and to communicate what is expected. A checklist pilot project can be a one or two year learning opportunity, with a checklist used to assign a value to an application once the local government has worked out its implementation.

### Case studies:

The **City of Port Coquitlam** has a Triple Bottom Line Sustainability Checklist,<sup>32</sup> which features a section on Environmental Protection and Enhancement and asks questions such as: whether the proposal protects riparian and other environmentally sensitive areas; whether the proposal requires extension of existing municipal servicing infrastructure; and whether the construction and design adopts LEED [Leadership in Energy and Environmental Design] or another green building standard. The checklist is provided to all development inquiries and as an incentive, applications with high scores are granted fast-track status through the rezoning and development approval processes.<sup>33</sup> Since implementation, applications with low scores have attracted some criticism and even disappointment (bearing in mind the checklist is a guide rather than a regulatory tool). On the whole, the checklist has contributed to building awareness of sustainability criteria; and it also appears to be prompting lower impact development in Port Coquitlam. The checklist is reviewed on an annual basis, and this year's review will likely include a re-consideration of the checklist's "one size fits all" approach, as well as how to increase the incentives to applicants to achieve higher checklist scores.

The **City of Vernon's** Smart Growth Development Checklist<sup>34</sup> asks development proponents to describe (amongst many things): on-site stormwater management and the percentage of impervious surfaces, floodplain mitigation, on-site wastewater treatment, water use reduction measures, and energy efficiency of proposed structures and use of renewable energy. It also asks proponents to identify any barriers in City bylaws to their smart growth development.

## Summary

In summary, governance structures, regional plans, community plans, and policy tools such as checklists, can all support green infrastructure implementation. Local governments are encouraged to gather together and integrate the community's resources, to create a decision-making environment that supports sustainable approaches. The next chapters discuss how local governments can use regulatory and land use powers to implement more specific green infrastructure objectives.

## 2. Regulating Rain and Subdivision of Land

Making good decisions about how rainwater is managed as a resource is a key pillar of sustainable development, and a good entry point for a local government wanting to commence implementing a “green infrastructure” approach. Overall goals<sup>35</sup> here include: encouraging infiltration to maintain existing hydrology; avoiding a net increase in runoff post-development; avoiding net loss of wetland; maintaining watercourse functioning (stream volumes, water quality and riparian health); and bonding for maintenance and operations into the future.

A number of legal and policy tools are available to encourage or require low impact designs as well as the finding of innovative alternatives and solutions to the environmental impacts of conducting “business as usual.” These tools include:

1. Passage of “alternative” subdivision and development standards
2. Use of development permit areas and guidelines
3. Regulatory bylaws: green infrastructure requirements in zoning, landscaping, runoff and sediment control, parking and comprehensive rain water management bylaws
4. Use of Development Cost Charges to support neighbourhood-level management
5. Use of site-based tools: covenants and the taking of financial security
6. Stormwater Management Policy
7. Pilot and Demonstration Projects

### 2.1 Acceptance of Stormwater Control Criteria<sup>36</sup>

For green infrastructure to perform as required, it must be designed to acceptable stormwater criteria. Otherwise, implementation of green infrastructure may do little more than mimic the hydrologic characteristics of an aged parking lot. For example, for many years it was thought that simply disconnecting roof leaders on new single family homes would provide an adequate green solution for roof tops. However, it has been demonstrated that unless the receiving soil area has been aerated

and constructed with sufficient depth, disconnected roof leaders may do little to promote the protection of downstream fish habitat.

There are several stormwater criteria applicable in the BC. Table 2-1 summarizes the main criteria. Additional local criteria have also been developed that the reader may wish to consult (see bylaw references in the next sections).

Table 2-1: Summary of Current Stormwater Discharge Criteria

Component	Target Rainfall Amount	Criteria/Guidelines
<b>Typical Municipal Criteria</b>		
Flood Protection	5 or 10-year storm	Minor drainage system – 5- or 10-year return period design event
	100-year storm	Major drainage system - 100-year return period design event
<b>Provincial Stormwater Guidebook</b>		
Volumetric Reduction	0 to 50 percent MAR <sup>1</sup> (Tier A/B rainfall events)	Capture 90 percent of the rainfall in a typical year and either infiltrate or evaporate it at the source (runoff volume reduction and water quality control).
Runoff Control for Large Storms	50 to 100 percent MAR <sup>1</sup> (Tier C storms)	Store runoff from infrequent large storms, and release at a rate that approximates the natural forested condition to decrease the erosive impact. (runoff rate reduction). On-site disposal features to retain 50 percent of the Mean Annual Rainfall (MAR) volume <sup>1</sup>
Flood Risk Management for the Extreme Storms	Greater than MAR <sup>1</sup> up to 100-year return period (Tier D storms)	Ensure that the drainage system is able to convey the extreme storm events with only minimal damage to public and private property. (peak flow conveyance)
<b>Fisheries and Oceans Canada (DFO)<sup>2</sup></b>		
Water Quality	Treat 90 percent of annual rainfall <sup>3</sup>	Provide treatment for 90 percent of rainfall events falling on impervious areas where source controls are not achievable
Volumetric Reduction	6-month <sup>4</sup>	Infiltrate, evaporate, transpire, or re-use all rainfall up to the 6-month storm - Only applicable to fish bearing creeks
Rate Control – Erosion	6-month <sup>4</sup> , 2-year and 5-year events	Control post-development flows to pre-development levels for 6-month, 2-year and 5-year events
<sup>1</sup> MAR is Mean Annual Rain Event (e.g. a two-year storm event). <sup>2</sup> Fisheries and Oceans Canada, 2001. <sup>3</sup> It is generally assumed that by treating the 6-month storm, 90% of all rainfall events will also be treated <sup>4</sup> Calculated by multiplying the 2-year, 24-hour rainfall amount on the IDF curve by 72% (see GVRD Source Control Design Guidelines 2005 <a href="http://www.gvrd.bc.ca/sewerage/stormwater_reports.htm">http://www.gvrd.bc.ca/sewerage/stormwater_reports.htm</a> )		

Adopting either the Provincial Stormwater Guidebook criteria or the Fisheries and Oceans Canada criteria would go a long way to adequately protecting the downstream aquatic habitat. It should be noted, however, if a federal fisheries authorization<sup>37</sup> or Canadian Environmental Assessment screening process is required, the latter criteria may be required.

## 2.2 Alternative Subdivision and Development Standards

Municipalities are granted the authority to regulate subdivision servicing requirements, further to section 938 of the *Local Government Act*.<sup>38</sup> This jurisdiction covers a lot of things, but specifically empowers municipalities to establish location and construction standards regarding stormwater collection/disposal, sewage collection/disposal and water distribution.

Municipalities typically pass a subdivision servicing bylaw which lays out not only the technical requirements but also the procedures for subdivision approval and for the division and recovery of costs for services that benefit both the subdivided lands and other lands.<sup>39</sup> Such bylaws, and related subdivision servicing agreements, clarify the rules and expectations of the municipality vis-à-vis servicing requirements.

There are essentially three approaches by which municipalities can demand a “softer” approach to subdivision and development. One approach is to prescribe specifications of the technology to be used; the other is to prescribe a performance standard. A third approach is a combination approach; i.e. to prescribe the technologies expected for achieving the required standard, with the option that developers may use alternative approaches if they can prove they meet or beat the standard. Underlying any low impact development approach is a shift away from a conventional “pipe it away” approach to one that instead mimics natural systems.

## Case Studies:

Local governments will be familiar with the **Master Municipal Construction Documents Association (MMCD)**, a non-profit society that provides design and construction documents for municipal infrastructure including roads, sidewalks, sewers, water, traffic signals and street lighting. The main products of the MMCD are the Master Municipal Construction Document and related training programs that support its use.<sup>40</sup>

In 2005 the MMCD released its first version of the **Green Design Guidelines Manual** (“the Green Supplement”).<sup>41</sup> Intended as a supplemental alternative to MMCD’s usual design and construction standards, the



Detention pond.

PHOTO CREDIT: CITY  
OF VANCOUVER

Green Supplement describes alternative low impact design practices for infrastructure and land development, as well as underlying theory, common technologies and design standards, but it leaves with the responsible design professional the decision on whether to employ a practice, and what practice to implement.<sup>42</sup> The Green Supplement tabulates relevant potential decision factors which may influence the choice to use the design, and for each supplemental design also provides a relative impact/ease

of implementation factor.<sup>43</sup> It therefore provides helpful starting guidance and referral to further resource material but is not directive in nature.

In 2005, the **District of Lantzville** passed Subdivision and Development Bylaw No. 55, 2005,<sup>44</sup> as a model bylaw for small communities desiring low impact development (LID) standards for roads and storm water management, and alternatives to impervious surfaces for parking lots, sidewalks and multi-use paths.<sup>45</sup> The bylaw adopts MMCD standards for most other standards. For Rain Water Management the bylaw provides the following:

### 3.5.1 General Principles

- The Municipality requires that Low Impact Development (LID) techniques be incorporated in all developments and that the Developer provide drainage structures that will:
  - reduce the rate of post development site runoff to predevelopment levels of a 10 year rainfall event
  - ensure a “zero net increase” in runoff

- improve the quality of drainage water
- reduce erosion and sediments
- address downstream impacts of peak rain runoffs created by development
- The Municipality is open to consideration of site specific drainage solutions brought forward by the Applicant, designed by the Engineer
- Rainwater shall be managed using surface structures as much as possible. Natural wetland areas, swamps and ponds shall be incorporated into LID designs. Natural wetlands, ponds and swamps may not be destroyed for housing development without the written approvals from a Ministry of Water Land Air Protection Official, Department of Fisheries and Oceans official, Land and Water BC Official and a District Official.
- The District Official may at his/her discretion request a peer review of the Engineer's design to ensure it is in keeping with current Low Impact Development techniques.
- Perimeter drains may be gravity to daylight or pump to surface.

Under section 3.5.2, Rain Water Management and Erosion Control, the subdivision bylaw stipulates:

The components of rain water management that shall be incorporated in the development depend on the type of the receiving watershed. These shall include: rain water storage, constructed wet lands, natural wet lands, sediment basins with inlet protection, oil/grit separators, grass swales, silt fencing and inlet protection. Direct ocean discharges will be individually addressed.

Section 3.5.2 then goes on to stipulate standards for:

- design concepts (where other techniques can be substituted provided similar efficiencies are proven to be achieved)
- water quality improvements
- oil/grit chambers
- sediment control
- location of facilities
- maintenance of facilities

The **District of Saanich** implemented similar wording changes to its subdivision bylaw in 2004,<sup>46</sup> and has as a result lightened the footprint of new development within its boundaries.

As in Lantzville, Saanich's specifications establish standards for: reduced runoff rates, improved drainage quality, and erosion and sediment control (during construction only). Standards depend on whether the watershed is classified Type I (more strict standards) or Type II. Specifications are prescribed for detention facilities, water quality improvements, oil and grit separators and temporary sediment basins. Appendix A (Development Guidelines for Surface Stormwater Management) states that the developer can in some cases use a dedicated park for storm water management – in essence, an engineered wetland.

The standards demand the developer post a bond or surety for maintenance costs, equivalent to the value of three years of service.<sup>47</sup> The bylaw imposes upon the owner of the storm water management system a duty to advise the Municipality annually that all required maintenance has been performed. After three years of adequate maintenance, the owner is eligible to recover its bond. After that, if adequate maintenance is not undertaken, the Municipality has stipulated that it can undertake it and charge the costs to the owner.

### Lessons learned in Saanich

The new storm water standard was implemented in response to both internal and external pressure to better protect Saanich's streams and water channels. As a result of these amendments, Saanich has achieved a positive shift in its development practices.

Saanich is now in the process of reviewing its subdivision engineering standards, to address issues that have arisen since implementation. One of the options being considered is to make the standards more objective and less prescriptive, reflecting some of the latitude Saanich has practiced in its decision-making to date. (Saanich witnessed a variety of implementation approaches, in particular a move towards rain gardens and infiltration that was not anticipated as a strategy.) Saanich is currently considering the benefit of having the bylaw present a palette of options with performance objectives specified; e.g. "you have to reduce and have to treat runoff to X level, and here are some examples of ways that you can achieve that from a technological standpoint."<sup>48</sup>

Saanich is also developing strategies for "ironing out wrinkles" associated with the process of getting from the design stage to the actual lived-in stage. In a few instances Saanich experienced servicing infrastructure that was built too early in the process, with damage resulting from the the construction or subdivision phases. This in turn led to a complicated situation of figuring out how to get the infrastructure restored, while trying to apportion responsibility among the developer, builder, inspector, purchaser and subsequent purchaser.<sup>49</sup>

A number of other municipalities (including the **City of Chilliwack**<sup>50</sup> and the **City of Coquitlam**<sup>51</sup>) have implemented green infrastructure standards for stormwater management. The City of Chilliwack's experience has led it to support a flexible approach, to accommodate not just developers' desire for flexibility in meeting standards, but also to meet the preferences of consumers.<sup>52</sup> The City of Campbell River is now in the process of revising its subdivision standards.<sup>53</sup>

The **District of North Vancouver** recently took the bold move of revising their Development Servicing Bylaw; in particular their Design Criteria Manual, and incorporated the Provincial Stormwater Guidebooks criteria<sup>54</sup> (December 2006). This action provides specifics on what criteria to use for design of new green infrastructure. It also removes the vagueness of current green design guidelines that make it difficult for design professionals to implement. It is a bold move as it mandates that green infrastructure is to be used on all new development and re-development sites, and sets a performance level that has a track record of protecting the environment.



## 2.3 Development Permit Areas and Guidelines for Green Infrastructure

Local governments have the ability to protect the natural environment using development permit areas (DPAs). Subdivision, alteration of land, construction or addition to a building or structure may not occur within a DPA without first obtaining a permit. DPAs are authorized by section 919.1 of the *Local Government Act* and must be identified and designated on a map within the OCP, accompanied by a description of the special conditions or objectives that justify the designation.<sup>55</sup> The OCP or a zoning bylaw must stipulate the Guidelines that apply to granting a DPA permit.<sup>56</sup>

The City of Kelowna's OCP provides an example of a natural environment DPA. In section 7.11 of its OCP, it has designated DPAs on the following basis:

Due to their environmental significance and sensitivity, water-based and land-based features within the City of Kelowna have been designated as part of the Natural Environment Development Permit Area. The designated areas are thought to contain features that may need special protective measures in order to ensure:

- protection of designated environmentally sensitive areas
- prevention or reduction of air, land, and water pollution
- protection of quality and quantity of ground water and surface water
- conservation of scarce resources

The OCP stipulates guidelines for development, and describes the kinds of conditions that may be imposed in order for the City to grant a permit. The conditions further stipulate that the City may require the developer to provide Development Approval Information,<sup>57</sup> where the City requires more information to assess the permit and to decide on the applicable conditions. By way of example, some of Kelowna's DPA guidelines stipulated for these areas include:<sup>58</sup>

### **Guidelines for Development**

In issuing conditions relating to a development permit waiver or in issuing development permit conditions, the City will specify how development permit objectives can be satisfied. This includes, but is not limited to, consideration of the following guidelines.

## Preservation of Natural Areas

- Protect unique or special natural features such as land forms, rock outcroppings, mature trees and vegetation, drainage courses, wetlands, hilltops and ridge lines.
- Retain mature vegetation wherever possible and incorporate into the design of the project.
- Demonstrate that a diligent effort has been made in site design to preserve both the natural vegetation and tree cover.
- Utilize low-flow or drip irrigation systems that minimize the use of water.
- Require that where land and/or natural vegetation is disturbed or damaged that the area be restored and/or replanted with plant material indigenous to the area. A list of recommended species is available in the *Handbook for Environment Development Permit Areas*.
- Require that restoration plans exclude plantings of the genus MALUS (apples or crabapples, including all ornamental or flowering crabapples), PYRUS (pears, including Asian and ornamental pears), CYDONIA (quince), CHAENOMELES (flowering quince or japonica), ULMNUS PUMILA (Siberian Elm) or ULMNUS PARVIFOLIA (Chinese Elm).

## Slopes

- Development will be directed to appropriate areas with slopes averaging less than 30%. Where it can be demonstrated that the proposed development will be sensitively integrated with the natural environment and will present no hazards to persons or property, development *may* be permitted on land with a natural slope that averages greater than 30%. Natural vegetation should be retained on slopes in order to control potential erosion, land slip and rock falls. (See Kelowna Hillside Development Guidelines dated October 2001).
- The pattern of development in hillside areas should be responsive to the varied topography, taking advantage of views and the surrounding natural landscape by emphasizing cluster development. All new residential development should be located to minimize interference with neighbouring property owners' views. In hillside areas, lot size and shape may vary in relation to topography. (See Kelowna Hillside Development Guidelines dated October 2001).
- Limit building heights to the height of existing tree cover.
- Maintain visibility to vegetative backdrop from off-site.
- Step back buildings on each floor to reflect the slope of the site.
- Minimize impervious paving surfaces to reduce storm runoff.

The OCP prescribes additional detailed guidelines for riparian management zones. In addition, section 7.2.3 of the OCP (“Water Conservation Policies”) stipulates that “...Development Permit requirements may stipulate the adherence to xeriscape principles for those properties subject to Development Permits.”

See also the very specific DPA Guidelines for the **City of Nanaimo**, especially with respect to slope development.<sup>59</sup>

The **Town of Osoyoos’** 2007 OCP has similar guidelines encouraging xeriscaping and discouraging “water features” in its Multi-Family Residential DPA.<sup>60</sup>

Under the Landscaping section of the **City of Merritt’s** OCP City Centre DPA Guidelines it is provided that the City should:

6.5.10 Encourage the use of drought tolerant native plant species; or alternatively low water consumption Xeriscape species, suitable for use in dry arid environments such as that of the Lower Nicola Valley.

## 2.4 Regulatory Bylaws – Green Infrastructure Requirements in Zoning, Landscaping, Runoff and Sediment Control, Parking and Comprehensive Rain Water Management Bylaws

### 2.4.1 Zoning

Using zoning bylaw powers (which, very generally, cover land use, and siting, size and dimensions of buildings and structures), a local government may stipulate land use design features that can provide important protection for sensitive natural environments – for example minimum setbacks.<sup>61</sup>

Apart from zoning, local governments have a number of specific powers through which they may require green infrastructure design. Options include local government jurisdiction over landscaping, runoff and sediment control and parking.

## 2.4.2 Landscaping

Some current examples of landscaping control in BC are:

- references in OCPs to xeriscaping;<sup>62</sup> and
- general landscaping requirements, e.g., the City of Langley's zoning bylaw<sup>63</sup> and the City of Duncan's Screening and Landscaping Bylaw, No. 1580, 1989 (with amendments to April 10, 1995)<sup>64</sup>.

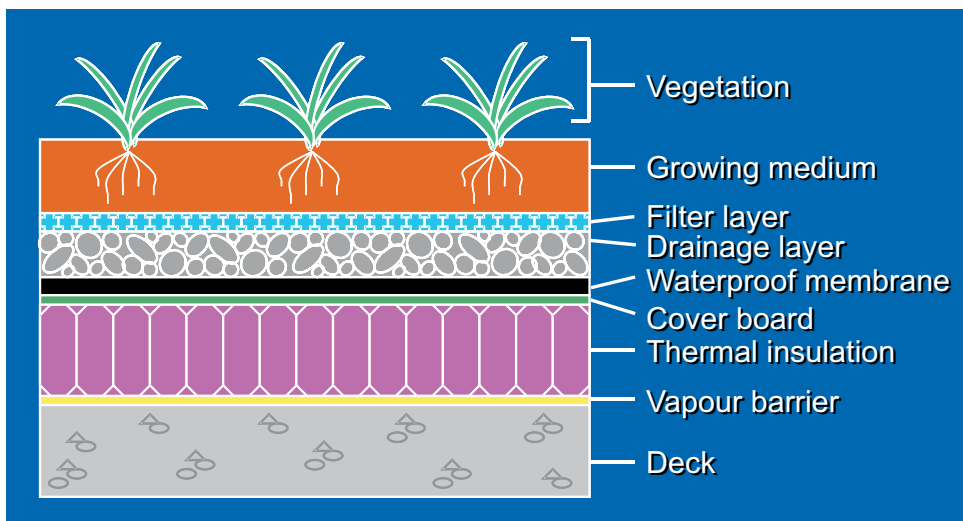
Section 909 of the *Local Government Act* provides that a local government may require, set standards for and/or regulate the provision of landscaping, to mask and separate uses, preserve, protect, restore and enhance the natural environment, or to prevent hazardous conditions.

In order to ensure that landscaping will take a form that contributes to the green infrastructure instead of placing a burden on it, a landscaping bylaw might, for example, stipulate the need to xeriscape or to otherwise retain or ensure a certain level of tree planting or vegetation in landscaping.

## 2.4.3 Runoff Control – Green Roofs

As a community grows, the green infrastructure challenge for planning, engineering and design professionals is how to maintain site and neighbourhood permeability. How to manage building footprints and more particularly, roof run-off, especially from larger buildings, are key considerations.

While there are a number of ways to manage roof rainwater run-off, one strategy that has gained momentum in recent years is the use of “green roof” technology.<sup>65</sup> With this technology, the roof itself is designed to mimic the previously permeable environment, using



Green roof cross section.

DIAGRAM CREDIT: INSTITUTE FOR RESEARCH IN CONSTRUCTION, NATIONAL RESEARCH COUNCIL

alternative roofing design and materials. This is instead of capturing the run-off and disposing of it through conventional gutter and pipe methods, and may be in lieu of, or more likely supplemental to, a low impact

development approach of directing runoff to a rain garden or detention pond, with the goal of encouraging on-site infiltration, reducing peak flows, and encouraging local groundwater recharge.

A recent paper has explored various regulatory options for BC local governments to promote green roofs.<sup>66</sup> Tools highlighted in the paper include using roof run-off control and landscaping jurisdictions (set out respectively under sections 907 and 909 of the *Local Government Act*), and using performance conditions for development permit area guidelines (section 919.1). The approach focuses local government efforts on their powers over roof run-off management and landscaping design rather than on building standards.<sup>67</sup>

## Case Studies:

### City of Port Coquitlam

The first municipality that has exercised its jurisdiction in the manner analyzed in the Buholzer/Wark paper is Port Coquitlam. Bylaw No. 3569, passed in December 2006, amended the City of Port Coquitlam's zoning bylaw to require "green roofs" on new large industrial or commercial use buildings.

Rather than focusing on roofing materials, the bylaw's definition of "green roof" prescribes the roof's performance vis-à-vis run-off and landscaping criteria, and stipulates compliance otherwise with the existing Building Code:

#### GREEN ROOF

Means an engineered roofing system that allows for the propagation of rooftop vegetation and the retention of storm water while maintaining the integrity of the underlying roof structure and membrane.

The bylaw then goes on to require a "green roof" (as defined) for industrial or commercial use buildings having a building area of 5000 square metres or more, on at least 75 percent of the roof area of the building "not including any roof area occupied by mechanical equipment."

Maintenance concerns are addressed by section 519(2) of the bylaw:

The owner of every building having a Green Roof must maintain the planting media and plant material in accordance with generally accepted landscape maintenance practices, replacing each as necessary to optimize the storm water retention capability of the roof.

The green roofs bylaw amendment is a component of the City of Port Coquitlam's Sustainability Initiative,<sup>68</sup> a vision established in the 2002 Corporate Strategic Plan and endorsed again in the 2005 Official Community plan.

## BC Homeowner Protection Office

To the frustration of many in the sustainable development community who have successfully used green roof technology for many years, BC's Homeowner Protection Office (HPO)<sup>69</sup> recently entered the green roofs debate to urge caution in the use of green technology in residential building construction.<sup>70</sup> The HPO has raised concerns specifically with respect to the insurability of green roof construction. Resolution of this issue is currently being hotly debated in BC.

### 2.4.4 Runoff and Sediment Control – General

With provincial approval under the *Community Charter's* concurrent jurisdiction provisions,<sup>71</sup> in early 2007 the City of Surrey passed an Erosion and Sediment Control Bylaw. The bylaw applies to any "contractor," a term designed to regulate the activities of anyone who might generate sediment, e.g. contractors engaged in new building construction, homeowners doing landscaping, or the City doing highway work. The bylaw aims to mitigate sediment impacts on the City's infrastructure and watercourses, and related maintenance and conveyance costs which were deemed too high.<sup>72</sup>

For compliance and enforcement, the bylaw implements both fines and "stop works," with the latter being expected to be more effective than fines.<sup>73</sup> On the softer side, the City has scheduled seminars to train City personnel, and has published an explanatory brochure in both English and Punjabi.<sup>74</sup> A website will track real time rainfall so people can determine what standards to meet for site discharges and sediment release both during and after a rainfall event.<sup>75</sup> The City intends to have two kinds of officers in the field monitoring and enforcing the bylaw: (1) uniformed bylaw enforcement officers, empowered to issue tickets; and (2) others, empowered to carry out monitoring and performance, and charged with working collaboratively with developers to help them to meet the stipulated targets.

The **District of Saanich** in its Bylaw No. 7501 for the Regulation and Protection of Natural Water Courses, Ditches and Drains<sup>76</sup> regulates a number of activities that potentially impact upon the natural green infrastructure,<sup>77</sup> and also stipulates requirements for engineered green infrastructure. For example, section 8 of the Bylaw requires an oil and grease interceptor to be installed to process the stormwater runoff from a parking lot wherever a paved or impervious motor vehicle

parking lot is constructed as part of any development except a single family dwelling or duplex.

The Bylaw works in tandem with the subdivision bylaw engineering standards (described above), by cross-referencing the specifications for the oil and grease interceptor to those standards.

In addition, the Bylaw requires a stormwater management facility to be provided by a developer, wherever the existing drainage system downstream from a proposed development has “insufficient capacity to accommodate the projected increase in stormwater runoff from the proposed development of lands.” Once again, the design specifications for the facility are cross-referenced to the subdivision bylaw engineering standards.

## 2.4.5 Parking

Local governments have jurisdiction over design standards for parking, pursuant to section 906 of the *Local Government Act*. This may include standards for parking capacity, maximum parking lot size, paving materials or permeability criteria, and even requirements for bicycle parking. As above, local governments may also impose requirements regarding the management and treatment of parking lot runoff (e.g. use of stormceptor technology).

## 2.4.6 Comprehensive Rain Water Management Bylaw

As an alternative, local governments may combine their regulatory jurisdiction over landscaping, runoff, sediment control and parking, to adopt a comprehensive approach to rain water management.

### Case study:

For example, the **District of Metchosin** adopted its Rain Water Bylaw No. 467<sup>78</sup> in 2004 as part of the District’s initiative to protect and manage rain water runoff. The bylaw complements other tools for rain water management - a revised DPA for Bilston Creek Floodplain, and floodplain building specifications identified in the Land Use Bylaw.<sup>79</sup>

The Bylaw’s Preamble references sections 907 and 909 of the *Local Government Act*, sections 8(3) and 69 of the *Community Charter*, and requirements to protect fish and their habitat under the federal *Fisheries Act* and the province’s Riparian Areas Regulation under the *Fish Protection Act*. In addition to these, the preamble invokes Council’s jurisdiction over health, safety and protection:

AND WHEREAS the Council deems it advisable and necessary for the health, safety and protection of persons, property and the environment in the municipality to protect and maintain the proper functioning condition of Riparian-wetland Areas, watercourses, water bodies, *drainageways*, drains and sewers.

The overarching approach of the District is explained in the District's Statement of Intent, issued to accompany the bylaw. It states:

As to activities within private properties, the intent of Bylaw 467 is to manage rainwater as near to its source as is practical, by establishing a performance target that would see at least 90% of all rain fall being addressed on-site. This goal advocates the use of "source controls" on the property, to direct rain water through the natural hydrologic pathways of a site that would have occurred prior to any development. Appendix A of Bylaw 467 provides a description of these source controls.

Bylaw 467 specifically rejects the traditions of 'urban' storm water management and engineering, including the principles that advocate shedding runoff overland from a site as quickly as possible, or concentrating and discharging runoff via connected pipes, drains, ditches and roads. Conversely, the Bylaw requires the use of natural hydrologic pathways at a site to maintain rain water, as this method is compatible with the 'rural' character of Metchosin.<sup>80</sup>

The Statement of Intent goes on to specify further intentions regarding the application of the Bylaw to different categories of situation.<sup>81</sup> For example, any impervious area that precedes adoption of the bylaw is grandfathered. For new development, generally, if total effective impervious area<sup>82</sup> is less than 5 percent of lot area, there is no expectation of the need for a qualified professional's report. If however total effective impervious area exceeds 5 percent of lot area, an owner is required to obtain a qualified professional's report.<sup>83</sup> There is a limit on effective impervious area of 10 percent.

The Bylaw is organized into six parts. The **Introduction** to the Bylaw addresses the purpose of the bylaw, states what principles it is trying to achieve,<sup>84</sup> describes the bylaw's application, and provides some detailed definitions.

**Part 2 - Prohibitions and Permissions**, addresses discharges to or works within approved drainage systems, watercourses and wetlands, owner's obligations and rain water management for subdivisions. The bylaw exempts activities that are of little or no consequence, e.g. those where there is no increase in effective impermeable surface or no impact on proper functioning condition. It prohibits a range of activities that are damaging or inconsistent with the bylaw's purpose.<sup>85</sup>

**Part 3 - Rain Water Protection and Source Control Requirements** generally aims for no net loss of proper functioning condition of any riparian-wetland area, watercourse or other water body, and details performance standards for water quality, runoff rates and volumes, erosion and sediment control, management of effective impervious areas, and drainage systems. Operation and maintenance requirements are triggered if there is effective impervious coverage of 5 percent or greater.<sup>86</sup>



#### Part 4 - Design Criteria:

- provides information and methodology for calculating rainwater runoff (this references the method, the tributary plan including site plan and rainfall intensity calculations);
- describes infiltration facilities (rain water source controls including absorbent landscaping, infiltration facilities, retention facilities and green roofs) to ensure no net increase in runoff between pre-development and post-development;
- has design criteria for infiltration facilities, rain water treatment facilities, rain water detention facilities and absorbent landscaping; and
- describes methods of infiltration including: use of sand, gravel, rock pits, ground absorption systems, ponding systems, in-storage drainage facilities that release to an infiltration area, green roofs, swales (e.g. absorbent layer over gravel filled soakaway) and the use of surface overflow escape routes for infiltration facilities.



Vancouver's first country lane.  
PHOTO CREDIT: CITY OF VANCOUVER

**Part 5 - Administration** speaks to administration and enforcement, and provides for a right to enter and inspect by the clerk or a bylaw enforcement officer. The bylaw establishes that contravention of the bylaw is an offence and establishes a minimum fine of \$100 per occurrence and a maximum fine of \$2500, where each day of the occurrence may be considered a separate offence.

**The Appendices and Drawings** include a Rain Water Management Manual, Engineer's Undertaking for Subdivision, a Subdivision Drainage Certificate and two Riparian-Wetland Checklists (Lotic and Lentic) for the Assessment of Proper Functioning Condition and a Form for the Simplified Approach to Rain Water Management.

#### Appendix A, the Rain Water Management Manual:

- contains a flow chart of steps required in respect of the development, describes the components needed in a site plan;

- identifies a set of “High Risk Activities” that constitute potential sources of pollution and entail additional pollution controls and management practices to treat water quality; and
- describes the “Simplified Rain Water Management Approach.”

When needed, qualified professionals (QPs) are required to give proof of professional liability and general liability insurance. The bylaw asks proponents to provide the reports of QPs for a range of tasks, such as certification of proper functioning condition, calculations of site permeability, development in compliance with section 4(3) of RAR, and preparation of final landscape plans, for all works associated with the installation of rain water management facilities required for a subdivision, etc. If the QP certifies the subdivision development will have no appreciable impact on proper functioning condition of a wetland, on runoff rates or volumes, or on water quality, the Subdivision Officer then has the discretion to waive the requirement for all or part of a rain water management plan.<sup>87</sup>

## 2.5 Use of Development Cost Charges to Support Neighbourhood-Level Storm Water Management

Sustainable approaches to drainage at the neighbourhood level can be funded using development cost charges (DCCs), further to the authority of local governments to charge developers for capital infrastructure provided, pursuant to section 933 of the *Local Government Act*.<sup>88</sup> DCC charges can be tailored to different uses or zones within a community.<sup>89</sup>

Development cost charges have been a key part of the **City of Surrey**'s strategy to build sustainable drainage infrastructure. Surrey has updated its DCC bylaw to keep pace with its new lower impact engineering approaches.

What Surrey denotes as the “Highway 99 Corridor” neighbourhood is one example where Surrey has innovated with DCCs. In this corridor's concept plan, Surrey obtained title to a large piece of “passive park land” that now serves multiple purposes within the watershed. The greenway acts as a passive park, preserving the ecosystem within its boundaries, and it is being designed to serve a storm water management purpose as well. Developers within the corridor who benefit from this service amenity are required to pay DCCs to facilitate Surrey's cost recovery respecting preservation of that piece of land.

Surrey's newest DCC innovation is proposed in the Grandview Heights Neighbourhood Concept Plan Area #2. In short, the plan proposes to have DCCs pay for a storm water management swale/multi-use greenway that will be located adjacent to the road throughout the development. These DCCs will be in lieu of the usual DCCs to purchase 5-6 percent of the area for the purposes of a detention pond. This is a significant innovation that has the potential to transform the way that municipalities do business in managing the rainwater resource.

In addition to these strategies, BC's DCC regime needs to be made more flexible so that innovations in private developments that result in savings to the capital costs of infrastructure (as opposed to savings on operational costs, which are not pertinent to DCCs) are recognized and rewarded/encouraged with DCC reductions.<sup>90</sup> For example, if a private development implementing green technologies reduces the capacity load on the sewage or stormwater systems by 50 percent, then arguably there should be a 50 percent reduction in the DCCs charged. Currently BC's DCC system has great difficulty accommodating project-specific DCC reductions.

## 2.6 Use of Site-Based Tools: Covenants

Section 219 of the *Land Title Act* authorizes local governments (and certain authorized non-governmental organizations) to hold covenants for the purpose of protecting, conserving or maintaining the land (or a specified amenity in relation to it) in its natural or existing state, in accordance with the covenant. Such covenants may be positive (you will do X) or negative (you will not do Y) in nature and unlike common law covenants, there is no need for the beneficiary of the covenant to own the adjoining land.

As a measure for green infrastructure, one of the advantages of covenants is that they can provide a clear legal stipulation of municipal requirements for on-site stormwater infrastructure construction and maintenance requirements. Since the infrastructure for proper stormwater handling may be required into the future, it is important that ongoing maintenance and operation obligations be attached to the title of the property, to alert subsequent owners of their legal requirements. Covenants can also be a vehicle through which a local government

may assert an explicit right to recover the costs of maintenance and repair of features promised under a covenant – e.g. a swale installed for drainage and infiltration purposes. This can help to defray costs in the event that the infrastructure is not installed as required.

One of the disadvantages of covenants is that local governments may find it inconvenient or expensive to enforce covenant provisions. When negotiation fails, enforcement entails an application to the BC Supreme Court. For covenants to be effective, they need to be monitored and enforced by the party holding the covenant. If local governments fail to monitor compliance with covenant provisions, or are reluctant to take enforcement action, the utility of covenants as a tool for environmental protection is undermined.

A number of BC municipalities use covenants to support their implementation of integrated stormwater management.

#### Case studies:

For example, the **City of Surrey** has a suite of easements and covenants set out as precedents in Appendix 3 to the *Engineering Land Development Customers' Manual* (October 2005).<sup>91</sup> These include:

- Easement with section 219 covenant (storm drainage – above ground only)
- Easement with section 219 covenant (combined swale and pipe system)
- Restrictive covenant: *Land Title Act* s. 219 (water quality/sediment control) – *for parking lots*
- Restrictive covenant: *Land Title Act* s. 219 (sediment control – general/commercial) – *pending construction being 90 percent completed*
- Restrictive covenant: *Land Title Act* s. 219 (interim storm drainage detention system for commercial/industrial developments) – *pending ultimate pipe system and detention facilities being connected*

The **District of North Vancouver** also uses a stormwater covenant to secure on-site infiltration and detention facilities. The covenant obliges the owner to

...construct, install, operate, monitor and maintain a storm water drainage system on the Land in good working order and in accordance with the Storm Water Drainage Plan attached hereto as Schedule “A”.

Schedule “A” establishes all of the standards, so that the system is constructed, installed, operated and maintained to perform as designed.

The District's covenant provides for record-keeping and inspection:

3. Records – The Owner must keep and maintain detailed written records documenting the construction, installation, operation, monitoring and maintenance work done under section 2.
4. Inspection – The District, its officers, employees, contractors and agents, will have reasonable access to the Land at all reasonable times as may be necessary to ascertain compliance with this Agreement and the Owner will make all records kept under section 3 available for review promptly upon request of any of those persons.

The Agreement further clarifies that it has no limiting effect on the powers of the District:

12. No Effect on Powers – This Agreement does not:
  - (a) affect or limit the discretion, rights or powers of the District under any enactment;
  - (b) affect or limit any enactment applying to the Land; or
  - (c) relieve the Owner from complying with any enactment, including in relation to the use or subdivision of the Land.

The District of North Vancouver's covenant includes language designed to make any necessary enforcement easier, in the event of a breach. The covenant provides:

10. Specific Relief – The Owner agrees with the District that because of the public interest in ensuring that all of the matters described in this Agreement, and the provisions of all applicable laws, are complied with, the public interest strongly favours the award of a prohibitory or mandatory injunction, or an order for specific performance or other specific relief, by the Supreme Court of British Columbia at the instance of the District, in the event of an actual or threatened breach of this Agreement.

## 2.7 Stormwater Management Policy or Plan

The **City of Surrey** is in the process of integrating its integrated stormwater management plan guidelines into the “neighbourhood concept plans” that it uses to detail uses and objectives on a lot by lot basis. Considering these details at the same time as considering integrated stormwater management objectives, enables the land use plan to protect such watershed values as channel stability and capacity, and to identify opportunities to integrate best management practices to protect hydrologic function and water quality.<sup>95</sup>

As a result of provincial and other initiatives leading on this issue,<sup>92</sup> many local governments are now developing integrated stormwater management plans to handle their rainwater and drainage challenges.<sup>93</sup> In some communities, these plans adopt a comprehensive community wide approach – for example, the **City of Burnaby**’s “Total” Stormwater Management Policy, which encompasses watershed mapping, standards, best practice tools, public education and communication. In others, the plans are more watershed-focused or neighbourhood specific.<sup>94</sup>

# 3. Metering, Reuse and Rainwater Harvesting

Clean, potable water is a valuable, even precious, resource. In the name of conserving it, communities are looking for alternatives to the use of potable water, and for strategies to reduce consumption. The conservation strategies specifically highlighted in this chapter are metering, water reuse and rainwater harvesting. Other strategies exist of course; and tools such as the province's new Water Conservation Calculator<sup>96</sup> can assist local governments in deciding on the best conservation strategy for their community.

## 3.1 Water Metering

Metering water and charging the user according to the volume of water consumed rather than on a flat rate basis, is a classic strategy for reducing water consumption and managing demand. Environment Canada Municipal Water Use Database (MUD) 2001 data showed that in 1999, the daily water consumption of flat rate users in Canada was 70 percent higher by volume than that of metered users.<sup>97</sup>

Metering is also a tool with which water suppliers and users may identify system “anomalies” – such as extreme use, unauthorized connections, leaks, or breakages – which can then be rectified as a further conservation measure.<sup>98</sup> In addition, MMCD has proposed that with real time metering and variable rates, it might be possible to shift load to avoid peak periods,<sup>99</sup> just as has been done by BC Hydro with electricity users in peak shifting pilots that have involved both industrial and commercial customers. The author is not aware of any jurisdiction that has yet implemented peak shifting for water.

Switching a local government to a metered system clearly involves more than simply installing metering infrastructure or passing a waterworks regulation bylaw with a schedule of metered rates. For example, in preparing for a residential retrofit program at the **District of West Vancouver**, staff estimated that the following scope of activities would be necessary to get a metering program up and running:

- receiving Council endorsement to proceed with research;



Water meter.

A number of BC local governments have water metering programs for some or all of their residential, commercial and industrial users.<sup>100</sup>

- issuing a Request for Proposals;
- receiving and reviewing proposals and reporting to Council;
- receiving Council authorization to negotiate with one proponent;
- consulting with the public;
- arranging installation, operation and maintenance by contracting company (assuming beyond local government expertise and capacity); and
- implementing or contracting for a number of activities related to meter reading, billing, collections, rate structure assistance and customer care services.<sup>101</sup>

Municipalities have the legal authority to provide and regulate any service that Council considers necessary or desirable, further to section 8(2) of the *Community Charter*.

### Case studies:

The **City of Chilliwack**'s water system is 100 percent metered.<sup>102</sup> The metering program works in conjunction with a number of other water conservation programs, including sales of residential water conservation kits, sales of rain barrels for lawn and garden watering, and a water restriction bylaw addressing increased demand due to lawn sprinkling in the summer months.<sup>103</sup>

The Chilliwack Waterworks Regulation Bylaw 2004, No. 2995<sup>104</sup> establishes the terms and rates for the supply and use of water. The Bylaw establishes a quarterly (three-month) billing cycle; establishes that the City may install a meter on any parcel, at a location to be determined by the City engineer; and that the meter shall remain the property of the City. Rates and charges for consumption are stipulated in Schedule B. The Bylaw addresses charges in the event of a meter failure, and addresses billing adjustments for leaks. Adjustments are only allowed if the water leak was accidental or otherwise beyond the control of the owner or occupier of the parcel.

The **District of West Vancouver** recently embarked on a residential retrofit program to make metering universal in the District.<sup>105</sup> Its Waterworks Regulation Bylaw warrants a look, as it was just completely revised to reflect the recent change to universal metering: see Bylaw No. 4490, 2006.<sup>106</sup>

West Vancouver launched its program in support of the District's Water Conservation Strategy, which noted that the District's residential water use was the highest per capita in the GVRD. The program, which the District hopes will lead to consumption savings of 15 percent or more, is also consistent with the District's Corporate Business Plan 2003-2005, and was pitched by staff to be "generally prudent," given water shortages which were experienced in 2003, and "towards realizing the objectives of the Eagle Lake Development Plan, which will optimize use of local resources and reduce reliance on GVRD water supplies."<sup>107</sup> The program achieves other environmental objectives as well, including: facilitating the District's ongoing commitment to supplement water flows in Eagle and Lower Nelson Creeks (necessary to meet water licence



obligations for fisheries protection); reducing the amount of chlorine required for treatment; and reducing the volume of sewage needing to be treated by the treatment plant.<sup>108</sup> Finally, the program fulfils a social function, enabling users to become better stewards of the resource by providing them with consumption information.<sup>109</sup>

The District retrofitted residences with meters and started sending metered consumption notices and water conservation brochures in 2006; actual metered billing under the retrofit program commenced in January 2007, with the first bills to be mailed by end of April, reflecting the first quarterly cycle.<sup>110</sup> Meters are installed primarily in outside pit mounted meter installations, and are read using radio frequency reading technology.

While the District is still at a relatively early stage of its implementation, community consultations during the lead-up to installation were positive.<sup>111</sup> Capital cost recovery will be achieved through a flat rate, staggered extra charge for installation, charged to retrofitted customers. Notable as well, the District used a variety of financial tools to facilitate the installations.<sup>112</sup> The District is predicting a pay-back period of 8-14 years, depending on GVRD bulk water rates and how much water the District is able to conserve as a result of the program.<sup>113</sup>

The Bylaw<sup>114</sup> covers a range of issues. Like the Chilliwack bylaw, it addresses such issues as installation, charges, and what happens if a leak occurs between the meter and the house. Ongoing unrepaired leaks can be grounds for refusing service.

## 3.2 Water Reuse or Reclamation

The reuse of reclaimed water can be an effective component of a community strategy to become more sustainable. Reclaimed water is water that has been treated in sewage or greywater treatment systems; effective treatment methods are now available such that the treated water can be “reclaimed” or reused safely to meet a variety of community water resource demands.<sup>115</sup> In some applications, using reclaimed water can reduce water consumption and outflow by more than 90 percent (35 percent overall) compared to conventional water and sewage systems – reducing fresh water use and reducing impacts on the environment from waste outflows.<sup>116</sup>

The use of reclaimed water is regulated provincially by the *Environmental Management Act's* Municipal Sewage Regulation, B.C. Reg. 129/99 (MSR). Section 10 of the MSR regulates the provision or use of reclaimed water, with reference to Schedule 2, which stipulates a list

of all possible uses of and detailed standards for treated wastewater,<sup>117</sup> and references Schedule 1, which requires an environmental impact study to be conducted.

Some of the uses of reclaimed water (with attached restrictions and standards stipulated) include:

- irrigation of parks, playgrounds, cemeteries and golf courses
- toilet flushing
- agricultural applications, such as aquaculture, food crops, orchards and vineyards and pasture
- frost protection
- stream augmentation
- snowmaking
- nurseries, sod farms, trickle/drip irrigation
- construction applications, such as dust control, soil compaction, making concrete
- industrial uses such as cooling towers, process water and boiler feed
- environmental uses such as for wetlands<sup>118</sup>

Other uses may be approved in writing on an individual basis by the director, in consultation with the Ministry of Health Services. Also note that section 10(8) of the MSR, there are additional requirements on provision of reclaimed water under the unrestricted use category.

The most cost-effective time to install such dual pipe systems is at the onset of development or redevelopment. Local governments may therefore wish to contemplate and plan for installation of dual pipe systems in areas where there is likely to be a demand for agricultural irrigation or other irrigation, or industrial process water.

The Ministry has published the Code of Practice for the Use of Reclaimed Water<sup>119</sup> as a “companion document to the Municipal Sewage Regulation,” though the Code of Practice is not formally referred to in the MSR nor listed with other Codes of Practice in the Waste Discharge Regulation under the same Act.<sup>120</sup>

From a regulatory perspective, the MSR specifically provides at section 10(7) that in order for a person to provide a service of providing reclaimed water for use, either a local service area bylaw is required<sup>121</sup> or the provider needs the written approval of the health department.

Administratively, the local government will need to establish a local government official or department, or contract out to a private corporation the responsibility to ensure the proper administration of the system in compliance with the regulation as well as proper operation and maintenance.

From a capital expenditure standpoint, implementing a reclaimed water system requires a local government to expend revenue installing a secondary pipe distribution system. The system must be designed to protect the primary water distribution system from contact with the reclaimed water distribution system.

### Case study:

For a number of years now, the **City of Vernon** has successfully implemented a reclaimed water system.<sup>122</sup> Its use of reclaimed water has “virtually eliminated the discharge of effluent to the environment.”<sup>123</sup> At a cost of \$29.7 million, Vernon recently commissioned the development of a new treatment facility, the Vernon Water Reclamation Centre. The plant uses biological nutrient removal technology with effluent filtration and ultraviolet disinfection capabilities.<sup>124</sup>

Vernon uses the reclaimed water to irrigate its golf and country club, its research station, a number of playing fields, as well as a number of other municipal facilities.<sup>125</sup> For “technical and economic reasons” it has abandoned plans to install a dual distribution system in residential areas, and it has applied to the Ministry to increase the amount of discharge it may direct to its deep lake outfall.<sup>126</sup>

Vernon holds an operational certificate for its use of reclaimed water, issued by the Ministry of Environment.<sup>127</sup> Vernon’s Operational Certificate No. ME 12215 stipulates that Vernon is responsible for passing an Irrigation Water Supply Bylaw that has terms and conditions in compliance with the operational certificate, and that Vernon must provide a copy of the operational certificate to each user prior to the commencement of irrigation each year.

Vernon’s Irrigation Water Supply Bylaw Number 4899, 2005<sup>128</sup> fulfills this function. The bylaw authorizes use of reclaimed water for irrigation for “normal irrigation purposes” which include:

- agricultural purposes (pasture land or crops for animals);
- commercial purposes (golf courses and commercial lands);
- landscape purposes (trees, shrubs etc for aesthetic purposes);
- public recreational purposes (athletic fields and park areas accessible to the general public);
- residential purposes (trees, shrubs, flowers etc for aesthetic purposes); and
- silvicultural purposes (forest and woodland vegetation in tended stands).

The bylaw refers to the City’s irrigation water distribution system, “the City owned pipes, fittings and equipment intended to supply irrigation water from the City’s irrigation water to the customer’s property line” and covers a range of regulatory measures including imposing a number of duties on the user of the reclaimed water (the customer) to:

- “supply and install an irrigation water meter...” which “...upon installation...becomes the property of the City of Vernon and the City will maintain the meter;”
- “install and maintain all the necessary backflow prevention units in order to protect the potable water system;”

- in using the reclaimed water, comply with the Code of Practice; and
- “provide, install and maintain any public notification and/or signage that may be required under the Code of Practice.”

Amongst other provisions, the bylaw reserves the right of the City to: stop the flow; change the pressure; precludes responsibility for clogging of sprinkler heads or irrigation systems; warns customers who need an uninterrupted supply to make other arrangements; and establishes the right to meter the water and collect fees for its supply.

To complement this bylaw and in particular, to protect the proper operation of the sewage collection system and the Vernon Water Reclamation Centre, in 2005 Vernon also passed a bylaw designed to regulate discharges into the Sanitary Sewer System and the Vernon Water Reclamation Centre. Bylaw No. 4863 has attached to it two Schedules that respectively list Prohibited Waste and Restricted Waste. While some prohibitions are specifically named, many are described functionally as anything that obstructs, infects, or contaminates the sewage collection or treatment system, or:

...cause[s] biosolids from the Reclamation Centre to fail to meet the criteria in the British Columbia Organic Matter Recycling Regulation for any end use that the city may choose to undertake at any given time.

The Restricted Waste list refers to results based water quality standards.

### 3.2.1 Reclamation of Water for Building Use

The use of reclaimed water in toilets is still relatively uncommon, but increasing. A few recent examples are:<sup>129</sup>

- The **University of Victoria** (UVic) reclaims city-supplied water after use in its Outdoor Aquatic Facility for use in toilets and urinals of its Medical Sciences Building, leading to water savings of more than 2 million litres per year.<sup>130</sup> Upcoming projects in line include the Engineering Computer Science Building (which will use the reclaimed water to save energy, using a heat pump system) and other campus buildings which were built with dual plumbing in anticipation of future connection to the system, following the completion of the initial pilots.<sup>131</sup>
- The **City of Kelowna** was recently successful in implementing grey water recycling for toilet use in a residence, which is expected to save the household 30 percent in water

consumption and reduce demand at the waste water treatment facility.<sup>132</sup>

- The **Dockside Green** project in Victoria is planning on-site tertiary sewage treatment and water reclamation.<sup>133</sup>

Each of these projects required a variety of regulatory approvals. For example, UVic staff noted that because UVic was the first to do this, there was no standard approval process. UVic received approval from all of the following agencies: Ministry of Water Land and Air Protection; Vancouver Island Health Authority; Capital Region District Water Commission; District of Oak Bay; and the Municipality of Saanich.<sup>134</sup> It also consulted with a variety of electrical and engineering firms and met with university staff.<sup>135</sup>



Rainwater catchment.

PHOTO CREDIT: WHOLE BUILDING DESIGN GUIDE (WWW.WBDG.ORG) AND DON HORN, GSA.

### 3.3 Residential Rainwater Harvesting

The **Islands Trust Fund** has had a rainwater harvesting demonstration project on Salt Spring Island since 2004, and hosts a wealth of information, publications and resources on rainwater harvesting systems on its website.<sup>136</sup> In 2006, the Trust Fund published a Guide to the regulatory framework pertaining to the installation of rainwater harvesting systems.<sup>137</sup>

## 4. Becoming Energy Smart – Buildings, District Heat and Other Innovations

Please refer to West Coast’s *Green Buildings Guide*<sup>138</sup> for a full discussion of strategies that local governments can use to encourage green building designs and practices.

The purpose of this chapter is to briefly highlight some of the actions BC communities are taking to make their infrastructure more energy efficient. **The chapter does NOT include a full discussion of legal and policy tools. Case study communities are identified so that readers may seek further information from staff.**

### 4.1 Implementing Energy-Saving Standards for Municipal Infrastructure

Bike lanes.

PHOTO CREDIT: TOWNSHIP OF LANGLEY  
WWW.TOL.BC.CA/CYCLING



Local governments have numerous opportunities to consciously reduce the energy footprint of their infrastructure – through changes to municipal buildings, vehicle fleets, street lighting, etc.

Shifts in policy can be accomplished by council or board resolution, through decisions concerning capital expenditures and purchasing policies), and (as discussed in Chapter 1) through policy set out in the regional growth strategy and/or official community plan.

Some of the policies that local governments may endorse include:

- LEED standards for new civic buildings,<sup>139</sup>
- retrofitting of buildings to incorporate energy efficient fixtures and appliances;
- retrofitting of street lighting;

- changing purchasing policies for vehicle fleets to fuel-efficient vehicles;
- for other goods, purchasing local in preference to those that have to be transported from a distance;
- installing bicycle infrastructure;<sup>140</sup>
- upgrading public transportation infrastructure;
- instituting training programs (e.g. anti-idling) to complement infrastructure changes;
- creating eco-industrial parks and implementing eco-industrial networking principles; and
- instituting energy efficient technology for water and wastewater infrastructure, e.g. energy efficient technology for water supply distribution, water treatment, wastewater (sewer) collection and pumping, and for wastewater treatment systems.

The **District of Squamish** recently announced a 12-Step Pledge to Reduce Greenhouse Gas Emissions.<sup>141</sup> The Pledge includes a comprehensive list of actions that will not only reduce greenhouse gases but will contribute to energy efficiency.

### Case Study:

A community that is making strides with its energy policies is the City of **Dawson Creek**, which recently won the 2006 Energy Aware Awards from the Community Energy Association, for initiatives flowing from its Natural Step Framework sustainability initiative, such as community energy planning, green retrofitting, a green vehicle purchasing policy, installation of a solar hot water system at city hall and working with the Ministry of Energy Mines and Petroleum Resources on creating a local building bylaw that will set energy efficiency requirements for new construction, such as solar-readiness.

## 4.2 District Heat Energy Systems

A number of BC communities have instituted district heat or district energy systems as a way to increase their efficiency in meeting community energy needs. District energy systems entail providing heat energy infrastructure to meet the heating needs of more than one building in a way that is more efficient than each building could otherwise achieve on its own. District energy systems can also incorporate cooling and power distribution. For example, a geo-exchange system within a district system can potentially provide cooling as well as heating.

Legal and policy implementation tools include:

- using zoning and other land use bylaws to ensure buildings will hook into the system;
- passage of local service area bylaws; and
- securing contractual commitments through redevelopment contracts with private developers.

### **Case Studies:**

The **City of North Vancouver** has innovated in this area with its launch of a district heat system of hydronic heat energy generated by a series of “mini-plant” high efficiency boilers distributed throughout the redevelopment area. The utility, Lonsdale Energy Corporation, is a wholly owned subsidiary of the City, and is operated by partner Terasen Utility Services Inc. The Federation of Canadian Municipalities provided critical seed funding.<sup>142</sup> The redevelopment project is integrated with the community energy plan, a first for BC.<sup>143</sup>

The **City of Revelstoke's** Community Energy Project has innovated with a biomass based district heat system. The system uses wood waste to fuel a biomass energy plant that then heats the Downie Street Sawmill's dry kilns as well as a number of other buildings including the local aquatic facility. The corporation directing the project is overseen by a separate Board of Directors.

Both **Whistler** and the **City of Vancouver** are using district heat systems in housing projects connected with the Olympics.

The system currently being designed for the new Whistler Athletes' Village near Function Junction will use heat energy from the resort's wastewater treatment plant, supplied through a two pipe system throughout the new village. Each unit will connect to the intact pipe then use a heat pump to increase the temperature for radiant heating. The cooler exhaust water will leave through the exhaust pipe back to the treatment plant for reheating.

The Canadian District Energy Association<sup>144</sup> has further resources on district energy initiatives.



## 4.3 Capturing and Benefiting from Municipal Waste Streams

### 4.3.1 Landfill Gas-to-Electricity Plants

More and more municipalities around BC are realizing the benefits of capturing landfill gas and burning it to produce electricity. Advantages of these systems include waste capture, reduction of greenhouse gases, generation of green power and a revenue stream for the local government.

Typical legal and policy tools used to implement projects like this include:

- Requests for Proposal
- Agreements for: partnership, development, and operations
- Lease agreements re: equipment
- Licence of occupation
- Landfill gas supply agreement
- Energy purchase agreement between Hydro and the supplier of electricity (local government or partner).

#### Case Studies:

In 2003, the **Capital Regional District** (CRD) established a landfill gas-to-electricity plant at its Hartland Landfill.<sup>145</sup> The facility produces almost 1.6 MW of green power.<sup>146</sup> Project development was undertaken by means of a public-private partnership with Maxim Power Corporation. Maxim designed, built and operates the facility; the CRD owns 70 percent of the equipment and leases it back to Maxim.<sup>147</sup> Maxim sells the power to BC Hydro and pays a royalty (a percentage of revenues) to the CRD in return for its use of the landfill gas.<sup>148</sup>

A region-wide counter-petition process was used in the CRD to obtain the necessary *Local Government Act* consent of the electors for the operating agreement, master equipment lease, licence of occupation and landfill gas supply agreement.

The CRD is currently investigating ways to generate additional revenue by marketing the GHG emission reduction credits.<sup>149</sup>

In June 2005, the **City of Kelowna** initiated its Glenmore Landfill Gas Recovery Pilot Project, which involves gathering landfill gas (primarily methane) and then burning it in a microturbine that then converts the gas to electricity. The electricity is being used to power landfill operations; surplus electricity is being purchased by Fortis BC.<sup>150</sup> Interestingly, “[t]he microturbine is leased from the Canmet Energy Technology Centre (a division of Natural Resources Canada) at \$10 per year.”<sup>151</sup> The project won a 2005 UBCM Community Excellence in Leadership & Innovation Award.<sup>152</sup>

The **City of Kelowna** has a facility for recycling and composting biosolids to produce sellable compost product.<sup>154</sup>

### 4.3.2 Other Waste Recycling

Another common way for a community to capture waste streams and divert energy expenditures from garbage to recycling is to institute the infrastructure for a broad recycling program, and to institute policies that encourage waste recycling and diversion, (e.g. of construction and demolition materials) using such tools as adopting LEED standards for construction (which give points for using recycled materials), outlawing landfills as a land use, instituting differential tipping fees, banning certain materials, etc.<sup>153</sup>

### 4.3.3 Using Community Water System Flow to Generate Power

The **District of West Vancouver** has shown leadership on the energy side, with its Eagle Lake hydro project, advanced through a partnership agreement with Pacific Cascade Hydro Inc. This hydro-electric generation project harnesses water flow from the District’s Eagle Lake community water supply, to generate energy as the water, flowing downhill to the water distribution system, passes through a turbine constructed on the reservoir’s roof. The project generates some 1.1 gigawatt hours (equivalent to approximately 20 percent of the District’s operation needs) and has a capacity of 0.2 MW.<sup>155</sup> The equipment was installed in 2002 and commenced commercial operation in May 2003.<sup>156</sup> The system was designed, built and is operated by Pacific Cascade Hydro Inc.

To get to implementation, a number of regulatory and financial hurdles had to be negotiated. These included provincial *Water Act* licence issues, federal *Fisheries Act* compliance, provincial regulations around becoming an independent power producer and cost recovery through a structured cost sharing agreement with the operator. The District anticipates recovering its original investment in five years.<sup>157</sup>

## 4.4 Resources

A number of helpful resources are available to local governments wanting to increase their energy efficiency. Visit the provincial government's Community Action on Energy Efficiency website.<sup>158</sup>

# 5. The Liability Elephant

Innovating with new development technologies can make many people nervous about the downside risks: that property will be flooded or damaged; that someone will get hurt; that things won't work the way they are supposed to; that taxpayers will end up footing the bill for a failed project; or uninsured individuals will get caught with a loss they cannot pay for, leaving them out of pocket, angry and frustrated.

There are many kinds of risk that enter into a local government's consideration of a project or infrastructure innovation. In some cases the worry is that the local government will get sued – for not living up to its obligations under statute, for doing something negligent, or for breaking a promise under contract. In other cases, the risk is financial – a worry that it will cost too much, or that there will be unforeseen hidden costs, for example, caused by a delay. There are also political risks to consider: will the project be popular? Will it be well received by the voting public and the development community?

So how does a local government reap the potential environmental and economic benefits of innovation and overcome the potential risks involved with utilizing new technology? What steps can a local government take to manage the risks?

## 5.1 Step One: Acknowledge the Risks

One of the most important steps to take when moving forward with an innovative project or technology is to acknowledge directly what might be referred to as the 'elephant in the room' – the local government's concern over potential liability. Local governments may quite willingly acknowledge the potential benefits to be gained from an innovation, but this may be accompanied by a real nervousness about changing from a known way of getting things done to a way that has a number of unknowns associated with it. It is best to tackle these concerns with a full and frank discussion right at the outset.

So what are some of the potential spheres of concern? There are a number of reasons why it may actually be risky, or just seem risky, to

change from “business as usual” to the use of new technologies. Some of the potential hurdles are:

- a) the technology may be new and therefore have an unproven performance record;
- b) the technology may be perceived as more expensive than “business as usual”;
- c) there may be concerns around joint and several liability and the risk of being left “holding the bag”;
- d) there may be concerns that the statutory defence for “malfunctions” does not protect against a design that simply performs insufficiently;
- e) the technology may be perceived as unnecessary or inappropriate for the climate;
- f) regulatory approval processes may be slowed down by political risk or public controversy associated with the proposal (e.g. use of biomass in the city); or
- g) there may be concerns over the validity of engineering assumptions, given the fact that historical data is now appearing less relevant under current conditions of global warming and the increasing occurrence of extreme weather events.

When considered in the abstract, any of these risks has the potential to stall innovation. However, risk management experience demonstrates that it makes sense to take the time to unbundle each hurdle and to define it in more specific terms. Like any problem, once it is broken down into smaller specific pieces or challenges, it becomes much easier to discover solutions, and to make rational choices about what level of risk is realistic, what is acceptable, and where the risk burden should properly fall.

## 5.2 Understand the Risk Framework

### 5.2.1 Relevant Legislative Provisions

#### (a) Immunity for Certain Nuisance Actions

Section 907 of the *Local Government Act* empowers local governments to pass a bylaw in relation to surface runoff and stormwater disposal for paved or roof areas. This authority gives local governments a wide discretion in setting such requirements and tailoring them to local circumstances.

Local governments have some limited statutory protection for drainage and sewer system failures, as set out in section 288 of the *Local Government Act*:

288. A municipality, council, regional district, board or improvement district, or a greater board, is not liable in any action based on nuisance or on the rule in the *Rylands v. Fletcher* case if damages arise, directly or indirectly, out of the breakdown or malfunction of

- a) a sewer system,
- b) a water or drainage facility or system, or
- c) a dike or a road.

The courts have interpreted this statutory defence narrowly, on the grounds that local governments should not enjoy a blanket protection and are required to meet a strict standard of diligence.

This provision has also been interpreted to only provide protection against clear breakdowns or malfunctions. If the sewer or drainage facility is working properly as designed, but the design is inadequate for the task (e.g. given new additional or unexpected load) the statutory defence will provide no protection.<sup>159</sup>

*Cutting Green Tape* suggests that local government action on green infrastructure might be better facilitated with the amendment of section 288 to limit liability for approvals of innovative stormwater or sewer treatment systems, or alternatively, limiting liability to cases of

gross negligence or cases where the local government failed to weigh the risks of innovative systems against the benefits.<sup>160</sup>

### **(b) Limited Liability for Certain Building Code Inspections – Reliance on Qualified Professionals**

Local governments will also be concerned about being implicated in lawsuits involving building failures – in particular, liability arising from approvals given in respect of the Building Code. Local governments have a heightened reason to be concerned about lawsuits, as they may get stuck footing the bill, even if they are found only partly liable (see discussion below re: joint and several liability). Regardless of findings of liability, it is very expensive to defend lawsuits, given the high cost of legal counsel and protracted court proceedings.

The *Local Government Act* also provides local governments with the ability to limit their potential liability in relation to building permit approvals, by relying on qualified professionals who have provided certain stipulated certifications of compliance. Section 290 provides that a municipality will not be liable for a failure in issuing a permit for a development that fails to comply with the Building Code, if in issuing the permit, the municipality obtained an engineer/architect's certificate of compliance, and indicated in issuing the permit that it relied on that certificate. The immunity does not apply if the local government knew the person certifying was not registered as a professional engineer or architect.

While providing a defence to a claim of negligent issuance of a building permit, section 290 does not provide a defence to an allegation of negligent inspection or any other activity not specifically covered by the limitation. Courts can be expected to apply a strict construction of this statutory defence, and as outlined in more detail in section 7.3 below, local governments can limit their potential exposure for operational negligence by stipulating the scope and procedures for local government review of the credentials and certifications provided by the qualified professional.<sup>161</sup>

In the event that risks materialize and a local government is faced with a lawsuit, limitation defences become a relevant consideration.

### (c) Limitation Defences

The relevant limitation periods for actions against local government are section 285 of the *Local Government Act* and sections 3(2) and 3(5) of the *Limitation Act*. Section 285 provides a six month limitation period, but only if the act complained about is purported to have been done pursuant to its statutory power and is something “that might have been lawfully done by the municipality if acting in the manner established by law.” If not, then the *Limitation Act* applies, and if the damage is direct, a two year limitation period applies. If in the latter case the damage is indirect, then there is a six year limitation period; and usually if there is any delay between the impugned act of the defendant and the impact to the plaintiff, it usually means it is considered indirect.<sup>162</sup> Section 285 of the *Local Government Act* does not apply to actions founded in negligence.<sup>163</sup>

All of this suggests that damage from green infrastructure “failing” would likely be seen to be indirect damage governed by a six year limitation; however, an opinion from a legal professional should be sought in every case.

### (d) Negligence Act – Joint and Several Liability

One of the important reasons that local governments need to avoid lawsuits is that under BC law, they may get stuck with paying the whole of a damages award, even if they are found only partially at fault for the damages. This is due to the “joint and several liability” provisions set out under section 4 of BC’s *Negligence Act*. As explained by Heal and Grégoire, “...the defendants bear the risk of non-recovery *inter se*, which means practically that a solvent defendant (usually an insured municipality) found at fault may get “stuck with the bill” where there is an uninsured or insolvent [defendant] contractor.”<sup>164</sup>

In summary, there are a number of legislative provisions that can affect a local government’s potential liability. In response to these risks and others, local governments have looked at ways to reduce or shift risk, using more cautious design strategies, and legal devices that ask other parties to assume some of the responsibility for potential failures.

BC’s joint and several liability provisions provide an important public policy benefit to injured or aggrieved individuals, in that successful plaintiffs are more likely to have their judgments honoured; however, the downside risk of this rule for local governments and taxpayers more generally is that there can be a significant financial burden associated with a finding of even partial local government liability.



## 5.3 Reducing the Risk: Requirements to Over-Engineer

### 5.3.1 Pilots and Dual Systems

A very practical strategy for managing the risk associated with a new or untested technology failing is to engage in a pilot project, and to require the old, known system to be installed as well, to act as a fail-safe in the event that the new piloted system does not perform as predicted. Pilots may be initiated by local governments on their own, or they may be done in partnership with other interested levels of government.<sup>165</sup> The data and the learning that comes out of pilot projects is irreplaceable, and provides a needed foundation upon which future alternative designs can grow.

Mitigating against a legal requirement for a redundant system is that it can be prohibitively expensive to build two systems and it is by definition an inefficient use of resources.

However, a requirement for a dual system may in fact be a reasonable interim strategy and a rational cost for proving out a desired system, while the new system undergoes a necessary “pilot” phase of testing and gathering data to prove system performance. Employing a dual system can also serve to reassure the skeptics that even in the event of a major system failure, no major consequences will result.

The **City of Surrey** employed a risk reduction strategy of installing a dual system in its East Clayton pilot. While this choice was not popular, and critics may have thought the decision was overly conservative, it provided the local government with a safety net and in fact, averted negative consequences when the technology did not prove out exactly as designed. In short, it provided Surrey with a buffer while it learned more about the technology’s performance in the field.

### 5.3.2 Overflow Systems

Another strategy for managing the risk of new technology is to require that any new system be built with an “overflow” system, designed to capture and manage really big water flows in the event of a major

failure. Unlike the requirement for complete redundancy, this involves a more strategic requirement that the larger events be managed.

### 5.3.3 Over-Engineering

Another strategy is to adjust upward the safety margin on engineering design standards, so that a bigger cushion of comfort is in place, in the event that some of the assumptions about design performance prove to be inaccurate. For example, the **District of Maple Ridge** in accepting the Silver Ridge development application required that a conventional storm sewer also be installed throughout the entire development and that the system be sized assuming all alternative source controls such as rain gardens fail. This requirement added additional costs to the development, but due to the areas of new practice being implemented, it was decided that the over-engineering was warranted. The District also required that for streets greater than 10 percent slope or streets where major overland flows are concentrated, more conventional measures shall be used. End-of-pipe solutions were developed in these areas.

## 5.4 Other Strategies to Manage Risk: Legally Limiting or Shifting Risk

In addition to engineering solutions, there are number of other strategies that local governments may use to manage risk, to either limit it or shift it to third parties.

### 5.4.1 “True Policy Decisions” by Council

Local government liability may arise in the context of negligence by local government officials, whether in executing local government responsibilities prescribed by statute, or in carrying out other responsibilities or actions. Liability may arise where a party aggrieved is able to demonstrate: (a) that the relationship between the parties was sufficiently close, such that it gave rise to a duty of care being owed; (b) that the legally applicable standard of care was not met; and (c) that the failure to meet that standard caused the harm at issue.

If the negligent failure in question is the result of the performance of a “true policy decision” by the local government, the local government will not be liable. A “true policy decision” is a decision by the local council or board that usually involves consideration of social, political and economic factors and constraints<sup>166</sup> (e.g. cost) in deciding the boundaries of what the local government will do in the performance of a particular function. In making such a decision, the local government indicates that as a matter of policy, it will only be doing X (e.g. a specified list of tasks) in the exercise of that function, and clarifying that due to the constraints upon it, it will not be doing Y. In this way, a local government may strategically limit the duty of care it is willing to assume, by actively making a policy decision – a considered decision – stipulating the manner in which it will assume and execute duties in a certain jurisdictional sphere. So long as it is a properly considered policy decision made with proper *bona fides*,<sup>167</sup> it will provide the local government with some degree of protection from claims of limitless duties owed.

True policy decisions can be distinguished from “operational” decisions or actions, the latter of which are, in their essence, the practical implementation of policy, a bylaw or a statutory duty; usually made on the basis of administrative direction, expert or professional opinion, technical standards or general standards of reasonableness.<sup>168</sup> Whereas operational implementation can be scrutinized and called to account to a certain standard, a properly made policy decision cannot.

Given the parameters of local government discretion, it is possible to imagine different ways in which a local government might deliberately make certain policy decisions to ensure that its liability is bounded, for those areas in which it has undertaken duties. For example, it is well established that a local government may make a *bona fide* policy decision, referring to the limited availability of funds, to limit the number or frequency of inspections required.<sup>170</sup> As long as the local government otherwise meets its statutory obligations, this is a perfectly legitimate exercise of local government discretion.

Reducing the amount of discretion to be exercised at the operational level is an appropriate strategy for trying to limit a local government’s potential exposure for operational negligence. For example, if a policy stipulates, considering all of the economic, social and political factors at stake, what specific practices or procedures need to be performed to meet the duty, then so long as staff adhere to those procedures, any failure to go beyond those procedures is likely to be determined to be

A local government may not escape a duty that is imposed by statute or bylaw. For example, in the now well known Delta decision, the court held that a local government bylaw that undertook to enforce the Building Code could not be undermined by a department-level practice not to enforce certain parts of it. Such a decision, made at the departmental level, and clearly in direct contravention of the blanket policy established by the bylaw, was found not to be an immune policy decision but rather an operational decision/failure for which the local government was held liable.<sup>169</sup>

the result of the true *bona fide* policy decision and not the result of operational negligence.<sup>171</sup>

Using this analysis, it might be possible to limit local government liability in the sphere of drainage, by council making a policy decision, for financial or other legitimate policy goals (e.g. environmental), that stormwater infrastructure would be designed only to a certain specified threshold standard, e.g. a 20-year or 50-year storm event instead of a 100-year storm event.<sup>172</sup> Of course, this would only be possible if it were found that such a decision would still be consistent with any statutory duty imposed upon local government to manage stormwater in a safe and responsible manner.<sup>173</sup> In addition, any such policy decision by the local government council or board would preferably follow an open and transparent process of consultation and discussion of risks and benefits with the public (see section 7.4 below). The idea would be that if a failure was to be found attributable to that design standard limitation, the local government would not be liable, given that it could be shown that the local government made a *bona fide* decision to adopt the alternative standard, after considering all of the competing environmental, social or economic considerations, risks and values.<sup>174</sup>

In a situation where best management practices are evolving and there otherwise exists the potential for public liability to flow from operational decisions, council might limit the risk of liability for operational negligence by adopting a management strategy that explicitly employs an identifiable set of “best management practices” and adaptive management principles. In making the policy, council would acknowledge the uncertainties but endorse a particular operational solution – i.e. identifiable best management practices and a risk management approach that learns and adapts based upon experience gained along the way through ongoing monitoring and reporting practices.<sup>175</sup>

Such a strategy seems well suited to a council decision to proceed with the use of innovative green infrastructure technologies.

## 5.4.2 Reliance on Qualified Professionals and Private Insurance

Local government may be able to limit its liability for a range of technical approvals by clearly predicating its approvals upon the provision of certifications from private third party “qualified professionals” (QPs).

### Practice Tip

In preparing for the effective use of true policy decision defences, it is important for local governments to institute procedures to preserve historical procedures, standards and guidelines (applicable to electronic or other documents).<sup>176</sup> A records retention policy is essential for establishing that a particular local government employee was adhering to the policy in force at the time.<sup>177</sup>

In this case, the QPs would provide evidence of stipulated professional and insurance qualifications. The local government would explicitly rely on those certifications.

As discussed above, the *Local Government Act* establishes a precedent for this kind of process to be used, in relation to Building Code approvals. In addition, the provincial *Fish Protection Act* now also authorizes local governments to rely on qualified professionals, in conducting development or other approvals with the potential to affect riparian areas.

In fact, such privatization or contracting out of certain local government services is becoming more commonplace as a practice around the country. Ontario, for example, recently established a system of “qualified registered code agencies” that permits outsourcing of building inspection services in that province.<sup>178</sup>

In the green infrastructure context, it is possible for a local government bylaw to establish a policy that it will make decisions in relation to approval of drainage facilities, relying upon the certification by qualified professionals that the drainage facilities meet certain (green) performance criteria.<sup>179</sup> In order to reduce the potential for a finding of operational negligence at the staff level, such bylaws should delimit the process to be followed by approval staff in reviewing an application (e.g. to determine credentials and/or to ensure that certain stipulated certifications are submitted), to limit the scope of review the municipality has assumed in undertaking action in that area of jurisdiction.<sup>180</sup>

Privatizing risk through the use of qualified professionals and their insurers may reduce the likelihood of local government liability but local governments will also need to consider whether a practice of relying upon qualified professionals will otherwise provide adequate public protection, considering the following significant concerns:

- a) whether there are sufficient numbers of qualified professionals to meet the need;
- b) whether an adequate system of training and qualification exists or can be established to ensure an ability to verify credentials;
- c) whether a private professional can within the context of a project certification sufficiently consider other values such as cumulative impacts;

- d) potential conflicts of interest created by qualified professionals being paid by private developers;
- e) whether the public has an appropriate and transparent mechanism to register concern, complaints or to obtain information; and
- f) that insurance provided by qualified professionals, like other errors and omissions insurance, is likely to be “claims made” insurance, i.e., providing protection only if the policy remains in effect when the claim is made.<sup>181</sup>



Crown Street, Vancouver.  
PHOTO CREDIT: CITY OF VANCOUVER

Note that a failure by local government to make a policy decision limiting the scope of staff review of the professional opinion, may expose the local government to potential liability arising from an alleged failure on the part of staff to review the application further.

Alternatively, given the public policy considerations described, a local government may decide that it is in the public interest for them to review the opinions of qualified professionals in detail, e.g. to ascertain that they adequately provide for ecosystem protection. Note that this may well however expose the local government to potential

liability and foreclose the local government from shifting the risk to the qualified professional and its insurer.

### 5.4.3 Legal Agreements to Shift Risk

A strategy employed by an increasing number of local governments is to utilize contractual undertakings, Land Title instruments and private insurance to allocate risks to the property owner. As discussed in Chapter 2, covenants are now being used to shift certain responsibilities for infrastructure construction and maintenance to the site owner/operator, and use such legal devices as waivers, guarantees, and insurance and indemnity provisions to secure those commitments against title to the land.

## 5.4.4 Bonding

Taking security from a developer and tying performance to its return, is one way for a local government to feel secure that infrastructure installations, or performance monitoring will take place into the future.

One of the challenges with bonding or letters of credit is that motivated developers view it as an additional, unnecessary cost, and in some cases, the cost it imposes may kill the project.

One strategy for making bonding more appealing to developers is to structure security so that it can be partially released as development progresses. This is one way that a municipality can work cooperatively with the development community to satisfy the municipality's need for security in the face of the uncertainty of things going wrong.

## 5.4.5 Interim “No-Build” Covenants as a Security Mechanism

An alternative to security bonds (which can be prohibitively expensive, and even when released incrementally upon fulfilment of conditions, are financially burdensome and unpopular with developers) is the imposition of a temporary “no-build” covenant (further to section 219 of the *Land Title Act*) that is released upon fulfilment or performance of all required green infrastructure installations. Using this tool is a useful strategy for local governments that want to avoid subjecting developers to the financial burden of giving security.

Local governments may have more confidence using this tool where the developer is known to the local government, is otherwise motivated to install green infrastructure designs, and/or is not considered in need of the “threat” of financial security to perform obligations. However, in a fast market where development is rapid and the local government may have trouble keeping up with monitoring development activities on the ground, this strategy could be less effective. Once residents have taken possession of newly built homes, for example, local governments

may be loath to risk political unpopularity pressing owners on the covenanted obligations that are attached to their title, as these tend to be poorly understood by the public.

## 5.5 The Need for Public Debate on Risks and Choice

Decisions concerning what infrastructure model to implement, and at what risk and value are significant decisions that warrant the support of a public consultation process that openly quantifies and weighs the associated benefits, costs and risks of different options.<sup>182</sup> Clear public policy choices need to be made vis-à-vis how limited financial resources should be allocated, whether the public or private actors should bear the risks associated with innovation (and indeed whether shifting risk to private developers will kill innovation), and what sort of environmental impact will result from the community's infrastructure design.

## 5.6 Financial Risks: Green Valuation

The financial risks associated with a project's design are often a significant factor in the decision on how to proceed. Given that infrastructure endures over years and sometimes decades, it makes sense for local governments to take a long view of the costs and savings to be had with one design versus another.

To meet financial challenges, local governments may apply for infrastructure and planning grants from both the provincial<sup>184</sup> and federal<sup>185</sup> levels of government, and there are also often opportunities to partner successfully with the private development sector as well. Government granting agencies regard green infrastructure proposals more favourably than conventional approaches.<sup>186</sup>

Another important consideration is that the provincial government has indicated that as of 2009, it will require local governments to report on capital assets using generally accepted accounting principles (GAAP).

This shift in local government reporting requirements concerning capital infrastructure seems likely to lead to more systematic planning for capital infrastructure, with an associated better appreciation of the costs of maintaining and replacing the infrastructure. Some local

Securing outside funding support may be a critical key to success. For example, Surrey, a large municipality, has acknowledged that seed funding of \$1.2 million (one-third each from the federal government, the province and the GVRD) was critical to its East Clayton pilot moving forward.<sup>183</sup> This funding was allocated one-half to infrastructure and the other half to education and monitoring programs.



government officials are optimistic that this will mean they will be better positioned to manage the financial “gap” so typical of infrastructure discussions.

The movement toward adoption of GAAP also paves the way for whole cost or life cycle accounting for infrastructure. As these methods are employed, it seems likely that we might expect a fuller appreciation of the benefits the green infrastructure alternative has to offer. In fact, the general trend in valuation circles is towards adopting life cycle or green valuation methods. For example, the March 2007 Vancouver Valuation Summit, sponsored by the Appraisal Institute, featured the launch of the Vancouver Valuation Accord, setting out a set of green valuation standards. These promise to lay the groundwork for the avoided costs of green infrastructure technology to be appreciated in the cost-benefit analysis.

## 6. Supporting Innovation with Monitoring and Adaptive Management

### 6.1 The Importance of Monitoring

One of the challenges with gaining acceptance for an innovation is to convince others that the innovation is needed, and how it will be an improvement over the existing system. On both counts there is a need for objective data. It makes sense to build in legal requirements for data collection and reporting.

Put simply, unless you actually monitor performance and gather data, there is no way to really know how a system is doing and what is needed to improve performance. Without data, all you have is an impression of how you are doing. With data, you can satisfy yourself that you are meeting measurable goals and you are equipped to prove the merit and performance of your system to third parties. Such data can help to build the case for cost-savings, and it can inform your efforts to adapt, to improve your design and your future performance, as well as the design and future performance of developments elsewhere that may look to you for learning. A failure to institute monitoring and data collection misses these important opportunities.

### 6.2 Instituting Monitoring Requirements

Local governments have a number of legal and policy tools available to them for instituting infrastructure performance monitoring requirements. They can require civic infrastructure systems to be monitored as a matter of internal operations policy and they can require private development owners to monitor performance and submit results.

## 6.2.1 Bylaws for Ongoing Maintenance and Monitoring of Surface Runoff Systems

Under section 907 of the *Local Government Act*, a local government may pass a bylaw to require that an owner of land who carries out construction of a paved area or roof area, manages and provides for the ongoing disposal of surface runoff and storm water in accordance with the requirements of the bylaw.

Such bylaws can stipulate a performance standard to be met on an ongoing basis. The bylaw could require the owner to monitor into the future to ensure compliance with the standard, and could further require the owner to submit the monitoring results to the local government at regular intervals.

### Case Studies:

The **District of Saanich** requires subdivision developers to maintain stormwater facilities and to provide a maintenance schedule for all private systems. New systems require posting of a three-year maintenance bond.<sup>187</sup>

The **City of Surrey**'s new Erosion and Sediment Control Bylaw requires an erosion and sediment control permit for sites larger than 2000 m<sup>2</sup>. On these sites, the permit "requires plans, deposits, [an] ESC [erosion and sediment control] supervisor for the site and regular monitoring and reporting on performance."<sup>188</sup>

## 6.2.2 On-Site Rain Water Management Covenants

Another means by which a local government may require ongoing performance monitoring and the submission of data, is using an on-site rain water management covenant. Such covenants are usually granted in favour of a municipality at the time of a site development approval. See Chapter 2.

## 6.2.3 Comprehensive Development Agreements

When local governments sell municipally-owned land for redevelopment, they can impose requirements on that redevelopment using contractual terms or means. Theoretically, then, in a redevelopment situation, a local government could negotiate monitoring as a term or

condition of the comprehensive development agreement. For example, the Docks Green Master Development Agreement on the City of Victoria's website provides for a variety of monitoring measures.<sup>189</sup>

## 6.2.4 Opportunities to Collaborate for Success

When instituting a monitoring or adaptive management program, the opportunity may exist to collaborate with others, to maximize the probability that the program will succeed. For example, there may be opportunities to spread monitoring duties among both municipal staff and other stakeholders. For example, once green infrastructure is installed in a residential neighbourhood, it may be possible to educate homeowners and to engage them to assist with system maintenance and problem identification.<sup>190</sup>

Alternatively, a project may be large enough or its approach sufficiently novel to justify the establishment of an inter-agency or multi-stakeholder committee, to review data and make recommendations to the local government and developer for improvements moving forward.<sup>191</sup> Every case is unique, but usually there is more than one set of constituents interested in the learning to be derived from a new way of doing things.

## 6.3 The Power of Results: Using Data to Monitor Performance and Build Success

Monitoring creates an opportunity not just to verify and prove earlier performance, but to build on previous successes. Documenting results facilitates subsequent approvals.

### Case studies:

#### Surrey – Building a Sustainable Storm Water and Sediment Control Regime

Surrey carried out three years of monitoring activities<sup>192</sup> on its East Clayton neighbourhood to verify whether the installed green infrastructure systems (extra foot of topsoil, disconnected roof leaders, constructed on-lot rock pits for exfiltration and detention, road-side swales) in fact made any difference to site permeability, and whether their performance deteriorated over time.<sup>193</sup> The results of this monitoring

demonstrated that the new systems have reduced runoff volumes, and they have not deteriorated over time.<sup>194</sup> While there has been mixed success for some of the designs, overall, the pilot is viewed as a success.

One of the lessons that Surrey learned as a result of this implementation of new systems is that there is a need to “close the circle” of performance and inspection, following the house construction phase. While developers did install green infrastructure as was required further to their site servicing obligations, the green infrastructure installations did not always survive the construction phase.<sup>195</sup> Builders did not always build with the green infrastructure in mind, and moreover, the building inspection department was not set up to inspect green infrastructure installations. Surrey has therefore identified a gap that needs to be fixed for future developments. One idea being considered for solving this issue is to tie the green infrastructure requirements to the occupancy certificate. This would however entail additional training and policy development, to ensure that all building professionals are fully engaged in the process of implementation.

Surrey is no longer monitoring East Clayton’s performance but it is trying to incorporate the learning gained from the data that was gathered. For example, on the engineering side, Surrey is:

- working to find improvements to curb cuts that were designed to direct water into the grassy swales but which in some cases have not performed and need maintenance or minor design modification;
- changing design of rock pits (plugging some stop-gap drainage holes), to improve exfiltration performance; and
- studying engineering successes from elsewhere, to optimize performance.

On the liability side, Surrey appears to be without regrets that its East Clayton development was designed and built with “dual systems” (new and old, green and traditional pipe systems) for handling storm water flows. Considering that some of the green infrastructure experienced some implementation hurdles, the system as a whole was seen as supportive of learning, with the benefit of a safety net. The fact that the traditional system was still there as a back-up served to quell concerns over liability. The experience also taught the City to proceed with caution, recognizing that implementation hurdles will be present in every new development. The current challenge is to find ways to ensure that post-construction on-site storm-water infrastructure is in place and working, before deviations from normal detention pond requirements are permitted.

In addition to applying the learning results to make improvements to East Clayton’s performance, Surrey has been able to apply the learning from East Clayton to other proposed developments in Surrey,<sup>196</sup> and to build on its success, by making low impact development a requirement for new plans. Using restrictive covenants, Surrey is requiring best management practices such as the use of bioswales, oil and grit separators, on-site exfiltration, and perforated pipe. Surrey’s goal is to exceed the performance of the East Clayton pilot.

## Burnaby – Alternate Street Design

The **City of Burnaby**'s Alternate Street Design pilot project serves as an example of how a community can build on the data and proven successes of pilots in other communities, to seed its own success. In pitching a pilot, alternate street design demonstration project in 2006, Burnaby staff reported to Council that “[t]wo years of flow monitoring by the City of Seattle on its first alternate street design project concluded that the total volume of stormwater run-off from the road has reduced by 98 percent for a two year storm event.”<sup>198</sup>

### **Silver Ridge – Stormwater Management**

The award-winning low impact development measures implemented in the steep terrain of the Silver Ridge residential development in the **District of Maple Ridge** have been documented.<sup>197</sup> The paper describes the development's stormwater plan, the facilities that were built, and provides preliminary performance monitoring results.

Burnaby staff also cited pilot projects in Vancouver (Crown Street, Marine Drive to 48th Ave) and Seattle for pitching the benefits of run-off reduction. Adapting these successes to Burnaby's context, they proposed their pilot keep wider road widths but use permeable asphalt to achieve the same infiltration performance. As part of their strategy, they also maximized the likelihood of future success and support by situating their pilot in a watershed in need supported by a good stewardship group. Council authorized the project to go ahead.

### **Saanich – Nature's Revenue Stream - Willowsbrook and Baxter's Pond**

Following on the **District of Saanich**'s new subdivision requirements for on-site infiltration standards, **Aqua-Tex Scientific Consulting Ltd.** has in the communities of Willowsbrook and Baxter's Pond incorporated a number of on-site water management approaches, founded on the principles of “engineered ecology” or “biomimicry” (where the emphasis and starting point are the ecological needs rather than the engineering needs).

City Farmer Lane.

PHOTO CREDIT: CITY OF VANCOUVER



These projects have been monitoring results using a broad range of indicators. The data collected is proving not just the ecological success of these projects, but also their economic benefits as well.<sup>199</sup>

### **Resort Municipality of Whistler – Tracking Sustainability to Move Forward**

Using the Natural Step as a planning matrix, and Whistler's new sustainability planning website [www.whistler2020.ca](http://www.whistler2020.ca) as communication vehicle, **Whistler** is moving forward

with an ambitious plan of ongoing monitoring and reporting on sustainability indicators. Results are summarized in yearly reports available on the website; results and information for individual indicators are also available by interacting with the website.

### Green Roofs

Green roofs on the **Vancouver Public Library** and the **White Rock Public Works Building** have been the subject of monitoring and study, the results of which are documented.<sup>200</sup>

**BCIT's Centre for the Advancement of Green Roof Technology** now has several years of performance data gathered and analyzed. This data has helped to inform and lend credibility to policy analysis and development carried out by the Green Roofs Working Group.<sup>201</sup>



Vancouver Public Library green roof.

PHOTO CREDIT: VANCOUVER PUBLIC LIBRARY

### Water Balance Model

The **Water Balance Model**<sup>202</sup> is greatly facilitating greener approaches to management of stormwater, by incorporating known science into an interactive tool that allows local governments to predict the “water balance” consequences of one kind of infrastructure versus another. This bank of knowledge is also growing: research is now being conducted by the University of British Columbia and District of North Vancouver on the rainfall interception of single trees and small stands in urban environments.<sup>203</sup>

## 6.4 Instituting Adaptive Management

Variations on a formal adaptive management model include: a one-year pilot; legislated “sunset” clauses for mandatory legislative review; and legislated community consultations for issue performance review.

Adaptive management entails making a commitment to continuously adapt and improve a system, in response to conclusions arising from data monitoring results. Fundamentally, such a management principle commits to accruing necessary information over time, learning from it, and in moving forward in this way, reducing the uncertainty of performance over time.

Adaptive management systems are well-suited to green infrastructure development, as in many circumstances, data is still needed to inform optimal design of green infrastructure systems. It makes sense to institute a requirement for data monitoring, to inform the design of future systems and improvements to existing systems.

### Case studies:

The **City of Burnaby’s UniverCity** development provides a successful example of adaptive management in action. This mixed use community, which sits adjacent to Simon Fraser University at the top of Burnaby Mountain, has been designed and built with the goal of minimizing the environmental impact of the development, and in particular, bringing a comprehensive or holistic storm water management approach to the development. Strategies employed include key components of rainfall capture, runoff control and flood risk management, as well as measures to protect water quality and habitat balance. Much of the design has incorporated engineered green infrastructure: roadways have pervious pavement parking lanes, adjacent grassy swales and underlying detention chambers; parcel designs include the use of both infiltration and exfiltration strategies; and both on-parcel sediment control facilities as well as common sediment control facilities augment parcel facilities and sediment and erosion control plans.<sup>204</sup> The stormwater management plan builds on a policy direction that started in 1995 and led to the adoption of Burnaby’s ‘Total’ Storm Water Management Approach in 2003.

The storm water management plan for the development requires extensive ongoing monitoring of a range of important values: control of sediments linked with construction activities; post-construction overall storm water management; post-construction on-parcel storm water; University Crescent; neighbourhood detention ponds; riparian area qualities; benthic invertebrates; in-stream complexity; and ambient water quality. Under the plan, the SFU Community Trust has responsibility for overall plan implementation; builders must perform environmental monitoring on the sites, under the supervision of the City.

The Trust has hired a consulting firm to fulfill its monitoring functions. Data is filed regularly and following significant rain events with the City of Burnaby; in addition, the Trust reports twice yearly to the Adaptive Management Committee, a committee that has representatives from the Trust, the Ministry of



Environment, the GVRD, the City of Burnaby, Fisheries and Oceans Canada (DFO), SFU, the local stream-keepers, and other interested parties. The Committee, which works by consensus, provides tremendous added value: it serves the important function of providing several additional knowledgeable perspectives on the performance data, and it also serves to validate that what the Trust is doing (in consultation with Burnaby) is on track. Everyone benefits from the flow of information.

While the monitoring of engineered systems at UniverCity has demonstrated that the system is largely working as designed (despite some challenging situations – five storm events over nine days in November 2006!), and in some instances performance is exceeding design criteria,<sup>205</sup> the data is also helping to inform design improvements moving forward on an adaptive management basis. New proposed subdivision plans are triggering design revisions that take into consideration the lessons learned from the experiences to date. Design changes also include increases to the number and changes to the locations of monitoring stations, which are designed to ensure that all relevant data is collected.

From a regulatory standpoint, the monitoring data is also helping to give Fisheries and Oceans Canada (DFO) the confidence to allow reductions of financial securities. The reductions likely also reflect DFO's confidence in the ongoing work and ability of the Trust's experienced monitoring consultants.

As set out in the plan, and as has been procedurally guaranteed through incorporation into covenant documents regulating site development, learning is being transferred from Trust staff to builders, through the use of training workshops on the topic of best practices with respect to construction sediments. This training is complemented by the provision of written resource materials for people to take away.

The data that has been collected and the learning that has resulted will now also benefit proposed developments elsewhere in the region. Much of the learning is quite transferable, for example:

- the development's infiltration experience with fill versus native sandstone (fill works very well and native sandstone increases its performance if disturbed and re-packed);
- learning around building on steep slopes, and managing the speed of water flow;
- performance of specific flow control systems/technologies;
- the use of a collaborative or partnership model for achieving results and necessary environmental approvals; and
- a model of building incrementally upon previous successes.

While so far, there has not been a great deal of academic work by students at SFU to build on this local laboratory of learning, it is anticipated that as faculty, staff and students move into the neighbourhood and become more aware of its potential as a "living laboratory," academic interest in the project will grow and help to disseminate and build on the learning opportunities.

# 7. Conclusion

Green infrastructure design implementation is a vast topic, covering such diverse infrastructure systems as rainwater infiltration and management systems, water metering, rainwater harvesting, district heating, landfill gas recovery and energy efficient retrofits to civic buildings. Governance structures, planning frameworks and policy tools, land use regulation, local government regulatory tools, partnership opportunities and financial and risk management considerations are all relevant to making a community's implementation strategy successful. The Guide has endeavoured to provide helpful, though by no means exhaustive, resources in all of these areas, to assist local governments in their implementation efforts of this particular smart growth element.

BC now has extensive experience implementing green infrastructure designs, and one of the purposes of this Guide was to showcase that experience, and to pass on some of the learning that has taken place in the communities that have successfully innovated. That learning is transferable, and sharing these models of success facilitates the way for others about to embark on the same or similar projects and challenges. The Guide encourages and supports monitoring and documenting of green infrastructure implementation and performance. It is with the cumulative documenting of results that communities can build on their own and others' prior successes, and adapt both design and implementation improvements.

The goal in implementing green infrastructure is to reduce the community's existing and future ecological footprint; to be smarter about the opportunities to be had from good design; and with implementation, to create a more liveable, sustainable community that reaps resource and financial savings and services, into the future.

# Endnotes

- <sup>1</sup> See *Stormwater Planning: A Guidebook for British Columbia* (<http://www.env.gov.bc.ca/epd/epdpa/mpp/stormwater/stormwater.html>) for a thorough discussion of green infrastructure designs in the stormwater context. See the Community Energy Association (<http://www.communityenergy.bc.ca/welcome.htm>) for resources on community energy strategies. See also West Coast's *Green Buildings Guide* (<http://www.wcel.org/wcelpub/2006/14252.pdf>) and the resources of the Canada Green Building Council, for more information about green buildings.
- <sup>2</sup> See e.g. Olewiler, N. (2004). *The Value of Natural Capital in Settled Areas of Canada*. Published by Ducks Unlimited Canada and the Nature Conservancy of Canada. 36 pp. Available by download from: <http://www.ducks.ca/aboutduc/news/archives/pdf/ncapital.pdf>
- <sup>3</sup> For more on smart growth elements and principles, see Deborah Curran, *The Case for Smart Growth* WCEL, 2003) at <http://www.wcel.org/wcelpub/2003/14177.pdf>
- <sup>4</sup> Found online at: <http://www.env.gov.bc.ca/epd/epdpa/mpp/stormwater/stormwater.html>
- <sup>5</sup> The Water Sustainability Committee (WSC) of the BC Water & Waste Association is a committee that includes government representatives as well as a wide variety of other stakeholders, and has provided key leadership and facilitation services promoting a water-centric approach to community planning. For more, see <http://www.waterbucket.ca/wsc/>.
- <sup>6</sup> The Green Infrastructure Partnership is a partnership between the WSC, the Master Municipal Construction Documents Association, the Ministry of Community Services and West Coast Environmental Law, and encourages implementation of clearly defined green infrastructure standards and regulatory models in British Columbia. Visit <http://www.waterbucket.ca/gi/> for more information.
- <sup>7</sup> <http://www.waterdsm.org/>
- <sup>8</sup> For more information on the CAEE initiative, visit [http://www.nrcan-mcan.gc.ca/media/newsreleases/2004/2004BCa\\_e.htm](http://www.nrcan-mcan.gc.ca/media/newsreleases/2004/2004BCa_e.htm) and see <http://www.saveenergynow.ca/caee1>
- <sup>9</sup> [http://www.gvrd.bc.ca/sewage/pdf/ISMP\\_Template\\_2005v2.pdf](http://www.gvrd.bc.ca/sewage/pdf/ISMP_Template_2005v2.pdf), prepared by Kerr Wood Leidal Associates Ltd. for the Greater Vancouver Regional District, December 2005.
- <sup>10</sup> Prepared by Environmental Law Clinic of the University of Victoria Faculty of Law and Deborah Curran and Company (2007) and available online at <http://www.ducksunlimited.ca/province/bc/index.html>.
- <sup>11</sup> BC now has some impressive examples not only of well-resourced communities like Whistler and Vancouver engaging in integrated sustainability planning, but also smaller communities like Dawson Creek, Oliver and Squamish demonstrating the success of an integrated planning approach. Several planning frameworks have now seen success in BC, including Smart Growth on the Ground, the Natural Step Framework, and community energy planning.
- <sup>12</sup> Dr. Rebekah R. Brown at Monash University in Australia has studied the organizational dynamics for making change with respect to environmental concerns, and has identified different phases that contribute to the climate of acceptance for those ideas. Her conclusions emphasize the importance of organizational and cross-sectoral interaction. See Rebekah R. Brown (2005), "Facilitating local organizational development for advancing sustainable urban water futures" (conference paper for *Proceedings of the 10th International Conference on Urban Drainage, 22-26 August 2005*, Copenhagen, International Water Association).
- <sup>13</sup> For example, the partnership approach implemented for the UniverCity comprehensive development at Simon Fraser University's Burnaby Mountain has been one of that development's great successes.

- <sup>14</sup> City of Port Coquitlam Sustainability Initiative, at [http://www.portcoquitlam.ca/\\_shared/assets/Sustainability\\_Initiative\\_Jan\\_073145.pdf](http://www.portcoquitlam.ca/_shared/assets/Sustainability_Initiative_Jan_073145.pdf)
- <sup>15</sup> “Non-legal” planning tools may also be drivers of change. See e.g., Chapter 5, *infra.*, on how the University of Victoria’s Campus Plan has led to exciting developments in water reclamation, and how Kelowna is fulfilling its Strategic Plan goal to conserve water with water conservation initiatives.
- <sup>16</sup> Currently six are in place, and two other regions have a RGS drafted or in process. See Ministry of Community Services, Local Government Department, “Status of Regional Growth Strategies in BC,” online at [http://www.cserv.gov.bc.ca/lgd/planning/growth\\_strategy\\_status.htm](http://www.cserv.gov.bc.ca/lgd/planning/growth_strategy_status.htm)
- <sup>17</sup> Preface to Ucluelet’s OCP, “What is an Official Community Plan?” online at <http://www.ucluelet.ca/UserFiles/File/Bylaws/OCP%20Jan%2011%202007.pdf>
- <sup>18</sup> *Ibid*
- <sup>19</sup> Section 866 of the *Local Government Act*. The rest of the OCP must also be consistent with the regional context statement.
- <sup>20</sup> The Regional Context Statement indicates that “The ISMPs [Integrated Stormwater Management Plans] will consider the impact of increased run-off resulting from densification and climate change and will identify mitigation strategies that will include both public capital works and on-site BMP’s.” (p. 74) The full Regional Context Statement is available for download at: [http://www.cnv.org/c//DATA/2/107/~~APPENDIX\\_01%20REGIONAL%20CONTEXT%20STATEMENT.PDF](http://www.cnv.org/c//DATA/2/107/~~APPENDIX_01%20REGIONAL%20CONTEXT%20STATEMENT.PDF)
- <sup>21</sup> See section 919.1 of the *Local Government Act*.
- <sup>22</sup> Ucluelet won an FCM CH2M Hill National Sustainable Community Planning Award for its OCP ([http://sustainablecommunities.fcm.ca/files/news\\_releases/news\\_releases\\_2006/scawardsnationnewsrelease-june32006-final-en.pdf](http://sustainablecommunities.fcm.ca/files/news_releases/news_releases_2006/scawardsnationnewsrelease-june32006-final-en.pdf)), and according to the *Ucluelet News* (December 2006) (<http://www.ucluelet.ca/UserFiles/File/Notices/Dec%202%20Newsletter.pdf>) Ucluelet also won a Gold Award for its OCP, a Silver Award for Most Liveable Community under a population of 20,000, and the overall award for United Nations endorsed International Awards for Liveable Communities held in China in November 2006.
- <sup>23</sup> Under section 15(2) of the *Community Charter*, municipal councils may, in regulating further to powers under the *Charter* or the *Local Government Act*, establish a standard, code or rule by adopting a standard, code or rule published by a provincial, national or international body or standards association.
- <sup>24</sup> [http://www.merritt.ca/upload/dcd618\\_1879\\_Consolidated\\_OCP\\_to\\_April\\_25\\_2006.pdf](http://www.merritt.ca/upload/dcd618_1879_Consolidated_OCP_to_April_25_2006.pdf)
- <sup>25</sup> [http://www.osoyoos.ca/upload/dcd279\\_OCP\\_2007.pdf](http://www.osoyoos.ca/upload/dcd279_OCP_2007.pdf)
- <sup>26</sup> [http://www.cityfsj.com/pdf/bylaw\\_1880\\_OCP.pdf](http://www.cityfsj.com/pdf/bylaw_1880_OCP.pdf)
- <sup>27</sup> The Fergus Creek Integrated Stormwater Management Plan is informing both the Highway 99 Corridor Neighbourhood Concept Plan (NCP) and the Grandview Heights NCP, discussed *infra*, and found at <http://www.surrey.ca/Doing+Business/Land+Development+and+Building/Plans+and+Policies/Plans+in+Progress/default.htm>.
- <sup>28</sup> Burnaby Mountain East Neighbourhood Stormwater Management Plan, Executive Summary, p. 1.
- <sup>29</sup> [http://www.mapleridge.ca/assets/Default/Planning/OCP/pdfs/10.3\\_silver\\_valley\\_section.pdf](http://www.mapleridge.ca/assets/Default/Planning/OCP/pdfs/10.3_silver_valley_section.pdf)
- <sup>30</sup> See pp. 42-43 of the Silver Valley Area Plan.
- <sup>31</sup> <http://www.dnv.org/upload/pdocsdocuments/84zb01!.htm>
- <sup>32</sup> [http://www.portcoquitlam.ca/\\_shared/assets/Sustainability\\_Checklist2040.pdf?method=1](http://www.portcoquitlam.ca/_shared/assets/Sustainability_Checklist2040.pdf?method=1)
- <sup>33</sup> See the City of Port Coquitlam’s Sustainability Initiative, *supra* note 14.
- <sup>34</sup> [http://www.vernon.ca/services/pde/documents/smart\\_growth\\_development\\_checklist.pdf](http://www.vernon.ca/services/pde/documents/smart_growth_development_checklist.pdf). The City of New Westminster’s Smart Growth Development Checklist (2004) is

very similar, at <http://city.new-westminster.bc.ca/cityhall/planning/06publications/02Zoning/pdf/Smart%20Growth%20Development%20-%20Checklist%202004.pdf>. Surrey has recently launched a Sustainability Charter initiative: see <http://www.surrey.ca/Doing+Business/Land+Development+and+Building/Plans+and+Policies/Plans+in+Progress/Sustainability+Charter.htm>

- <sup>35</sup> The focus of a rainwater management strategy needs to be adapted to the local climate and ecology, taking into consideration whether there are creeks that may be affected, or the presence of fish. In some climates, the greater focus is on maintaining water quantity (i.e. volume); in others, the greater focus is on maintaining water quality (e.g. reducing total suspended solids). What the focus is will impact the source controls that are chosen as well as best management practices for the area.
- <sup>36</sup> Thanks to Chris Johnston, P.Eng., of Kerr Wood Leidal Associates Limited – Consulting Engineers, for contributing this section.
- <sup>37</sup> Section 35 of the federal *Fisheries Act*.
- <sup>38</sup> Further to section 938(3.1), standards or requirements in relation to highways outside of a municipality established by regional districts must be approved by the Minister of Transportation. Practically, this means that regional districts wanting to innovate are dependent upon the province also wanting to innovate.
- <sup>39</sup> See e.g. Bylaw No. 2241, a Bylaw to Regulate the Servicing of Subdivisions for the City of Port Coquitlam, [http://www.portcoquitlam.ca/\\_shared/assets/2241\\_-\\_Subdivision\\_Servicing\\_Bylaw69.pdf](http://www.portcoquitlam.ca/_shared/assets/2241_-_Subdivision_Servicing_Bylaw69.pdf)
- <sup>40</sup> MMCD Green Design Guidelines Manual, Draft November 4, 2005, Abstract.
- <sup>41</sup> The Green Supplement is available online at <http://www.mmcd.net/admin/24093-GreenDesignGuidelines-Sept1-05.pdf>
- <sup>42</sup> *Ibid*, p. 6.
- <sup>43</sup> *Ibid*.
- <sup>44</sup> Bylaw No. 55 is available for download online at [http://www.lantzville.ca/upload/dcd263\\_BylawNo55.pdf](http://www.lantzville.ca/upload/dcd263_BylawNo55.pdf)
- <sup>45</sup> The bylaw was developed with the help of provincial government funding. Other small communities that supported the development of Lantzville's bylaw were the Village of Cumberland, the Town of Gibsons and the Municipality of Bowen Island.
- <sup>46</sup> See Engineering Specifications - Schedule H to Saanich's Subdivision Bylaw No. 7452, at <http://www.saanich.ca/business/development/eng/specs.html>. These specifications supplement the MMCD construction specifications which have otherwise been adopted.
- <sup>47</sup> Section 3.5.16.8.1 Maintenance of Facilities, Schedule H to Bylaw 7452, *ibid*.
- <sup>48</sup> N.B. An approach similar to this is now being crafted by Campbell River, as it revises its standards.
- <sup>49</sup> The City of Surrey is also grappling with this issue, as a result of its experience in East Clayton. One option being considered is to tie green infrastructure requirements to issuance of the occupancy certificate. See Chapter 8.
- <sup>50</sup> See the Policy and Design Criteria Manual for Surface Water Management in the City of Chilliwack (May 2002), a document that replaced the drainage section of the Subdivisions and Development Control Bylaw. As stated at p. 1 of the Manual, it was "undertaken as a case study application of *Stormwater Planning: A Guidebook for British Columbia*, a collaborative effort of the Federal and Provincial governments that was funded under the *Georgia Basin Ecosystem Initiative*."
- <sup>51</sup> See e.g. "A Natural Systems Approach to Stormwater Management – Implementing Low Impact Development on Burke Mountain" (Vancouver: Wesbild Holdings Limited, 2004)
- <sup>52</sup> Chilliwack developers are now implementing new exfiltration technologies like plastic catacomb– similar to buried milk crates – in riparian setback zones to meet performance standards, in response to feedback from developers that homeowners do not wish to have ponds in their residential neighbourhoods.

- <sup>53</sup> Campbell River's new approach will give developers a choice on how to implement low impact development - either they can use prescribed technologies with known specifications and function, or they can, with the assistance of a qualified professional engineer, meet a performance standard. This flexible approach is intended to respond to situations where smaller developers may not have the expertise to design in an alternative way, while larger developers would enjoy being able to meet standards in innovative ways. The new subdivision bylaw is expected to be voted on by Council in 2007.
- <sup>54</sup> [http://www.dnv.org/upload/documents/Council\\_Reports/773013.pdf](http://www.dnv.org/upload/documents/Council_Reports/773013.pdf), Section C.3.5.2 p. 133
- <sup>55</sup> DPAs may be designated for any of the following purposes listed in section 919.1(1):
- (a) protection of the natural environment, its ecosystems and biological diversity;
  - (b) protection of development from hazardous conditions;
  - (c) protection of farming;
  - (d) revitalization of an area in which a commercial use is permitted;
  - (e) establishment of objectives for the form and character of intensive residential development; or
  - (f) establishment of objectives for the form and character of commercial, industrial or multi-family residential development
- <sup>56</sup> Section 920 of the *Local Government Act*. This section also provides guidance on DPA guidelines.
- <sup>57</sup> A requirement for Development Approval Information is authorized by section 920.1 of the *Local Government Act*.
- <sup>58</sup> *Kelowna 2020 – Official Community Plan*, Chapter 7, section 7.11 Development Permit Guidelines for the Protection of the Natural Environment, its Ecosystems and Biological Diversity, online at: <http://www.kelowna.ca/CityPage/Docs/PDFs%5C%5Cbylaws%5COfficial%20Community%20Plan%20%2D%20Bylaw%20No%2E%207600%5COCP%202020%20Chapter%2007%20%2D%20Environment%2Epdf>
- <sup>59</sup> [http://www.nanaimo.ca/uploadedfiles/Site\\_Structure/Development\\_Services/Planning\\_and\\_Development/Community\\_Planning/ocp\\_10.pdf](http://www.nanaimo.ca/uploadedfiles/Site_Structure/Development_Services/Planning_and_Development/Community_Planning/ocp_10.pdf)
- <sup>60</sup> At pp. 60, 70 and 74. [http://www.osoyoos.ca/upload/dcd279\\_OCP\\_2007.pdf](http://www.osoyoos.ca/upload/dcd279_OCP_2007.pdf)
- <sup>61</sup> For example, in February 2006 Surrey amended its zoning bylaw to require a 10m setback and landscape buffer for Semiahmoo trail. See <http://www.surrey.ca/NR/rdonlyres/129085F7-2258-4B66-BCF0-2751C877941D/0/Feb152006SemiahmooTrail-PublicInformationMeeting.pdf>
- <sup>62</sup> See above under Development Permit Areas (Kelowna OCP) and also Chapter 2, under "Official Community Plan."
- <sup>63</sup> <http://www.city.langley.bc.ca/dev/pdf/Landscaping.pdf>
- <sup>64</sup> <http://www.city.duncan.bc.ca/pdf/1580-landscaping%20Consolidated.pdf>
- <sup>65</sup> While BC is making significant progress in this area, it lags behind European leaders such as Germany.
- <sup>66</sup> Bill Buholzer and Robyn Wark, "Regulatory Options for Promoting Green Roofs in British Columbia" *Planning West* (September 2006) at 11-14. The paper was released as an initiative of BCIT's Green Roof Regional Working Group – Policy and Regulatory Committee, hosted by BCIT's Centre for the Advancement of Green Roof Technology. See <http://commons.bcit.ca/greenroof/>
- <sup>67</sup> This strategy neatly sidesteps the more problematic exercise of municipal jurisdiction over "buildings and other structures" authorized by section 8(3)(l) of the *Community Charter*. This is a clever strategy, since exercise of the latter jurisdiction is specifically limited to regulations for health, safety or protection of persons or property: see Part 3 Division 8, section 53 of the *Community Charter*.
- <sup>68</sup> See Chapter 2 for more on the Sustainability Initiative.
- <sup>69</sup> The HPO was set up primarily to protect residential building owners from building envelope failures. See the *Homeowner Protection Act*, S.B.C. 1998, c. 31.

- <sup>70</sup> See the January 2007 letter and background paper sent to all BC local governments, “Green Buildings, Green Roofs and Homeowner Protection in British Columbia,” outlining HPO concerns, posted on the HPO website at <http://www.hpo.bc.ca/WhatsNew/index.htm>.
- <sup>71</sup> Prohibitions on soil removal and some prohibitions on soil deposit are subject to concurrent authority, further to section 8(3)(m) and 9(1)(e) of the *Community Charter*.
- <sup>72</sup> Surrey Agricultural Advisory Committee Minutes, January 11, 2007
- <sup>73</sup> *Ibid*
- <sup>74</sup> *Ibid* and Surrey Environmental Advisory Committee Minutes, December 6, 2006
- <sup>75</sup> *Ibid*
- <sup>76</sup> <http://www.gov.saanich.bc.ca/municipal/clerks/bylaws/watercourse7501.pdf>
- <sup>77</sup> Such impacting activities include obstructions of a watercourse, work on a watercourse or drainage system or discharges to storm sewers or watercourses. See sections 1-5 of the Bylaw.
- <sup>78</sup> Bylaw 467 is found online at <http://www.district.metchosin.bc.ca/467/467.pdf>
- <sup>79</sup> District of Metchosin, “Statement of Intent as to the interpretation and application of the Rain Water Bylaw,” online at: <http://www.district.metchosin.bc.ca>
- <sup>80</sup> District of Metchosin, “Statement of Intent as to the interpretation and application of the Rain Water Bylaw,” online at: <http://www.district.metchosin.bc.ca>.
- <sup>81</sup> *Ibid*.
- <sup>82</sup> “Effective impervious area” is the calculation of impervious area that remains after actual impervious area is effectively reduced by using engineering designs that infiltrate impervious area runoff water that would otherwise be shed and piped away – e.g. by routing runoff water over grassy or other pervious surfaces.
- <sup>83</sup> Qualified professionals are required to give proof of professional liability and general liability insurance. The bylaw asks proponents to provide the reports of qualified professionals for a range of parameters, such as certification of proper functioning condition, calculations of site permeability, development in compliance with section 4(3) of RAR, preparation of final landscape plans, for all works associated with the installation of rain water management facilities required for a subdivision, etc.
- <sup>84</sup> These merit a read, and include blurbs for each of the following principles: ecosystem integrity, sustainability, stewardship, accountability, water quality, public awareness and property values. See section 1.2.2 of the Bylaw, at <http://www.district.metchosin.bc.ca/467/467.pdf>
- <sup>85</sup> Such as: undertaking development within a “riparian assessment area”; enclosing a watercourse, channel or swale in a pipe; intentionally damaging or breaking a rain water management facility; or making a connection of roof gutter down spouts, exterior foundation drains, driveway drains or other sources of surface runoff if those are connected directly to a watercourse, water body and/or riparian wetland area. For further details on prohibitions, see Part 2 of the Bylaw, at <http://www.district.metchosin.bc.ca/467/467.pdf>
- <sup>86</sup> This triggers the need to file with the clerk an operation and maintenance plan to be prepared by a qualified professional in respect of the required rain water quality and control facilities. For a subdivision, this triggers some further obligations, including a requirement to register (at the owner’s cost) a section 219 covenant under the *Land Title Act* in favour of the District, providing terms for the ongoing maintenance and operation of the rain water management facility, and providing a right of way in favour of the District for inspection purposes. See section 3.7 of the Bylaw, at <http://www.district.metchosin.bc.ca/467/467.pdf>, for further details.
- <sup>87</sup> See section 2.1.2 of the Bylaw, at <http://www.district.metchosin.bc.ca/467/467.pdf>
- <sup>88</sup> Development cost recovery is covered in Part 26, Division 10 of the *Local Government Act*, encompassing sections 932 through 937.1.
- <sup>89</sup> Section 934 of the *Local Government Act*.
- <sup>90</sup> One would need to establish a DCC regime charging a reduction for all “uses” resulting in comparable costs and savings attributable to high performance design.

For a further discussion of this and related issues, see Coriolis Consulting, *Do Development Cost Charges Encourage Smart Growth and High Performance Building Design?* (2003), a report prepared for West Coast Environmental Law, available for download from <http://www.wcel.org/wcelpub/2003/14083.pdf>

- <sup>91</sup> City of Surrey, Engineering Land Development Customers' Manual, found online at <http://www.surrey.ca/NR/rdonlyres/F5C55E04-CB36-4DA5-A8E6-0D76B0E7E7E8/0/CustomersManual1005.pdf>
- <sup>92</sup> See, e.g. the province's *Stormwater Planning: A Guidebook for British Columbia*, *supra* note 4 and the Water Balance Model, at <http://www.waterbalance.ca>.
- <sup>93</sup> An additional tool to be considered along with land use planning is incorporating rain/storm water considerations into a liquid waste management plan under the Municipal Sewage Regulation of the Environmental Management Act. These plans may be legally binding and may cover stormwater. For discussion, see <http://www.env.gov.bc.ca/epd/epdpa/mpp/gfdalwmp.html#14>
- <sup>94</sup> With the support of an infrastructure planning grant from the Ministry of Community Services in 2006, the Sunshine Coast Regional District and the Ministry of Transportation commenced Integrated Stormwater Management Planning for the Elphinstone, West Howe Sound and East Roberts Creek communities.
- <sup>95</sup> See e.g. Terms of Reference for Grandview Heights NCP Area #2, at <http://www.surrey.ca/Doing+Business/Land+Development+and+Building/Plans+and+Policies/Plans+in+Progress/default.htm>
- <sup>96</sup> The Water Conservation Calculator (WC2) is being developed by the Municipal Engineering Services Branch of the Ministry of Community Services. The WC2 is a software spreadsheet based decision support tool designed for municipal water systems. The purpose of the WC2 is to illustrate how specific conservation measures yield both fiscal and physical water consumption savings. The WC2 is also designed to assist water managers to present their conservation case to council and/or other decision makers. It can:
- assist in decision making around new infrastructure (can illustrate the possibility of capital deferment),
  - assist in more accurately targeting conservation efforts, thereby increasing the cost effectiveness of conservation campaigns;
  - provide useful information about the current state of the water service provider's system;
  - offer a 'snap shot' of future demands and the positive impacts of conservation on those demands; and
  - provide tools and capacity for water service providers to take positive conservation action.
- The WC2 requires very little data in order to generate useful information. The more data the user has available for entry into the WC2, the more beneficial the outcomes. The WC2 is still in a pilot stage, with the aim of being posted to the Ministry's website within one year. Participation in the pilot stage is welcome with a requirement to provide feedback within a reasonable time frame. For more information, contact Liam Edwards, Infrastructure Resource Officer, Municipal Engineering Services Branch, Ministry of Community Services BC, PO Box 9838, STN Prov Govt BC, Victoria, BC V8W 9T1, (250) 356-0218.
- <sup>97</sup> For data gathered across Canada, the daily consumption of flat-rate users was 457 litres/person. This is 70 percent more water than the consumption of metered users (269 litres/person). (BC Ministry of Environment, State of Environment Reporting – Effect of Metering on Water Use, at <http://www.env.gov.bc.ca/soerpt/8surfacewateruse/metering.html>).
- <sup>98</sup> MMCD Green Design Guidelines Manual, Draft November 4, 2005, at section 2.2. Online at <http://www.mmcd.net/admin/24093-GreenDesignGuidelines-Sept1-05.pdf>
- <sup>99</sup> *Ibid.*
- <sup>100</sup> An overview of metering programs across the province (outdated now) may be found in the Water Stewardship Division of the Ministry of Environment's Water Use



Efficiency Catalogue for British Columbia. Ministry of Environment, Water Stewardship Division, *Water Use Efficiency Catalogue for British Columbia*, online at [http://www.env.gov.bc.ca/wsd/plan\\_protect\\_sustain\\_water\\_conservation/wtr\\_use\\_eff\\_cat\\_bc/op\\_mgt\\_tools.html](http://www.env.gov.bc.ca/wsd/plan_protect_sustain_water_conservation/wtr_use_eff_cat_bc/op_mgt_tools.html)

- <sup>101</sup> District of West Vancouver, staff report to Council dated January 28, 2004. Note the last set of items in this list was noted as "...more complicated and contentious as they involve the relationship between rates and behaviour modification." To maximize the conservation effectiveness of a metering program, local governments are advised to seek expert advice in establishing a rate structure. For metering to have the desired effect, the conservation activity must trigger a true incentive - an appreciable reduction in price to "reward" the conservation activity. West Vancouver, like Vernon, Nanaimo and Qualicum Beach has adopted an inclining rate structure to encourage conservation.
- <sup>102</sup> Ministry of Environment, Water Stewardship Division, *Water Use Efficiency Catalogue for British Columbia*, *supra* note 100.
- <sup>103</sup> Chilliwack's Water Conservation website notes that summer water use jumps to 48 million litres per day from a norm of 26 million litres per day, primarily due to lawn watering activities. See <http://www.chilliwack.ca/main/page.cfm?id=1240>
- <sup>104</sup> Online at [http://www.chilliwack.com/main/attachments/files/363/BL%202995%20Waterworks%20Regulation%20%20\(Consolidated\)2.pdf](http://www.chilliwack.com/main/attachments/files/363/BL%202995%20Waterworks%20Regulation%20%20(Consolidated)2.pdf)
- <sup>105</sup> The City of Richmond has a voluntary water metering program. See <http://www.richmond.ca/services/rdws/water/meters.htm> and the City's contractor, Neptune Technology Group (Canada) Ltd., at [www.watermeter.ca](http://www.watermeter.ca), for more information.
- <sup>106</sup> Online at [http://www.westvancouver.ca/upload/pdocsdocuments//5\\_P01!.pdf](http://www.westvancouver.ca/upload/pdocsdocuments//5_P01!.pdf) and came into effect December 18, 2006.
- <sup>107</sup> District of West Vancouver, staff report to Council dated July 2004, available at <http://www.westvancouver.ca/article.asp?c=870&a=3306>
- <sup>108</sup> *Ibid*
- <sup>109</sup> *Ibid*.
- <sup>110</sup> The purpose behind sending mock bills or consumption notices was to start informing users about their consumption patterns, both for educational purposes and to prepare them for real billing. (*Ibid*; and see Water Meter Brochure, at [http://www.westvancouver.ca/upload/documents/water/Water\\_Meter\\_brochure\\_07.pdf](http://www.westvancouver.ca/upload/documents/water/Water_Meter_brochure_07.pdf))
- <sup>111</sup> District of West Vancouver staff report to Council, July 2004, *supra*, note 104.
- <sup>112</sup> District of West Vancouver Waterworks Regulation Bylaw No. 3859, 1994 Amendment Bylaw No. 4398, 2004 provided residents with an opportunity to reduce the financial impact of having to upgrade an old, leaking private water service in conjunction with the water meter installation by offering a loan of up to \$2000, which could be paid back over time on residents' future water bills. [This provision was deleted from the new bylaw, as installations have mostly been completed.] In addition, Water Meter Loan Authorization Bylaw No. 4407, 2004, provided for the universal water metering capital project to be financed through the Municipal Finance Authority as long term debt.
- <sup>113</sup> *Ibid*.
- <sup>114</sup> District of West Vancouver Waterworks Regulation Bylaw No. 4490, 2006, online at [http://www.westvancouver.ca/upload/pdocsdocuments//5\\_P01!.pdf](http://www.westvancouver.ca/upload/pdocsdocuments//5_P01!.pdf)
- <sup>115</sup> Ministry of Environment, Environmental Protection Division, *FS#2 – Fact Sheet on the Municipal Sewage Regulation. Highlights Regarding Use of Reclaimed Water*, online at <http://www.wnv.gov.bc.ca/epd/epdpa/mpp/fs2reclaimedwater.html>
- <sup>116</sup> *Ibid*. Overall, the Ministry estimates a savings of approximately 35 percent as a result of the implementation of water reclamation and reuse technologies: Ministry of Environment, Water Stewardship Division, *Water Use Efficiency Catalogue for British Columbia*, *supra* note 100.
- <sup>117</sup> Standards are very much dependent on whether public access is restricted or unrestricted.

- <sup>118</sup> Please refer to the actual Regulation for details around use and the applicable standard. There are detailed requirements around seasonal and emergency storage, reliability of treatment process, calculation of effluent quality, etc., and as noted *infra*, standards very much depend on whether public access is restricted or unrestricted.
- <sup>119</sup> See [http://www.env.gov.bc.ca/epd/epdpa/mpp/pdfs/cop\\_reclaimedwater.pdf](http://www.env.gov.bc.ca/epd/epdpa/mpp/pdfs/cop_reclaimedwater.pdf)
- <sup>120</sup> While designed as an aid to ensure compliance with the MSR, the Code of Practice specifically notes that in the event of any discrepancy, the MSR takes precedence.
- <sup>121</sup> The bylaw must have the municipality or a private corporation under contract to the municipality assume the responsibility for ensuring compliance with the MSR, and that proper operation and maintenance will be carried out.
- <sup>122</sup> The community of Cranbrook also uses reclaimed water for irrigation: see the BC Ministry of Environment, Environmental Protection Division's FS#2 - Fact Sheet on Municipal Sewage Regulation, at <http://www.env.gov.bc.ca/epd/epdpa/mpp/fs2reclaimedwater.html>
- <sup>123</sup> Ministry of Environment, Environmental Protection Division, *FS#2 – Fact Sheet on the Municipal Sewage Regulation*, *supra* note 115. Note, however, that Vernon has applied to the Ministry for approval to increase its deep lake outfall discharge.
- <sup>124</sup> Letter, City of Vernon to MOE, dated July 7, 2006.
- <sup>125</sup> News item regarding Application for an Amendment to a Ministry of Environment Operational Certificate under the provisions of the *Environmental Management Act*, found online September 2006, at <http://www.vernon.ca/news/index.html>
- <sup>126</sup> *Ibid.*
- <sup>127</sup> The certificate is a relic of the old system of regulation that has been grandfathered for Vernon. As explained above, the new system is the MSR and Code of Practice.
- <sup>128</sup> [http://www.vernon.ca/bylaws/4899\\_irrigation\\_water\\_supply.pdf](http://www.vernon.ca/bylaws/4899_irrigation_water_supply.pdf)
- <sup>129</sup> An office building near Sooke showcases a further example of water reclamation in action, boasting some 90 percent savings in water consumption and effluent outflow compared to conventional systems: see BC Ministry of Environment, Environmental Protection Division's *FS#2 - Fact Sheet on Municipal Sewage Regulation*, *supra*, note 112.
- <sup>130</sup> Presentation by Sarah Webb, Sustainability Coordinator at the University of Victoria, at Water Conservation on the Island workshop, Victoria, March 10, 2006.
- <sup>131</sup> *Ibid.* Buildings to be connected include a 294 bed residence, a 60 bed residence, a 120 bed residence and the Continuing Studies Building.
- <sup>132</sup> "City Meeting Goal with New Water-Saving Initiative," news release dated November 2, 2006 announcing the installation of a recycled water system in a new Kelowna residence. The release ties the installation of this system with the City's goal to conserve water, set out in its Strategic Plan.
- <sup>133</sup> The Dockside development will not have to pay development cost charges for sewer costs, as the development will not be connected to the municipal system.
- <sup>134</sup> Presentation by Sarah Webb, Sustainability Coordinator at the University of Victoria, Water Conservation on the Island workshop, Victoria, March 10, 2006. Discussion following this presentation noted the Canadian Standards Association is currently examining non-potable water standards, with CMHC support. Toilets would be the first standard to change in the Plumbing Code.
- <sup>135</sup> *Ibid.* Presenter Sarah Webb further noted the project is capturing the interest of other universities, and that the payback time for the initial capital investment is reduced with the addition of new buildings.
- <sup>136</sup> The Trust's rainwater harvesting website is at <http://www.islandstrustfund.bc.ca/projects/rainwater.cfm>
- <sup>137</sup> The Guide can be downloaded free of charge. Dick F. Stubbs, *Rainwater Harvesting on the Gulf Islands Guide for Regulating the Installation of Rainwater Harvesting Systems – Potable and Non-Potable Uses* (Salt Spring Island, BC: The Islands Trust Fund, 2006), available at <http://www.islandstrustfund.bc.ca/projects/rainwater.cfm>
- <sup>138</sup> Available for free download online at <http://www.wcel.org/wcelpub/2006/14252.pdf>

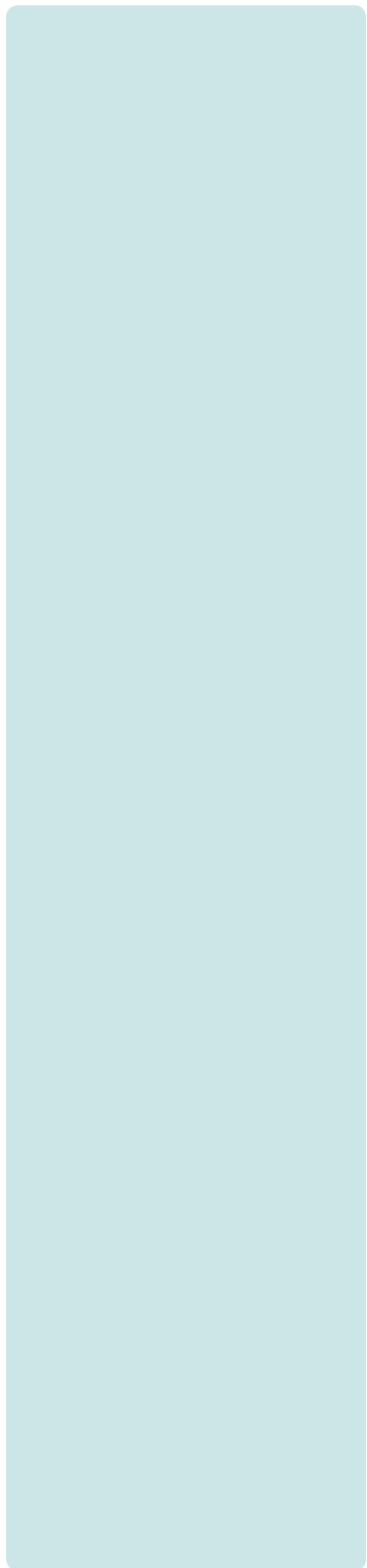
- <sup>139</sup> For other policies and laws to support green building development, see West Coast's *Green Buildings Guide*, at <http://www.wcel.org/wcelpub/2006/14252.pdf>. See also the Kelowna Sustainable Building Pilot Project, an initiative of Community Action on Energy Efficiency, at <http://www.kelowna.ca/CM/Page888.aspx>
- <sup>140</sup> See the Township of Langley's Cycling website (<http://www.tol.bc.ca/cycling>) that features the Township's efforts to construct cycling infrastructure (with routes being divided into categories of commuter, recreation and neighbourhood), to remove hindrances to cycling, and to link the public to useful cycling information to encourage cycling as an alternative to motor vehicle travel.
- <sup>141</sup> <http://www.squamish.ca/files/PDF/DOSPIedge-2.pdf>
- <sup>142</sup> The City of North Vancouver has a website with resources that share the success of this project implementation, at <http://www.cnv.org/server.aspx?c=2&i=98>
- <sup>143</sup> <http://www.wcel.org/wcelpub/2006/14252.pdf>
- <sup>144</sup> <http://www.cdea.ca/>
- <sup>145</sup> The project won a 2005 UBCM Community Excellence Award for Leadership and Innovation and a 2006 Sustainable Community Award from the Federation of Canadian Municipalities / CH2M HILL.
- <sup>146</sup> See [http://www.crd.bc.ca/es/hartland/lfg\\_electricity.htm](http://www.crd.bc.ca/es/hartland/lfg_electricity.htm). This is enough power to supply 1600 homes.
- <sup>147</sup> *Ibid.*
- <sup>148</sup> Maxim owns and operates other similar facilities including one at the City of Vancouver's landfill in Delta. *Ibid.*
- <sup>149</sup> See the report to the Environment Committee dated February 28, 2007, at [http://www.crd.bc.ca/reports/environmentcommittee\\_/2007\\_/02february\\_/feb07item06/feb07item06.pdf](http://www.crd.bc.ca/reports/environmentcommittee_/2007_/02february_/feb07item06/feb07item06.pdf)
- <sup>150</sup> See CivicInfoBC story at <http://www.civicinfo.bc.ca/302n.asp?newsid=1633>
- <sup>151</sup> [http://www.summitconnects.com/In\\_the\\_News/ARCHIVE/2005\\_07.htm#2](http://www.summitconnects.com/In_the_News/ARCHIVE/2005_07.htm#2)
- <sup>152</sup> <http://www.civicnet.bc.ca/siteengine/activepage.asp?PageID=272&bhcp=1>
- <sup>153</sup> For example, see Maria Kelleher's presentation on construction and demolition waste diversion best practices, at [http://www.calgary.ca/docgallery/bu/sws/cnd\\_waste\\_diversion\\_in\\_other\\_juridictions.pdf](http://www.calgary.ca/docgallery/bu/sws/cnd_waste_diversion_in_other_juridictions.pdf)
- <sup>154</sup> See e.g. [http://www.compost.org/WDO\\_website/pdf/2000light.PDF](http://www.compost.org/WDO_website/pdf/2000light.PDF). For more information on composting, visit the website of the Composting Council of Canada, at <http://www.compost.org/englishoverview.html> which has a table of laws and regulations applying to composting activities: <http://www.compost.org/pdf/ccs.sw&r.legislation.PDF>
- <sup>155</sup> "Green Energy Project, District of West Vancouver," online at <http://www.gvrd.bc.ca/sustainability/casestudies/greenenergy.htm>.
- <sup>156</sup> *Ibid.*
- <sup>157</sup> *Ibid.*
- <sup>158</sup> [http://www.em.gov.bc.ca/AlternativeEnergy/EnergyEfficiency/CAEE\\_1.htm](http://www.em.gov.bc.ca/AlternativeEnergy/EnergyEfficiency/CAEE_1.htm)
- <sup>159</sup> See e.g. *Medomist Farms Ltd. v. Surrey (District)*(1989), 62 B.C.L.R.(2d) 168 (C.A.) aff'g 1 M.P.L.R. (2d) 46 (B.C.S.C.), where a storm channel overflowed, not because of a failure but because of increased flows as a result of new development.
- <sup>160</sup> *Cutting Green Tape: An Action Plan for Removing Regulatory Barrier to Green Innovationse* (West Coast Environmental Law, 2002), online at <http://www.wcel.org/wcelpub/2002/13724.pdf>, at p. 35. The discussion concludes, "These different formulations provide decreasing comfort to municipalities, but involve less dramatic departures from the common law."
- <sup>161</sup> See also the legal opinion on local government liability in the context of the new Riparian Areas Regulation and *Fish Protection Act* provisions, provided by Kathryn Stuart of Staples McDannold Stuart in October 2005 to the Ministry of Attorney General, posted online at [http://www.env.gov.bc.ca/habitat/fish\\_protection\\_act/riparian/riparian\\_areas.html](http://www.env.gov.bc.ca/habitat/fish_protection_act/riparian/riparian_areas.html)

- <sup>162</sup> See Daniel R. Bennett and Holman Wang, “Negligence and Nuisance: Liability and Limitations” (Vancouver: Continuing Legal Education Society of British Columbia, February 2006), at p. 7.1.7.
- <sup>163</sup> See *Gringmuth v. North Vancouver (District)* (2002), 98 B.C.L.R. (3d) 116 (C.A.)
- <sup>164</sup> Andrew J. Heal and Louis-Pierre Grégoire, “Municipal Liability: Building Construction and Inspection Issues” (2006) 54 Construction Law Reports (3d) 9.
- <sup>165</sup> Surrey’s East Clayton neighbourhood was an initiative supported by several layers of government, and has spawned numerous innovations since. In 2004, the District of North Vancouver piloted a permeable pavement lane. UBC and the District of North Vancouver are currently partnering to conduct research that will quantify the rainfall interception of single trees and small stands in an urban environment: see “University of British Columbia Undertakes Tree Canopy Research Project to Support Water Balance Model” (online at <http://www.waterbucket.ca/rm/index.asp?sid=33&id=271&type=single>). In 2005, the District of Metchosin placed a green roof on Metchosin Pavilion, to demonstrate the rainwater runoff mitigation principles of Bylaw 467, for the Protection and Management of Rain Water (discussed above). See <http://www.greenroofs.com/projects/pview.php?id=153>.
- <sup>166</sup> See *Brown v. British Columbia (Minister of Transportation & Highways)*, [1994] 1 S.C.R. 420 (S.C.C.) (esp. the judgment of Cory J.); and *Ingles v. Tutkaluk Construction Ltd.*, [2000] 1 S.C.R. 298 S.C.C.).
- <sup>167</sup> As stated in *Strata Plan NW 3341 v. Canlan Ice Sports Corp.* (2001), [2001] B.C.J. No. 1723, 10 C.L.R. (3d) 293 (B.C.S.C.); additional reasons at (2001), 2001 CarswellBC 2812 (B.C.S.C.); aff’d (2002), [2002] B.C.J. No. 2142, 2002 CarswellBC 2184 (B.C.C.A.) (popularly known as the Delta decision), “The requirement of good faith is an overriding consideration that will extend liability no matter how a particular government act or omission is characterized. At pp. 435-6 of *Brown*, Cory J. said:
- It will always be open to a plaintiff to attempt to establish, on a balance of probabilities, that the policy decision was not bona fide or was so irrational and unreasonable as to constitute an improper exercise of governmental discretion.”
- <sup>168</sup> *Brown v. British Columbia*, *supra* note 166.
- <sup>169</sup> See *Strata Plan NW 3341 v. Canlan Ice Sports Corp and others*, [2001] B.C.J. No 1723 (S.C.) (“Delta”), aff’d (B.C.C.A.) that relied on *Ingles v. Tutkuluk*, [2000] 1 S.C.R. 298. In addition, see Bennett and Wang, *supra* note 162. For further discussion also see Heal and Grégoire, *supra* note 164.
- <sup>170</sup> E.g. *Brown v. B.C.*, [1994] S.C.C. 19
- <sup>171</sup> For a good discussion of this approach, see Staples McDannold Stuart, *supra* note 161.
- <sup>172</sup> West Coast is not aware of any local governments that have done this; however, the standard design specification appears not to be statutorily prescribed but is likely attributable back to MMCD standards, which may or may not be explicitly endorsed in a particular local government jurisdiction.
- <sup>173</sup> Local governments should seek specific legal advice with respect to this issue, just as they should with respect to all other matters discussed in the Guide.
- <sup>174</sup> See also the discussion in *Cutting Green Tape*, *supra* note 160, at p. C4
- <sup>175</sup> For example, to address the potential threat or risk of West Nile Virus, Burnaby Council by resolution adopted a Mosquito Control Strategy recommended by its Environment Committee that uses integrated pest management and adaptive management principles. This strategy was monitored, reviewed and reported on over time, and on May 15, 2006 a further Council resolution approved of the use of the strategy for 2006 risk management. The GVRD’s Drinking Water Management Plan (implemented August 2005) (available at <http://www.gvrd.bc.ca/water/pdfs/Drinking-WaterManagementPlanA.pdf>) uses an adaptive management approach that requires a progress report every two years and a review of the plan every five years, to enable the Region to adapt to changes in the science of water management and the evolution of public values, and to respond to evolving challenges and opportunities (e.g. climate change, asset management information) (pp. 2, 10).

- <sup>176</sup> Heal and Grégoire, *supra* note 164. The authors recommend local governments institute a policy to preserve records for a period of at least 15 years.
- <sup>177</sup> *Ibid.*
- <sup>178</sup> Heal and Grégoire, *supra* note 164.
- <sup>179</sup> See e.g. the District of Metchosin's Rain Water Bylaw No. 467, discussed in Chapter 2.
- <sup>180</sup> See e.g. Staples McDannold Stuart, *supra* note 161.
- <sup>181</sup> The Association of Professional Engineers and Geoscientists (APEG) provides some background on some of the limitations and challenges with "claims-made insurance" in its *Guidelines for Professional Excellence* (January 1994), at Chapter 8.
- <sup>182</sup> Conversation with Deborah Curran.
- <sup>183</sup> Presentation by the City of Surrey at Showcasing Innovation event, June 2006. See <http://www.waterbucket.ca/gi/index.asp?sid=74&id=32&type=single>
- <sup>184</sup> See MCS for infrastructure and integrated community planning funding at [http://www.cserv.gov.bc.ca/lgd/infra/infrastructure\\_grants.htm](http://www.cserv.gov.bc.ca/lgd/infra/infrastructure_grants.htm). BC Green Cities Infrastructure Grants for 2007 are listed in [http://www2.news.gov.bc.ca/news\\_releases\\_2005-2009/2007CS0020-000301.htm](http://www2.news.gov.bc.ca/news_releases_2005-2009/2007CS0020-000301.htm)
- <sup>185</sup> The federal gas tax funding is outlined in the Gas Tax Agreement, at [http://www.infrastructure.gc.ca/communities-collectivites/agreements-ententes/gas-essence\\_tax/gt\\_can\\_bc\\_e.shtml](http://www.infrastructure.gc.ca/communities-collectivites/agreements-ententes/gas-essence_tax/gt_can_bc_e.shtml).
- <sup>186</sup> Note that the BC Ministry of Community Services is now requiring successful grant applicants under its grant projects to use its Infrastructure Benchmarking Initiative (IBI), a software spreadsheet based performance management tool. The IBI promotes sustainable development through the development and implementation of increased efficiencies within the following local government services: drinking water services, wastewater management, stormwater management and energy efficiencies and/or community energy projects. The IBI has two primary objectives:
1. Development of internal (i.e. individual user) infrastructure performance benchmark measures (e.g. operating cost of wastewater treatment plant per cubic meter).
  2. Grant applicant assistance – identifying industry cost estimates and efficiency targets/benchmarks.
- The IBI is still in a pilot stage, with the aim of being posted to the Ministry's website in a year. Voluntary participation in the pilot stage is welcome with a requirement to provide feedback within a reasonable time frame. For further information, contact: Liam Edwards, Infrastructure Resource Officer, Ministry of Community Services BC, PO Box 9838, STN Prov Govt BC, Victoria, BC, V8W 9T1, (250) 356-0218.
- <sup>187</sup> Section 3.5.16.8.1, Schedule H to Bylaw 7452, Subdivision Bylaw
- <sup>188</sup> Surrey Agricultural Advisory Committee Minutes, January 11, 2007
- <sup>189</sup> See Master Development Agreement [http://www.victoria.ca/cityhall/pdfs/currentprojects\\_dockside\\_masterdev.pdf?zoom\\_highlight=dockside+green+master+development+](http://www.victoria.ca/cityhall/pdfs/currentprojects_dockside_masterdev.pdf?zoom_highlight=dockside+green+master+development+).
- <sup>190</sup> This has been done with some success, using pamphlets in Surrey's East Clayton neighbourhood.
- <sup>191</sup> Burnaby's UniverCity project has established a formal inter-agency committee for review and adaptive management advice. See discussion below.
- <sup>192</sup> Monitoring carried out between 2003 and 2006 consisted of shallow groundwater monitoring (of water level in exfiltration trench, and water level in undisturbed soil near trench), flow monitoring in the downstream storm sewer, as well as a climate station. Surrey did not monitor detention ponds because considered it a proven technology. (Presentation by Engineer David Hislop at Green Infrastructure Partnership's "Showcasing Innovation" workshop series event, held in Surrey, June 2006.)
- <sup>193</sup> Surrey's monitoring has revealed that the rock pits have served more of a detention function than exfiltration function, but exfiltration performance has been constant and did not deteriorate. They further learned that at least 75 percent of the lots did not, post construction, meet the criteria for topsoil thickness; however, because

of the disconnected roof leaders, there was still an improvement in permeability, compared to business as usual lots. In sum, the disconnected roof leaders have made a difference, and the swale systems are generally achieving their design intent or can be made to work with some minor alterations or maintenance.

- <sup>194</sup> Monitoring proved that for single family homes, the use of a thick topsoil layer resulted in a 28 percent annual volume reduction, and the rock pits a 4 percent annual volume reduction. In multi-family homes, exfiltration provided 15 to 20 percent peak flow reduction and 4 percent volume reduction. Monitoring over time has proven that exfiltration rates have not degraded over three years. Monitoring also proved the case for disconnection of roof leaders. (Presentation by David Hislop, *supra* note 192)
- <sup>195</sup> Part of the difficulty was that when the builders would arrive, there was little space to excavate the site, retain the topsoil, and carefully replace it overtop of the site after the construction had taken place.
- <sup>196</sup> See the Campbell Heights Economic Development Plan and the Highway 99 Corridor Land Use Plan, at <http://www.surrey.ca/Doing+Business/Land+Development+and+Building/Plans+and+Policies/Plans+in+Progress/default.htm>
- <sup>197</sup> Craig Kipkie, M.Sc. and P.Eng. and Chris Johnston, P.Eng., "Silver Ridge Low Impact Residential Development," at [http://www.kwl.bc.ca/docs/CWRA2006-Silver\\_Ridge\\_Paper.pdf](http://www.kwl.bc.ca/docs/CWRA2006-Silver_Ridge_Paper.pdf).
- <sup>198</sup> City of Burnaby Staff Environment Committee report to Council dated March 27, 2006.
- <sup>199</sup> Conference presentation by Patrick Lucey and Cori Barraclough of Aqua-Tex and Chris Corps of Asset Strategics at Water in the City, held in Victoria, September 18-20, 2006.
- <sup>200</sup> Chris Johnston, P. Eng., Kathryn McCreary B.A.Sc., and Cheryl Nelms, B.Eng., "Vancouver Public Library Green Roof Monitoring Project", <http://www.kwl.bc.ca/docs/GreenRoofPaper04-0430FINAL.PDF>.
- <sup>201</sup> Visit BCIT's Centre for the Advancement of Green Roof Technology at <http://commons.bcit.ca/greenroof/>
- <sup>202</sup> Found at <http://www.waterbalance.ca/waterbalance/home/wbnIndex.asp>
- <sup>203</sup> For more on this research project, visit <http://www.waterbucket.ca/rm/index.asp?sid=26&id=285&type=single>
- <sup>204</sup> See Stormwater Management Plan, Executive Summary.
- <sup>205</sup> According to the Stormwater Management Plan Executive Summary, design standards are "...consistent with the BC government Ambient Water Quality Guidelines for turbidity, suspended and benthic sediments, for the protection of aquatic life."



West Coast Environmental Law is BC's legal champion for the environment. West Coast empowers citizens and organizations to protect our environment and advocates for the innovative solutions that will build a just and sustainable world.

---

**West Coast Environmental Law**

1001 – 207 West Hastings, Vancouver, BC  
CANADA V6B 1H7

phone: 604.684.7378 or 1 800 330 WCEL  
fax: 604.684.1312 email: [admin@wcel.org](mailto:admin@wcel.org)  
[www.wcel.org](http://www.wcel.org)

