# The Clovelly-Caulfeild Neighbourhood Planning Process

## Discussion Papers

prepared by

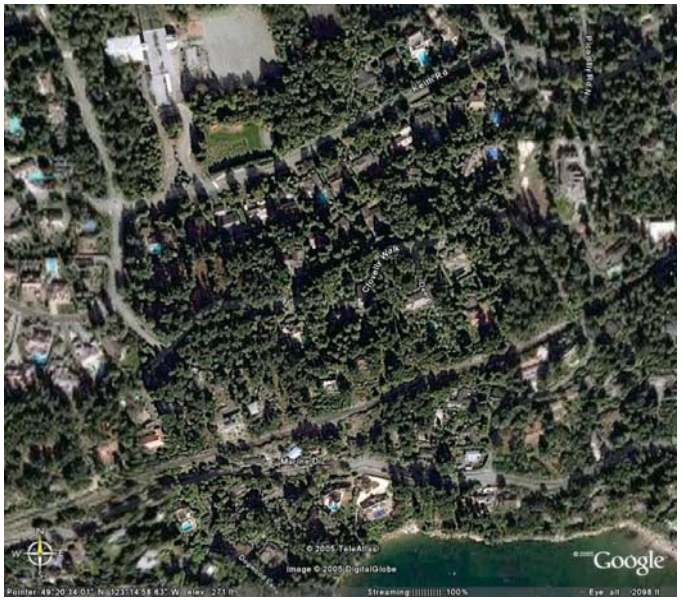
Individual Working Group Members

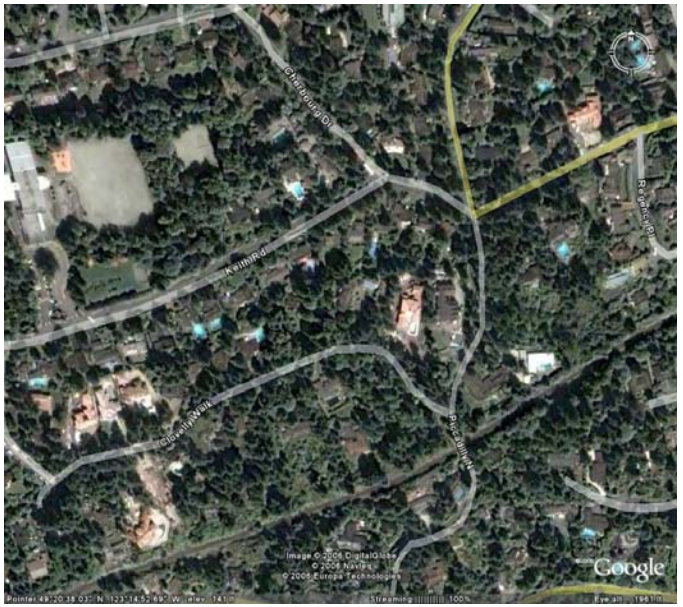
# Preface

Rainwater runoff is created when land development alters the natural water balance. As trees, vegetation and soils are replaced with bigger and bigger houses and hard surfaces, less rainfall volume infiltrates naturally into the ground, less gets taken up by trees and vegetation, and more and more of the rainfall volume becomes runoff.

Historically, drainage has not been an issue in the Clovelly-Caulfeild area. But this has changed - recent experience shows that drainage has emerged as a problem under both rainy weather and drought conditions. Because there is measurable rainfall on approximately half the days in a year, drainage impacts are often either insidious or nuisance in nature.

If 'design with nature' solutions are not standard practice in future, the risks within the Willow and Piccadilly creek zones will be magnified as the Clovelly-Caulfeild housing stock is progressively replaced over time. This Discussion Paper explains the impact of land redevelopment on drainage flows and creek stability. To facilitate an understanding of cause-and-effect, a Water Balance Model case study is presented.




**TOP PHOTO:** Taken in 2004 prior to subdivision of the Mrs. Dien Pieters East Estate on Clovelly Walk

**BOTTOM PHOTO:** Taken in 2006 after blasting and landscape alteration along Clovelly Walk (left), North Piccadilly (centre) and Keith Road (right)

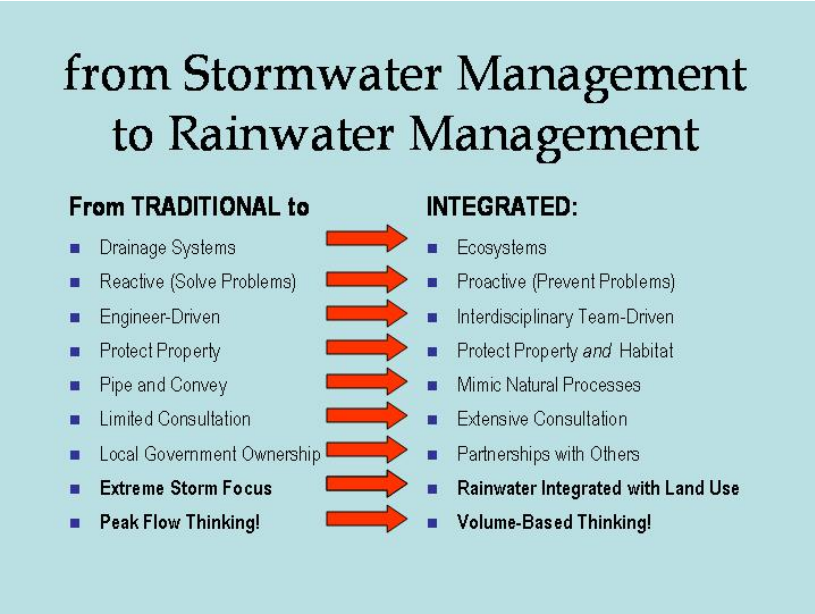
# Table of Contents

1. **Well, What is 'Rainwater Management', Really?**
   - What 'Rainwater Management' Means
2. **Regulatory Context**
3. **Drainage Impacts in Clovelly-Caulfeild**
   - The Obvious and the Insidious
   - North Piccadilly Park
   - Clovelly Walk
   - Marine Drive
4. **Implications for Willow and Piccadilly Creeks**
   - No Net Increase in Volume
5. **Integrated Strategy for Managing Rainfall**
   - Rainwater Management
   - Universal Relationships
6. **Water Balance Model Case Study**
   - Site Information
   - Synopsis of Water Balance Model Results
   - Landscape-Based Solutions Reduce Runoff
   - Greener Development
7. **UBC Tree Canopy Research Program**
   - North Shore Partnership
   - The Right Trees in the Right Places
8. **Recommendations**
9. **Resources**

**About the Author**

# 1. Well, What is 'Rainwater Management', Really?

There has been a change in thinking among drainage practitioners, and the technical language is in transition. This change has seen the single function view of traditional 'stormwater management' give way to the integrated and comprehensive perspective that is captured by the term 'rainwater management'. Stormwater suggests there is a problem and an inherent liability, whereas rainwater is a resource. The evolution to an integrated approach is summarized below:




**What 'Rainwater Management' Means:** Changing the language is part and parcel of implementing 'integrated solutions' that are landscape-based, reflect a **design with nature** way-of-thinking and acting, and are guided by this over-arching principle:

> *The way land is developed determines how water is used, and how water runs off the land.*

Traditional stormwater management had a narrow scope: it was event-based and only considered a handful of runoff events that might occur in a given year. In contrast:

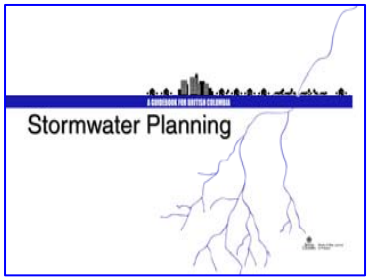
- Contemporary rainwater management has a broad scope and accounts for all the rainfall-days that occur each year.
- Furthermore, rainwater management encompasses both water use and rainwater runoff.
- Desired rainwater management outcomes include using less irrigation water and reducing rainwater runoff.
- These two outcomes are achieved through soil depth and landscaping: soil depth serves as a sponge when it is raining and results in healthier landscaping; well-rooted landscaping then requires less irrigation and stays green longer during a drought.

Drainage practitioners are now advancing the design of 'green infrastructure' so that *cumulative benefits* can accrue over time, rather than *cumulative impacts*.

# 2. Regulatory Context

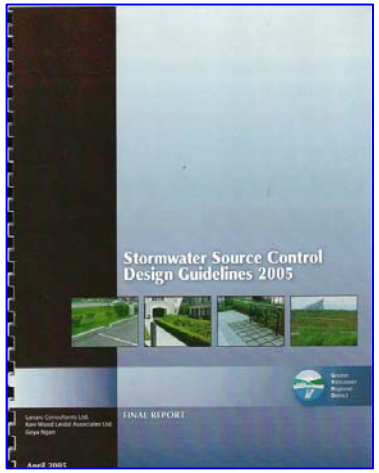
Rainwater management is a key component of protecting quality of life, property and ecosystems. This is why, in 2000, West Vancouver and all other Greater Vancouver municipalities signed a regulatory commitment to fully implement integrated rainwater management policies, plans and practices by 2012.

In 2002, the Province published ***Stormwater Planning: A Guidebook for British Columbia***. The Guidebook formalized a science-based understanding to set performance targets for reducing rainwater runoff volumes from individual sites.




Also in 2002, an Inter-Governmental Partnership was formed to develop the web-based ***Water Balance Model for British Columbia*** as an extension of the Guidebook. West Vancouver is a founding member. The Partnership recognized that practitioners and others needed an easy-to-use tool so that they could readily calculate annual runoff volumes under different combinations of building coverage, rainfall, soil type and depth, tree canopy coverage, and source controls.

To complement the Water Balance Model, West Vancouver and the other Greater Vancouver municipalities commissioned a set of ***Source Control Design Guidelines*** for landscape-based solutions – that is, absorbent landscapes, rain gardens, pervious pavers, infiltration swale systems, infiltration trenches and green roofs – for reducing rainwater runoff volumes. Published in 2005, the Guidelines are supplemented by a set of posters that display the results of the applied research. The Guidelines were adapted from design standards from areas of England, Europe, Australia, New Zealand and North America with comparable soil and climate conditions to Greater Vancouver.




The Water Balance Model includes a tree canopy module so that the rainfall interception benefits of trees in the urban environment can be quantified. This module was developed at the instigation of the three North Shore municipalities. To populate the module with local data, the Inter-Governmental Partnership and the University of British Columbia have embarked upon an applied research program. The District of North Vancouver is acting on behalf of the Partnership and the North Shore municipalities in leading this on-the-ground initiative.

# 3. Drainage Impacts in Clovelly-Caulfeild

New house construction in Clovelly-Caulfeild continues to result in noticeable drainage impacts on other properties. The pervasive effects are becoming more and more visible, and are extending over a larger and larger area. Locations where the cascading impacts are increasingly apparent include:

- North Piccadilly Park
- The former East Estate
- Clovelly Park Trail
- Regency Place

The first two locations are the subject of this impact assessment. Because they are recent, they provide vivid case study illustrations of what happens when properties are clear-cut and the natural landform is radically altered through prolonged and extensive blasting over a large area. The other two locations are of interest and relevance because they demonstrate how, once created by land development, drainage problems persist over time.

Experience shows that nuisance problems are the bane of municipal drainage engineers**:** off-site complaints are never-ending when problems are not mitigated at their source, where rain lands.

**The Obvious and the Insidious:** Drainage impacts in Clovelly-Caulfeild fall into two broad categories:

- **The Obvious** – Trees, soil and vegetation create a natural 'sponge' that absorbs rainfall. Remove the sponge and rainwater runs off. This sets in motion a chain of events that ultimately creates risks downhill when uncontrolled water flows overland; and when creek channels erode and drainage facilities fail.
- **The Insidious** – Repeated blasting of bedrock creates a 'spiders web' of cracks and fissures. Because water follows the path of least resistance, seepage problems show up where least expected. Impacts are incremental. Impacts are cumulative.

In the next three pages, the situations at three locations are described. The three case studies illustrate the range of impacts that are currently being experienced. Drainage patterns have been changed, and resulting problems are either obvious or insidious.

By shining the spotlight on the three examples, the objective is to create awareness that the drainage issue in Clovelly-Caulfeild is serious. Prompt action is necessary to prevent poor development practices from being perpetuated elsewhere in the neighbourhood.

Nuisance drainage problems have been experienced during a summer drought – when the only apparent source of water is lawn and garden irrigation! The inescapable conclusion is that excessive blasting has created underground pathways for conveying this water. Looking ahead, a preventative solution is to limit blasting.

**North Piccadilly Park:** The drainage impacts on the park that resulted from clear-cutting and rock excavation on the adjacent property (as shown below) provide a classic illustration of cause and effect. In a nutshell:

- Landform alteration resulted in flooding of the adjacent park.
- To contain the drainage outflows, a ditch now intercepts runoff at the property line and conveys it to Piccadilly Creek.
- The look-and-feel of this section of Clovelly Walk has been altered by the roadside ditch.
- Piccadilly Creek now has more flow more often.
- The drainage impact has been transferred downhill.

**The retrofitting of a drainage outlet** to Piccadilly Creek is shown in the set of photographs below. The ditch can now be described as a creek tributary.

**Above - Drainage outlet retrofitted from #4551 through park to Clovelly:**

**Left Photo:** View of excavation looking back from Clovelly to the stacked rock
**Right Photo:** View from property line of pipe installation to Clovelly roadway

**Above - Flow in ditch during rainstorm on September 20, 2006:**

**Left Photo:** New ditch along Clovelly Walk to connect with Piccadilly Creek
**Right Photo:** Culvert under Clovelly discharges into Piccailly Creek

**Clovelly Walk:** The drainage consequences of subdivision of the former East Estate into five lots, combined with wholesale tree removal on a nearby developed property, have been two-fold:

- Three properties on the south (low) side of Clovelly Walk have been experiencing flooding and/or an exacerbation of water-related problem. The latter have been occurring under both rainy weather and drought conditions.
- The new storm sewer serving the three newly subdivided lots on the north side has transferred the drainage outflow, and hence the impact, east to Piccadilly Creek (i.e. because foundation and roof drainage from the three lots is piped under a high point in the road to discharge into the open channel that starts at #4659).

**Runoff During a Summer Drought:** With the exception of the narrow setback adjacent to the roadway, the three lots on the north side of Clovelly were stripped of all native soil to expose the underlying bedrock during site development. The absence of water absorptive capacity was evident under summer drought conditions in 2006: for example, lawn and garden watering appeared to be the source of a continual outflow of water onto and down Clovelly Walk. The photo below was taken on August 26th after 16 straight days without rain, and virtually no rainfall in over a month.

**When You Remove a Forest:** Wholesale tree removal on a property with an existing house resulted in immediate drainage and erosion impacts downhill. To prevent spillage onto the neighbouring properties, runoff is now collected at the bottom of the property and pumped uphill to the open channel on the north side of the roadway. This has transferred the drainage impact east to Piccadilly Creek.

**Marine Drive:** Downhill, insidious drainage impacts resulting from subdivision of the former East Estate are being experienced by Beverley Sharpe of #4681 Marine Drive. In her words:

"There is a big drainage problem on my property as a result of the construction of the new home above me. Muddy coloured water drained into my beautiful pond all summer. My pond was my pride and joy, but all summer, I drained, and refilled, hoping that the warm summer months would "dry up" the runoff from up above my property, and result in me enjoying my pristine pond. It did not happen. I got a lot of runoff even on very hot days. So, I just ordered seven and a half tonnes of river rock ($380 with delivery fee) and am slowly, bucket by bucket, hauling the river rock to the back of my property to fill up my pond. I am so very sad about having to do this, but I could no longer keep cleaning, and re filling my pond. We are all going to start paying for our water, as of January, and that was a secondary consideration, as my pond holds about 1200 litres. My pond will be filled, I have to say good bye to our pond that my children and I enjoyed so much. The constant drainage is causing me great concern for the upcoming winter season. The freezing of the run-off will cause some of my walkways to be very icy. Again, more cost, due to the salt and sand I will have to purchase, and more work for me. Not a desirable situation.."

Seepage outflows onto Marine Drive are evident along the #4681 frontage, even during a summer drought.

# 4. Implications for Willow and Piccadilly Creeks

Creeks are a prominent feature within Clovelly-Caulfeild, yet for the most part are invisible to the public at large. Roughly one-quarter of the properties in the planning area abut Willow and Piccadilly Creeks. Six streets, for example, are tributary to Willow Creek. Also of relevance and significance, the drainage catchment areas for each creek extend beyond the boundaries of the Neighbourhood Plan.

If redevelopment and estate subdivision that is insensitive is allowed to continue – whereby trees, soil and vegetation are replaced with a greater and greater proportion of hard surfaces - the risks within the Willow and Piccadilly creek zones will be magnified as the Clovelly-Caulfeild housing stock is progressively replaced over time.

Risks result from the increased frequency of occurrence of runoff, combined with the increasing magnitude of those runoff events. The impacts are cumulative.

More volume results in faster flows. In turn, faster flows result in more erosion. As the chain reaction continues, more and more sand, gravel, rocks, vegetation and branches are carried down the creek channels. And the likelihood of blockages at culverts and/or channel constrictions increases.

**No Net Increase in Runoff Volume:** Ensuring the long-term stability of the Willow and Piccadilly creek channels starts with on-property rainwater management, and a requirement that there be "no net increase" in runoff volume after a property is redeveloped. Regulatory agencies in British Columbia have embraced volume management for four main reasons

- British Columbia case law is clear: land developers are responsible for controlling volume.
- The capital costs are often prohibitive to retrofit traditional engineered solutions that manage volume downstream. (*For example: Based on engineering judgment and long-term North Shore experience in managing creek stabilization and culvert replacement programs, the cost for remedial works on Willow and Piccadilly Creeks could conceivably be in the range $0.5M to $1.0M, especially when the cost implications for the culvert crossings under Keith Road, the railway and Marine Drive are considered)*
- Preventing the creation of rainfall runoff at the source makes sense, especially when it can be achieved through landscaping that property owners will be doing anyway.
- Protection of aquatic habitat and fisheries resources depends on preserving and/or restoring natural flow conditions.

Because the headwaters of Willow and Piccadilly Creeks originate outside the Neighbourhood Plan area, the volume issue needs to be addressed watershed-wide.

# 5. Integrated Strategy for Managing the Rainfall Spectrum

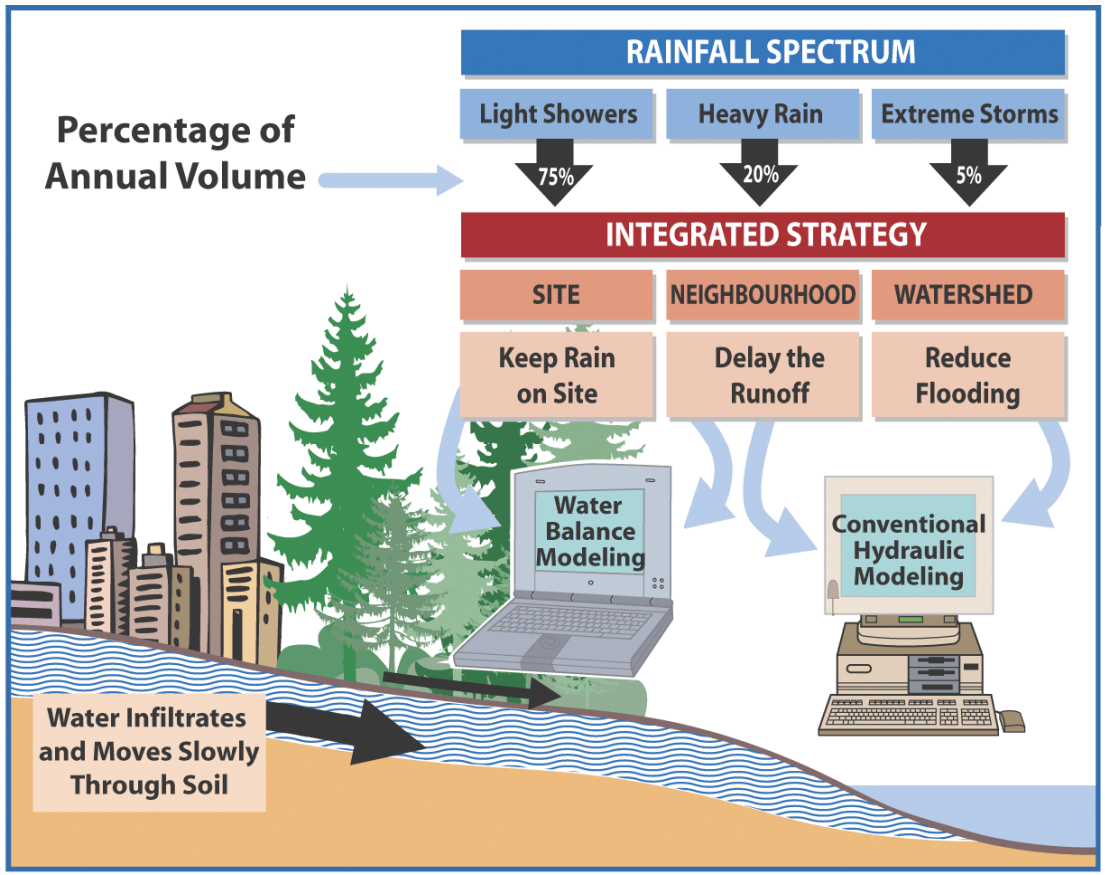
Traditional single-purpose 'stormwater management' was reactive because it dealt only with the consequences of the handful of extreme storms that occurred infrequently; while ignoring the property and environmental impacts that resulted from the frequently occurring rainfalls.

**Rainwater Management,** on the other hand, is proactive in managing all the rainfall events that occur in a year. The graphic opposite illustrates the integrated strategy for protection of life, property and the environment that is being implemented throughout British Columbia as a result of publication of the Guidebook and development of the Water Balance Model.

**Landscape-Based Solutions:** Because 'light showers' account for most of the annual rainfall volume, landscape-based solutions are effective in reducing both runoff volume and the number of occurrences in a year; as well as rates of runoff. In addition, the 'light shower' category accounts for most of the rainfall days that occur in a year in our region – that is, 160 of 170 on average. Refer to graphs on next page for more information.

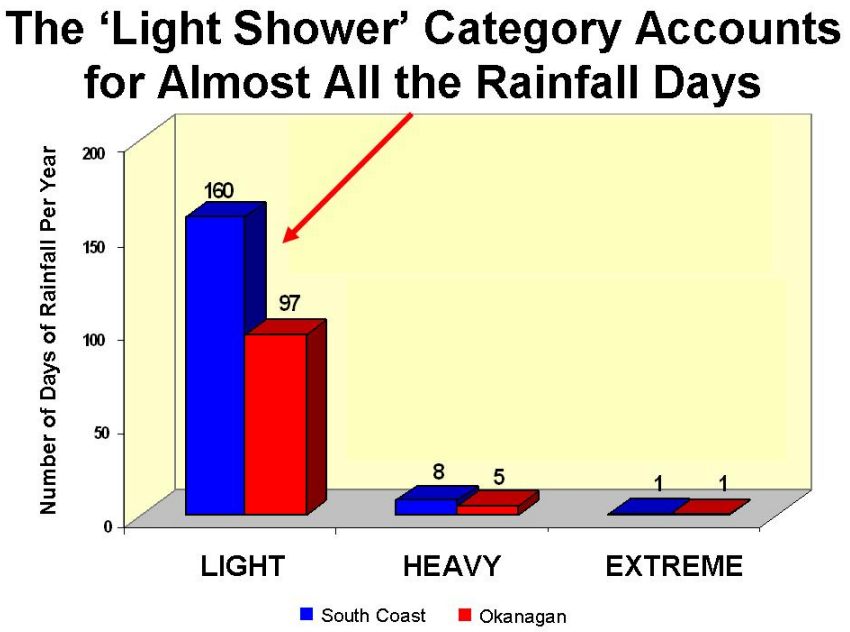
Landscape-based solutions enable multiple objectives to be achieved when developing a property:

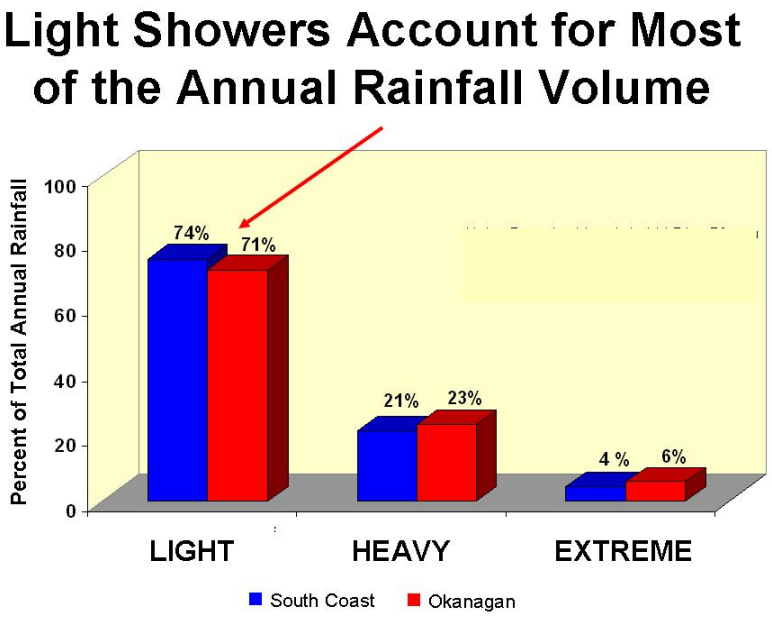
- Overall aesthetics.
- Specific environmental enhancements.
- Rainfall capture.
- Drought tolerance.



**Universal Relationships:** The graphics below serve two purposes. First, they show that the distribution pattern of rainfall frequency and volume is universal even though total annual rainfall varies from region to region. Secondly, they underscore why properly implemented landscape-based solutions lend themselves to rainwater management – in Clovelly-Caulfeild, the 'light showers' that comprise the majority of rainfall-days are less than ¾-inch (18mm) in magnitude. This threshold is consistent with the interception and absorptive capacities of the forest canopy, ground vegetation and soils (whether native or imported).

"The rain gauge in our backyard shows that almost 5 feet of rain had fallen on Clovelly-Caulfeild during the 12-month period ending March 2006



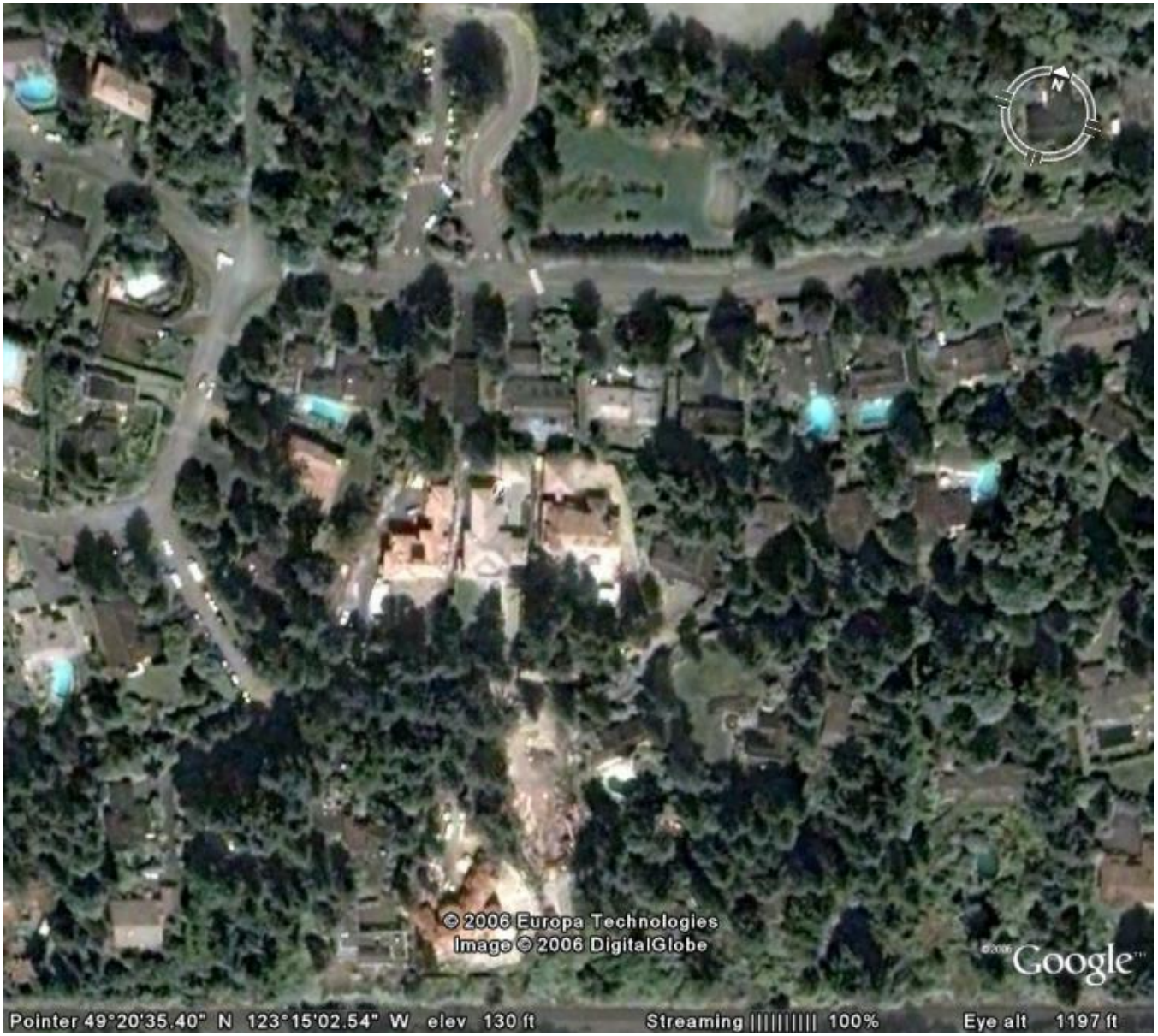



# 6. Water Balance Model Case Study

The Water Balance Model is an evaluation and decision support tool that anyone with a computer and internet connection can access at www.waterbalance.ca and use online. It was developed in British Columbia and is now a national initiative. Relevant points to note include:

- Before the Water Balance Model was developed, the missing link in urban hydrology was a tool that could easily quantify the benefits, at a neighbourhood or watershed scale, achieved by reducing rainwater runoff volume at the site scale.
- It allows one to view the existing situation and compare it to what may have been in the past and what may be in the future.
- The Water Balance Model enables developers, planners, engineers, landscape architects, educators and others to readily quantify the effectiveness of source-control performance (as measured by runoff volume) under different combinations of land use, soil and rainfall.
- It simulates the continuous performance of *landscape-based solutions* over a single year (all four seasons) or over a multi-year period.
- It simulates the drying and wetting of soil, and evaporation-transpiration from trees and ground cover.

The Water Balance Model has been applied to Clovelly Walk to illustrate the dramatic impact on rainwater runoff volume when forested land is virtually clear-cut, stripped of all soil down to bedrock, and then blasted to create flat areas for house construction.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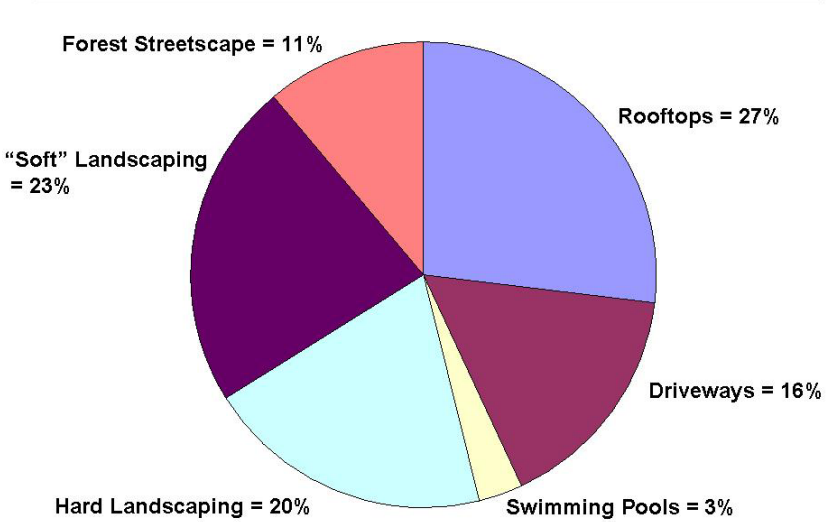
© 2006 Europa Technologies
Image © 2006 DigitalGlobe
Google
Pointer 49°20'35.40" N 123°15'02.54" W elev 130 ft
Streaming 100%
Eye alt 1197 ft

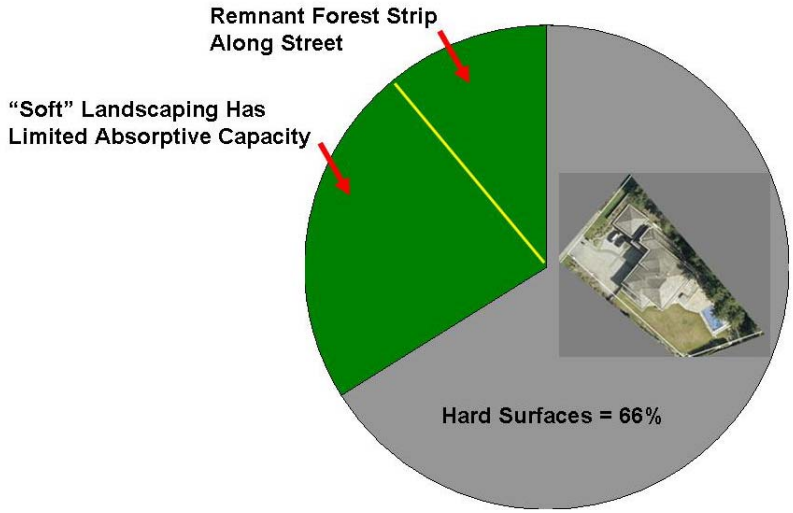
**Site Information:** The area selected for the Water Balance Model case study application was the portion of Mrs. East's former estate on the north side of Clovelly Walk. This ~1.4 acre parcel has been subdivided into three 20,000 square foot properties.

**Site Coverage After Development:** The pie chart below shows the average percentages for each of six categories of ground surface coverage:




**Hard versus Absorbent Surfaces:** The pie chart opposite looks at the same information in a different light. A distinction is made between 'hard' and 'soft' surfaces, where 'green' is equated with 'soft', and 'soft' is equated with 'absorbent'.

**Runoff During a Summer Drought:** The ability of the landscaping to retain water is quite limited, as validated by observations this past summer. While the site is nominally one-third 'green', the portion that is actually capable of absorbing rainfall appears to be closer to 10%. This observation is attributable to the nature of the landscape practices that have been implemented, for example as shown in the photo opposite: turf was placed directly onto a layer of free-draining sand which in turn was placed directly onto the excavated rock surface. In effect, ~90% of the site may be functioning as though it is hard-surfaced.

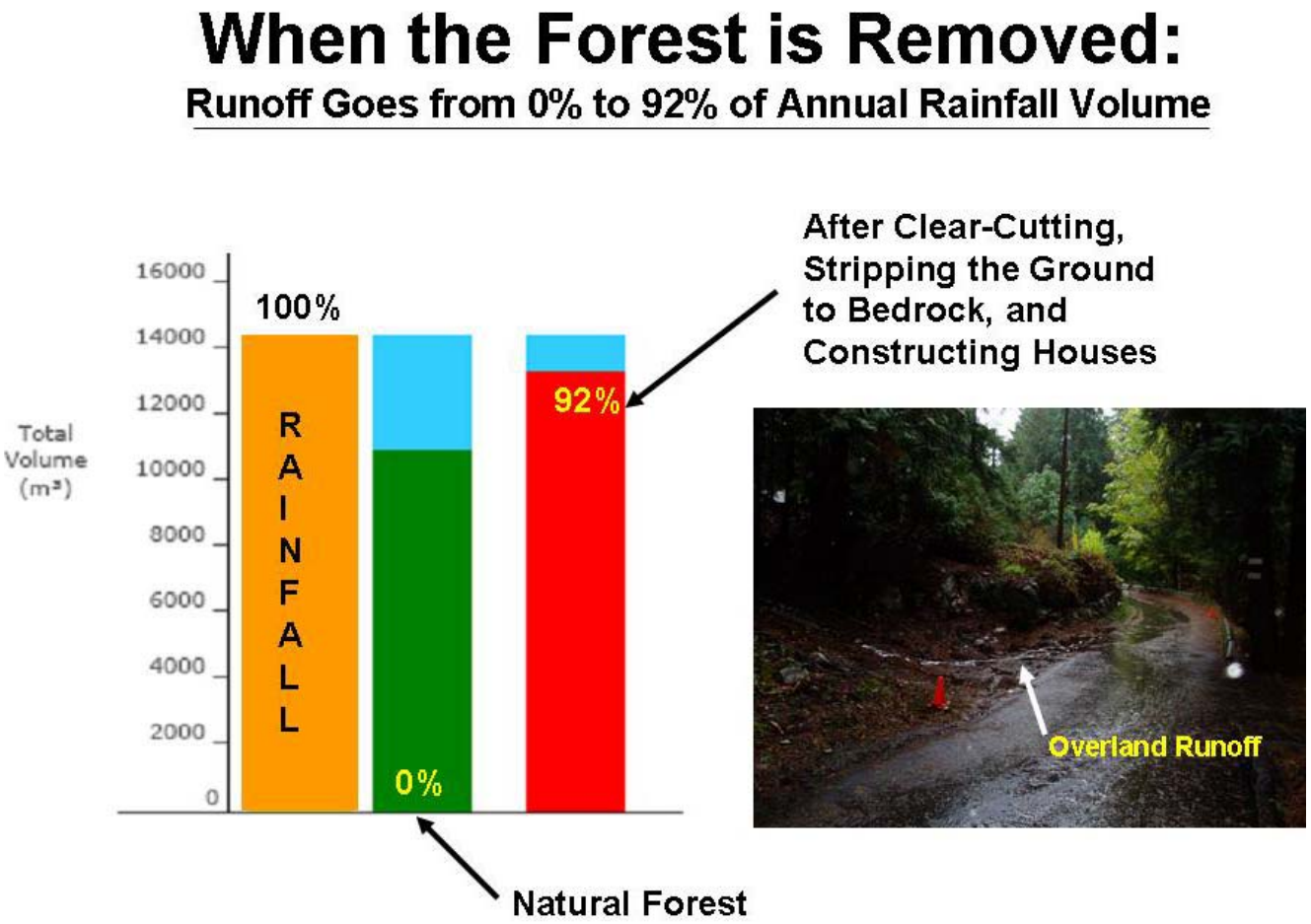


## Synopsis of Water Balance Model Results:

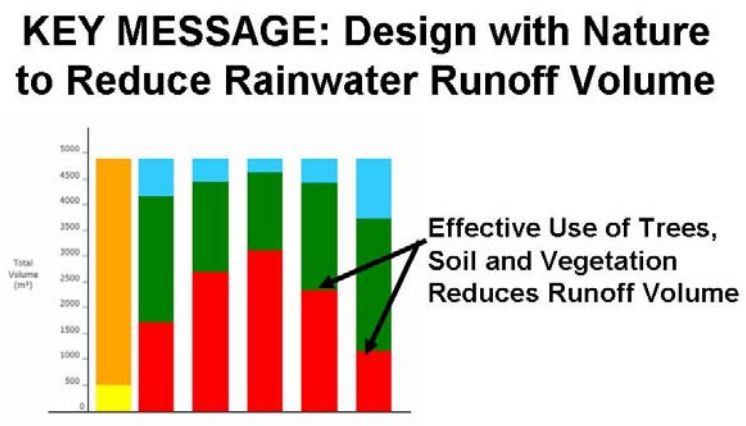
When the East estate was forested, there was virtually no overland runoff. The tree canopy, forest litter and extensive pockets of deep soil throughout the site combined to intercept and absorb rainfall. As shown in the photo below, taken during one of the most extreme periods of wet weather in the past century, the initial forest grooming created the first noticeable overland runoff. The photo was taken in October 2003. This impact can be attributed to compaction of the forest litter and native soil by heavy construction equipment tracking back and forth.

Now that three houses have been constructed, runoff can be expected whenever it rains. Observations of the land's response to garden watering during the Summer 2006 drought provide validation of the runoff characteristics of this 3-lot subdivision.

Given that there are ~170 rainfall-days per year, the frequency of occurrence of runoff events has implications for the existing Clovelly Walk roadway drainage system and Piccadilly Creek channel stability. These implications were introduced in the previous section.



**Landscaped-Based Solutions Reduce Runoff Volume:** The graphic below is borrowed from a District of North Vancouver case study. It illustrates how one can systematically apply the Water Balance Model to customize an appropriate landscaping plan. The bar graphs represent a number of scenarios. The three bars on the left correspond to different development conditions, without source controls. The two on the right show the benefits in progressively adding landscaping elements to capture rain where it falls.

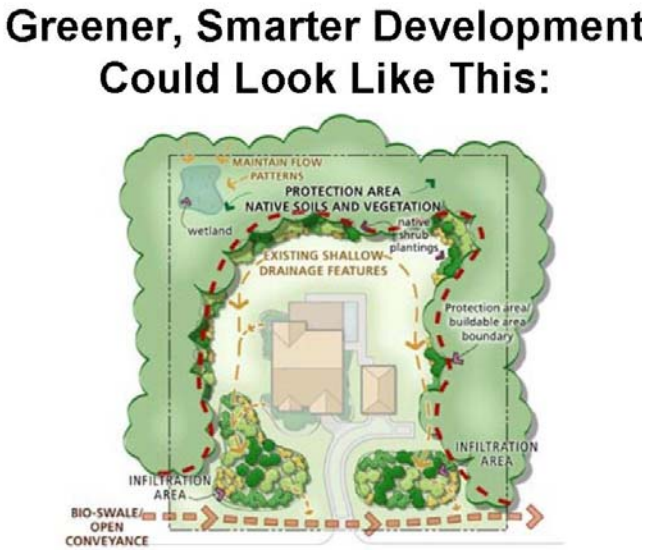



In British Columbia, the technical language is being simplified so that there will be clearer public understanding of the suite of source control options for capturing rain where it falls:

The Source Control Design Guidelines commissioned by Greater Vancouver municipalities has reduced information barriers that previously stood in the way of effective implementation of rainwater runoff source controls.

The combination of the Water Balance Model and the Source Control Design Guidelines enables site developers to select, assess and implement landscape-based solutions that make sense.

**Greener Development:** The graphic below is also borrowed from the District of North Vancouver.



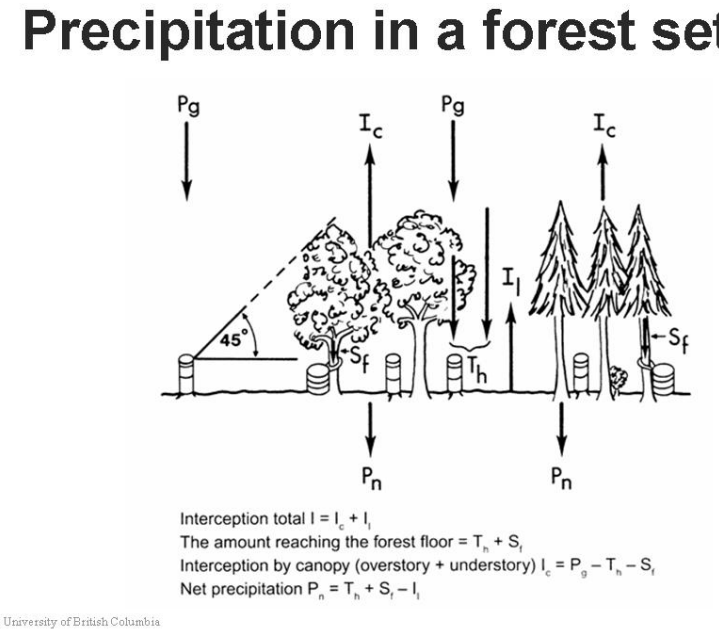

It is intended to conceptualize how Mrs. East's estate could have been developed by retaining natural features and/or incorporating any or all of the following landscaped-based measures:

- Absorbent Landscape
- Rain Garden(s)
- Pervious Paving (on an infiltrating foundation)
- Infiltration Swale System
- Infiltration Trench and Soakaway Manhole

Preserving and/or enhancing soil depth achieves rainwater management and drought management objectives: soil depth serves as a sponge when it is raining and results in healthier gardens; well rooted lawns and gardens then require less irrigation and stay green longer during a drought.

# 7. UBC Tree Canopy Interception Research Program

Tree canopy interception is the process of storing precipitation temporarily in the canopy and releasing it slowly to the ground and back to the atmosphere. It is an important component of the water balance, easily accounting for up to 35% of gross annual precipitation. Removing trees will in general decrease interception and thus increase annual runoff and rainwater runoff. Vegetation also reduces rainfall intensity due to the temporal storage effect.




**North Shore Partnership:** Collaboration between the University of British Columbia (UBC) and the Inter-Governmental Water Balance Model Partnership has opened the door to a long-term partnership to bring science into the community:

- Because of the urban context for the North Shore research program, a principal focus is on quantifying the interception effectiveness of a single tree versus that for a cluster of trees.
- The variables influencing the interception process will be explored and quantified.
- Researchers will investigate the effects of tree density, tree structure and tree species on rainfall interception.

The District of West Vancouver, the District of North Vancouver, and the City of North Vancouver have combined their efforts to implement a total of 60 tree monitoring stations across the North Shore. With guidance from Dr. Markus Weiler, the Chair of Forest Hydrology at UBC, an inter-municipal coordinating team developed tree/site selection criteria and designed an innovative system for capturing rain that makes it through the tree canopy.

The Province of British Columbia, the Greater Vancouver Regional District, and the Real Estate Foundation of British Columbia have funded the project start-up. The project is precedent-setting

**Clovelly-Caulfeild:** Five monitoring locations were chosen in Clovelly-Caulfeild. They are on Keith Road, North Piccadilly and Willow Creek Road. The first two stations were installed on January 19, 2007 by a UBC researcher with the assistance of community volunteers.

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**The Right Trees in the Right Places:** The research project will directly inform urban planning and will be used to populate the Water Balance Model with rainfall interception data. According to Dr. Markus Weiler:

> *"In theory, it is highly probable that interception losses of a tree that stands in an urban setting is larger compared to a tree within a forest stand. There may be even an optimum of tree density and structure whereby the interception is largest for a certain tree density.*
>
> *If this density can be determined, or even the relation of tree density to interception loss, local governments could provide urban developers with guidance as to how many trees need to be maintained within a residential lot to maintain a certain interception effect.*
>
> *This observation underscores the importance of maintaining some tree cover on residential lots. Also, it leads one to articulate the counter-intuitive argument that fewer trees is actually better from a rainwater management perspective - provided there is still a reasonable canopy."*

While considerable research has been undertaken in forest stands in the natural environment, very little has been done in an urban setting anywhere in North America.

# 8. Recommendations

Seven recommendations that flow from the foregoing analysis are listed as follows:

1. Implement a goal that there be "no net increase" in rainwater runoff volume after redevelopment of individual properties.

2. Promote tree canopy coverage as a rainwater management tool.

3. Encourage landscape-based solutions that prevent creation of rainwater runoff.

4. Encourage redevelopment proponents to apply the Water Balance Model in combination with the Source Control Design Guidelines to show how their landscaping plans will achieve "no net increase" in rainwater runoff volume after redevelopment.

5. Develop a brochure that provides property owners with guidance on how to implement runoff volume control solutions.

6. Include a soil depth preservation and enhancement policy in the toolkit for landscape-based solutions.

7. Explore the concept for a Creek Owners Stewardship Group that would take responsibility for protecting and monitoring conditions in Willow and Piccadilly Creeks.

# 9. Resources

Web links for rainwater management guidance documents referenced in this Discussion Paper are listed as follows:

- Stormwater Planning: A Guidebook for British Columbia
  http://www.waterbucket.ca/rm/index.asp?sid=49&id=229&type=single
- Water Balance Model for British Columbia:
  http://www.waterbalance.ca/waterbalance/home/wbnBCIndex.asp
- Stormwater Source Control Design Guidelines 2005
  http://www.waterbucket.ca/rm/index.asp?sid=18&id=236&type=single

For stories and information on the latest developments in BC relating to the state-of-the-art, go to: www.rainwater-management.ca

For a historical perspective on the British Columbia experience, and to understand the changes that have seen the single function view of traditional 'stormwater management' give way to the integrated and comprehensive perspective that is captured by the term 'rainwater management', go to:
http://www.waterbucket.ca/rm/index.asp?sid=43&id=13&type=single

For more on the Tree Canopy Research Program go to:
http://www.waterbucket.ca/rm/index.asp?sid=33&id=271&type=single

# ABOUT THE AUTHOR:

This Discussion Paper was authored by **Kim A Stephens**, M.Eng., P.Eng., and reflects input provided by members of the Clovelly-Caulfeild Working Group. Kim Stephens is a long-time resident of West Vancouver, having graduated from Hillside Secondary in 1968. He has lived on Keith Road in Clovelly-Caulfeild since 1987.

Formerly a Vice-President with CH2M Hill, one of North America's largest environmental engineering corporations, Kim Stephens is an engineer-planner who has been an independent practitioner since 2002. Currently, he is the Program Coordinator for implementation of the Water Sustainability Action Plan for British Columbia, a partnership umbrella for four provincial initiatives that are inter-linked and inter-governmental, and that promote a 'water-centric' approach to community planning:

- Convening for Action in British Columbia
- Green Infrastructure Partnership
- Water Balance Model Partnership
- Water Bucket Website Partnership

Kim has 30-plus years of on-the-ground experience related to water-centric planning, water resource management, water supply development and infrastructure servicing. He has received local and international recognition for his pioneering efforts related to rainwater management, water conservation and smart land development; and has been invited to speak on 'the British Columbia experience' and make keynote presentations at forums in Australia and throughout North America.

He was the recipient of the ***2000 Environmental Award*** from the APEGBC (Association of Professional Engineers and Geoscientists of British Columbia).

**Noteworthy Accomplishments:** Kim was Project Manager and principal author of *Stormwater Planning: A Guidebook for British Columbia*, published by the Province and Environment Canada in 2002. This guidance document introduced a performance-based methodology for changing the way we develop land by designing with nature. Kim also created the vision for the *Water Balance Model for British Columbia* as an extension of the Guidebook; and as project manager for an inter-governmental partnership, has been responsible for taking this Internet-based decision support tool from concept to reality.

The Guidebook set in motion a chain of outcomes that has resulted in British Columbia being recognized internationally as a leader in implementing a natural systems approach to rainwater management in the urban environment. The provincial Convening for Action initiative is building on the successful precedent established with the Guidebook and Water Balance Model, and creates an opportunity to move beyond rainwater management to embrace all components of the water cycle through integrated water management.

Under the umbrella of the Water Sustainability Action Plan, Kim has pioneered development and implementation of a comprehensive and multi-layered outreach and continuing education program. The program is designed for an array of audiences, ranging from elected officials to stewardship groups. Key partners for delivery of seminars and training workshops for practitioners, for example, are the Real Estate Foundation of British Columbia, the Urban Development Institute, the British Columbia Water & Waste Association, and APEGBC.

His work related to the UniverCity sustainable community at Simon Fraser University on Burnaby Mountain is featured in the book *Dancing with the Tiger: Learning Sustainability Step by Natural Step*, by Brian Nattrass and Mary Altomare.