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Coquitlam Green Development Guide

practices that are transforming our cities

Coquitlam

Acknowledgements

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This Guide was assembled by City of Coquitlam's Community Planning Division, in particular Erin Ferguson and Aleksandra Brzozowski.

Cover photo credit: Amanda Gilligan

INTRODUCTION

What is Green Development?

Green development practices are methods of building our communities in a manner that respects our natural environment. It recognizes that conventional development practices can negatively impact the natural ecosystems that we depend on but that by changing the way we develop our towns and cities we can lessen or eliminate ecosystem degradation and improve our quality of life.

Who is involved? Why is it important?

Some individuals and firms have been implementing environmentally responsible practices for over a decade or more; however, currently the green sector of the development industry is experiencing rapid growth. 'Green' development is making headlines in the media, development industry journals, and at all levels of government. Innovative firms have embraced principles of sustainable design, creating projects having a minimal impact on the environment. Municipalities have also encouraged expansion of the green sector through policies promoting green development practices. Recently the provincial government has demonstrated its commitment to creating sustainable communities through the development of a unified BC Green Building Code to be completed in early 2008, and the new Energy Plan which calls for improved energy efficiency for new and existing buildings. Targets for the new Energy Plan include all new detached homes having an enerGuide rating of at least 80, which translates into homes being approximately 36% more energy efficient than a standard home constructed today.

What is the Green Development Guide?

The Green Development Guide is intended to be an information and reference tool used by the development community and their consultants, City Council, and staff in the preparation, review, and consideration of development applications in Coquitlam. It provides an explanation of green development topics and highlights green development practices which are applicable to development conditions within Coquitlam. Material contained in the Green Development Guide can be used to facilitate discussions regarding sustainable development and as a potential resource for further study.

How does it work?

The Green Development Guide is a series of primers and case studies. Primers provide background material on the following topics: Green Building, Green Infrastructure, Open Space, Sustainable Transportation, and Sustainable Neighbourhoods. Each Primer is followed by a series of case studies related to that particular topic. As more case studies occur, they will be added to the Green Development Guide. The Further Resources section at the end of the guide provides additional information related to each topic.

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GREEN BUILDING PRIMER

Introduction

Building green offers an alternative to conventional practices, and seeks to achieve high performance buildings that lessen detrimental impacts to the natural environment, human health, and communities. Green building practices are applicable to both existing structures and new structures, and for all building types and uses.

Because options vary from relatively expensive to no additional cost, any project can be built greener. Canada's Green Building Council suggests that most green buildings can be achieved for a capital cost increase of 2.0% or less, depending on site conditions[1].

The following six-page overview outlines the key aspects of green building and essentials that should be considered when exploring green building possibilities.

Fundamentals

Common green building elements are **site planning, efficient use of energy, water and materials, indoor air quality, material selection,** and **building longevity.**

Photo Credit: Building Green, Inc.
White Rock Operations Centre

Green buildings can cut energy usage by over 30% & reduce water consumption by over 40% compared to standard buildings.

[1]Canada Green Building Council Report to Industry, 2005.
[2]Urban Land. March 2007, p. 27. "LEED Program Evaluates Homes"

Over half of the builders stated that buyers are willing to pay a premium of 11 to 25 % for green-built homes[2]

Successful green building projects...

- are typically driven by a multidisciplinary project team, educated and trained in green building practices
- clearly define a vision statement and project goals prior to construction
- assess building site characteristics
- adjust contracts to ensure builders uphold green building practices
- design and build flexibility to increase the building's lifespan
- choose materials with reduced lifecycle costs
- construct with minimum impact and waste
- create a green building brand and take advantage of marketing opportunities

Benefits

Green building practices offer economic, environmental, and social benefits. Realizing the full range of benefits requires looking at the building from many perspectives and at a longer time frame than conventional buildings; maximizing these benefits requires an integrated design approach and a commitment to green building goals and strategies early in the project.

Environmental

Green buildings benefit the environment in numerous ways:

- reducing green house gas emissions which contribute to climate change
- preserving the quantity and quality of our water resources by reducing consumption and managing stormwater
- conserving, restoring or creating wildlife habitat
- reducing amount of materials sent to landfill
- decreasing pollutant emissions from building materials
- selecting ecologically friendly building materials to protect forests, farmland and biodiversity
- minimizing light pollution and the heat island effect

Social

Green buildings also have positive impacts on health, community, and education.

- Low volatile organic compound (VOC) emitting materials reduce levels of harmful chemicals and carcinogens
- Natural hard surface flooring minimizes allergens and respiratory irritants
- Ventilation circulates fresh air and flushes out pollutants
- Schools report increased attendance, faster progress, higher math & reading test scores
- Building with local construction materials and hiring local firms contribute to local product development, and provides training and education opportunities

The top two desired features for first time-home buyers are energy efficiency and a healthy indoor environment.

Economic

Using resources wisely can generate substantial savings by:

- reducing waste disposal costs
- using recycled or salvaged materials
- reducing utility fees
- eliminating development cost charges if off-grid
- reducing infrastructure costs with clustered buildings
- decreasing building size and simplifying layout to reduce material and energy demands

Additional savings result from considering building longevity through:

- lifecycle costing of building and materials
- flexible building design reduces conversion costs
- techniques such as raised access floors & modular wiring that reduce office workspace reconfiguration costs

Utility fees can be minimized through:

- High quality building envelopes
- high energy efficiency appliances
- low-flow fixtures
- re-use of greywater
- naturalized landscaping

Improving indoor environmental quality, including air quality, translates into economic savings with:

- decreased absenteeism
- a 2-16% increase in employee productivity[2]
- increased employee retention through a less-toxic, more comfortable, & individually controlled environment
- reducing liability related to sick-building syndrome lawsuits

Additional economic benefits include

- increased property value
- rapid sales and lease-outs
- increased public exposure & free marketing
- improved public image
- increased retail sales by 40% in daylit stores[4]

[2]US Green Building Council
[3]Urban Land, "LEED Program Evaluates Homes", March 2007.
[4] Heschong Mahone Group, 2003 study cited in Morrison Hershfield, 2005, "A business case for green buildings in Canada" www.cagbc.org

Essential: ENERGY USE

Energy use is the central focus of most green building strategies and presents an opportunity for substantially reducing greenhouse gases. The most important step in lowering greenhouse gas emissions is reducing demand for electricity and other energy to heat and cool interior spaces.

Electricity consumption can be reduced through a number of green building strategies and options:

Optimizing natural daylight to reduce the need for lighting:

- » *consider solar exposure of site*
- » *install large south facing windows*
- » *create open foorplan with narrow building widths to allow sunlight penetration*
- » *site building around atria or place skylights to increase available daylight into inner spaces*

Energy efficient lighting:

- » *consider motion sensored lighting for parkades and other less used common spaces*
- » *replace incadescent bulbs with compact flourescents (CF use 75% less energy, last up to 8 times longer, and save up to $30/bulb)* [1]

Energy efficient appliances and electronics:

- » *use front loading washers, which use about 50% less energy than standard top-loading washers*[2]
- » *a 14 inch LED monitor can use 65-75% less energy than a 14 inch CRT monitor* [3]

In British Columbia, 46% [4] of home energy use is used for space heating. Certain strategies can minimize this use.

Orienting buildings:

- » *orient buildings along an east-west axis and installing large south facing windows can provide additional heat in the winter in northern climates.*
- » *provide window overhangs and planting large deciduous trees on southern facades will help cool the structure in the summer.*
- » *have small northern facing windows and planting conifers near the building envelope will help to insulate the structure in the winter.*

Using the highest quality, highest performance envelope within budget:

- » *provide improved insulation in walls, windows, and roofs*
- » *seal drafts with weather striping (in older homes air leakages account for 30-40% of heat loss)* [5]
- » *install windows with double E glazing which reduces the penetration of short wave solar heat from entering into a building and prevents long wave heat produced by interior heating from escaping out through the window.*

Building the smallest structure possible that will accommodate programming, as smaller spaces are easier to heat.

A reduced demand for energy may also offer the opportunity to employ systems for heat, hot water, and electricity that, while higher efficiency, can only produce a limited amount; this may include using renewable energy sources. Further efficiencies can be gained by clustering multiple buildings to share a single energy source with district heating systems.

Footnotes

[1] BC Hydro PowerSmart Tips & products
www.bchydro.com/powersmart/elibrary/elibrary679.html

[2] BC Hydro PowerSmart Tips "Shopping for energy efficient appliances"
www.bchydro.com/powersmart/elibrary/elibrary708.html
Natural Resources Canada, "Look for Energy Star"
www.oee.nrcan.gc.ca/energystar

[3] BC Hydro PowerSmart Tips "LCD Monitors"
www.bchydro.com/business/investigate/investigate30111.html

[4] Natural Resorces Canada, 2004 data.
www.oee.nrcan.gc.ca

[5] Ministry of Energy, Mines and Petroleum Resources
www.em.gov.bc.ca/AlternativeEnergy/EnergyEfficiency

Essential: WATER

Buildings are large consumers of potable water yet the use of potable water can be reduced by 40% using water conserving fixtures and appliances.

- Low flow showerheads use up to 60% less water than standard showerheads without increased costs
- A shut off button on the showerhead interrupts flow when it is not needed
- Aerators can be installed to provide the same pressure with less water
- Flow restrictors for faucets in the kitchen or hand sinks
- Sensors can be installed in public restrooms.
- Low-flush toilets use about 6L or less saving up to 70% over standard toilets
- Dual flush toilets allow the user to choose either a short 3L flush or a long 6L flush
- Composting toilets use minimal water or are waterless and transform organics into compost fertilizer
- Waterless urinals can be installed in public restrooms
- Installing water saving dishwashers and frontloading washing machines

Conserving hot water also has additional energy saving benefits as heating water is a large residential energy expense.

Collecting rainwater for toilet flushing and irrigation or reusing the greywater generated in the building can further reduce potable water consumption.

Rain water collection systems vary in complexity and cost. The simplest systems collect rainwater from roofs and use gravity to convey it into the barrel. Hoses connected to the barrel disperse the rain for landscape irrigation. More complex systems use cisterns, pumps and have flow controls. These systems often use rain water for flushing toilets as well as for irrigation purposes .

Not all roofs are suitable for collecting rainwater intended to irrigate food plants. Some roofing materials, namely redwood, cedar, treated wood shingles and shakes, and asphalt shakes, can contaminate the rain water by leaching toxins.

Rain water can be harvested from other impervious surfaces such as patios or pavement. The amount of rainwater a system is able to collect depends on the amount of rainfall, surface area of the collection surface, and the storage capacity of the collection system.

The reuse of greywater can also reduce potable water consumption. Greywater or wastewater from sinks, showers, and washing machines can be filtered through wetland vegetation and ponds to remove and breakdown pollutants. The water quality of greywater will depend on the previous use and treatment type. Like rain water, treated greywater can be used in irrigation or for toilet flushing but this decision needs to be made early as it effects landscaping design, size and placement of the buildings mechanical systems.

dual flush toilets can reduce water use by up to 68% in residential settings and 56% in office settings.

water saving dishwashers and front loading washing machines can also use up to 30 to 40% less water compared to standard models.

Water Conservation references:

Government of Canada Water Conservation Tips
www.on.ec.gc.ca

Natural Resources Canada
www.oee.nrcan.gc.ca

Composting toilets:
http://compostingtoilet.org

Essential: SITE PLANNING

Site planning is important for the conservation of resources, habitat, watersheds and biodiversity. Choosing a previously developed site in an area close to existing supporting uses can contain growth, re-use existing infrastructure, protect undeveloped lands, and reduce auto dependence. Infill sites can be brownfield or greyfield sites but are often residential sites redeveloped to greater densities. Building on brownfield or greyfield sites have an additional environmental benefit through the clean-up and remediation of existing on-site contamination.

Performing a site assessment may identify resources and techniques that can be incorporated into green building strategies:

Adjusting the location and size of the building footprint can:

- » *protect slope stability*
- » *provide shelter from prevailing winds*
- » *enhance thermal comfort*
- » *preserve important ecological habitat or protect rare species*

Siting the building along an east-west axis will help take advantage of passive solar opportunities to:

- » *improve energy efficiency*
- » *improve indoor environmental quality through daylighting*

Noting the directions of predominant winds can:

- » *orient structures to take advantage of natural ventilation and cooling opportunities*

Minimizing re-grading can:

- » *avoid vegetation, soil, and hydrological disturbance*

Reducing the amount of impervious surfaces such as roofs and asphalt can:

- » *reduce the amount of stormwater generated*
- » *minimize contribution to the heat island effect*

Municipal stormwater systems have been designed to collect and convey water away from a site as quickly and efficiently as possible before discharge into a local waterbody. This can cause:

- bank erosion
- siltation of the waterbody
- reduced baseflows through reduced infiltration
- degraded water quality from urban pollutants

Managing stormwater on-site can improve the health of the urban watershed and reduce consumption of potable water.

On-site stormwater management strategies are usually meant to **reduce stormwater volume and runoff rates**, and **improve water quality.**

Stormwater management is detailed in the green infrastructure section of this guide. An additional benefit of some green infrastructure practices is the reduction of potable water consumption. (Potable water reduction is discussed in the water section of this guide.)

Landscape practices specific to the local climate can drastically improve the sustainability of the site.

- landscaping with native plants can reduce potable water consumption as they are adapted to the local climate
- native plants can provide habitat for local wildlife species & increase biodiversity, (Naturescape BC is a program offering advice for creating backyard habitat patches)
- Lawn alternatives (naturescaping, xeriscaping, alternative groundcover, and food gardens) can reduce water use and green house gases emitted by lawn maintenance
- Preserving or planting trees can help insulate buildings (coniferous trees on northern side) or cool buildings (deciduous trees on southern side), remove air pollutants, intercept rainfall, provide windscreen, protect slope stability, and provide habitat

Essential: INDOOR AIR QUALITY

Indoor air quality can have significant impacts on health. Green building techniques improve indoor air quality by:

Using finishing products with reduced levels of harmful chemicals such as volatile organic compounds (VOC)

- » *VOCs are off-gassed from many building products (plywood, particle board, glues, certain textiles, cleaner, foam insulation)*
- » *Off-gassing VOCs can cause respiratory irritations, headaches, nausea, skin problems & some forms of cancer*

Eliminating carpets in favour of hard surfaces

- » *eliminates or reduces a VOC source*
- » *reduces dust, dander, & mold spores which are allergens and can trigger asthma*
- » *eliminates absorbtion and trapping of pollutants brought in from outside or released from other products such as paint*
- » *in addition to the carpets, underlay, adhesives, and sealants may also contain and release known toxins*

Using natural fibre carpets instead of synthetics:

- » *eliminates the off-gassing of pollutants found in the carpet fibres themselves but it has been suggested that wool fibres may absorb more irritants and pollutants than synthetics.*

Preventing mold growth by development of a moisture control program

Using natural non-toxic janitorial products or providing residential units with green cleaning products

Keeping ducts clean of debris during construction

Indoor Air Quality References

Resource Guide for Sustainable Development
www.vulcanrealestate.com/content/docs/Resource GuideForSustainableDevelopment.pdf

Building Green-Carpeting, Indoor Air Quality and the Environment
www.buildinggreen.com

Agrium Building, Vancouver

While eliminating the source of harmful pollutants is the most important way to provide good indoor air quality, ventilation is also a key consideration. Inadequate ventilation contributes to poor indoor air quality as:

- it allows irritants and harmful substances to accumulate causing discomfort, illness and decreased productivity
- improperly maintained ventilation systems can produce & disperse air pollutants

Green building techniques reduce ventilation problems by utilizing natural ventilation whenever possible and better ventilation system design. There are two main natural ventilation processes: cross ventilation and stack ventilation. Cross-ventilation uses low and high pressure zones created by wind to draw air through a building while stack ventilation uses high and low pressure zones created by rising heat.

Natural ventilation can be achieved with vents, and operable windows and skylights. In addition to energy saved from not having a mechanized ventilation system, natural ventilation can lower cooling costs, and eliminate fan noise. If mechanized ventilation systems are used, they can be tied directly into carbon dioxide sensors to ensure an adequate supply of fresh air is reaching all areas of a room.

Canadians spend on average 90% of their time indoors

Essential: MATERIALS & WASTE

Building and construction practices represent 40% of the world's total raw materials consumption each year[1]. Significant environmental impacts are generated during extraction, processing, transportation, and disposal. Green building processes take all of these impacts into consideration in choosing materials. Reuse of existing structures, using salvaged materials, integrating materials with recycled content, and using sustainably harvested bio-based materials all offer more environmentally responsible choices.

Reusing the original building is best way to minimize environmental impacts as fewer new materials are required and fewer used materials are sent to landfill. Another option is the use of salvaged materials from other buildings. This also reduces the volume of materials sent to landfill, the amount of raw materials consumed, and the amount of energy used in processing however environmental impacts are incurred from transportation. Integrating recycled content also reduces raw material consumption.

The sustainable use of new materials selects natural, rapidly renewable, and sustainably harvested materials. Generally natural products such as cork, stone, marmoleum, wool, wood and bamboo are more environmentally favourable than synthetics because of reduced processing. Plant-based materials are often preferred over synthetics as they tend to undergo less intensive manufacturing than petroleum based materials in addition to having a much higher renewal rate. Some products, such as wood, have third party certification processes available.

Another consideration in choosing materials is transportation costs. Building materials are often shipped from across North America and even worldwide. This consumes a substantial amount of energy. Utilizing and developing local material sources lessens transportation impacts and supports the local economy.

[1] Roodman and Lenssen, Worldwatch Institute Paper 124, 1995.

Concrete is the most consumed substance in the world after water. The main ingredient is cement and producing 1 tonne of cement produces 0.9 tonnes of Co^2 emissions and accounts for 7 to 8% of Co^2 emissions globally. Replacing cement with industrial by-products such as flyash or blast-furnace slag can significantly reduce greenhouse gas emissions.

Embodied energy and life-cycle costing are two measures used to compare green building products. Embodied energy is the amount of energy consumed in producing a material and is used to compare green building products. Life-cycle costing keeps track of all of the inputs, such as resources and materials consumed, and the outputs, such as the pollution generated throughout the life of the product from processing to disposal. Products with smaller life-cycle costs represent more sustainable choices.

Building and construction practices generate a lot of waste, much of which ends up in landfills. Careful management of materials can divert up to 90% of construction wastes away from landfills by keeping standard construction material dimensions in mind in determining building size and shape, reusing materials on-site, or separating wastes on-site for off-site reuse or recycling.

Choosing the most environmentally friendly materials can be challenging with many products available and new products continuing to appear. Three resources to assist in selecting materials are the GVRD Best Practices Guide Material Choices for Sustainable Design, the emerging Pharos evaluation tool, and the Government of Canada's EcoLogo program.

Green Materials references

GVRD Best Practices Guide Material Choices for Sustainable Design
www.gvrd.bc.ca/buildsmart

Building Materials Backgrounder
www.greenerbuildings.com

American Institute of Architects – Differences in Environmentally Preferable Products
www.aia.org

EcoSmart Concrete
www.ec.gc.ca

EcoLogo
www.environmentalchoice.com

Pharos Project
www.pharosproject.net

RATING SYSTEMS

Many rating systems are available to provide green building guidelines and to establish a benchmark for what constitutes a green or sustainable building. Each rating system provides a different interpretation of green buildings but all go above and beyond current building codes in terms of energy efficiency. Most rating systems also incorporate principles and criteria guiding design and building practices in four other key areas: site planning, water, materials and waste, and indoor environmental quality. Using a rating system sets a recognizable standard for the structure and provides a marketing tool that can create further demand for green buildings.

LEED Canada-NC 1.0

Leadership in Energy and Environmental Design, LEED, is the most widely recognized rating system and was first launched by the US Green Building Council in 1998. There are several different LEED rating systems currently available or in the pilot phase which apply to different project types. LEED Canada-NC 1.0 has been adapted from the US Green Building Council's LEED-NC 2.1 and is produced by the Canadian Green Building Council (CaGBC) with the goal of improving occupant well-being, environmental performance and economic returns. LEED Canada-NC 1.0 provides a benchmark for high performance buildings specific to the Canadian climate, regulations and standards and it is applicable to all new construction or major renovation of commercial, institutional and high rise residential buildings.

The LEED Canada-NC 1.0 rating system is comprised of 7 prerequisites and 35 credits in six categories:

- sustainable sites
- water efficiency
- energy and atmosphere
- indoor environmental quality
- materials and resources
- innovation and design process

Prerequisites must be met by every project and have no point value whereas credits are met voluntarily in exchange for points. The total number of points earned by a project determines the overall project rating. Ratings (listed from lowest to highest) are Certified, Silver, Gold, Platinum. In order to gain certification, LEED rating systems require a checklist and extensive documentation demonstrating how the prerequisites and credits have been met, and each project undergoes third party verification. Certification for a project ranges from $3,500 to $16,500. LEED rated projects are led by architects, planners, and engineers, and an additional point is earned if the project team has a LEED accredited professional.

Presently there are 66 LEED certified projects in Canada and BC is home to over a third. Most of LEED certified projects are office buildings with only 2 high-rise and 1 low-rise residential building certified. Other certified building types include industrial, mixed-use, retail, and schools. Certified projects are predominantly owned by commerical owners or municipalities. LEED is rapidly expanding in Canada with membership growing by 10% each month and over 476 registered projects. There are about 85 registered projects within Metro Vancouver, two of which are in Coquitlam.

LEED-H

LEED for Homes is a new rating system developed by USGBC specifically for new single detached and low-rise multi-family dwellings. It is currently still in the pilot phase. The pilot program is scheduled to finish in Fall 2007 with the official program launch at that time. LEED-H has 8 evaluation categories:

- innovation & design process
- location and linkages
- sustainable sites
- water efficiency
- energy and atmosphere
- materials and resources
- indoor environmental quality
- awareness and education

There are a total of 18 prerequisites which must be met as well as 61 voluntary credits with point values. Like other LEED rating systems there are 4 levels of certification: certified, silver, gold, and platinum. Quality assurance is provided by third party verification in the form of Raters and the LEED for Homes Provider. Currently the cost for registration is about $500-$3000 per structure.

Built Green BC

Built Green BC is a program run by the BC Canadian Home Builders Association to promote buildings that are healthier for occupants and the environment. It is a member of the Built Green Society of Canada which manages the Built Green program. The Built Green program, launched in October 2003, is described below:

- builder driven
- applicable to all new houses and low-rise multi-family buildings
- pilot program for Built Green™ Multi-Storey and Residential Tower was launched in October 2006
- has checklist with two components: EnerGuide for new houses rating & a points system for the seven other checklist categories
- categories contain numerous options to earn points
- a minimum number of points must be achieved for each category
- together the EnerGuide rating & the cumulative points determine the Built Green rating
  - » Bronze (Energuide 72, Cumulative points 75)
  - » Silver (Energuide 75, Cumulative points 80)
  - » Gold (Energuide 77, Cumulative points 85)
- project must be built by a Built Green certified builder & undergo a blower door test prior to occupancy
- 5% of projects are randomly audited for verification & checklist items and points must be provided upon audit
- cost is about $200 per building
- builders must complete $350 training and pay annual membership fee of $250

The seven cumulative point categories are:

- operational systems
- building materials
- exterior & interior finishes
- indoor air quality
- waste management
- water conservation
- business practices

Currently there are 4638 homes in Canada in the Built Green program and 388 in BC, 230 of these are enrolled by builders located within Metro Vancouver.

Photo credit: Morningstar Homes Ltd.

R-2000

R-2000 is a standard for residential buildings managed by Natural Resources Canada Office of Energy Efficiency in partnership with the Canadian Home Builders Association. The goal is to promote the energy efficiency and reduction of greenhouse gas emissions of Canada's new housing stock through an industry led, market-driven, leading edge housing standard presented as a cooperative partnership of the private and public sectors.

- initiated in 1981
- expanded from an energy efficiency initiative to include water efficiency, resource conservation, and indoor environmental air quality
- several components:
  - 2000 standard
  - Quality assurance process
  - R-2000 home certification
  - training and licensing for builders
- all homes are built by professionals who have undergone the training.
- certification cost is similar to a Built Green home
- training & licensing costs for builders
- quality assurance process has plans evaluator & R-2000 inspector to verify the structure
- building undergoes air leakage test to confirm that it meets the energy efficiency envelope standards

Generally R-2000 homes are at least 30% more energy efficient than conventional new homes, and all R-2000 homes must have a whole-house ventilation system and water efficient fixtures in addition to other green building options.

Living Building

The Living Building rating system is under development by Cascadia Region Green Building Council. The intent of the rating system is to push green building further to create structures which:

- incorporate the eco-region's characteristics
- generate all of its own energy through renewable resources
- utilize only water captured on-site and treats all water on-site
- uses resources efficiently
- designs for beauty

The Living Building rating system:

- performance based
- has 16 prerequisites and no credits
- applies to all existing and new buildings regardless of type or use

It is very challenging to obtain and no single current structure has met all 16 prerequisites; however, each of the prerequisites have been achieved in other projects around the world. The prerequisites fall into 6 categories:

- site design
- energy
- materials
- water
- indoor environmental quality
- beauty and inspiration

The ease of achieving the standard varies according to factors such as climate and building type. Certification as a living building can only be achieved if all the prerequisites have been met and the building has operated for at least one year. The Cascadia Region Green Building Council envisions the Living Building standard to fit within the LEED system either as an automatic Platinum rating, or be the rating above platinum.

Go Green

The objective of Go Green is to help create healthier workplaces and lead sustainable building development and management practices. Go Green is a national standard for the operation and maintenance of existing commercial buildings in an environmentally conscious manner. The program was brought to Canada in 1996 aand has continued to evolve into Green Globes for existing buildings which was adopted by the Building Owners and Manufacturers Association of Canada in 2004.

The program has since emerged into Go Green and Go Green Plus.

- It is an industry developed best practices model
- It is relevant to all aspects of building operation and maintenance including:
  - resource consumption
  - waste reduction and recycling,
  - building materials
  - interior environment,
  - tenant awareness.
- There are 10 prerequisites within these 5 categories that must be met to obtain certification
- Certification is open to all occupied commercial building owners regardless of their participation in BOMA
- Certification requirements include:
  - Go Green Application and Declaration Form
  - submit the application fees
  - compiance with all of the stated prerequisites

Go Green Plus provides an even higher standard with more detail and scoring reports stating how the building is performing. Go Green Plus measures each building's environmental performance by comparing it to the best industry operations and maintenance practices. Requirements of Go Green Plus apply to:

- energy
- water
- resources
- emissions
- effluent and other impacts
- indoor environmental quality
- environmental management.

Rating Systems References

Canada Green Building Council - LEED and other Building Ratings Systems
www.cagbc.org

BC Canadian Homebuilders Association
www.chbabc.org

Built Green website
www.builtgreencanada.ca

R-2000 Program
http://r2000.chba.ca

Office of Energy Efficiency
http://oee.nrcan.gc.ca

The Living Building Challenge
www.cascadiagbc.org

BOMA Canada Go Green Program
www.bomagogreen.com

RENEWABLE ENERGY TABLE

Source	Applicability	Advantages	Disadvantages	Cost	Output
Wind	• small -scale on-site solution • large-scale offsite windfarm, sometimes available to purchaser through green power utility program	• can be stand alone • can sell extra energy to grid in some circumstances • BC has potential to produce a lot of wind energy	• some of the best locations in terms of wind supply are remote, heavily vegetated and mountainous therefore less suitable for development	• 6 - 12 cents per kWh for strong steady wind	• small scale 30W to 30 kW • depends on wind velocity
Microhydro	site with year round flow and necessary elevation change	• constant predictable cost-effective • produces 10-100 times the power of solar or wind for equal capital investment	• very site specific • may require more maintanance than other renewable sources	• average cost $5000 for system • less expensive than solar or wind	• Microhydro 2 MW • larger run of river 20 MW • depends on water flow rate and elevation change
Ground Source Heating	installed throughout BC in projects of varying size and type	• EPA & Natural Resources Canada consider it one of the most energy-efficient, environmentally clean, cost-effective space conditioning systems available • wide applicability • reduces heating/cooling costs by 30% to 80% per year • requires less maintenance than other renewable energy technologies • maintenance is relatively easy	• heating/cooling system only	• for average 2000 sq. ft home $6, 250 (2004) • costs vary with lot size & configuration and heating/ cooling demands of project	unknown
Solar	numerous types of developments and uses, but currently used largely for demonstration purposes or visibility of technology	• versatile with many different types of collectors for different uses (heating water, space heating,electricity, etc) and climates • modular so you can start small and easily expand • requires little maintenance • 40 year life expectancy • easily identifiable to public	• higher embodied energy than other renewable energy technologies • more expensive than other technologies	• $6 to $8 per watt (2004) • average domestic solar hot water system is $5,523	• 200 - 240 kWh/m2
Biomass	widely applicable	• versatile • readily available in some areas • reduces waste sent to landfill • can utilize landfill gas • many different technologies and processes	• suppy can be remote in some urban areas • transportation can be expensive and emit green house gases • potential for particulate emissions if improper installation or poor technology used	• 5 cents per kWh	• varies substantially
Tidal	still emerging technology no commercial operations in Canada, site specific requires ocean current	• huge energy potential in BC (27000 GWh/yr) • very predictable, constant energy supply	• site specific • could potentially interfere with marine life and transportation	• currently costs estimated at 11 - 25 cents per kWh • expected to fall to 5 - 7 cents per kWh	• varies hundreds of kWs to hundreds of MWs • depends on geography narrow & shallow is best
Sewage Heat Recovery	widely applicable	• local solution	• heating only & still requires additional energy source	unknown	unknown

Sources for Renewable Energy Table

BC Sustainable Energy Association *www.bcsea.org/sustainableenergy*
Canadian Wind Energy Association *www.canwea.ca*
Energy Alternatives Ltd. *www.energyalternatives.ca*
BC Hydro's Handbook for Developing Micro Hydro in BC
Natural Resources Canada, "Ground Source Heat Pumps" *www.oee.nrcan.gc.ca*
The Canadian GeoExchange Coalition *www.geo-exchange.ca*
Natural Resources Canada, Shadow Ridge Example *www.canren.gc.ca*
The Canadian Solar Industries Association *www.cansia.ca*
Solar Energy Society of Canada Inc. *www.sesci.ca*
BCIT Applied Research Team *www.bcit.ca/appliedresearch/pv*
Natural Resources Canada, Solar Collectors *www.canren.gc.ca/solar/index.asp*
Centre for Energy *www.centreforenergy.com*
SouthEast False Creek, Sewage Heat Recovery *http://vancouver.ca/sustainability*
Blue Energy *www.bluenergy.com*
World Energy Council *www.worldenergy.org/documents/ser2004.pdf*

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The Silva
North Vancouver

THE SILVA PROJECT OVERVIEW

- located in the Lonsdale area of North Vancouver
- 16 storey, 67 unit residential high-rise atop a 2 storey podium with 4800 sq. ft. of retail space
- the first LEED-Certified high-rise in Canada, certified in October 2005
- impetus to build with green features arose in the rezoning process
- cost increase of adopting & documenting green building practices is estimated at 1%

ENVIRONMENTAL PERFORMANCE

- $16,000 savings in energy per year
- 14% more energy efficient
- 40% reduction in water consumption
- 83% of waste recycled or reused & 57% materials manufactured in this region
- 27% reduction in stormwater flow rate & quantity

Photo Credit: City of North Vancouver Website

SITE

The site incorporates sustainable design principles through location and site design.

- built upon a previously developed site
- good access to public transit & local amenities
- FSR was increased from 2.6 to 4.7 through density transfers from surrounding sites
- provision of bike storage facilities
- 50% of the parking is underground to minimize heat island effect
- light pollution is minimized through the use of downlighting on exterior features at no additional capital cost
- 4100 sq. ft. green roof vegetated with drought resistant plants to absorb and store stormwater (35% of roof surface)

These features have improved the sustainability of the site. Previously the site was entirely impervious with stormwater collected & discharged into nearby Mosquito Creek. Improved site design and stormwater management has resulted in a 27% reduction in stormwater volume.

WATER

The following features helped to reduce water usage by 40% when compared to conventionally built residential high-rise buildings in post occupancy evaluation:

- Dual flush toilets (average 4.3 L flush)
- Low flow bathroom faucets (1.9 L/min)
- Ultra low flow showerhead (5.6 L/min)
- Front loading washing machines
- Water efficient dishwashers
- No outdoor irrigation, drought tolerant plants used in landscaping

The water efficient bathroom fixtures were estimated to add an additional cost of $100 per suite and contributed to a 30% reduction in hot water use.

ENERGY

The Silva energy efficiency strategies resulted in about a 14% reduction in energy consumption by implementing:

- Low E glazing for all windows
- Low flow water fixtures to reduce hot water demand
- Daylighting
- Operable windows
- EnergyStar appliances
- Occupancy sensors for parkade and common areas
- Lower lighting levels in common areas
- Demand ventilation in retail areas
- Heat rated gas fireplaces

These features have resulted in over $16,000 in energy savings per year, and it is expected that the payback period will be about 5 years.

MATERIALS AND WASTE

The Silva project team either recycled or reused 83% of the waste generated in the demolition, development and construction processes.

- asphalt and concrete from the existing development were broken apart and reprocessed
- glue-lam beams & excavation material were re-used in other projects
- recycling was done at little or no additional cost & was easy to achieve in the lower mainland because of the availability of waste hauling services and recycling facilities for most materials

A significant amount of the material used in constructing the Silva came from local sources:

- 25% of materials were locally harvested or extracted
- 57% of materials were manufactured regionally
- incorporated recycled materials
- parkade concrete had high volumes of flyash and flyash was also incorporated into tower slabs

The strategy utilized to achieve the specified amount of recycled materials was to identify high cost and high volume material and try to add recycled content into these materials.

INDOOR ENVIRONMENTAL QUALITY

A high quality indoor environment was achieved through:

- daylighting and views (easy to achieve with this project)
- low VOC finishing materials such as paints, adhesives, and sealants
- finishing materials met the requirement of the Carpet & Rug Institute's Green Label and the US Green Seal

Meeting the requirements for the adhesives and sealants was challenging as it involved onsite management of sub contractors to ensure that the proper products were used.

PROJECT TEAM

DEVELOPER: West Coast Projects Ltd.

ARCHITECT: Perkins & Company

STRUCTURAL: John Bryson and Partners

MECHANICAL: VEL Engineering

ELECTRICAL: Arnold Nemetz & Associates

LANDSCAPE ARCHITECT: Eckford & Associates

CONSTRUCTION MANAGEMENT: Marcon

GREEN BUILDING CONSULTANT: reSource Rethinking Building

REFERENCES

Canada Green Building Council
www.cagbc.org

reSource: A Case Study of the Application of LEED BC to a highrise residential development
www.gvrd.bc.ca/buildsmart/pdfs/silvacasestudyresourcerethink.pdf

BENEFITS

There are three primary benefits in constructing the Silva according to LEED standards.

- the incorporation of green building features generated a differentiated building project in the market
- speed and ease of the rezoning and approvals process (obtaining the necessary density transfers went smoothly because of the support of City staff and officials)
- media exposure and free promotion of the project

40% of suites are designed to be adapted to wheelchair users

CHALLENGES

The Silva was the first high-rise residential building to apply the LEED standard in Canada and faced several challenges.

- using standards that were targeted towards commercial buildings presented difficulties
- hard to acquire green building materials such as composite doors and engineered flooring that did not contain urea formaldehyde
- the steep learning curve for the project team was one of the most significant challenges
- lack of experienced modelers for residential energy

LESSONS LEARNED

- having an integrated design process is fundamental in the green building process in order to acheive desired objectives
- the green building consultants joined the project team late in the design process resulting in lost opportunities for energy savings as it was too late to make changes
- green buildings present an opportunity to address local issues; In North Vancouver this was potable water consumption and stormwater management
- green features are appealing to buyers and should be included in marketing packages

Cranberry Commons
Burnaby

Cranberry Commons is a cohousing development in The Heights neighbourhood of Burnaby. Sustainability is reflected in construction practices, design, and the lifestyle and actions of current residents.

- 22 strata titled private homes
- One-level apartments to three-storey townhouses (500 to 1300 square feet)
- Project began in 1998, construction started in 2000, residents moved into homes in 2001
- Cohousing form facilitates a strong sense of community and collaboration
- Received City of Burnaby 2002 Environmental Development Award
- Received honourable mention for the Fraser Basin Council's 2002 Sustainability Award

Photo Credit: CDC Cohousing Development Consultanting

Photo Credit: Cranberry Commons Cohousing

SITE

The site was chosen because of its location near Hastings Street, a busy commercial street with many local amenities. Hastings is also a major public transportation corridor.

- approximately 0.5 acres
- 26,662 square feet (3400 sq ft. common space)
- units are arranged around a courtyard containing a community garden & children's play space
- 38 underground parking stalls, 30% remain vacant as many residents share cares or choose other methods of transportation
- common areas reduce consumption as residents often share appliances, tools, & sports equipment

The common house includes:

- kitchen & dining area
- children's area
- reading room
- lounge
- meeting room
- laundry room
- workroom
- guest room
- storage space
- rooftop deck

WATER

Water conservation features include:

- low flow shower heads
- low flush toilets
- rain barrels for irrigation
- landscaped using native plants

ENERGY

Cranberry Commons has reduced the amount of energy used in heating, lighting, and transportation. Highlights include:

- commissioned control system for central boilers
- radiant infloor heating
- 18 solar collectors on roof offset energy required to heat water by 50%
- compact fluorescent lighting outside and halogen inside resulting in savings of $1000/yr
- 50% fewer vehicle trips per household compared to similar buildings in the area
- Over $3,500/yr in energy savings

All suites are equipped to faciiliate live/work arrangements and share a LAN and high speed internet connection for telecommuting.

MATERIALS AND WASTE

Construction materials were sorted on-site (cardboard, clean dimensioned timber, palette wood, concrete, scrap metal, drywall and paint) and then recycled as mandated in the construction contract.

Waste generated from building occupancy is minimized through:

- community composting & recycling bins
- reduced consumption through the sharing of goods

Materials were chosen for recycled content and durability:

- parkade concrete has a high fly ash content
- about 10% of the wood was reclaimed timber including wood joists, studs, and hardwood flooring
- Long life asphalt shingles extend the replacement period from 25 years to 40 years
- very high quality rainscreen technology was installed

INDOOR ENVIRONMENTAL QUALITY

- low VOC paints

BENEFITS

- City of Burnaby relaxed zoning requirements to allow flexibility in the design of the building and setbacks
- cohousing encourages greater social interconnectedness facilitating resource sharing
- cohousing can be more innovative because end users are active in the design process
- residents are knowledgable of the green features and have an active interest in the operation and maintenance of the development
- funding opportunities under Canada's Renewable Energy Development Initiative, and BC's Renewable Energy Technology grants
- Re-sales about 15 - 20% above market for similar sized units

CHALLENGES

- Townhouse zoning includes circulation space in FSR therefore required FSR relaxation to accommodate common space and elevator space to reach third floor apartments
- cohousing tends to be more expensive than conventional development
- cost was a barrier to the incorporation of more green features
- underground parking is expensive and project was required to provide more parking than is needed
- it took more than a year after installation to receive approved grant money
- difficult to get a good supply of reclaimed wood and on-site nail removal was expensive

PROJECT TEAM

OWNER/DEVELOPER: Cranberry Commons Cohousing Development Corporation

ARCHITECT: Birmingham & Wood

STRUCTURAL ENGINEER: Chiu Sandys Wunsch Engineering

MECHANICAL: Keen Engineering

ELECTRICAL: Falcon Engineering

CIVIL ENGINEER: Reid Crowther & Partners Ltd.

PROJECT MANAGER: CDC Cohousing Development Consulting

LANDSCAPE ARCHITECT: Vagelatus Associates

CONTRACTOR: Artian Construction

SOLAR SYSTEMS: Taylor Munro Energy Systems Inc.

BUILDING ENVELOPE: Aqua-Thermal Consultant Ltd.

SUSTAINABILITY CONSULTANTS: ReSource Rethinking Building

REFERENCES

Cranberry Commons Website
/www.cranberrycommons.ca/
CDC Cohousing Development Consulting
www.gvrd.bc.ca/sustainability/casestudies/cranberry.htm

LESSONS LEARNED

- intensive planning process prior to construction paid off in being able to implement green features and the satisfaction of the residents
- solar panels provide a very visible and identifiable green feature
- understanding of sustainability among professionals was limited
- more information on green building needs to be available

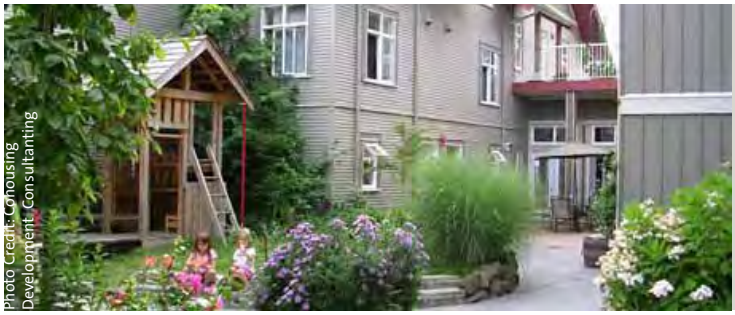


Photo Credit: Cohousing Development Consultanting

ENVIRONMENTAL PERFORMANCE

* over $3,500/yr in energy savings
* 30% of parking stalls remain vacant
* $1000/yr saved in lighting costs
* 50% fewer vehicle trips per household

PROJECT COST: $5,317,750 ($239 per sq. ft.)

Koo's Corner
Vancouver

PROJECT OVERVIEW

- six unit infill housing project (720 - 1170 sq. ft.)
- located in the Strathcona neighbourhood (mix of single-family & multi-family housing, businesses, and industries)
- named after Koo's Auto Service, the original building & neighbourhood landmark
- garage moved to the northern portion of the site and converted into two loft style townhomes
- three additional new 3-storey townhouses were built on the southern portion of the site & a smaller new 2- storey townhouse bridges the garage and 3-storey units
- developed over two years by Chesterman Property Group Inc. & was completed in August 2002


Photo Source: CMHC


Photo Source: CMHC

SITE

The site is an infill property previously used as a garage. The Developer reused the existing structure because of the building's history and environmental advantages. Details of the site are listed below:

- 6,100 sq. ft. corner lot in the Strathcona neighbourhood
- buildings cover 63% of the site so greenspace is maximized by front porches, patios and roof top decks
- FSR for the site is 0.95

The site design incorporates the following green building features:

- remediation of site contamination
- permeable GrassPave system replaces asphalt on some driveways
- fencing made from recycled telephone & hydro poles
- pavers instead of concrete or asphalt for walkways

ENERGY

Energy-efficient measure include:

- large windows & skylights
- low-E glazing on windows
- stack ventilation through high operable windows and/or mechanical fans
- GFX device in one of the units captures heat from the shower drain water to preheat incoming water
- solar hot water heater in another unit
- solar hot water ready pre-plumbing in all units
- compact fluorescent bulbs & fixtures
- heat recovery ventilators in 3-storey townhomes
- insulation far exceeding code requirements

WATER

Water conservation features include:

- a dual flush toilet installed in one unit
- EnergyStar dishwashers
- water-efficient front loading washing machines
- rain barrels for irrigation
- drought-resistant vegetation

Environmental sustainability & healthy indoor environments were key considerations for all of the buyers.

MATERIALS AND WASTE

Reuse of materials began with the conversion of the garage structure and continued with:

- reclaimed Douglas Fir flooring supplied by Vancouver Timber
- kitchen cabinet doors made with old beams from the Steveston Cannery
- over 50% framing wood was used in previous buildings
- insulation has 60-80% recycled content (highest available at that time)
- composite cement and wood waste exterior cladding (50 year warranty)
- bathroom tiles made from recycled porcelain
- compost bin under each kitchen sink & shared compost bin
- poured concrete with 50% flash

INDOOR ENVIRONMENTAL QUALITY

- Lifemaster 2000 paints to reduce off-gassing
- Carpet was minimized and used Green Label carpet
- kitchen cabinets made from fibreboard and have no urea formaldehyde

Photo Source: CMHC

BENEFITS

- all units sold prior to and during construction before formal marketing was needed
- potential additional costs of some green features were reduced by future proofing the development (pre-plumbing for solar hot water)
- installing pilot features allowed developer to monitor sucess and rate satisfaction before incorporating into future projects
- developer and consultant ensured green features were very visible or saleable & benefited more than one purpose
- bringing community on-side

CHALLENGES

- vocal and skeptical local community
- a very tight site
- complex zoning and approvals process
- detailed city design requirements
- site contamination

COMMUNITY CONSULTATION

Prior to making a formal application to the City, the developer delivered plans to all neighbours. In response to residents' concerns, a large bay window was added to the side facing Keefer Street, curb cuts were minimized, and Grass Pave was used to provide a continuous green strip. Seeking resident input in the initial stages aided in the approvals process.

PROJECT TEAM

DEVELOPER: Chesterman Property Group Inc.

ARCHITECT: Hotson Bakker Boniface Haden Architects

STRUCTURAL: Read Jones Christoffersen Ltd

ENVELOPE SPECIALIST: SEL Engineering

LANDSCAPE: Wave Design and Claire Kennedy

CIVIL ENGINEER: Reid Crowther & Partners Ltd.

CONTRACTOR: Timberland Homes

LANDSCAPE ARCHITECT: Vagelatus Associates

GREEN BUILDING CONSULTANT: reSource Rethinking Building Inc.

REFERENCES

CMHC Innovative Buildings - Koo's Corner
www.cmhc.ca/en/inpr/bude/himu/inbu/loader.cfm?url=/commonspot/security/getfile.cfm&PageID=58803

CMHC Residential Intensification Case Study - Koo's Corner
www.sustainablebuildingcentre.com/sites/default/files/Koo-s-Corner-Vancouver-B-C.pdf

Design Centre for Sustainability at UBC. *Greater Vancouver Green Guide, 2006*.

LESSONS LEARNED

- Begin with a strong vision and articulate it to all stakeholders
- Be proactive & open to addressing community concerns
- Spend time researching locally-available & cost-effective green materials
- Incorporate green design features that do not add significant costs

PROJECT COST: $1, 430,000 ($247 / sq. ft.)
TOTAL GREEN FEATURES: $33,000 OR 2.3%
GREEN FEATURE COSTS:

* Heat Recovery Ventilators ($3,200/unit)
* Healthy and sustainable kitchen materials ($6,000)
* Solar Heater ($4,000)
* Siding, concrete, insulation, bathroom tile, reclaimed wood floors (no added cost)
* Reclaimed framing wood, fence poles (savings)

Photo Source: CMHC

Lakeside at Yorkson
Langley

Lakeside at Yorkson is part of the first Built Green community in Canada. Environmentally responsible features are included at both the house and neighbourhood level.

- Located in Langley's Willoughby community
- 35 single family homes all constructed to Built Green™ Gold standards.
- Neighbohood features include retention ponds, salmon habitat restoration, and street trees.
- Completed and sold in 2007.
- Canadian Home Builders Association of BC awarded the 2006 Georgie for Built Green BC Builder of the Year to Morningstar Homes Ltd, in recognition of Yorkson homes


Photo Credit: Morningstar Homes Ltd.


Photo Credit: Morningstar Homes Ltd.

SITE

Lakeside at Yorkson is part of a new urban neighbourhood in the Yorkson Creek watershed. Green site features include:

- a neighbourhood that will support a variety of housing types, greenspace, and local commercial activity
- a series of detention ponds to regulate & filter stormwater runoff
- detention ponds create a wetland area providing habitat for many wildlife species
- salmon habitat enhancements to local watercourse
- releasing salmon fry into enhanced channel
- re-establishing streamside vegetation

WATER

Water consumption was reduced both indoors and outdoors using:

- low flush toilets (6 L flush)
- EnergyStar washing machines (optional) which use up to 50% less water than conventional washers[1]
- landscaping with drought tolerant plants and native species
- provision of a list of drought tolerant plant species, water requirements, and local municipality water useage guide to each home owner

[1] Office of Energy Efficiency, Natural Resources Canada. *http://oee.nrcan.gc.ca*

ENERGY

Energy conservation measure include:

- low E glazing for all windows
- high-efficiency, sealed combustion furnace (6-19% more efficient than standard units)[1]
- power vented hot water system (thermal efficiency 75-80% vs. typical hot water heater 50 - 55%)[1]
- enhanced insulation, R12 basement, R19.6 exterior walls, non-HCFC expandable foam sealant around openings
- EnergyStar appliances use 15% - 50% less energy than standard appliances[1]
- 25% of all lighting fixtures are EnergyStar fixtures with CFL bulbs

INDOOR ENVIRONMENTAL QUALITY

Creating a good quality indoor environment is a key consideration for BuiltGreen homes. This project implemented the following practices and features to improve IEQ:

- moisture resistant insulation
- formaldehyde not used during insulation process, negligable off-gassing
- pre-finished, low VOC laminate flooring
- Low-VOC, IAQ certified carpet, and underlay
- Low-VOC vinyl adhesives
- water based low-VOC paint

Photo Credit: Morningstar Homes Ltd.

MATERIALS

Durability

- low maintenace deck surfacing (no refinishing for min. 5 years)
- low maintenance roof - 30 yr warranty
- PVD finish on all hardware and faucets

Recycled Content

- Gypsum wallboard with minimum 15% recycled content
- Roofing material has at least 25% recycled content
- Insulation has minimum 40% recycled content
- carpet pad made from textile, carpet cushion or tire waste

Environmental Impact

- reduced wood use through use of engineered products, eliminating header at non-bearing walls,using finger-jointed studs made from lumber cutoffs
- all wood utilized for framing and decks was third-party certified as sustainable harvest
- Non-HCFC insulating foam
- construction products manufactured within 800km

PROJECT TEAM

BUILDER:
Morningstar Homes Ltd.

REFERENCES

MORNINGSTAR - Lakeside at Yorkson Information Packet
www.morningstarhomes.bc.ca

BC Homes Magazine.
Morningstar homes leeding the country with Built Green™ BC.
www.chbabc.org/uploads/files/summer_06_web.pdf

WASTE

Construction waste reduced by:

- using DURAFORM re-usable forms for concrete foundation
- comprehensive recycling program
- reusable bracing for framing

Kitchen and yard waste reduced by:

- supplying earth machine composter for each home

BENEFITS

- Most building materials are readily available
- Built Green standard is builder driven & accessible to all builders
- Greater satisfaction in building with environmentally responsible practices
- Positive corporate image & increased credibility
- Current media and political attention for environmental issues
- Canada Housing and Mortgage Corporation (CMHC) offers a 10% refund on the Mortgage Loan Insurance premium if buyers use CMHC insured financing to buy an energy efficient home, and buyers can extend the repayment period to 35 years

CHALLENGES

- Premium of about 25% for green building materials
- About 50% of buyers willing to pay premium for green features
- Competition amoung programs & rating systems with different goals and standards is confusing
- Lack of awareness of Built Green program from buyers and municipalities
- Energy efficiency features in the lower mainland have a longer payback (about 10 yrs), people tend to stay in their homes for about 5 - 7 years on average
- Less funding currently available for recovering costs of green features

LESSONS LEARNED

- Built Green standard has reasonable targets and requirements & has easy to follow checklist
- Built Green program is credible and measurable and allows for continuity across regions
- 3rd pipe drainage system required by Township of Langley did not function as intended

Photo Credit: Morningstar Homes Ltd.

GREEN INFRASTRUCTURE PRIMER

Introduction

Green infrastructure refers to a network of natural areas, or a series of engineered solutions working with natural processes, which mitigate environmental impacts from urbanization. Natural green infrastructure is an approach that preserves watercourses, wetlands, forests, wildlife habitats, greenways, and parks recognizing that these areas are essential to ensure clean air, water and natural resources. Engineered green infrastructure is a series of practices for water and energy management that take a "design with nature" approach.

This section of the green development guide will highlight engineered green infrastructure practices. Natural green infrastructure is discussed in its own section of this guide.




All Photos: City of Coquitlam

Stormwater Management

Green infrastructure techniques address stormwater management. Conventional stormwater practices collect water from impervious surfaces and convey stormwater and urban pollutants directly into local watercourses. This degrades water quality and depletes ground water supplies. Large rainfall events can result in flooding and bank erosion, which also negatively affects watercourses. Rainwater management measures store, infiltrate, evaporate, and detain stormwater runoff to minimize flooding and improve water quality. The overall goal is to mimic pre-development hydrological conditions in developed areas.

BENEFITS

- Decreasing the volume of runoff
- Reducing pollutant concentrations through biological or chemical degradation
- Reducing infrastructure costs because stormwater is managed on-site where it is generated and requires less site preparation, paving, and piping
- Provides flexibility and can be retrofitted for existing developments or created for newly developed areas and at the site or neighbourhood scale
- Can be introduced incrementally allowing costs to be spread over a longer time frame
- Reducing or eliminating large stormwater ponds
- Filtration of air pollutants through vegetation in wetlands, rain gardens and bioswales
- Provision of wildlife habitat
- Provision of recreational space
- Increasing property value

CHALLENGES

- Retrofits can be expensive
- Effectiveness of some measures can be limited by space constraints
- Site geology and topography may be unsuitable for some techniques
- Maintenance can be more intensive than conventional practices
- Knowledge gap
- Policy or regulatory barriers

Stormwater Management Practices

Stormwater controls work towards minimizing impervious surfaces, infiltrating stormwater to remove pollutants and recharge groundwater, and detention of stormwater to reduce flooding and remove pollutants. The following selection of stormwater management practices is summarized below:

- Green roofs
- Downspout disconnection
- Rain barrels and cisterns
- Infiltration trenches
- Rain gardens
- Vegetated swales
- Constructed wetlands
- Living walls
- Porous surfaces

Mountain Equipment Co-op, Toronto

Green Roofs

Green roofs are roofs that support vegetation. They consist of a waterproof membrane to protect the roof structure, layers to ensure proper drainage and a special growing medium. There are two types of green roof technology: extensive and intensive. Extensive systems have a thin layer of soil capable of supporting shallow rooted drought tolerant plants. Extensive systems are often suitable for existing as well as new roofs. Intensive systems have a deeper soil layer and are heavier requiring a more complex roof structure. Intensive systems are more suitable for new construction.

- Detains a significant volume of rainfall, which is then used by plants or evaporates
- Vegetation can remove air pollutants and minimizes the urban heat island effect
- Provides wildlife habitat
- Aesthetically pleasing
- Provide increased building insulation
- Highly variable cost
- Some uncertainty regarding durability therefore some companies will not provide home warranty insurance for residential green roofs

Downspout disconnection

Instead of directly conveying water from the downspout into the storm sewer, downspout disconnection either collects runoff from the roof to store in a rain barrel or cistern, or runoff is redirected to the lawn or landscaped surfaces.

- Reduces total volume and peak flows and recharges groundwater
- Effective at reducing impacts from frequent small rainfall events
- Easy to install and stored water can be used for irrigation purposes
- Cost-effective

Rain Barrels and Cisterns

Rain barrels and cisterns collect and store stormwater for later use for non-potable purposes such as irrigation and flushing toilets. They can be used for a single residence or be quite large to achieve economies of scale. Rain barrels typically hold up to 380 litres and are stored above ground while cisterns are typically much larger and are partially or fully buried.

- Reduce peak discharge rates and reduce total volume
- Conserve potable water through use for irrigation and other activities
- Overflow into infiltration areas should be provided
- Simple and cost-effective

Infiltration Trenches

Infiltration trenches are shallow trenches filled with porous materials that allow for temporary storage of stormwater. Water collects in the trench before infiltrates into surrounding soils. Infiltration Trench Systems consist of inlet or water source, catch basin sump, perforated distribution pipe, infiltration trench and an overflow to the storm sewer system.

- Increases infiltration recharging groundwater and reducing peak discharge
- Removes soluble and particulate pollutants
- Efficient at removing suspended solids, trace metals, bacteria
- Suitable for clean stormwater runoff such as office or residential roof runoff but not suitable for runoff from parking lots or other high traffic areas
- Suitability and cost depends on topography, soil conditions, hydrological conditions
- Can be used in combination with grass, vegetated, or sand filters or oil/grit separators to remove sediments prior to infiltration
- Maintenance requirements include regular inspections, cleaning of inlets to prevent clogging, mowing and inspection of observation wells

Rain Gardens

A rain garden is a planted or stone bed designed to receive and infiltrate stormwater. It is a shallow depression or low-lying area which dries between rainfall events.

- Removes pollutants and infiltrates stormwater reducing runoff volume
- Support habitat for wildlife
- Aesthetically pleasing
- Easy to maintain once established
- Cost varies depending on site conditions and required site preparations as well as chosen plants

Vegetated Swales

Vegetated swales, or bioswales, are shallow depressions that collect, slow, and infiltrate stormwater generated from adjacent impervious surfaces. Vegetation in the depression slows runoff and removes pollutants with sedimentation or by biological processes.

- Decreases runoff velocity & reduces peak flows subsequently reducing downstream erosion
- Infiltrates and evaporates runoff, and provides some temporary storage
- Suitable for new areas or retrofits, yet need to be carefully incorporated in site planning and landscape design
- Contaminant removal is a function of swale grade and length
- Effective at capturing suspended solids, oils, particulate metals, less effective at removing soluable metals and nutrients
- Cost is typically about $24 - $74 per linear metre but varies with depth, length, grade and soil conditions
- Simple technology
- Can reduce development costs by combining conveyance and treatment in one system and minimizing or eliminating curbs, pipes, and inlets

Vegetated Swale Design

Green Wall, Tokyo

Green Walls

Green walls, also called biowalls, allow plants to grow vertically and filter air and water as it passes through. Living wall systems typically have pumps and fans for water and air flow along with a specialized growing media. They can be installed used indoors and outdoors and as low dividing walls or along tall building walls.

- Filter out air pollutants such as VOCs and CO^2
- Improve water quality of stormwater or greywater by removing pollutants
- Reduce quantity of stormwater as it is evaporated or used by plants
- Aesthetically pleasing and highly visible
- Reduce costs by cleaning indoor air naturally thereby reducing mechanical ventilation requirements
- Reduces energy consumption
- Costs about \$1,200 per m^2 which treats about 100 square meters of floor space [(1)]
- Walls can provide habitat for insects, amphibians, and fish
- Some walls support urban agriculture

[1] Business Edge Magazine. "Living Wall is growing on sceptics." July 7, 2005.

[2] Still Creek Rehabilitation and Enhancement Study *www.city.vancouver.bc.ca*

Porous Surfaces

Porous paving provides and alternative to impervious pavement. It has a porous surface and subsurface layer that temporarily stores and slowly releases stormwater. Types of porous surfaces include: porous asphalt, interlocking pavers, and Grass pavers. Porous asphalt eliminates fines from the aggregate mix leaving pore spaces to infiltrate water:

- Most appropriate for areas with low volume traffic
- Requires surface native material that also allows infiltration
- Cost about \$20 - \$30 per m^2 [(2)]
- Maintanance involves vacuum street sweeping and high pressure washing

Grass Pave has a rigid grid of concrete or plastic with grass growing in the voids.

- Reduces peak volume, improves water quality, recharges groundwater
- Effective contaminant removal depending on subsoil
- Reduces urban heat buildup
- Suitable for parking areas and access roads
- Cost is higher than regular pavement but maintenance is less, capital costs are about \$80 to \$115 m^2 for concrete grid, less for plastic
- Maintenance involves watering, fertilizing, and mowing

Grass Stone

Roof Top Storage

Temporarily holds rainwater on the roof before directing it to infiltration basins, use in site irrigation, or direction to stormwater sewer. It is suitable for densely developed areas where there is insufficient space for other measures.

- Provides temporary storage and reduces peak flows
- Requires roof to hold at least 6 inches of water
- Require adjustments to parapets and extensive application of waterproof membrane
- Overflow measures should be provided for large storm events
- Relatively inexpensive

Parking Lot Detention

Parking surface functions as a detention basin for stormwater and is most suitable for highly urbanized areas with few alternatives available.

- Reduces peak discharge of moderate storms
- May remove large particles from stormwater
- Parking lot should be relatively level and underutilized
- Overflow measures should be provided
- Can be inconvenient for pedestrians and safety concern during freezing conditions
- Can be used in conjunction with infiltration measures

Constructed Wetlands

Constructed wetlands are shallow ponds that treat stormwater with wetland vegetation. Pollutants are removed by microbial breakdown, plant uptake, settling sediments and adsorption.

- Provide short-term storage of high flows & improve water quality
- Remove nutrients, sediments, heavy metals, hydrocarbons, fecal coliforms (approximate efficiency: total suspended solids 78%, total phosphorous 51%, lead 63%, copper 39%, zinc 54%,hydrocarbons 90%) (2)
- Provide habitat & aesthetically pleasing space with educational value
- Require large contributing drainage area or dry weather base flow
- Use limited by soil type, available land area, depth from groundwater table
- Public concern about nuisances and safety
- Relatively high construction costs, $33 - $66m^3 (2)
- Maintenance costs average 3% to 6% per year, can be difficult to maintain vegetation in varied flow conditions

[2] Still Creek Rehabilitation and Enhancement Study *www.city.vancouver.bc.ca*

Constructed Wetland

DISTRICT ENERGY

District energy is a system for distributing energy generated in a centralized location for use in residential and commercial buildings for heating, cooling or electricity. District heating systems use either steam or water to transfer heat from the central heat generating plant through heat exchangers to individual buildings. Possible energy sources for district heating include:

- Geothermal
- Solar
- Biomass
- Surplus heat from industrial processes

District energy systems have been around for centuries and are often used as strictly heating systems. Cogeneration systems allow the simultaneous production of heat and electricity which has even greater efficiencies. Steam produced from combustion turns the turbines to generate electricity and the waste heat generated in this process is usually released back into the environment but with cogeneration it is captured as used to heat local buildings greatly improving the efficiency of this process.

Green Infrastructure References

GVRD Storm Source Control Design Guidelines 2005
www.gvrd.bc.ca

Low Impact Development Center
www.lowimpactdevelopment.org
www.lid-stormwater.net

Capital Regional District - Living Walls
www.crd.bc.ca/watersheds/lid/walls.htm

Michigan Department of Environmental Quality
www.deq.state.mi.us/documents/deq-swq-nps-rts.pdf

Minneapolis Metropolitan Council Environmental Services
www.metrocouncil.org/Environment/Watershed/BMP/CH3_STConstWLSwWetland.pdf

Benefits

- Greater energy efficiency
- Economies of scale with equipment and technology more efficient and versatile with district energy than individual building heating systems
- Reduced greenhouse gas emissions through greater efficiency and renewable sources
- Reliability and proven success
- Less maintenance for individual building owners
- Low life-cycle costs
- Design flexibility
- Central plants face stricter environmental standards than individual systems reducing environmental impact
- Removes a possible source of indoor air pollution
- Stabilized energy costs
- Energy is produced near users and better able to serve remote communities
- Local facilities can be used to engage community in energy conservation

Challenges

- Hasn't gained widespread acceptance therefore more difficult to finance and implement
- Renewable energy supplies vary between locations
- High capital cost
- High costs for small scale projects
- Longer payback for investor
- Policy, regulatory, and legal barriers in use of some renewable energy sources

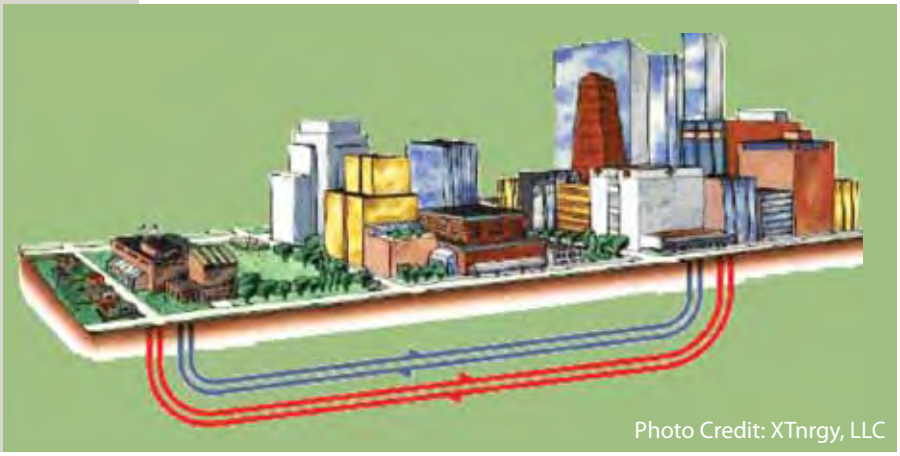


Photo Credit: XTnrgy, LLC

District Energy Diagram

Silver Ridge
Maple Ridge

Silver Ridge is a unique project with widescale implementation of low impact development measures in an area with steep topography.

Silver Ridge is a community of 393 single family homes located in Maple Ridge. The site is 34 hectares of rolling bedrock terrain overlayed with glacial till, and was forested prior to development. The site drains into an important salmon bearing stream and Blaney Bog, an environmentally sensitive area.

The stormwater mangement plan includes a rainfall capture strategy, a dention strategy and a water quality strategy. It was designed to address flood conveyance and provide environmental protection to receiving watercourses. The stormwater management plan is a combination of on-lot and roadside volume reduction and water quality controls.

Photo Credit: Kerr Wood Leidal Associates Ltd.

ON LOT DESIGN & OPERATION

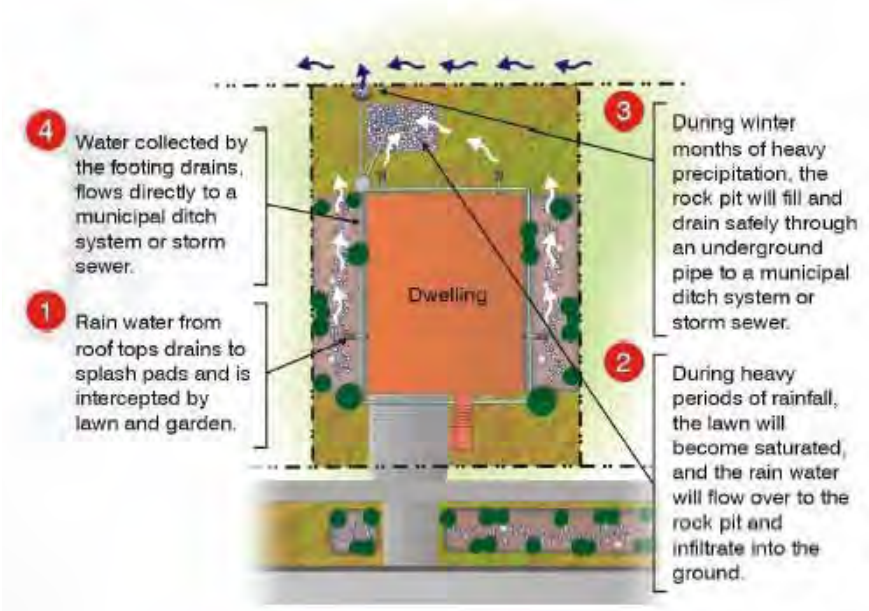


Diagram Credit: Kerr Wood Leidal Associates Ltd.

Stormwater from roof leaders drain onto lawns or gardens. If the lawn is saturated the overflow is intercepted by a rock pit. The rock pit is sized according to the 6-month 24-hour rainfall event, the average lot impervious area, and a 1mm/hr infiltration rate.

The rock pit is wrapped in a non-woven filter fabric to prevent migration of surrounding soil. Overflow from the rock pit is connected to the roadway ditch or storm sewer.

On-lot controls include:

- disconnected roof leaders
- absorbent soils
- rock pits
- rain gardens

In addition to the roadside and on-lot controls, detention ponds have been constructed at each of the outfall locations to protect water quality. The ponds are designed to detain 6 months, 2 year, 5 year storms and to release water at the pre-development rates.

ROADSIDE RAIN GARDEN DESIGN AND OPERATION CONCEPT

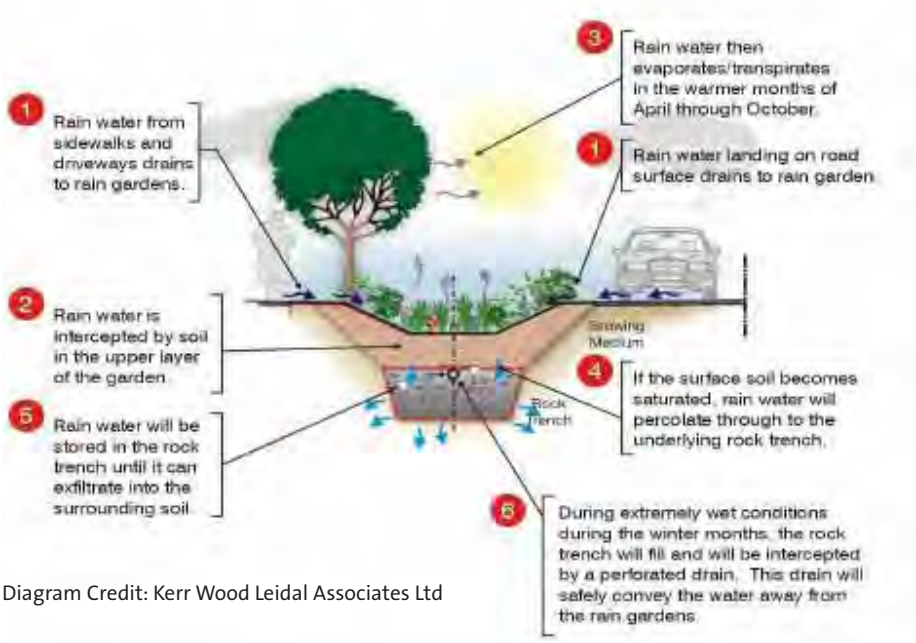


Diagram Credit: Kerr Wood Leidal Associates Ltd

The roadside rain gardens are constructed in the 20m road rights-of-way in glacial till. Weirs limit the grade to 2% to promote infiltration. They collect, store, infiltrate and evaporate runoff for rainfall events up to a 6 month 24-hour return period.

Runoff from larger storm events overflows through ditches and into the storm sewer system. Gardens are enforced with erosion protection fabrics. They form part of the 100 year overflow path. Roadside controls include:

- rain gardens
- rock trench
- storm sewer

PERFORMANCE

GVRD, Environment Canada, District of Maple Ridge and Portrait Homes have funded a 3 year monitoring program which began in February 2005. Preliminary results have demonstrated:

- rain gardens are effective at attenuating frequent rainfall events (less than 5-year events)
- 89% of > 5 year, 24-hour rainfall event was captured after dry conditions
- 80% - 89% of a rainfall event with less than a 2-year return period was captured in saturated conditions
- Residents are very satisified with on-lot controls
- detention ponds required minor adjustments

CHALLENGES

- development required stream crossings, outfalls, and creek setbacks
- Developer had to balance costs, performance, adherence to regulations and market acceptance
- LID premium of $7,500 per lot which includes on-lot as well as roadside rain garden construction although this was reduced with greater efficiencies
- lot grades of 5% to 25%, road grades 2% to 15%

BENEFITS

- rapid DFO approval
- rain gardens provide attractive landscaping and contribute to marketability of the development
- separation of pedestrians and vehicles with rain gardens
- Over 40% of the community has been preserved as natural forest, parks, or hiking trails.

REFERENCES

Kerr Wood Leidal Associates Ltd. 2006. Silver Ridge Low Impact Residential Development Paper *www.kwl.bc.ca/docs/CWRA2006-Silver_Ridge_Paper.pdf*

Kerr Wood Leidal Associates Ltd. 2006. Silver Ridge Low Impact Residential Development Presentation *www.kwl.bc.ca/docs/CWRA2006-Silver_Ridge_Presentation.pdf*

Portrait Homes Website *www.portraithomes.ca*

PROJECT TEAM

DEVELOPER: Portrait Homes
DRAINAGE: Kerr Wood Leidal Associates Ltd

AWARDS

2006 Georgie Awards:

Best MultiFamily Landscape Design, Best Large Volume Single Family Home Builder of the Year

2005 Georgie Award:

Best Residential Development in BC, Finalist for Best Single Family Landscape Design, Finalist for Best Environmental Consideration and Energy Efficiency

David Avenue Connector
Coquitlam

The **David Avenue Connector** is a four lane arterial road linking Northeast Coquitlam to Coquitlam Regional Town Centre. The connector is designed to manage stormwater with green infrastructure features and to accommodate more sustainable forms of transportation in addition to the car. The project includes:

- a 2 km roadway extending from Coast Meridian Road to Pipeline Road
- bridge crossings over Coquitlam River, Hockaday Creek and Hyde Creek which are fish bearing watercourses
- open bottom culvert crossings of East and West Watkins Creek
- direct runoff to grassed biofiltration swales
- significant habitat compensation measures

Photo Credits: City of Coquitlam

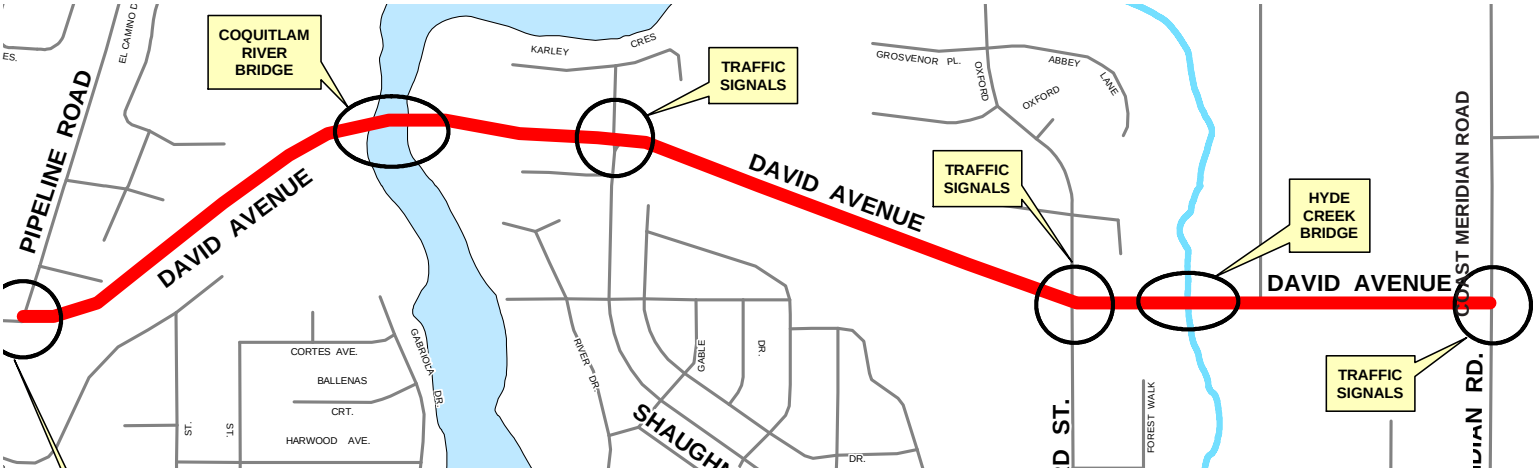
Stormwater management features include:

- grassed bioswales
- street trees
- landscaped boulevards and medians
- water quality ponds
- exfiltration chambers

Street trees and plantings in boulevards and medians intercept rainfall before it hits the ground and becomes stormwater.

Stormwater generated by the road and pathways is directed into grassed bioswales. The bioswales are designed to capture and filter runoff. Runoff exceeding the capacity of the bioswales enters the stormwater sewers and are discharged into one of the water quality ponds. The water quality ponds temporarily store runoff and remove sediments before the water is discharged into the Coquitlam River or Hyde Creek.

The Consulting Engineers of BC awarded the City of Coquitlam & Golder Associates an Award of Merit for Engineering Excellence for the habitat compensation work completed as a part of this project



David Avenue Connector

TRANSPORTATION

Alternate forms of transportation are promoted by:

- clearly marked bike lanes on both sides of the road
- David Avenue Trail, a 3m wide multi-use trail on the south side of the road which forms part of the TransCanada Trail system
- bike/bus bulges allowing buses to pull off the road without blocking the bike lane
- sidewalk and pathway separated from vehicles by bioswales and street trees

HABITAT COMPENSATION

Habitat compensation measures include:

- riparian plantings
- overwintering ponds
- enhanced wildlife corridors
- 5 year monitoring program for all habitat works

Riparian planting was conducted at four off-site locations in compensation for the vegetation removal required for the bridge crossings. The planting program consists of native plant species to enhance and restore riparian corridors. Plantings along banks and slopes provide slope stabilization.

An off-channel overwintering pond was constructed Watkins creek in compensation for the open bottomed culvert crossings. The pond provides habitat for salmonids and amphibians. A fish ladder facilitates upstream movement. An offchannel overwintering pond was also constructed under the Eleanor Ward Brigdge in 2007. Triangular large woody debris structures were added to the Coquitlam River to increase habitat diversity, provide protection and cover, and to collect more woody debris.

BENEFITS

- A pedestrian link has been provided to the Northeast
- Provides off-channel salmonoid habitat, amphibian habitat, and small mammal habitat
- enhanced wildlife corridors
- Treatment of road side and bridge drainage prior to entering creeks and river
- 5 year monitoring program for all habitat works

CHALLENGES

- Acquiring all properties necessary
- Magnitude of project (largest capital project completed by Engineering)
- New technology such as acoustic fences required special consideration
- Uncooperative weather conditions

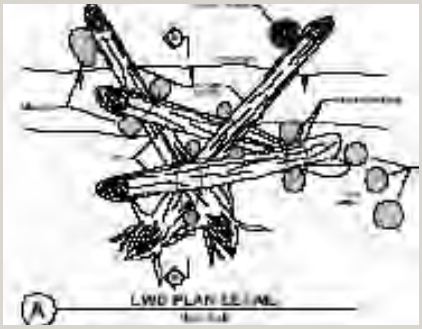
PROJECT TEAM

City of Coquitlam
Golder Associates
Delcan Corporation

FUNDING

City of Coquitlam
Translink
Province of BC

David Avenue Trail



Large Woody Debris Structures

Off-Channel Pond & Woody Debris

REFERENCES

City of Coquitlam. 2006. Project Status Report *www.coquitlam.ca*

NATURAL INFRASTRUCTURE PRIMER

Introduction

In addition to engineering-focused green infrastructure, the natural green infrastructure of green space networks and programming also contributes to sustainability and green development. Extensive urban growth in Coquitlam has significantly reduced the amount of natural habitat for native plants, birds, and animals. Systems of open space and natural infrastructure help to protect and restore naturally functioning ecosystems.

Natural green infrastructure includes approaches such as **open space networks**, **naturescaping**, and **urban agriculture**.

All Photos: City of Coquitlam

Open Space Networks

Open Space Networks preserve watercourses, wetlands, forests, wildlife, habitats, greenways, and parks in order to support local habitat, provide passive recreational opportunities, and to mitigate stormwater runoff.

To maximize benefits, open space should be created and maintained as part of a network so that they can function as an ecological whole; corridors (trails, linear parks, greenways, riparian corridors) should connect hubs of green space like parks and wetlands.

Benefits:

- Protect and restore naturally functioning ecosystems
- Enriches and maintains habitat and biodiversity
- Provide recreational opportunities
- Improve health
- Increase property values.

Challenges:

- Coordination is required to create a functional network of green space
- Policy or regulatory barriers
- Site geology or topography may be unsuitable for some techniques

Popular Open Space Practices:

» Greenways
» Riparian Corridors
» Constructed Wetlands

Greenways

Greenways are linear open spaces that serve as both green space and a route for pedestrians and cyclists. Greenways can happen at any scale.

- Provide connectivity between community amenities
- Offer pedestrian access through the community
- Promote physical fitness
- Provide habitat for wildlife and natural vegetation
- Filter air pollution

Riparian Corridors

Riparian corridors are narrow tracts of land centred on a stream, designated to preserve habitats directly adjacent to watercourses. Riparian corridors serve as the transition between watercourses and urbanized environments, and provide important pervious surfaces. Healthy riparian zones are those with plenty of vegetation to serve as buffers and water storage areas, mitigating environmental fluctuations like floods and erosion.

- Provide aquifer recharge
- Provide habitat
- Absorb sediments and other substances
- Improve water quality

Constructed Wetland

Constructed Wetlands

Constructed wetlands are shallow ponds that treat stormwater, filtered through wetland vegetation. Wetlands are typically created on sites adjacent to, or within, an existing stream channel, and can be constructed in parks and golf courses.

- Provide short-term storage of peak water flows
- Reduce downstream flooding
- Remove pollutants from storm and waste water and improve water quality
- Create habitat for birds and wildlife
- Have high aesthetic value
- Typical construction cost of a wetland: \$33- \$66 per m^3 (adapted from Brown and Schueler, 1997)

Naturescaping

Naturescaping is a style of landscaping designed to have minimal negative impact on the environment. Features are native plants, natural-like settings, minimal chemicals, and low water use gardening techniques.

Naturescaping happens on a small level. Remaining segments of natural habitat in urban settings are preserved or restored on private yards and public spaces.

Benefits:

- Provide local habitat
- Use less water than traditional gardens
- Native plants attract local birds and animals, making for more vibrant natural spaces.

Challenges:

- Site geology and topography may be unsuitable for certain techniques
- In some cases, maintenance can be more intensive than with conventional practices
- Green roofs, particularly intensive systems, are costly at the outset

Popular Naturescaping Practices

- Green Roofs
- Lawn Alternatives
- Public gardens

Intensive Green Roofs

Green roofs are roofs that support vegetation. They consist of a waterproof membrane to protect the roof structure, layers to ensure proper drainage, and a special growing medium. Intensive green roof systems require a deeper soil layer and a more complex roof structure for support, but can serve a dual purpose as a rooftop park.

- Absorb a significant amount of rainfall
- Vegetation remove air pollutants and reduces urban heat island effect
- Provide wildlife habitat
- Aesthetically pleasing

Lawn Alternatives

Private developments can create higher-functioning open space by simply reconsidering the materials used on lawns. While common lawn turfgrasses require a high level of water and maintenance, hardy turfgrasses and broadleaf species such as clover require far less time and resource. Another alternative is "shrinking" a lawn, replacing areas of lawn with groundcover plants or native shrubs.

- Use less water than conventional lawns
- Cost less money than conventional lawns
- Use less fuel than conventional lawns

Community Gardens and Green Streets

Community gardens and their linear equivalents, green streets, are high-functioning green spaces in urban environments. Community gardens are typically maintained by community members.

- Aesthetically pleasing
- Native vegetation maintains itself more easily
- Vegetation absorbs and filters stormwater
- Provide opportunities for environmental education
- Require continued volunteered stewardship from the community

Intensive Green Roof (Millenium Park, Chicago)

Urban Agriculture (UA)

Urban Agriculture is essentially "farming in the city" – growing produce and other food products in urban environments. While vegetable gardens are the most common example of urban agriculture, it can also occur by integrating food-producing plants into general landscaping and building design.

Benefits:

- Offers a productive landscape
- Certain plants and trees require less maintenance than traditional annuals
- Increases food security
- Increases property values (Been & Voicu, 2006),
- Diverts waste
- Manages open space
- Promotes environmental education

Challenges:

- Require buy-in from community members to maintain
- Site geology and topography may be unsuitable for some techniques
- Some urban agriculture techniques require significant management

Popular Urban Agriculture Practices

» Community Gardens
» Edible Greenways
» Rooftop Gardens
» Edible window boxes

Natural Infrastructure References:

Designing Urban Agriculture Opportunities for SEFC, 2007

About Your House: Low Maintenance Lawns – No. 63488
www.cmhc.ca

Naturescape British Columbia
www.hctf.ca/nature

Photo Credit: Erin Ferguson

Urban agriculture can be created in a number of places:

- around buildings
- in courtyards
- on rooftops and balconies
- along streets
- in parks
- outside schools and community centres
- in demonstration gardens

Photo Credit: Balcombe Street Windowbox Co.

Growing Vine Street
Seattle

Growing Vine Street is a project transforming an urban street into an eight block urban oasis. Stormwater is collected off the rooftops of adjacent buildings, held in large cisterns and flows into a runnel which meanders through the street right-of-way before being released into Puget Sound. Plants in wetlands and gardens filter impurities from the water along the way. The aims of the project are to treat roof runoff through biofiltration, create greenspace for the community, and to reintroduce the natural hydrological cycle into the urban environment.

LOCATION

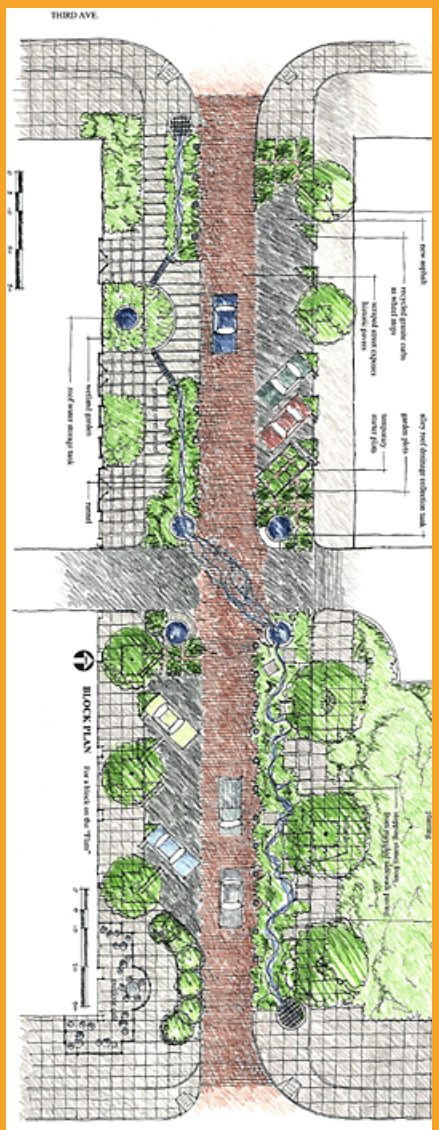
- In the densely populated Belltown neighbourhood of Seattle which is a mix of commercial, residential, and marine uses
- adjacent to the cultural area of Seattle Centre to the north, and Pike Place Market and the commercial centre to the south.

PROCESS

- Vine was designated as a "Green Street" in 1985 by the City of Seattle with the intention of providing open space in the right-of-ways for neighbourhoods lacking greenspace.
- evolved out of the Belltown P-Patch, a community garden that opened in 1995 after years of lobbying by local residents
- an open house was held to develop ideas for extending the P-Patch greenspace up Vine Street

DEVELOPMENT

- re-design is guided by the Steering Committee, who envision Vine street as a watershed & have outlined ecosystem design guidelines
- Carlson Architects produced the design concept after a series of neighbourhood workshops
- development is intended to be completed incrementally with the "Growing Vine Street Implementation Guide Book" to help City officials align new developments with the vision and goals of this project



Source: "Growing Vine Street Revisisted 2004"


Photo credit: Carolyn Geise


Source: "Growing Vine Street Revisisted 2004"

LEFT | Artist's rendering of Cistern Steps Design Concept
BOTTOM LEFT | Bee Mosiac on P-Patch wall
BOTTOM RIGHT | Solar powered fountain
TOP RIGHT | Belltown P-Patch Entrance
FAR RIGHT | The Beckoning Cistern by Buster Simpson


Photo credit: Myke Woodwell

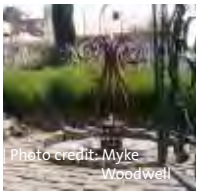


Photo credit: Myke Woodwell

The Growing Vine Street Design Concept divides Vine Street into 3 zones:
1) the slopes 2) the flats 3) the portals

Cistern Steps

The Slopes

The lower portion of Vine Street is a 12% slope and is used to form the terraces of the Cistern Steps. As the water flows down the runnel it flows into the top terrace wetland and spills over into the next wetland or paddy as it makes its way down the slope. It will then flow into a French drain crossing at the community plaza proposed at the alley intersection before forming a small pool at Elliot Aveune. This section of Vine is adjacent to the Belltown P-Patch.

Bird's eye view looking down Vine Street

The Flats

The upper portion of Vine Street is flat with a narrow right-of-way on one side and a wider right-of-way on the other side. The narrower side will have a walkway with tree plantings and pockets of greenery. The wider side will have the runnel, small water features, gardens, walkways, arbours and other green features.

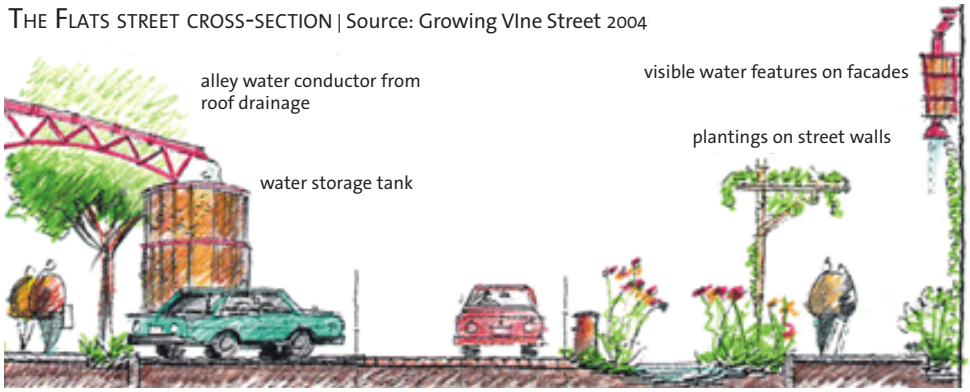
Future Portal Location

The Portals

The portals form the entries at both the east and west ends of Vine Street, which is to be a one-way street with back-in parking on each block. The design concept has the current roadway stripped away to expose the sandstone cobbled surface beneath.

Future possibilities include "accoustical trees" to minimize urban noise, vegetated walls, orchard groves, and extention into alleys connecting to a parallel green street. Interim elements include portable planters tended by local residents and businesses. Existing elements are the beckoning cistern, cistern steps, the Belltown P-Patch, the cottages, and 81 Vine Street.

THE FLATS STREET CROSS-SECTION | Source: Growing VIne Street 2004



The Belltown P-Patch

The Belltown P-Patch was created in 1995 by the local community. Garden features include mosaics made by the community group, an entrance gate created by a local blacksmith, and a solar fountain. There are 40 garden plots ranging from 5 x 5 ft to 10 x 10 ft. The garden is 1/8 of a city block.

Cottage Park

Cottage Park is next to the P-Patch and has 3 renovated cottages which were designated as Seattle Landmarks in Spring 2000. Originally there were 11 cottages built along the Seattle waterfront from 1906-1916. The renovated cottages are home to 2 writers-in-residence and the third is a community centre managed by Friends of Belltown P-patch.

81 Vine Street

Renovation and conversion of a 1914 factory into storefronts, offices and condominiums. Roof terraces are headwaters for Growing Vine street. Water flows through terrace in an open culvert planter. Downspout on west has 4 planter loops with native vegetation and downspout on east feeds the beckoning cistern.

The Belltown P-Patch

P-Patch Entrance

Vertical Planter 81 Vine|

References
1. Belltown P-Patch *www.speakeasy.org/~mykejw/ppatch*
2. Growing Vine Street Project Website *www.growingvinestreet.org*
3. Growing Vine Street Revisited 2004 *www.growingvinestreet.org/book.php*

Burquitlam Community Garden
Coquitlam

Burquitlam Community Organic Gardens is a 0.44 acre environmentally focused garden located at the corner of Ebert Avenue and Whiting Way in the Burquitlam Neighbourhood of Coquitlam. In addition to allocated plots for growing food and flowers, the garden supports a variety of educational demonstration projects and provides spaces for people to gather.

All Photos: Erin Ferguson

THE PROCESS

- Local residents recognized the need for a community garden in their neighbourhood.
- Residents approached the City with the idea, as well as the location.
- The City of Coquitlam purchased the property.
- A committee comprised of community project leaders, a volunteer landscape designer, City staff, and RCMP developed the garden.
- Burquitlam Residents' Association and other community volunteers, local businesses, contractors and the City worked together to construct the garden in 2000.

Vegetable Plot

Raised Beds

Food Bank Plots

THE PLOTS

- Approximately 50 plots available to Burquitlam residents
- Plots vary in form, size and content
- Organic vegetables are grown in most plots, some plots have flowers
- Smaller plots are designated as herb gardens
- Raised accessible plots are available for persons with reduced mobility
- Plots in the southwest portion of the garden produce vegetables for the food bank.

TOP LEFT | Dry Creek Channel
TOP RIGHT | Rainwater Collection
BOTTOM LEFT | Composting Bins
CENTRE | Mason Bee Houses
BOTTOM RIGHT | Bat House

Photos Credit: Erin Ferguson

SOCIAL SPACES

In addition to the garden plots themselves, other spaces provide community information, a chance for conversation, and places to escape the heat. These include:

- Community garden shed
- Community bulletin board
- Deck with picnic benches
- Trellis and arbours

ADDITIONAL FEATURES

- Espallier fruit trees (very narrow trees used to form a bufffer with residence)
- Hand water pumps for plots
- Cedar beds not treated wood (prevents toxin leaching)
- Preservation of large cedar trees on the site

Environmental Education

There are a number of educational projects in the gardens:

- composting bins & demonstrations
- water conservation through collecting rainwater from the roof of the gardening shed and storing it in cisterns
- mason bee houses
- bat boxes
- dry creek channel demonstrating Naturescape principles for creating backyard wildlife habitat using native plants

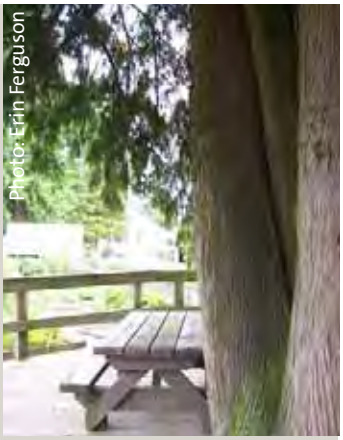
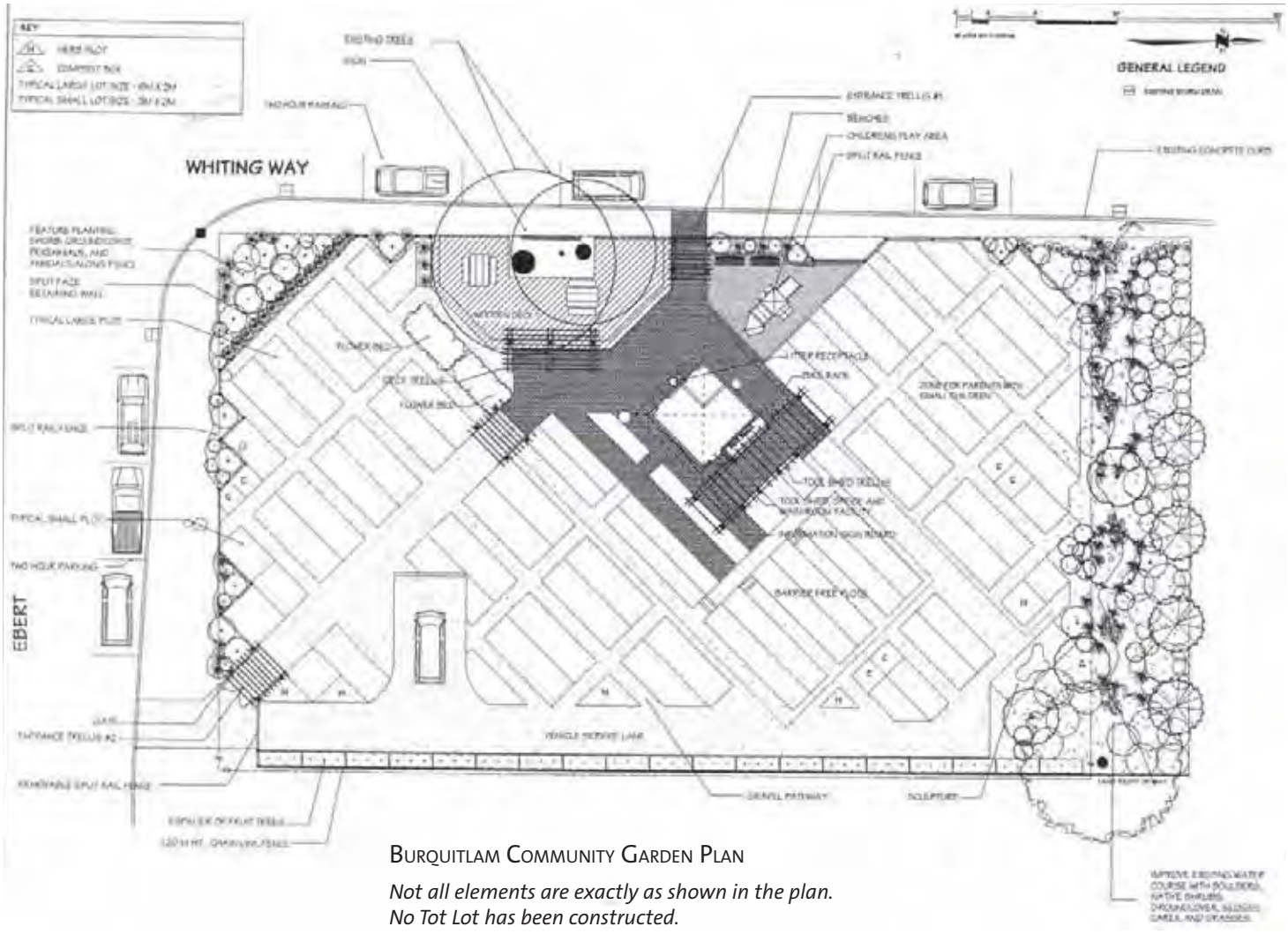


Photo: Erin Ferguson


Photo: Erin Ferguson

www.coquitlam.ca
604.927.3000



Burquitlam Community Garden Plan

Not all elements are exactly as shown in the plan.
No Tot Lot has been constructed.

SUSTAINABLE TRANSPORTATION PRIMER

Introduction

One of the key goals of green development is to decrease dependency upon single-occupancy vehicles by offering alternative transportation options. In order to encourage walking, cycling, and transit use, these transportation choices must be accessible, safe, and well-integrated into the transportation grid.

Both land use choices and urban design can have a significant influence on the transportation choices that residents make.

BENEFITS

- Transit-oriented development improves access and accessibility
- Fewer vehicles on the road improves air quality
- Pedestrian and cycling networks promote healthy lifestyles
- Better pedestrian design features improve street safety
- Transit-oriented development and improved access encourages streetfront retail
- Less congestion leads to quicker transport of goods

CHALLENGES

- Land use planning needs to integrate sustainable transportation practices
- If the population growth rate is slow in an area, it may limit the potential to bring about change in the short term
- Requires a shift from focusing on mobility to focusing on accessibility

All Photos: City of Coquitlam

Sustainable Transportation Practices

There are a number of innovative, simple, and cost-effective methods that private and public developments can employ to promote transportation sustainability.

» Transit-Oriented Development

» Pedestrian-oriented and cycling-oriented circulation systems

» Street Design / Alternative Engineering Standards

» Complete Streets / Home Zones

Transit-Oriented Development

A transit-oriented development (TOD) is a mixed-use residential or commercial area designed for the pedestrian and to maximize access to public transit. Such developments are typically new constructions or redevelopments.

Benefits

- Improved access to community, commercial, and work facilities
- Increased variety of services and facilities located closer to where people live and work
- Higher transit and alternate mode use
- Denser land use
- Higher quality pedestrian environments
- Improved connectivity
- Higher property values
- Lower infrastructure costs

Challenges

- Requires entire site plan to integrate with transit (not just density near transit)
- Greater degree of risk than traditional building
- Requires attention to individual context (not 'one size fits all')

Photo Credit: Raise The Hammer

Pedestrian and Cycling paths

Beyond recreation and leisure enjoyment, paths designed for pedestrians and cyclists can also serve as viable transportation options. Well-designed sidewalks and designated bicycle lanes as well as facilities like sheltered areas, rest areas, bicycle parking, and end-of-trip facilities are important components of a successful pedestrian or bicycle circulation system.

Benefits

- Fewer single-occupancy vehicles on the road for shorter trips
- Improved air quality
- Improved mobility for residents without regular access to their own car (youth, seniors)
- Improved healthy lifestyles
- Quieter neighbourhoods due to decreased traffic congestion and noise
- Increased safety for pedestrians and cyclists
- Reduced road maintenance costs

Challenges

- Requires maintenance
- Requires integration with other infrastructure (lighting, crosswalks, connectivity to transit)
- Cycle paths require a continuous grid to achieve maximum impact

Photo Credit: City of Vancouver

Street Design

The physical design of streets in a development can have an impact on transit modes used in a neighbourhood. Designing streets that slow cars on the road and are inviting to pedestrians and cyclists can have positive impacts on the number of single-occupancy vehicles in an area.

Characteristics of green street design include:

- » *Traffic Calming*
- » *Design Incentives for Higher Occupancy Vehicles*
- » *Skinny Streets*

Traffic Calming

Traffic calming aims to slow traffic in local streets. Measures include traffic circles, curb narrowing, chokers, and raised intersections.

- Increases real and perceived safety of pedestrians and cyclists
- Discourages the use of single-occupancy vehicles as a transportation method for short trips
- Discourages short-cutting
- Creates a more inviting street for walking and cycling
- Reduces noise
- Offers opportunities for streetscaping, which has positive effects on air quality and stormwater management

Skinny Streets

Skinny streets allow residential streets to be 6 metres wide with parking on one side, or 8 metres with parking on both sides.

- Reduce impervious surface
- Reduce stormwater runoff and stormwater pollution
- Enhance character of neighbourhood
- Enhance walkability of streets
- Reduce auto collisions (0.32/mile each year vs. 1.21/mile per year for regular-sized streets)
- Provide adequate access for emergency vehicles
- Discourages short-cutting

Green Street Design

Design Incentives for Higher Occupancy Vehicles

Street and parking designs do not typically give priority to those driving in carpools. Offering preferential parking near workplaces and integrating pick-up/drop-off areas onto streets encourage residents to drive with higher occupancy.

Complete Streets & Home Zones

Complete Streets and Home Zones both aim to 'reclaim' streets from uses dominated by single-occupancy vehicles.

Characteristics of Complete Streets include:

» *sidewalks*
» *bike lanes*
» *wide shoulders*
» *sidewalk bulb-outs*
» *special bus lanes*
» *bus pullouts*
» *raised crosswalks*
» *refuge medians*

Home zones integrate all transportation modes onto the main street, rather than separating them out.

Home zones contain:

» *streetscaping*
» *traffic calming measures*
» *play areas*
» *green spaces*

Benefits

- Improved mobility for residents without regular access to their own car (youth, seniors)
- Improved healthy lifestyles
- Quieter neighbourhoods due to decreased traffic congestion and noise
- Increased safety for pedestrians and cyclists
- Improved air quality
- Incorporates facilities for all modes of transport at once – fewer retrofit costs

Challenges

- May delay response rates of emergency services
- Traffic calming measures can create congestion in local area traffic
- Homes on complete streets will not have on-street parking

Public Street in Barcelona

Woonerf in Delft, Netherlands

Sustainable Transportation References

Go for Green: Active Living and Environmental Solutions
www.goforgreen.ca

Complete the Streets
www.completestreets.org

Homezones
www.homezones.org

Better Environmentally Sound Transportation
www.best.bc.ca

Living Streets - Peverel Street
Christchurch, New Zealand

Living Streets challenge the assumption that streets are for cars and that cars have automatic priority over people in all streets. Through the design or redesign of roadways Living Streets shift the priority from cars to living and community interaction where residents, businesses, pedestrians, and cyclists are at the very least equal to cars, but cars are not excluded. Living Streets are designed to alter driving behaviour by signalling to drivers that other street users are important in this area. This is done without the use of constructed devices such as speed bumps, in much the same way that driving through parks or private lanes causes drivers to slow. Any street can become a living street with the exception of highways which have a pure transit function. Peverel Street was the first Living Street in Christchurch.


Source: Christchurch City Council
Children's artwork tiles


Source: Christchurch City Council
Another Living Street in Christchurch

Peverel Street is within the suburb of Riccarton in Christchurch. The Living Streets project focused on one block of the street between Clarence Street and Picton Avenue. Peverel was a traditionally designed street, wide and straight, with the purpose of moving and parking cars although few cars use the street. It had very little greenspace.

Peverel had funding allocated for a kerb and channel renewal which provided part of the budget for the transformation into a Living Street. The total budget for the project was about $340,000, a traditional approach without any of these features would have cost $290,000.

Residents wanted to preserve car parking and the accessibility of the street. Limiting either of the two functions would allow more space for other things but residents were not comfortable giving these functions up as they could not envision how the street would work.

Living streets are a collaborative process between council and the public. There are 5 broad forms of living streets:

1. Community Street
2. Walkable Street
3. Small Public Areas
4. Mixed-use Street or boulevard
5. Quiet street

Community streets are mainly residential streets that provide easy and safe access for all ages and abilities. They are convenient areas for cars as well as places for recreation and other activities. Walkable streets have mixed residential and commercial use and offer opportunities for some recreation space. Small public areas provide recreational space in mainly commercial areas and are often next to busy streets. They can be used to host small events. A Mixed-use street or boulevard is predominantly commercial and incorporates more of a constructed and designed environment.

"First and foremost, a great street should help make a community"
~ Allan B Jacobs

Lastly, Living Streets are residential streets that have undergone calming to allow both residents and cars equal use.

Christchurch's Living Streets strategy outlines 8 ways in which a Living Street can contribute to our quality of life:

1. Safety and security
2. Economic vitality
3. Quality housing
4. Community networks
5. Sense of place & identity
6. Cultural activities
7. Sustainable Environment
8. Ease of access

The theme for Peverel Street is water which is reflected in the meandering nature of the street as well as 4 main features:

1) the fountain
2) the natural spring viewing window
3) the braided river footpath
4) the seating well

REFERENCES

City of Christchruch - Living Streets
www.ccc.govt.nz/LivingStreets

Creative Places Award: Peverel Street, a Living Street
www.ccc.govt.nz/LivingStreets/Awards/CreativePlacesAward2001_PeverelStreet.pdf


Source: Christchurch City Council

The Fountain

The fountain marks the main entry into Peverel Street and provides a landmark to help identify a changed roadway environment. Seating is provided around the fountain and glass tiles containing children's artwork are featured around the rim.


Source: Christchurch City Council

The Spring Viewing Window

The area is quite swampy and a number of natural springs are covered by the roadway and piped through the stormwater system. A viewing area was constructed to allow people to see the natural springs bubbling up. The viewing area is a brick chamber covered by a glass window through which the spring and old city infrastructure can be seen. A motion sensor lights the chamber so contents can be viewed at night.


Source: Christchurch City Council

Braided River Footpath

The braided river starts at the spring viewing area and ends at the seating wall and follows the underground pipes carrying spring water. It is constructed from coloured aggregated within concrete along a intertwining alignment to signify the braided river channels common of the Canterbury Plains.


Source: Christchurch City Council

The Seating Well

The seating well allows people to hear, touch, and interact with the spring water. The pressure of the spring was insufficient to bring water up to sidewalk level so a stepped well goes down to the water which is piped into the well from the spring. The water then cascades into a rock pool prior to disappearing through a sump at the headwall. The headwall contains glass tiles depicting children's drawings of the theme "water - from mountains to sea". Individual elements of the drawings were extracted to comprise a larger mountains to sea image. At night, a light illuminates the glass art and creates an array of colours and flickering shadows from the spring water below.

Source: Google Earth, 2006.


Source: Christchurch City Council

NEIGHBOURHOOD DESIGN PRIMER

Introduction

Sustainable neighbourhood planning seeks to achieve long-term socially, environmentally and economically viable communities through design. Planning neighbourhoods and large-scale residential developments to incorporate a mix of housing types, employment opportunities, alternative transportation, and an efficient use of energy and resources take a large step to building sustainable neighbourhoods.


Photo Credit: City of Coquitlam


Photo Credit: Erin Ferguson

Principles of Sustainable Design

Mixed use
Integrated land uses (residential, commercial) promote accessibility

Higher density building forms
Promotes a more compact community

Resource Efficiency & Pollution Prevention
Reduces footprint of community

Transportation Choices
Promotes non-auto transport

Connectivity
Routes and facilities easily accessible and integrated

Human Scale
Pedestrian friendly environment

Provision of Open Space
Supports natural ecosystems

Public Involvement & Stewardship
Encourages public participation

Resiliency / Flexibility
Ensures long-term sustainability

Benefits:

- Healthier living environments
- Compact building forms and alternative energy reduces costs for heating and cooling
- Reduced greenhouse gas emissions
- Local employment opportunities
- Safe and liveable neighbourhoods

Challenges:

- Alternative development standards not yet empirically proven
- Fragmented land ownerships can make implementation more difficult
- Dwelling unit mix difficult to obtain on small level

Popular Neighbourhood Design Frameworks

The two most popular approaches to Sustainable Design are New Urbanism, and Smart Growth.

NEW URBANISM

New Urbanism is one of the most popular approaches to sustainable urban design. Emerging from urban design principles, the emphasis of New Urbanism is on design and neighbourhood character rather than innovations in ecological infrastructure.

- Walkability
- Connectivity
- Mixed Use and Diversity
- Mixed Housing
- Quality Architecture and Urban Design
- Traditional Neighbourhood Structure
- Increased Density
- Smart Transportation
- Sustainability
- Quality of Life

www.newurbanism.org

SMART GROWTH

Smart Growth is a comprehensive approach to planning residential developments and neighbourhoods. Smart Growth's emphasis is on ecological sustainability.

"A strategy for urban growth that emphasizes high density development, consideration for natural spaces and processes, and a general commitment to social and environmental wellbeing."

The following are the elements of Smart Growth:

- Mixed land uses
- Well-designed compact land uses
- Growth in existing communities
- Variety of transportation choices and transit-oriented development
- Diverse housing opportunities
- Open spaces, natural beauty, and environmentally sensitive areas
- Protected agricultural lands
- Smarter and cheaper infrastructure and green buildings
- Unique neighbourhood identity
- Engaged citizens

Smart Growth on the Ground: www.sgog.bc.ca

Photo Credits: Complete the Streets

Evaluation Systems

Evaluation systems are important methods for empirically measuring the sustainability of a neighbourhood's design.

LEED-ND

LEED for Neighbourhood Development (LEED-ND) is a rating system that integrates the principles of smart growth, new urbanism, and green building into the first standard for neighbourhood design. Using the framework of other LEED rating systems, LEED-ND recognizes developments that successfully protect and enhance overall health, natural environment, and transportation choice in their projects.

Image Credit: Dockside Green

Founded on scientific standards, neighbourhoods earn points for innovative strategies regarding sustainable site development, water savings, energy efficiency, materials selection, and indoor environmental quality.

In addition to general point categories, neighbourhoods designated as LEED-ND must meet standards in the following compulsory pre-requisites:

- Smart Location
- Proximity to Water and Wastewater Infrastructure
- Imperiled Species and Ecological Communities
- Wetland and Water Body Conservation
- Agricultural Land Conservation
- Floodplain Avoidance
- Open Community
- Compact Development
- Construction Activity Pollution Prevention

LEED-ND rating system is in the pilot phase from 2007-2008. 238 projects are registered as pilot projects, including a number in Canada and Northwest U.S., and seven in British Columbia:

- Dockside Green, Victoria
- Garrison Crossing, Chilliwack
- Rainbow Hill, Victoria
- South East False Creek, Vancouver
- Wesbrook Place Neighbourhood Plan, Vancouver
- Westhills Green Community, Langford
- Whistler Athletes Village, Whistler

Sustainable Neighbourhood References:

Federation of Canadian Municipalities - Sustainable Communities
http://sustainablecommunities.fcm.ca

New Urbanism
www.newurbanism.org

Smart Growth on the Ground
www.sgog.bc.ca

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UniverCity
Burnaby

Image Credits: UniverCity

UniverCity is an award-winning sustainable community atop Burnaby Mountain on Simon Fraser University (SFU) lands. In 1995, SFU entered into an agreement with the City of Burnaby that resulted in the transfer of 332 hectares of university land to the City of Burnaby as a conservation area in exchange for approval to build a new community surrounding the campus.

Development will occur within two areas inside of Ring Road: the East neighbourhood (The Highlands) and the south neighbourhoods adjacent to Naheeno Park. Naheeno Park contains the headwaters for local watercourses and is to be maintained as a 28.7 acre natural area.

Currently the project is in construction of the first phase (The Highlands) with many buildings completed. Development of the UniverCity community is expected to occur over a 20 year time frame.

Development is managed by the SFU Community Trust with input from the Community Advisory Committee which is comprised of members from the campus community, as well as local interest groups.

Land Area:	200 acres (81 hectares)
Residential units:	about 4500, no detached single family homes
Estimated pop.:	10,000
Density:	30 units/acre with underground parking
FSR:	0.45 - 1.89
Office/Retail:	25,000 m^2
Developers:	Intergulf Development Group, Liberty Homes Ltd, Millenium University Homes Ltd, Polygon Family of Companies, VanCity Enterprises

Awards:
- 2005 BC Hydro Power Smart Award for Residential Building Development
- 2005 Association of University Real Estate Officials
- 2005 City of Burnaby Environmental Award
- 2005 Urban Development Institute Award of Excellence
- 2005 Georgie Award (Best Environmental consideration & energy efficiency)
- 2005 SAM Community Development Award

GOAL

"to create a vibrant, self-sustaining community known for its well planned neighbourhoods, its strong links to the university and its deep respect for the natural heritage of Burnaby Mountain"

GUIDING PRINCIPLES

Environment
A community with a sustainable future

Equity
A livable and inclusive community

Economy
A financially secure community

Education
A community focus on lifelong learning

BUILDINGS

Sustainability guidelines are enforced through a land-lease mechanism and ensure buildings are constructed in a more environmentally responsible manner. The green building guidelines have several performance categories with specified required green building practices. An additional list of encouraged practices can be adopted in exchange for an increase in density.

The Cornerstone is a 4 storey mixed-use building with over 15 street level retail units, office space above, and 115 residential units. It was developed by the Trust to allow greater control over design, innovation and tenancy. Green features include geothermal heating, dual flush toilets, waterless urinals, low flow showerheads, green roof, a ventilation system that recovers heat from building exhaust, and EnergyStar appliances.

The Verdant is a non-market residential townhouse project developed by VanCity Enterprises in partnership with SFU Community Trust. Verdant is 60% below the model national energy code emitting 374 fewer tonnes of greenhouse gas emissions than a similar project built to code. Energy saving features include low-E windows, energy-efficient appliances, compact fluorescent lighting, natural cross ventilation, geoexchange heating system, and zoned occupancy controlled lighting in circulation spaces. Other green features include 2 dedicated car coop parking stalls, onsite stormwater detention, healthy paints, adhesives, sealants and carpets. Verdant provides affordable housing with its pricing program. Homes are sold at 20% below current market value with 3 conditions: owners must live in the unit, preference is given to SFU staff and faculty with children, and units must be resold at 20% below then-current market prices.

SFU Highlands

The Verdant

The Cornerstone

The Fountain

STORMWATER MANAGEMENT

UniverCity manages stormwater through innovative approaches aimed at demonstrating new municipal standards for stormwater management integrating public road design and on-site infiltration. Developments are required to implement and maintain site specific stormwater management practices such as permeable pavers, swales, retention ponds. Part of the funding for the stormwater initiatives was provided by a $350,000 Green Municipal Fund Grant.

LANDSCAPING

A series of bike and pedestrian trails provide both recreational and transportation opportunities in the community. Native plants are used in landscaping, and an integrated pest management plan has been developed. Garbage is kept locked-up underground to avoid conflicts between humans and wildlife.

TRANSPORTATION

UniverCity is designed as a mixed-use community encouraging walking, cycling, and the use of public transportation. Transportation initiatives include providing a shuttle service from the bus loop to the SkyTrain, a car coop with 2 hybrid cars, bicycle storage facilities, a subsidized transit pass offered at one quarter of the regular transit pass cost, and a solar powered traffic signal. Landscaped curb bulges, a roundabout for traffic calming and serving as a gateway, and walking and bike paths also contribute to pedestrian friendly roadways.

SOCIAL SUSTAINABILITY

Housing affordability is ensured through non-market housing in the Verdant building as well as the provision of secondary suites within condominium units. The secondary suites are provided as the third bedroom which contain a kitchen and bathroom, and have a direct entrance to the main building corridor. Retail opportunities promote the family-owned business and prohibit national and international chains. Residents of UniverCity have access to many amenities at SFU such as the athletic facilities and libraries through a community card.

UniverCity incorporates principles of stewardship and environmental education through highly visible processes such as stormwater management and a solar powered trash compactor.

By adopting the green building techniques featured in the Cornerstone, the SFU Community Trust has encouraged developers to expand green building practices. This has also led to residents adopting environmental initiatives.

REFERENCES

UniverCity website
www.univercity.ca

SFU Media Release
www.sfu.ca/pamr/news_releases/archives/news07060501.htm

City of Burnaby
www.burnaby.ca/cityhall/departments/departments_planning/plnnng_plans/plnnng_plans_smnfrs.html

Dockside Green
Victoria


Image Credit: Dockside Green


Image Credit: Dockside Green

Dockside Green is a sustainable community built to LEED Platinum standards. It is a $365 million dollar mixed-use development with residential, retail, office, and light industrial space.

Land Area: 15 acres
Residential Dwellings: 1,100
Estimated Population: 2,200
Gross Density: 73.3 dwelling units per acre (147 persons per acre)
Built Area: 1.3 million square feet (120,774 square meters)
Retail: up to 7100m² **Office:** 8000m² Some Light Industrial
Developers: Windmill Development and VanCity Enterprises

"Dockside Green will be a socially vibrant, ecologically restorative, and economically sound and just community. It will be a distinct collection of beautifully designed live, work, play and rest spaces designed to enhance the health and well being of both people and ecosystems, both now and in the future."

SITE

The Dockside Lands are located across the harbour from downtown Victoria on land previously used for industrial activities including a shipyard, rail line, propane operation, asphalt plant, and cedar shingle mill. Adjacent land uses include residential to the west, industrial land and the harbour to the east, hotel and resort to the south, and industrial to the north. The regional Galloping Goose Trail runs along the eastern portion of the property.

Residential units will be a mix of 1, 2, and 3 bedroom condominiums, garden flats, and 2 and 3 storey townhouses, some of which accommodate live/work units. Approximately 10% of all units on the municipal purchased lands will be designated as affordable housing. The Capital Region Housing Authority will manage 47 rental units and the developers will provide 26 market affordable units for purchase geared towards households with incomes between $35,000 and $51,000. Buildings are constructed around a central greenway featuring a stormwater wetland and providing pedestrian connections throughout the development.

GUIDING PRINCIPLES

A committee was organized to create a long-term vision for the Dockside lands owned by the City of Victoria. The committee devised 10 planning principles to guide future development that were then transformed into the development concept and led to the creation of a detailed evaluation matrix for the RFP. This matrix evaluated projects based on the triple bottom line approach and proposals were able to earn points in each of the social, environmental, and economic categories. The Triple Bottom Line approach balances economic development and profit with environmental and social benefits and now serves as the guiding principle for the development of Dockside Green.

BUILDINGS

Dockside Green is striving to have all buildings certified according to LEED Platinum standards. Failure to achieve this means forfeiting a $1 million dollar security bond to the City. LEED - Platinum buildings incorporate environmentally responsible practices in site selection and design, energy use, water use, materials, and waste.

Materials *(over 90% of construction waste diverted from landfill)*

In addition to salvaging, recycling and reusing materials during construction many buildings use sustainable building materials including:

- using wood harvested from forests submerged by hydro dam development
- sustainably harvested bamboo flooring
- wheat board substrate used in cabinets
- option for wool carpets
- 30-40% fly ash content in cement
- *Cool Carpet* a green house gas neutral product used in common areas

Energy *(51% modeled energy savings)*

All of the heat required by the development is produced on-site through a district biomass system and sewage recovery unit. The biomass system takes hog fuel and converts it into gas in order to produce heat. Within the buildings energy conservation measures add up to about 51% less energy consumed than a typical development and include:

- motion sensor lighting
- heat recovery on ventilated air
- Low E double glaze windows

Waste

All sewage and wastewater generated from the development will be treated on site in the tertiary sewage treatment plant. Untreated sewage and wastewater flows into a bioreactor, passes through a series of filters, then is disinfected with UV lights. Dockside Green has applied to the City to treat municipal sewage in order to keep the plant operating before the all of the Dockside residences are occupied. All buildings have recycling rooms.

Food

The development is exploring the purchase of shares in community-supported agriculture and is near weekly summer farmers markets.

Water *(approximately 66.5% less water used than typical development)*

As stormwater flows from buildings into the wetland, natural vegetation filters out pollutants, and treated grey water and stormwater slowly make their way to the harbour. Water conserving features will include:

- treated wastewater will be used for irrigation, flushing toilets, and water features
- low flow fixtures and appliances in the buildings
- stormwater will be captured by green roofs and used to irrigate roof vegetation, balcony planters, and to recharge the water features.

Transportation

The transportation plan includes:

- a central pedestrian pathway
- bike paths
- a car share program
- secure bike storage facilities for each unit
- a mini-shuttle to downtown
- enhancing the regional Galloping Goose trail
- harbour ferry dock.

Car access remains at the periphery of the site and streets will be enhanced with the provision of bike lanes and an improved pedestrian-friendly environment.

Image Credit: Dockside Green

"We are attracting purchasers who are interested in sustainable living and businesses that are committed to social and environmental ethics"

~Joe Bellegham as quoted in the Globe and Mail, July 13 2007

Image Credit: Dockside Green

A potential challenge to the overall sustainability of the project is that 26% of buyers are from Alberta, most of whom are purchasing the condos as recreational properties.

Dockside Green is striving to be the first platinum LEED Neighbourhood Development in North America.

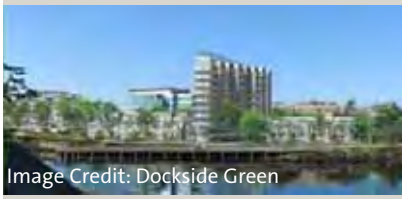

Image Credit: Dockside Green

REFERENCES

The Dockside Green project website
www.docksidegreen.com

Dockside Green Annual Sustainability Report
www.victoria.ca/cityhall/pdfs/currentprojects_dockside_sstnbl_rprt.pdf

City of Victoria Dockside Green Website
www.victoria.ca/cityhall/currentprojects_dockside.shtml

ENVIRONMENTAL EDUCATION

Initiatives supporting environmental education include:

- digital meters in each unit so residents can track water & electricity consumption
- interpretive signs detailing the environmental & social history of the area
- eco-education sessions for all new residents
- visibility of environmental processes such as the stormwater management system

Southeast False Creek
Vancouver

Source: City of Vancouver




Image Credits: City of Vancouver

Southeast False Creek is a model sustainable community incorporating energy efficient design. It will be a mixed-use community located on what was formerly industrial land supporting sawmills, foundries, ship building, metal working, salt distribution, and warehousing. Included in the new community plan is the preservation of five historic industrial buildings.

Land Area: Total: 80 acres (32 ha)
City-owned 50 acres (20 ha)
Privately owned 30 acres (12.1 ha)
Residential Dwellings: >5,000 units
Estimated Population: Total 12,000-16,000
Gross Density: 62.5 dwelling units per acre
Commercial/Light Industrial Space: 18,600m^2

"SEFC is envisioned as a community in which people live, work, play and learn in a neighbourhood that has been designed to maintain and balance the highest possible levels of social equity, livability, ecological health and economic prosperity, so as to support their choices to live in a sustainable manner."

SITE

Southeast False Creek's residential development focuses on family housing with provisions for non-market and modest-market housing. The community is organized into three precincts based on historic land use patterns in the area: works yard, shipyard, and rail yard. Each precinct will have distinct features but common elements uniting the precincts include parks, greenways, openspace, and the street network.

The Works yard will be primarily residential with townhouses and four to eight storey apartments, pocket parks, and a large waterfront park under Cambie Bridge.

The Shipyard will be a mix of commercial, institutional, and residential uses which features a vibrant waterfront with connections to 1st Avenue along Manitoba Street. It will also contain the community centre and elementary school and building heights will be lower at the waterfront and become taller towards 1st Ave.

The Rail yard's focus is a large waterfront park which extends to 1st Ave and the Ontario Street Greenway/Bikeway. Residential units will be predominantly low-rise and mid-rise apartments.

GUIDING PRINCIPLES

Implementing Sustainability:
SEFC should promote the implementation of sustainable development principles in an urban setting.

Stewardship of Ecosystem Health:
SEFC plan should improve the health of the False Creek Basin and encourage resouce conservation and waste reduction.

Economic Viability and Vitality:
SEFC development should ensure viability without subsidy and encourage a vibrant and vital community.

Social and Community Health:
SEFC should be a livable, complete comunity suporting social networks and enhancing quality of life for all in the neighbourhood.

ENVIRONMENTAL SUSTAINABILITY

Energy

The goal is to establish an energy efficient and green house gas neutral neighbourhood. This will be achieved through the use of renewable energy sources, energy conservation strategies, core system strategies, and heat source and systems strategies. For Phase 1, the Olympic Village, sewer heat recovery will provide the heat source for buildings and domestic hot water.

Buildings

All buildings in SEFC are to be at least LEED Silver. The Olympic Village is seeking LEED Gold and the community centre will be LEED Platinum.

Water

In SEFC, the use of potable water will be minimized in domestic use as well as irrigation. Stormwater will be captured by green roofs on all buildings as well as retained on site, and filtered through bioswales before being discharged.

Food

An urban agriculture strategy has been created for SEFC. This will include a demonstration community garden adjacent to the waterfront park and the school, the introduction of edible landscapes in public spaces, a farmers market site, and green roofs supporting urban agriculture.

Waste

There will be facilities available for the separation, storage, and collection of garbage, organics, and recyclables as well as onsite composting used in landscaping.

Transportation

Transportation routes are designed with priority given to pedestrians, bicycles, transit, movement of goods, and the automobile, in that order. There will be dedicated bike lanes, off-street bike pathways and greenways. A street car will run along 1st Avenue, and a ferry dock will be installed on the waterfront. The street patten will be altered in the mid-rise buidlings area resulting in a finer grain, more pedestrian friendly urban environment. The north-south alignments will connect the private and public lands, and mews will be added to the east-west alignments. The northernmost street will be shifted closer to the water.

Environmental Education

SEFC will encourage awareness and understanding of the principles of sustainability, and their implementation
through demonstration projects, a stewardship advisory group, and design features.

Model/Photo: Millenium Properties

Source: City of Vancouver

REFERENCES

City of Vancouver Southeast False Creek website: *www.city.vancouver.bc.ca/commsvcs/southeast*

Southeast False Creek & Olympic Village Office: *www.city.vancouver.bc.ca/olympicvillage/*

Southeast False Creek Policy Statement *http://ftp.vancouver.ca/commsvcs/southeast/policystatement/sefcpolicy1999.htm#vision*

A potential challenge to the overall triple of the project is that 26% of buyers are from Alberta, most of whom are purchasing the condos as recreational properties.

1A | Works yard
2A | Shipyard
3A, 3B, 3C | Rail yard

Lands designated with an A are City owned. Lands designated with a B or C are privately owned. Affordable housing will comprise at least 20% of 1A, 2A, 3A combined and modest market housing will be up to 33% of 1A and 3A combined, and 33% of 2A. In 1A, 2A, 3A, 3B 35% of housing will be suitable for families with small children and 25% of housing in 1B, 2B, 3C will be suitable for families with small children.

Source: City of Vancouver (http://www.city.vancouver.bc.ca/commsvcs/southeast/public/07mar13+15/illustrativeplan.pdf)

FURTHER RESOURCES

Green Building

General

Green Value - Green Buildings growing assets
www.gvrd.bc.ca

Lighthouse Sustainable Building Centre
www.sustainablebuildingcentre.com

GVRD BuildSmart
www.gvrd.bc.ca/buildsmart

Greener Buildings
www.greenerbuildings.com

Green Building.com
www.buildinggreen.com

Santa Monica Green Building Program
http://greenbuildings.santa-monica.org

Resource Guide for Sustainable Development in an Urban Environment
www.vulcanrealestate.com

Planning, Design & Construction Strategies for Green Buildings
www.greenbuildingsbc.com

Canadian Construction Association
www.cca-acc.com/greenbuilding

The Green Building Initiative
www.thegbi.org/gbi

International Initiative for a Sustainable Built Environment
www.iisbe.org

BC Building.Info
www.bcbuilding.info

Advanced Buildings Technology and Practices
www.advancedbuildings.org

American Institute of Archites - Committee on the Environment
www.aia.org/cote_default

Whole Building Design Guide
www.wbdg.org

A Sourcebook for Green and Sustainable Building
www.greenbuilder.com

Environmental Design + Construction
www.edcmag.com

Green Building Resource Centre
www.globalgreen.org/gbrc

Green Biz.Com
www.greenbiz.com

Joint UK-Sweden Initiative on Sustainable Construction
www.ukswedensustainability.org

Basic Green Practices

16 Ways to Green Your Home: Lower the Impacts of Everyday Living
www.usgbc.org

What to Look for in an Eco-home
www.saltspringenergystrategy.org

Basic No Cost Green Building Strategies- American Institute of Architects
www.aia.org

Green Design Process

Green Practice Advice - American Institiute of Architects
www.aia.org

GreenBiz Architecture and Design Backgrounder
www.greenerbuildings.com

Checklist for Environmentally Responsible Design and Construction
www.buildinggreen.com

Challenges

Watch out for the pitfalls of green design - The American Institute of Architects
http://soloso.aia.org

Materials

GreenBiz Materials Backgrounder
www.greenerbuildings.com

Sustainable Buildings: A Materials Perspective
www.chha.ca

Eco Options
www.ecobuildingoptions.ca

Pharos - Material Selection
www.pharosproject.net

Products

Green Building .Com Green Building Products Directory
www.buildinggreen.com

Environmental Home Centre
www.environmentalhomecenter.com

Eco Options
www.ecobuildingoptions.ca

Rating Systems

LEED- US Green Building Coucil
www.usgbc.org

LEED Canada - Canada Green Building Council
www.cagbc.org

The Living Building Challenge
www.cascadiagbc.org

Residential Environmental Assessment Program (REAP)
www.planning.ubc.ca

R-2000 Program
r2000.chba.ca OR
www.oee.nrcan.gc.ca

Built Green Society of Canada
www.builtgreencanada.ca

Built Green BC
www.chbabc.org

Green Globes: Building Owners and Managers Association of BC
www.boma.bc.ca/gogreen.php

Site

Sustainable Sites

http://sustainablesites.org

Market

Market Insights in BC Building Industry
www.sustainablebuildingcentre.com

Funding

Canadian Construction Association
www.cca-acc.com/greenbuilding

FCM Green Municipal Fund
http://sustainablecommunities.fcm.ca

Water

Environment Canada - Water Efficiency/Conservation
www.ec.gc.ca/water

Water Balance
www.waterbalance.ca

Case Studies

The Green Building Initiative
www.thegbi.org/gbi

Lighthouse Sustainable Building Centre
www.sustainablebuildingcentre.com

Canada Housing and Mortgage Corporation
www.cmhc.ca

Canada Green Building Council
www.cagbc.org

Cascadia Region Green Building Council
http://cascadiagbc.org/resources

Advanced Buildings Technology and Practices
www.advancedbuildings.org

Joint UK-Sweden Initiative on Sustainable Construction
www.ukswedensustainability.org

Saltspring Eco-Home Tour
www.saltspringenergystrategy.org

Policy

The Green Buildings Guide: Tools for Local Governments to Promote Site Sustainability
www.wcel.org

Energy

BC Sustainable Energy Association
www.bcsea.org

BC Energy Plan
www.energyplan.gov.bc.ca

Canadian Solar Industries Association
www.cansia.ca

Solar Energy Society of Canada
www.sesci.ca

Canadian GeoExchange Coalition
www.geo-exchange.ca

Clean Energy Canada
www.cleanenergy.gc.ca

BC Hydro
www.bchydro.com

Canadian Renewable Energy Network
www.canren.gc.ca

Canadian Wind Energy Association
http://canwea.ca

Centre for Energy
www.centreforenergy.com

BCIT Applied Research
www.bcit.ca/appliedresearch

World Energy Council
www.worldenergy.org

Equilibrium Housing
http://www.cmhc-schl.gc.ca

Green Communities Canada EcoEnergy
http://egh.gca.ca

Green Infrastructure

General

Federation of Canadian Municipalities - InfraGuide
http://sustainablecommunities.fcm.ca

The Green Infrastructure Guide : Issues, Implementation Strategies, and Success Stories
www.wcel.org

Green Roofs

BCIT Centre for the Advancement of Green Roof Technology
http://commons.bcit.ca/greenroof

District Energy

District Energy Community Resource Centre
www.cdea.ca

District Energy Library
www.energy.rochester.edu/deassn.htm

International District Energy Association
www.districtenergy.org

Low Impact Development

GVRD Storm Source Control Design Guidelines
www.gvrd.bc.ca

Low Impact Development Centre
www.lowimpactdevelopment.org
www.lid-stormwater.net

Still Creek Rehabilitation and Enhancement Study
www.city.vancouver.bc.ca

Low Impact Development Design Strategies
www.epa.gov

Sustainable Neighbourhoods

ECOCITY Builders
www.ecocitybuilders.org

Smart Communities Network
www.smartcommunities.ncat.org

Federation of Canadian Municipalities - Sustainable Communities
http://sustainablecommunities.fcm.ca

Ubafabrik Berlin
www.ufafabrik.de

CityGreen Solutions
www.citygreen.ca

Sustainability Now
www.sustainability.ca

Natural Infrastructure

Natural Green Infrastructure

Open Space Seattle 2100
www.open2100.org

EPA Greenscapes
www.epa.gov/epaoswer/non-hw/green

NaturescapeBC
www.hctf.ca

Green Infrastructure: Smart Conservation for the 21st Century
www.sprawlwatch.org/greeninfrastructure.pdf

Cities in Nature: Case Studies of Urban Greening Partnerships
www.evergreen.ca

Urban Agriculture

City Farmer
www.cityfarmer.org

Vancouver Urban Agriculture
http://vancouverurbanagriculture.ca

Transportation

Transportation Alternatives
www.transalt.org

Home Zones
www.homezones.org

SMILE - Sustainable Mobility
www.smile-europe.org

CarFree Cities
www.carfree.com

Better Environmentally Sound Transportation
www.best.bc.ca

Go For Green: Active Living and Environmental Solutions
www.goforgreen.ca