Smart Growth on the Ground

A Partnership of:
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TECHNICAL BULLETIN

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Rainwater Management in Maple Ridge

1.0 Introduction

"*The region will manage waste in a manner that enhances environmental quality*."

This principle is the foundation for the Greater Vancouver Regional District's (GVRD) **Liquid Waste Management Plan** (LWMP), approved in 2002.[1] Within the LWMP, a key strategy is to treat "stormwater as a resource" (GVRD, 2002, p7). This means managing rainfall so that it is available to maintain or restore fish-bearing streams; creates open, public amenities that enhance the liveability of the region; and recharge groundwater wherever appropriate and feasible[2].

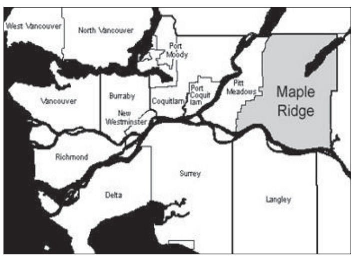

Figure 1: Maple Ridge in the Greater Vancouver Regional District

The District of Maple Ridge is a signatory to LWMP implementation (Figure 1). This commits the municipality to adopting or updating at least two by-laws and policies that relate to rainwater management, and completing an Integrated Stormwater Management Plan (ISMP) for each watershed. This commitment includes public participation.

Maple Ridge also belongs to the inter-governmental partnership that developed the **Water Balance Model for British Columbia** (www.waterbalance.ca). This internet accessible planning and decision support tool is built around established soil science principles. It creates an understanding of how to get rainwater into the ground and/or absorbed by trees and landscaping - under any combination of land use, soil and climatic conditions. This enables the model user to quantify the benefits that result at a neighbourhood or watershed scale by reducing rainwater runoff at the site level.

This technical bulletin applies the Water Balance Model to the north half of the downtown centre of Maple Ridge. It presents the results of scenario modeling to assess how runoff could potentially be reduced to 10% of the total volume of rain that falls on the site, to enhance the environmental quality of that area.

2.0 Why The 10% Target

The 10% target represents a synthesis of biophysical and hydrologic understanding. Analysis of rainfall patterns shows that 90% rainfall capture is typically within reach.

In coastal watersheds, annual runoff under natural forested conditions ranges between 1% and 10% (Figure 2). Most water is captured by plants, or absorbed into the ground, slowly recharging the interflow zone and sustainaing flow in streams. 10% impervious urban area is a threshold at which aquatic diversity and abundance is initially and significantly impacted (Figure 3). By 30%, most urban watersheds may be unable to sustain self-supporting and abundant populations of cold water fish.

To preserve and/or restore the natural water balance in the built environment, the goal is to design site landscaping and infiltration systems to absorb 90% of rainfall, and in doing so limit runoff to 10% (Figure 4). In the Georgia Basin, this is generally equivalent to absorbing 1mm per hour or approximately one inch a day. The one inch figure has been practically achieved locally at East Clayton, in Surrey, BC at densities of 10 dwelling untis per acre, and at Simon Fraser University with densities twice that high.

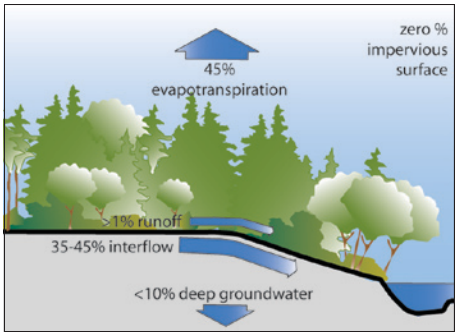

Figure 2: Runoff in an undeveloped watershed: 'Water Balance'.

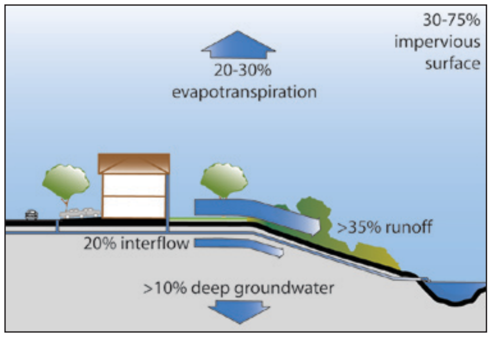

Figure 3: Runoff in a moderate to heavily developed watershed.

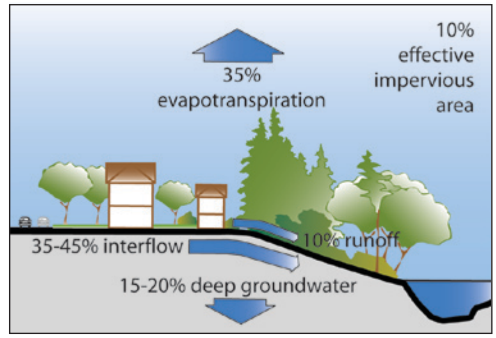

Figure 4: Runoff controlled in a moderate to heavily developed watershed to move towards 'water balance'.

3.0 Maple Ridge Centre 2004

Land Use and Soil

Figure 5: Maple Ridge Centre (approx. 300 ha)

Maple Ridge Centre (Figure 5) is approximately 300 hectares ($3km^2$), and consists of 4 broad land use types: Single Family Residential; Urban; Multi Family Residential; and Open Space, each with varying amounts of impervious area. By combining aerial photography with previous neighbourhood pattern research[3], certain assumptions can be made about the proportion of 'impervious area' in each land use type. Typically, impervious area is made up of roads, parking lots, and rooftops. In the Single Family residential area, about 55% is impervious; the Urban area is 75% impervious; the Multi Family area is 40% impervious; and Open Space is 10% impervious (see Figure 6). Table 1 indicates the area of each land use type and the percentage of the area covered by roads and parking, rooftop, grass, and forest.[4]

Table 1: Area covered by roads and parking, rooftop, grass and forest

Land Use	Area (ha)	Impervious Area		Pervious Area	
		Roads and Parking Lots	Rooftop	Grass	Forest
Single Family	117	25%	30%	45%	n/a
Urban	66	45%	30%	25%	n/a
Multi-Family	66	20%	20%	45%	15%
Open Space	51	10%	n/a	10%	80%

The soil in the Maple Ridge Centre is generally a combination of shallow (less than 450mm) Webster and Whonnock soils. These are silty, clayey soils that drain moderately well to moderately poorly. The rate at which water moves through this soil when it is saturated is 2.3mm per hour.

Application of the Water Balance Model, to simulate what happens when rain falls on this mix of land use, impervious area, and soil types, indicates that about 55% of the annual rainfall volume that falls on the Centre becomes surface runoff.

Storm System

The storm system in the Centre is a conventional system of underground pipes with the occasional exposed ditch flowing into open stream channels. North of the Dewdney Trunk Road, the system drains into Latimer Creek, a tributary to the Alouette River. South of the Dewdney Trunk Road, the system empties directly into the Fraser River (Figure 7). From the standpoint of rainwater management this north-south divide is very important, and suggests that the 10% target should perhaps be applied only to

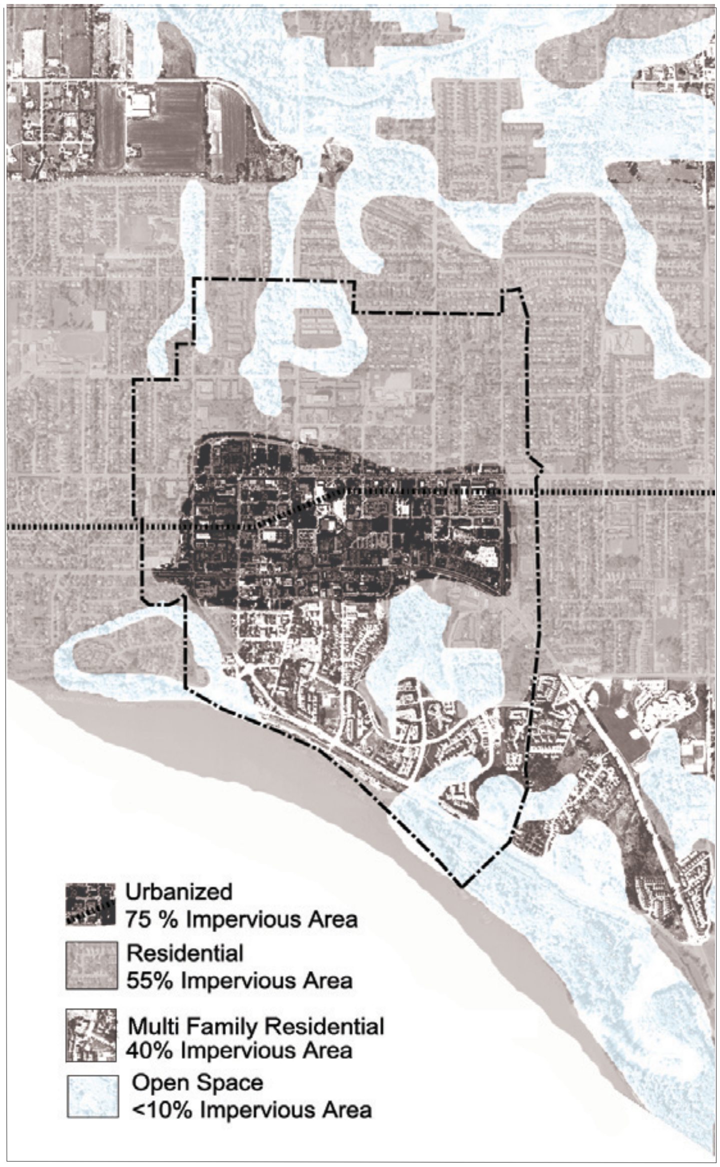

Figure 6: Land Use and Cover in Maple Ridge

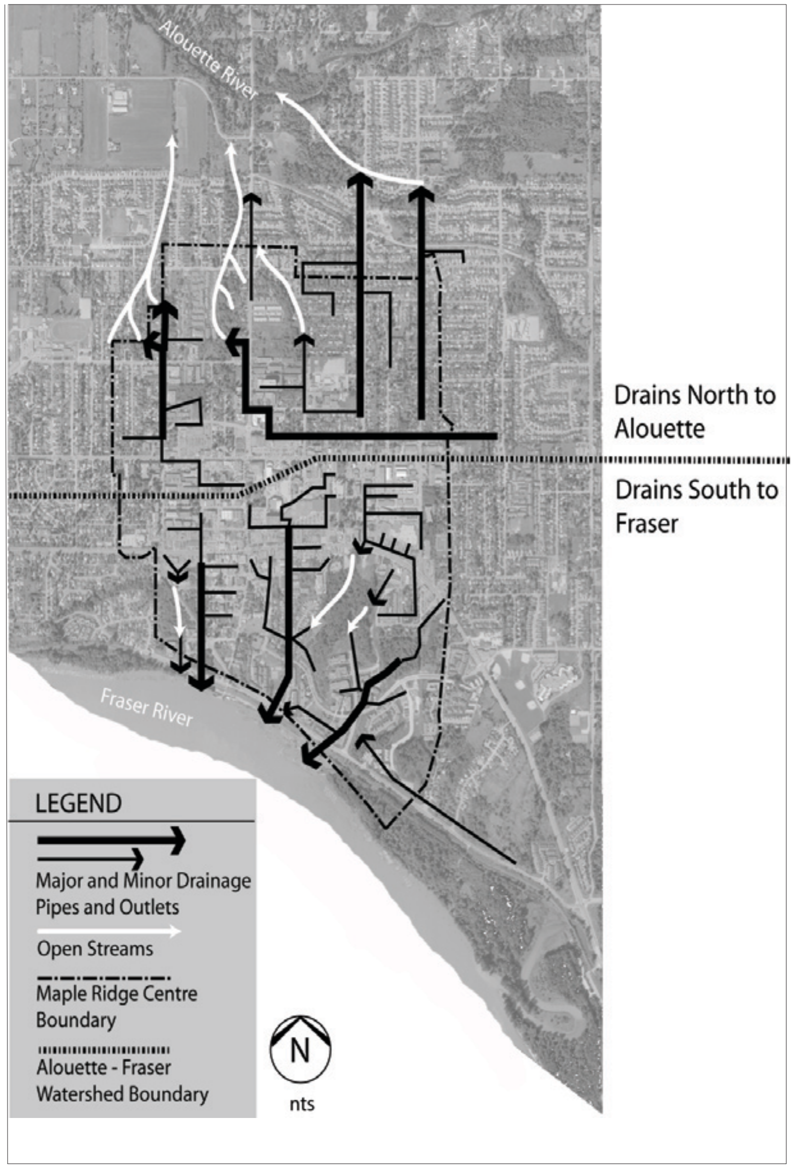

Figure 7: Maple Ridge Storm System

the north half of the Centre. Of relevance, the Alouette River is a BC Heritage River that has undergone significant restoration. Increasing salmon stocks are now being observed after almost 10 years of work. In order to ensure that this encouraging trend continues, the volume and quality of runoff entering the Alouette River need to be carefully controlled and protected, respectively.

By contrast, only the quality of runoff entering the Fraser River must be controlled. The reason is that the volume of all the runoff from the entire south half of Maple Ridge Centre will have a negligible impact on a tidally influenced body of water as large as the Fraser River, though quality at any scale has an impact.

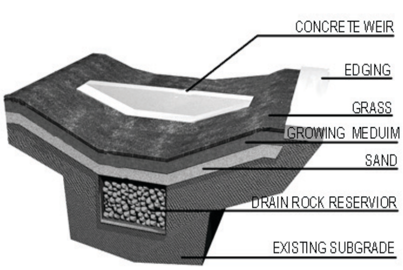

Figure 8: Infiltration trench

4.0 A Scenario for Source Control

There are many ways to manage the volume and quality of runoff from residential, commercial, and industrial development sites. What follows is one scenario that illustrates how the 10% Water Balance performance target could be achieved in the north half of the Maple Ridge Centre using a natural systems approach to rainwater management on private property and along public roadways.

Figure 9: Disconnected downspout

Figure 10: Rain garden / infiltration swale

Source control measures that have been considered for the overview purposes of this technical bulletin include on-lot absorbent landscaping, roadside swales and green roofs. The analysis assumes two types of swales: open vegetated swales for curb-less roads, and a subsurface infiltration trench and underdrain in more urbanized areas.

The scenario modeling has established that the 10% target for runoff could be potentially achieved in the study area by removing runoff from the storm sewer system through an integrated strategy as follows: direct road and parking lot runoff to swales occupying 10% of road rights-of way; direct all residential rooftop runoff to 10% of yards; and capture half of all urban rooftop runoff in green roofs, with the other half diverted to vetgetated swales and grass areas on 10% of the lot area.

Along roadways, rainwater management will be a bonus benefit if and when integrated with community enhancement strategies that are designed to achieve safer and greener streets - for example, rainwater management integrates well with many traffic calming features. Because green streetscaping enhances liveability and quality of life, rainwater management in conjunction with an overall 'green roads' strategy could encompass practical 'small steps' such as these:

- Reduced pavement widths to make a tree canopy achievable
- Pull sidewalks back from curb edges to create a landscape strip beside the roadway
- Plant appropriate tree types within the landscape strip to promote tree canopy growth over the roadway
- Utilize landscape features along roadways to create rain gardens and infiltration swales
- Construct percolating catch basins connected to infiltration trenches within boulevard areas

Considering the area south of the Dewdney Trunk Road that drains directly to the Fraser River, strategies that focus on water quality could be emphasized - for example a simple curb cut that allows water to seep into a small garden at a curb bulge before entering the existing storm system will effectively remove the metals, hydrocarbons, and other suspended solids that are typically found in road runoff.

5.0 Conclusion

Rainwater management is best achieved through practical, incremental 'small steps' that combine to ultimately create a greener community through a landscape and infiltration-based approach to source control that is integrated with streetscape enhancement. Guided by the overview-type results of the Water Balance Model simulation, this technical bulletin assesses one scenario for demonstrating how the natural water balance could eventually be substantially restored in the Maple Ridge Centre. The major change lies in a new look for public infrastructure and the open space around private development, and a new attitude towards managing rainwater as a resource, recognizing its role in maintaining regional environmental quality and liveability. Over time, the progressive 'greening' of neighbourhoods will occur naturally as landscaped areas and trees mature. This greening will result in cumulative benefits that further mitigate the original changes to the natural water balance.

Notes:

[1] "The Liquid Waste Management Plan was prepared by the GVRD, adopted by all municipalities and the Greater Vancouver Sewerage and Drainage District Board in 2001, and approved by the Province of B.C. under the Waste Management Act in 2002," (http://www.gvrd.bc.ca/sewerage/plans.htm).

[2] GVRD. 2002.

[3] Condon, Teed, Muir, Midgley (2002). Sustainable Urban Landscapes: Neighbourhood Pattern Typologies. http://www.sustainable-communities.agsci.ubc.ca/projects/typology.htm

[4] These numbers were estimated using orthographic aerial photography in order to substantially simplify use of the Water Balance Model Tool.