water + building landscape

Millennium Water:
The Southeast False Creek Olympic Village
Vancouver, Canada

THE CHALLENGE SERIES

06

THE CHALLENGE
SERIES

CELEBRATING WATER

In an environment as water-rich as the Lower Mainland of British Columbia, it is easy to use water with complete abandon. We don't save it, we throw it away blithely, we think little about how we use it. Water is taken for granted – as it is in many other industrialized, wealthy, water-rich corners of the world.

We overlook important truths when we are frivolous with water. The first is that water – the treated, drinkable, piped-to-your home commodity used in North America for every household purpose – is energy intensive. Every time we use it we depend upon a vast infrastructure that collects, cleans and delivers it to us, then carries it away, treats it and discharges it far from our homes. Using less water saves energy, and reduces the polluting and warming impacts of energy production.

Of course, it is easy to overlook what you do not see. In aiming for all sorts of goals, laudable and otherwise, modern cities have effectively rendered water invisible. To allow for unhindered vehicle movement, public health, dry basements, tall buildings, efficient maintenance and development patterns based on straight lines and hard surfaces, modern cities have paved over streams, drained wetlands, channelled water into culverts and pipes, and forced this precious resource underground, inside walls and out of sight.

This causes us to overlook another important truth. We know, scientifically, that our bodies are made of water. But we have lost our relationship to it. Most of us only know it as a flow from a tap. We are unaware of its cycles, its ecology. We forget that we share it with salmon and eagles, forests and farms. We don't know where it goes when it disappears down the drain.

Water is perhaps the best place to start the shift towards sustainability because it defies non-holistic thinking. It flows from place to place, adapts to any environment, infiltrates any opening. It is a connective tissue, linking us to our landscape and all the life around us – literally flowing through our bodies as it cycles within our ecosystem. Stopping the flow of water is like ceasing to drink – life withers quickly.

The designers of SEFC were told to bring water back onto the landscape, to make it visible, to "Celebrate the Water." Celebrate, indeed. For where we have water, we have life. How we treat water is, then, how we treat life. And where we learn to celebrate life – its perpetual flows and transformations of matter, energy, spirit, and yes, water – we take another critical step towards sustainability.

CHAPTER SIX OVERVIEW

Water is a connective tissue, linking us to our landscape and all the life around us

This chapter explores the skin and lifeblood of the Millennium Water Olympic Village. That is, the green landscape stretched like living fabric over the buildings, and the rain that flows through building catchment systems, circulating back to rooftop and sky, before journeying beyond the development on its various paths to the sea.

Building landscape – once considered little more than a decoration at a doorstep – has evolved into a critical living element of sustainable building. Green roofs support passive design and mitigate the negative impacts of the built environment on the natural one, while rooftop and ground-level gardens encourage neighbourly exchanges, shared food and social sustainability. Bees, birds and barbecues are welcome here. In more ways than one, the building thrives.

The story of water at the Olympic Village can be rendered simply: rainwater is used for toilet flushing and irrigation, reducing water taken from the municipal reservoir. And runoff from dirty streets is cleaned in a wetland, where children and fish can also play. As with all stories of sustainability, however, there is much more under the skin. The intensity of design shifts, the challenge of leaving known territory for new initiatives, the complexity of trying to address multiple sustainability imperatives within single, elegant solutions – these are the stories of this chapter, captured so they can continue to inform the future.

Patrick Lucey – A Completely Different Design Approach

India and China are proposing to build 200 new cities over the next 15-20 years, each the size of Vancouver. What will those cities look like? At the moment, new cities mostly look and function like existing cities – a very daunting picture. To understand why, look back 2,000 years.

The Romans figured out how to do three things extremely well: build good roads, bring water over enormous distances and get waste out of cities. But they couldn't build up because they didn't have electric pumps or steel-reinforced concrete. Their curse was sprawl; it drove them insane and made their cities inefficient.

In comparison, consider the fundamental patterns that nature has used repeatedly for 4.5 billion years. First, all life forms are based on water. Second, nature doesn't have an open-ended system – she has no "wastes."

In nature, when rainwater falls from the sky, much of it evaporates directly back from the surface of plants, or is taken up by their roots and transpired. If you track a single molecule of water, it doesn't go from the sky, to the ground, into the river and back to the ocean. It's recycled many, many times by plants and animals first.

However, for 2,000 years we've followed the Romans' lead. We have a water supply – often pirated from outside our own watershed – which we pipe into the city. We use it once and then discharge it, usually harming the environment that receives it. We bring resources in and we discharge waste out: sewage, wet organic waste, garbage. We use everything once in an open-ended transport system.

To fix this, we're focusing on the wrong things. Low-flow toilets, water conservation – this is still the path of consumption and waste. They are mitigation, when what we need is regeneration – a completely different design approach for the 21st century.

At SEFC, we've begun to close the loop. There's a dramatic reduction in the amount of water needed from outside the system, and water is back on the landscape where it belongs. The SEFC development represents a fundamental shift in design – a bit like looking into a crystal ball. It says, "This is what is possible."

We have to bow to the people at the City of Vancouver who had the courage to step outside their regulations and codes, to say, "This needs to be done and we will be the first to do it." Now, they face a real opportunity – four blocks to the east, where 500 acres of old rail yards lie. There, they could build a completely self-contained city within one giant eco-block – and show the world what the smart, clean, green cities of the 21st century can be.

Patrick Lucey
Aqua-Tex

The SEFC development says, "This is what is possible."

As a society, we have classified water to try and understand and manage it. This has created a problem, however, because there is no such thing as stormwater, drinking water, rainwater or wastewater. There is only water. By classifying types of water and believing that we understand it, we have oversimplified the complex set of interactions and pathways that nature uses to clean, store and renew the resource.

We have also created rules around how each type of water can be used. This has led to a disintegration and fragmentation of ecosystems and their services. For example, we use the terms surface water (e.g. lakes and streams) and groundwater. Yet where does surface water come from in the summer months? The ground.

Where does groundwater come from? Not the hot centre of the earth; it comes from the sky. Many people never mentally connect the two so we pave over the soil and inhibit groundwater recharge, and then wonder why our streams dry up.

Value is derived from complexity, yet we seek to simplify ecosystems all the time. Thus we devalue them and the rich services they provide. This can lead to some very poor (and potentially dangerous) decisions.

Cori Barraclough
Aqua-Tex

CELEBRATE THE WATER The management of stormwater within SEFC has been one of the main guiding principles informing the design of the public and private open space, leading to strategies of retention, reuse and replenishment. Rainwater will be treated as a valuable resource. SEFC Official Development Plan

The design of the Millennium Water Olympic Village was heavily influenced by a single imperative laid out in the official development plan: no potable water was to be used for irrigation. As the integrated design process took hold, however, the team pushed well beyond this simple water-saving concept.

"We get plenty of water between October and May, and then little between May and October," says landscape architect Peter Kreuk (see page 27). "So we would fill our cisterns quickly in October, and the water would just sit there till we need it in June. Meanwhile, the rest of the year, water would just keep running off the site as it normally would have. We wanted to do more with the water, so that's why we thought of toilet flushing."

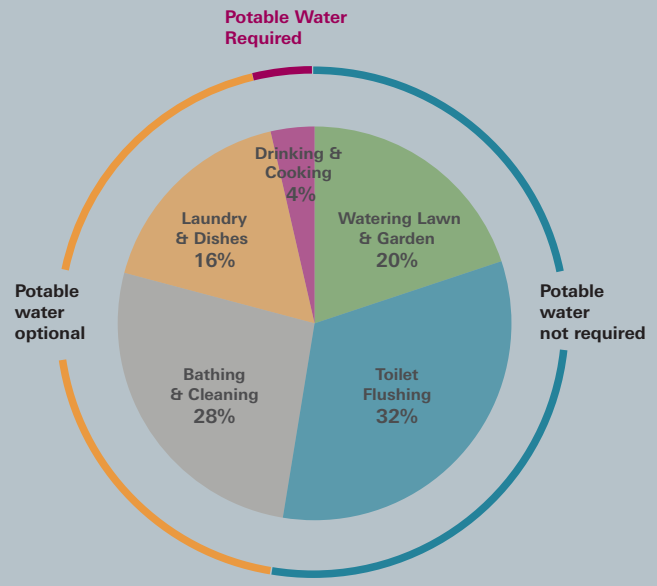
Rainwater that falls on Olympic Village roofs is collected into basement cisterns. These tanks provide water for toilet flushing and irrigation, so municipal water is drawn for these purposes only when the banked supplies run low. The continual collection and use of rainwater throughout the year will provide a 40% reduction in total water demand that the Village places on the municipal reservoir – a far superior conservation performance than if the rainwater were used solely for irrigation.

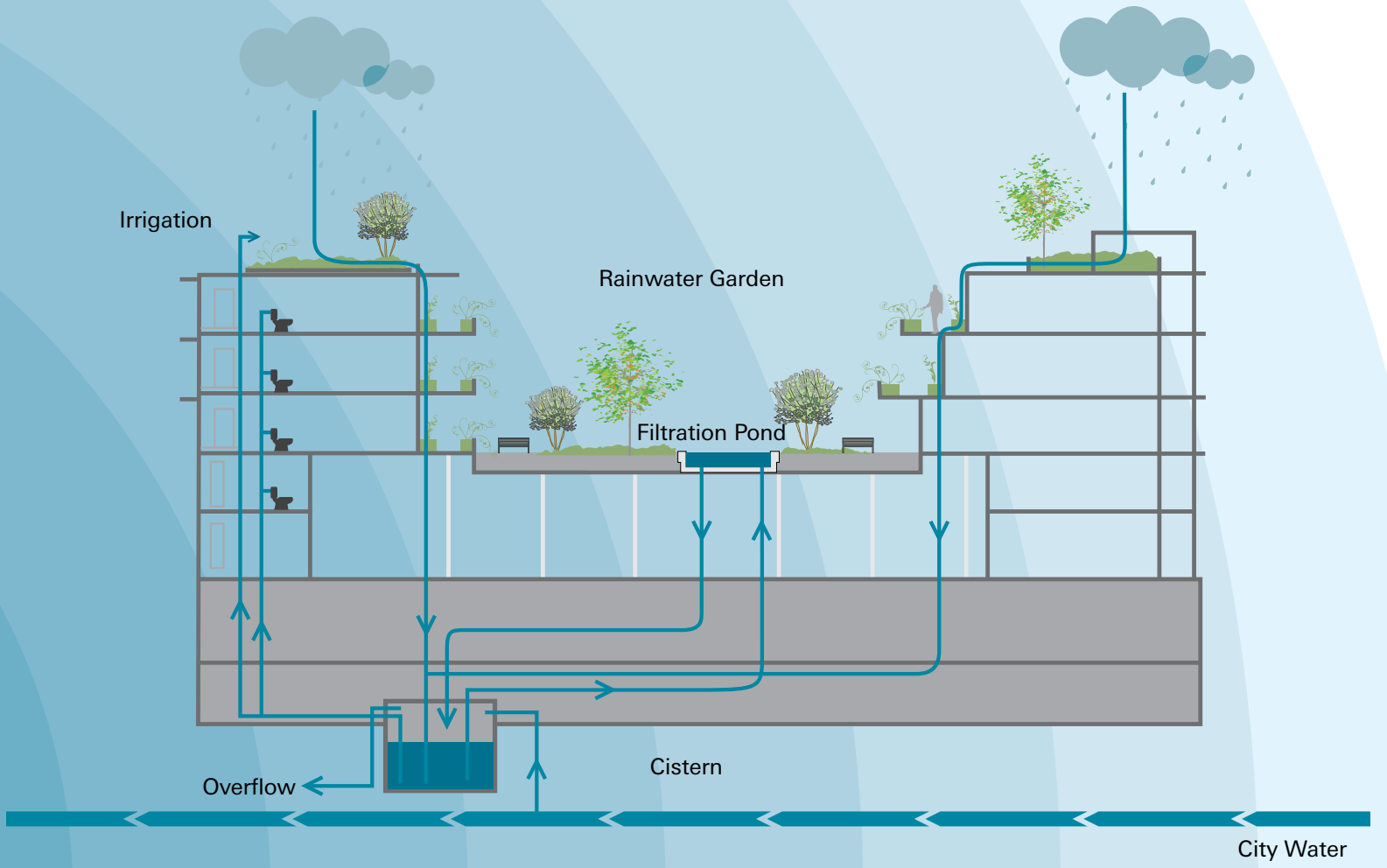
"In SEFC we said, 'We're going to use a fit-for-purpose' approach," says Patrick Lucey, an aquatic ecologist involved in the design. "What that means is that we have two sources of water. For every cubic metre of water we capture from the rooftops, we get to "bank" in the reservoir an equivalent amount of water. Then, we get to use that banked water for irrigation during the dry period if it's necessary, because we haven't put a strain on the reservoir during the rest of the year like everyone else has."

Capturing and using water that naturally falls on the site is one step closer to a system that mimics nature, which recycles water within local systems many times before it runs back to the ocean. While the Olympic Village does not reuse grey water [water left over from cooking or washing] as some sustainable developments do, Lucey says its use of rainwater banking is groundbreaking for the region.

"This whole notion of water banking and water balance is a huge step forward, and a very important and strategic change in the way the City and the region can begin thinking about its water supply. If everybody in the City did what they're doing at False Creek, intuitively, the reservoirs would always stay full."

Capturing and using water that naturally falls on the site is closer to a system that mimics nature





Above: Rainwater circulation diagram shows how rainwater is captured, stored, circulated and used within a typical building.

Left: Chart shows how water is used by residents of Greater Vancouver. Toilet flushing and irrigation are two of the heaviest demands on municipal water supplies. Using rainwater for these activities contributes to the Olympic Village's 40% reduction in standard potable water use.

Systems and Cisterns

Buildings in the Olympic Village include an internal infrastructure entirely dedicated to the capture, storage and usage of rainwater.

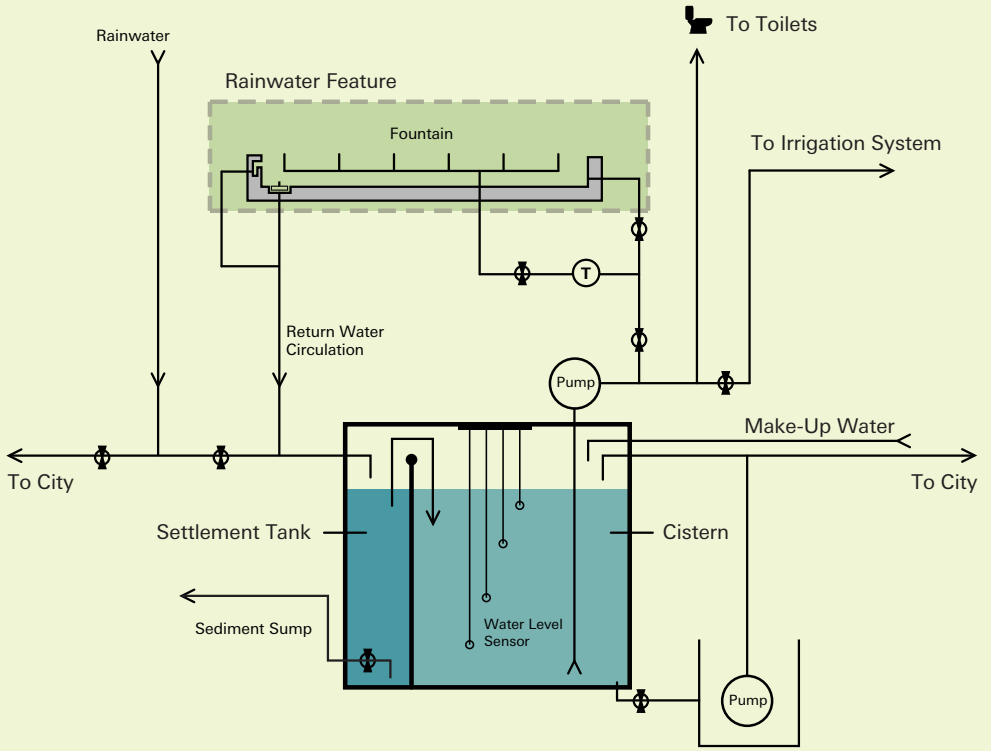
Water is collected from roof and building podium areas, then channelled to cisterns in each building's basement. The rainwater is continuously pumped through courtyard water features and to toilet tanks throughout the building (see page 10) as demand requires. During the summer, water is directed towards irrigation as well.

Each building is able to draw make-up water from the municipal reservoir when needed. During times of heavy rainfall when cisterns are full, the buildings will shed excess water to the first tier of the Village's two-tier stormwater system (page 14).

"Moving forward, this is the type of system that can really help residents use water wisely," says Jason Christensen of Keystone Environmental, which has provided monitoring services for the water in the cisterns. "It's something that needs to happen, so it's good to see."

KEY

- Modulating Valve
- T Timer
- V Solenoid Valve



Rainwater stored in cisterns is circulated continuously through decorative water features in courtyards and on rooftops. This aerates the water and exposes it to sunlight, inhibiting unwanted bacterial growth.

Extended roofing structures on Parcel 2 help collect extra rainwater, and make its collection and use more visible to residents.

Roof Structures

All Millennium Water roofs collect rain. But Parcels 2 and 9 have additional structures specifically for this purpose. "They're like visors, at the top of the building above the parapet," says Stu Lyon of gBL Architects. "They help rain-shield the building, and they extend its capacity to collect rain." The water will fill rain barrels for use in rooftop community gardens before overflowing to the underground cisterns.

"It's a very visible piece of sustainability for anybody working on those rooftops," says Lyon. "No one sees the cistern in the basement, but they can see the water coming off the roof and going into the barrels. Hopefully this has an impact on the way people see their world, and gives them a better appreciation for the value of water, and for saving it for later use."

CHALLENGE **To all North American municipalities: to mandate that all new developments capture, store, and reuse rainwater for toilet flushing and irrigation, on a "water balance" basis, to achieve maximum reductions in the use of municipal potable water supplies.**

PROFILE

Patrick Lucey

Aqua-Tex Scientific Consulting Ltd.

Patrick Lucey's background spans marine, intertidal and freshwater aquatic ecology, as well as 10 years spent in the construction industry. Originally planning to be a pediatrician, a professor changed his mind. "He said the world will have enough pediatricians in 25 years," says Lucey. "What it will need is planetary physicians – people who understand how nature structures the world we live in." Lucey now advocates that every community have a staff "municipal ecologist." "When we have a question about how the landscape works, there is no one to go to, whose primary role is to understand how the landscape we live in functions, and whether it is healthy or not."

Lucey's work has led to several trademarked concepts. The first is "regenerative adaptive design." "It's not enough to mitigate damage," he says. "We need to regenerate natural capital and ecosystem services, and close the loops of energy and water. That's the design process embodied at SEFC."

Another concept is "engineered ecology." "We have to continue our shift from the engineering we've done for 2,000 years, past environmental engineering that started in the 1970s, to the newest form of high tech on the planet – engineered ecology."

Lucey points to the success of the newly rehabilitated shoreline at SEFC, where herring have spawned for the first time in decades. "That's amazing; herring are very sensitive. They told us, "you guys got it right."

Decorative Water Features and Water Quality

Within every parcel of buildings at Olympic Village there is at least one water feature – a rooftop stream, a reflecting pond, even a waterfall. These features help "celebrate water" – but they accomplish much more.

"The features are used to keep rainwater from the cisterns in constant motion so it won't stagnate," says Peter Kreuk. "Running it through the water features aerates it and exposes it to sunlight, which helps kill off bacteria. It's a pretty important functional role in the whole system." Circulation will help maintain the water at a "recreational" quality level – the same required for public swimming at beaches and lakes. "That allows for a certain level of bacteria in the water," says Bill Donald of Keystone Environmental.

"The recreational standard means, 'It's okay to swim in this water, and even swallow some of it, it won't kill you.'" (Nevertheless, it is anticipated that toilets throughout the development will be labeled with a sign reading, "Do not drink.")

Meanwhile, during hot weather, building water features will help provide a cooling effect for residents. "Passive design is subtle. The water in the ponds doesn't do all the work – the surroundings and the local climatic conditions will contribute," says SK Lai of Cobalt Engineering. "But if you sit there and the wind picks it up, the combination of our usually low humidity plus the effect of the pond will mean you'll feel a little cooler."

Walk through SEFC – the "celebration of water" is everywhere you look. Water has been brought back into the landscape – it's on the roofs, it's in the piazzas, it's in the basements. It's extraordinary. Patrick Lucey, Aqua-Tex

Inset series, left: Reflecting ponds at Parcel 4 add beauty and intrigue to the structure's design – and serve the functional purpose of circulating stored rainwater to ensure it stays clean. The water in the ponds thus does not require chlorination, giving the option of adding aquatic plants if desired.

Background: An illustrative plan of the courtyard of Parcel 4 helps to articulate the designer's intent – a thoughtful combination of pedestrian pathways, water features, an LED light sculpture, and a bamboo garden.

Irrigation

With extensive landscaping on the Millennium Water buildings, making sure plants are watered during dry periods is important.

"There is an automatic irrigation system throughout the project," says Kreuk. "There's a weather station and groundwater soil sensors, so if it has just rained, the irrigation system won't go on, but if the soil is dry and there's a scheduled watering, it will. It's based on plant needs and soil conditions, as compared to a standard system where you turn it on in May and it goes on every week until you turn it off in September. It will reduce water use for irrigation by almost 50 percent."

Rainwater Toilet-Flushing

Toilet-flushing is one of the most water-intensive activities in the modern home – which is why using rainwater for this purpose can have a dramatic effect on reducing the demand for municipally supplied drinking water. (See chart, page 6.)

But will residents adopt rainwater toilets with pride, or prejudice? Although the water is expected to eventually run clear once the building landscape has settled and fine organic matter has generally processed away, it is possible that the water may be slightly coloured due to its natural condition. For this reason, the system is designed so that future strata councils can install an additional filtering system if desired.

Inset, left: Water-conserving low-flow fixtures have been used throughout the Olympic Village. Dual-flush toilets such as the one shown output water in either three or six litre capacities – as compared to the approximately 13 litres of water used each flush by conventional toilets. "Three years ago we didn't see these anywhere; now, they're becoming the standard," says Stu Lyon of gBL Architects. "It's a big shift, because these fixtures make it very obvious to the user that they're making a difference [in water consumption] through the way they choose to operate the fixture."

Inset, right: Residents in the Olympic Village will be able to track how much water they're using, and challenge themselves to continually improve their conservation tactics. Each suite is equipped with this Energy Aware visual display system that details the use of resources. (See story, Chapter 5.)

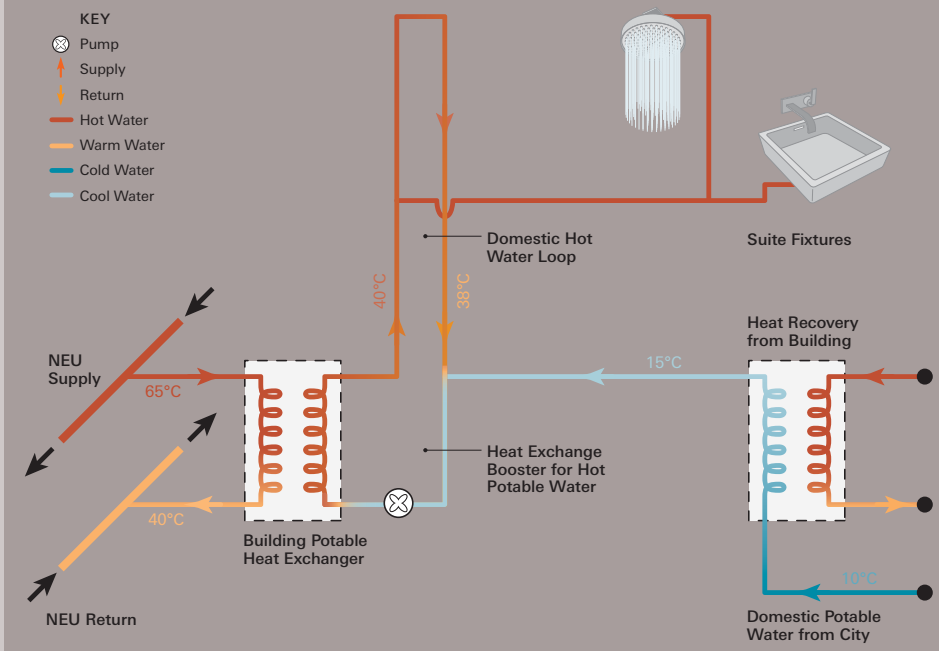
Background: Rooftop plantings will be automatically irrigated when required using stored rainwater.

Heat Recovery and Water Pre-Heating

"If you look at the top of a typical apartment building in the winter, you'll see misty condensation coming off the roof," says SK Lai of Cobalt Engineering. "That's excess heat – it's basically being dumped into the environment and doing nothing else. In the Olympic Village, instead of dumping that heat, we put it back into the system."

Turn on a hot water tap in Olympic Village and you feel warmth captured from a number of sources in the building: cooling systems in the suites, which extract heat during hot weather; parkades, which are warmed by cars and building activities; commercial spaces that generate heat from refrigerators, lighting, cooking and high customer volume; and on a few buildings, solar panels. Heat pumps recycle and transfer this energy, which is then used to warm potable water in a large tank with a coil running around the inside, called a heat exchanger.

Lai says Vancouver's potable water tends to be quite cold – around seven degrees Celsius. For use in a bath or shower, energy from the Neighbourhood Energy Utility is used to bring the temperature up to 45-50 degrees. "To increase the efficiency, we use waste energy to pre-warm that water as much as possible," says Lai. "Then we don't have to use the [NEU] to heat the full amount, which is the savings we're looking for."



Heat recovered from various building activities will be used to pre-heat domestic hot water, reducing the energy required from the Neighbourhood Energy Utility.

Durable Piping

Peek inside the walls in Parcels 3 and 6 and you'll see the way of the future. Gone are the metal pipes used by plumbers for generations.

"This is the only high-rise development that I'm aware of in North America that has done a plumbing system entirely in plastic," says Jim Myers of Jeda Mechanical, the company that plumbed the parcels. Myers says in the past, plastic piping did not meet fire codes, but newer products (Wirsbo and Aquatherm) now do.

Myers says this makes the plumbing system more sustainable and efficient in several ways: plastic pipes last 75-100 years, where copper typically wears out in 15-20, requiring costly and wasteful re-piping of the entire building; water flows more smoothly through plastic, so pipe sizes can be reduced and walls built thinner, increasing interior space; plastic pipes are less labour intensive to install; and plastic pipes can be recycled at the end of their life.

"This is the way all projects should go," says Myers. "This system will last the life of the building."

With building heights in the Millennium Water development ranging up to 13 storeys tall, potable water sitting in the domestic plumbing will create positive pressure in basement water pre-heating tanks. This helps reduce the risk that potable water could ever be contaminated by heat-recovery fluid (which only circulates as high as two storeys), allowing the use of more efficient, single-walled heat exchangers.

Physics and Common Sense

Initially, there was concern that if a breach ever occurred within the heat exchanger used for water pre-heating, the potable water could become contaminated (the heating medium contains chemicals to keep the piping system clean). City officials required a double-wall heat exchanger – a system with an air gap between the heating medium and the potable water.

The trouble, says SK Lai, is that "air is known to be a very good insulating medium. Heat exchanging through an insulator is kind of a waste of time. So we worked with the City to sort this out."

The answer turned out to be gravity. Engineers realized the heating medium would never circulate above two storeys – the highest level of commercial space – whereas potable water will fill pipes to the top storey of each building. Therefore, the potable water system is always under significantly more pressure than the heating medium. If a breach occurs, potable water will infiltrate the heating medium – not the other way around. Based on this (plus sensitive electronic monitors), the City approved the more efficient single-wall heat exchanger.

"If you walk around the site, what you're looking at is common sense and simplicity," says Lai. "Sometimes being green is just coming back to the simple laws of physics."

CHALLENGE **To all residential plumbing system designers: to adopt domestic potable water pre-heating from heat recovery systems, where applicable, using single-wall heat exchanges.**

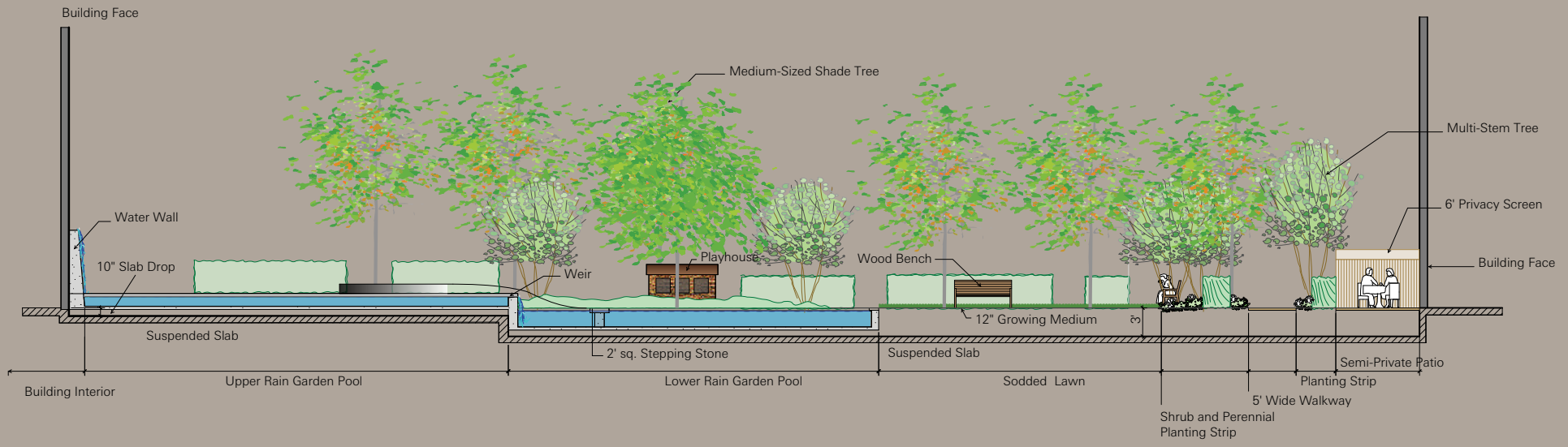
A Two-Tier System

The SEFC Official Development Plan provided specific direction on some aspects of water management for the site. Among them was the idea that stormwater would be showcased in a wetland, rather than hidden in conventional underground storm sewers away from public awareness.

This created challenges for Stantec, which designed the stormwater collection and treatment system. "Ideally, for an area of this size, we would have had a larger stormwater pond," says Garry Romanetz of Stantec. "However, there was only so much land available for Hinge Park and the wetland. So we were forced to work backwards and figure out how much water we could convey and treat within the site constraints. This resulted in a two-tier stormwater system, so we were able to best utilize the lands that were made available."

The two-tier system collects "cleaner" stormwater separately from "dirtier" water. When rain falls on building roofs and podium areas, it is stored in cisterns for reuse. When the cisterns are full, the rainwater is discharged directly into False Creek. "Dirtier" rainwater is that which falls on streets – where vehicle traffic and human activities are heavy. Depending on the location and the site grade, this water is handled in different ways. Some is collected and channelled to the wetland in Hinge Park, where it is calmed, circulated and cleaned by plants (see pages 17-18). Elsewhere, the water enters infiltration galleries underground, which use layers of gravel and sand to remove contaminants before the water enters False Creek. A bioswale along Ontario Street will also pre-treat water prior to discharge from the east end of the site.

The stormwater management plan was also influenced by a flood protection elevation that had to be established at the foreshore. This established roadway grades along First Avenue, and minimum building elevations. In some areas, this required nearly a metre of additional fill.



A Showcase for the Future

Re-thinking centuries of stormwater management proved challenging at times for the integrated design team at SEFC. "I've worked on a number of different Olympic venues," says Garry Romanetz, "and this was the biggest challenge in terms of trying to achieve all the objectives within the constraints presented. It challenged us to provide multiple solutions, because the objectives for the environmental and planning group at times are different from the engineering or the operations and maintenance divisions. It was challenging to see a job scrutinized to the extent this one was."

Wally Konowalchuk, engineer with the City of Vancouver, agrees. "For example, part of the idea of showcasing water was to try to get it on the surface to highlight that we are trying to use it. But water on the surface presents challenges, such as accessibility, and whether people in wheelchairs will be able to get through without facing streams of water, and if it freezes in the winter, will it be a huge icy area." Similarly, a desire for the permeability and aesthetic appeal of paving stones had to be balanced with concerns about long-term maintenance. Says Konowalchuk, "It's hard to bring everyone to a consensus on how to change things from how they are traditionally done."

Romanetz says the end result, including some inverted crown streets, a wetland, infiltration galleries, a bioswale and a two-tier stormwater system, is a plus for the City. "They've got a system that is unique," he says, "and that will offer them tremendous opportunities to evaluate and showcase similar green stormwater alternatives in the future."

> **"It's hard to bring everyone to a consensus to change things from how they are traditionally done."**
>
> Wally Konowalchuk, City of Vancouver

Left page: "Cleaner" stormwater is first used by building landscape systems and stored in cisterns – or, if full, discharged to False Creek.
Inset, left and background: "Inverted crown" streets (with collection channel at centre rather than sides) help make stormwater visible to residents.
Inset, centre and right: Infiltration galleries of sand and gravel help trap contaminants in "dirtier" stormwater.

PROFILE

Garry Romanetz

PEng
Stantec

"I grew up on a farm in rural Manitoba that had its share of man-made drainage issues," says Garry Romanetz of Stantec, who designed the stormwater management plan for SEFC. "We basically had a river that ran through our farm, and a big wetland area. My dad would frequently give me a shovel and send me out to dig a ditch in order to get the water off the farmland fields. I've had a passion for working with stormwater and I've focused most of my career on it – I guess you could say I've been doing drainage work since I was a kid."

Romanetz says the Olympic Village project was complex because of the many goals – from flood protection and aesthetic values to implementing new designs and "celebrating water" – that were to be achieved on a site with limited space.

"There were a lot of ideas," he says, "but my challenge was how to 'engineer' them and get approval from the engineering and operations department. A lot of green ideas potentially have a cost premium and then a long-term maintenance component. I think we managed to balance the concerns of engineering and planning and maintenance for years to come."

THE HINGE PARK WETLAND

At first glance, it's a pleasant place to sit and let the kids play. But this wetland isn't just a community amenity. It also cleans the water that runs off the Village's grounds and streets.

"We developed a layout for the wetland in Hinge Park that's linear and meanders, to reduce the water velocity," says Garry Romanetz of Stantec. "Basically, the longer you are able to put the water through the wetland, the more it gets cleaned before it is discharged to False Creek."

Silt and debris settle in the channel and get trapped by two levels of wetland plants. "They'll keep the water fairly clean," says John Clelland, the City's Coordinator for Hinge Park. "It will never be crystal clear because you're looking at natural water – there will be algae and water bugs and fish swimming around." (Already, there are "tens of thousands" of native stickleback minnows.) The channel opens into a pond where contaminated sediments will collect. These can be pumped out periodically and taken to landfill, instead of entering the ocean.

The wetland also collects water from streams that were long ago paved over but still flow underground. This groundwater base flow will assist in keeping the system wet even during dry periods – with an irrigation system as a final backup if needed. A pumping system also ensures good circulation.

"We often dealt with competing issues when designing various components of the system," says Wally Konowalchuk, the City engineer overseeing the project. "The pump is not needed for the functioning of the wetland itself, and on the face of it, it doesn't sound very sustainable. But there are public health concerns about stagnant water and breeding mosquitoes, so we installed it."

The entire system helps people see and understand the flows of water in their city. "The general public has no idea what's under the road," says Clelland. "Everyone knows there are pipes, but they don't think about what they are or where they're going. Here, we have taken rainwater that we usually hide and created a park. It helps prolong the life of the sewage treatment plant, plus we have birds, we'll have animals. It will be a wonderful place to be, and also a great learning experience for people.

"In Olympic Village and in the park, we're thinking about today and about future generations, by being sensible and practicing good stewardship."

Two levels of aquatic plantings will help trap sediments and contaminants in the Hinge Park stormwater treatment wetland.

"We have taken rainwater that we usually hide and created a park. It will be a wonderful place to be, and a great learning experience for people."

John Clelland, City of Vancouver

A piece of conventional underground storm sewer pipe has been "brought to the surface" and used as a playful bridge.

CHALLENGE **To municipal planners and infrastructure designers: to increase the creative treatment of stormwater as a landscape-level public amenity, both to reduce demand on municipal stormwater infrastructure and to educate communities about water in our ecosystem.**

PROFILE

Wally Konowalchuk

PEng
City of Vancouver

Over six years with the City of Vancouver, Wally Konowalchuk was involved with other sustainability-oriented projects before SEFC. Still, the complexity of building the Olympic Village has been a challenge, particularly trying to adapt current standards to allow for greener options.

"People developed those standards over time, for good reasons," he says. "But they become 'this is what you always have to do.' People get concerned about who is liable, for instance.

"It's evident now that to solve our issues, we have to think outside the box, outside of our own little silo, to come to a greater good. If you don't, you lose a lot of the true functions of engineering – about taking science and applying it to overcome a problem, not just applying science as it was understood 20 years ago.

"Without taking risks, we won't make improvements. We'll just keep building the way we build now – which we know doesn't work. We've got global warming and environmental problems, so we all have to scratch our heads and say, 'How do we change that?' Once people wrap their minds around that, they really get into it. They say, 'What can we do, how can we overcome this challenge?'"

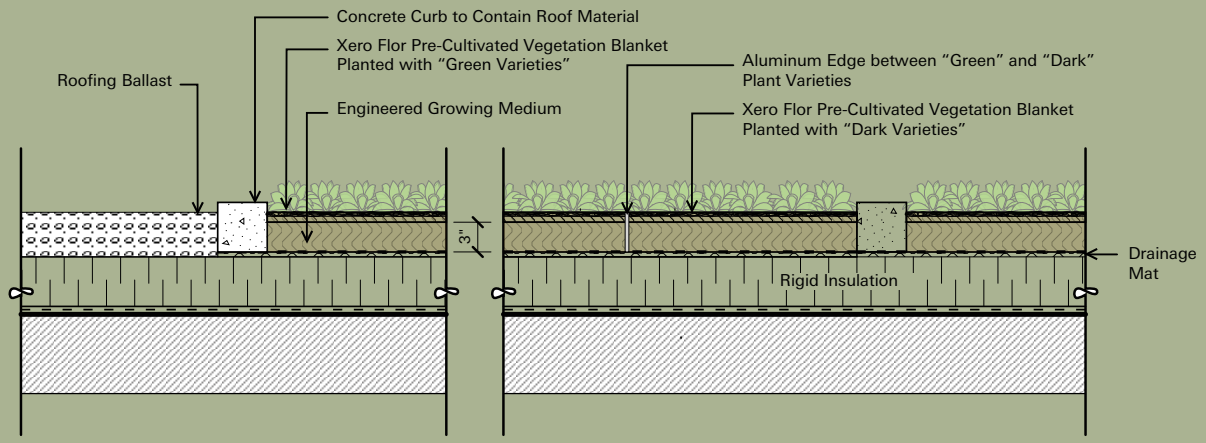
DECONSTRUCTING GREEN ROOFS

Gardens in the sky

Green roofs are vegetated areas installed as an addition to a conventional rooftop. The structure of a green roof can take a number of forms, but always includes a handful of key components: high quality waterproofing and root barrier, a drainage layer, filter cloth, a mineral-growing medium and plants. Root barriers are absolutely essential as they ensure that roots do not penetrate the roof membrane–one of the major fears about installing green roofs. While typical green roof plants do not have aggressive rooting, root barriers are installed as a precaution should any weed species such as cottonwood or alder trees sprout up.

"Intensive" vs. "extensive"

Crossing Vancouver's Cambie Street bridge, if you look out across the Millennium Water development, you'll see trees growing up from the rooftops of the buildings. What you're seeing is referred to as intensive roof gardens. Intensive green roofs feature deeper soil (over 8 inches) and can support a wider variety of plant types. Intensive green roofs are often more labour-intensive than extensive green roofs, which are thinner and lighter, characterized by a light layer of vegetation and growing medium (2-6 inches on average). The plants chosen for extensive green roofs are usually drought-tolerant varieties that, once established, do not require irrigation.



These are five key elements of a green roof:

- Root-resistant layer – a root barrier deters roots from penetrating or damaging the roof membrane
- Drainage layer – drainage mats are used to remove excess water from the growing medium and channel it to drains
- Filter layer – a textile material prevents fine particles from being washed out of the growing medium and impacting stormwater quality
- Growing medium – up to six inches in depth, the mineral-based growing medium has the basic physical, chemical and biological properties needed for plant growth requiring minimal long-term maintenance
- Vegetative layer – plants that can be sustained in a very shallow growing medium (for plant list, see page 20)

Benefits of Vegetated Roofs

People are buzzing about green roofs, likely because green roofs are one of the most visible and easily recognizable green design features on a building. Aside from adding visual appeal, green roofs offer a number of potential social, economic and environmental sustainability benefits.

Beating the Heat

The "heat island effect" is an urban phenomenon, wherein the temperature in a city is a few degrees higher than its surrounding area. Heat islands occur when materials in our built environment (asphalt, concrete) absorb solar radiation, and re-radiate it as heat into the surrounding area. According to the US EPA, cities can be 1-3 degrees Celsius warmer in the daytime and up to 12 degrees Celsius warmer at night. Heat islands can have an adverse effect on air quality. Green roofs help beat the heat by instead using the sun's energy to conduct photosynthesis – effectively transforming light energy into food – and cool the air through evaporative cooling.

Energy Efficiency: Turn off Your A/C!

Green roofs lower a roof's temperature in two ways: by providing shade and by removing heat from the air through evapotranspiration – the process by which plants and soil absorb and release water into the atmosphere. The interior temperature of the building is in turn affected by the green roof's ability to moderate the roof's surface temperature, helping to keep the interior cooler during hot summer months. Green roofs also help moderate the temperature of the roof membrane, buffering it from hot and cold extremes. On hot summer days, the surface temperature of a green roof can be cooler than the air temperature, whereas the surface of a conventional rooftop can be up to 50 degrees Celsius warmer than the air temperature.

Life-Cycle Value

Reducing the roof's exposure to temperature extremes can prolong the life of the roof membrane, thus reducing the cost, energy, waste and material use associated with re-roofing. Green roofs protect the roof's membrane by blocking exposure to ultra-violet rays; by reducing thermal stresses associated with temperature fluctuation (expansion and contraction); and by reducing physical stresses such as exposure to wind and materials that may wear the surface.

Habitat: Birds and Critters

A vegetated roof is an oasis in an urban desert, offering wildlife a refuge from the asphalt and concrete that characterize the built environment. Plants attract birds and bees, and the soil becomes a habitat for small insects. At the Olympic Village, soil on the extensive green roofs is relatively shallow. While the shallow soils will not support a wide range of animal life, it is still a welcome habitat addition for creatures who make their homes in an urban environment.

Social Benefits: Looks Matter!

From the point of view of human health and sustainability, the aesthetic qualities of green roofs have a positive effect on people's psyche. At the Olympic Village, people will look out their windows and see roofs and courtyards planted and designed to look friendly and inviting. Research shows that access to views of nature is associated with improving people's health: boosting productivity and reducing absenteeism in offices and reducing the average length of stay among hospital patients.

Stormwater Management

By capturing and storing rainwater in their soils, green roofs can help reduce the rate and quantity of stormwater outflow. Stormwater volumes are reduced and flow rates diminished by slowing down the water via soil percolation. Green roofs are most effective for stormwater management in climates with regular, moderate rain patterns. In rainy climates like Vancouver, green roofs essentially reach capacity (saturation) early in the season, and thus their contribution to stormwater management is less significant than in other climatic zones.

TREES BOTANICAL NAME / COMMON NAME Acer campestre / Hedge Maple <copper fall colour Acer circinatum / Vine Maple <graceful branches when grown in the shade Acer ginnala/ Amur Maple Acer negundo / Boxelder Acer palmatum varieties / Specimen Green Japanese Maples Albizia julibrissin / Silk Tree <fine textured Amelanchier alnifolia / Western Serviceberry <abundant white flowers in spring Arbutus unedo / Strawberry Tree Carpinus betulus / European Hornbeam Cornus / 'Eddies White Wonder' Pacific Dogwood <large white flowers Cornus kousa / Kousa Dogwood <red fruits Corylus avellana / Filbert <edible nuts Cotinus coggygria / 'Royal Purple' European Smoke Tree <very drought tolerant Cydonia oblonga / Quince Diospyros kaki / 'Fuyu' Japanese Persimmon <brilliant orange fruit Ficus / Brown Turkey Fig <edible figs Ficus / Desert King Fig Ginkgo biloba / Maidenhair Tree <yellow fall colour Hamamelis i. / 'Diane' Witch Hazel <early spring flowers Liquidambar styraciflua / Sweetgum Maackia amurensis / Maackia Magnolia sieboldii / Japanese Magnolia Magnolia soulangeana / Brozzonii Magnolia Malus x zumi / 'Calocarpa' Redbud Crabapple Pinus contorta / Shore Pine <native conifer Pinus sylvestris / 'Nana' Scots Pine Populus tremula / 'Erecta' Upright European Aspen <compact crown Prunus persica / Golden Glory Peach Pyrus calleryana / Ornamental Pear Pyrus communis / Pear Rhus typhina / Sumac Sassafras albidium / Sassafras Sophora japonica / Japanese Pagoda Tree Sorbus aucuparia / Western Mountain Ash <berries for birds Zelkova serrata / Japanese Zelkova **SHRUBS** BOTANICAL NAME / COMMON NAME Buddleia alternifolia / Fountain Butterfly Bush Buxus microphylla / 'Green Beauty' Boxwood Ceanothus impressus / 'Victoria' California Lilac Ceanothus spp. / California Lilac <popular with bees Chaenomeles spp. / Flowering Quince Choisya ternata / Mexican Orange Blossom <fragrant white flowers Cistus spp. / Rock Rose Cornus sericea / 'Kelseyii' Dwarf Red-Osier <red twigs in winter Escallonia / 'Newport Dwarf' Escallonia Escallonia spp. / Escallonia Euonymus alatas / 'Compacta' Dwarf Burning Bush Gaultheria shallon / Salal Hebe buxifolia / Hebe Kalmia latifolia / Mountain Laurel Kolkwitzia amabilis / Beautybush Ligustrum spp. / Privet Nandina domestica / Heavenly Bamboo <not a true bamboo Osmanthus delavayi / Osmanthus Philadelphus lewisii / Western Mockorange <fragrant summer flowers Phyllostachys nigra / Black Bamboo Field grown Polystichum munitum / Sword Fern, Western Sword Fern <native fern Potentilla fruticosa / 'Abbotswood' Abbotswood Cinquefoil Potentilla fruticosa / Potentilla Raphiolepis umbellata / Yedda Buckthorn Rhus typhina / Sumac Ribes / 'Hinninmaeki Red' Red Gooseberry Ribes / 'Hinninmaeki Yellow' Yellow Gooseberry Ribes / 'Red Lake' Red Currant Ribes / 'White Lake' White Currant Ribes sanguineum / Red Flowering Currant Rosa rugosa / Rugosa Rose Rubus idaeus / 'Double Delight' Red River Raspberry <in common harvest gardens Rubus idaeus / Red River Raspberry <in common harvest gardens Rubus ursinus x idaeus / Loganberry Sarcococca hookeriana v. humilis / Sweetbox <shade tolerant Sarcococca ruscifolia / Fragrant Sweetbox Spiraea japonica / Spiraea Spirea bumalda / Spirea japonica / Japanese Spirea Spirea x bumalda / Bumald Spirea Symphoricarpos albus / Snowberry Taxus x media / 'Hicksii' Yew Hedge <privacy screening Vaccinium / Northblue Blueberry edible Vaccinium ovatum / Evergreen Huckleberry <pie supplies Vaccinium vitis-idaea / Rock cranberry Viburnum bod. / Viburnum <fragrant winter flowers **PERENNIALS** BOTANICAL NAME / COMMON NAME Andropogon scoparium / 'The Blues' Barren Strawberry Coreopsis spp. / Tickseed Dianthus deltoides / 'Albus' Dianthus spp. / Pinks Echinacea purpurea / Coneflower Euphorbia spp. / Spurge Euphorbia x martinii / Euphorbia Geranium spp. / Cranesbill Helleborus orientalis / Lenten Rose <winter flowers Hemerocallis spp. / Daylily Heuchera / 'Velvet Night' Coral Bells <evergreen perennial Heuchera sanguinea / Coral Bells Hosta / June Hosta Hosta spp. / Hosta <bold leaves in shade Iberis sempervirens / Candytuft Iris foetidissima / Gladwin Iris Kniphofia hybrida / Torch Lily Lavandula angustifolia / 'Munstead' Lavender Lavandula spp. / English Lavender Liatris spicata / Blazing Star Lithodora diffusa / Lithodora Oenothera spp. / Evening Primrose <abundant flowers Penstemon spp. / Beard Tongue <abundant flowers Perovskia atriplicifolia / Russian Sage <abundant flowers Phlomis fruticosa / Jerusalem Sage <abundant flowers Phlox subulata / Moss Pink Rudbeckia hirta / Gloriosa Daisy Salvia spp. / Perennial Sage Santolina chamaecyparissus / Lavender Cotton Stachys byzantina / Lamb's Ear <silky soft leaves Thymus spp. / Thyme Verbascum spp. / Mullein Verbena spp. / Verbena Waldsteinia ternata / Barren Strawberry **ORNAMENTAL GRASSES** BOTANICAL NAME / COMMON NAME Calamagrostis x acut. / 'Karl Foerster' Feather Reed Grass Carex flacca / Blue Creeping Sedge Chasmanthium latifolium / Sea Oats <shade grass (unusual) Festuca ovina / 'Glauca' Blue Fescue Festuca spp. / Blue Fescue Fragaria vesca / 'Yellow Wonder' Coastal Strawberry Helictotrichon sempervirens / Blue Oat Grass Ophiopogon planiscapus 'nigrescens' / Black Mondo Grass <jet black leaves Pennisetum / 'Big Mandry' Red Oriental Fountain Grass Pennisetum alopecuroides / 'Hameln' Dwarf Fountain Grass Phormium tenax / 'Atropurpureum' New Zealand Flax Phormium tenax / 'Jack Spratt' Dwarf New Zealand Flax Phyllostachys nigra / Black Bamboo Sedum Capoblanca / Stonecrop Sesleria caerulea / Blue Moor Grass Stipa tenuissima / Mexican Feather Grass <sways in the wind Miscanthus sinensis 'Yaku Jima' / Japanese Silver Grass **GROUND COVERS** BOTANICAL NAME / COMMON NAME Actinidia chinensis / Kiwi Vine <plant 5 males to 1 female for fruit Arctostaphylos uva-ursi / 'Van. Jade' Kinnikinnick <native plant Cotoneaster dammeri / Bearberry Erica carnea / Heath Euonymus fortunei / Wintercreeper Helianthemum / Rock Rose Helianthemum / 'Wisley Primrose' Rock Rose Houttuynia cordata / Chameleon Plant Liriope muscari / Lilyturf Liriope muscari / 'Big Blue' Lilyturf Liriope muscari variegata / Lilyturf muscari Mahonia repens / Creeping Oregon Grape <creeping ground cover Pachysandra terminalis / Japanese Spurge Polystichum munitum / Western Sword Fern Sedum / Silver Moon Sedum Thymus pseudolanuginosus / Woolly Thyme Thymus spp. / Thyme Plugs <good with roasted veggies

TREES SHRUBS PERENNIALS ORNAMENTAL GRASSES GROUND COVERS

Viewed from Above, a Sea of Green

Choosing plants for green roofs is not an easy feat. Extensive green roofs call for drought-tolerant plants, to limit or eliminate the need for irrigation. Another challenge is that climatic conditions on a rooftop are more extreme than on the ground. Plants must be hardy and able to endure high winds and drought. "In Vancouver, it's always a challenge to find plants that are drought tolerant when you know you're going to drown them in the winter," says Jennifer Stamp, landscape architect at Durante Kreuk who was responsible for plant selection.

"A critical component in plant selection is choosing plants that will look good in drought conditions. From this perspective, Mediterranean plants are ideally suited for roof gardens," says Stamp. This approach can conflict with LEED's green roof credit requirement, which specifies the use of "native and/or adaptive plants." "As long as they're not invasive in any way, [many non-native] plants meet the adaptive requirement," says Stamp. Other characteristics that drive plant selection include maintenance, appearance, habitat value and edible fruit.

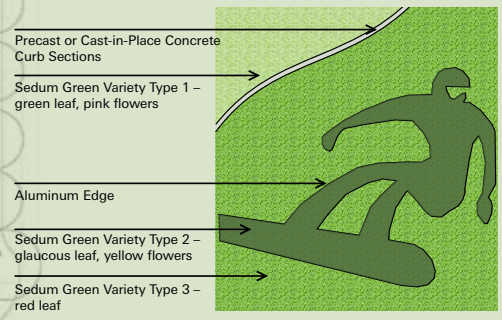
Over 287,000 Square Feet of Green Roofs

The Millennium Water design team was charged by the City of Vancouver with the requirement that 50 percent of total roof area be vegetated. This requirement was a first for the developer, who was concerned about the appearance of the green roofs, visible from many of the residential units. While green roofs generally enhance the view in an urban environment, if they are not properly maintained they can dry up or grow unwieldy, detracting from the appearance of the urban environment.

Durante Kreuk, landscape designers for the Olympic Village, did their best to create lasting, attractive landscapes. "When you're on the site, the complexity of roof forms and spaces is really interesting – and unique for Vancouver. Each garden is quite a wonderful place," says Peter Kreuk. The team added visual interest to the plantings by arranging them into giant motifs of Olympic athletes (see image). These will remain as a legacy of the neighbourhood's role as the Olympic Village.

As for the long-term appearance of the roofs, the role of the landscape architect has its limitations. "After we've designed and installed the roof gardens, they are handed over to the strata councils," says Kreuk. "The landscape should look better in five years, but it's up to the residents to maintain."

Choosing the right type of green roof system can help ensure that the plants require little maintenance and will maintain their appearance. The majority of the extensive rooftop area is covered with a blanket of sedums, provided by Xero Flor, a German company specializing in green roof design and installation for 40 years. Sedum is a succulent plant tolerant to extremes in temperature that survives with little or no irrigation while requiring very little maintenance. These "blanket" systems are cultivated at ground level, then rolled and transported to the rooftop as a complete system on pallets or by crane.



Durante Kreuk, landscape architects for the Olympic Village development, were playful in their approach to green roof design. In this aerial view of the rooftops of the Olympic Village, plants were placed into shapes showing motifs of Olympic athletes playing hockey, curling and competing at luge. The Olympic athlete figures are created with different plant types, colours and textures, and are outlined within a metal border.

CHALLENGE **To municipal authorities and landscape designers: to require and implement, at a minimum, a 50% requirement for green roofs on all new buildings.**

DESIGN CONCEPT

Building landscape refers to the natural environment that complements and forms part of buildings such as planter boxes, green roofs and patio plantings (as opposed to parkland). The design concept for building landscapes at the Millennium Water Olympic Village is to create spaces where people want to be. "Often with green spaces on large podiums, they are great places to look down upon from other buildings but people don't actually hang out on them much," says Jennifer Stamp of Durante Kreuk, the landscape architecture firm hired by Millennium. Stamp aimed instead for spaces that would contribute to social sustainability. "We wanted to provide a place for people to meet and know their neighbours, aiding in creating community; having urban agriculture was part of that," explains Stamp. Making these green areas more accessible meant connecting inside and outside spaces.

Amenity rooms were built that spill out onto landscaped courtyards. At Parcel 10, the third-storey courtyard is connected to the ground floor by a waterfall, bringing the courtyard garden down to Ontario Street.

The landscape architect's job is to understand both the developer's and the City's goals for semi-public and semi-private open space, pulling all the ideas together, and making it functional and highly aesthetic. "The process can be interesting, challenging and fun," says Peter Kreuk, co-founder of Durante Kreuk. Examples of design parameters in the job were ensuring that plants would look good in drought conditions, and aiming for various LEED credits that require the use of native and adaptive plant species.

An illustrative plan of the Olympic Village by landscape architects Durante Kreuk highlights the intensity of vegetation on the rooftops throughout the site. Combining intensive and extensive green roofing, fifty percent of the overall area is vegetated.

Providing a place to meet and know your neighbours

PUBLIC AMENITY SPACES

Programming

Exterior spaces on each building and parcel have been carefully designed to include many program elements while addressing issues of privacy. As a starting point for each open space design, each building courtyard has a rainwater feature, a children's play area most often consisting of naturalistic play features, and an open lawn, garden plots and an amenity room, which might consist of a kitchenette, a games room or an exercise room. The question becomes how to divide the space up so that each area feels connected to the others and that the edges all meet successfully with semi-private patios typically at the perimeter of these spaces.

From a simple sketch to a complex reality:

Background: This early sketch from landscape architects Durante Kreuk maps out potential spaces in the inner courtyard of Parcel 10.

Inset, left: This photo-realistic rendering presents the designer's vision for the inner courtyard once completed.

Right: Construction workers install the central water feature. The courtyard includes a waterfall, which connects the garden down to Ontario Street.

PROFILE

Durante Kreuk

Durante Kreuk, an award-winning landscape architecture firm with over 30 years of experience in design and development of private and public realms, took on the challenge of fulfilling the ODP's requirement for "greening" fifty percent of the rooftops of Olympic Village.

"Stormwater management and green roofs have been standard practice for 30 years," says co-founder Peter Kreuk. "What's new is that we are now looking at how buildings and their infrastructure can work in synchronicity with landscape systems. For the Olympic Village, our goal was to recirculate and use rainwater to support landscape irrigation, toilet flushing and rainwater gardens, and we did it."

Durante Kreuk believes in an integrated team approach to solving design problems; they push boundaries by exploring how to make previously unoccupied, often ugly spaces into places of curiosity, beauty and community building.

Kreuk says, "We believe sustainable development can be incorporated into designs that are highly aesthetic and meet the environmental and social aspirations of the community."

The Importance of Local Food

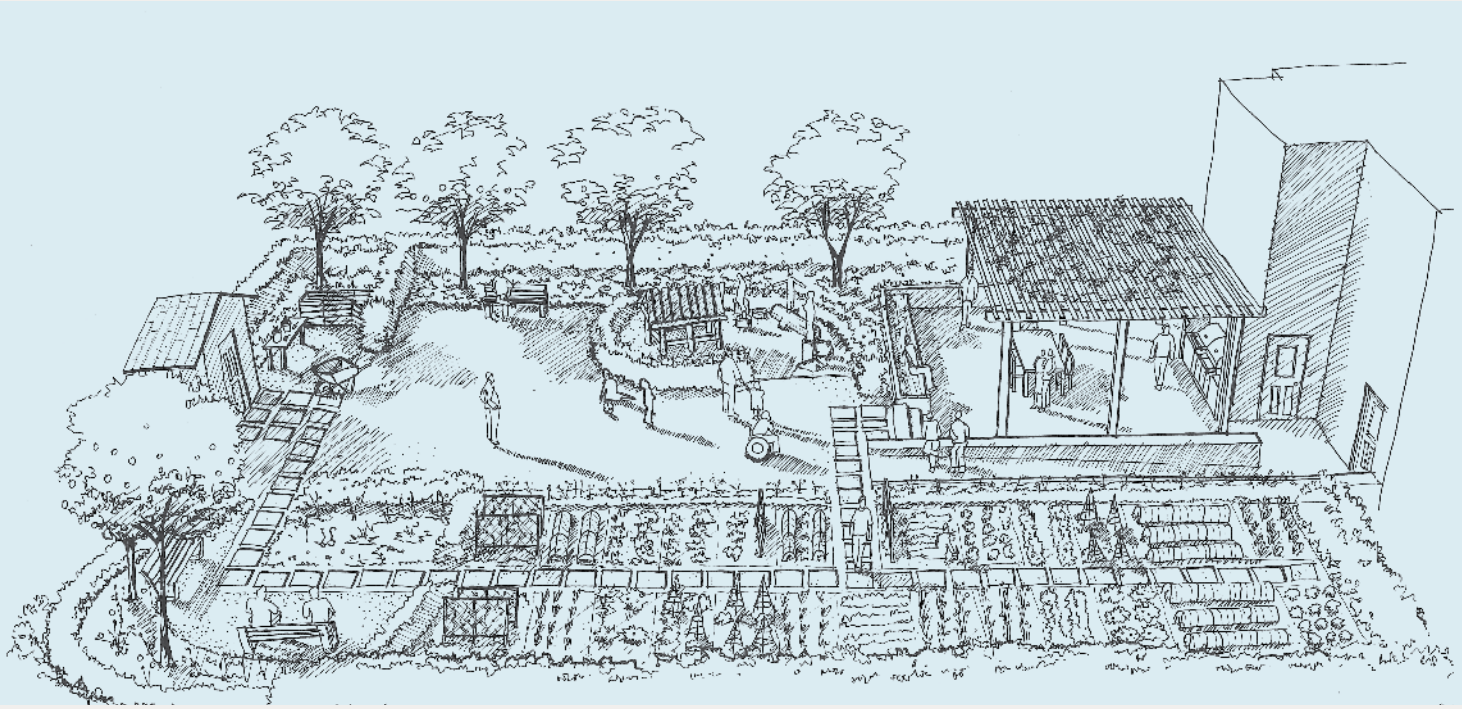
By almost any measure, our current food system is not sustainable. Human development and urban sprawl are causing the local and global agricultural land base to shrink. We use large amounts of energy, chemicals, synthetic fertilizers and water, and we rely on imports and food produced far from the point of consumption. For these reasons, locally grown food is an important element of a community working to be sustainable.

As the SEFC Urban Agriculture Study states, "Most of us take our food for granted – so much so that we often forget the role it plays in our social relationships, community building and the role that food and agriculture have in shaping our economy and environment." Similar to energy, water and waste in the context of sustainable development, food can be seen as a "flow" from the environment through the community back to the environment in the form of wastes. How we address this flow affects the relative sustainability of our community. Community gardens and urban agriculture are beneficial for educational, social, economic and environmental reasons.

By almost any measure, our current food system is not sustainable.

Definition of Urban Agriculture from SEFC Urban Agriculture Study:

The term urban agriculture, as it is commonly used, refers to any agricultural production that takes place within the urban and peri-urban region. This could include the growing of food (vegetables, grains, mushrooms, even meat and dairy products), medicinal plants, herbs and ornamental plants. It includes a diverse array of techniques and approaches ranging from backyard growing to large-scale urban market gardening, hydroponic greenhouses and aquaculture. It is not just community gardening, although this is an important component in many cities. Food is of paramount importance because of its primary contribution to survival, health, culture and impact on the environment.



An artist's sketch illustrates the possibilities for rooftop urban agriculture and the rich potential for community connection.

Vancouver is experiencing a growing wave of interest in urban agriculture. People are becoming more aware of the environmental, and social benefits of buying local food; going to the local farmers' markets has become an enjoyable way to meet your neighbours and pass a Saturday afternoon. As well, people recognize they are contributing to their local economy by buying local food.

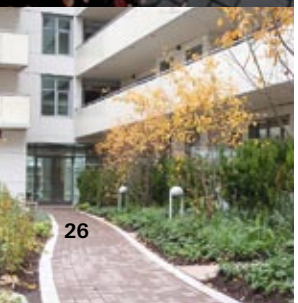
Community Demonstration Garden

Located west of Parcel 4, the community demonstration garden will be designed and constructed after the Olympics. "The idea isn't to have little plots for people to garden, but rather a space that is programmed with the school, community centre and neighbourhood for all to use and to learn about urban agriculture," says Robin Petri from the City of Vancouver. Specific designs and programming have not yet been determined.

Because of the site's historic industrial use, the City has begun investigating how to handle nearby contaminated soils. The garden will be separated by a membrane from the contaminated industrial soil that underlies Hinge Park.

Urban community gardens are an important element of improving local food supply. Davie Village Community Garden (shown) is an example of what will be possible on rooftops and demonstration gardens at the Olympic Village.

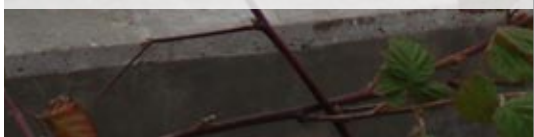
edges



Instead of using fences or "keep out" signs, hedges, dense planting, guardrails and raised patios are all ways in which edges (different hierarchies of space) are delineated.

play space

The site was designed with children in mind. Instead of having the typical children's programmed playground, the play area is more naturalistic, using ecosystem elements such as logs and rocks. "We wanted to have play areas that expand children's imaginations and where there is mystery and discovery," says Kreuk.



Hinge Park

The "storybook area" uses some of the 400 boulders pulled from the ground as the SEFC lands were excavated and graded. The spot provides a place to climb, sit, read a book.

The footbridge archway in Hinge Park is formed from beams left on the site from previous industrial activities.

"Some of the walls are constructed of recycled sidewalk, material that traditionally would have been dumped. At first, the stonemasons thought it was kind of hokey, but when they built the wall they realized it looks beautiful. A lot of people won't even know that we're using recycled sidewalk – they'll think it's rock that we quarried somewhere." John Clelland, Hinge Park Coordinator, City of Vancouver

PROFILE

Peter Kreuk

President, Durante Kreuk

"This project was fun, mentally challenging and a great initiative," says Peter Kreuk, a landscape architect and co-President of Durante Kreuk. Kreuk led the design of building landscapes for Millennium Water.

With 30 years' experience in the design and construction industry, Kreuk's knowledge and understanding of municipal requirements and guidelines are paramount in leading projects from the initial design stage through to project completion. Kreuk has worked with Millennium on a number of projects. However, the scale and complexity of this project was new.

"Some of the most interesting parts of the Olympic Village project are the rainwater features. They are great and we are thrilled to be a part of their innovation," says Kreuk. "The complexity of roof forms also makes it an interesting place. Each garden is a special place. The excitement is how it all fits together."

ROOFTOP + GRADE FOOD-GROWING GARDENS

With the requirement of fifty percent of the site area having to be green, grade (street-level) growing and rooftop gardens became key. Every Millennium Water parcel includes opportunities for urban agriculture except Parcel 4, which has patios well over 100 square feet. The city's formula for urban agriculture is that there must be 24 square feet of gardening space for 30 percent of the units whose balcony or patio is under 100 square feet. This means approximately 1,000-1,500 square feet of urban agriculture per parcel (and more for non-market parcels), which translates into approximately 20-30 twenty-four square foot plots per parcel.

Each building's strata council will manage how gardening plots will be allocated to residents. In non-market urban agriculture areas, there are communal crops where plots are not delineated and where everyone can harvest. The grade (street level) growing gardens are owned by the strata corporations but are publicly accessible.

"There needs to be an attitudinal shift," says Peter Kreuk. Initially, the developers were concerned about how urban agriculture would look. "The perception of urban agricultural areas as being 'weed patches' with timber retaining walls is changing. Developers are realizing that urban agriculture can be beautifully integrated into a garden's design."

Growing Veggies On Your Roof

Unlike growing produce in your backyard where there is at least a few feet of dirt, the soil depth on the roof gardens of the Olympic Village is 18 inches. "This soil depth should be plenty to grow your carrots," says Jennifer Stamp. However, it is important to note that the soil heats up faster when you have planting on roofs, due to a thinner soil profile and the concrete underneath. There is no irrigation system in the SEFC urban agricultural areas in part due to plumbing and health bylaws not allowing non-potable water for edible plant irrigation and in part because many gardeners are particular about watering their veggies. For each urban agricultural area, there are compost bins, hose bibs with potable water and a potting bench.

URBAN AGRICULTURE IN SEFC

The SEFC Policy Statement set the stage for urban agriculture in SEFC. Its objectives were: "to establish clarity on the role food production should play in the development of a sustainable city and neighbourhood" and "to use urban agriculture and community gardens to assist in meeting other social, environmental and economic objectives in SEFC."

The City retained Holland Barrs Planning Group (now HB Lanarc) to look at the range of urban agricultural possibilities in a high-density site. In November 2002, the SEFC Urban Agriculture Study highlighted the importance of food-related activity and urban agriculture in the planning of a sustainable community. This study outlined a range of recommendations from community gardens and rooftop gardens to more complex systems such as on-site aquaculture and rooftop greenhouses. In March 2007, "Designing Urban Agricultural Opportunities for SEFC" provided more site-level detail.

The Merge Consultancy report (2003) summarized the SEFC urban agricultural study and proposed to move the following recommendations to satisfy the strategy of capacity building:

- Create community gardens that might be shared with the school while the school is in session
- Require edible landscaping capacity in building projects
- Create a Community Kitchen to encourage micro-food processors
- Provide educational programming for gardeners to improve the effectiveness of urban agriculture in SEFC
- Use stormwater/rainwater collection on site to provide irrigation water for edible landscaping
- Make provision for a farmers' market in the proposed site plan.

The challenges of implementing urban agriculture are numerous. Rob Barrs of HB Lanarc says, "The typical reaction to the idea of growing food in high-density areas is 'you've got to be nuts.' Food has largely been ignored by planners and designers until recently so the first challenge is overcoming the perception that this is a weird thing to do, and secondly, you're also competing for expensive real estate."

The green roofs and community demonstration garden within SEFC will showcase how to integrate urban agriculture and high-density living. Barrs remarks, "I think we're 30 percent of the way there to the full potential of urban agriculture. I'm pretty pleased about what we got done and am grateful for those successes. The next challenge will be getting some research dollars to really understand how we integrate urban agriculture into closed-loop systems."

"SEFC has become a model for the rest of the community and a testing ground for how you do high density urban agriculture," says Barrs. "This project has educated the planning, design and building industry to include urban agriculture in their projects."

CHALLENGE **To municipal and building developers: to explore and facilitate the implementation of urban agriculture and to support the provision of retail and amenity space that supports the distribution of locally grown produce.**

ACKNOWLEDGEMENTS

Acknowledgements

Cori Barraclough, Rob Barrs, Heather Braun, Jason Christensen, John Clelland, Bill Donald, Wally Konowalchuk, Peter Kreuk, SK Lai, Margot Long, Patrick Lucey, Stu Lyon, Jim Myers, Robin Petri, Garry Romanetz, Jennifer Stamp

Contributors

THE CHALLENGE SERIES TEAM

Roger Bayley
Principal, Roger Bayley Inc.

Sarah Cheevers
Writer and Project Manager

Sarah Hay
Communications Coordinator

Ashlee Jollymore
Public Relations

Mizu Creative
Graphic Design

Rachel Moscovich
Writer and Project Manager

Grace Tang
Asian Marketing

Nina Winham
Editorial Director and Writer

GUEST WRITER

Patrick Lucey

roger bayley inc

SPONSORS / PARTNERS

PLATINUM

Millennium Southeast False Creek Properties Ltd.

Millennium Group is an award-winning Vancouver-based team of professionals and the developers of Millennium Water Olympic Village. They are renowned for their disciplined commitment to high quality architecture and luxurious design. At 1.4 million square feet, Millennium Water is the largest single-phase development in Canada. It is designed to be Canada's largest LEED Gold neighbourhood and a leading model of how to build a sustainable residential community.

Metro-Can Construction (OV) Ltd.

Metro-Can Construction is among the top 50 general contractors in Canada and the top five in British Columbia. Focusing on turning visions into buildings and delivering value to their clients, Metro-Can has completed over 280 institutional, commercial and multi-family residential projects. Since placing the first foundations on the Millennium Water project in June 2007, Metro-Can has proceeded to construct 10 LEED Gold buildings incorporating 540 condominiums, 250 social housing units, 60,000 square feet of retail space and a LEED Platinum community and boating centre.

ITC Construction Group

ITC Construction Group has proven capabilities in multi-unit residential, commercial and social housing construction projects. Established in 1983, they have successfully completed over 100 projects for private developers and public initiatives in BC and Alberta. ITC is proud to be the General Contractor of the eight luxury waterfront towers at Millennium Water. These LEED Gold certified structures consist of 315 condominiums and will be complemented by 13,619 square feet of commercial/retail space at the ground level. Quality Counts.

Rennie Marketing Systems

Rennie Marketing Systems (RMS) proudly leads the sales and marketing campaign for the residential component of Millennium Water. Led by Bob Rennie, RMS works closely as "Millennium's representative" to bring to market the most innovative sustainable community in North America. Maintaining the project's identity of environmental awareness, RMS utilizes eco-friendly elements throughout the marketing campaign. RMS marketing objectives extend beyond sales achievements and include increasing global awareness of a new standard of development.

Durante Kreuk Landscape Architects

Durante Kreuk is an award-winning landscape architectural firm with over thirty years' experience in the private and public realms of design and development. A broad perspective and diverse thinking are the key to creating a wide range of sustainable, people-focused urban places. At Millennium Water, the unique challenge of creating a sustainable neighbourhood through an integrated design process was both complex and rewarding. The result speaks for itself.

GOLD

VANOC

Merrick Architecture

gBL Architects

Cobalt Engineering Co. Ltd

VIA Architecture

BC Hydro Power Smart

Nemetz (S/A) & Associates Ltd.

Keystone Environmental Ltd.

PacBlue Printing

SunProject Toro Inc.

Storm Guard Water Treatment Inc.

Neighborhood Energy Utility

SILVER

Nick Milkovich Architects Inc.

Walter Francl Architecture Inc.

Robert Ciccozzi Architecture Inc.

Glotman·Simpson Group of Companies

GeoPacific Consultants Ltd.

KD Engineering

Letterbox Design Group

Morrison Hershfield

PWL Partnership Landscape Architects Inc.

Quoin Project and Cost Management Ltd.

Recollective Consulting

Vector Engineering Services Limited

FVB Energy Inc.

Femo Construction Ltd.

Jeda Mechanical Ltd.

Pitt Meadows Mechanical

Power Drywall Ltd.

Sentrax Mechanical Contracting Ltd.

William Kelly & Sons Plumbing Contractors Ltd.

BRONZE

Aqua-Tex Scientific Consulting Ltd.

Blue Mountain Technologies, Inc.

Commonwealth Historic Resource Management Ltd.

IBI Group

Levelton Consultants Ltd.

Fraser Milner Casgrain LLP

Pioneer Consultants Ltd.

Contrada Enterprises Ltd.

Energy Aware Technology Inc.

Sandwell Engineering Inc.

FAMA Industries Corp.

Inform Projects Partnership

PricewaterhouseCoopers LLP

Trane

Olympic International Inc.

Olympic International creates comfortable, healthy and energy-conscious indoor environments. As a manufacturers' representative, they are committed to bringing the world's most innovative and sustainable technology to local markets. The Millennium Water project utilizes radiant heating and cooling technology, which will substantially reduce energy consumption and system noise, increase available ceiling height and improve overall thermal comfort and indoor air quality.

Enerpro Systems Corp.

Enerpro Systems Corp. are market leaders in intelligent energy management for new construction and infrastructure upgrades to existing buildings. Since 1996, BC's only customizable energy management programs have been providing no-cost, full-service solutions that maximize efficiencies in energy and water use, reduce consumption and provide numerous economic benefits. This groundbreaking innovation has spurred a series of firsts in energy management, such as the ability to view a real-time display of all energy and water consumption within 1,100 housing units at Millennium Water.

Keith Panel Systems

Keith Panel Systems (KPS) is North America's leader in the design, manufacture and installation of rainscreen wall systems. They are proud to be part of constructing Millennium Water. The wall systems installed by KPS will preserve the performance integrity of the exteriors, reduce the heating and cooling loads, provide an extended service life and are virtually maintenance free. Alucobond®, Swisspearl® and specialty glass are the quality exterior finish products featured on proprietary systems by KPS.

Wilco Landscape Westcoast Inc.

Wilco has become expert in the construction and delivery of built landscapes. Offering project management and landscape construction services for civil, parks and development projects, Wilco is a leader in successfully delivering complex projects to its clients. Wilco thrives on diversity and challenges and seeks out projects that require the depth of experience and knowledge that they have accumulated through the vast array of projects the company has built throughout BC and Western Canada.

The City of Vancouver

The City of Vancouver is one of the most livable cities in the world. The City has now also adopted the target of being the "Greenest City" in the world by 2020. Vancouver has received several awards for its various services and programs, including a United Nations (UN) award for Innovation in Public Service and being among the four inaugural cities invited to join the UN's Carbon Neutral Network. To further support these goals Vancouver has spent over a decade in conceiving, and now developing, the Southeast False Creek and Olympic Village Shipyards Neighbourhood as a global model for sustainable urban development.

PARTNERS

Canada Mortgage and Housing Corporation

Environment Canada

CITY OF VANCOUVER

VANCOUVER GREEN CAPITAL

Vancouver Green Capital is a statement about Vancouver's commitment to, and position at the forefront of the emerging global green economy. Vancouver Green Capital showcases the City's sustainability leadership and serves to challenge imagination, innovation, and the pursuit of new opportunities. Welcome to Vancouver, where business is green and green means business!

Vancouver Green Capital is especially relevant to Southeast False Creek and the Olympic Village, which has created an exceptional cluster of green expertise and facilities. Learn more at Vancouver.ca or vancouvereconomic.com.

Next Chapter: Living Today + Tomorrow

Chapter Seven explores sustainable living – today, in the Millennium Water Olympic Village, and into the future. The chapter presents interior design and health aspects of the development, including green building finishes, tobacco smoke control and ventilation measures. Next, the net zero building on Parcel 9 is documented – a building whose systems generate as much energy as its occupants consume. From there, we look to the future: "net zero, closed-loop *everything*?" Based on the experience gleaned from the building of Olympic Village, can sustainable development help restore and protect the planet we call home? What have we learned, and what are the next steps?

Subscribe

Be part of this historic resource. Subscribe to The Challenge Series e-bulletin to follow the story of Millennium Water: The Southeast False Creek Olympic Village.

www.thechallengeseries.ca/subscribe

THE CHALLENGE SERIES

Image Credits

front cover: Danny Singer, 2009; pages 02-03: Danny Singer, 2009; page 05: www.flickr.com/photos/jmtimages/3748991146, accessed Nov. 2009; page 07: The Challenge Series, 2009; page 08: Durante Kreuk Landscape Architects, 2009; page 09: Danny Singer, 2009; page 10: #1 Durante Kreuk Landscape Architects, 2009; #2-4 Danny Singer, 2009; page 11: #1,2 Danny Singer, 2009; #3 Energy Aware Technology, 2009; page 12: Cobalt Engineering with illustrative support from Letterbox Design Group, 2009; page 13: Danny Singer, 2009; page 14: Durante Kreuk Landscape Architects, 2008; page 15: Danny Singer, 2009; page 16: #1 Danny Singer, 2009; #2 PWL Landscape Partnership Architects, 2009; page 17: Danny Singer, 2009; page 18: #1 Durante Kreuk Landscape Architects, 2008; #2 Danny Singer, 2009; page 19: Danny Singer, 2009; page 21: #1,2 Durante Kreuk Landscape Architects, 2008; #3 Danny Singer, 2009; page 22: Durante Kreuk Landscape Architects, 2008; page 23: #1,2 Durante Kreuk Landscape Architects, 2008; #3 Danny Singer, 2009; page 24: Durante Kreuk Landscape Architects, 2008; page 25: Sarah Northcott, 2009; pages 26-27: Danny Singer, 2009; page 28: www.flickr.com/photos/cpt_obvious/sets/72157604969682512, accessed Nov. 2009; back cover: Danny Singer, 2009.

Information Sources:

page 5: SEFC Official Development Plan; page 6: Greater Vancouver Regional District, 2006; pages 24 & 29: SEFC Urban Agriculture Study, 2002; Merge Consultancy Report, 2003.

FRONT COVER Constructed from a piece of traditional storm sewer pipe, the curious tunnel bridge at Hinge Park brings stormwater infrastructure typically hidden from view into the public eye. Beyond, Parcels 3 and 4 receive final construction touches.

BACK COVER The level of detail and planning invested in Olympic Village building landscapes is evident as one views the courtyard of Parcel 6.

THE CHALLENGE SERIES