Appendix B

GRI Typologies

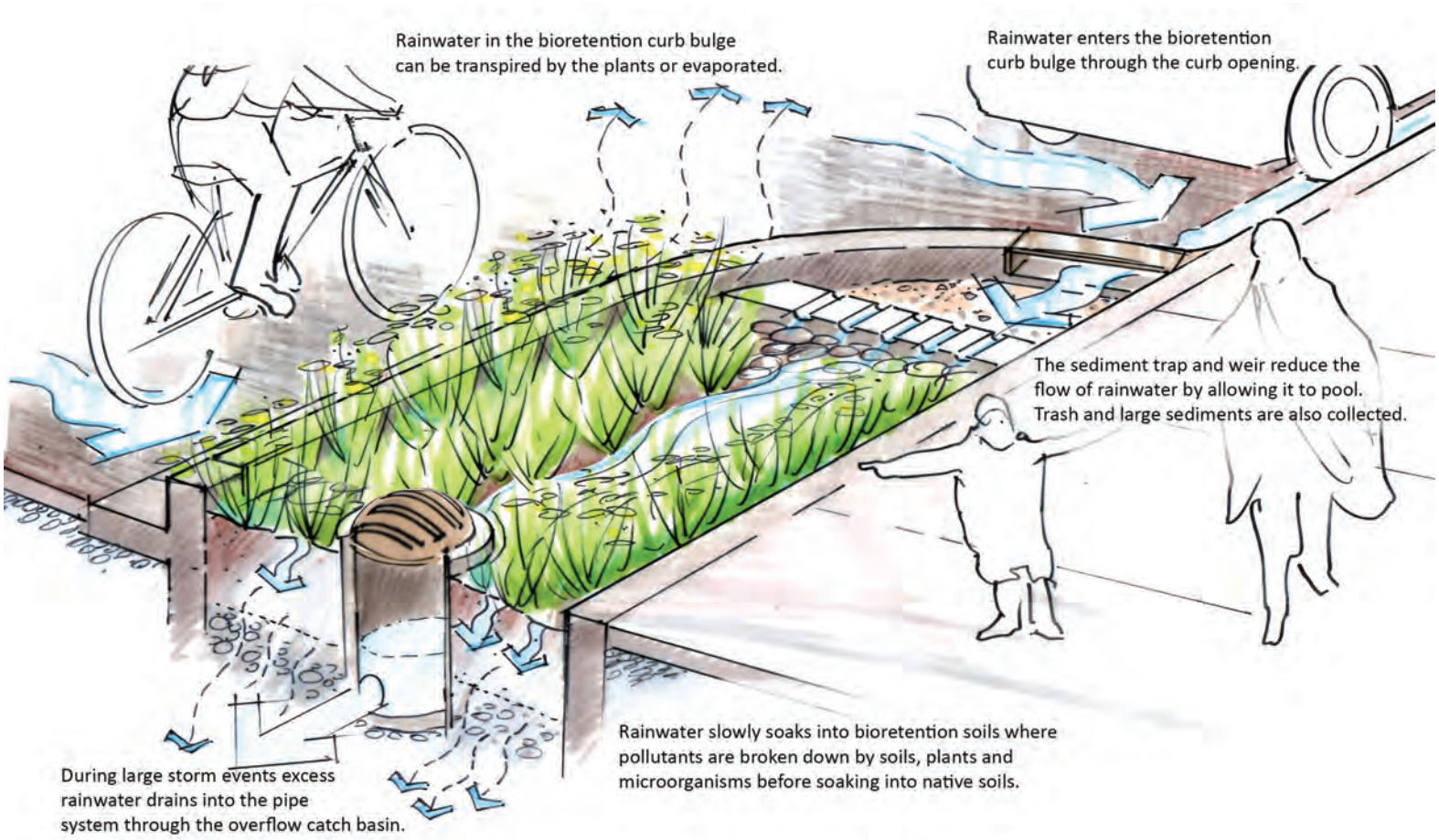
There are several typologies of green rainwater infrastructure. The following appendix provides illustrations and descriptions of the typologies at our disposal along with typical applications and examples in Vancouver and other parts of the world.

BIORETENTION PRACTICES

Bioswales, bioretention bulges and cells, rain gardens

What are bioretention practices?

Bioretention practices are engineered landscapes designed to infiltrate and filter urban rainwater runoff. They can be designed as rain gardens, bioswales, bioretention cells, bioretention planters and bioretention corner bulges. This common practice typically consists of a shallow depression or basin that features layers of rock, engineered soils, and resilient vegetation that can tolerate extreme rain and drought events. During a rainfall event, rainwater is directed into the practice, where water pools temporarily before soaking into the soil layer. Harmful pollutants are either broken down or captured in the soils and plant roots. Once cleaned, water is taken up by plants and released as water vapour, infiltrated into the ground, or carried away by a drainage pipe into our aquatic ecosystems.



Example: 63rd at Yukon

The enhanced public space at West 63rd Avenue and Yukon Street in Vancouver uses bioretention practices to manage rainwater runoff from adjacent streets. The location was highlighted for intervention in the Marpole Community Plan. The plaza includes 102 m^2 of bioretention systems—a rain garden and a bioswale—which capture, retain and treat urban rainwater runoff from more than 1,170 m^2 of adjacent roads and sidewalks. Together, these systems capture 90% of average annual rainfall that falls within the 1,170 m^2 drainage area, resulting in 2,200m^3 of rainwater diverted from the sewer system in a typical rainfall year. The plaza also includes seating areas, a drinking water fountain, and public art installations. This project was designed by the City's Green Infrastructure Implementation Branch and built by City crews.

63rd Avenue at Yukon Rain Garden and Bioswale

Typical applications

- Traffic calming bulges
- Greenways
- Bikeways
- School crossings
- Local streets
- Park connector streets
- Pollinator highways
- Yards
- Parks
- Plazas

Rain Garden, Tupper Greenway

Bioretention Bulge, River District (EFL)

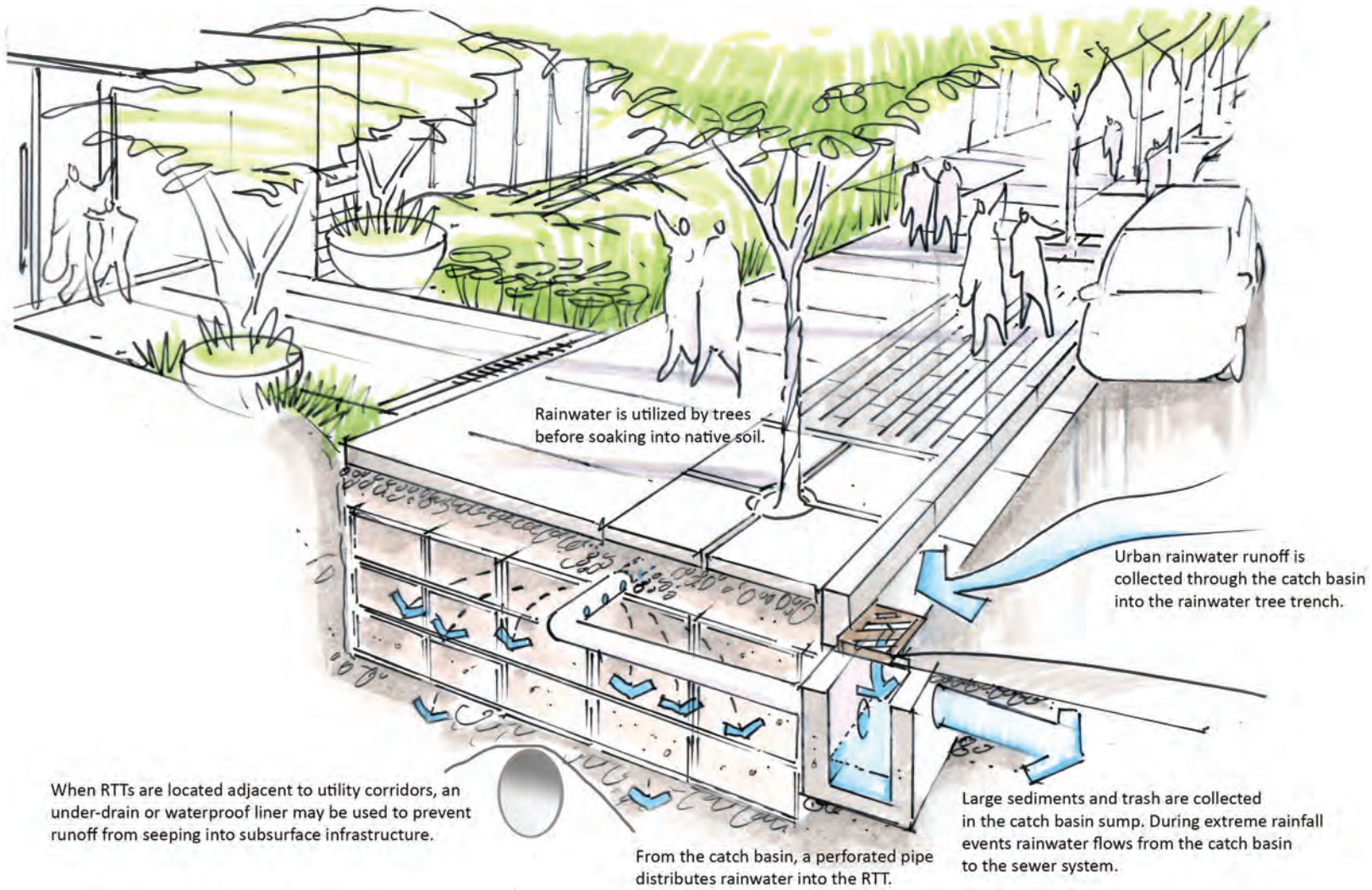
RAINWATER TREE TRENCH

Soil cells, structural soil

What are rainwater tree trenches?

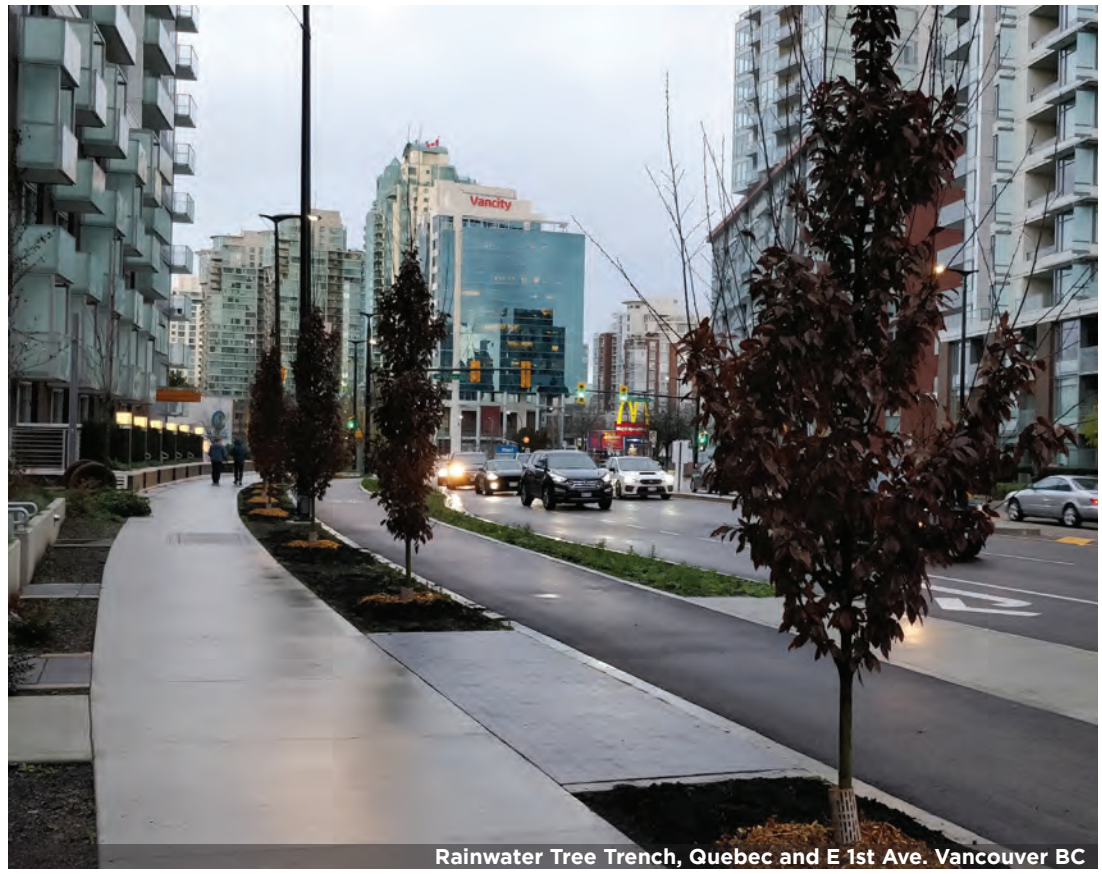
Rainwater Tree Trenches (RTTs) are multifunctional GRI practices that provide both storage for rainwater and support to street trees. This type of GRI practice, typically located in dense urban environments, directs urban rainwater runoff from adjacent impermeable areas such as streets, parking lots, sidewalks, plazas and rooftops into underground trenches for treatment and then infiltration or uptake by street trees.

There are two types of RTTs in the City of Vancouver: structural soil and soil cells. Soil cells consists of plastic frames that are strong enough to bear the weight of surfaces like sidewalks. Soil fills the void left in the plastic frame, leaving space for tree roots. Structural soil uses a mix of large crushed stone and soil. The stone bears the weight of the surface while the soil and the space between the stone allows tree root growth.



Example: Quebec and 1st Avenue

Underneath the new separated bike lane in Quebec & East 1st Avenue, a RTT was installed as part of the precinct upgrades. This RTT installation will be monitored for performance to better understand the benefits of the system and improve on the design for future projects. The RTT has been monitored continuously since September 2018 and has performed similarly in terms of rainwater treatment and capture as the more common bioretention systems. Altogether, this project was a collaborative effort between the Green Infrastructure Implementation Branch and the Transportation and Street Divisions.



Rainwater Tree Trench, Quebec and E 1st Ave. Vancouver BC

Typical applications

- Streets
- Greenways
- Bike lanes
- Laneways


Seaside Greenway, Olympic Village, Vancouver


Rainwater tree trenches, 10th Avenue Bikeway

RESILIENT ROOFS

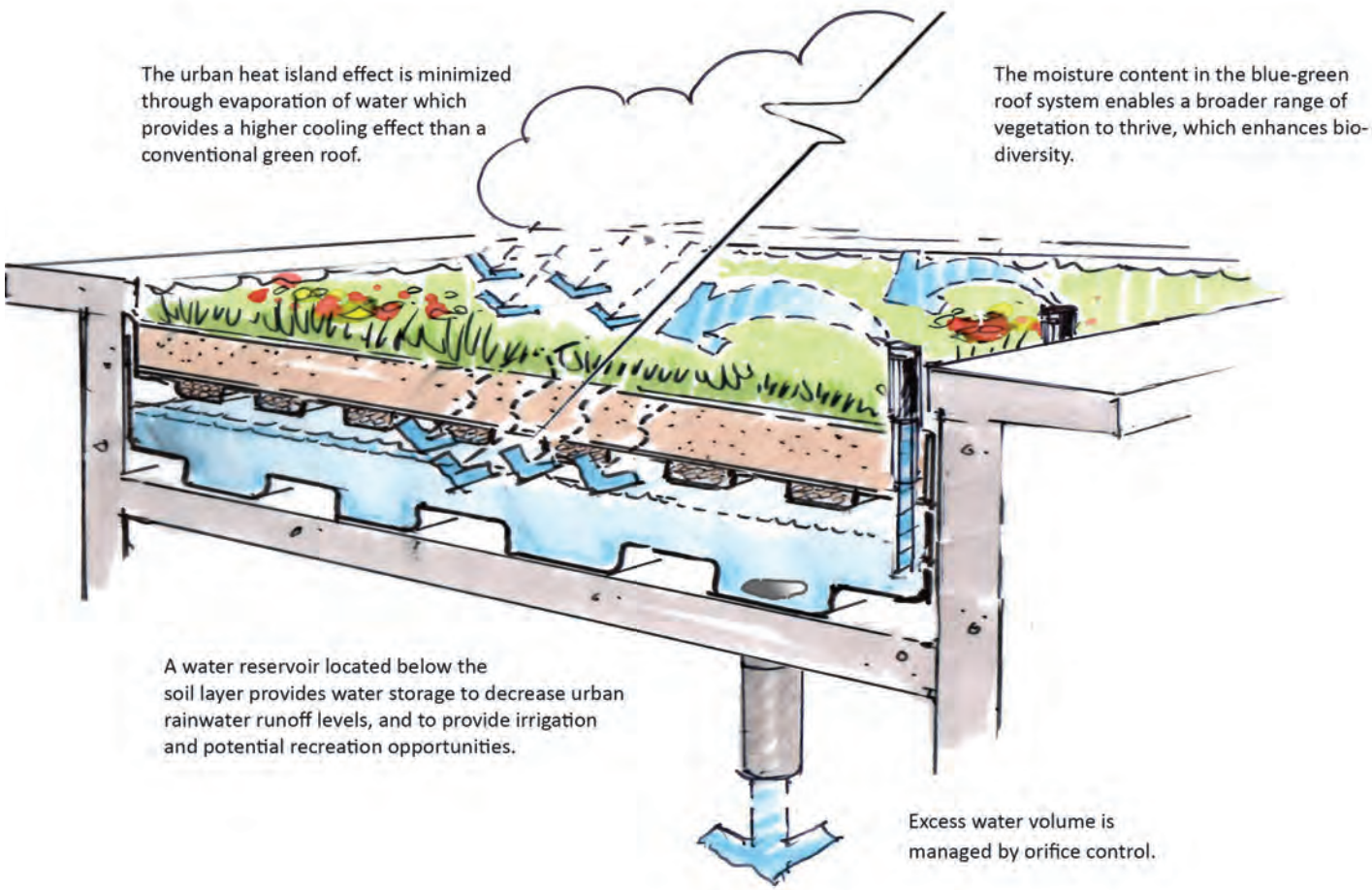
Green roofs (extensive and intensive), blue roofs, blue-green roofs, white roofs

What are resilient roofs?

Resilient roofs are roofs that can be designed to manage rainwater and support plant growth. Examples of resilient roofs include green roofs (extensive or intensive), blue roofs, blue-green roofs and white roofs. While white roofs are included in this group and serve to mitigate the urban heat island effect by reflecting sunlight, because they lack a rainwater management component they are not further discussed in this section.

Green roofs use vegetation and soils to absorb rainwater, to provide insulation for buildings, and to improve biodiversity. Intensive green roofs support larger plants with a thick layer of soil (up to 730 kg/m^2 of vegetation) and are typically accessible to building users, whereas extensive green roofs support smaller plants with a thin layer of soil (up to 120 kg/m^2 of vegetation) and are generally not accessible.

Blue roofs are designed to temporarily store rainwater before releasing it into the sewer system. They can be combined with other measures to improve water quality and reduce the volume of water entering pipes to reduce combined sewer overflow (CSO) volume. They can also be designed to allow evaporation of stored rainwater. When blue roofs are designed with vegetation, they are called Blue-green roofs. Blue-green roofs help keep plants watered even during hot summer season while reducing flows to the sewer system and improving water quality.



Example: Blue-green roof retrofit

The roof of Building 002 at the former Navy Yard in Amsterdam has been retrofitted with a blue-green roof system that captures and stores rainwater. The roof system consists of an 85 mm thick hollow drainage layer located directly under the planted soil layer that provides rainwater storage. This hollow drainage layer is comprised of lightweight recycled plastic drainage units called permavoid units that are fitted with special fibre cylinders. The fibre cylinders utilize capillary action to transport water to the upper soil layer to naturally irrigate the plants without the use of pumps, hoses, valves or energy.

Building 002 Blue-Green Roof, Amsterdam, Netherlands

Typical applications

- Multi-unit residential buildings
- Commercial and office buildings
- University buildings
- Civic buildings
- Community centers
- Hospitals
- Libraries

Green roof, VanDusen Botanical Garden

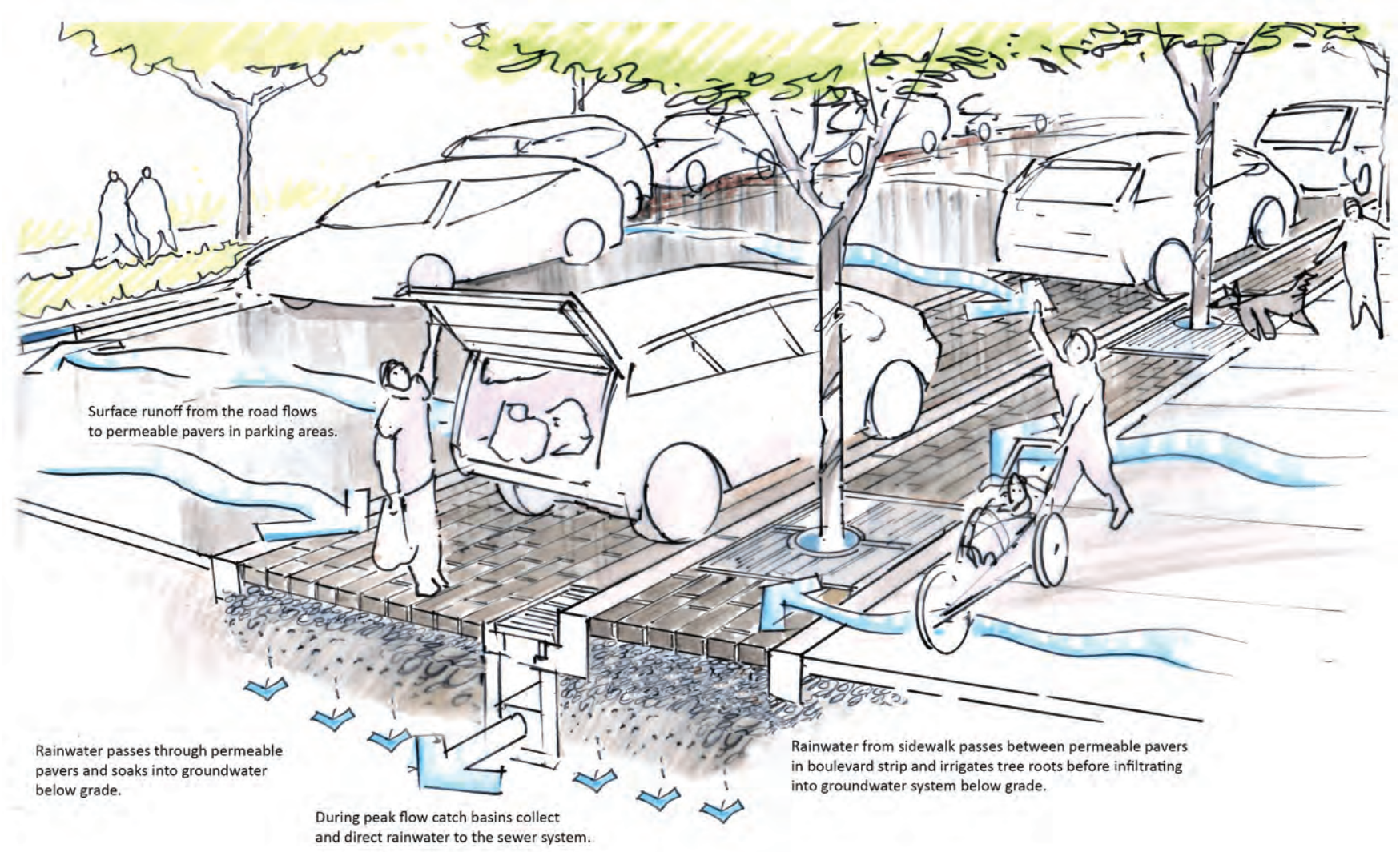
Blue roof, Olympic Village, Vancouver BC

PERMEABLE PAVEMENT

Permeable concrete pavers, pervious concrete, porous asphalt, grass grid pavers/country lane, porous rubber, permeable epoxied gravel

What is permeable pavement?

Permeable pavement comes in a variety of forms similar to the various types of conventional paving materials. All permeable pavement types allow rainfall to soak into an underlying reservoir base where it is either infiltrated to the ground or removed by a subsurface drain. Rainwater is filtered and cleaned through the different aggregate layers and the underlying subsoil layer. Permeable pavement provides a hard, usable surface, whether by cars, bikes, or pedestrians, while reducing runoff volume and improving water quality.



Example: Permeable Parking in Olympic Village

The on-street parking spots along Athletes Way and Columbia Street in Olympic Village are paved with permeable interlocking concrete pavers. These pavers allow rainwater to pass through the paving and infiltrate into the soils below. Permeable pavement projects can be designed to collect and infiltrate rainwater from the surrounding street surfaces; however, this particular application was not designed for this purpose.

Permeable Interlocking Concrete Pavers, Olympic Village, Vancouver BC

Typical applications

- Bike lanes
- Laneways
- Plazas
- Sidewalks
- Parking lots
- Parking lanes
- Low traffic streets

Pervious concrete plaza, Vancouver

Porous Rubber, 10th Avenue Bikeway

LARGE SCALE PRACTICES

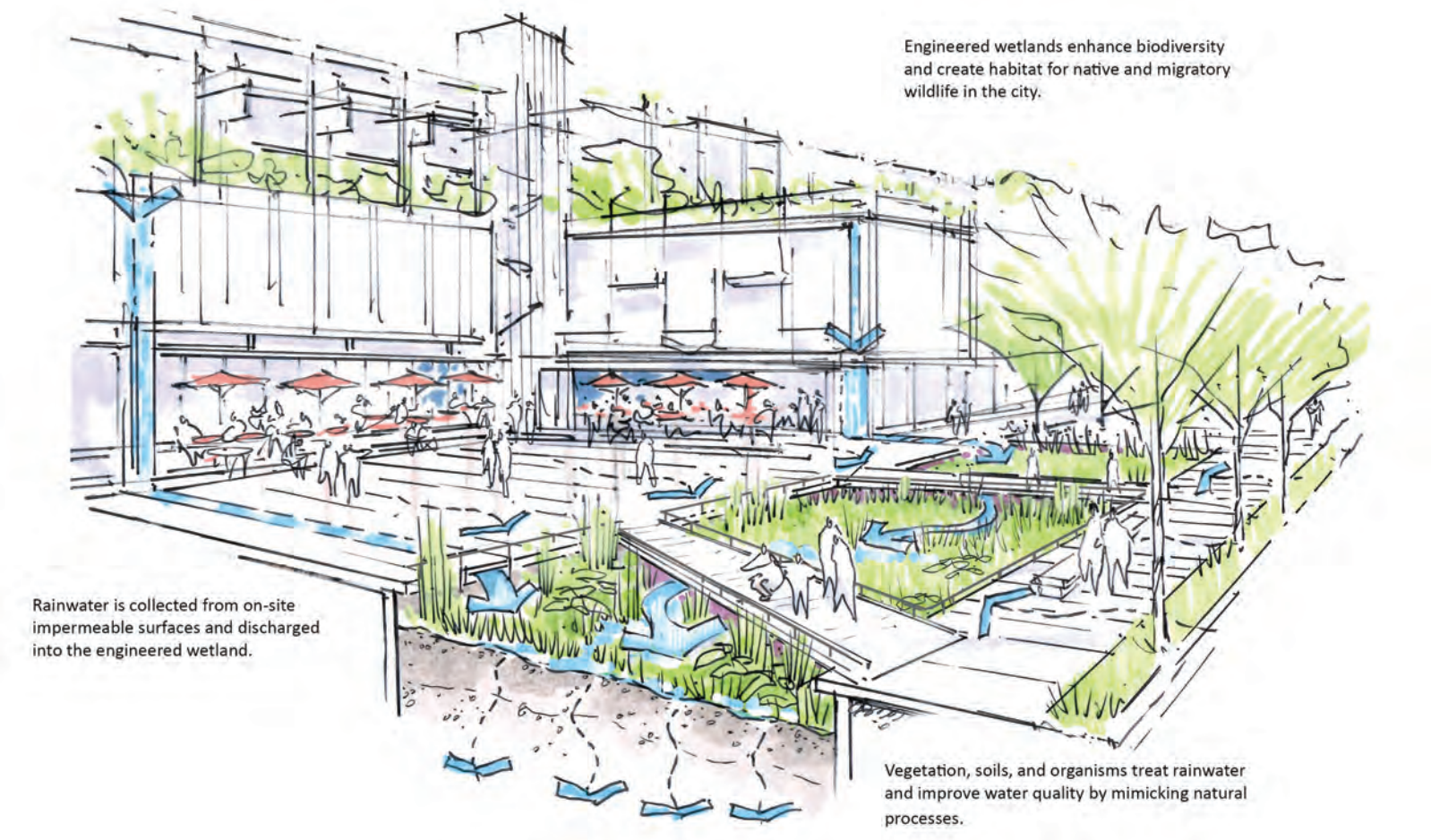
Engineered wetlands, floodable spaces, stream daylighting

What are large scale practices?

This category of GRI practices includes a variety of tools that collect and manage large volumes of surface water. Large scale practices include engineered wetlands, floodable spaces or stream daylighting. Engineered wetlands are designed to use the same processes that natural wetlands use to clean and absorb rainwater runoff.

Floodable spaces include plazas and parks designed with a depression that will fill in with water during heavy rain events and will drain out slowly through an outlet. The space can be multifunctional; designed to be used for recreation during dry weather and flood in wet weather; or be more static in design, retaining visible water features year-round.

Stream daylighting is the practice of recreating or uncovering natural waterways buried as a result of urbanization. Stream daylighting is most beneficial if the restoration includes streamside vegetation and upstream watershed improvements. Opportunities for more projects of this GRI type are being assessed as part of many upcoming projects including the Cambie Corridor and Broadway Area plans and other major projects working to address sea level rise.



Example : Hinge Park Wetland

Hinge Park in Olympic Village includes an engineered wetland which collects and manages two thirds of the rainwater that runs off of roadways, plazas and other public spaces in Olympic Village. The wetland uses native plants and naturally occurring microorganisms to filter water, removing pollutants before the water enters False Creek. The wetland also provides an important habitat for wildlife.

Hinge Park Wetland, Vancouver BC

Typical applications

- Park amenity spaces
- Skate parks and sport courts
- Greenways
- Reconfigured streets
- Plazas

Tanner Springs Park, Portland OR

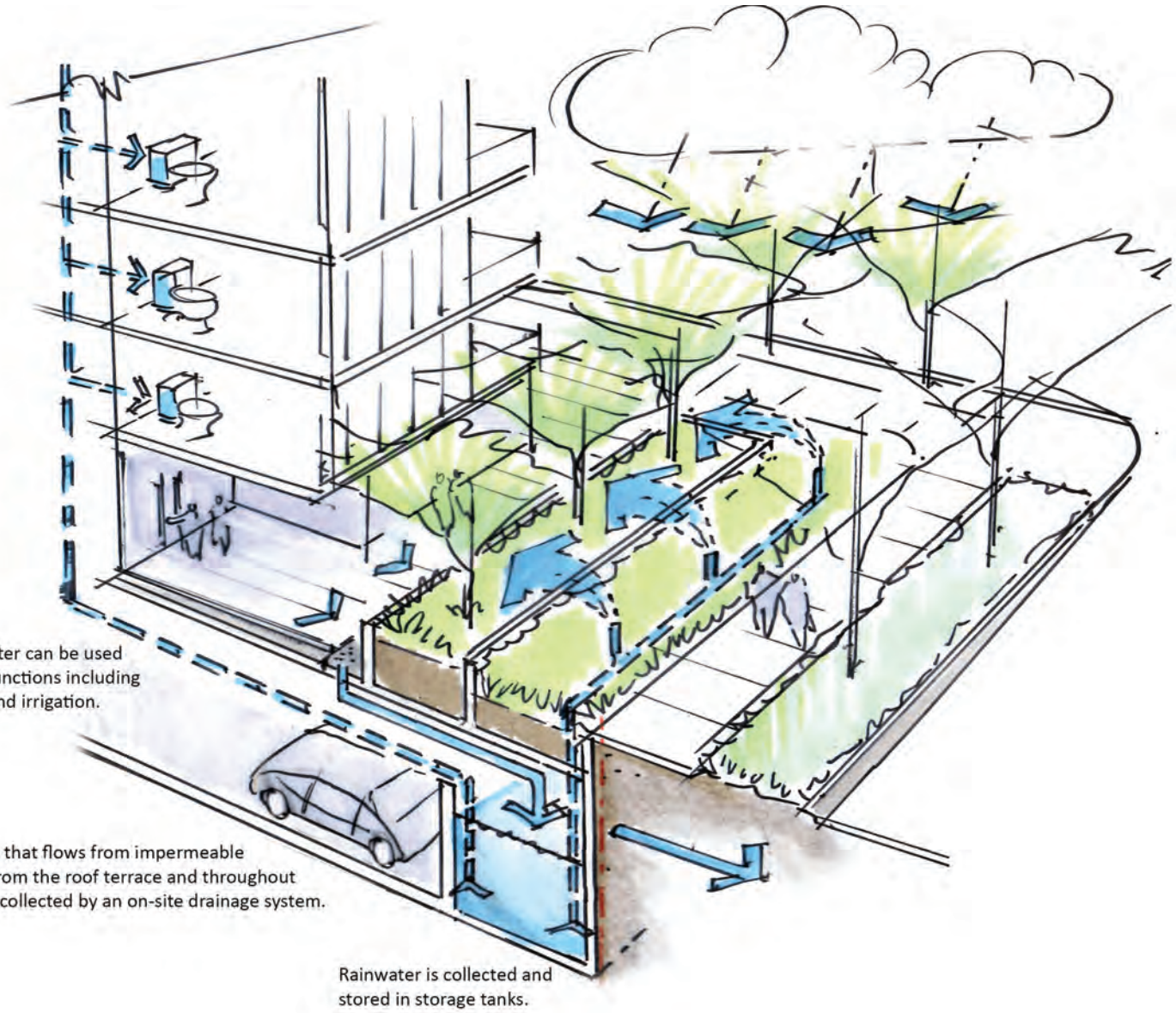
Creekway Park, Creek daylighting, Vancouver

NON-POTABLE SYSTEMS

Water harvest, re-use, and treatment

What are non-potable water systems?

Non-potable water systems aim to collect, store, treat and supply non-potable water in buildings and facilities. Non-potable water is not safe for drinking but can still be used for other applications such as toilet flushing and irrigation. Sources of non-potable water include rainwater, groundwater, greywater and/or blackwater for which strict regulations and guidelines may apply. Greywater refers to wastewater from less intensive uses like showering, hand and dish washing and laundry whereas blackwater refers to wastewater from intensive uses like flushing toilets, and is also referred to as sanitary sewage. Greywater requires less intensive treatment than blackwater before it can be discharged or reused. However, the current regulation for collection and treatment in Vancouver does not differentiate between these two types of wastewater.



Example: Vancouver Convention Centre

The Vancouver Convention Centre reduces its wastewater discharge to the sewer and its potable water demand through the use of an on-site wastewater (blackwater) treatment plant and distribution system. The use of water efficient fixtures and the blackwater system reduces water use by 38% annually, the equivalent of 300,000 toilet flushes per year.

Vancouver Convention Centre, Vancouver BC

Photo: Courtesy Vancouver Convention Centre

Typical applications

- Multi-unit residential buildings
- Single-family homes
- Townhouses
- Commercial/office buildings
- City works yards
- Schools
- Community Centers
- Golf courses

District Blackwater Treatment, Portland OR

MEC Head Office, Vancouver BC

Photo: Ed White

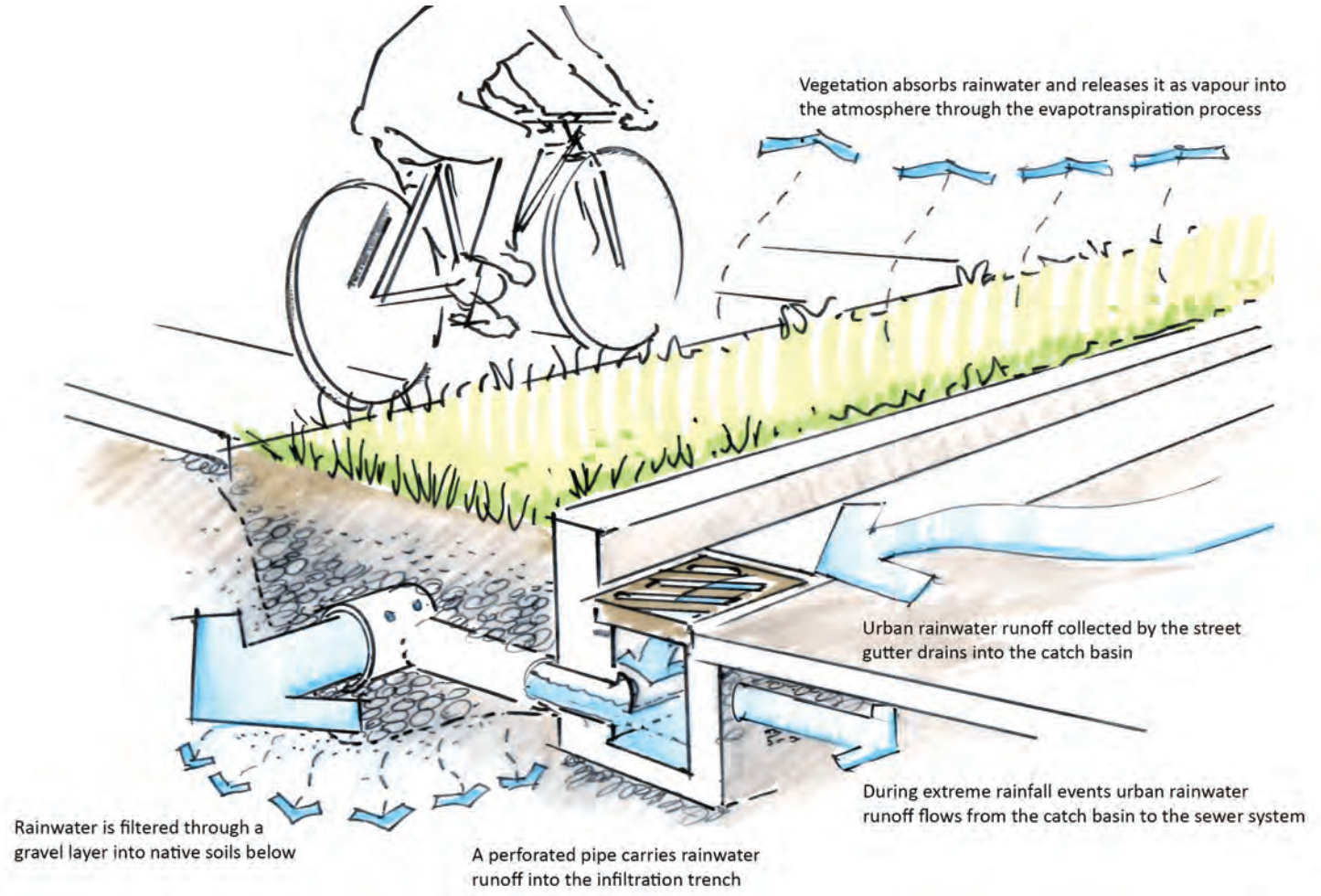
SUBSURFACE INFILTRATION

Infiltration trenches, dry wells, soakways, chambers, arches, modular systems

What are subsurface infiltration practices?

Subsurface infiltration practices use conventional grey rainwater infrastructure to collect and convey rainwater to areas where it can be stored and infiltrated. Large aggregate materials with void spaces and/or modular crates and arches are used to create storage space below the ground's surface. Rainwater is temporarily stored in these practices, giving it a chance to soak back into the ground. Subsurface infiltration practices include infiltration trenches, dry wells, soakways, chambers, arches and modular systems.

Infiltration trenches are typically used to collect and infiltrate rainwater from large areas such as streets, bike lanes, sidewalks and laneways. Dry wells are similar to manholes with perforations that infiltrate rainwater, and can be constructed in series with catchbasins. Soakways, chambers, arches and modular systems can be sized to infiltrate runoff from small or large areas and can be incorporated beneath plazas, natural and artificial turf fields and other locations where sufficient space is available. To date, Vancouver has built 48 subsurface trenches and chambers.



Example: Burrard and Cornwall infiltration trench

Infiltration trenches have been built underneath the existing grass boulevard at the intersection of Burrard Street and Cornwall Avenue in the Kitsilano neighbourhood. The surface runoff is collected by conventional street catch basins and then conveyed into the gravel trench where the water can soak into the soils below. City staff have been monitoring the performance of the infiltration trench since February 2018 and found the trenches are capable of capturing more than 24 mm of rainfall within 24 hours.

Infiltration trench under construction, Burrard at Cornwall, Vancouver BC

Typical applications

- Bike lanes
- Laneways
- Sidewalks
- Underneath plazas
- Natural and artificial turf fields

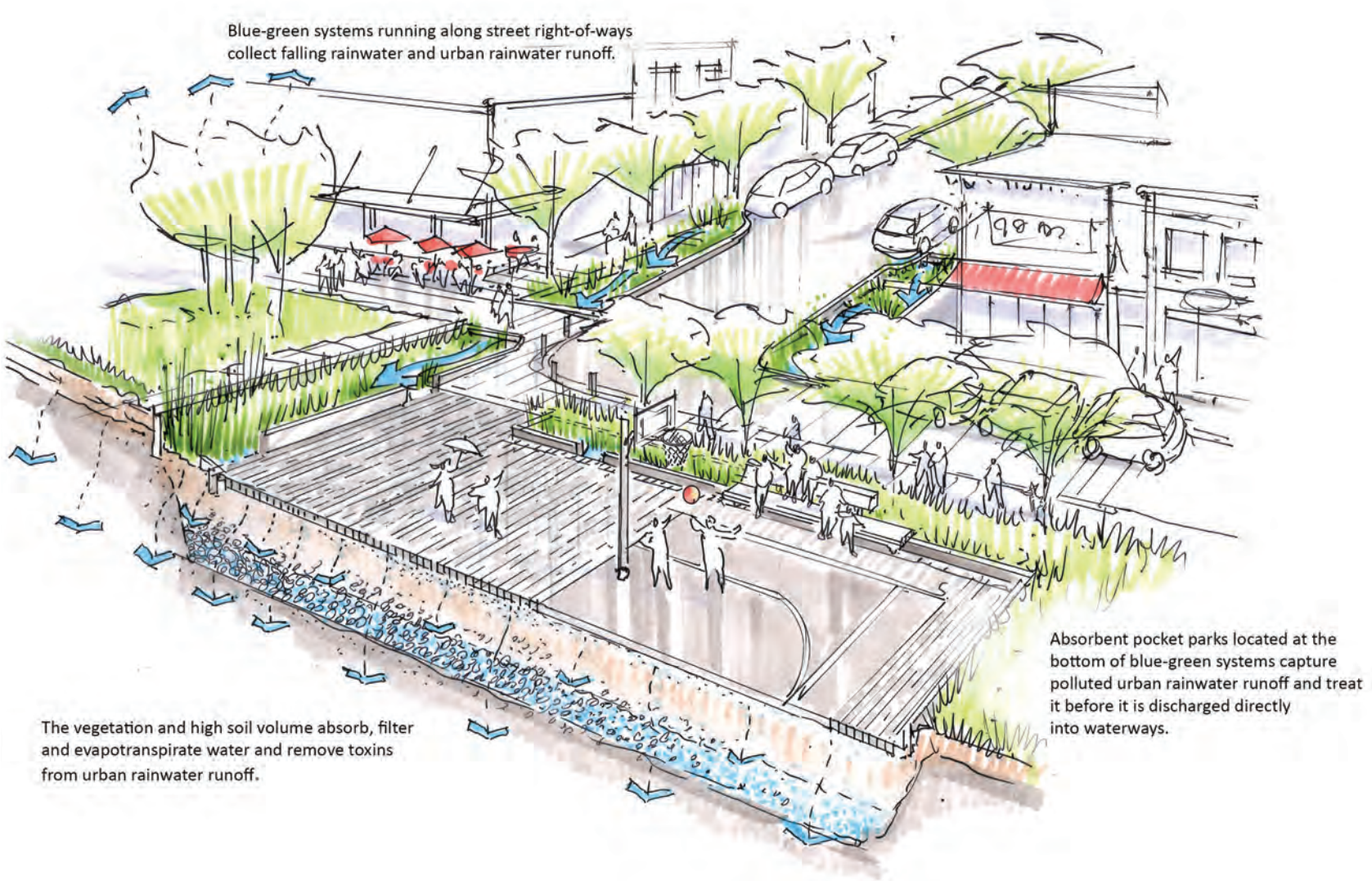
Dry Well

Infiltration Chambers

ABSORBENT LANDSCAPES

What are absorbent landscapes?

Absorbent landscapes are vegetated areas designed to absorb and retain larger amounts of rainfall than conventional compacted landscapes without ponding. The practice can be as simple as providing an increased uncompacted topsoil depth or including other design features that can capture and retain water. Examples include large evergreen trees to intercept rainwater in their upper branches; plentiful surface vegetation to absorb water, prevent erosion and encourage evapotranspiration; and healthy soil with the right sand and organic matter content, which offers the right balance of permeability and water holding capacity. Absorbent landscapes can improve water quality, reduce runoff and increase biodiversity while creating aesthetic appeal.



Example: Grange Park

The new and revitalized Grange Park in Toronto re-opened in 2017. The design is anchored by a large civic green defined by a circular promenade. The bowl-shaped civic green is designed to collect runoff from the entire lawn and recharge the water table. The park has a zone of historic trees called the 'Grove' on the west side of the park that incorporates intimate gathering spaces that also allow for absorbent landscaping. In addition, many of the large trees planted onsite account for increased evapotranspiration, further reducing the volume of rainwater to be managed. Tree species include American Elm, Horse Chestnut, Beech and Oak and others.

Grange Park Civic Green, Toronto Ontario

Photo: PFS Studio

Typical applications

- Residential front yards
- City boulevards
- Park amenity spaces

Absorbent Landscape, residential

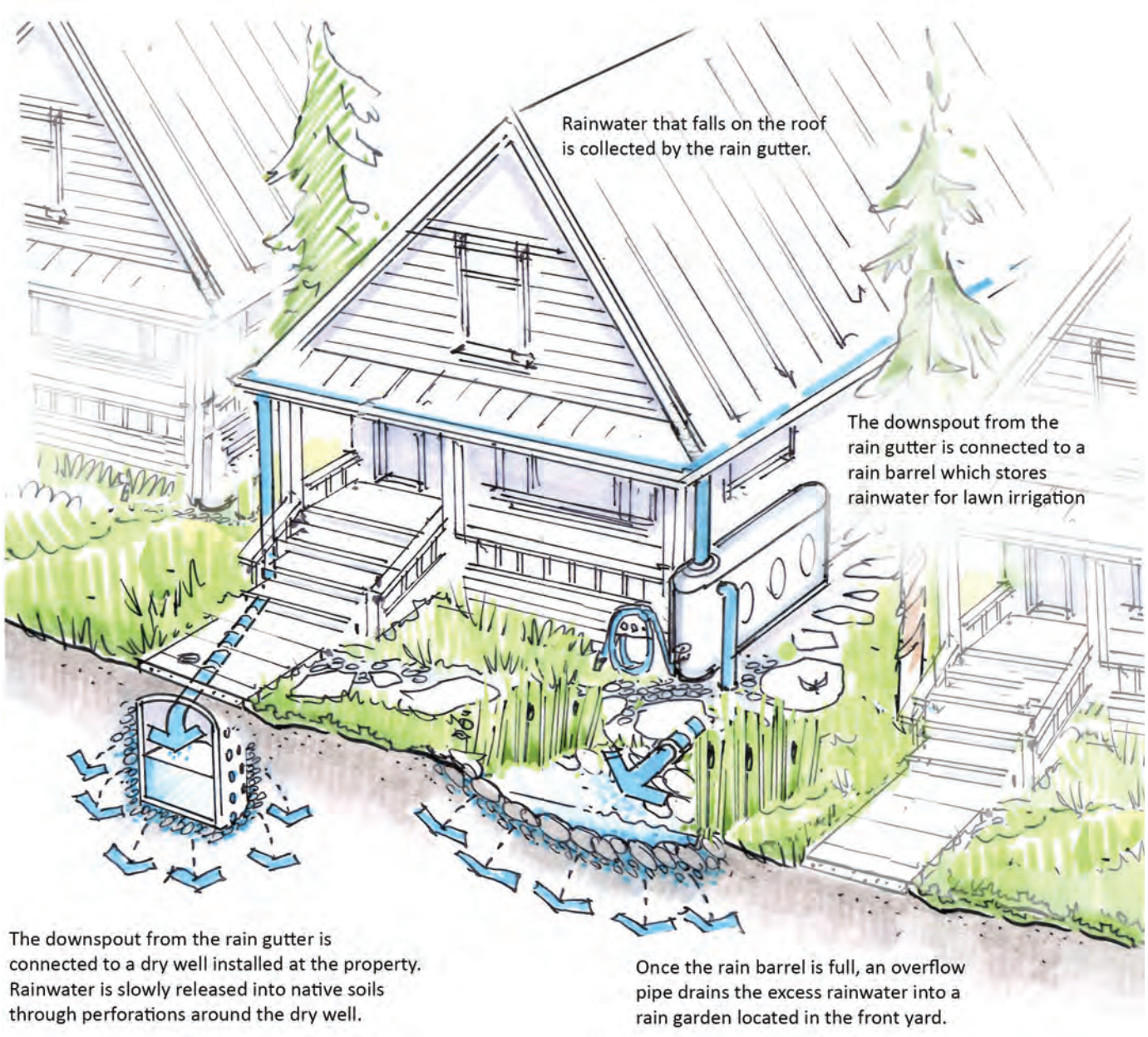
Absorbent lawn, public park

Photo: KWL

DOWNSPOUT DISCONNECTION

What is downspout disconnection?

Downspout disconnection is the process of redirecting rainwater flowing from downspouts away from the sewer system to complementary rainwater management practices designed to use or absorb rainwater. These practices can include rain gardens and other types of bioretention, rainwater harvest and reuse, absorbent landscapes and subsurface infiltration. When combined with these complementary practices, downspout disconnection reduces the volume of rainwater entering local water bodies through the sewer system thereby reducing CSO volumes.



Example: Stormwater Education Plaza

The City of Portland Environmental Services has collaborated with Portland Community College (PCC) to create the Stormwater Education Plaza at the CLIMB Center on PCC's Central Campus. The disconnected downspout at this location allows rainwater runoff from the Centre's 5,200 ft^2 roof to flow over a concrete and steel slab waterfall into a rain garden. Water that enters the rain garden soaks into the ground. This practice transports rainwater from a 5,200 ft2 (483 m^2) roof space and feeds into a rain garden. The raingarden also captures 3,000 ft (915 m) surface runoff from the adjacent street. In an extreme rain event, the water flows back into an outlet to a catch basin.

Stormwater Education Plaza, Portland Oregon

Photo: City of Portland

Typical applications

- Single-family homes
- Townhouses
- Multi-unit residential buildings
- Large public buildings
- Commercial/office buildings
- Underpass drainage for bridges

Downspout disconnection, Portland OR

Downspout disconnection, Portland OR

Appendix C

IRMP Report Card

The citywide Integrated Rainwater Management Plan suggested a 5 year period to ramp up the implementation of GRI on public, private and park lands. The work of the Rain City Strategy and the accompanying action plans have built upon the strong foundation of the IRMP phasing and scheduling strategy. The report card presented in this appendix demonstrates our progress in correspondence with the Rain City Strategy.

IRMP Report Card

The citywide Integrated Rainwater Management Plan (IRMP) outlines a phasing structure to implement a mix of GRI on public, private and park land, gradually working towards making GRI the preferred default option for managing urban rainwater runoff.

The IRMP suggested a 5 year period to ramp up the implementation of GRI. With each step, the City will mature its approach and expand the reach of the programmes. The work of the Rain City Strategy and the accompanying action plans have built upon the strong foundation of the IRMP phasing and scheduling strategy.

The report card presented here shows our progress against this phasing and scheduling strategy:

- Phase A: immediate and ongoing (2016)
- Phase B: remove barriers, build capacity (2017)
- Phase C: expand GRI into new non-single family projects (2018)
- Phase D: expand GRI to new one/two family and lane housing (2019)
- Phase E: expand GRI to retrofits (2020)
- Phase F: long term aspirations (beyond 2020)

Integrated Rainwater Management Plan Priorities

#	PHASE	REALM	STATUS	COMMENT ON STATUS
A	PHASE A: IMMEDIATE AND ONGOING (2016)			
A1	Implement GI team	All	🟢	Completed
A2	Catch basin cleaning action / awareness	Public	🟢	Completed and ongoing 'Adopt a catch basin'
A3	Cross connection control action / awareness	Public	🔴	To be part of the CSO Mitigation Strategy
A4	Require Green Rainwater Infrastructure (GRI) in large rezonings	Private	🟢	Completed
A5	Integrate GRI demonstration / learning in current projects	Public	🟢	Completed and ongoing (Olympic Village - 63rd & Yukon)
B	PHASE B: REMOVE BARRIERS, BUILD CAPACITY (2017)			
B1	Green Rainwater Infrastructure (GRI) public awareness (stage one)	All	🟢	Completed
B2	Identify priority areas for street GRI implementation	All	🟢	Completed
B3	Update Engineering standards to include GRI	Public	🟠	Priority for 2019
B4	Water Quality Monitoring / Adapt to meet regulations	Public	🟢	Ongoing to report back on Feb 2019
B5	City Off-Street Property GRI demo / monitoring projects (pilot on institutional projects)	Public	🔴	PDS / REFM
C	PHASE C: EXPAND GREEN RAINWATER INFRASTRUCTURE INTO NEW NON-SF PROJECT (2018)			
C1	Review surface parking treatment fee options	All	🟠	Policy from Engineering, implemented by PDS
C2	Study storm water utility feasibility	All	🟠	Financing model for O&M to develop
C3	Street block GRI demo / monitoring projects	Public	🟢	Quebec & 1st, 63rd & Yukon
C4	Parks sites GRI and biodiversity demo / monitoring projects	Parks	🟠	To scope wtih master plans (i.e. QE Park)
C5	Require GRI in new MF ICI projects (update regulations)	Private	🟠	Currently only for rezoning
C6	On-street surface parking treatment integrated with sewer separation	Public	🟠	Initiated. Cassiar project
D	PHASE D: EXPAND GREEN RAINWATER INFRASTRUCTURE TO NEW ONE/TWO FAMILY / LANE HOUSING (2019), NEW CONSTRUCTION			
D1	Private SF GRI demo / monitoring projects	Private	🔴	Not initiated
D2	Require GRI in new SF/Duplex projects (update regulations)	Private	🔴	Rainwater management requirements not for SF/Duplex
E	PHASE E: EXPAND GREEN RAINWATER INFRASTRUCTURE TO RETROFITS (2020)			
E1	Private surface parking GRI demo / monitoring projects	Private	🔴	Not initiated
E2	Launch charges for GRI in existing private surface parking	Private	🔴	Not initiated
F	PHASE F: LONG TERM ASPIRATIONS (BEYOND 2021)			
F1	Rainwater capture / reuse demo / monitoring projects	All	🔴	Not initiated
F2	Launch capture / reuse projects	All	🟠	Reuse expert hired. Oakridge injection study
F3	Start Absorbent Lanes program	Public	🟠	Trial projects initiated with Streets (W 10th lane, Cambie)

Appendix D

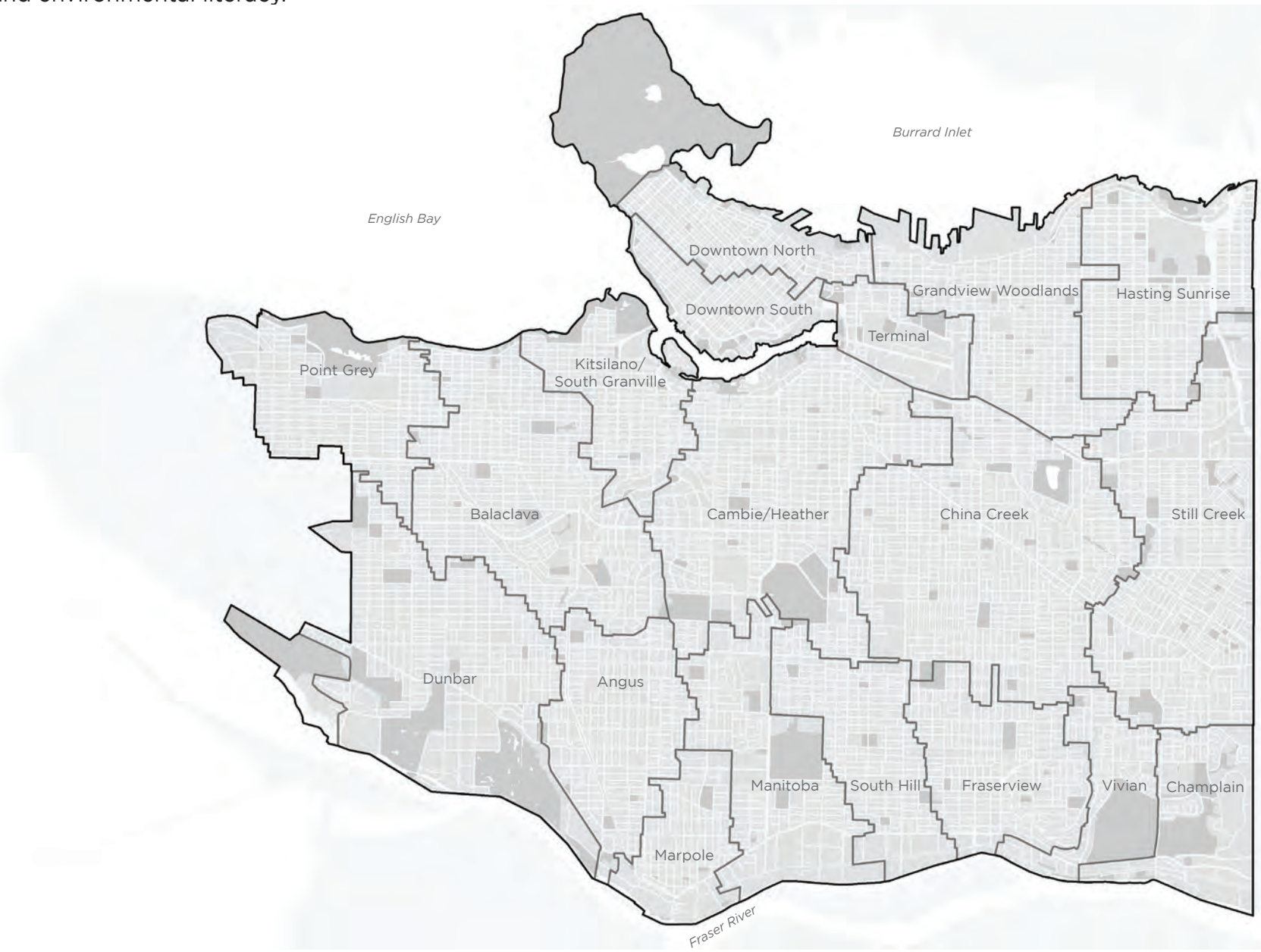
Watershed Characterization

The maps and spider diagrams provided in this appendix aid in understanding the unique characteristics, needs and challenges of each of the City's urban watersheds. Using this information will ensure health and sustainability of the watershed, while identifying and acting on opportunities for rainwater management, flood management, climate change mitigation and resilience, economic development, biodiversity, ecological rehabilitation, public health and well-being, urban growth and housing, transportation connectivity, partnerships and collaborations, cultural and amenity services, education and environmental literacy.

Jericho Beach

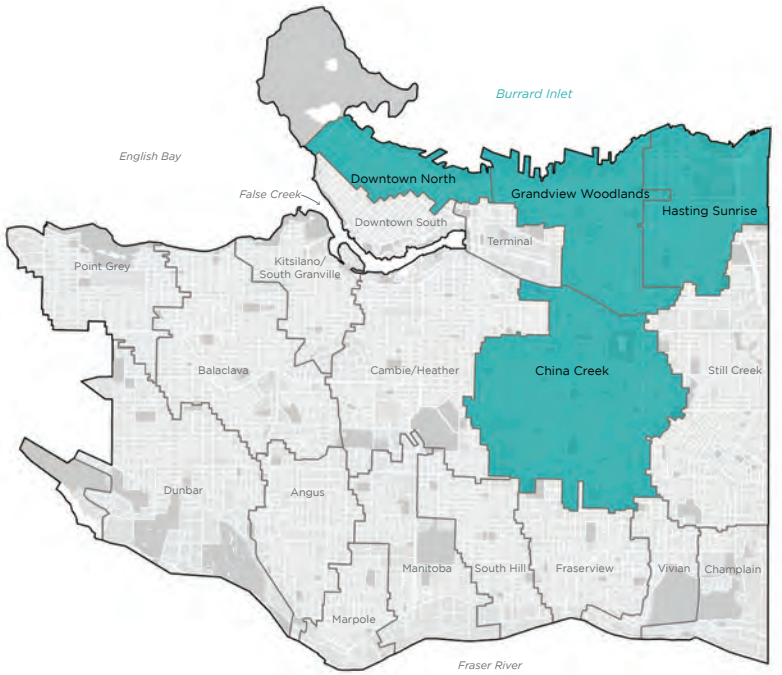
PLANNING BY WATERSHED

Watershed planning provides a science-based and community-driven approach to understand our past, current and future relationship with the ground and surface water resources, their ecological functions and human activities within a watershed. As a progressive water management strategy, watershed planning informs and guides public policy by assessing the unique characteristics, needs and challenges of each of the City's urban watersheds, such as ecology, soil type, underlying geology, age of infrastructure and urban development patterns. Watershed planning aims to ensure health and sustainability of the watershed, while identifying and acting on opportunities for rainwater management (quality and volume), flood management, climate change mitigation and resilience, economic development, biodiversity, ecological rehabilitation, public health and well-being, urban growth and housing, transportation connectivity, partnerships and collaborations, cultural and amenity services, and education and environmental literacy.



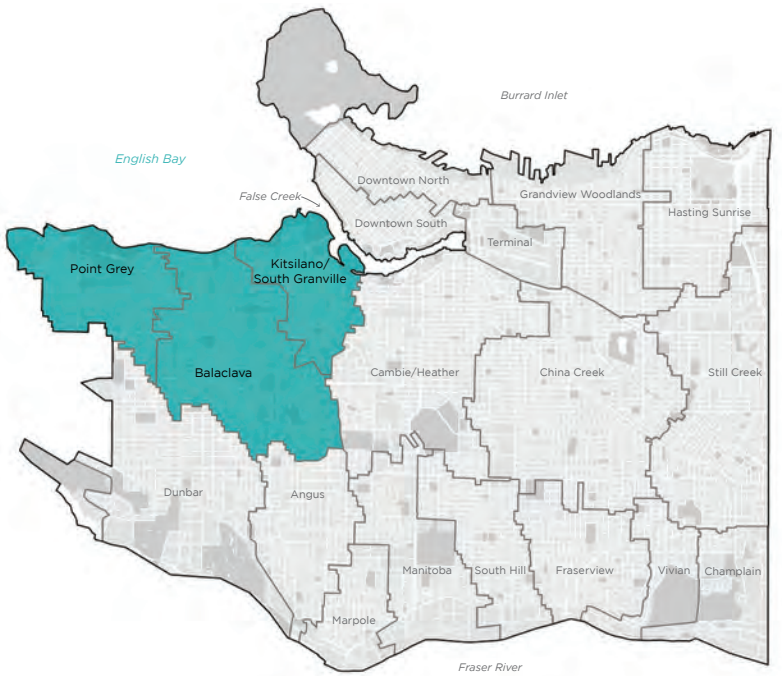
RECEIVING WATERS

Vancouver's 19 urban watersheds drain into the receiving waters which surround the city: Burrard Inlet, False Creek, English Bay, and the Fraser River. These waters sustained Indigenous communities for millenia prior to First Contact, and were instrumental in the founding and development of the City of Vancouver. One of the driving concerns of the Metro Vancouver Integrated Liquid Waste and Resource Management Plan (ILWRMP) and the Rain City Strategy is to protect and improve the quality of these waters and the ecosystems and people they support.



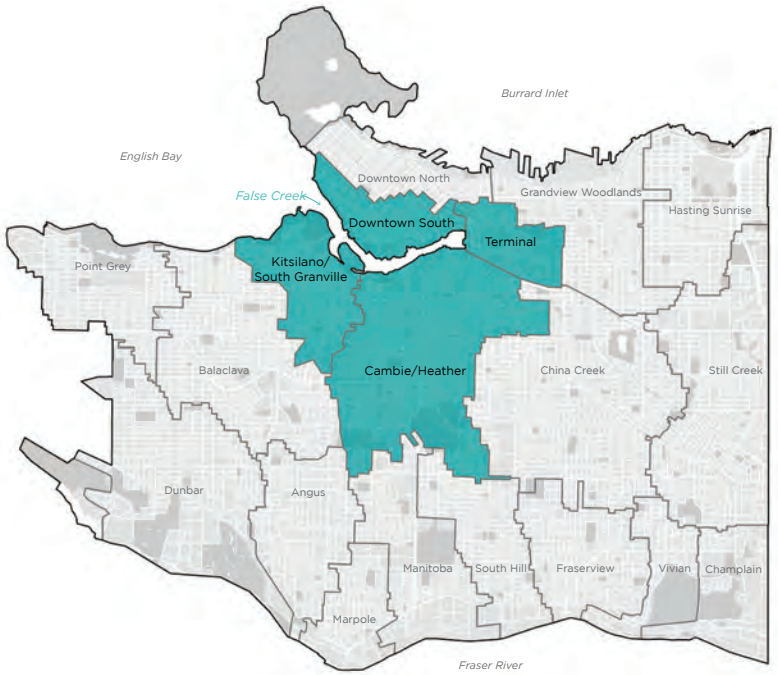
Burrard Inlet | *Sasamat*

Burrard Inlet, known as *Sasamat* by the Coast Salish Peoples, is a short body of water that separates the City of Vancouver from the North Shore municipalities. Burrard Inlet is an active waterway, providing important marine habitat and serving significant port and cruise ship operations. Within the City of Vancouver there are 15 combined sewage outfalls and 56 urban rainwater runoff outfalls along the Burrard Inlet. North Shore municipalities also have their own respective outfalls that discharge into Burrard Inlet. The Vancouver watersheds that drain into Burrard Inlet are Downtown-North, Grandview-Woodlands, Hastings-Sunrise and China Creek. Burrard Inlet is subject to the Burrard Inlet Action Plan, a science-based initiative led by the Tsleil-Waututh Nation to improve the health of the inlet ecosystem.



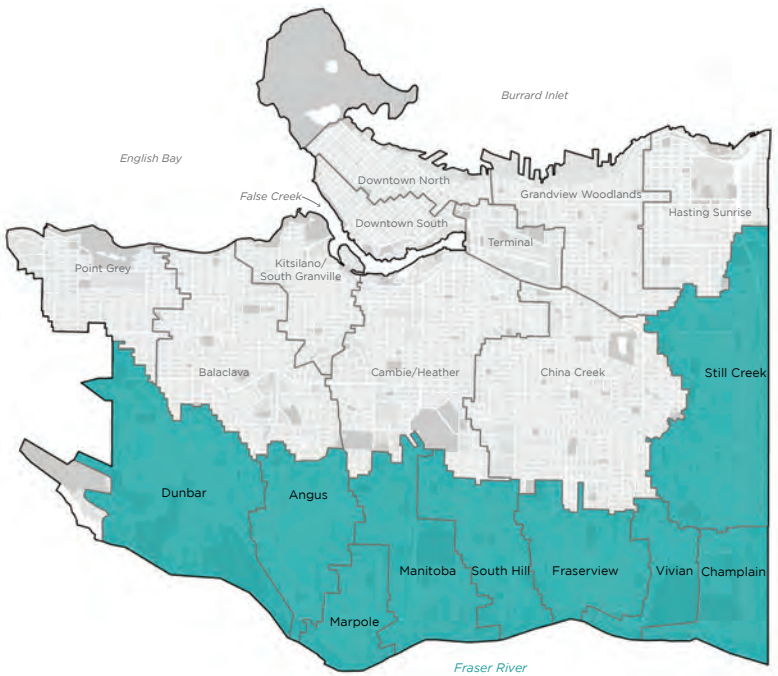
English Bay | *Ayyulshun*

English Bay, known as *Ayyulshun* by the Coast Salish Peoples is a bay off of the Salish Sea that is bound on the south side by Vancouver and the University Endowment Lands, and on the north by the North Shore municipality of West Vancouver. Significant port and cruise ship traffic traverse English Bay, and it is the site of several important recreational beaches and marinas. There are 7 combined sewage outfalls and 5 urban rainwater runoff outfalls along English Bay from the City of Vancouver, and the Point-Grey, Balaclava, and some of Kitsilano / South Granville watersheds drain into the Bay. A further impact on water quality in English Bay is the large amount of sediment from the Fraser River which is deposited on the south-western parts of the bay.



False Creek | *Snauq*

False Creek, known as *Snauq* by the Coast Salish Peoples, is a small inlet separating downtown Vancouver from the rest of the city. False creek was historically a centre of industry in Vancouver, and is now a high traffic area for recreational boating. The majority of False Creek is surrounded by development, and the remainder is scheduled to undergo significant redevelopment in the next few years. The watersheds that drain into False Creek are Downtown South, Terminal, Cambie-Heather, and some of Kitsilano-South Granville. From these watersheds, there are 4 combined sewer outfalls and 16 urban rainwater runoff outfalls that drain into False Creek. Vancouver City Council has begun to explore the potential for a future where False Creek is swimmable.



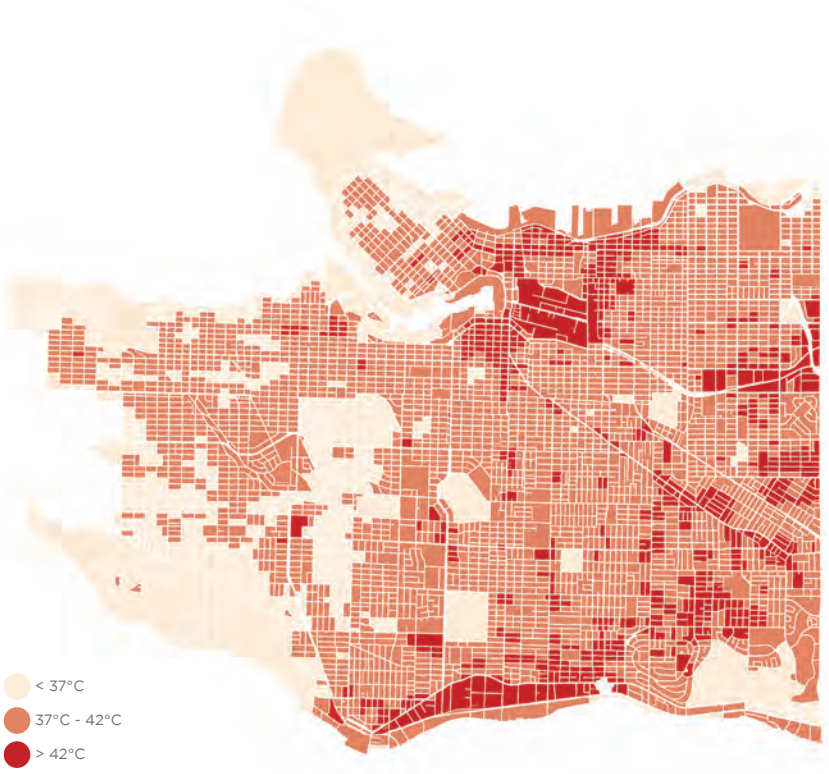
Fraser River | *Sto:lo*

The Fraser River, known to the Coast Salish Peoples as *Sto:lo*, flows from its headwaters in the Rocky Mountains near the border with Alberta, to its delta south of the City of Vancouver. The Fraser is the world's premier salmon fishery and an important stop over for migrating shore birds. The North Arm, which runs between the City of Vancouver and the City of Richmond, supports a variety of industrial uses, while the South Arm has more protected natural areas. The Dunbar, Angus, Marpole, Manitoba, South Hill, Fraserview, Vivian, and Champlain watersheds drain into the Fraser River. From these watersheds there are 8 combined and 26 urban rainwater runoff outfalls that drain into the Fraser. The Still Creek watershed drains to Burnaby Lake in the City of Burnaby, and then out into the Fraser via the Brunette River.

Drivers for Implementing Green Rainwater Infrastructure

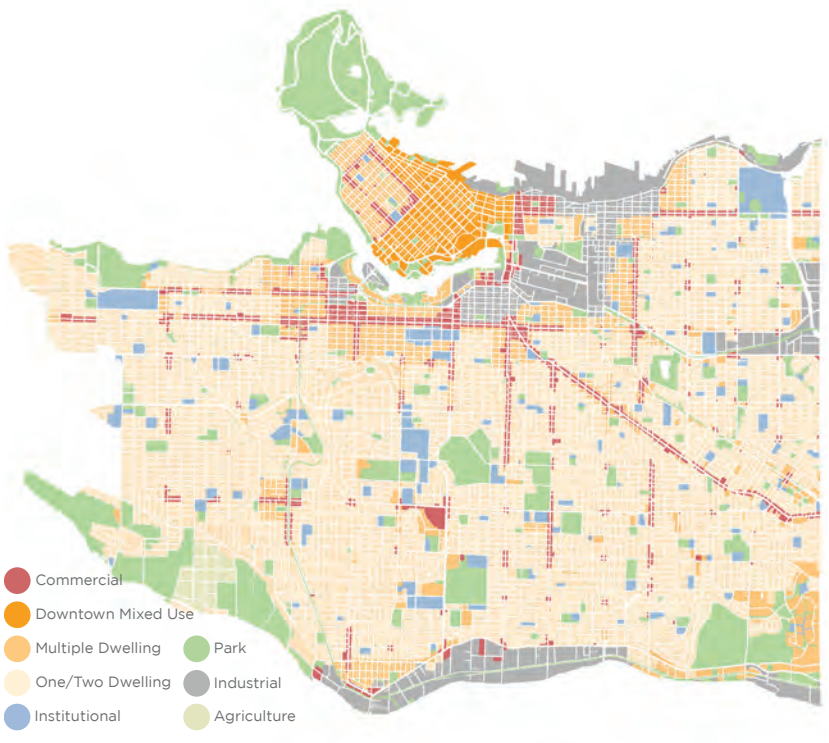
Urban heat island effect

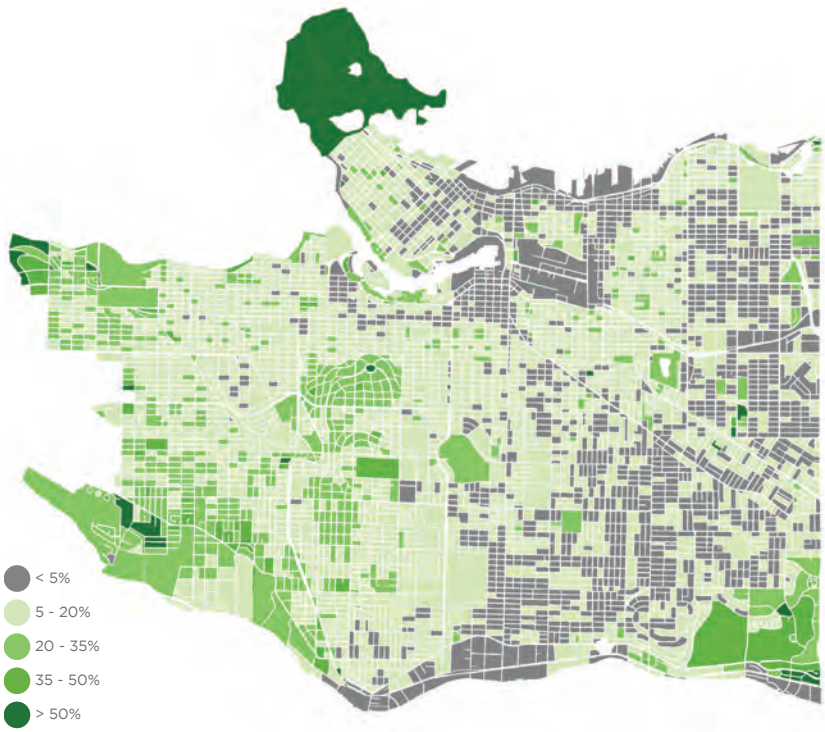
Urban heat island describes the effect of urban areas being hotter than surrounded rural areas. Urban heat island effect is exacerbated by large paved areas and built up areas, limited green space, and limited tree canopy cover. In Vancouver, the areas which experience urban heat island tend to be industrial areas, and some residential areas on the east side of the city. The west side and downtown experience less urban heat due to both an improved tree canopy and proximity to the ocean.



Land use

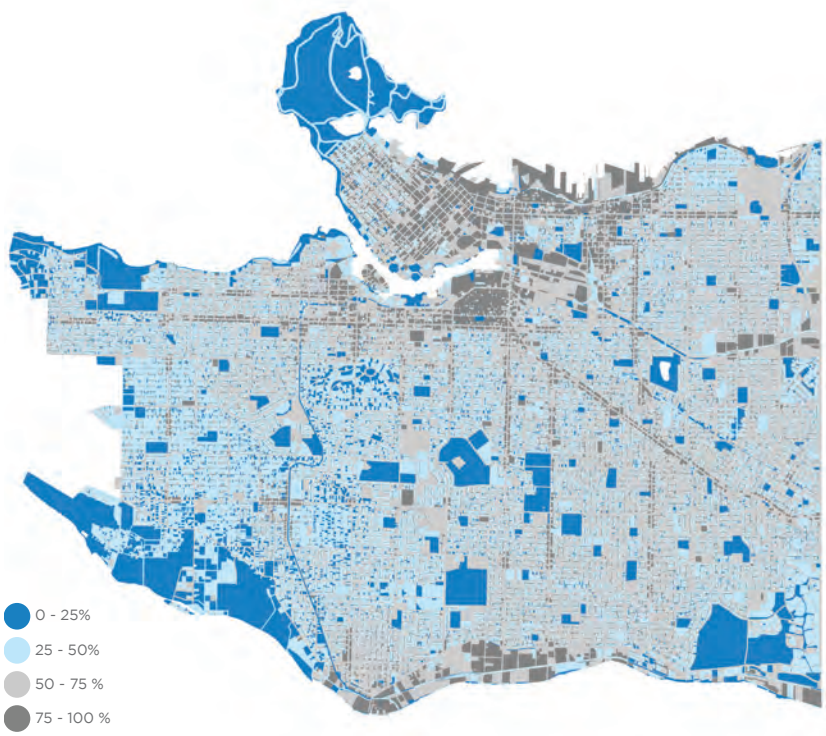
Land use is a critical driver for green rainwater infrastructure (GRI), as different typologies have different requirements for the amount of land that can be covered by buildings and impervious materials. The most predominant land use typology is One/Two Family Dwellings, where on average a parcel is 60% covered by impervious materials. In order to address water quality issues related to urban rainwater runoff contamination and combined-sewer overflows, rainwater management is a process that will need to be undertaken on both public and private property. This will involve working with residents, business-owners, and various levels of government in order to deliver an effective GRI program.





Tree canopy cover

Vancouver is home to an urban forest that comprises approximately 140,000 street trees, 300,000 park trees, and an unknown number of trees on private property. The urban forest plays important environmental and social roles, such as cleaning the air, absorbing storm water, storing carbon, providing habitat, and improving health and well-being. Additionally, a robust tree canopy provides localized cooling to help mitigate urban heat island effect and the hotter summers Vancouver will experience as climate change progresses. Trees filter and retain rainwater, helping to clean it and restore natural water cycles.



Impervious area

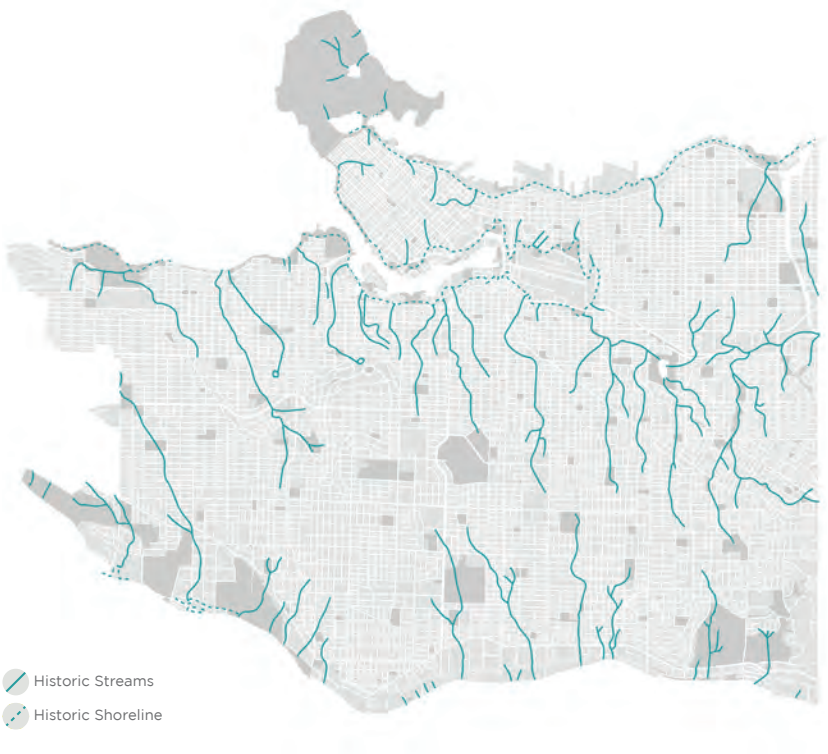
Impervious surfaces are paved areas, roofs, and other hard surfaces that do not allow for rainwater to soak into the ground. Vancouver, like other urban areas, is characterized by a high degree of imperviousness. As the city continues to develop and grow, it is critical to retain pervious areas where water can infiltrate back into the ground and where street trees have ample room to grow. Retaining pervious areas helps to prevent localized flooding, cool local environments, clean rainwater runoff, and reduce the volume of water entering the sewer system.

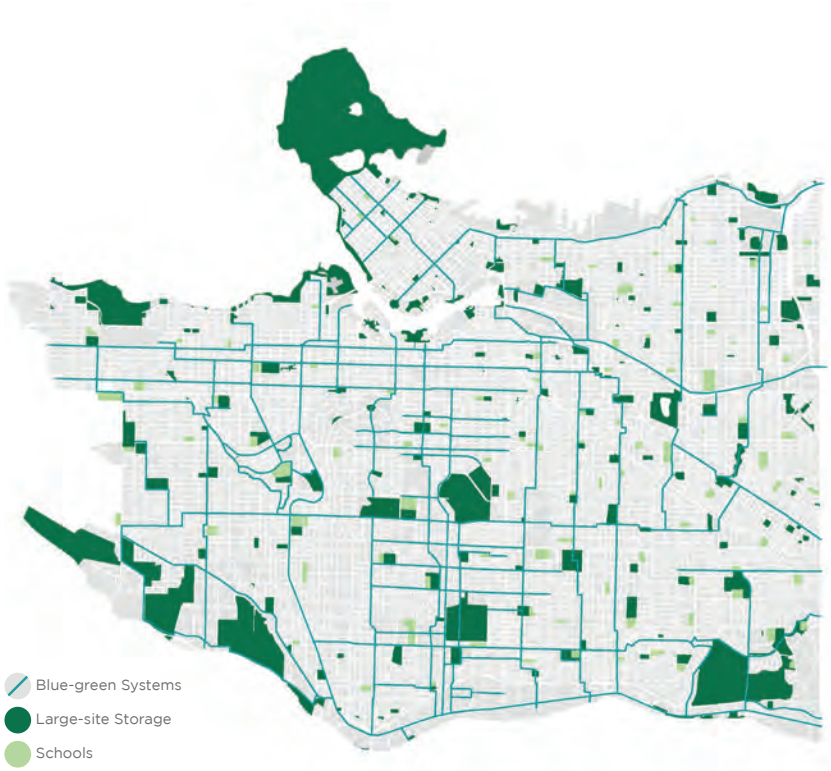
Road network

Streets, roads, and highways are the primary mode for moving goods, people, and services but also can carry urban rainwater runoff pollutants from the adjacent land and from cars, trucks, and buses, including heavy metals from tires, brakes, and engine wear, and hydrocarbons from lubricating fluids. If the pollutants are not properly controlled, they can impair waters causing them to no longer support the water's designated uses and biotic communities. Pollutants often adhere to sediments on our streets which can then be washed into receiving waters. Street sweeping programs is one effective tools to help protect water quality impacts from our streets.

Lost streams

While it may be difficult to imagine now, in our highly urbanized city, Vancouver once had a vast network of natural streams and creeks. As the city developed and grew, many streams were buried under pipes, filled in, or diverted. Many of these streams were salmon-bearing and provided sustenance to the Indigenous people who lived in these lands prior to First Contact. The City of Vancouver has recently completed some daylighting projects where streams were restored to a more natural state above ground, although this will not be possible everywhere. Daylighting streams does provide effective rainwater management by cleaning rainwater and allowing it to infiltrate and filter through plant and soil material before discharging into our receiving water bodies.

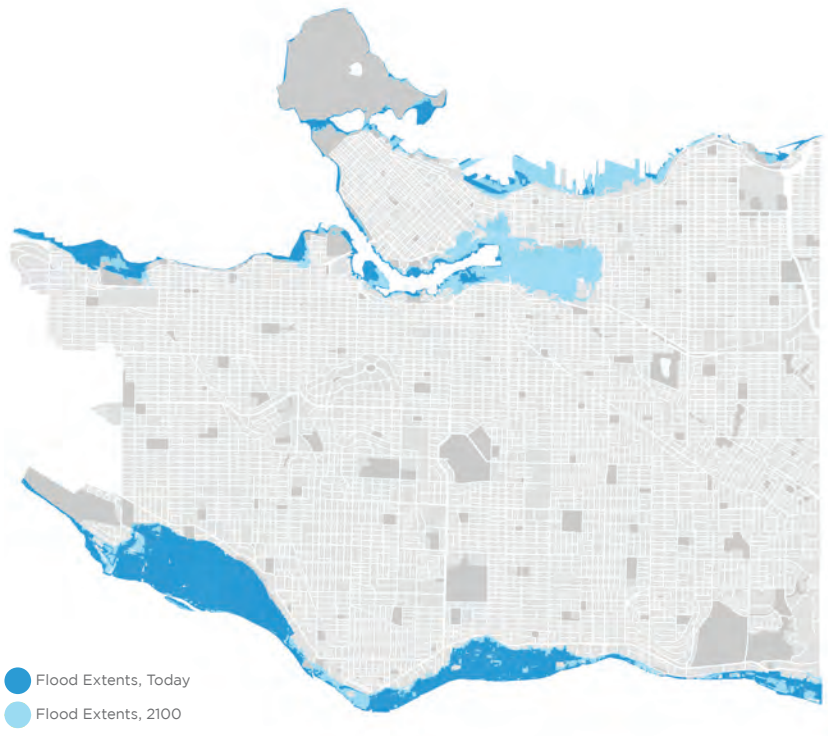




Blue-green systems

Blue-green systems are networks of park-like corridors that manage water, contribute to the urban forest, and provide active transportation routes. They seek to protect the ecological, hydrological, and social values of the urban landscape and water cycle, and to provide resilient measures to address climate change and flood management, increase connectivity, and enhance access to nature.

The blue in blue-green system refers to the presence of water and ideally includes management of both minor and major rainfall events, where as the green refers to elements of terrestrial vegetation including trees or urban forest as well as other layers of plants that comprise and offer ecological services.



Sea level rise

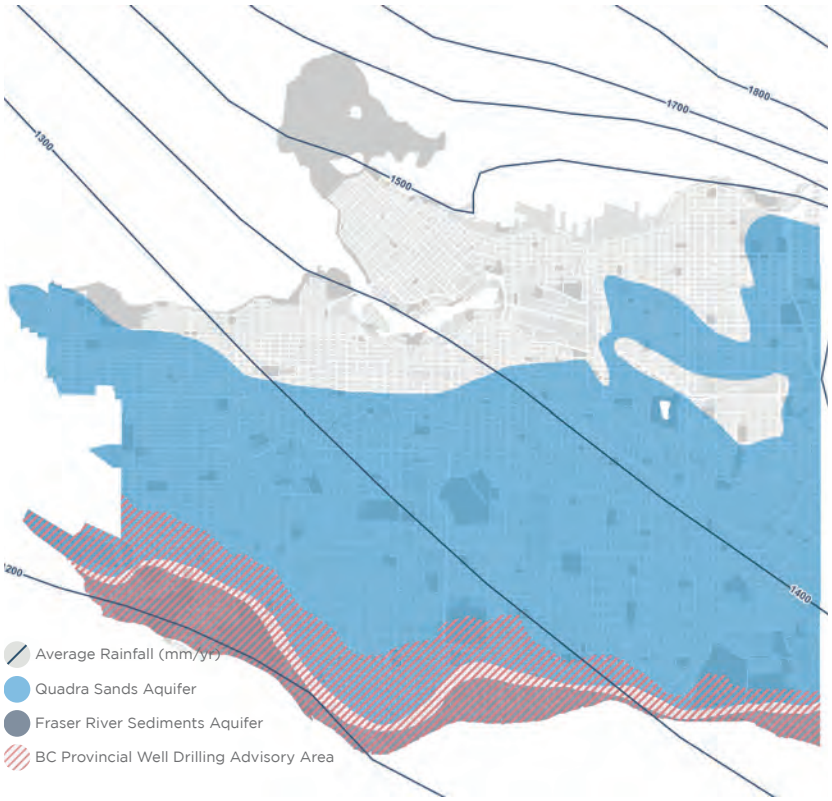
Sea level rise is caused by the ocean expanding as it heats up due to global warming and as major stores of ice from glaciers and ice sheets melt. Around the world, sea level rise and flood-related events are causing billions of dollars in damage. To date, observed sea level change in Vancouver over the past century has been 3. 7cm. While the pace of sea level rise is uncertain, we are making plans that are flexible and that can accommodate sea level rise of 50cm by 2050, and 1 metre by 2100, and additional 1 metre thereafter. Approximately 13km2 and $7B of property are vulnerable to the effects of sea level rise and climate change-related storm surges.

Water in the city

Integrated water management strategies are heavily influenced by local patterns of precipitation, expression of surface water and sub-surface groundwater.

Vancouver is well-known for its rain. On average, it rains over 160 days and between 1200 – 1600 millimetres a year. Rainwater that flows off of our roofs, streets, parking lots and other surfaces, picks up pollutants, and is conveyed through our pipes, either to the treatment plant or directly into our local waterbodies.

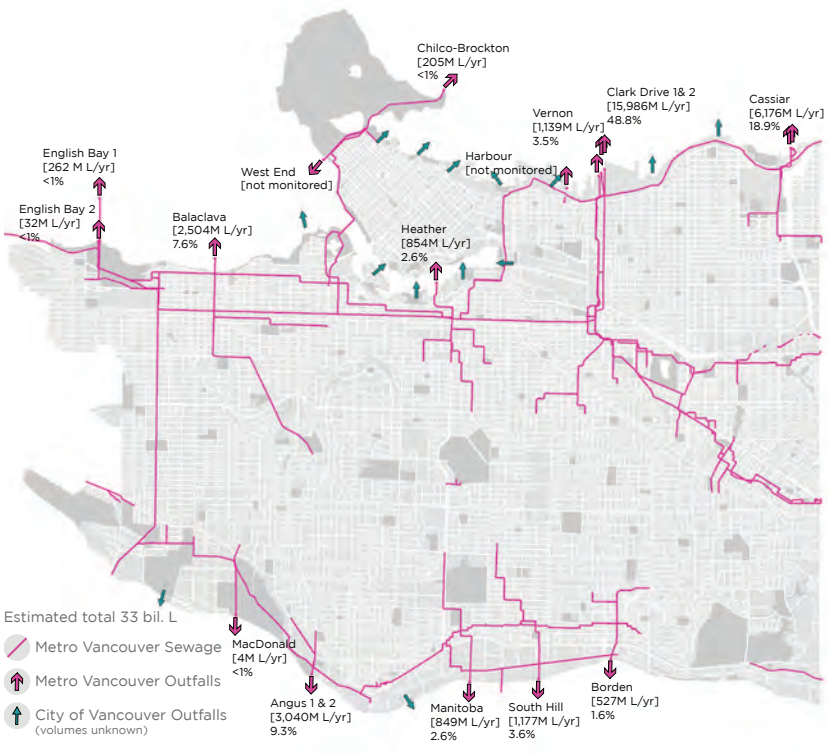
Groundwater is found underground in cracks and spaces in soil, sand, and rocks. Surface water is water on the surface of the earth, and includes streams, rivers, lakes, wetlands, and oceans.

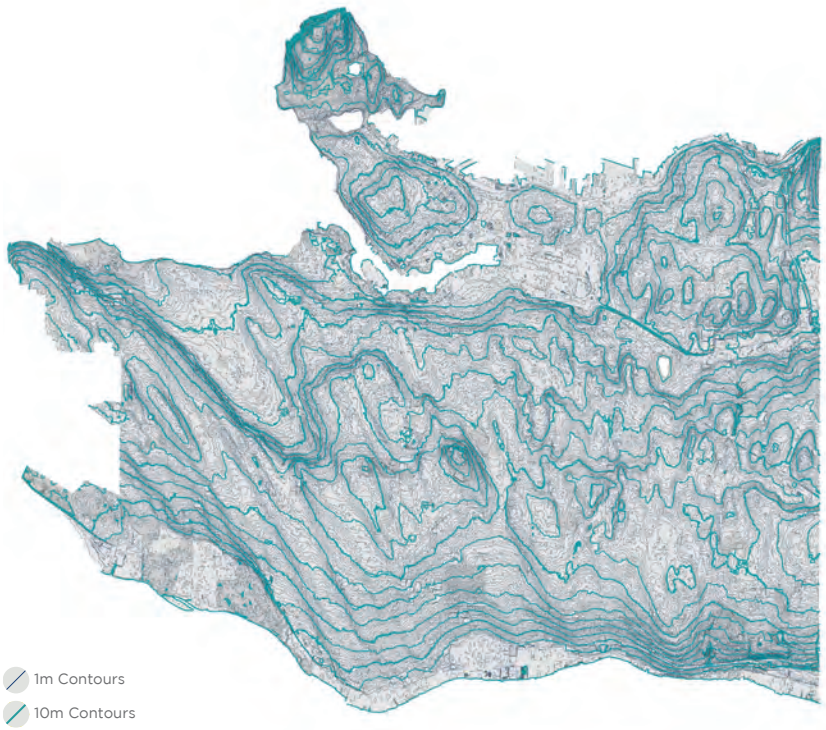


Combined Sewer Overflow (CSO)

Vancouver has a semi-separated sewer system, where some areas are served by a system which conveys sewage and rainwater in one combined pipe, and some areas by separate pipes. During and immediately after rain events, capacity in the system is exhausted, resulting in rainwater-diluted sewage being discharged directly into our receiving water bodies through combined sewage outfalls. These overflow events are called combined sewer overflows (CSOs).

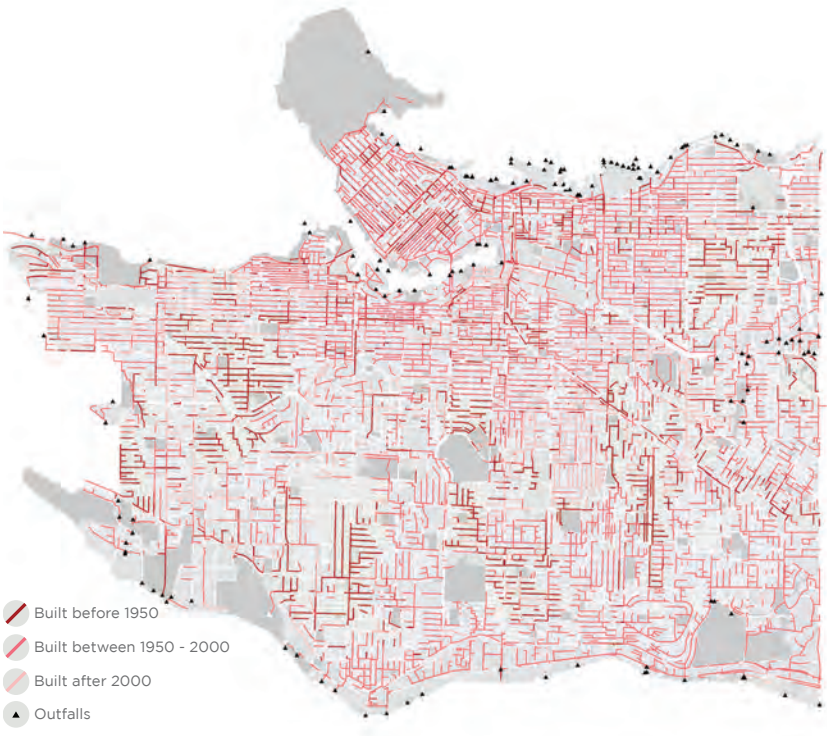
In 2018, the Vancouver Sewerage Area generated nearly 33 billion litres of CSO discharge volume. Additional CSOs occurred at the City of Vancouver-owned and operated outfalls.





Topography

The topography of the land dictates patterns of water drainage and storage. For example, areas of depression provide opportunities for water storage whereas sloped areas provide opportunities for water drainage. Also, the pattern of rainfall in Vancouver is influenced by the effect of the North Shore Mountains that force moisture-laden clouds to rise, cool, and then drop their rainfall. The variation in rainfall and the pattern of drainage to receiving waters may influence sizing of rainwater infrastructure, and priorities for action.



Age of infrastructure

Infrastructure systems are the facilities that allow our cities to function. These include roads and bridges, electrical grids, water supply pipes, and sanitary and rainwater sewers. Vancouver's infrastructure varies in age across the city. Pipes typically have a lifespan of approximately 100 years. With the goal of maximizing the usefulness of our existing system, watershed-based solutions will differ depending on the age of the infrastructure.

EXISTING CONDITIONS DASHBOARD

The figures in this document describe the current state of each of Vancouver's 19 watersheds, as they relate to green rainwater infrastructure (GRI) and rainwater management. While some characteristics of watersheds may be similar, there are dramatic differences across the city and no two areas are identical. The information presented in these pages allows an examination of the cumulative impacts of many characteristics across the watershed and downstream to the receiving water body.

Name of watershed

Map of watershed

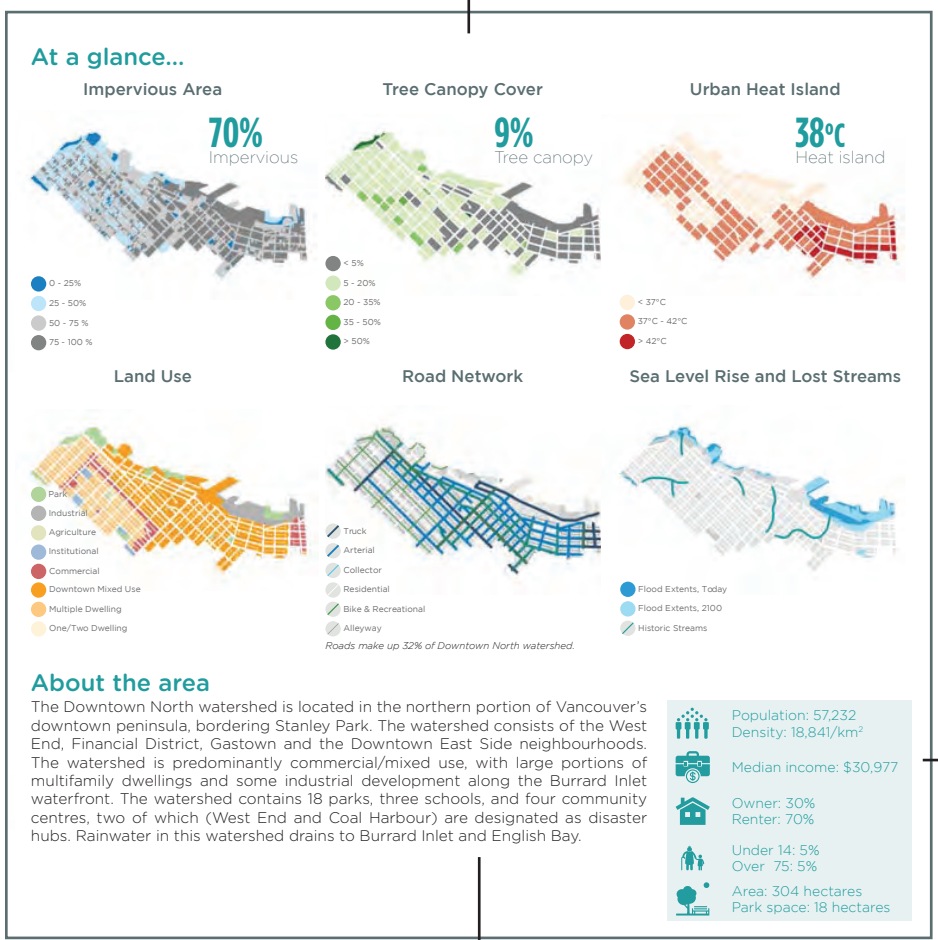
Each spread introduces a different urban watershed. This map is meant to help the reader situate themselves, and understand what streets, parks, and other features are in the watershed.

Location of watershed

This small inset map highlights the current watershed in teal, helping the reader understand where in the city the watershed is located.

Landmarks and disaster hubs

Schools and community centres are highlighted as they often occupy large sites and are focal points for communities. They serve as gathering places and service providers, which sets them up well as hubs for future programming or post-disaster water provision.



Physical indicators

The six figures presented for each watershed explain physical characteristics of the area. For urban heat island effect, tree canopy cover, and impervious area, geographically weighted averages are presented alongside the figures.

Land Use describes how each parcel is utilized in a particular watershed.

The road network has been included as street rights of way are primarily the areas where rainwater falls and is diverted into catch basins. Arterial roads and truck roads are especially important for consideration as they generate highly polluted rainwater runoff that is damaging to the marine environment if it is discharged without treatment.

The City of Vancouver used to be a landscape of surface streams and forests. The urban landscape is significantly transformed, as is our shoreline. It is expected that the City will experience 1m of sea level rise by 2100, and more intense weather events related to climate change.

Social indicators

Social aspects, like physical aspects, differ by watershed. Social indicators are presented to provide readers with information that may inform how the Rain City Strategy is implemented and what tools are appropriate.

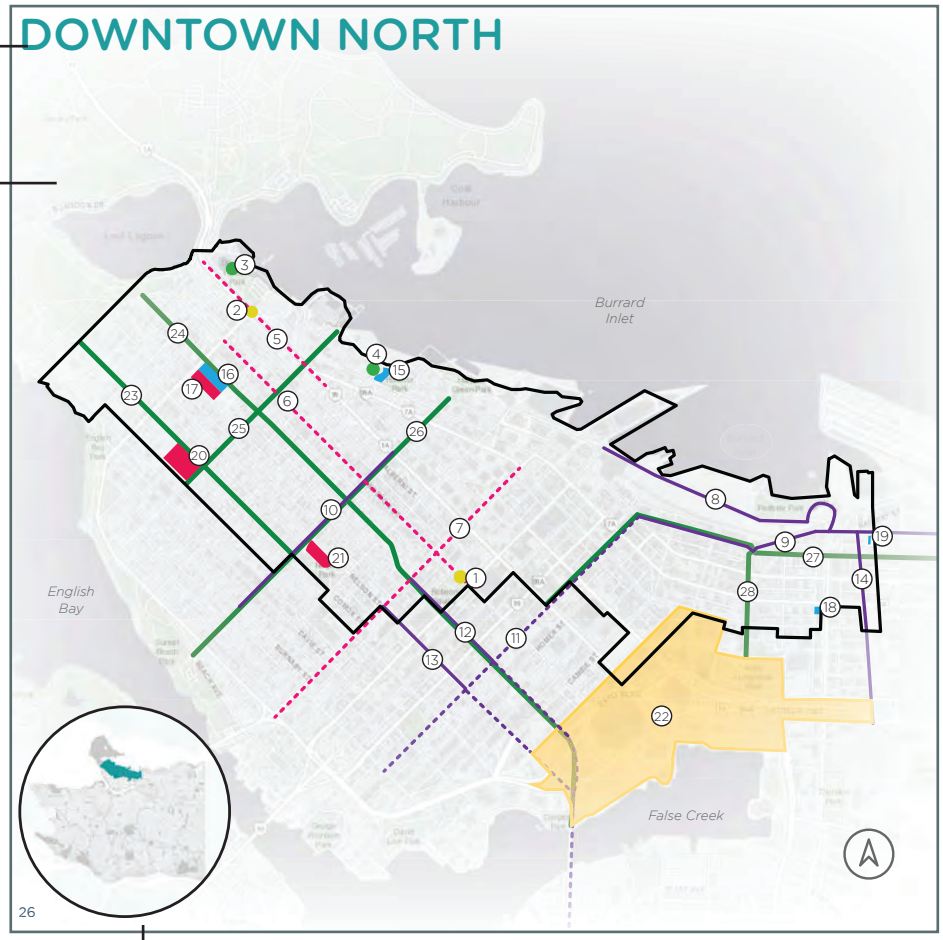
Description of watershed

Each watershed layout describes the neighbourhoods contained in the watershed, the land use character, the degree of sewer separation, and identifies the number of schools, community centres, and disaster hubs.

OPPORTUNITIES DASHBOARD

The opportunities dashboard is meant to be used as a reference document, and showcases overlapping initiatives that present strategic opportunities to implement green rainwater infrastructure on public lands and rights-of-way.

Name of watershed



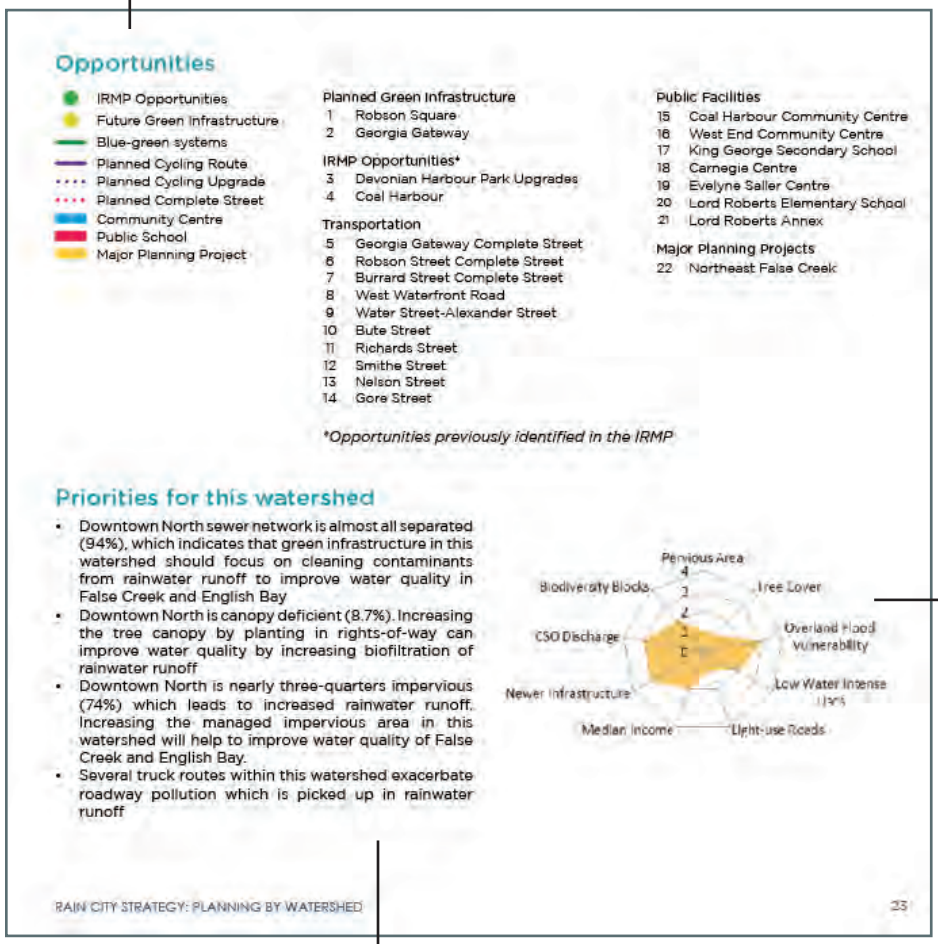
Opportunities map

The following layers have been overlaid upon each watershed map:

- planned cycling network expansions and upgrades
- planned complete streets
- blue-green systems corridors
- public schools
- community centres
- major planning projects
- future planned green rainwater infrastructure
- opportunities identified in the IRMP

Location of watershed

This small inset map highlights the current watershed in teal, helping the reader understand where in the city the watershed is located.



Opportunities

IRMP Opportunities
Future Green Infrastructure
Blue-green systems
Planned Cycling Route
Planned Cycling Upgrade
Planned Complete Street
Community Centre
Public School
Major Planning Project

Planned Green Infrastructure
1 Robson Square
2 Georgia Gateway

IRMP Opportunities*
3 Devonian Harbour Park Upgrades
4 Coal Harbour

Transportation
5 Georgia Gateway Complete Street
6 Robson Street Complete Street
7 Burrard Street Complete Street
8 West Waterfront Road
9 Water Street-Alexander Street
10 Bute Street
11 Richards Street
12 Smithe Street
13 Nelson Street
14 Gore Street

Public Facilities
15 Coal Harbour Community Centre
16 West End Community Centre
17 King George Secondary School
18 Carnegie Centre
19 Evelyne Saller Centre
20 Lord Roberts Elementary School
21 Lord Roberts Annex

Major Planning Projects
22 Northeast False Creek

**Opportunities previously identified in the IRMP*

Priorities for this watershed

- Downtown North sewer network is almost all separated (94%), which indicates that green infrastructure in this watershed should focus on cleaning contaminants from rainwater runoff to improve water quality in False Creek and English Bay
- Downtown North is canopy deficient (8.7%). Increasing the tree canopy by planting in rights-of-way can improve water quality by increasing biofiltration of rainwater runoff
- Downtown North is nearly three-quarters impervious (74%) which leads to increased rainwater runoff. Increasing the managed impervious area in this watershed will help to improve water quality of False Creek and English Bay.
- Several truck routes within this watershed exacerbate roadway pollution which is picked up in rainwater runoff

RAIN CITY STRATEGY: PLANNING BY WATERSHED 23

Opportunities

All opportunity sites are listed here. These include public facilities where the City may be more easily able to implement green rainwater infrastructure, transportation upgrades and facilities where green rainwater infrastructure can be incorporated into designs from the outset, among others.

Spider diagram

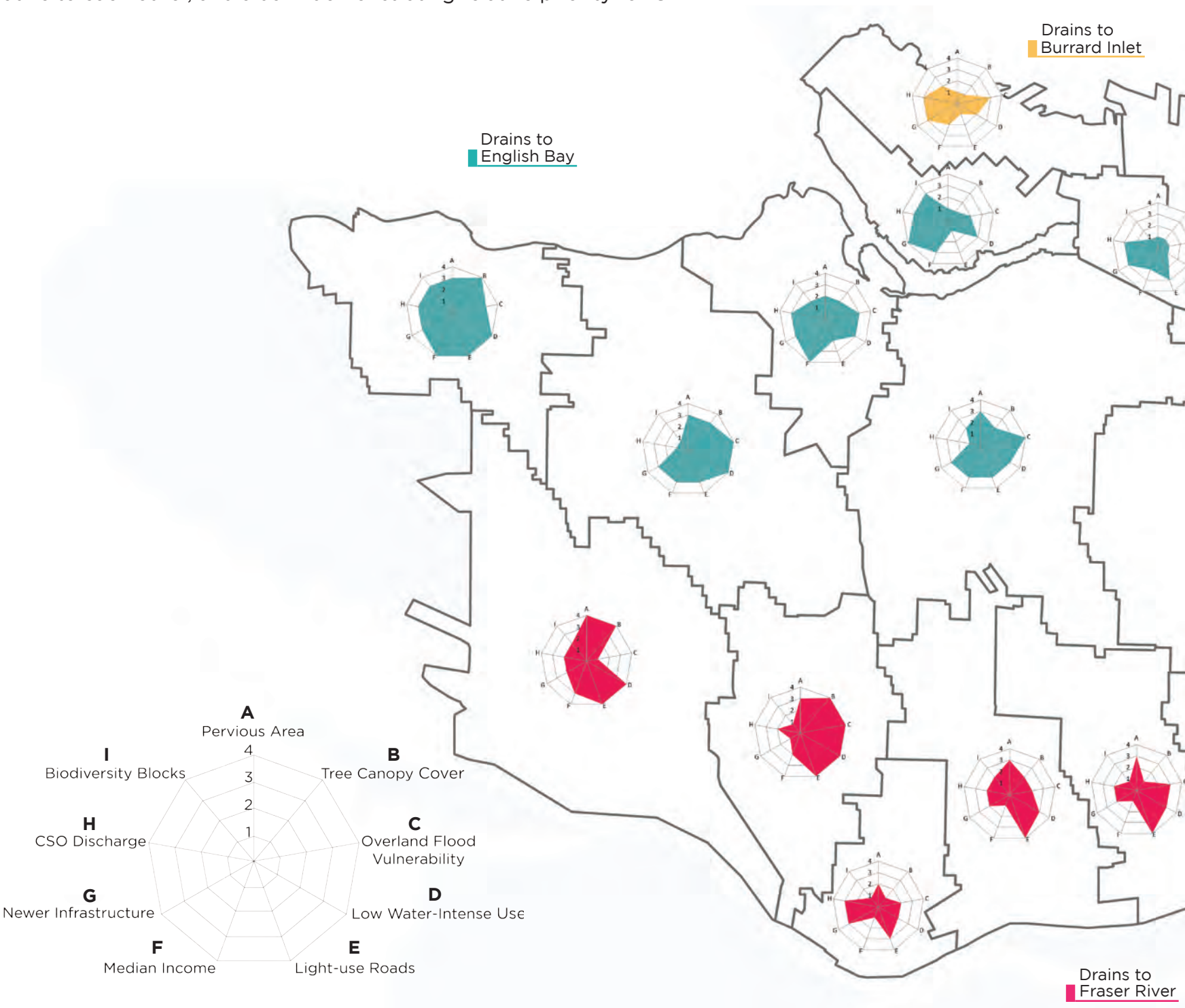
The Spider diagram provides a snapshot of Vancouver's watershed characteristics relative to each other. There are nine indicators rated from 1 to 4 where 1 represents a deficiency and 4 represents a positive attribute. Spider diagrams are used to prioritize GRI projects.

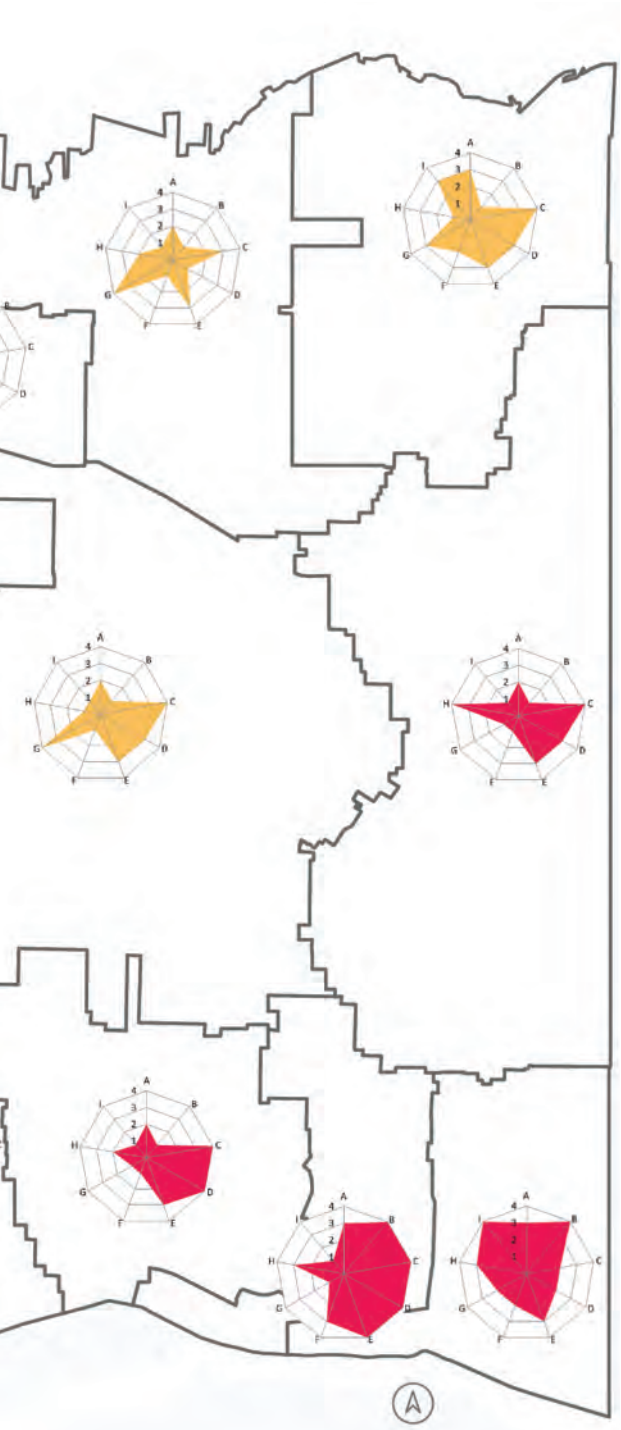
Watershed priorities

These sections highlight the relevant characteristics of each watershed and how this influences the appropriate approach to meeting the Rain City Strategy objectives.

WATERSHED CHARACTERIZATION MAP

This map shows spider diagrams for each of the watersheds in Vancouver. Spider diagrams are an excellent tool for creating an overview of complex data. Each diagram provides a snapshot of Vancouver's watershed characteristics relative to each other, and aids in demonstrating relative priority for GRI.





Legend

There are nine indicators, rated from 1 to 4 (where 1 represents a deficiency and 4 represents a positive attribute). The indicators, calculated per watershed, are as follows:

A Pervious Areas
Aggregated area of pervious surfaces such as parks, gardens, and other pervious surfaces, divided by the total area.

1	<40%	2	40-50%	3	50-60%	4	>60%

B Tree Canopy Cover
Aggregated area of tree canopy cover, divided by the total area.

1	<10%	2	10-15%	3	15-20%	4	>20%

C Low Overland Flood Vulnerability
Aggregated area that is above the flood extent zone, divided by the total area.

1	<75%	2	75-85%	3	85-95%	4	>95%

D Low Water-Intense Uses
Aggregated area of low water-intense uses such as single and double family residential, and park areas, divided by the total area.

1	<40%	2	40-60%	3	60-80%	4	>80%

E Light-Use Roads
Aggregated length of the light-use roads (km), such as residential and alleyway roads, divided by the total area (ha).

1	>0. 07	2	0. 05-0. 07	3	0. 03-0. 05	4	<0. 03

F Median Income
Average median income within a watershed (in CAD).

1	<25K	2	25-32. 5K	3	32. 5-40K	4	>40K

G Newer Infrastructure
Aggregated length of sewage infrastructure built after 2000, divided by the total length of infrastructure.

1	<40%	2	40-60%	3	60-80%	4	>80%

H CSO Discharge
Qualitative representation of average CSO discharge rates to our receiving water bodies.

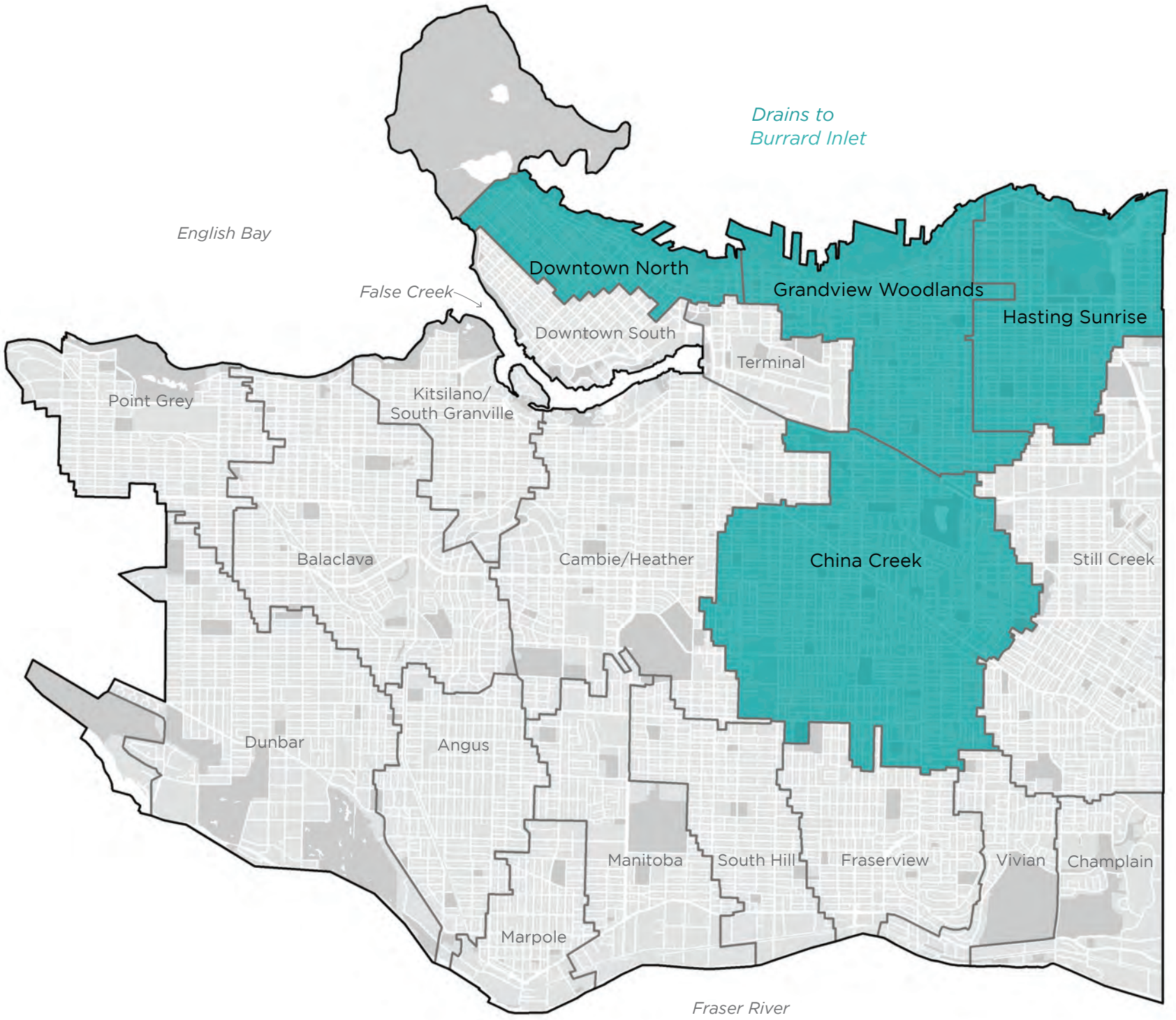
1	Very high	2	High	3	Moderate	4	Low/none

I Biodiversity Blocks
Aggregated area of city blocks that are biodiversity-rich, divided by the total area.

1	70%	2	70-80%	3	80-90%	4	>90%

Burrard inlet and seawall at Stanley Park

BURRARD INLET | *SASAMAT*

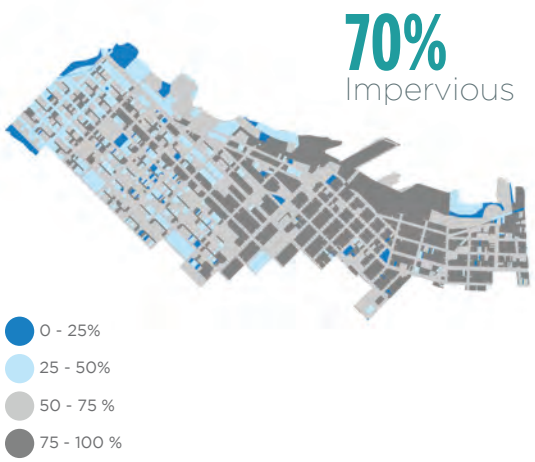


DOWNTOWN NORTH

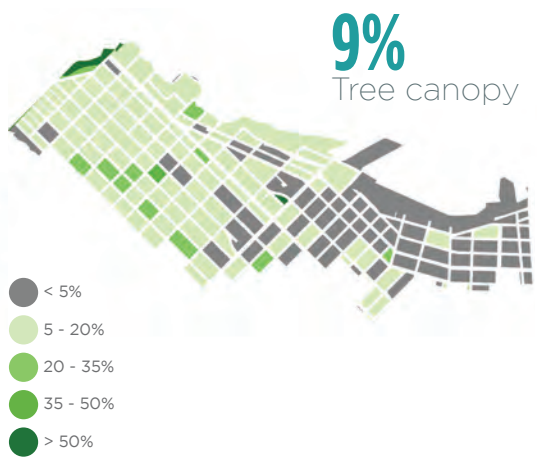
- Existing GRI
- Community Centre & Disaster Hub
- Community Centre
- Public School

At a glance...

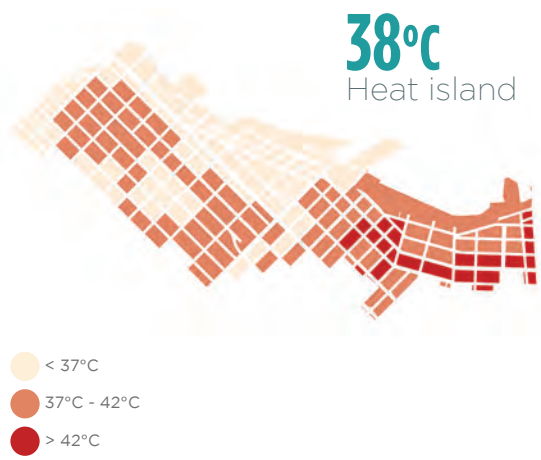
Impervious Area



Tree Canopy Cover

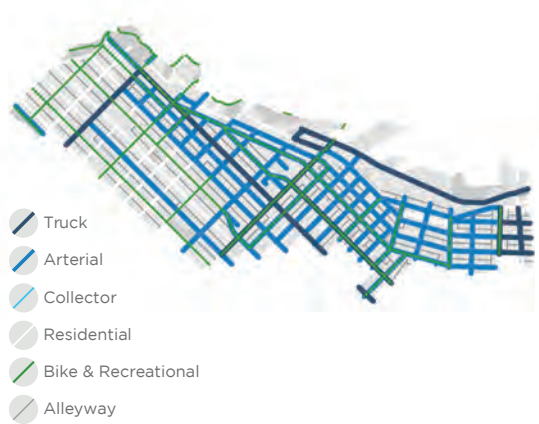


Urban Heat Island



Land Use

Road Network



Roads make up 32% of Downtown North watershed.

Sea Level Rise and Lost Streams

About the area

The Downtown North watershed is located in the northern portion of Vancouver's downtown peninsula, bordering Stanley Park. The watershed consists of the West End, Financial District, Gastown and the Downtown East Side neighbourhoods. The watershed is predominantly commercial/mixed use, with large portions of multifamily dwellings and some industrial development along the Burrard Inlet waterfront. The watershed contains 18 parks, three schools, and four community centres, two of which (West End and Coal Harbour) are designated as disaster hubs. Rainwater in this watershed drains to Burrard Inlet and English Bay.

Population: 57,232
Density: 18,841/km^2

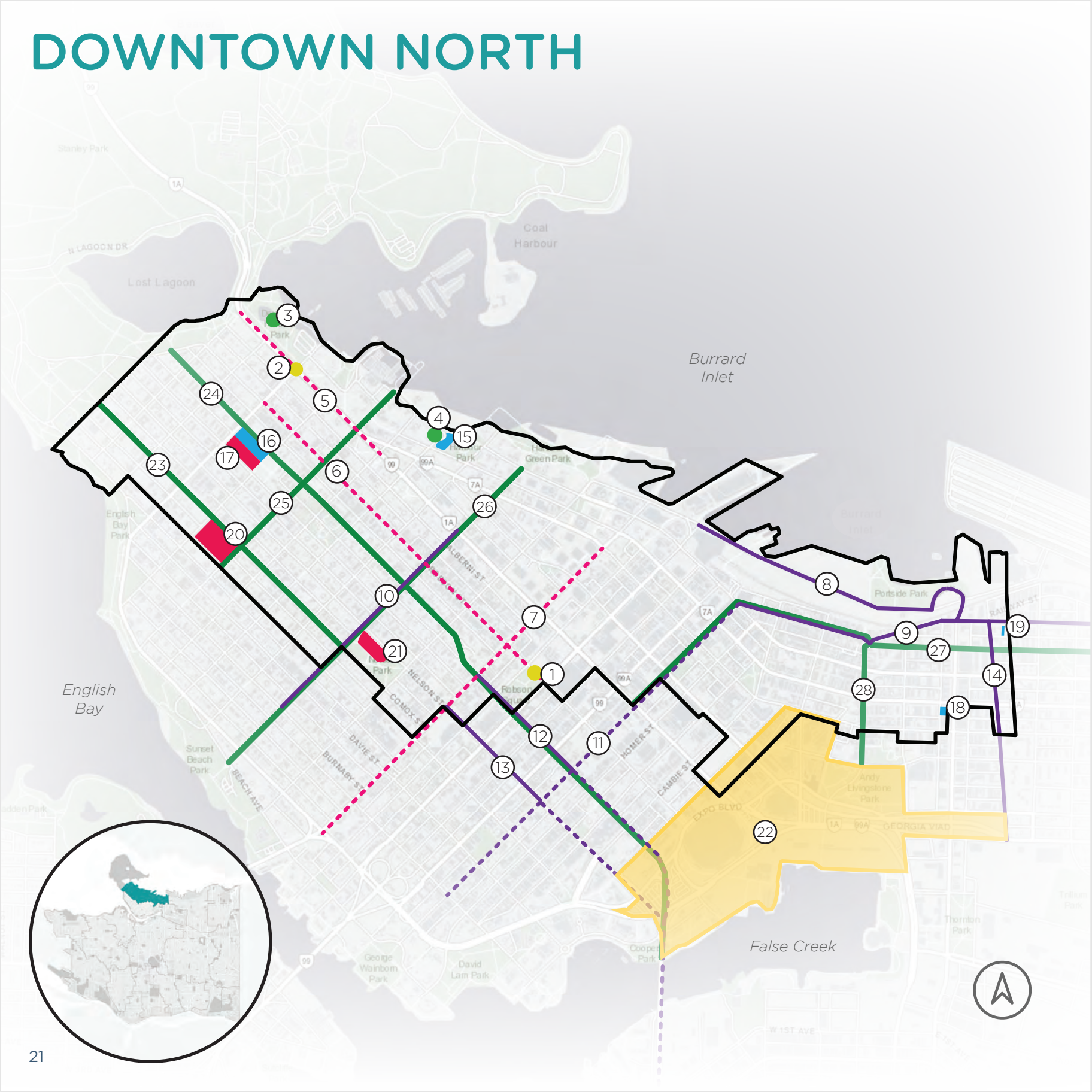
Median income: $30,977

Owner: 30%
Renter: 70%

Under 14: 5%
Over 75: 5%

Area: 304 hectares
Park space: 18 hectares

DOWNTOWN NORTH



Opportunities

- IRMP Opportunities
- Future GRI
- Blue-green systems
- Planned Cycling Route
- Planned Cycling Upgrade
- Planned Complete Street
- Community Centre
- Public School
- Major Planning Project

Planned GRI

1 Robson Square
2 Georgia Gateway

IRMP Opportunities*

3 Devonian Harbour Park Upgrades
4 Coal Harbour

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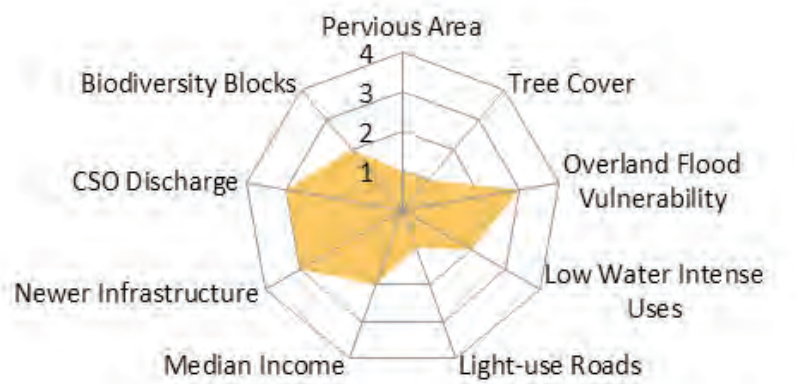
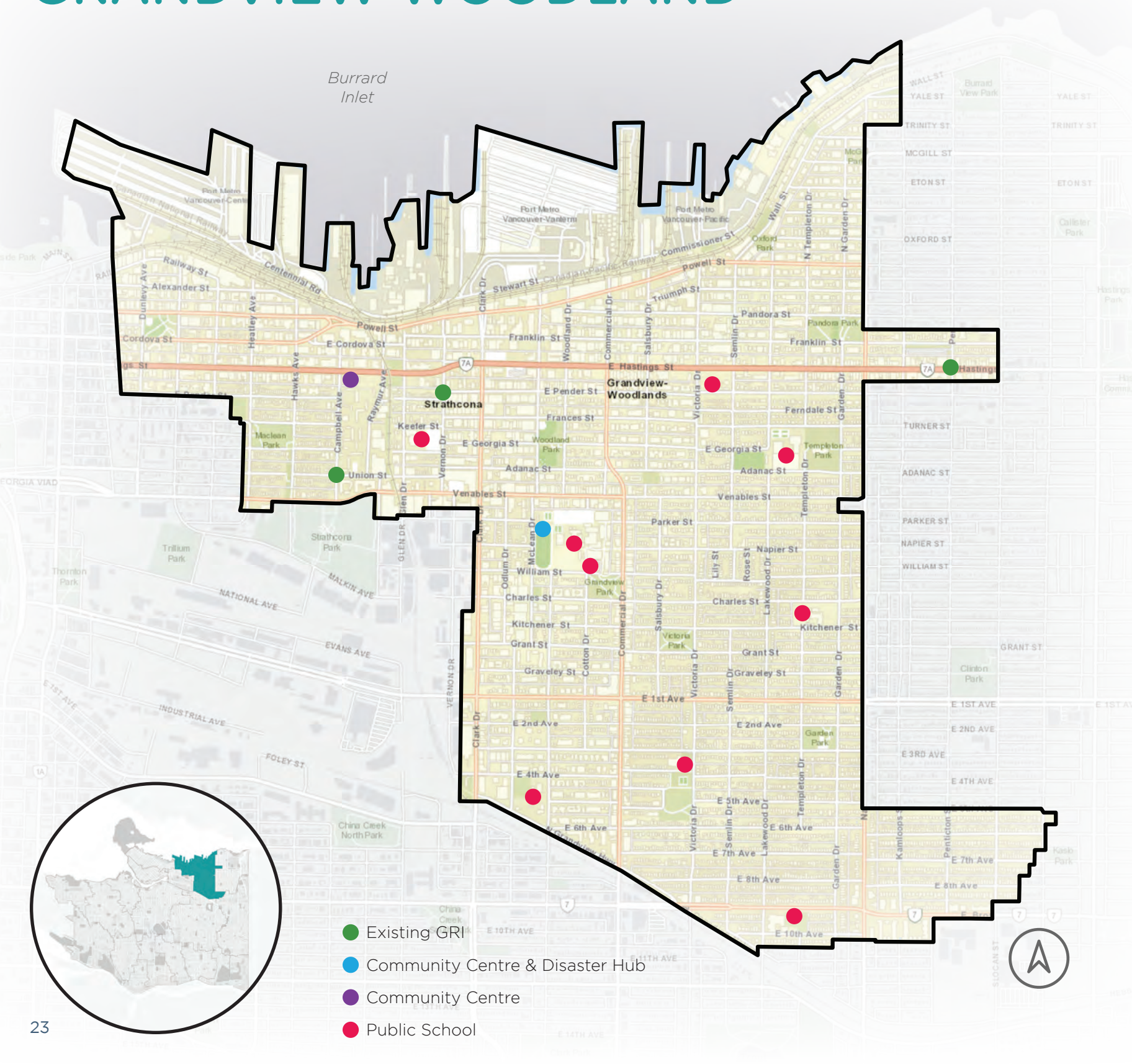
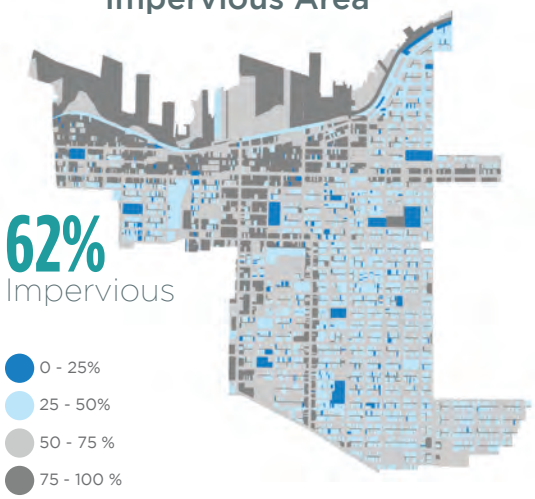


GRANDVIEW WOODLAND

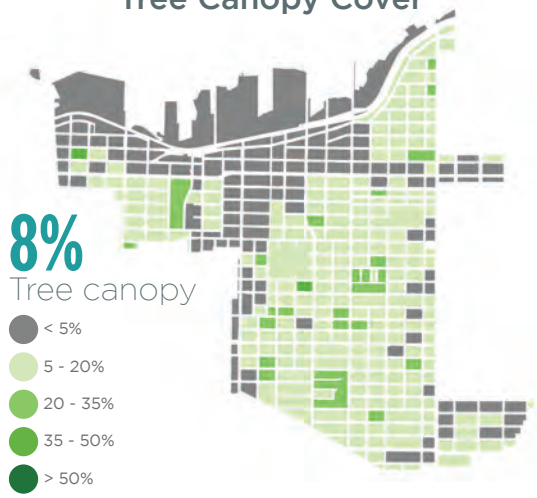


At a glance...

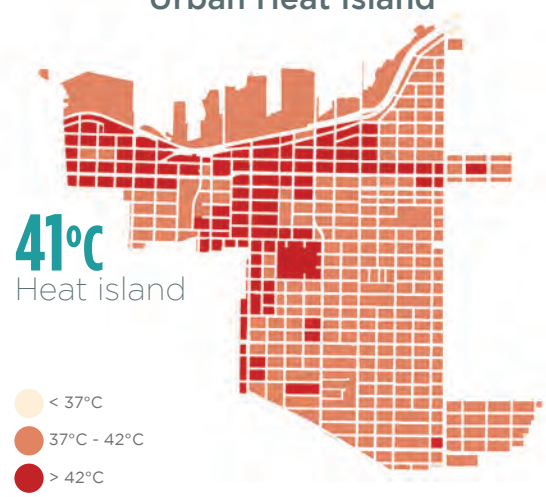
Impervious Area



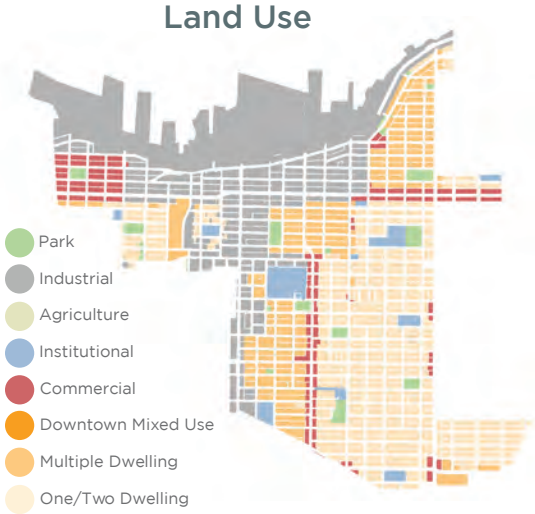
Tree Canopy Cover



Urban Heat Island



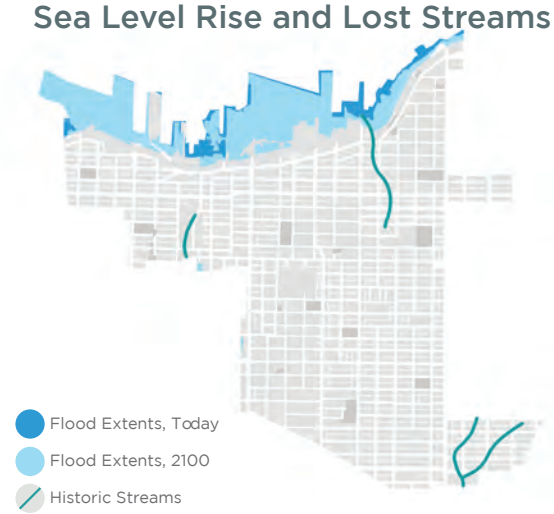
Land Use



Road Network

Roads make up 30% of Grandview Woodland watershed.

Sea Level Rise and Lost Streams



About the area

The Grandview Woodland watershed is located in northeast Vancouver, bordering the Burrard Inlet on the north. The watershed is located primarily in the Grandview Woodland neighbourhood, with portions in the Strathcona, Hastings Sunrise, Renfrew-Collingwood, and Kensington-Cedar Cottage neighbourhoods. The watershed contains a mix of single family dwellings, commercial/mixed-use, multi-family and industrial areas. Commercial activity is clustered around E Hastings Street, Commercial Drive, and Nanaimo Street. The watershed contains 21 parks, nine schools, and two community centres, one of which (Britannia) is a disaster hub. Rainwater in this watershed drains to Burrard Inlet.

Population: 34,645
Density: 5,372/km^2

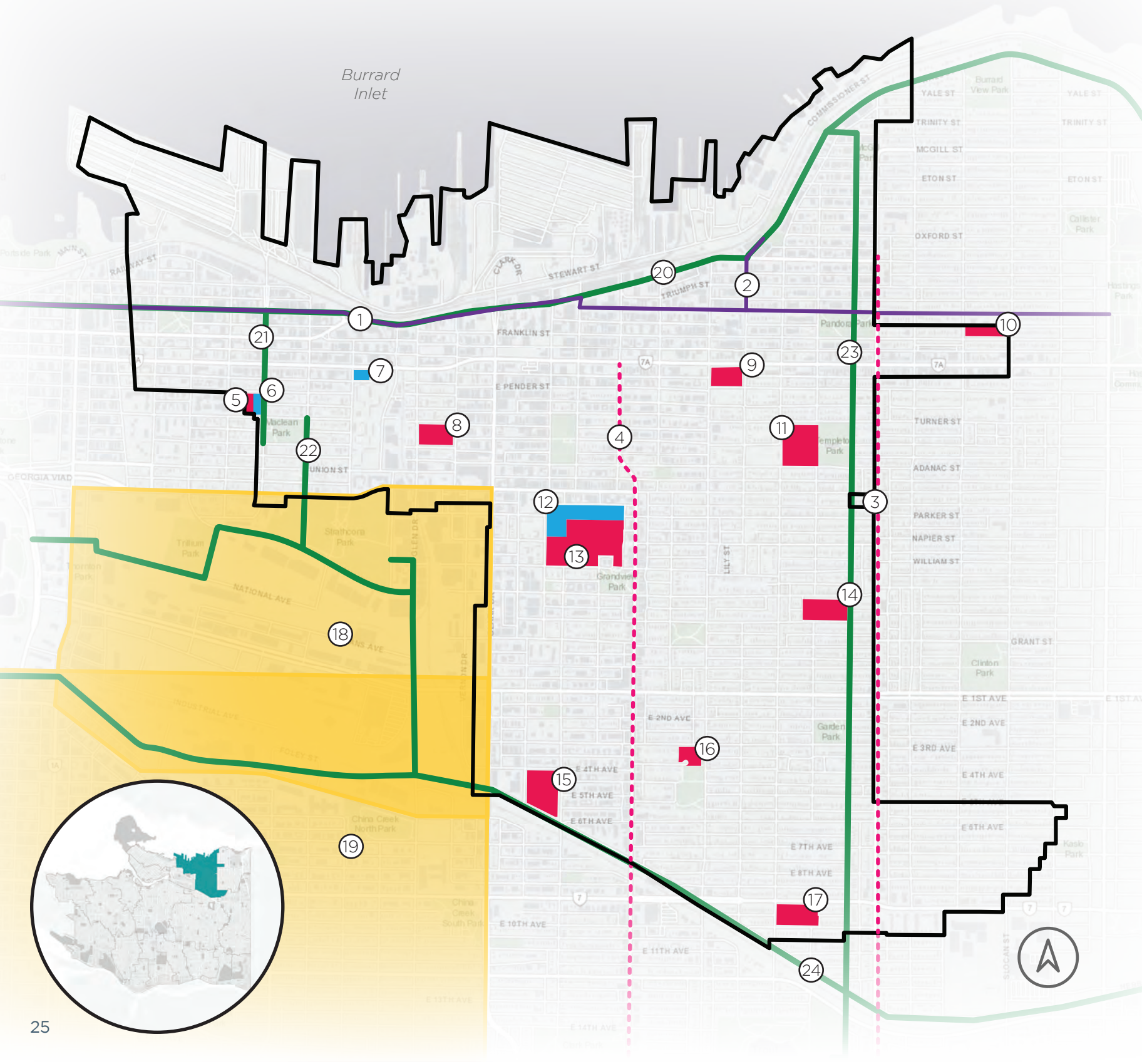
Median income: $24,737

Owner: 71%
Renter: 29%

Under 14: 11%
Over 75: 6%

Area: 645 hectares
Park space: 14 hectares

GRANDVIEW WOODLAND



Opportunities

- Blue-green systems
- Planned Cycling Route
- Planned Complete Street
- Community Centre
- Public School
- Major Planning Project

Transportation

1 Pandora Street
2 Semlin Drive
3 Nanaimo Complete Street
4 Commercial Complete Street

Public Facilities

5 Lord Strathcona Elementary School
6 Strathcona Community Centre
7 Ray-Cam Co-operative Centre
8 Admiral Seymour Elementary School
9 MacDonald Elementary School
10 Hastings Elementary School
11 Templeton Secondary School
12 Britannia Community Services Centre
13 Britannia Secondary School
14 Lord Nelson Elementary School
15 Grandview Elementary School
16 Queen Victoria Annex
17 Laura Secord Elementary

Major Planning Projects

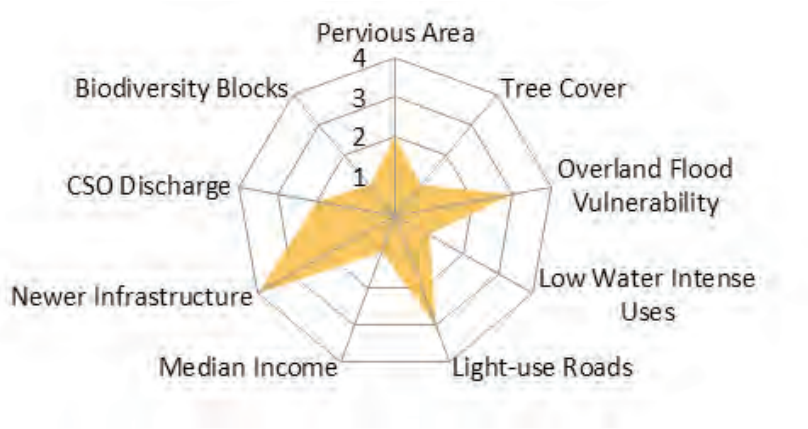
18 False Creek Flats
19 Broadway Corridor

Blue-green systems

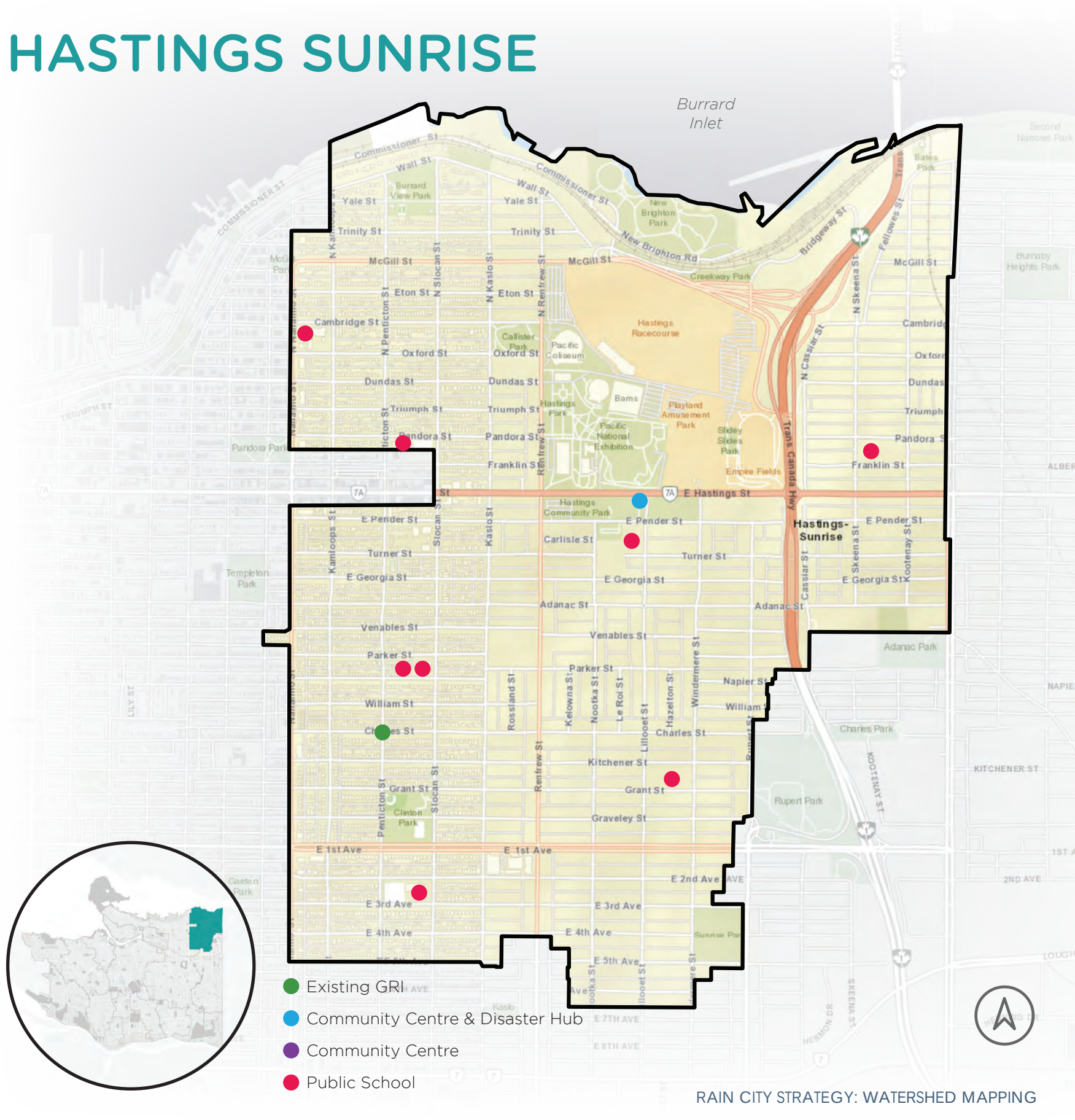
20 Powell Street - Wall Street
21 Heatley Avenue
22 Hawks Avenue
23 Garden Drive
24 Central Valley Greenway

Priorities for this watershed

- While nearly three-quarters of this watershed's sewers are separated, they merge into combined trunks which result in combined sewage overflows when system capacity is exhausted. Removing rainwater runoff volume from the system is critical in this watershed to reduce CSOs here and in other downstream watersheds
- Urban heat island is of concern in this watershed (41°C). Green rainwater infrastructure should prioritize practices with green surface expression which enable evapotranspiration and localized cooling.
- This watershed is canopy deficient (7. 6%). Increasing the tree canopy can reduce the volume of rainwater runoff entering the system and mitigate the urban heat island effect by increasing canopy and shade, and evapotranspiration.
- This watershed is more than 50% impervious. Implementing GRI in rights-of-way will increase the amount of impervious area managed



HASTINGS SUNRISE



RAIN CITY STRATEGY: WATERSHED MAPPING

At a glance...

Impervious Area

53%
Impervious

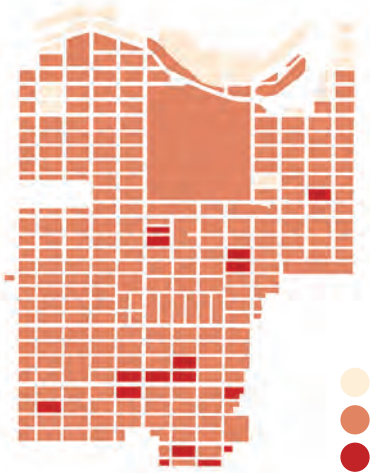
- 0 - 25%
- 25 - 50%
- 50 - 75 %
- 75 - 100 %

Tree Canopy Cover

7%
Tree canopy

- < 5%
- 5 - 20%
- 20 - 35%
- 35 - 50%
- > 50%

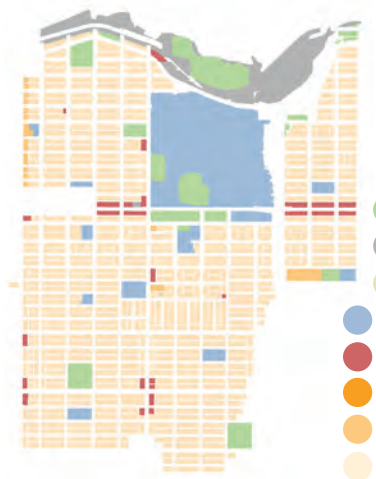
Urban Heat Island



40°C
Heat island

- < 37°C
- 37°C - 42°C
- > 42°C

Land Use



- Park
- Industrial
- Agriculture
- Institutional
- Commercial
- Downtown Mixed Use
- Multiple Dwelling
- One/Two Dwelling

Road Network

- Truck
- Arterial
- Collector
- Residential
- Bike & Recreational
- Alleyway

Sea Level Rise and Lost Streams

- Flood Extents, Today
- Flood Extents, 2100
- Historic Streams

Roads make up 35% of Hastings Sunrise watershed.

About the area

The Hastings Sunrise watershed is located in northeast Vancouver, bordering Burnaby on the east and the Burrard Inlet on the north. The watershed is located entirely within the Hastings Sunrise neighbourhood. The watershed is primarily single family dwellings, with commercial/mixed-use activity along E. Hastings Street and Nanaimo Street. The watershed contains 19 parks, eight schools, and one community centre that is designated as a disaster hub. Rainwater in this watershed drains to Burrard Inlet.

Population: 25,617
Density: 4,166/km^2

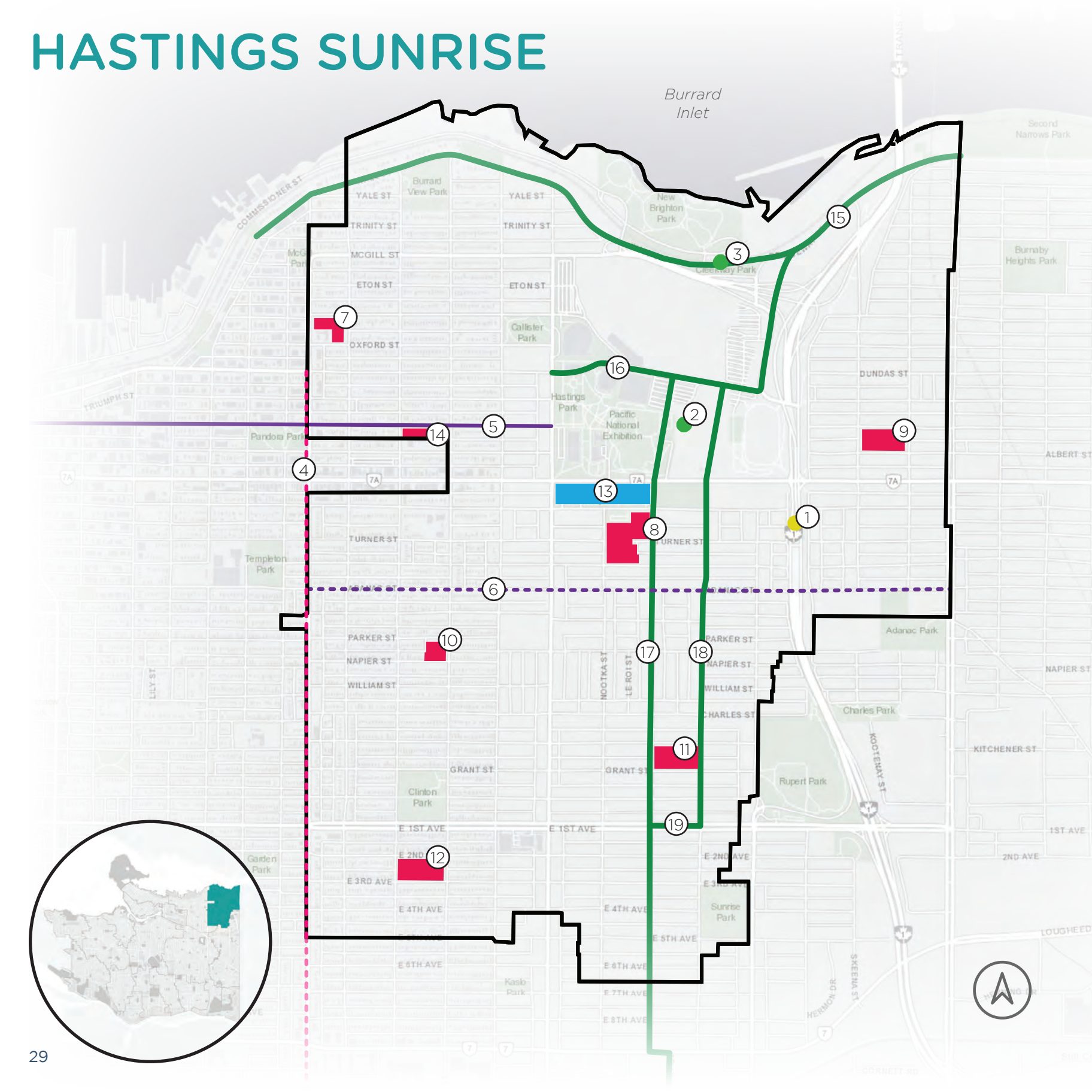
Median income: $25,705

Owner: 62%
Renter: 38%

Under 14: 13%
Over 75: 9%

Area: 615 hectares
Park space: 39 hectares

HASTINGS SUNRISE



Opportunities

- IRMP Opportunities
- Future GRI
- Blue-green systems
- Planned Cycling Route
- Planned Cycling Upgrade
- Planned Complete Street
- Community Centre
- Public School

Planned GRI

1 Cassiar Sewer Separation

IRMP Opportunities

2 Playland Redevelopment
3 Hastings Park Creek

Transportation

4 Nanaimo Complete Street
5 Pandora Street
6 Adanac Street

Public Facilities

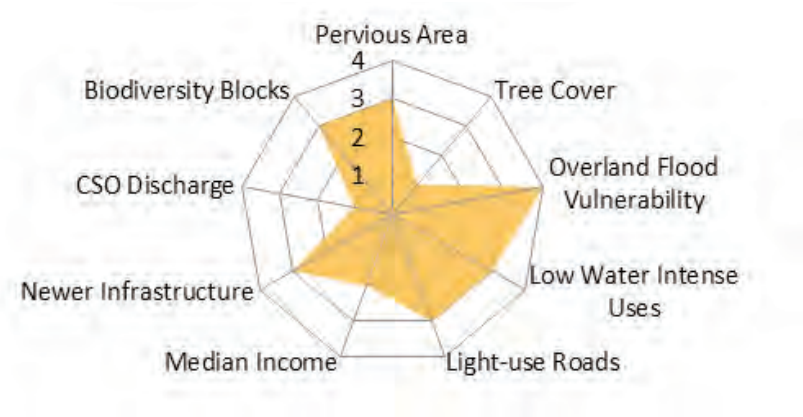
7 Tillicum Annex
8 Dr. A. R. Lord Elementary School
9 Franklin Elementary School
10 Garibaldi Annex
11 Begbie Elementary School
12 Chief Maquinna Elementary School
13 Hastings Community Centre
14 Hastings Elementary School

Blue-green systems

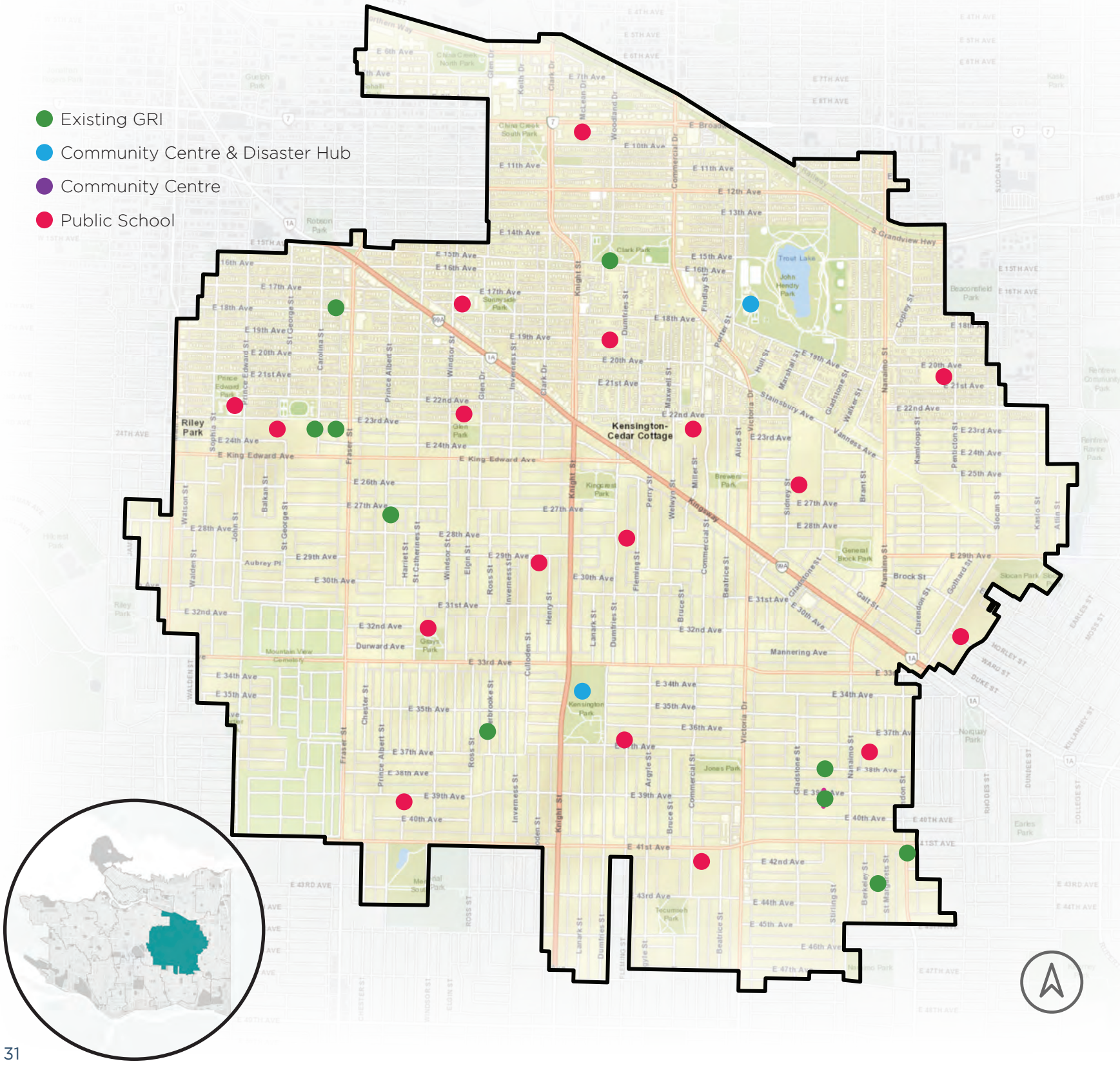
15 Wall Street - Bridgeway Street
16 Dundas Street - Bridgeway Street
17 Lillooet Street
18 Windermere Street
19 E 1st Avenue

Priorities for this watershed

- Nearly two thirds of the watershed remains combined, and the separated portions feed into combined outfalls which discharge combined sewage when system capacity is exhausted. GRI strategies should focus on reducing volume of rainwater runoff entering system
- Canopy deficient (7. 1%)
- Average in terms of urban heat island
- 50% impervious
- Major truck routes and freeway through watershed exacerbate road runoff pollution issue



CHINA CREEK


Existing GRI
Community Centre & Disaster Hub
Community Centre
Public School
Riley Park
Kensington-Cedar Cottage
Kingsway
Knight St
Main St
Fraser St
Victoria Dr
Nanaimo St
Clark Dr
Commercial Dr
Trout Lake
John Hendry Park
Kensington Park
Clark Park
Sunnyside Park
Glen Park
Gray's Park
Jones Park
Brewery Park
Kingcrest Park
Tecumseh Park
Mountain View Cemetery
Aubrey Pl
Durward Ave
Mannering Ave
Brock St
E 6th Ave
E 7th Ave
E 10th Ave
E 11th Ave
E 12th Ave
E 13th Ave
E 14th Ave
E 15th Ave
E 16th Ave
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E 22nd Ave
E 23rd Ave
E 24th Ave
E King Edward Ave
E 25th Ave
E 26th Ave
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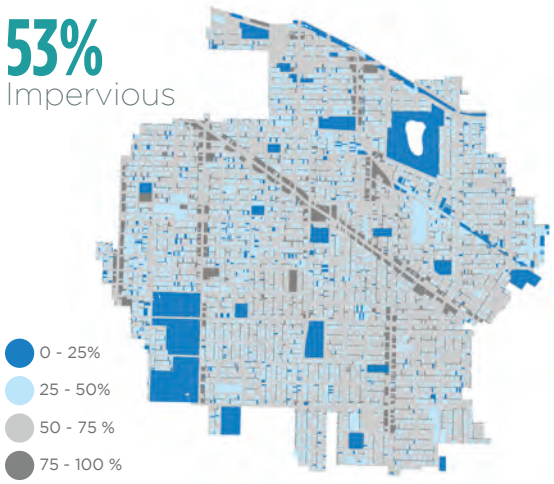
E 39th Ave
E 40th Ave
E 41st Ave
E 42nd Ave
43rd Ave
E 44th Ave
E 45th Ave
E 46th Ave
E 47th Ave

At a glance...

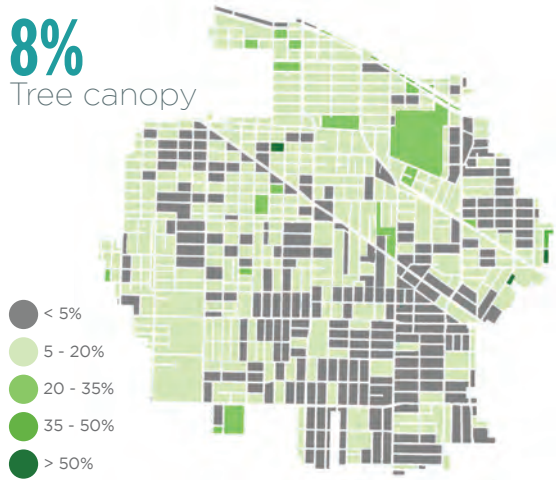
Impervious Area

53%
Impervious



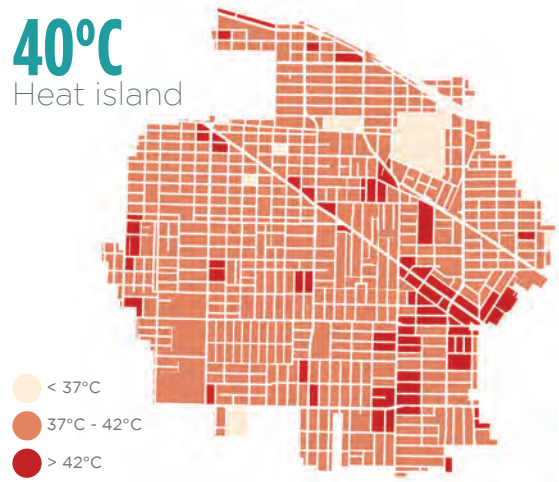
Tree Canopy Cover

8%
Tree canopy



Urban Heat Island

40°C
Heat island

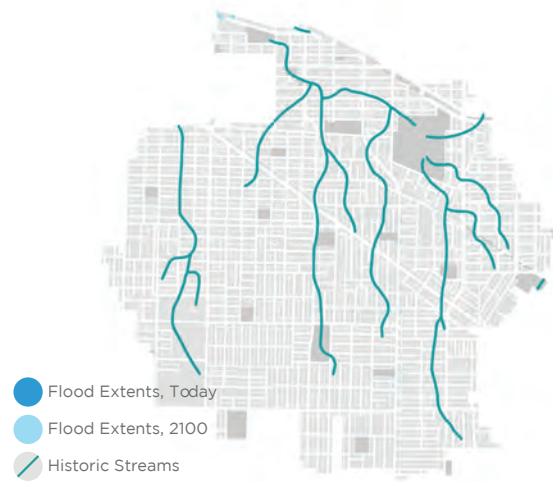


Land Use

Road Network

Roads make up 33% of China Creek watershed.

Sea Level Rise and Lost Streams



About the area

The China Creek watershed is located in east-central Vancouver. Along with the Still Creek watershed, the China Creek watershed does not border any receiving water body. The watershed consists primarily of the Kensington-Cedar Cottage neighbourhood, with portions of the Mount Pleasant, Riley Park, Sunset, Victoria-Fraserview, Renfrew-Collingwood, and Grandview-Woodland neighbourhoods. The watershed is primarily single-family dwellings, with commercial/mixed-use activity along Main Street, Fraser Street, Kingsway, Commercial Drive, and Victoria Drive. The watershed contains 24 parks, 17 schools, and two community centres which are designated as disaster hubs. Rainwater in this watershed drains to False Creek.

Population: 78,380
Density: 6,365/km^2

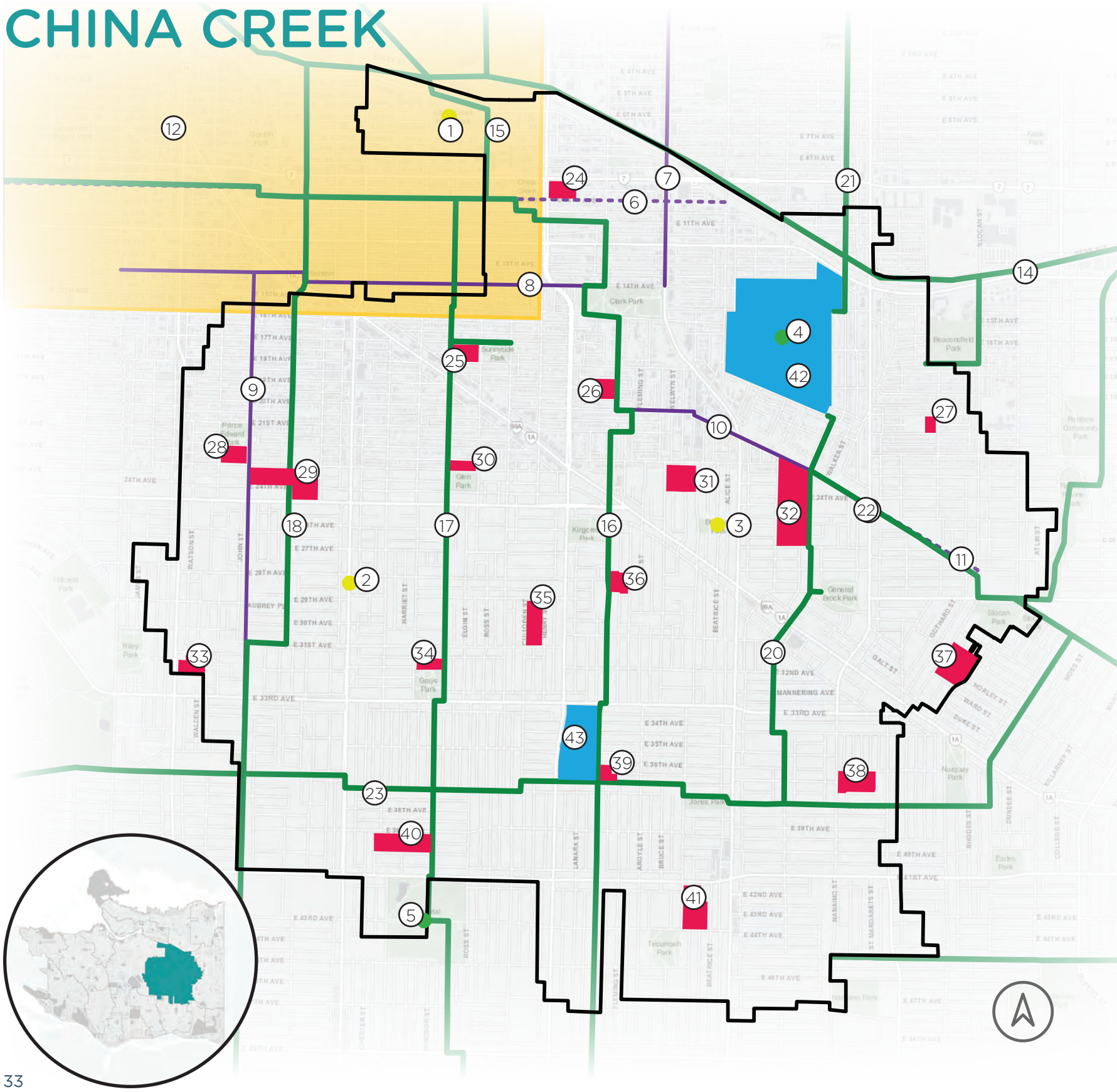
Median income: $24,756

Owner: 64%
Renter: 36%

Under 14: 13%
Over 75: 7%

Area: 1231 hectares
Park space: 68 hectares

CHINA CREEK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Opportunities

- IRMP Opportunities
- Future GRI
- Blue-green systems
- Planned Cycling Route
- Planned Cycling Upgrade
- Planned Complete Street
- Community Centre
- Public School
- Major Planning Project

Planned GRI

1 China Creek North Park
2 Fraser Street
3 Brewers Park

IRMP Opportunities

4 Trout Lake Watershed Reconnect
5 Memorial South Park

Transportation

6 10th Avenue Bikeway
7 Commercial Drive
8 14th Avenue Bikeway
9 Prince Edward Street
10 Stainsbury Avenue
11 BC Parkway

Major Planning Projects

12 Broadway Area Plan

Blue-green systems

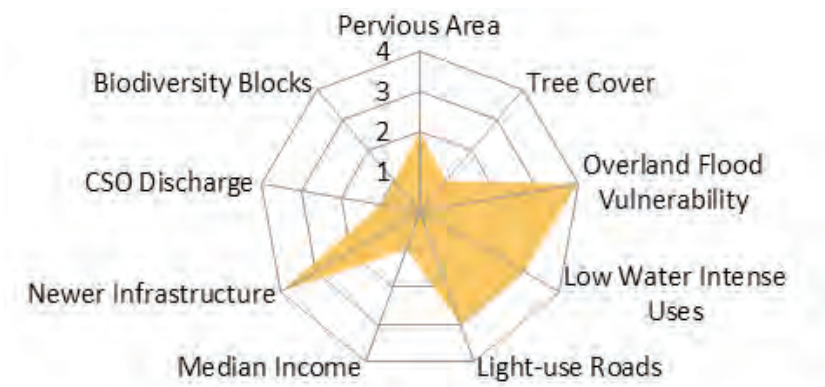
13 10th Avenue
14 Central Valley Greenway
15 Glen Drive (south)
16 Woodland Street-Dumfries Street
17 Windsor Street-Elgin Street
18 St. George Street
19 Ridgeway
20 Gladstone Street
21 Garden Drive
22 Stainsbury Street - Vanness Avenue
23 Ridgeway

Public Facilities

24 Queen Alexandra Elementary School
25 Dickens Elementary School
26 Tyee Elementary School
27 Lord Beaconsfield Elementary School
28 Livingstone Elementary School
29 Sir Charles Tupper Secondary School
30 Dickens Annex
31 Lord Selkirk Elementary School
32 Gladstone Secondary School
33 Brock Elementary School
34 McBride Annex
35 McBride Elementary School
36 Lord Selkirk Annex
37 John Norquay Elementary School
38 Cunningham Elementary School
39 Tecumseh Annex
40 Sir Alexander Mackenzie Elementary School
41 Tecumseh Elementary School
42 Trout Lake Community Centre
43 Kensington Community Centre

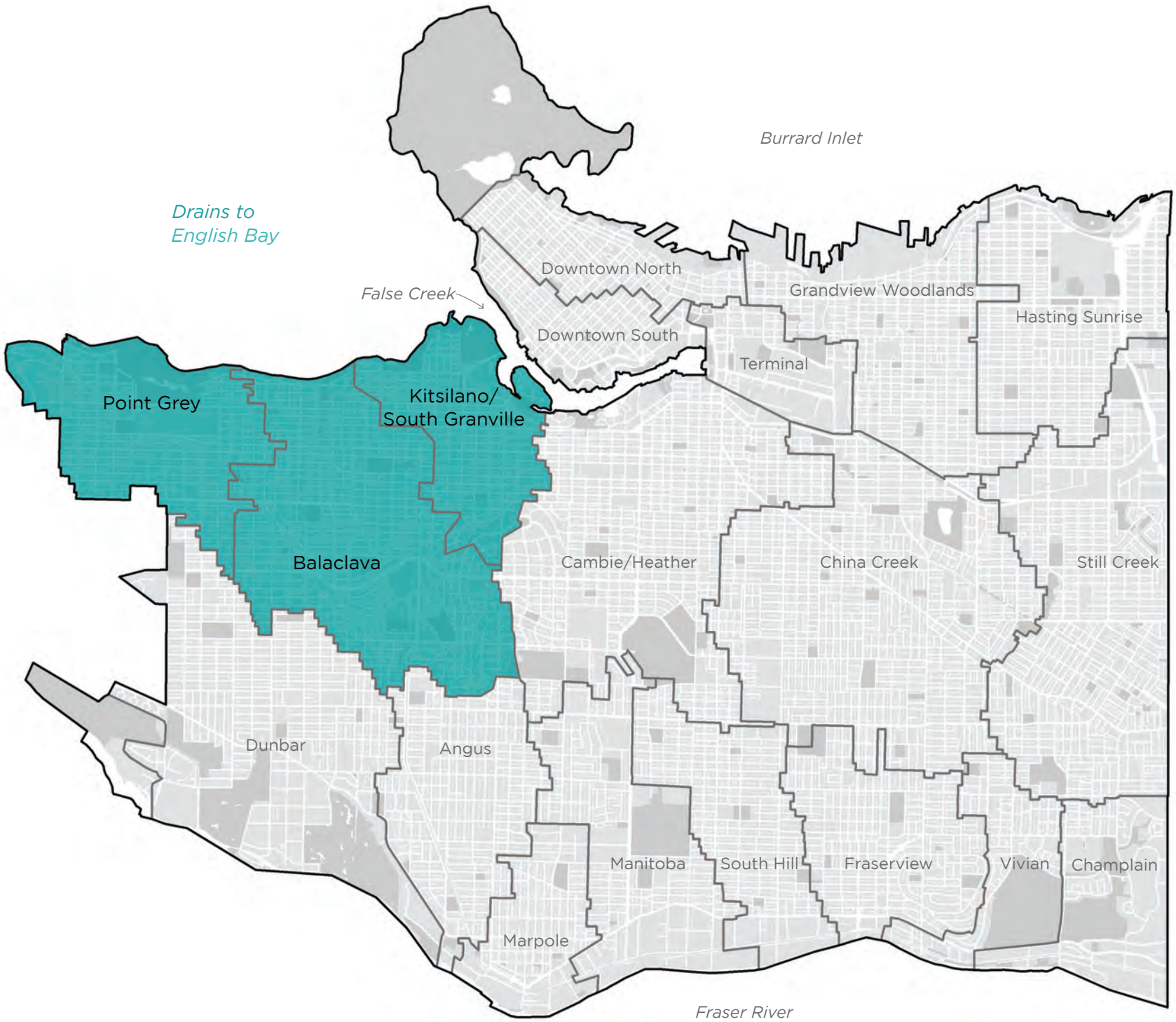
Priorities for this watershed

- 44% separated - reducing volume of rainwater runoff is a priority
- Urban heat island effect above average (40°C)
- Canopy deficient (8%)
- Increase managed impervious area
- 10 truck routes in watershed exacerbate pollution in rights of way

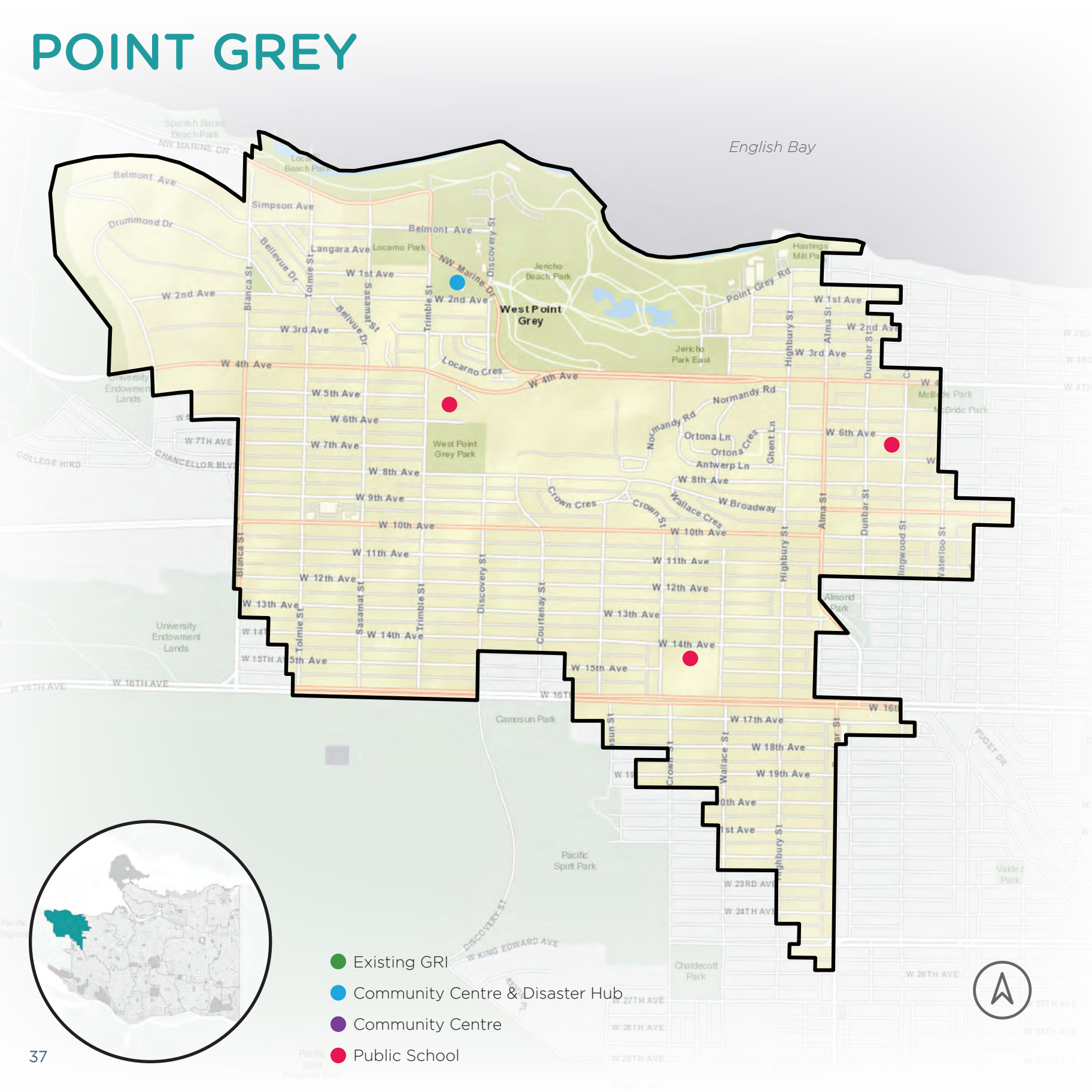


Hadden Park beach looking towards the West End

ENGLISH BAY | *AYYULSHUN*

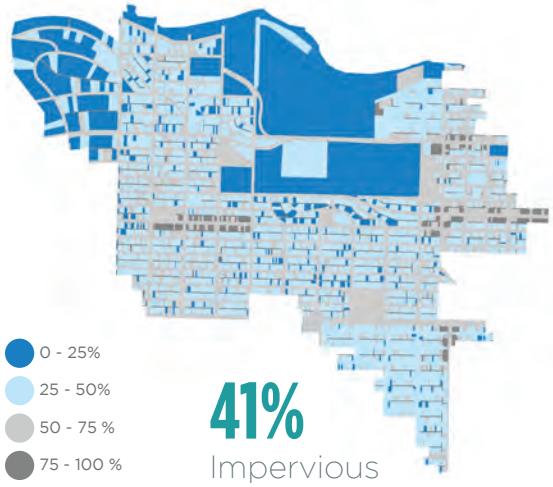


POINT GREY


English Bay
West Point Grey
Jericho Beach Park
Locarno Park
West Point Grey Park
Jericho Park East
Hastings Mill Park
Camosun Park
Almond Park
Pacific Spirit Park
Chaldecott Park
University Endowment Lands
Spanish Banks Beach Park
Belmont Ave
Simpson Ave
Drummond Dr
Langara Ave
Bellevue Dr
Tolmie St
Bianca St
Sasamat St
Trimble St
Discovery St
NW Marine Dr
W 1st Ave
W 2nd Ave
W 3rd Ave
W 4th Ave
W 5th Ave
W 6th Ave
W 7th Ave
W 8th Ave
W 9th Ave
W 10th Ave
W 11th Ave
W 12th Ave
W 13th Ave
W 14th Ave
W 15th Ave
W 16th Ave
W 17th Ave
W 18th Ave
W 19th Ave
Locarno Cres
Point Grey Rd
Normandy Rd
Ortona Ln
Ortona Cres
Antwerp Ln
Ghent Ln
Crown Cres
Crown St
Wallace Cres
Courtenay St
Highbury St
Alma St
Dunbar St
Ilingwood St
Waterloo St
W Broadway
Chancellor Blvd
College Hird
Discovery St
W King Edward Ave
Puget Dr
Existing GRI
Community Centre & Disaster Hub
Community Centre
Public School

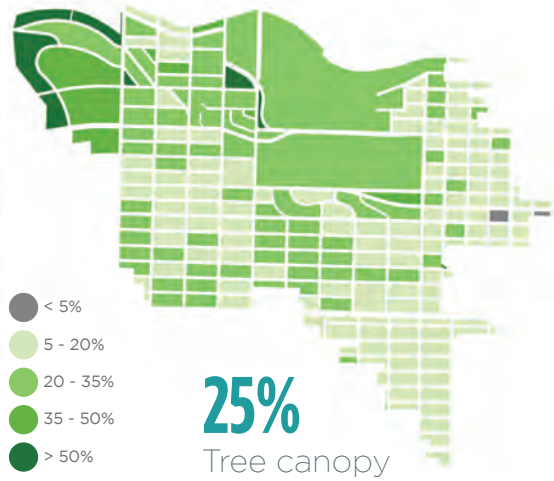
At a glance...

Impervious Area



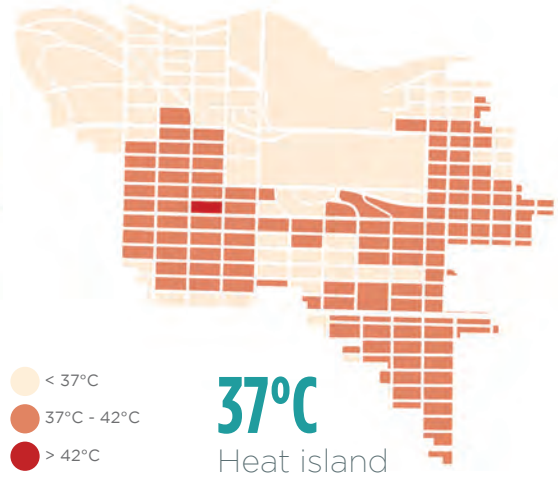
41% Impervious

Tree Canopy Cover



25% Tree canopy

Urban Heat Island



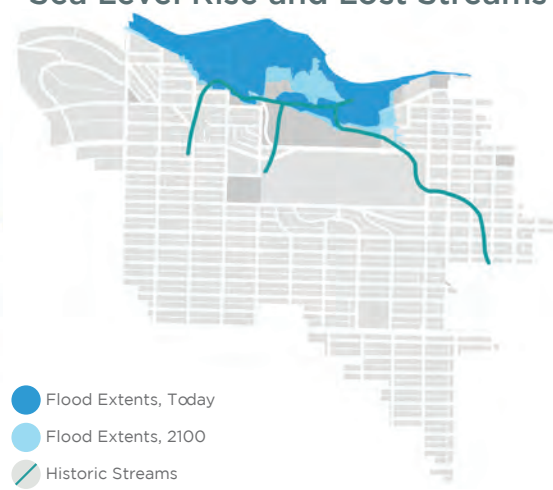
37°C Heat island

Land Use

Road Network

Roads make up 27% of Point Grey watershed.

Sea Level Rise and Lost Streams



About the area

The Point Grey watershed is located on Vancouver's west side, and consists mainly of the Point Grey neighbourhood and portions of the Kitsilano and Dunbar-Southlands neighbourhoods. The watershed is predominantly single family dwellings, with some commercial/mixed use along W 10th Avenue, W 4th Avenue, and W Broadway. The watershed contains 13 parks, four schools, and one community centre that is designated as a disaster hub. Rainwater in this watershed drains to English Bay.

Population: 18,329
Density: 3,427/km^2

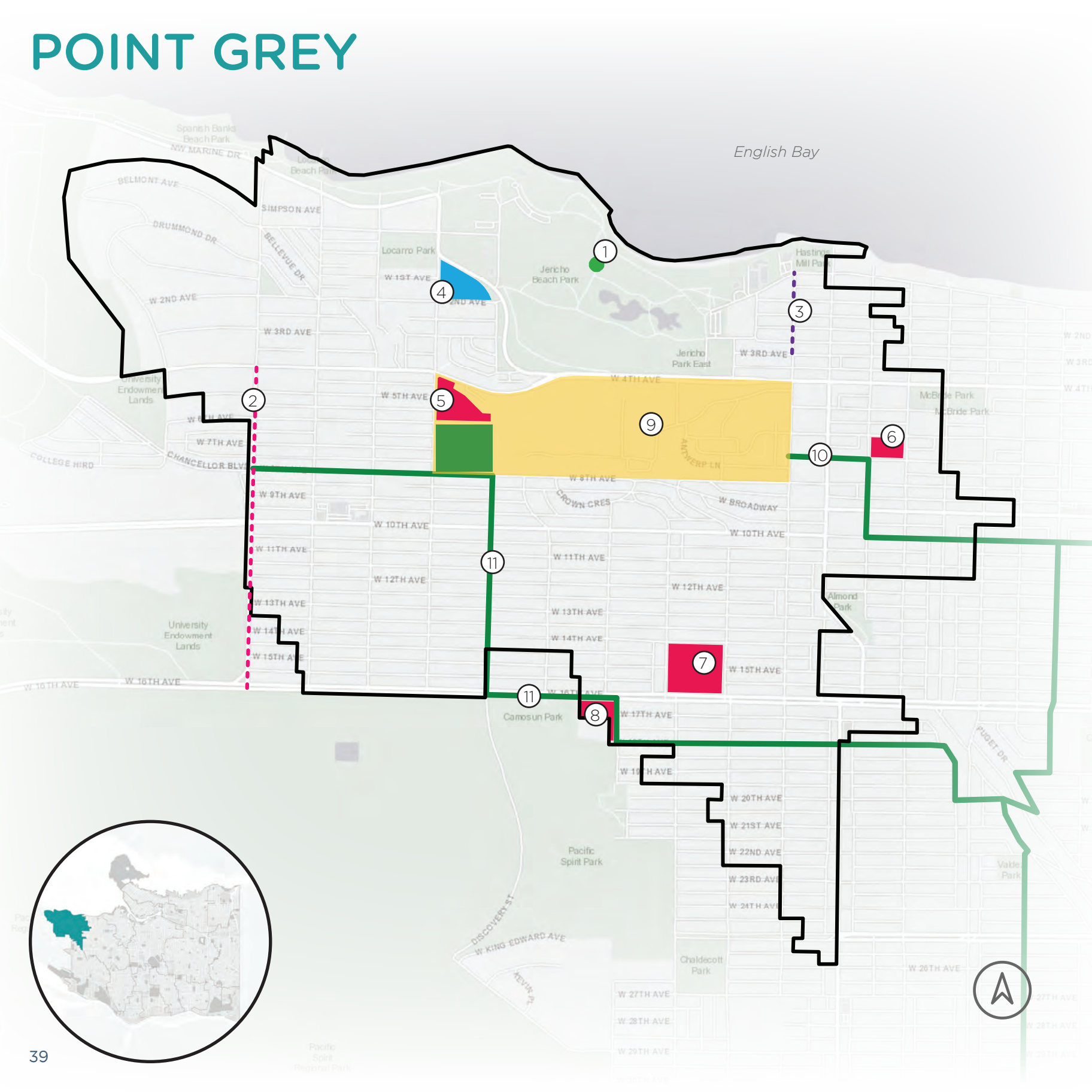
Median income: $41,393

Owner: 60%
Renter: 40%

Under 14: 14%
Over 75: 7%

Area: 535 hectares
Park space: 73 hectares

POINT GREY


English Bay
Spanish Banks Beach Park
NW MARINE DR
BELMONT AVE
SIMPSON AVE
DRUMMOND DR
BELLEVUE DR
Locarno Park
W 1ST AVE
Jericho Beach Park
Hastings Mill Park
W 2ND AVE
W 3RD AVE
Jericho Park East
University Endowment Lands
W 4TH AVE
W 5TH AVE
McBride Park
W 6TH AVE
W 7TH AVE
COLLEGE HWY
CHANCELLOR BLVD
W 8TH AVE
CROWN CRES
W BROADWAY
W 9TH AVE
W 10TH AVE
W 11TH AVE
W 12TH AVE
W 13TH AVE
W 14TH AVE
W 15TH AVE
W 16TH AVE
Almond Park
Camosun Park
W 17TH AVE
PUGET DR
W 20TH AVE
W 21ST AVE
W 22ND AVE
W 23RD AVE
W 24TH AVE
Pacific Spirit Park
DISCOVERY ST
W KING EDWARD AVE
KEVIN PL
Chaldecott Park
W 26TH AVE
W 27TH AVE
W 28TH AVE
W 29TH AVE
ANTWERP LN
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Opportunities

- IRMP Opportunities
- Blue-green systems
- Planned Cycling Route
- Planned Cycling Upgrade
- Planned Complete Street
- Community Centre
- Public School
- Park

IRMP Opportunities

1 Jericho Beach Park

Transportation

2 Blanca Complete Street
3 Highbury Street

Public Facilities

4 West Point Grey Community Centre
5 Queen Mary Elementary School
6 Bayview Elementary School
7 Lord Byng Secondary School
8 Queen Elizabeth Elementary School

Major Planning Projects

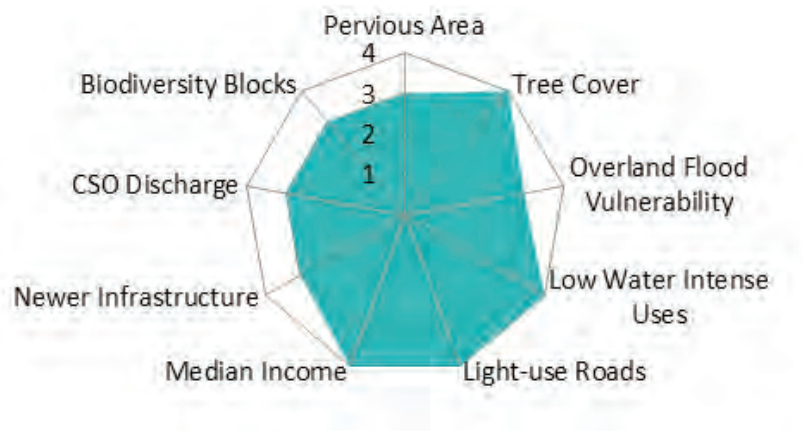
9 Jericho Lands

Blue-green systems

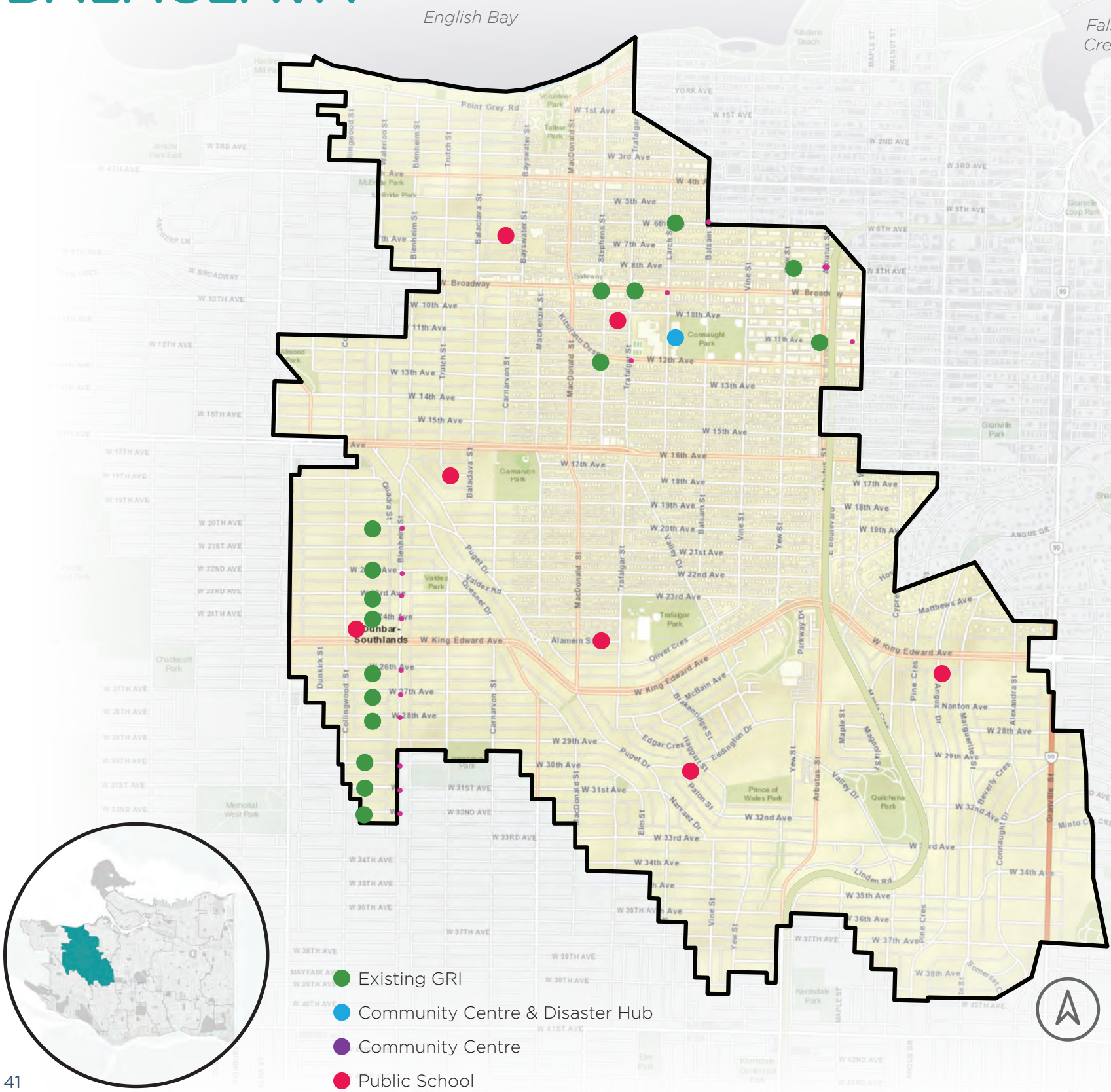
10 West 8th Avenue
11 Discovery Street
12 West 16th Avenue
13 West 20th Avenue
14 10th Avenue Bikeway
15 Dunbar Street
16 West 7th Avenue

Priorities for this watershed

- More than half separated, but major combined outfalls make reducing volume here a priority
- Cleaning for the separated areas



BALACLAVA

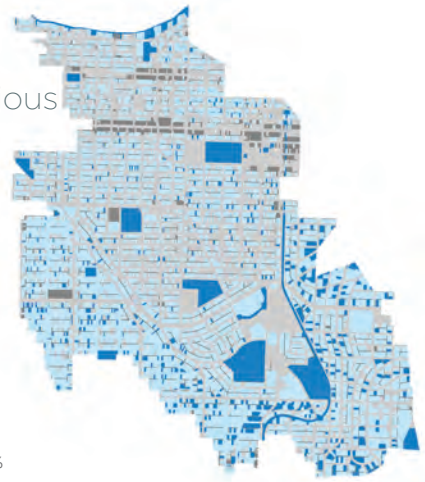


- Existing GRI
- Community Centre & Disaster Hub
- Community Centre
- Public School

At a glance...

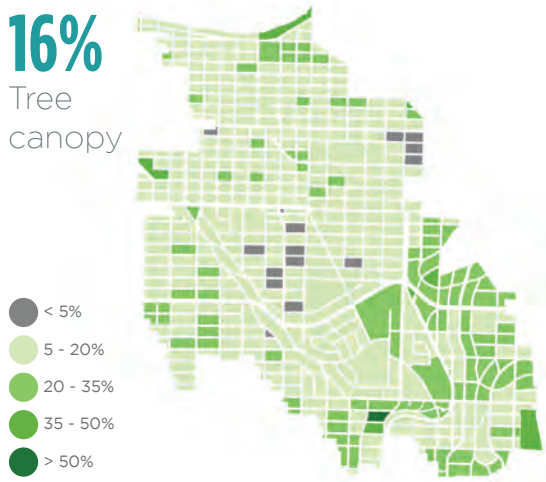
Impervious Area

48%
Impervious area



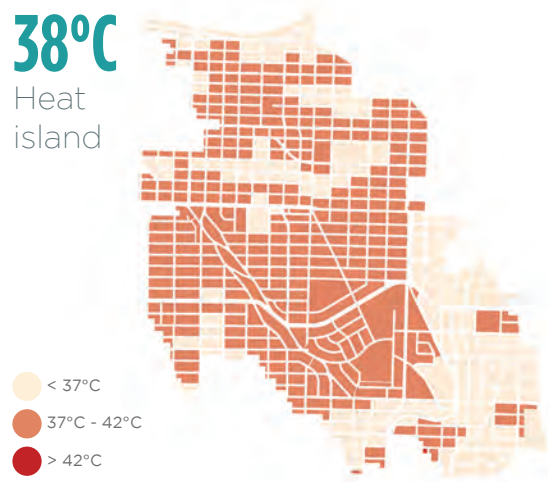
Tree Canopy Cover

16%
Tree canopy



Urban Heat Island

38°C
Heat island

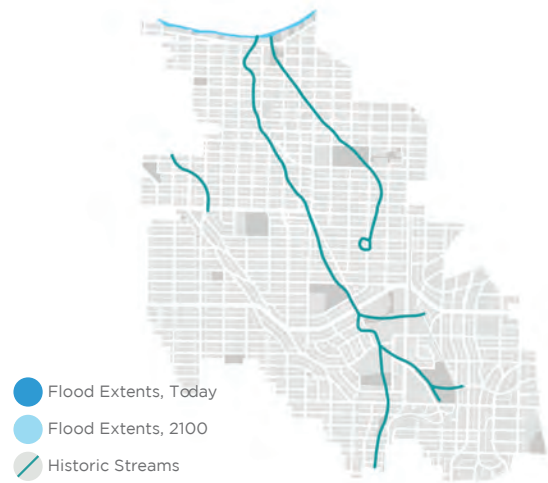


Land Use

Road Network

Roads make up 33% of Balaclava watershed.

Sea Level Rise and Lost Streams



About the area

The Balaclava watershed is located on Vancouver's west side, and consists of portions of the Kitsilano, Shaughnessy, Arbutus Ridge, and Dunbar-Southlands neighbourhoods. The watershed is predominantly a single family dwelling neighbourhood, with limited commercial/mixed-use activity along Arbutus Street, W Broadway and W 4th Avenue. The watershed contains 33 parks, seven schools, and one community centre that is designated as a disaster hub. Rainwater in this watershed drains to English Bay.

Population: 42,730
Density: 4,641/km^2

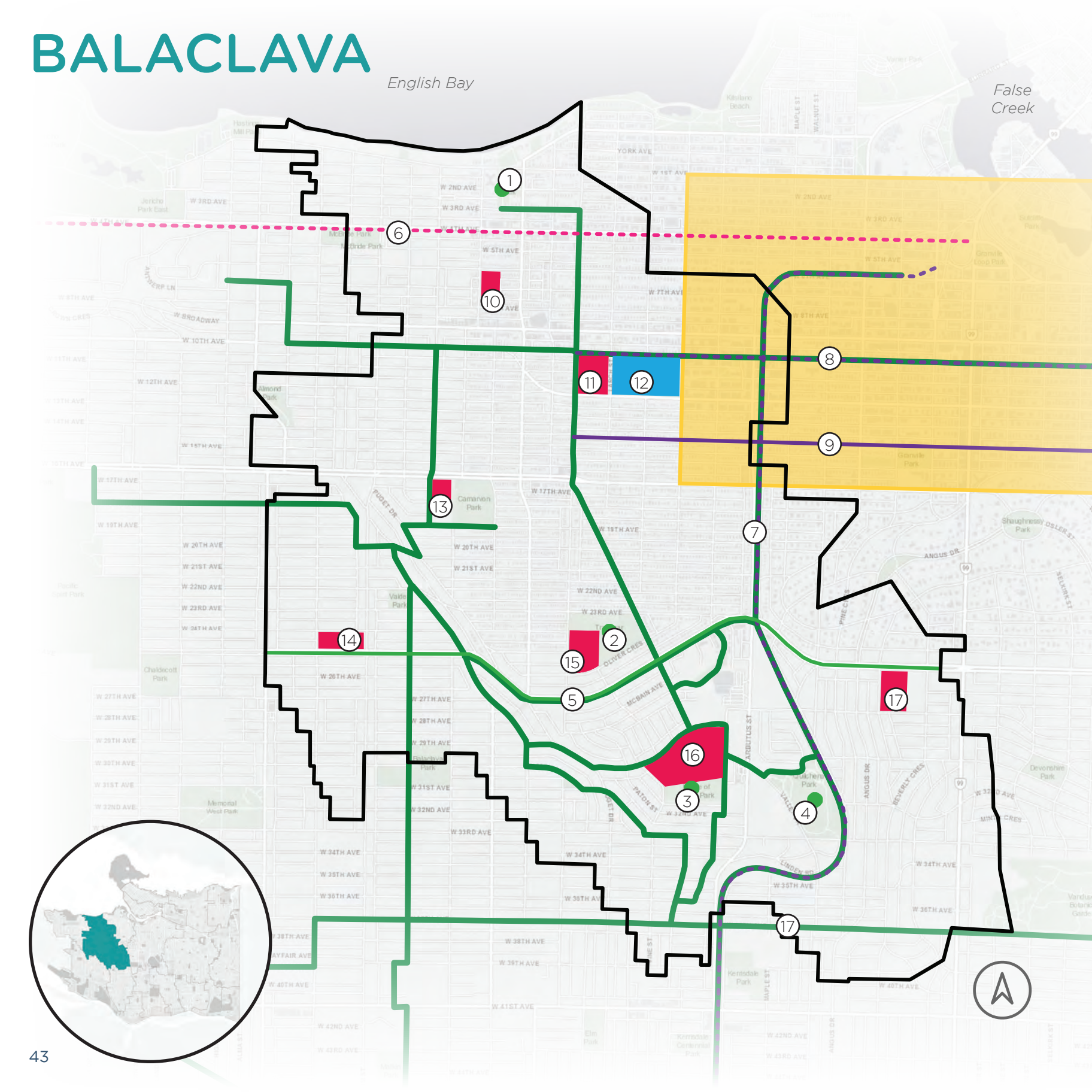
Median income: $35,914

Owner: 62%
Renter: 38%

Under 14: 13%
Over 75: 7%

Area: 921 hectares
Park space: 40 hectares

BALACLAVA



Opportunities

- IRMP Opportunities
- Blue-green systems
- Planned Cycling Route
- Planned Cycling Upgrade
- Planned Complete Street
- Community Centre
- Public School
- Major Planning Project

IRMP Opportunities

1 Tatlow Creek Daylighting
2 Trafalgar Park
3 Prince of Wales Park
4 Quilchena Park
5 King Edward Avenue Boulevard

Transportation

6 W 4th Avenue Complete Street
7 Arbutus Greenway
8 10th Avenue Bikeway
9 14th Avenue Bikeway

Public Facilities

10 Gordon Elementary School
11 Kitsilano Secondary School
12 Kitsilano Community Centre
13 Carnarvon Elementary School
14 Kitchener Elementary School
15 Trafalgar Elementary School
16 Prince of Wales Secondary School
17 Shaughnessy Elementary School
18 Quilchena Elementary School

Major Planning Projects

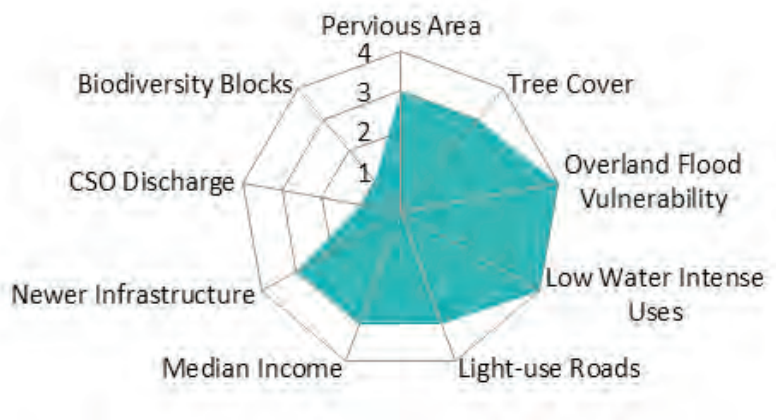
19 Broadway Area Plan

Blue-green systems

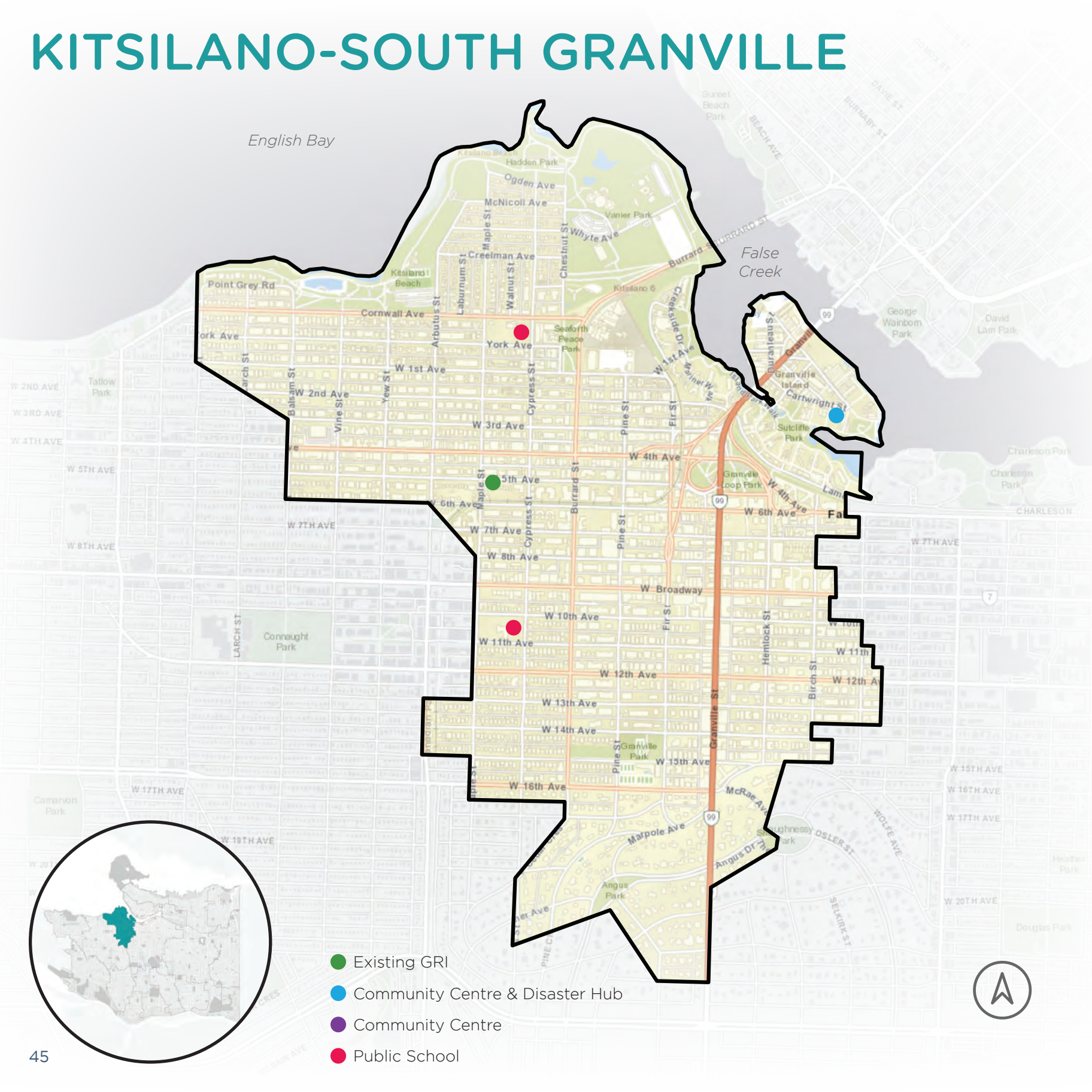
20 W 3rd Avenue
21 Trafalgar Street - Valley Drive
22 10th Avenue Bikeway
23 W 19th Avenue
24 W King Edward Avenue
25 Quesnel Drive - Narvaez Drive
26 Balaclava Street
27 Eddington Drive - Puget Drive
28 Arbutus Village Walk
29 Arbutus Greenway
30 Ridgeway
31 Valley Drive (South) - Quilchena

Priorities for this watershed

- Only about one-quarter separated (28%) but network feeds into combined trunk which overflows into English Bay, therefore volume reduction is a priority
- Tree canopy is lower than city target (18%)
- Truck routes on arterials contribute to higher pollution loading in runoff

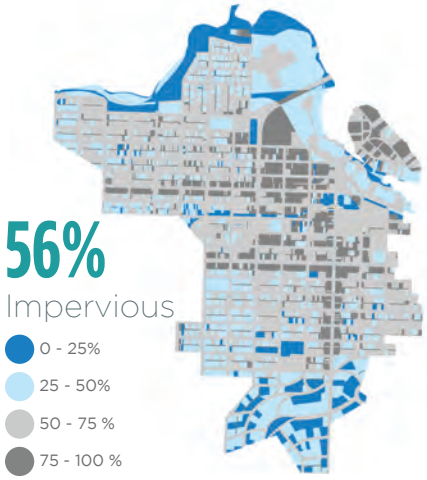


KITSILANO-SOUTH GRANVILLE

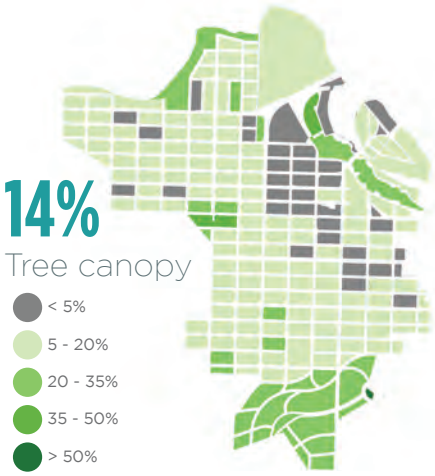


At a glance...

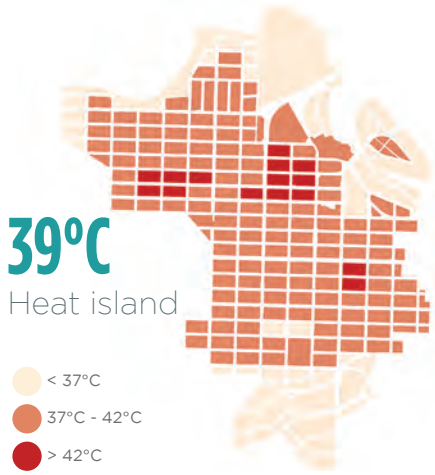
Impervious Area



Tree Canopy Cover



Urban Heat Island



Land Use

Road Network

Roads make up 31% of Kitsilano-South Granville watershed.

Sea Level Rise and Lost Streams

About the area

The Kitsilano-South Granville watershed is located in central Vancouver, across False Creek from the downtown peninsula. The watershed contains Granville Island, and portions of the Kitsilano, Fairview, and Shaughnessy neighbourhoods. The watershed is predominantly commercial/mixed-use and multifamily dwelling in nature, with some light industrial development and single family dwellings. The watershed contains 13 parks, two schools, and one community centre that is designated as a disaster hub. Rainwater in this watershed drains to False Creek and English Bay.

Population: 32,225
Density: 7,847/km^2

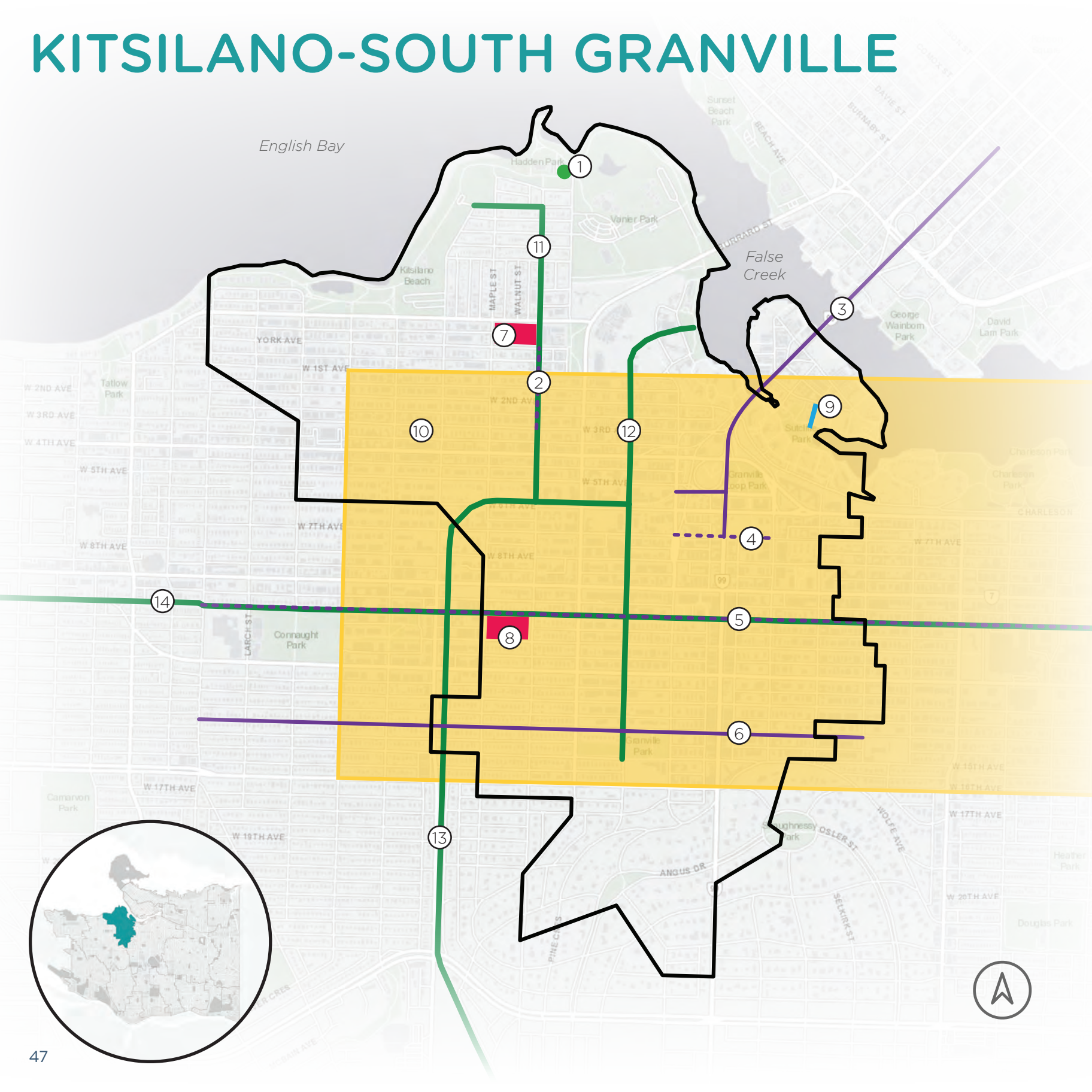
Median income: $40,909

Owner: 44%
Renter: 56%

Under 14: 9%
Over 75: 7%

Area: 411 hectares
Park space: 40 hectares

KITSILANO-SOUTH GRANVILLE



Opportunities

- IRMP Opportunities
- Blue-green systems
- Planned Cycling Route
- Planned Cycling Upgrade
- Planned Complete Street
- Community Centre
- Public School
- Major Planning Project

IRMP Opportunities

1 Hadden Park/Vanier Park

Transportation

2 Cypress Street
3 Granville Bridge
4 W 7th Avenue
5 10th Avenue Bikeway
6 14th Avenue

Public Facilities

7 Henry Hudson Elementary School
8 Tennyson Elementary School
9 False Creek Community Centre

Major Planning Projects

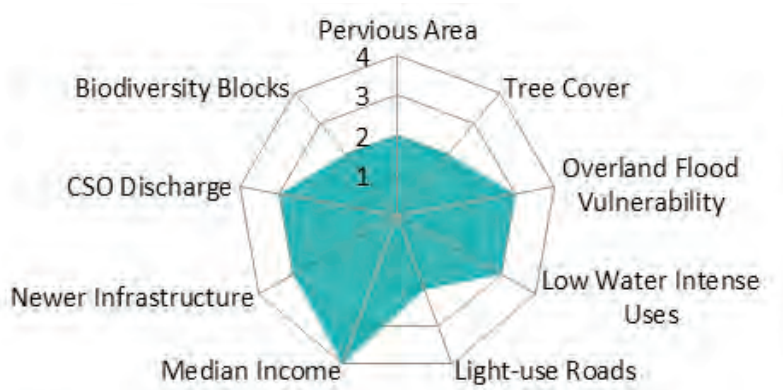
10 Broadway Area Plan

Blue-green systems

11 Cypress Street
12 Pine Street
13 Arbutus Greenway
14 10th Avenue Bikeway

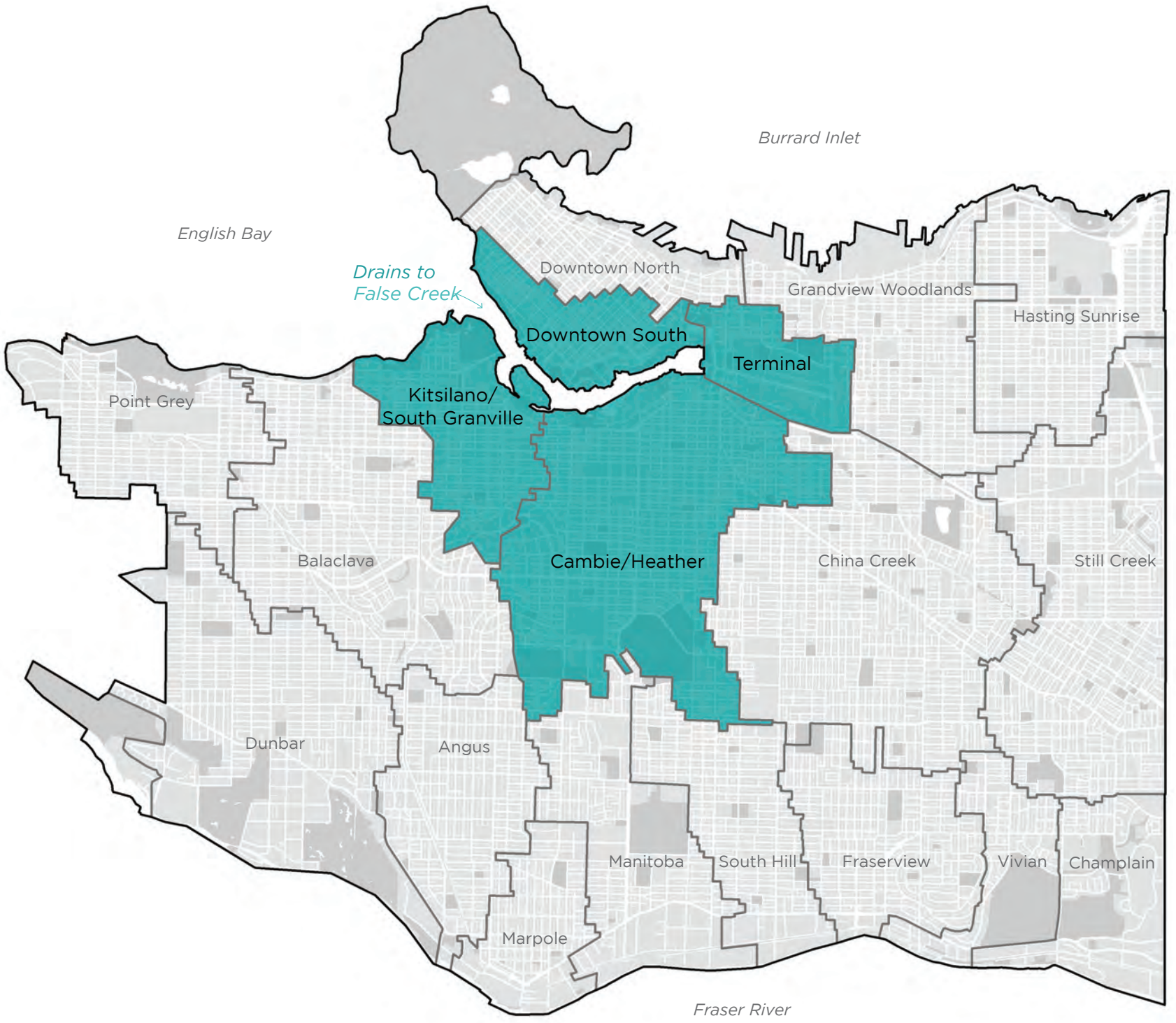
Priorities for this watershed

- Nearly three-quarter separated but pipes still combine into combined outfalls, makes volume reduction a priority
- Cleaning a priority for separated sections which lead to urban rainwater runoff outfalls
- False Creek watershed - major water quality issues
- Truck routes on arterials exacerbate pollution in runoff
- Highly impervious - limited area for groundwater recharge and infiltration
- Lower than target tree canopy (15%)

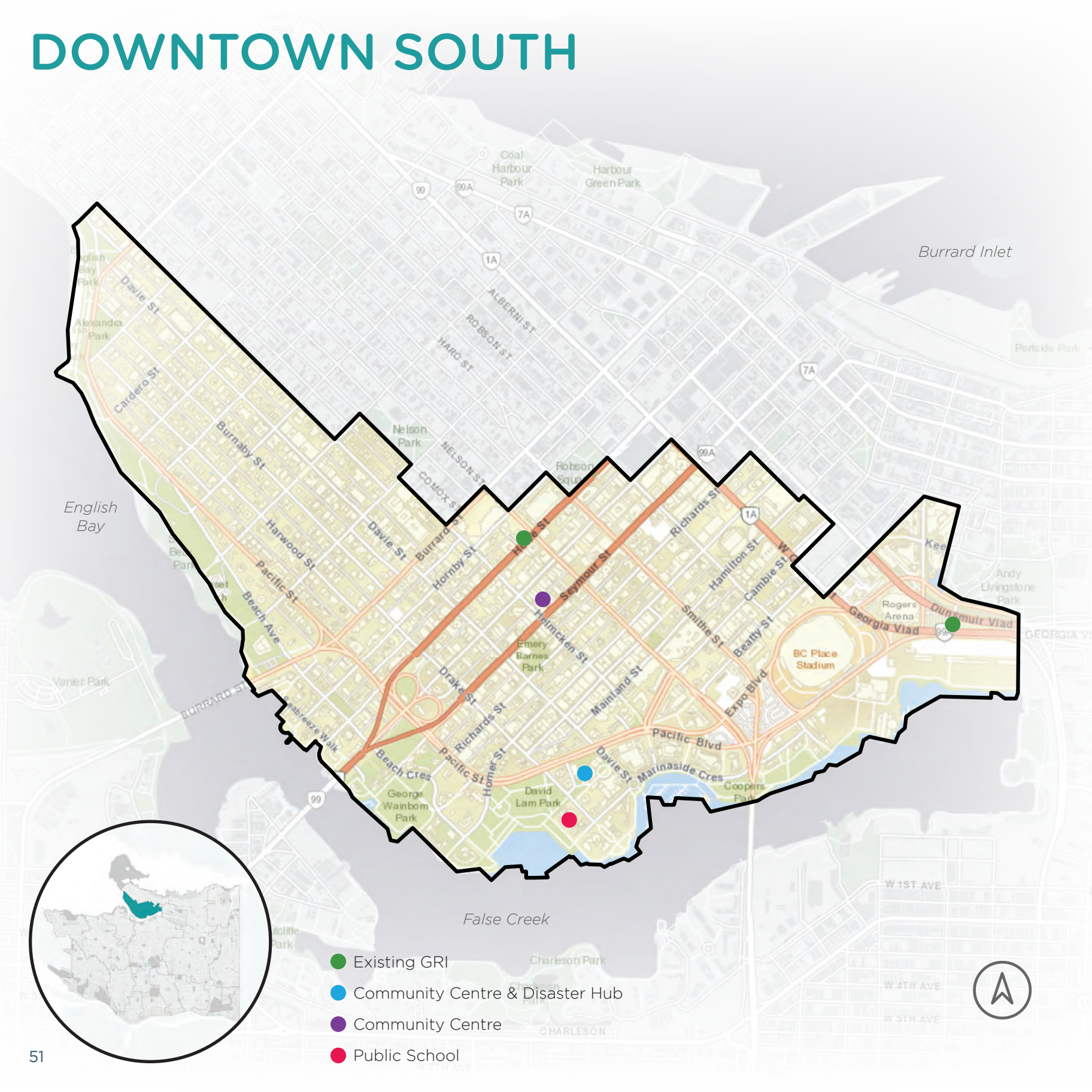


False Creek looking to downtown from Charleston Park

FALSE CREEK | *SNAUQ*

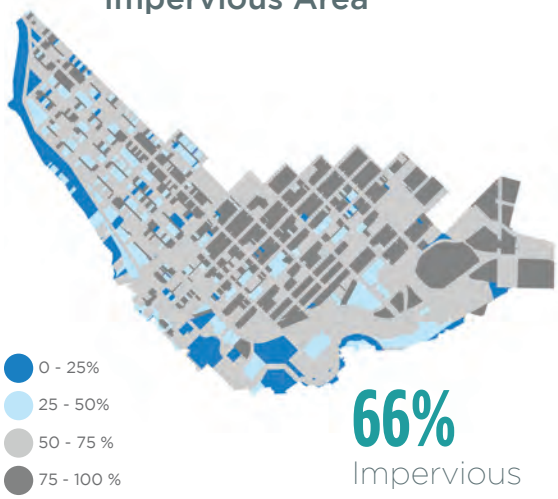


DOWNTOWN SOUTH



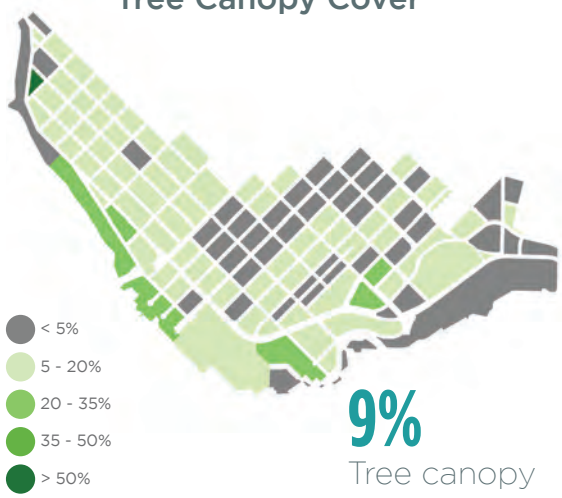
At a glance...

Impervious Area



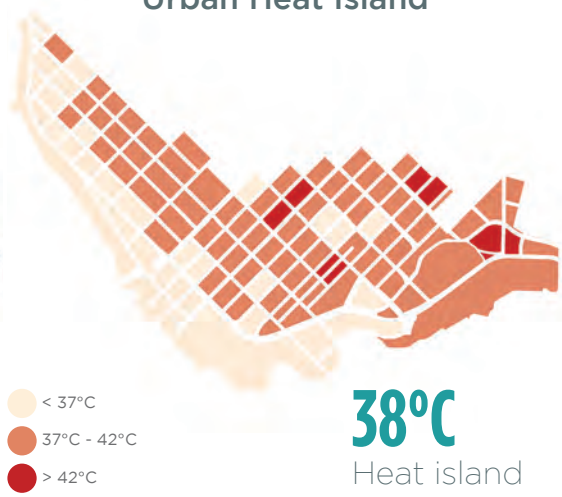
66%
Impervious

Tree Canopy Cover



9%
Tree canopy

Urban Heat Island



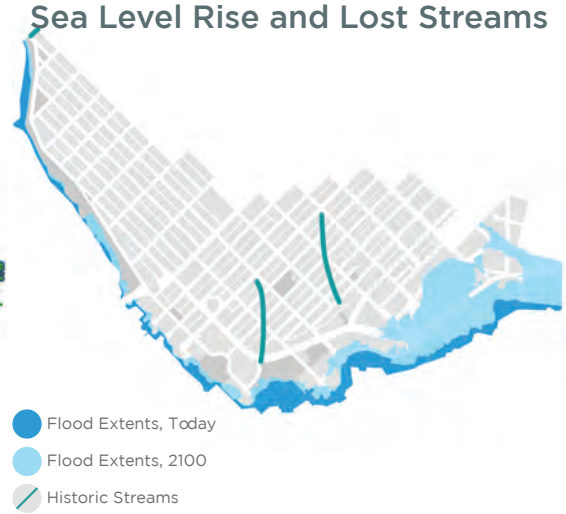
38°C
Heat island

Land Use

Road Network

Roads make up 33% of Downtown South watershed.

Sea Level Rise and Lost Streams



About the area

The Downtown South watershed is located in the southern portion of Vancouver's downtown peninsula. The watershed includes the West End, Granville Entertainment District, and Yaletown neighbourhoods. The watershed is predominantly made up of commercial/mixed-use and multifamily dwellings. The watershed contains 16 parks, one school, and two community centres, one of which (Roundhouse) is designated as a disaster hub. Rainwater in this watershed drains to English Bay and False Creek.

Population: 60,280
Density: 23,217/km^2

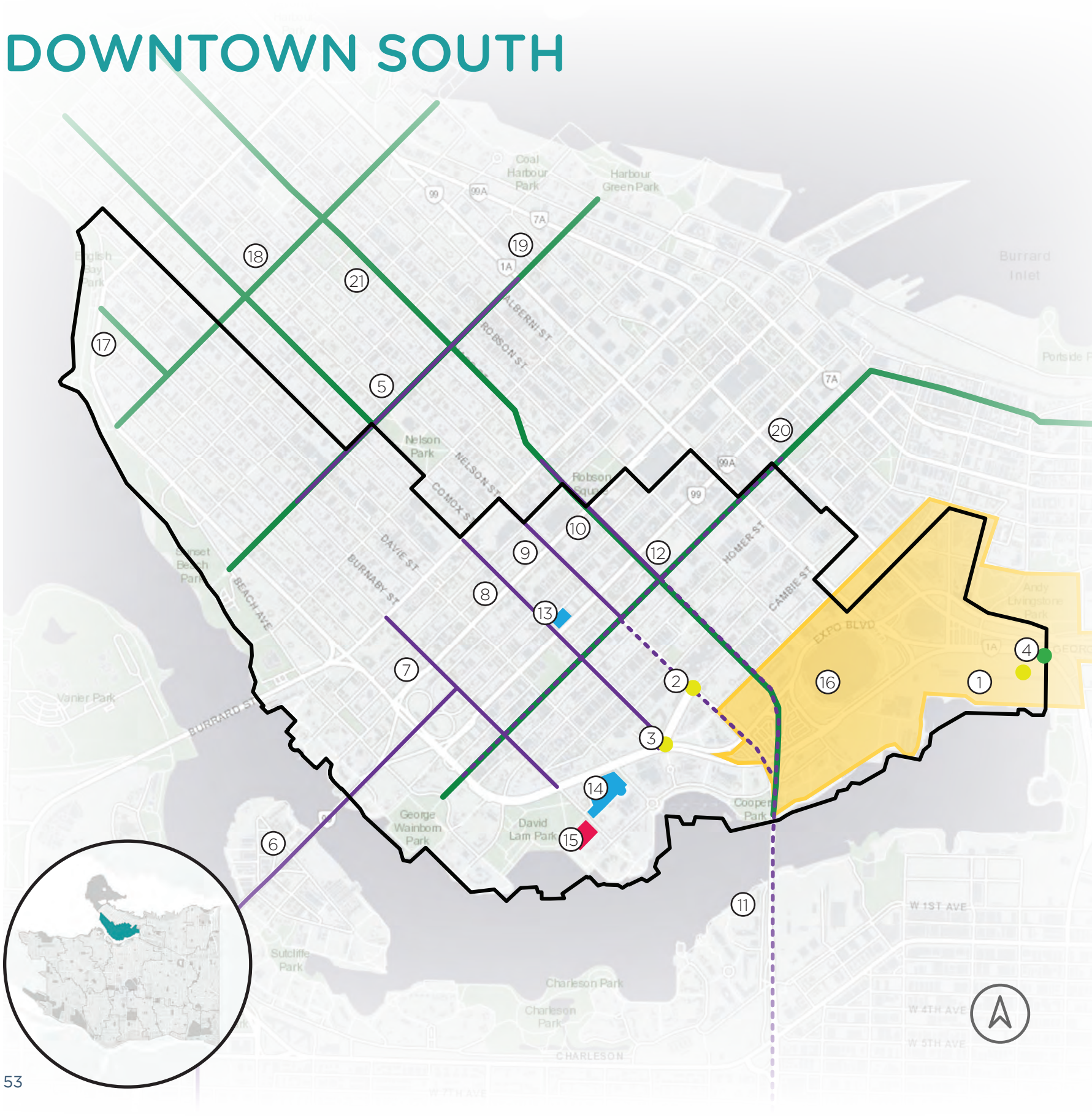
Median income: $36,254

Owner: 39%
Renter: 61%

Under 14: 5%
Over 75: 4%

Area: 260 hectares
Park space: 21 hectares

DOWNTOWN SOUTH



Opportunities

- IRMP Opportunities
- Future GRI
- Blue-green systems
- Planned Cycling Route
- Planned Cycling Upgrade
- Planned Complete Street
- Community Centre
- Public School
- Major Planning Project

Planned GRI

1 Northeast False Creek
2 Nelson Street / Cambie Street
3 Expo Boulevard / Cambie Street

IRMP Opportunities

4 Northeast False Creek

Transportation

5 Bute Street
6 Granville Bridge
7 Drake Street
8 Helmcken Street
9 Nelson Street
10 Smithe Street
11 Cambie Bridge
12 Richards Street

Public Facilities

13 The Gathering Place Centre
14 Roundhouse Community Centre
15 Elsie Roy Elementary School

Major Planning Projects

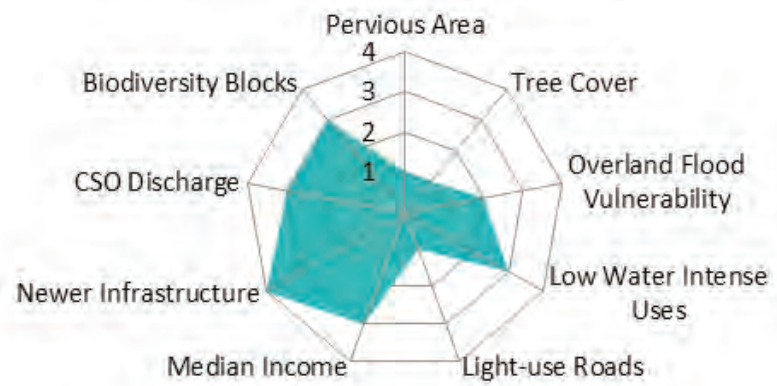
16 Northeast False Creek

Blue-green systems

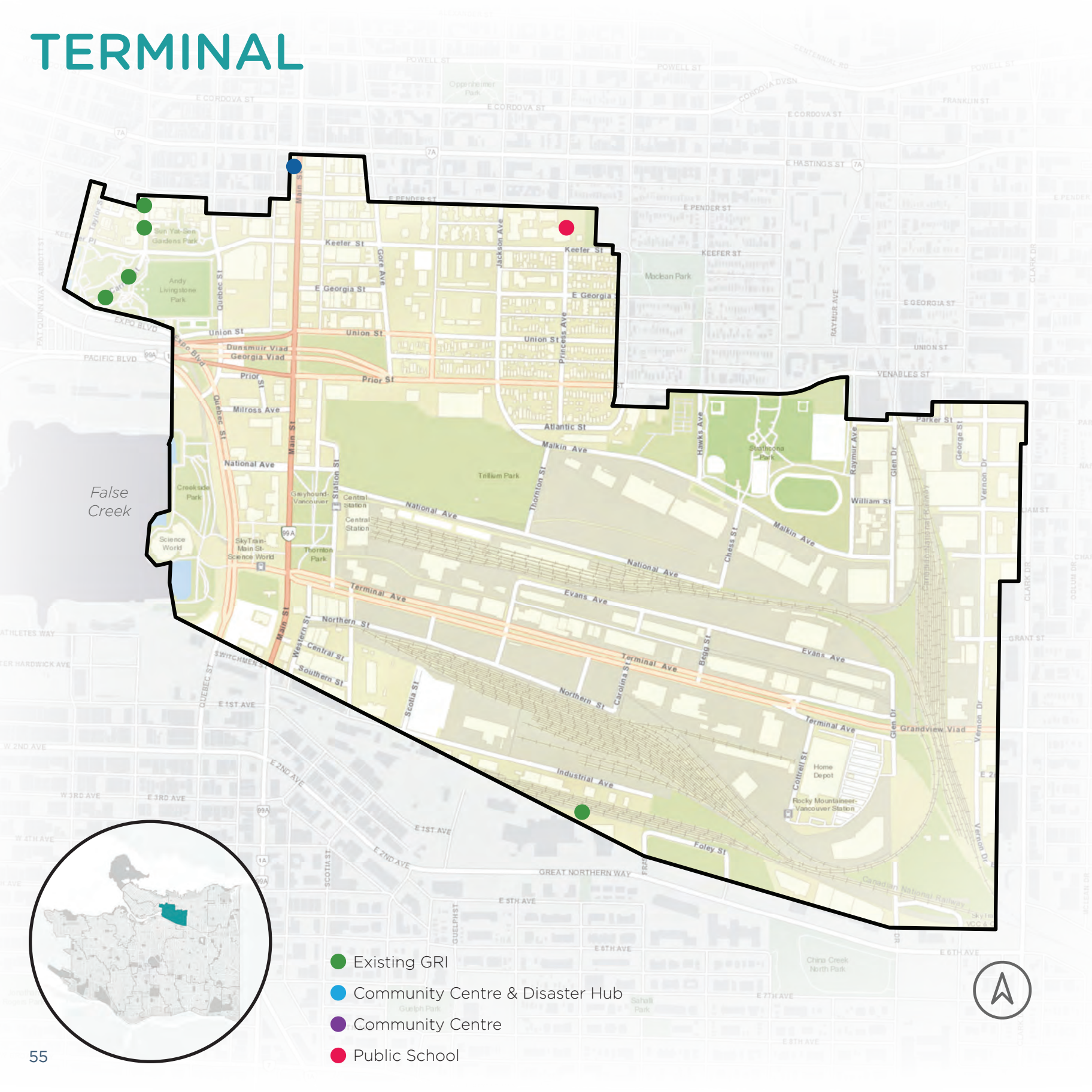
17 Burnaby Street
18 Cardero Street
19 Bute Street
20 Richards Street
21 Haro Street - Smithe Street

Priorities for this watershed

- Nearly 100% separated, so cleaning the urban rainwater runoff is a priority here as it drains to False Creek and English Bay
- Canopy-deficient (8. 4%)
- Highly impervious - opportunities to increase perviousness or to manage impervious area will improve water quality

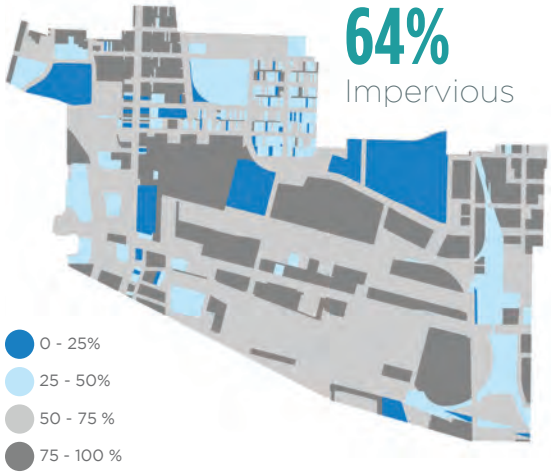


TERMINAL

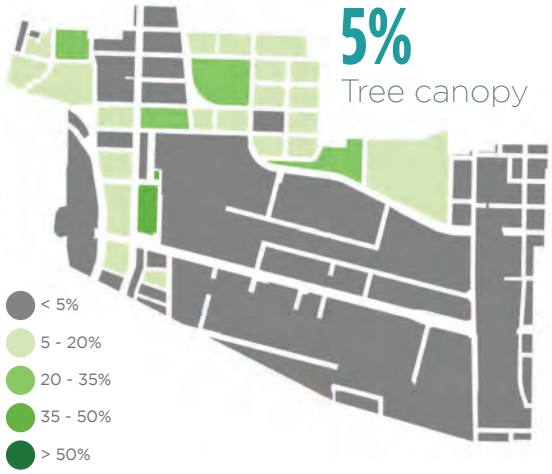

False Creek
Existing GRI
Community Centre & Disaster Hub
Community Centre
Public School

At a glance...

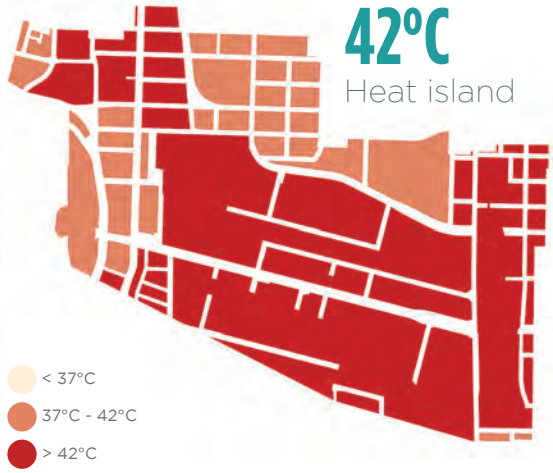
Impervious Area



Tree Canopy Cover

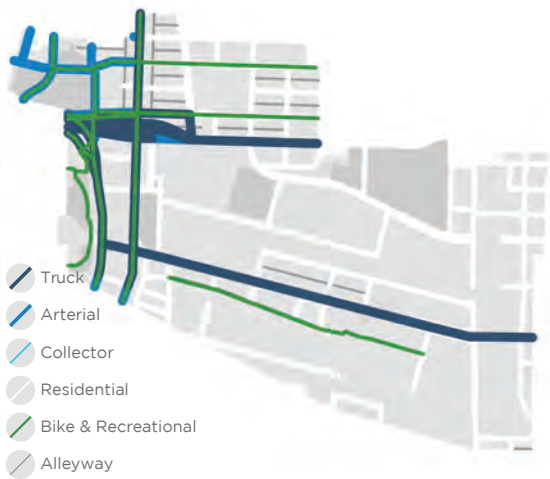


Urban Heat Island



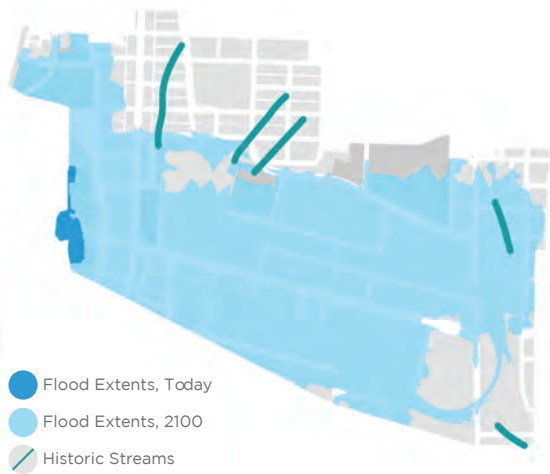
Land Use

Road Network



Roads make up 22% of Terminal watershed.

Sea Level Rise and Lost Streams



About the area

The Terminal watershed is located in central Vancouver, adjacent to the downtown peninsula. The watershed is located primarily in the Strathcona neighbourhood, with small portions in the Downtown and Mount Pleasant neighbourhoods. The watershed is characterized primarily by light industrial land uses, with some one and two family dwellings and commercial/mixed use. The watershed contains ten parks, one school, and one community centre that is designated as a disaster hub. Rainwater in this watershed drains to False Creek.

Population: 10,243
Density: 4,634/km^2

Median income: $27,218

Owner: 36%
Renter: 64%

Under 14: 7%
Over 75: 10%

Area: 221 hectares
Park space: 22 hectares

TERMINAL


11
4
6
7
8
3
15
14
13
12
2
5
9
16
1
17
18
10
False Creek
E CORDOVA ST
E PENDER ST
KEEFER ST
E GEORGIA ST
UNION ST
ATLANTIC ST
NATIONAL AVE
TERMINAL AVE
EVANS AVE
CENTRAL ST
SOUTHERN ST
INDUSTRIAL AVE
E 5TH AVE
E 6TH AVE
Sun Yat-Sen Gardens Park
Maclean Park
Oppenheimer Park
Andy Livingstone Park
Thornton Park
Strathcona Park
Crab Park
Chinatown Millennium Gate Park
Chinese Cultural Centre Park
Dude Chilling Park
Guelph Park
Science World
Olympic Village Station
Main Street-Science World Station
Stadium-Chinatown Station
Waterfront Station
Granville Bridge
Dunsmuir Viaduct
Georgia Viaduct
Cambie Bridge
Burrard Bridge
Pacific Blvd
Expo Blvd
Cardero St
Jervis St
Burrard St
Howe St
Granville St
Seymour St
Richards St
Abbott St
Carrall St
Main St
Station St
Gore Ave
Glen Dr
Clark Dr
Raymur Ave
Chess St
Cottrell St
Scotia St
Guelph St
Quebec St
Fraser St
Kingsway
Pat Quinn Way
Athletes Way
Hardwick Ave
W 2nd Ave
W 3rd Ave
E 3rd Ave
Switchmen St
Powell St
Centennial Rd
Cordova Dvsn
Franklin St
E Hastings St
7A
1A
99A
99B

Opportunities

- IRMP Opportunities
- Future GRI
- Blue-green systems
- Planned Cycling Route
- Planned Cycling Upgrade
- Planned Complete Street
- Community Centre
- Public School
- Major Planning Project

IRMP Opportunities

1 False Creek Flats
2 Creekside Park
3 St. Paul's Hospital

Transportation

4 Gore Avenue
5 Quebec Street

Public Facilities

6 Strathcona Community Centre
7 Lord Strathcona Elementary School

Major Planning Projects

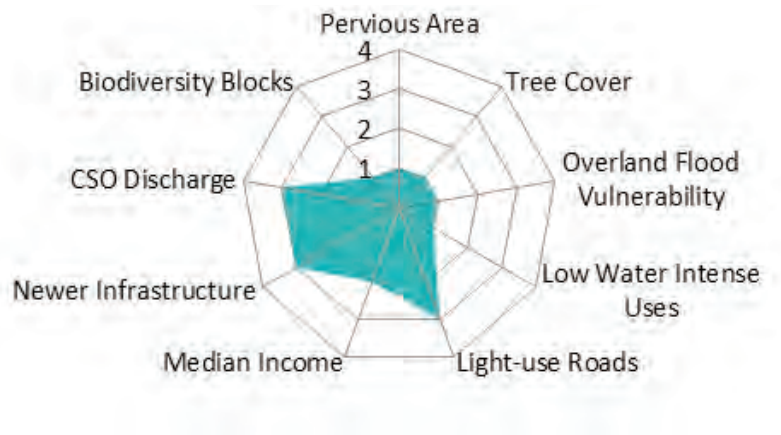
8 Northeast False Creek
9 False Creek Flats
10 Broadway Area Plan

Blue-green systems

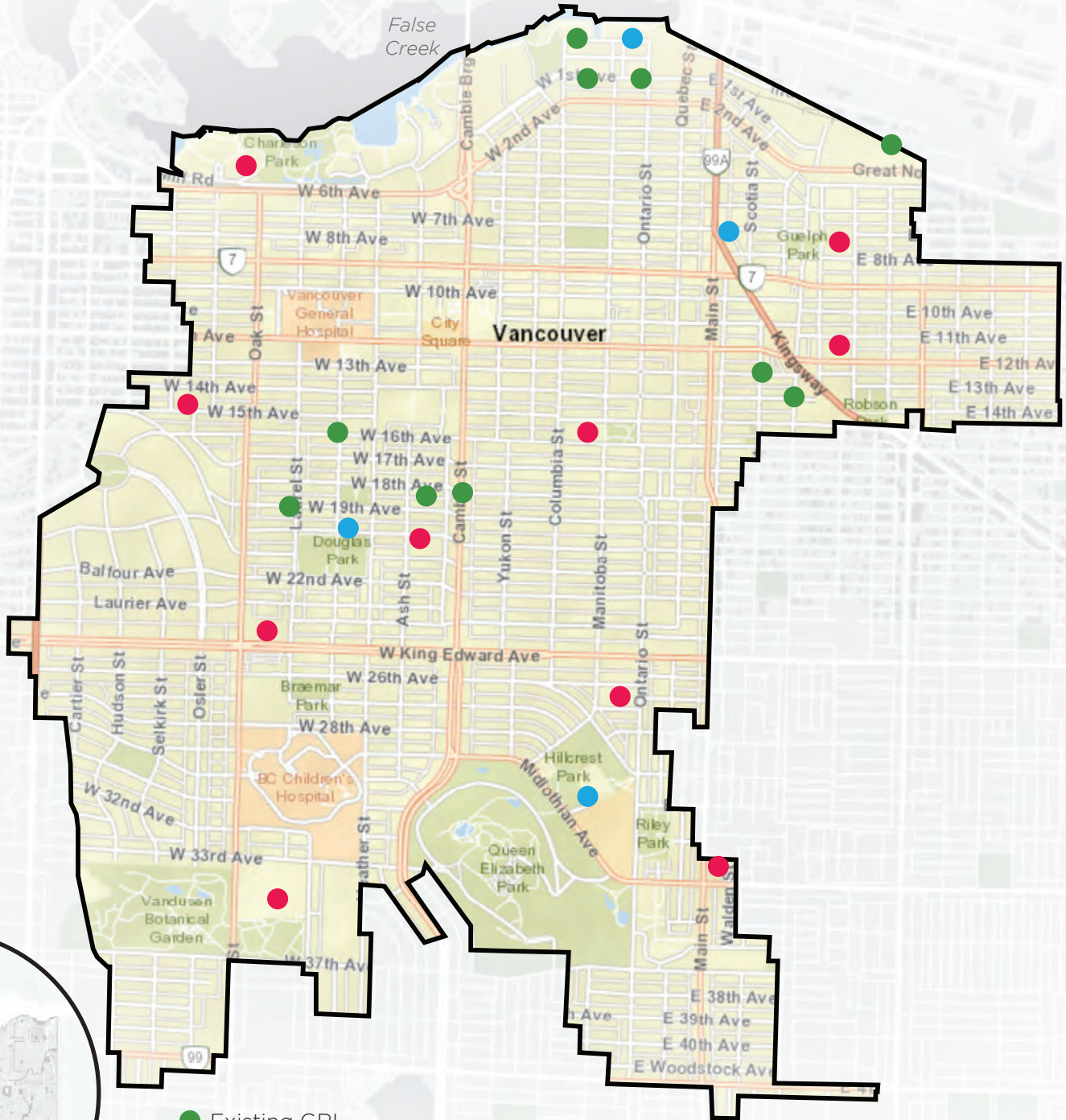
11 Carrall Street
12 National Avenue
13 Thornton Street
14 Malkin Avenue
15 Hawks Avenue
16 Northern Street
17 Glen Drive
18 Central Valley Greenway

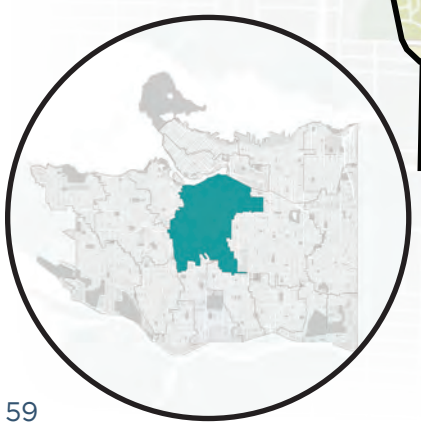
Priorities for this watershed

- 95% separated, so emphasis on water quality
- Industrial area, so higher pollutant loading in runoff
- Hottest watershed (42°C)
- Minimal tree canopy (5. 1%)
- Highly impervious



CAMBIE-HEATHER



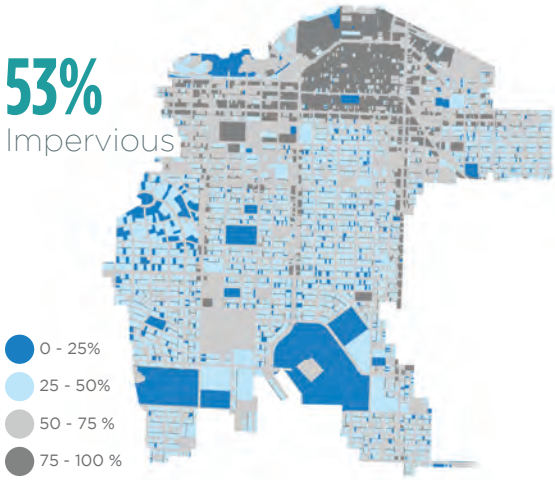


- Existing GRI
- Community Centre & Disaster Hub
- Community Centre
- Public School

At a glance...

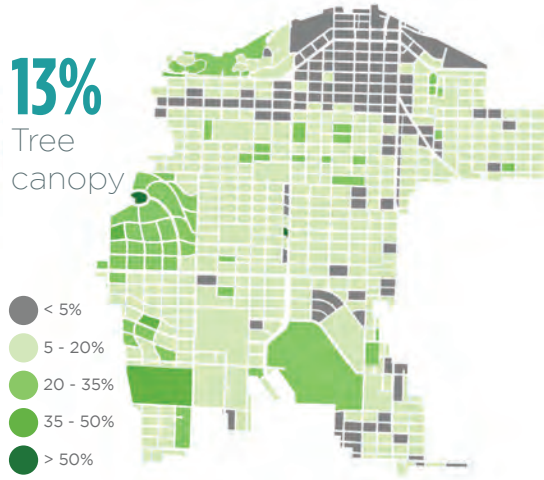
Impervious Area

53%
Impervious



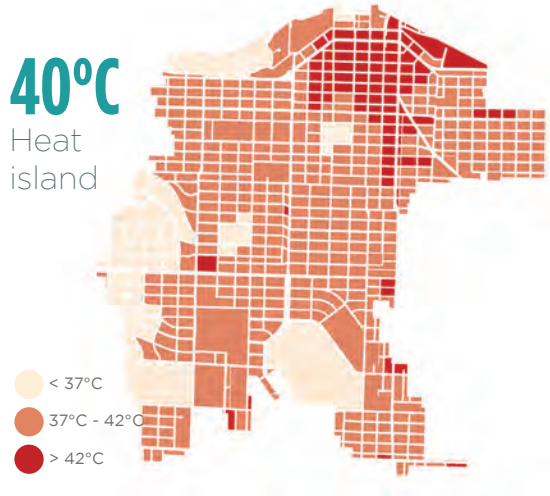
Tree Canopy Cover

13%
Tree canopy

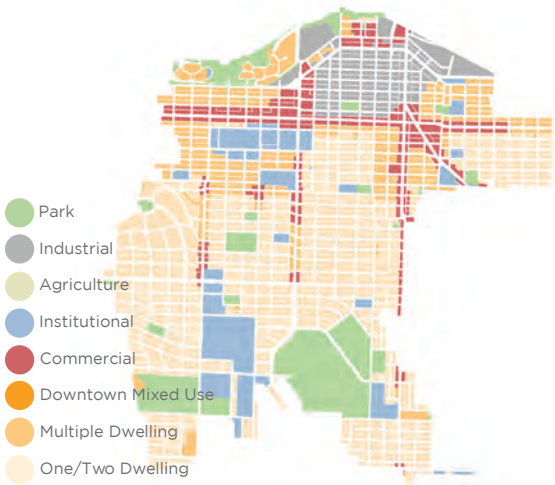


Urban Heat Island

40°C
Heat island



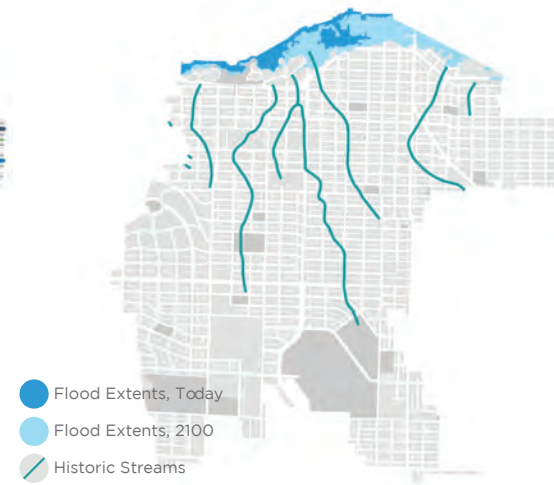
Land Use



Road Network

Roads make up 31% of Cambie-Heather watershed.

Sea Level Rise and Lost Streams



About the area

The Cambie-Heather watershed is located in central Vancouver, and contains the majority of the Mount Pleasant and South Cambie neighbourhoods, and portions of the Shaughnessy, Riley Park, Fairview, and Strathcona neighbourhoods. The Olympic Village development is located within this watershed. The southern and eastern sections are predominantly one and two family dwellings, while the northern and western portions are predominantly light industrial and mixed use development. The watershed contains 29 parks, ten schools, and four community centres which are all designated as disaster hubs. Rainwater in this watershed drains to False Creek.

Population: 62,632
Density: 5,586/km^2

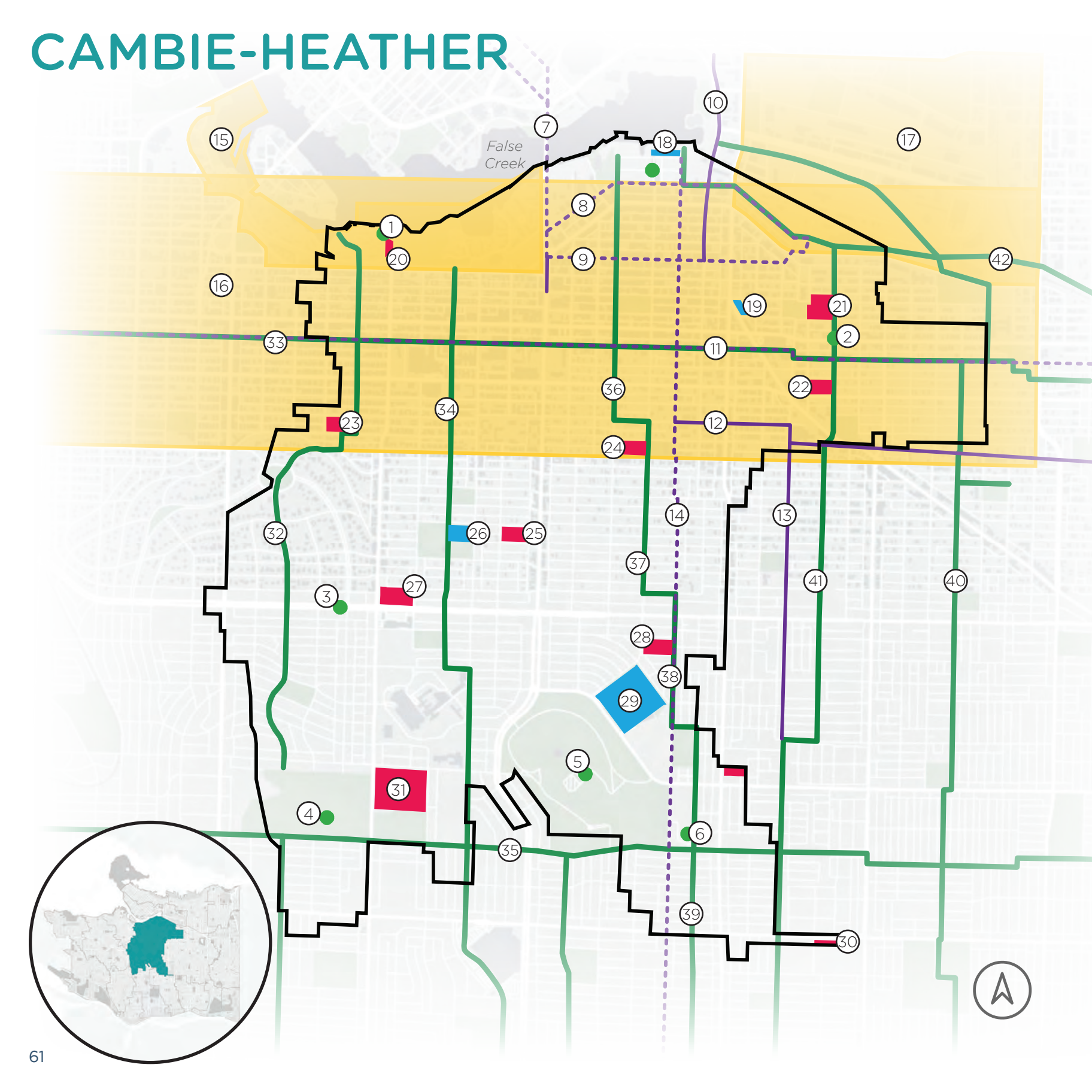
Median income: $34,662

Owner: 51%
Renter: 49%

Under 14: 11%
Over 75: 6%

Area: 1121 hectares
Park space: 118 hectares

CAMBIE-HEATHER



Opportunities

- IRMP Opportunities
- Blue-green systems
- Planned Cycling Route
- Planned Cycling Upgrade
- Planned Complete Street
- Community Centre
- Public School
- Major Planning Project

IRMP Opportunities

1 False Creek South
2 St. George Rainway
3 King Edward Avenue Boulevard
4 Van Dusen Botanical Gardens
5 Queen Elizabeth Park
6 Little Mountain

Transportation

7 Cambie Bridge
8 1st Avenue
9 5th Avenue
10 Quebec Street
11 10th Avenue Bikeway
12 14th Avenue
13 Prince Edward Street
14 Ontario Street

Major Planning Projects

15 False Creek South
16 Broadway Area Plan
17 False Creek Flats

Public Facilities

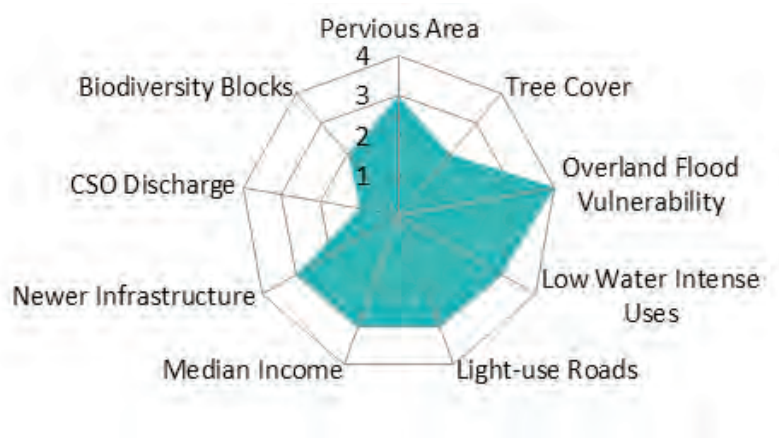
18 Creekside Community Centre
19 Mount Pleasant Community Centre
20 False Creek Elementary School
21 Mount Pleasant Elementary School
22 Nightingale Elementary School
23 L'Ecole Bilingue Elementary School
24 Fraser Elementary School
25 Edith Cavell Elementary School
26 Douglas Park Community Centre
27 Carr Elementary School
28 Wolfe Elementary School
29 Hillcrest Centre
30 John Oliver Secondary School
31 Eric Hamber Secondary School

Blue-green systems

32 Hudson Street - Spruce Street
33 10th Avenue Bikeway
34 Willow Street - Heather Street
35 Ridgeway
36 Columbia Street
37 Manitoba Street
38 Ontario Street
39 Quebec Street
40 Windsor Street
41 St. George Street
42 Central Valley Greenway

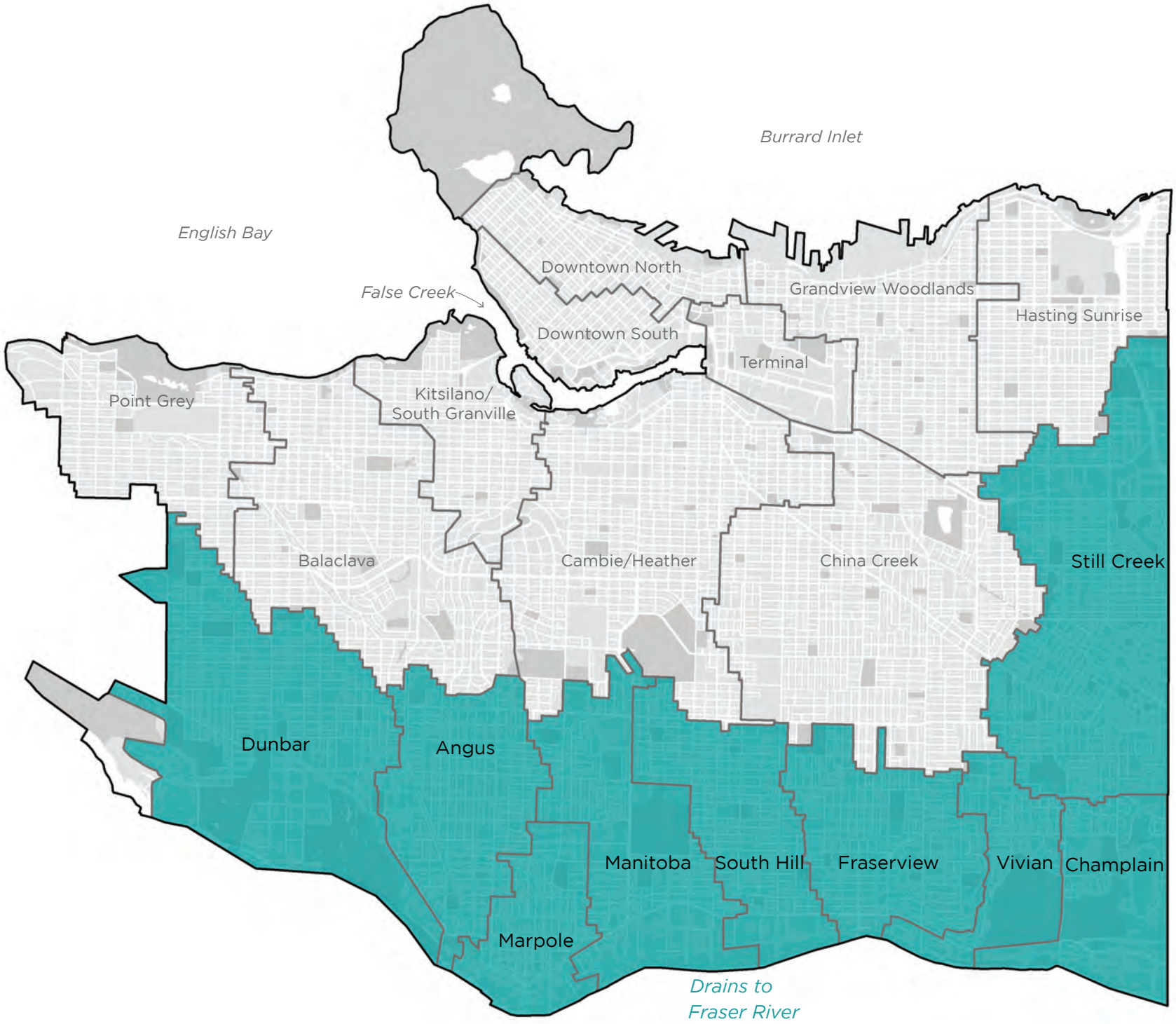
Priorities for this watershed

- 53% separated but feed into combined outfalls so reducing volume is a major priority
- Yukon Gate is in this watershed
- Cleaning is a priority particularly in separated areas
- Truck routes on arterials exacerbate runoff pollution loading
- Canopy below target (13%)

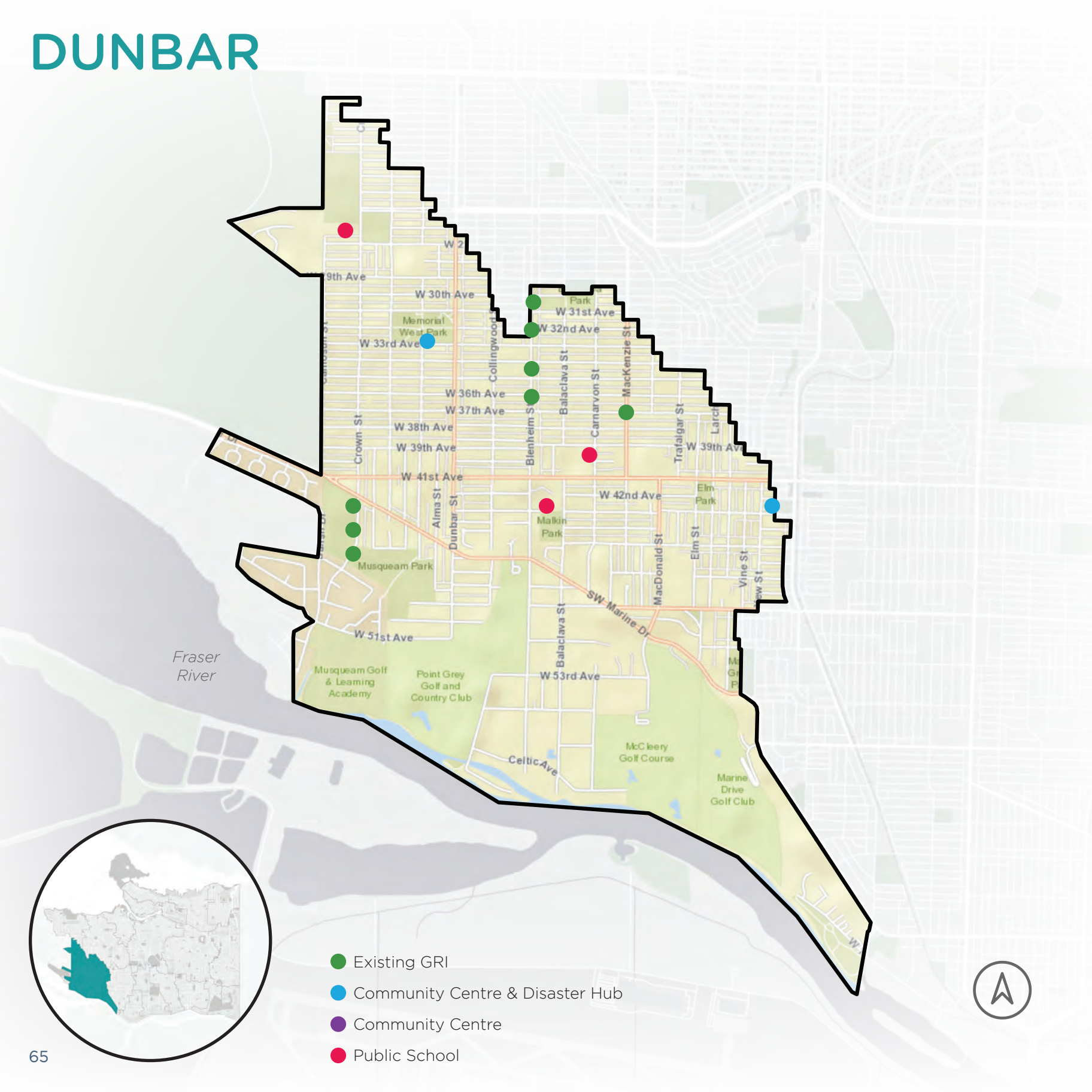


North Arm of the Fraser River

FRASER RIVER | *STO:LO*



DUNBAR

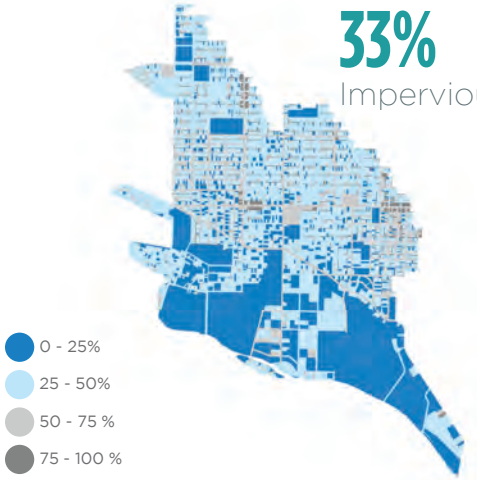


- Existing GRI
- Community Centre & Disaster Hub
- Community Centre
- Public School

At a glance...

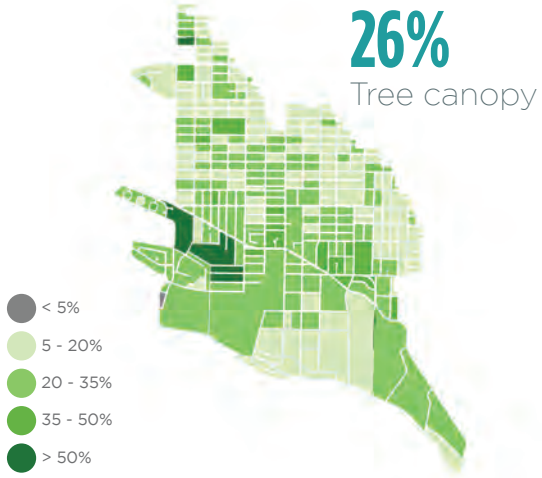
Impervious Area

33%
Impervious



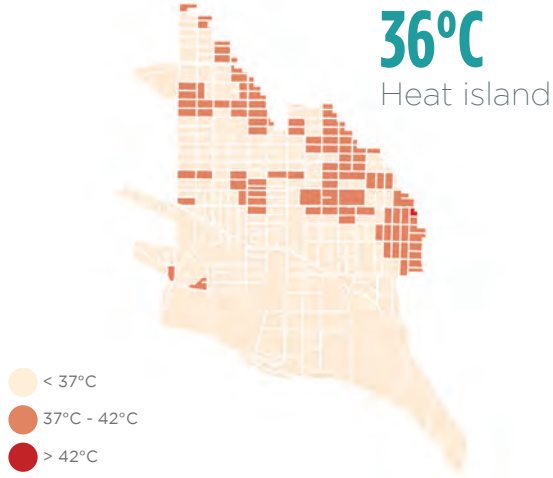
Tree Canopy Cover

26%
Tree canopy

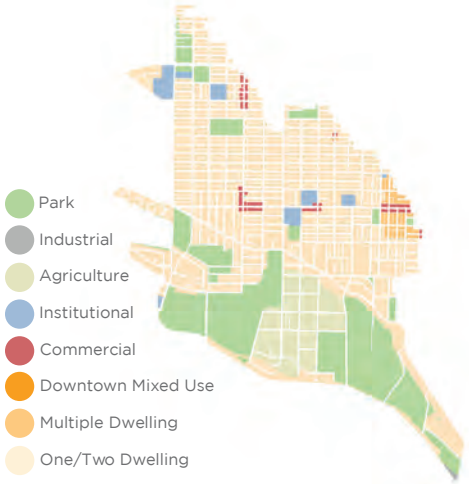


Urban Heat Island

36°C
Heat island



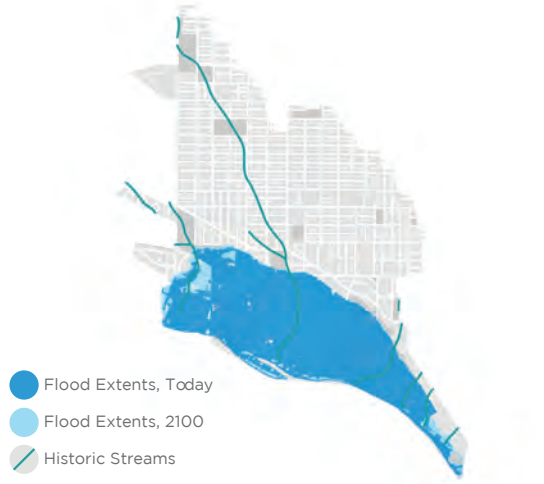
Land Use



Road Network

Roads make up 22% of Dunbar watershed.

Sea Level Rise and Lost Streams



About the area

The Dunbar watershed is located in Vancouver's west side, and is bordered on the south by the Fraser River. The watershed contains portions of the Dunbar-Southlands, Kerrisdale, and Arbutus Ridge neighbourhoods. Dunbar's land use is characterized primarily by one and two family dwellings, with pockets of commercial activity along Dunbar St, W 41st Avenue, and Mackenzie Street, and multifamily dwellings at the eastern edge of the watershed along W 41st Ave in Kerrisdale. The only agricultural land use in Vancouver is located within this watershed, in the southern portion along the Fraser River. The watershed contains more than a dozen parks, three schools, and two community centres which are both designated as disaster hubs. Rainwater in this watershed drains to the Fraser River.

Population: 21,265
Density: 2,090/km^2

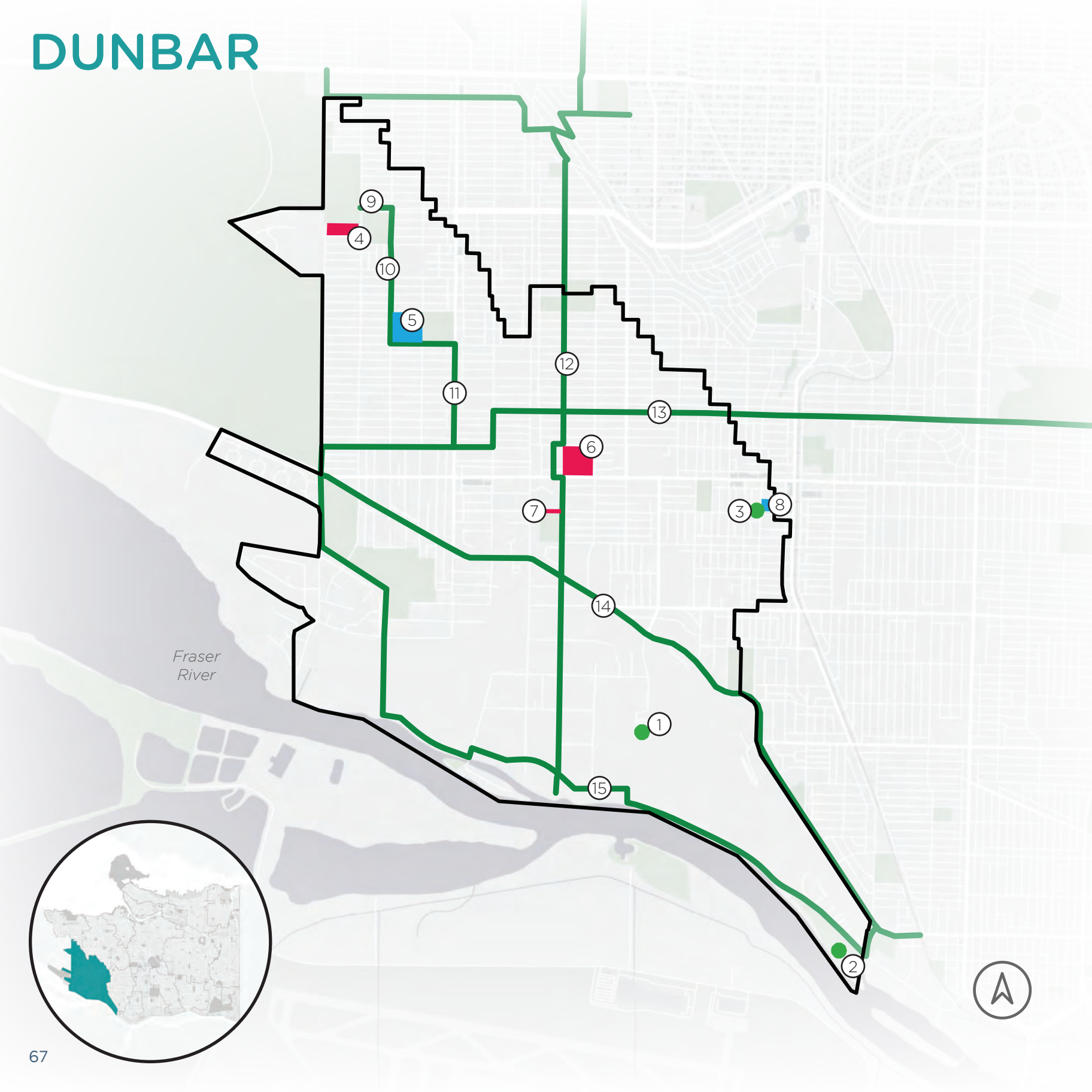
Median income: $35,709

Owner: 72%
Renter: 25%

Under 14: 15%
Over 75: 9%

Area: 1018 hectares
Park space: 211 hectares

DUNBAR



Opportunities

- IRMP Opportunities
- Laneway
- Blue-green systems
- Planned Cycling Route
- Planned Cycling Upgrade
- Planned Complete Street
- Community Centre
- Public School
- Major Planning Project

IRMP Opportunities

1 McCleery Golf Course
2 Fraser River Park
3 Kerrisdale Centennial Park

Public Facilities

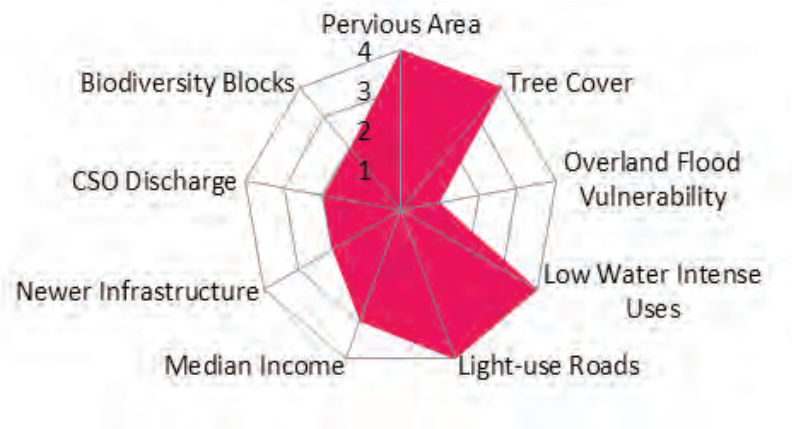
4 Queen Elizabeth Annex
5 Dunbar Community Centre
6 Kerrisdale Elementary School
7 Kerrisdale Annex
8 Kerrisdale Community Centre

Blue-green systems

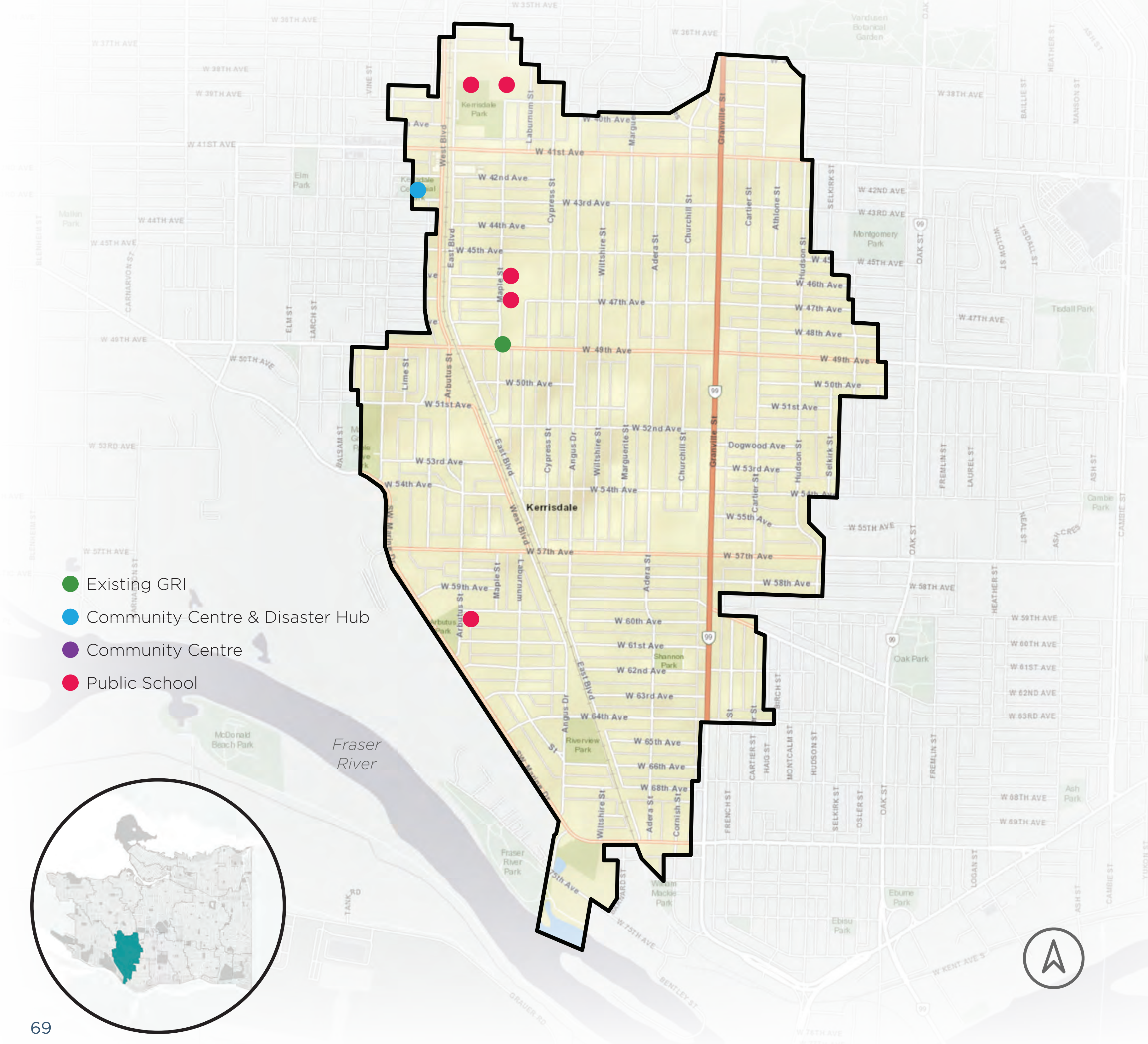
9 King Edward Avenue
10 Wallace Street
11 Dunbar Street
12 Balaclava Street
13 Ridgeway
14 SW Marine Drive
15 Fraser River Shore

Priorities for this watershed

- Majority combined, so reducing volume entering system is a priority
- Cleaning of runoff in separated areas
- Area vulnerable to sea level rise



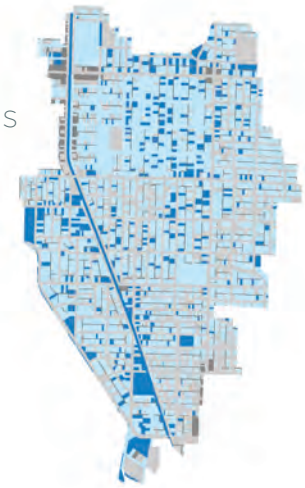
ANGUS


Existing GRI
Community Centre & Disaster Hub
Community Centre
Public School
Kerrisdale
Fraser River
Kerrisdale Park
Granville St
West Blvd
East Blvd
SW Marine Dr
W 41st Ave
W 49th Ave
W 57th Ave
Vandusen Botanical Garden
Montgomery Park
Oak Park
McDonald Beach Park
Fraser River Park
Riverview Park
Shannon Park

At a glance...

Impervious Area

46%
Impervious



- 0 - 25%
- 25 - 50%
- 50 - 75 %
- 75 - 100 %

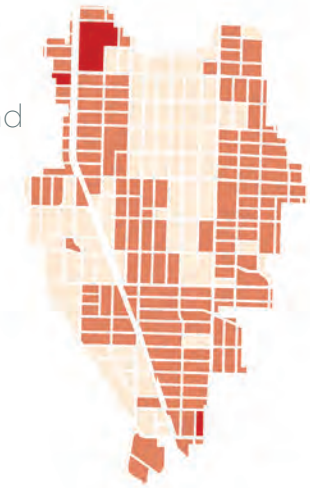
Tree Canopy Cover

18%
Tree canopy

- < 5%
- 5 - 20%
- 20 - 35%
- 35 - 50%
- > 50%

Urban Heat Island

38°C
Heat island



- < 37°C
- 37°C - 42°C
- > 42°C

Land Use

- Park
- Industrial
- Agriculture
- Institutional
- Commercial
- Downtown Mixed Use
- Multiple Dwelling
- One/Two Dwelling

Road Network

- Truck
- Arterial
- Collector
- Residential
- Bike & Recreational
- Alleyway

Roads make up 32% of Angus watershed.

Sea Level Rise and Lost Streams

- Flood Extents, Today
- Flood Extents, 2100
- Historic Streams

About the area

The Angus watershed is located on Vancouver's west side, and briefly borders the Fraser River. The watershed consists of the Kerrisdale, Marpole, Oakridge, Shaughnessy, and Arbutus Ridge neighbourhoods. The neighbourhood is primarily single family dwellings, with limited industrial areas along the Fraser River, and some commercial/mixed-use along West Boulevard and W 41st Avenue. The watershed contains nine parks, five schools, and one community centre that is designated as a disaster hub. Rainwater in this watershed drains to the Fraser River.

Population: 17,501
Density: 3,430/km^2

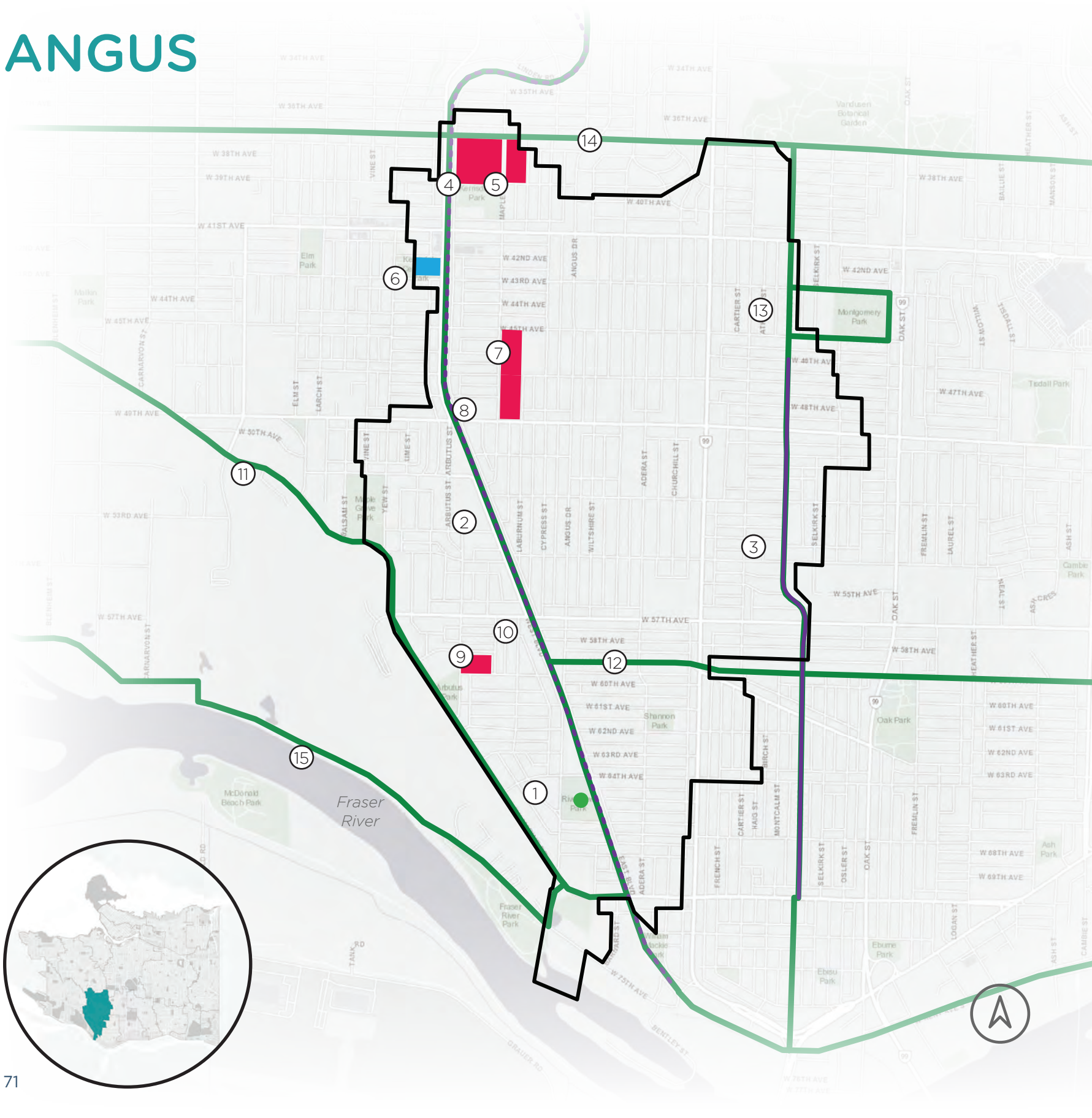
Median income: $27,297

Owner: 63%
Renter: 37%

Under 14: 13%
Over 75: 8%

Area: 510 hectares
Park space: 13 hectares

ANGUS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Fraser River
W 34TH AVE
W 35TH AVE
W 36TH AVE
W 38TH AVE
W 39TH AVE
W 40TH AVE
W 41ST AVE
W 42ND AVE
W 43RD AVE
W 44TH AVE
W 45TH AVE
W 47TH AVE
W 48TH AVE
W 49TH AVE
W 50TH AVE
W 53RD AVE
W 55TH AVE
W 57TH AVE
W 58TH AVE
W 60TH AVE
W 61ST AVE
W 62ND AVE
W 63RD AVE
W 64TH AVE
W 68TH AVE
W 69TH AVE
W 75TH AVE
Vandusen Botanical Garden
Elm Park
Montgomery Park
Tisdall Park
Shannon Park
Oak Park
McDonald Beach Park
Fraser River Park
Ebutus Park
Ebutus Park
Ash Park
Cambie Park
ANGUS DR
ARBUTUS ST
ADERA ST
CHURCHILL ST
CYPRESS ST
LABURNUM ST
WILTSHIRE ST
SELKIRK ST
CARTIER ST
OAK ST
FREMLIN ST
LAUREL ST
ASH ST
BIRCH ST
MONTCALM ST
FRENCH ST
OSLER ST
HAIG ST
LOGAN ST
HEATHER ST
MAPLE ST
VINE ST
ELM ST
LARCH ST
LIME ST
YEW ST
CARNARVON ST
SALISH ST
ELKIRK ST
ATTRIDGE ST
WILLOW ST
HEMLOCK ST
MANSON ST
BALLIE ST
ASH CRES
HEAL ST
TANK RD
BENTLEY ST
GRAUER RD
99

Opportunities

- IRMP Opportunities
- Laneway
- Blue-green systems
- Planned Cycling Route
- Planned Cycling Upgrade
- Planned Complete Street
- Community Centre
- Public School
- Major Planning Project

IRMP Opportunities

1 Riverview Park

Transportation

2 Arbutus Greenway Upgrades
3 Hudson Street

Public Facilities

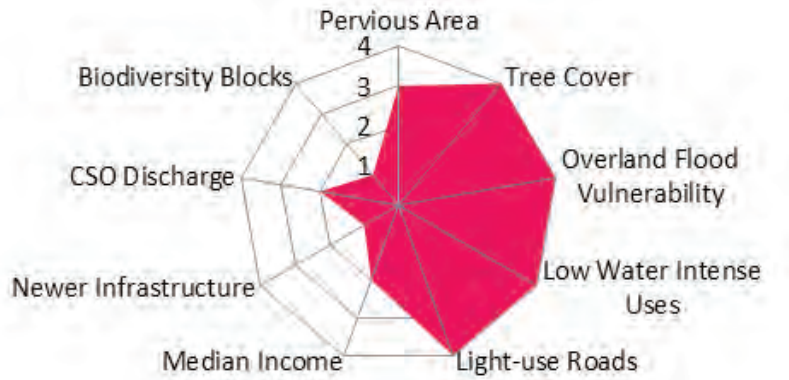
4 Point Grey Secondary School
5 Quilchena Elementary School
6 Kerrisdale Community Centre
7 Maple Grove Elementary School
8 Magee Secondary School
9 McKechnie Elementary School

Blue-green systems

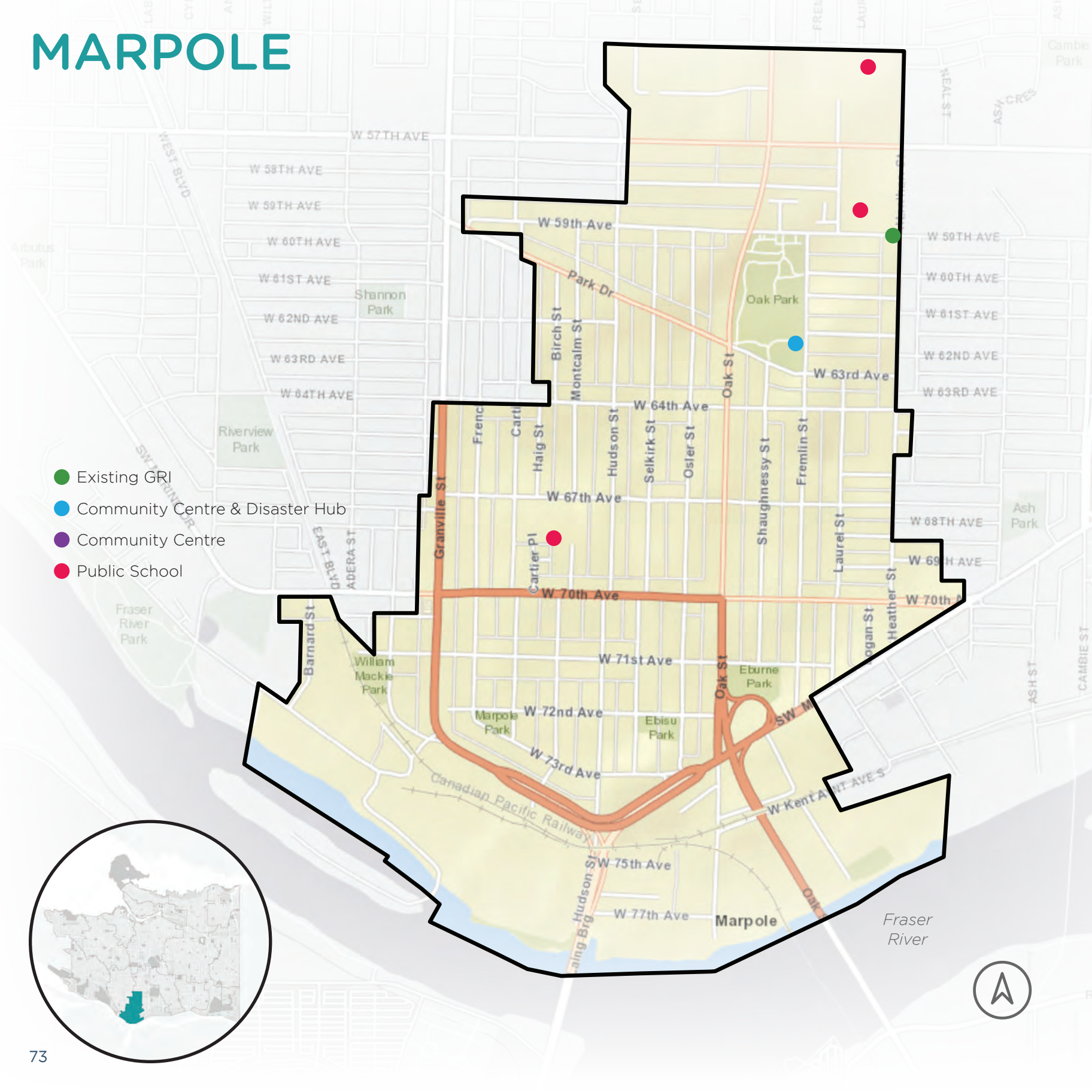
10 Arbutus Greenway
11 SW Marine Drive
12 59th Avenue - North Arm Trail
13 Hudson Street
14 Ridgeway
15 Fraser River Trail

Priorities for this watershed

- Majority combined (92%) so reducing volume entering system is a priority
- Green space deficient (3% park space)
- Area vulnerable to sea level rise



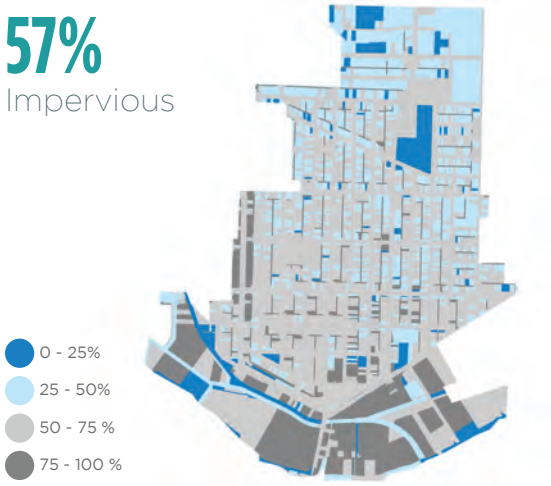
MARPOLE


Existing GRI
Community Centre & Disaster Hub
Community Centre
Public School
W 59th Ave
Park Dr
Oak Park
W 63rd Ave
W 64th Ave
W 67th Ave
W 70th Ave
W 71st Ave
W 72nd Ave
W 73rd Ave
W 75th Ave
W 77th Ave
Marpole
Granville St
Oak St
Birch St
Montcalm St
Hudson St
Selkirk St
Osler St
Shaughnessy St
Fremlin St
Laurel St
Heather St
Haig St
Cartier Pl
Barnard St
Shannon Park
Riverview Park
Fraser River Park
William Mackie Park
Marpole Park
Ebisu Park
Eburne Park
Ash Park
Canadian Pacific Railway
Fraser River

At a glance...

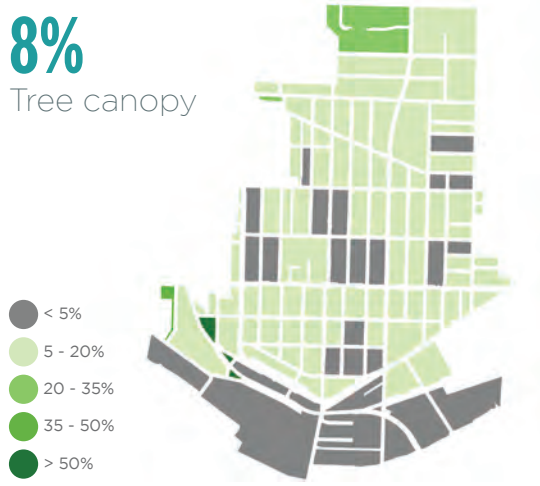
Impervious Area

57%
Impervious



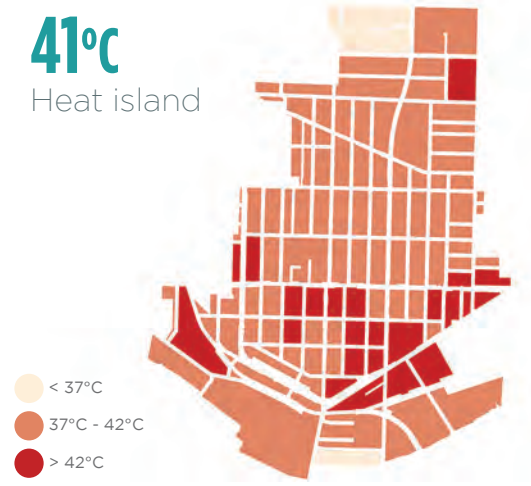
Tree Canopy Cover

8%
Tree canopy



Urban Heat Island

41°C
Heat island



Land Use

Road Network

Roads make up 27% of Marpole watershed.

Sea Level Rise and Lost Streams

About the area

The Marpole watershed is located in South Vancouver and consists largely of the Marpole neighbourhood as well as a small portion of the Oakridge neighbourhood. The watershed is predominantly one and two family dwellings, with commercial/ mixed use development along Granville Street and SW Marine Drive, and industrial development along the Fraser River. The watershed contains seven parks, three schools, and one community centre that is designated a disaster hub. Rainwater in this watershed drains to the Fraser River.

Population: 14,915
Density: 5,267/km^2

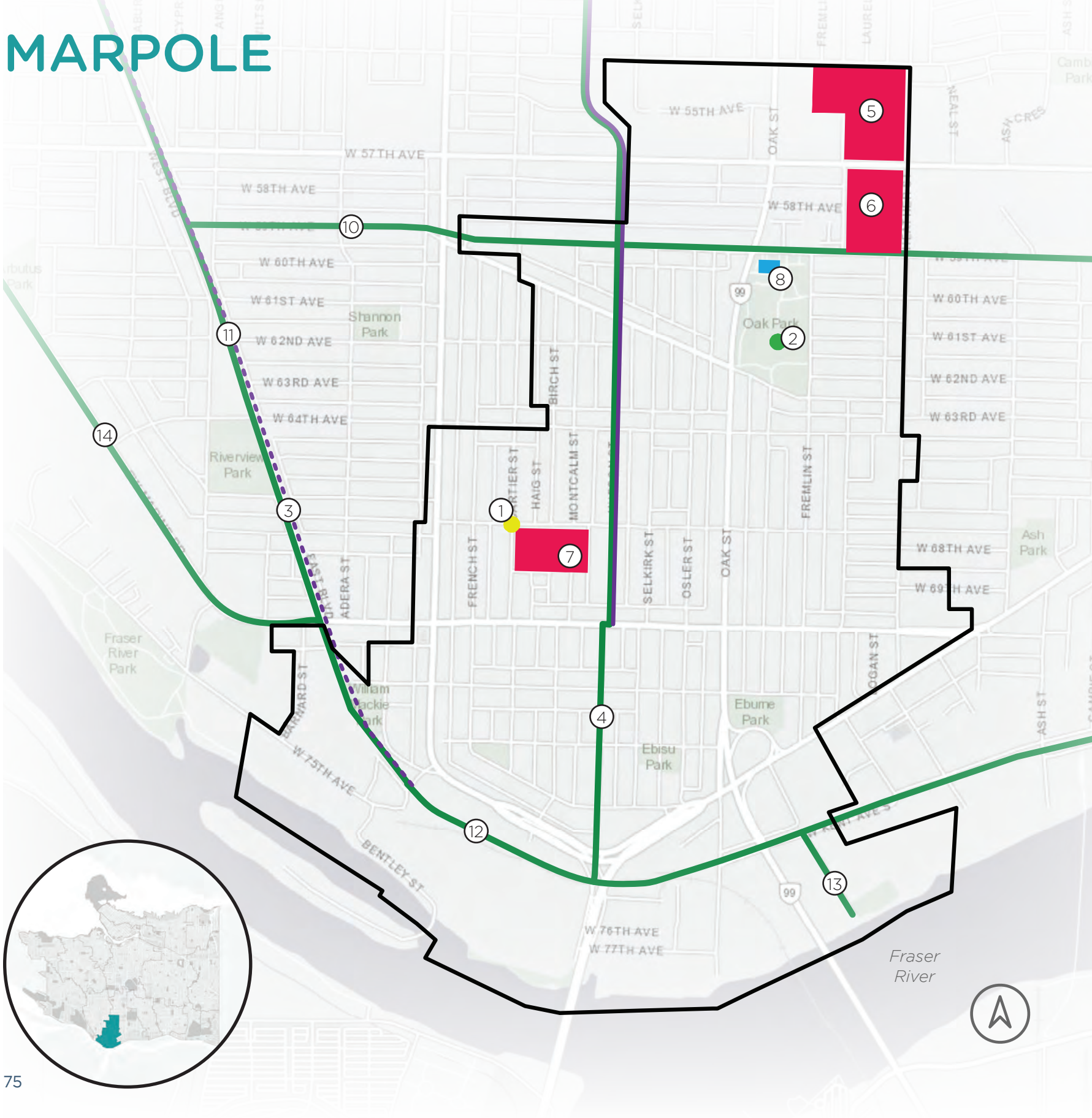
Median income: $24,869

Owner: 32%
Renter: 68%

Under 14: 12%
Over 75: 6%

Area: 283 hectares
Park space: 8 hectares

MARPOLE


W 55TH AVE
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W 61ST AVE
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W 63RD AVE
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W 75TH AVE
W 76TH AVE
W 77TH AVE
OAK ST
NEAL ST
ASH CRES
BIRCH ST
MONTCALM ST
HAIG ST
CARTIER ST
FRENCH ST
ADERA ST
SELKIRK ST
OSLER ST
OAK ST
FREMLIN ST
ASH ST
BENTLEY ST
Shannon Park
Riverview Park
Fraser River Park
William Hackie Park
Oak Park
Ebume Park
Ebisu Park
Ash Park
Fraser River
99
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Opportunities

- IRMP Opportunities
- Future GRI
- Laneway
- Blue-green systems
- Planned Cycling Route
- Planned Cycling Upgrade
- Planned Complete Street
- Community Centre
- Public School
- Major Planning Project

Planned GRI

1 W 67th Avenue & Cartier Street

IRMP Opportunities

2 Oak Park

Transportation

3 Arbutus Greenway Upgrades
4 Hudson Street

Public Facilities

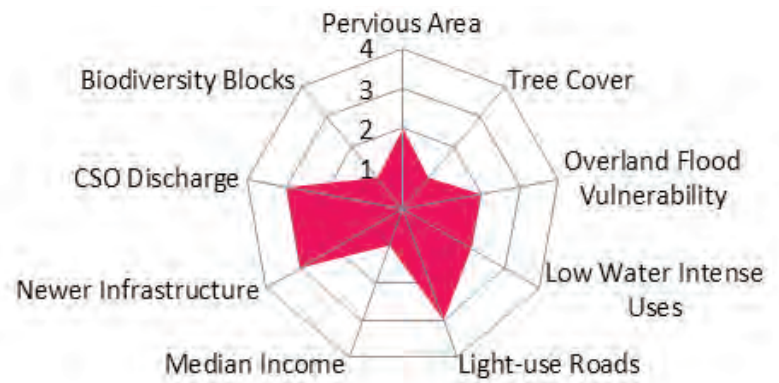
5 Sir Winston Churchill Secondary School
6 Laurier Elementary School
7 David Lloyd George Elementary School
8 Marpole Oakridge Community Centre

Blue-green systems

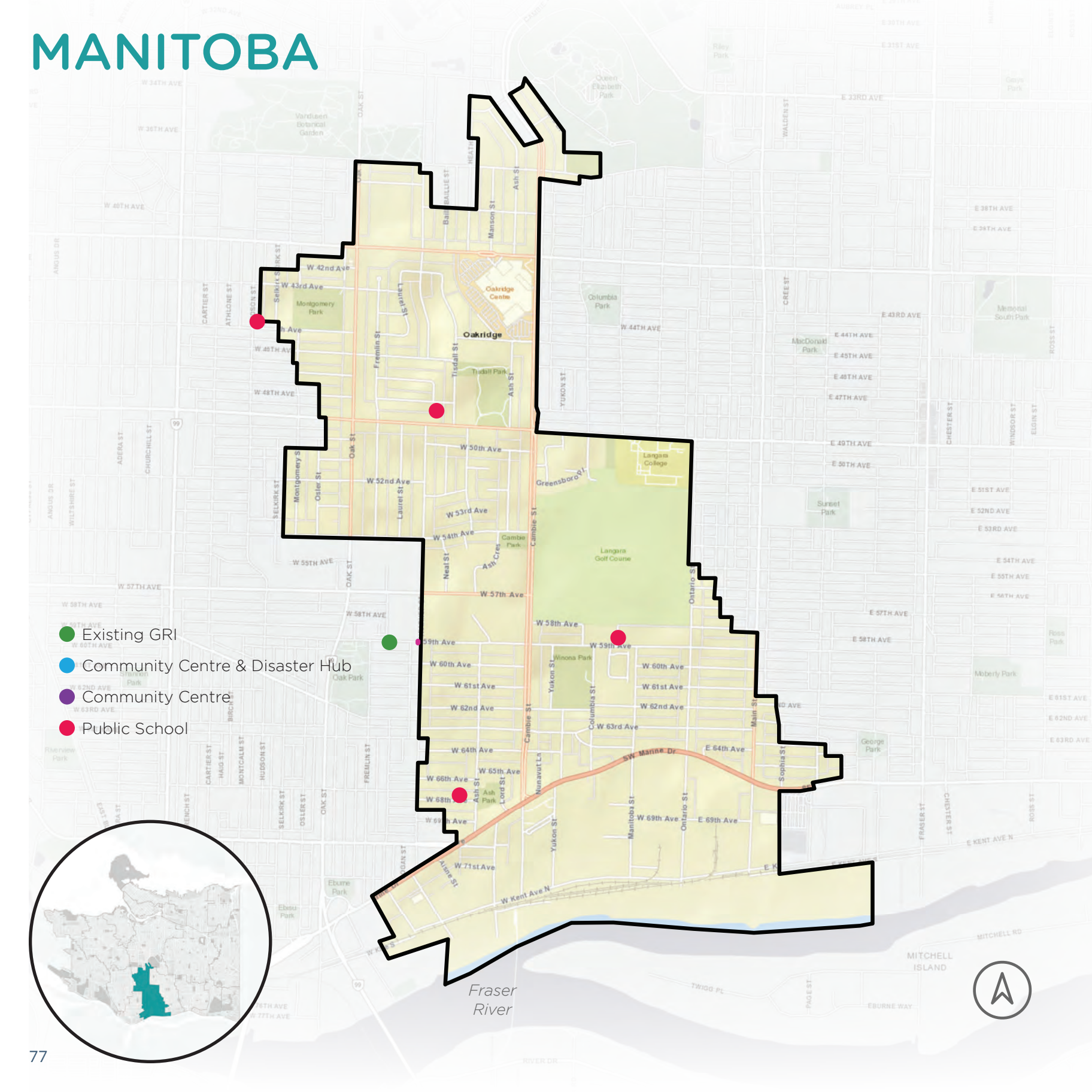
9 Hudson Street
10 59th Avenue - North Arm Trail
11 Arbutus Greenway
12 Fraser River Trail
13 Shaughnessy Street
14 SW Marine Drive

Priorities for this watershed

- About half combined, so volume reduction is a major priority
- Canopy deficient (8. 8%)
- Urban heat island (41°C)
- 52% impervious - opportunities to manage impervious area and reduce volume by allowing for infiltration
- Green space deficient (3% park space)
- Truck routes on Marine Dr, 70th, and Oak exacerbate pollution loading
- Area vulnerable to sea level rise



MANITOBA


Existing GRI
Community Centre & Disaster Hub
Community Centre
Public School
Oakridge
Oakridge Centre
Montgomery Park
Tisdall Park
Columbia Park
Langara College
Langara Golf Course
Sunset Park
Cambie Park
Winona Park
Ash Park
Oak Park
Eburne Park
Ebsu Park
George Park
Moberly Park
MacDonald Park
Memorial South Park
Queen Elizabeth Park
Vanduesen Botanical Garden
Riley Park
Riverview Park
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W 50th Ave
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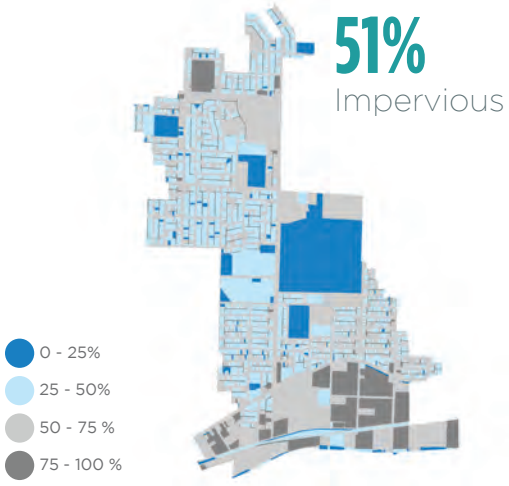
W 64th Ave
W 65th Ave
W 66th Ave
W 68th Ave
W 69th Ave
W 71st Ave
E 64th Ave
E 69th Ave
W Kent Ave N
SW Marine Dr
Cambie St
Ash St
Oak St
Yukon St
Columbia St
Main St
Ontario St
Manitoba St
Sophia St
Fraser River
MITCHELL ISLAND

At a glance...

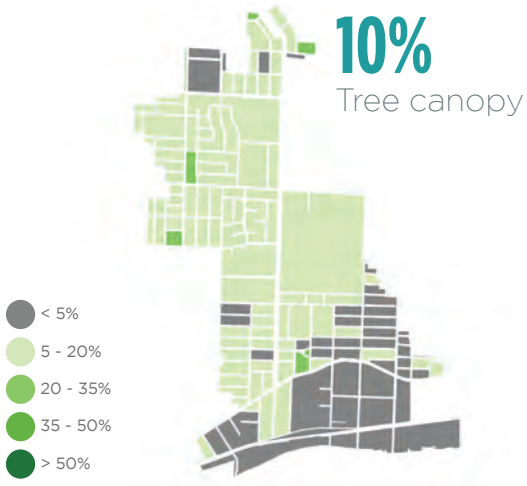
Impervious Area

51%
Impervious



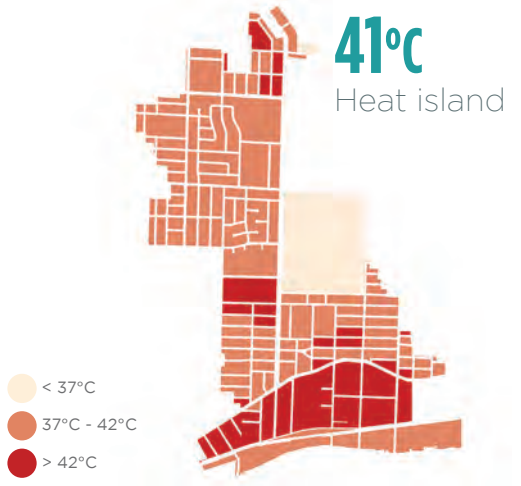
Tree Canopy Cover

10%
Tree canopy

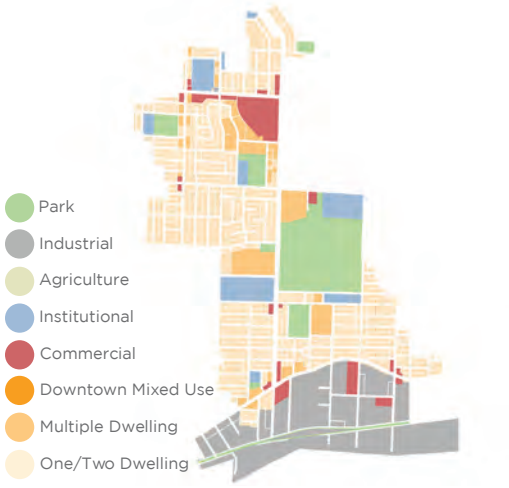


Urban Heat Island

41°C
Heat island



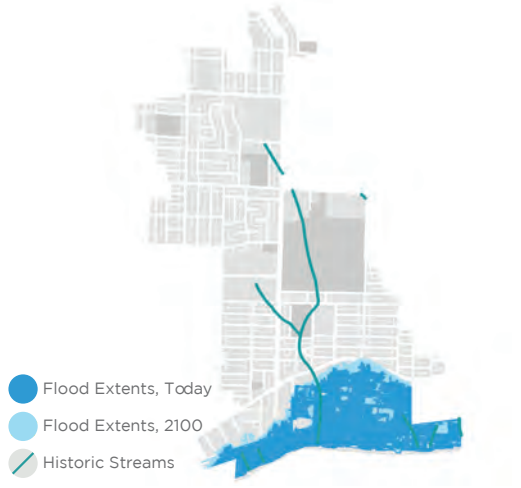
Land Use



Road Network

Roads make up 23% of Manitoba watershed.

Sea Level Rise and Lost Streams



About the area

The Manitoba watershed is located in South Vancouver, and straddles the Riley Park, South Cambie, Oakridge, Marpole, and Sunset neighbourhoods. The watershed is predominantly one and two family dwellings, with significant commercial activity on W 41st Avenue around Oakridge Centre, and in the southern portion along SW Marine Drive. The watershed also has significant industrial areas along the Fraser River. The watershed contains eight parks and four schools. There are no community centres in the watershed.

Population: 18,220
Density: 3,196/km^2

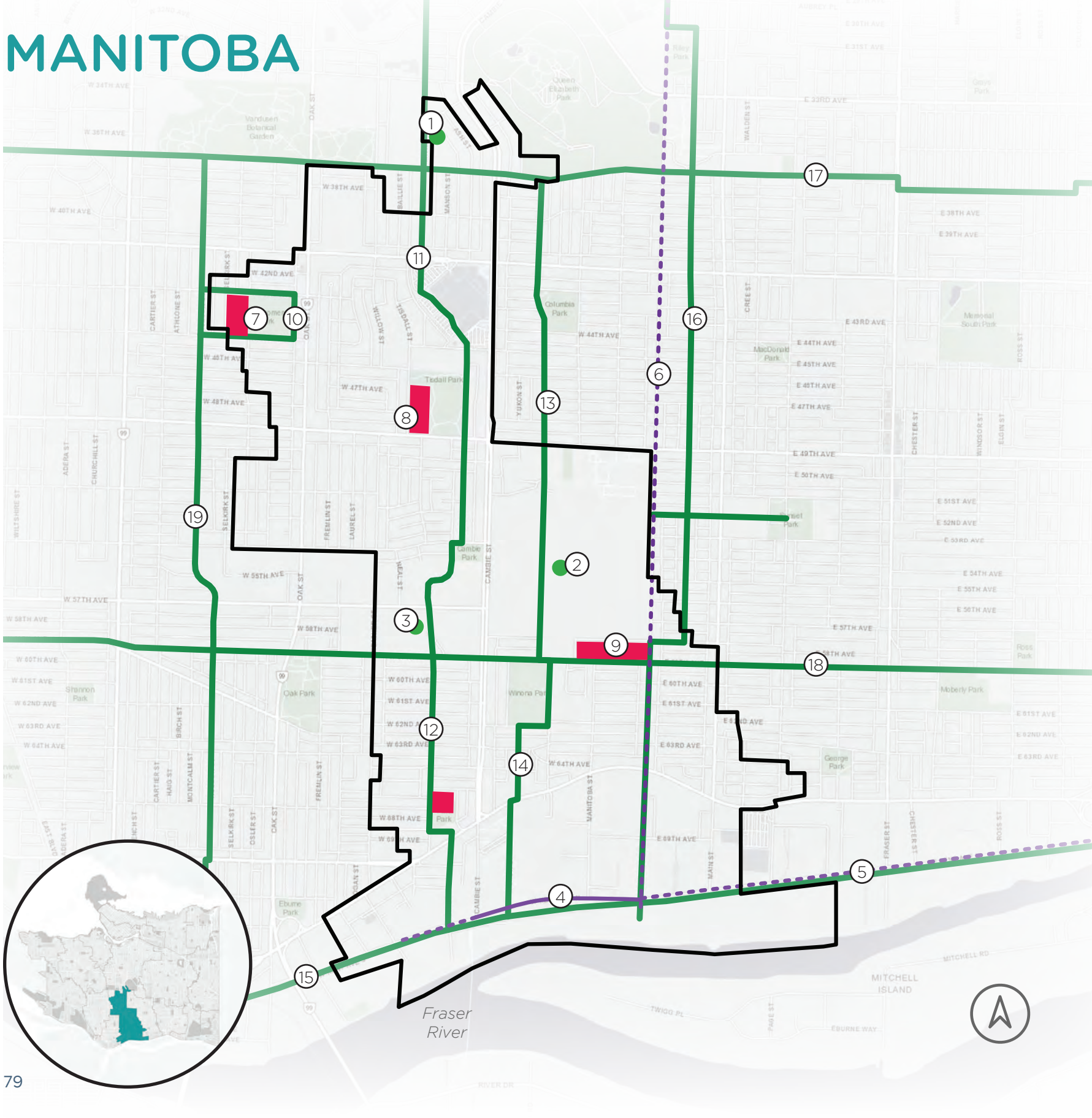
Median income: $23,105

Owner: 53%
Renter: 47%

Under 14: 12%
Over 75: 12%

Area: 570 hectares
Park space: 67 hectares

MANITOBA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Fraser River
MITCHELL ISLAND
Tisdall Park
Columbia Park
MacDonald Park
Oak Park
Winona Park
Shannon Park
Ebume Park
George Park
Moberly Park
Ross Park
Queen Elizabeth Park
Vandusen Botanical Garden
Memorial South Park
Cambie Park
Riley Park
Sunset Park
W 38TH AVE
W 40TH AVE
W 42ND AVE
W 44TH AVE
W 47TH AVE
W 48TH AVE
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CAMBIE ST
MANITOBA ST
MAIN ST
FRASER ST
OAK ST
SELKIRK ST
FREMLIN ST
LAUREL ST
YUKON ST
MANSON ST
HUDSON ST
CHESTER ST
ELGIN ST
WINDSOR ST
ROSS ST
CREE ST
MITCHELL RD
EBURNE WAY

Opportunities

- IRMP Opportunities
- Laneway
- Blue-green systems
- Planned Cycling Route
- Planned Cycling Upgrade
- Planned Complete Street
- Community Centre
- Public School
- Major Planning Project

IRMP Opportunities

1 Heather Lands
2 Langara Golf Course
3 Pearson Dogwood

Transportation

4 Kent Street
5 Kent Street Upgrades
6 Ontario Street Upgrades

Public Facilities

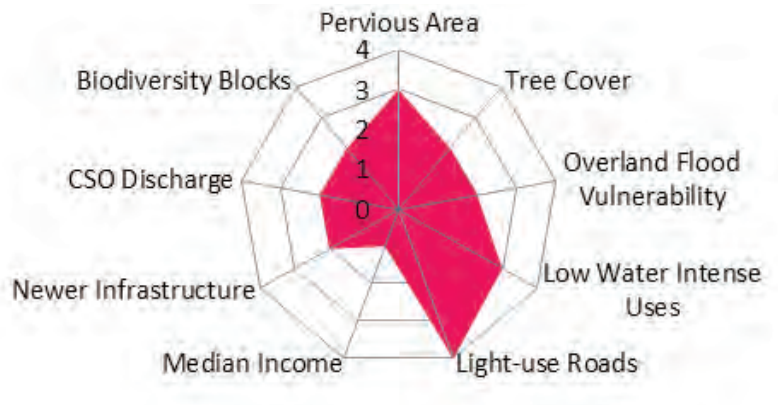
7 Sir William Osler Elementary School
8 Jamieson Elementary School
9 Sexsmith Elementary School

Blue-green systems

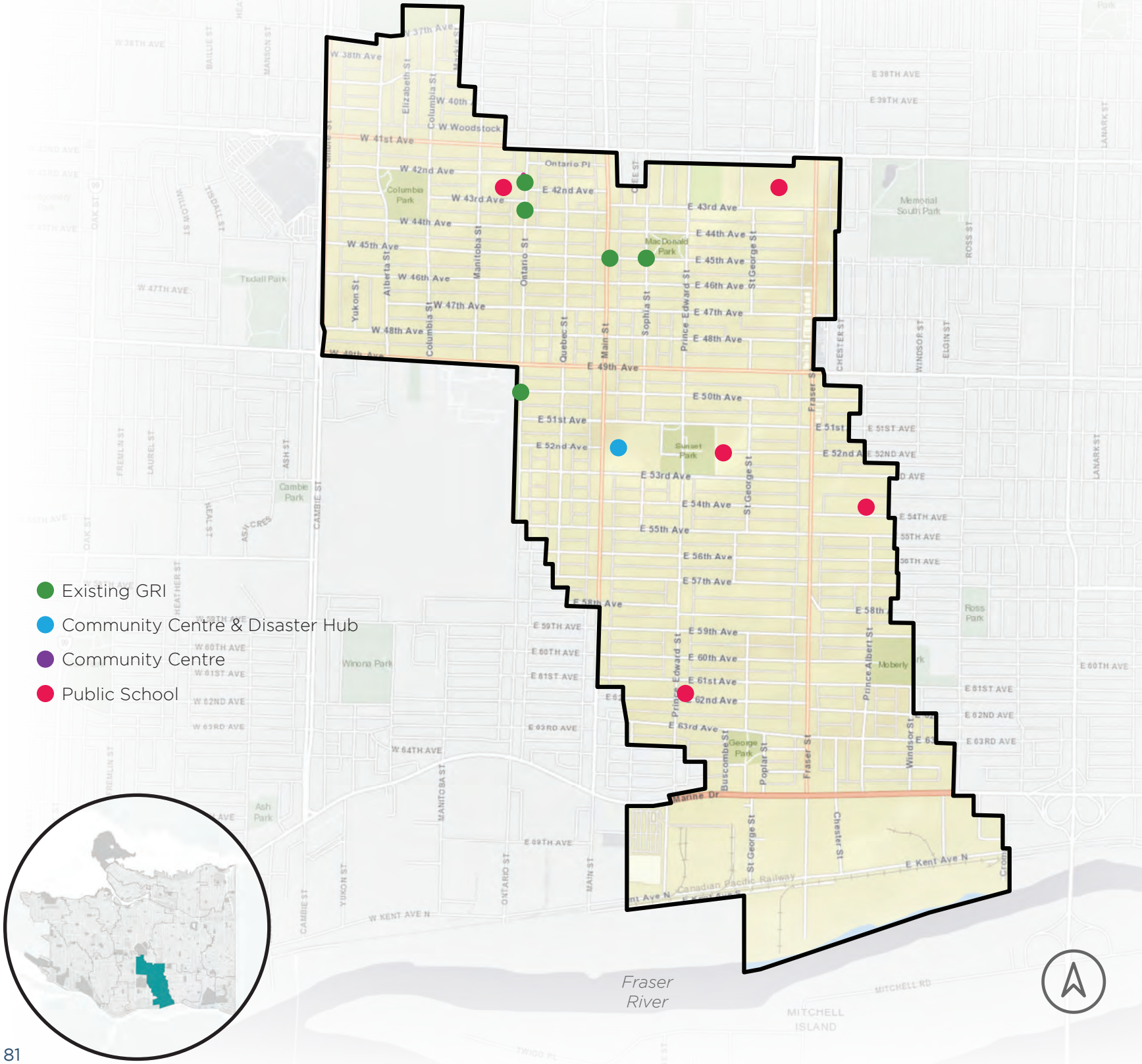
10 43rd Avenue - 44th Avenue
11 Heather Street
12 Ash Street
13 Alberta Street
14 Yukon Street
15 Fraser River Trail
16 Ontario Street - Quebec Street
17 Ridgeway
18 59th Avenue - North Arm Trail
19 Hudson Street

Priorities for this watershed

- Area is 80% combined - volume is a major priority
- Separated areas (20%) are primarily industrial areas, where cleaning is a major priority
- Urban heat is an issue (41°C)
- Green space deficient (11. 6%)
- Area vulnerable to sea level rise



SOUTH HILL


Existing GRI
Community Centre & Disaster Hub
Community Centre
Public School
Fraser River
Columbia Park
Ontario Pl
MacDonald Park
Memorial South Park
Sunset Park
George Park
Moberly
Ross Park
Cambie Park
Winona Park
Ash Park
Tisdall Park
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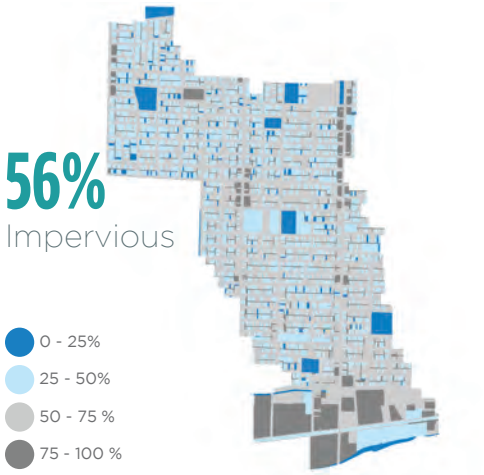
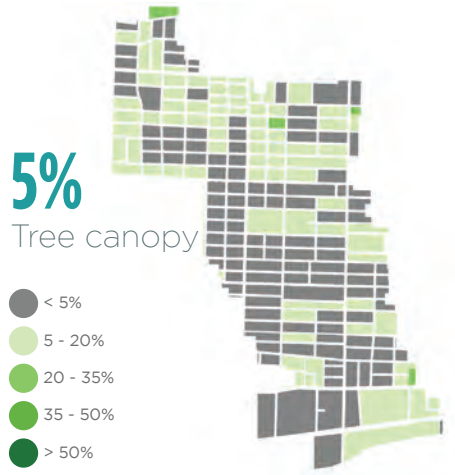
Columbia St
Elizabeth St
Manitoba St
Ontario St
Yukon St
Alberta St
Quebec St
Main St
Sophia St
Prince Edward St
St George St
Fraser St
Prince Albert St
Buscombe St
Poplar St
Windsor St
Chester St
Marine Dr
E Kent Ave N
Canadian Pacific Railway
MITCHELL ISLAND
MITCHELL RD

At a glance...

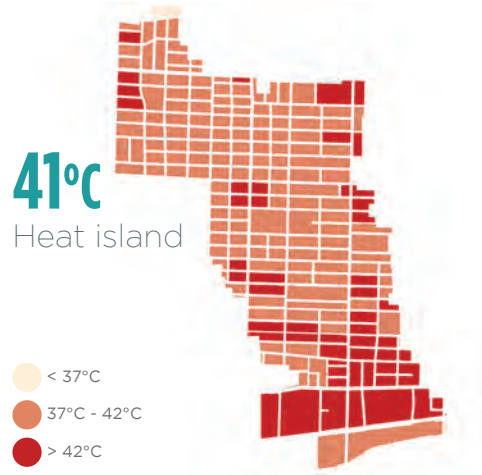
Impervious Area



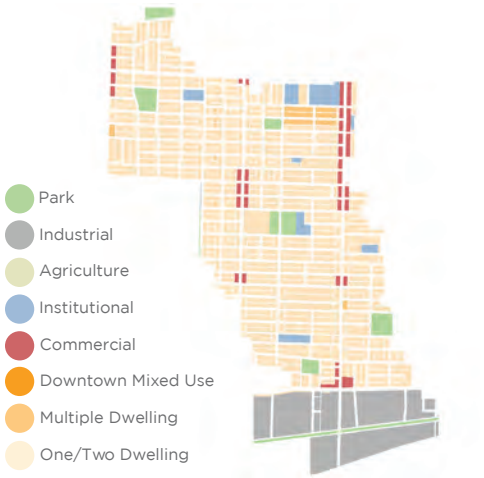
Tree Canopy Cover



Urban Heat Island



Land Use



Road Network

Roads make up 31% of South Hill watershed.

Sea Level Rise and Lost Streams

About the area

The South Hill watershed is located in South Vancouver, and is largely within the Sunset neighbourhood, with portions in the Riley Park and Oakridge neighbourhoods. The watershed is predominantly one and two family dwellings, with some commercial activity along Fraser Street, Main Street, and SE Marine Drive. There is an industrial area along the Fraser River. The watershed contains eight parks, five schools, and one community centre that is designated as a disaster hub. Rainwater in this watershed drains to the Fraser River.

Population: 25,376
Density: 5,663/km^2

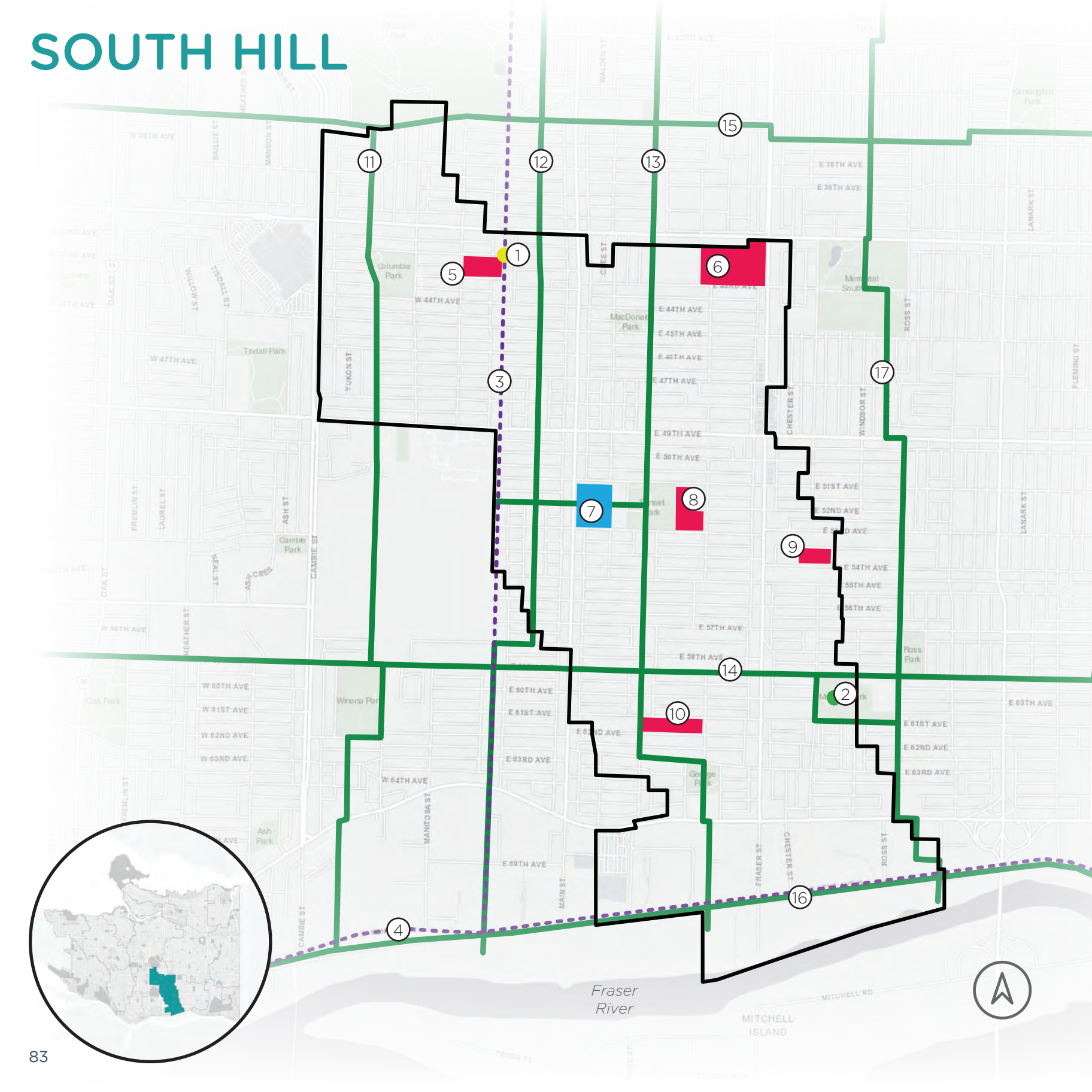
Median income: $22,600

Owner: 56%
Renter: 44%

Under 14: 13%
Over 75: 7%

Area: 448 hectares
Park space: 14 hectares

SOUTH HILL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16
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Columbia Park
Tisdall Park
Cambie Park
Winona Park
Ash Park
MacDonald Park
Ross Park
Fraser River
MITCHELL ISLAND
W 38TH AVE
W 42ND AVE
W 43RD AVE
W 44TH AVE
W 47TH AVE
W 58TH AVE
W 60TH AVE
W 61ST AVE
W 62ND AVE
W 63RD AVE
W 64TH AVE
E 33RD AVE
E 38TH AVE
E 39TH AVE
E 44TH AVE
E 45TH AVE
E 46TH AVE
E 47TH AVE
E 49TH AVE
E 50TH AVE
E 51ST AVE
E 52ND AVE
E 54TH AVE
55TH AVE
56TH AVE
E 57TH AVE
E 58TH AVE
E 60TH AVE
E 61ST AVE
E 62ND AVE
E 63RD AVE
E 69TH AVE
YUKON ST
CAMBIE ST
ASH ST
MANITOBA ST
MAIN ST
FRASER ST
CHESTER ST
WINDSOR ST
ROSS ST
LANARK ST
FLEMING ST
MITCHELL RD

Opportunities

- IRMP Opportunities
- Future GRI
- Laneway
- Blue-green systems
- Planned Cycling Route
- Planned Cycling Upgrade
- Planned Complete Street
- Community Centre
- Public School
- Major Planning Project

Planned GRI

1 W 42nd Avenue & Ontario Street

IRMP Opportunities

2 Moberly Park

Transportation

3 Ontario Street Upgrades
4 Kent Street Upgrades

Public Facilities

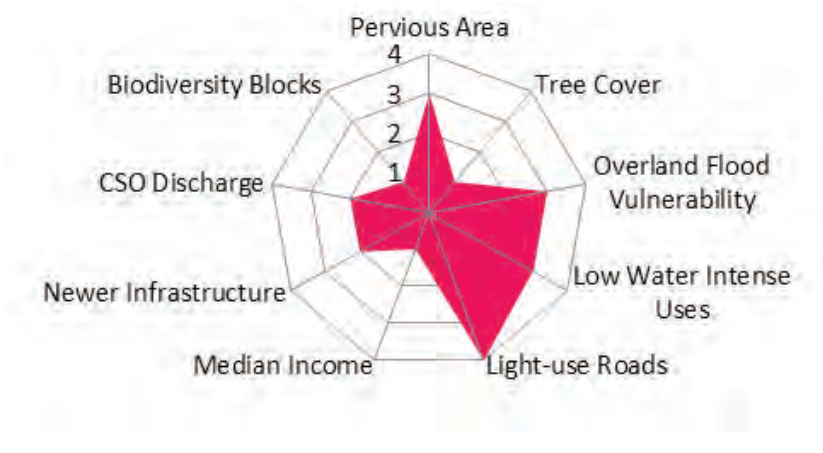
5 Van Horne Elementary School
6 John Oliver Secondary School
7 Sunset Community Centre
8 Henderson Elementary School
9 Henderson Annex
10 Trudeau Elementary School

Blue-green systems

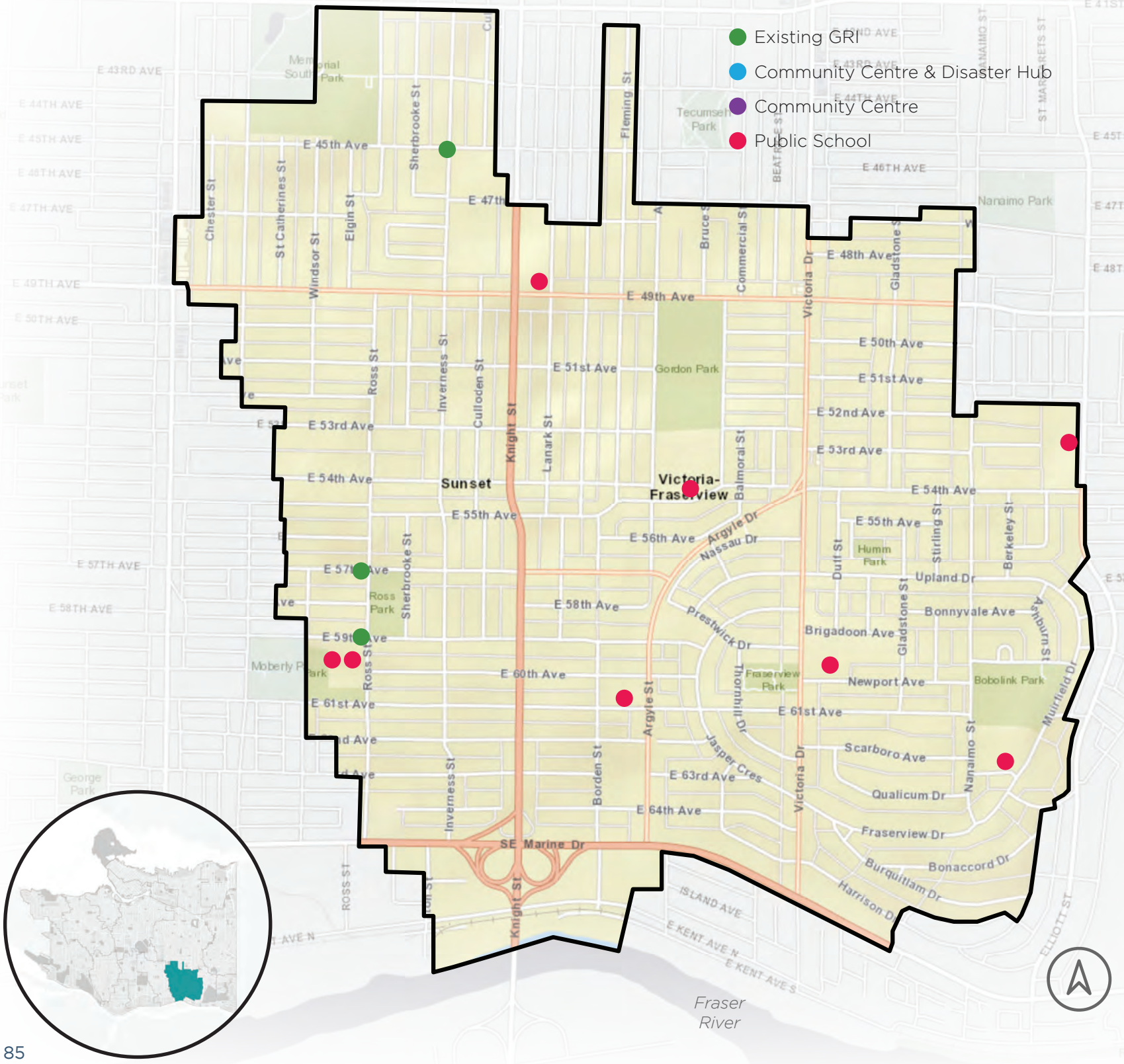
11 Alberta Street
12 Quebec Street
13 St. George Street
14 59th Avenue - North Arm Trail
15 Ridgeway
16 Fraser River Trail
17 Windsor Street - Ross Street

Priorities for this watershed

- Area is 80% combined - volume is a major priority
- Separated areas (20%) are primarily industrial areas, where cleaning is a major priority
- Urban heat is an issue (41°C)
- Very green space deficient (3%)
- Area vulnerable to sea level rise

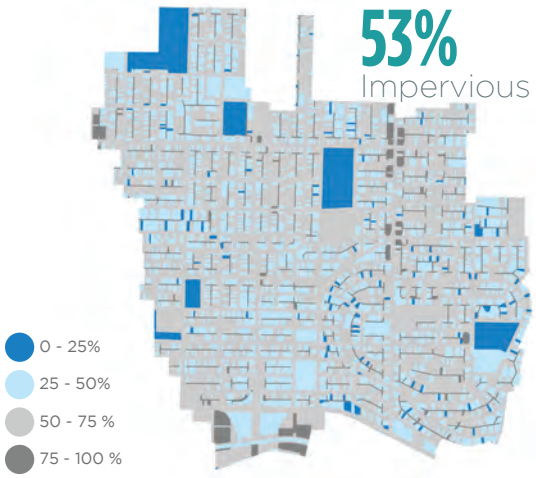


FRASERVIEW

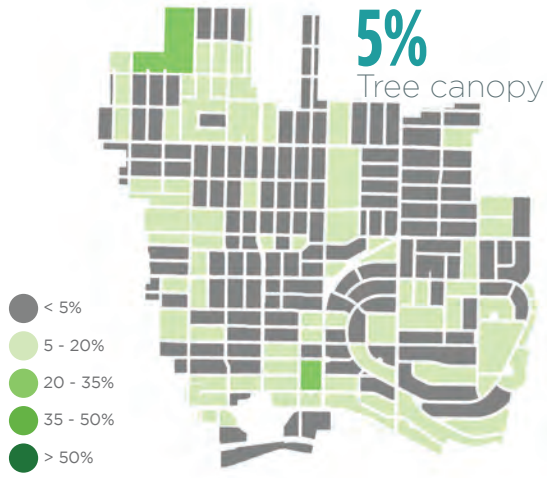

Existing GRI
Community Centre & Disaster Hub
Community Centre
Public School
Sunset
Victoria-Fraserview
Gordon Park
Ross Park
Moberly Park
Fraserview Park
Humm Park
Nanaimo Park
Bobolink Park
Tecumseh Park
George Park
E 45th Ave
E 47th
E 49th Ave
E 51st Ave
E 53rd Ave
E 54th Ave
E 55th Ave
E 56th Ave
E 58th Ave
E 59th Ave
E 60th Ave
E 61st Ave
E 63rd Ave
E 64th Ave
E 48th Ave
E 50th Ave
E 52nd Ave
Chester St
St Catherines St
Windsor St
Elgin St
Sherbrooke St
Ross St
Inverness St
Culloden St
Knight St
Lanark St
Fleming St
Bruce St
Commercial St
Balmoral St
Victoria Dr
Gladstone St
Argyle Dr
Nassau Dr
Prestwick Dr
Duff St
Stirling St
Berkeley St
Upland Dr
Bonnyvale Ave
Brigadoon Ave
Newport Ave
Ashburn St
Muirfield Dr
Scarboro Ave
Qualicum Dr
Fraserview Dr
Bonaccord Dr
Burquitlam Dr
Harrison Dr
Jasper Cres
Thornhill Dr
Nanaimo St
Borden St
SE Marine Dr
Fraser River

At a glance...

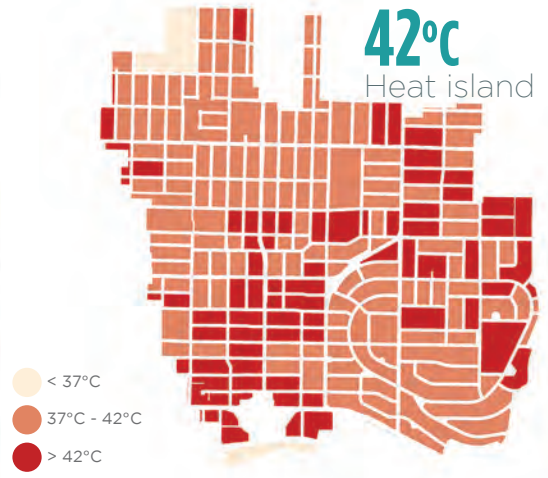
Impervious Area



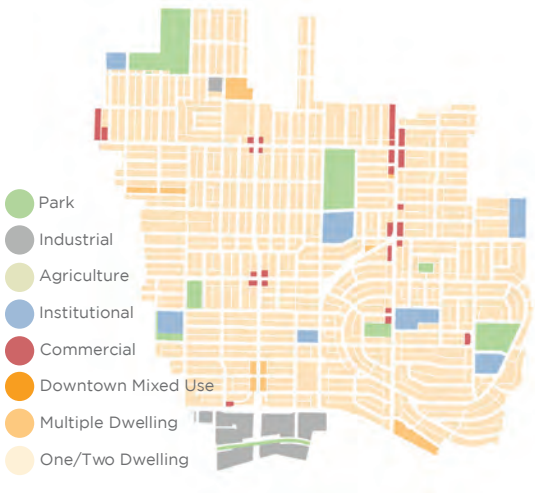
Tree Canopy Cover



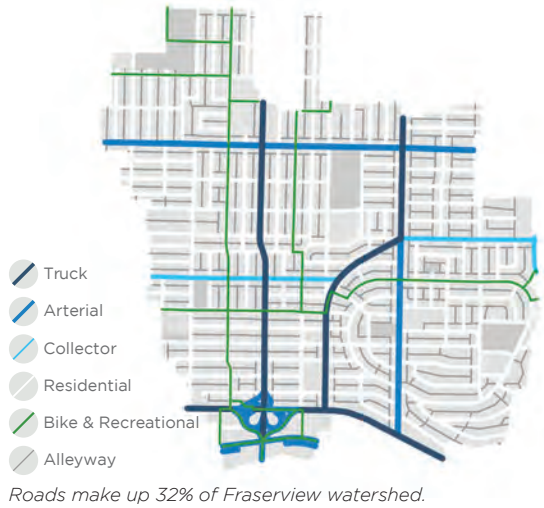
Urban Heat Island



Land Use



Road Network



Roads make up 32% of Fraserview watershed.

Sea Level Rise and Lost Streams

About the area

The Fraserview watershed is located in South Vancouver, and straddles the Sunset and Victoria-Fraserview neighbourhoods. The watershed is predominantly one and two family dwellings, with some commercial activity along Victoria Drive and Knight Street at E 49th Avenue and E 57th Avenue. There is industrial activity along the Fraser River. The watershed contains eight parks and eight schools. There are no community centres in the watershed. Rainwater in this watershed drains to the Fraser River.

Population: 28,256
Density: 5,846/km^2

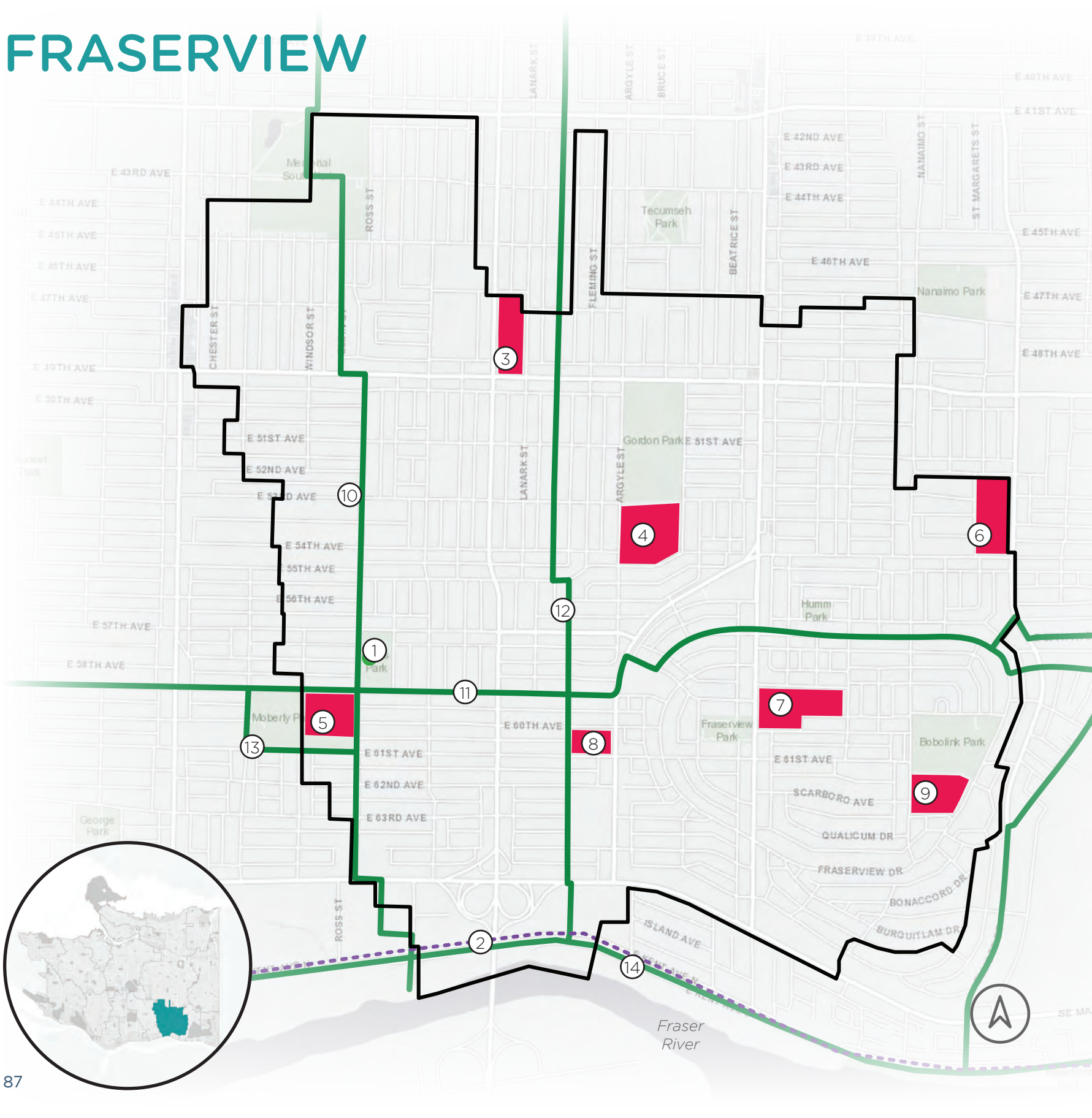
Median income: $21,865

Owner: 58%
Renter: 42%

Under 14: 13%
Over 75: 9%

Area: 483 hectares
Park space: 24 hectares

FRASERVIEW


E 43RD AVE
E 44TH AVE
E 45TH AVE
E 46TH AVE
E 47TH AVE
E 49TH AVE
E 50TH AVE
E 51ST AVE
E 52ND AVE
E 54TH AVE
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E 61ST AVE
E 62ND AVE
E 63RD AVE
E 42ND AVE
E 43RD AVE
E 44TH AVE
E 46TH AVE
E 48TH AVE
ROSS ST
CHESTER ST
WINDSOR ST
LANARK ST
FLEMING ST
ARGYLE ST
BRUCE ST
BEATRICE ST
NANAIMO ST
ST MARGARETS ST
Tecumseh Park
Gordon Park
Nanaimo Park
Humm Park
Fraserview Park
Bobolink Park
Moberly Park
George Park
SCARBORO AVE
QUALICUM DR
FRASERVIEW DR
BONACCORD DR
BURQUITLAM DR
ISLAND AVE
Fraser River
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Opportunities

- IRMP Opportunities
- Laneway
- Blue-green systems
- Planned Cycling Route
- Planned Cycling Upgrade
- Planned Complete Street
- Community Centre
- Public School
- Major Planning Project

IRMP Opportunities

1 Ross Park

Transportation

2 Kent Street Upgrades

Public Facilities

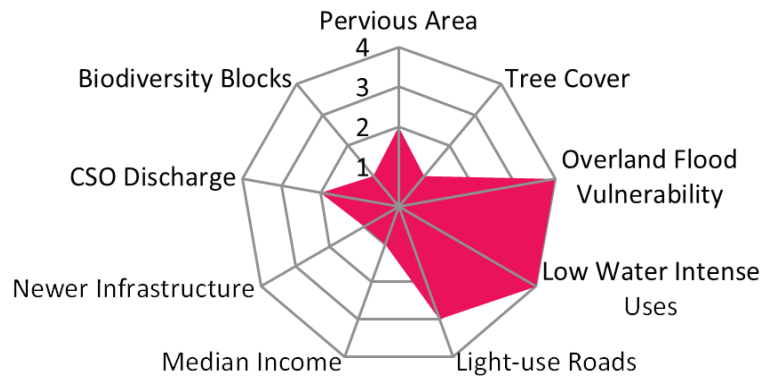
3 Sir Sanford Fleming Elementary School
4 David Thompson Secondary School
5 Walter Moberly Elementary School
6 Sir Charles Kingford-Smith Elementary School
7 Sir James Douglas Elementary School
8 Sir James Douglas Annex
9 Oppenheimer Elementary School

Blue-green systems

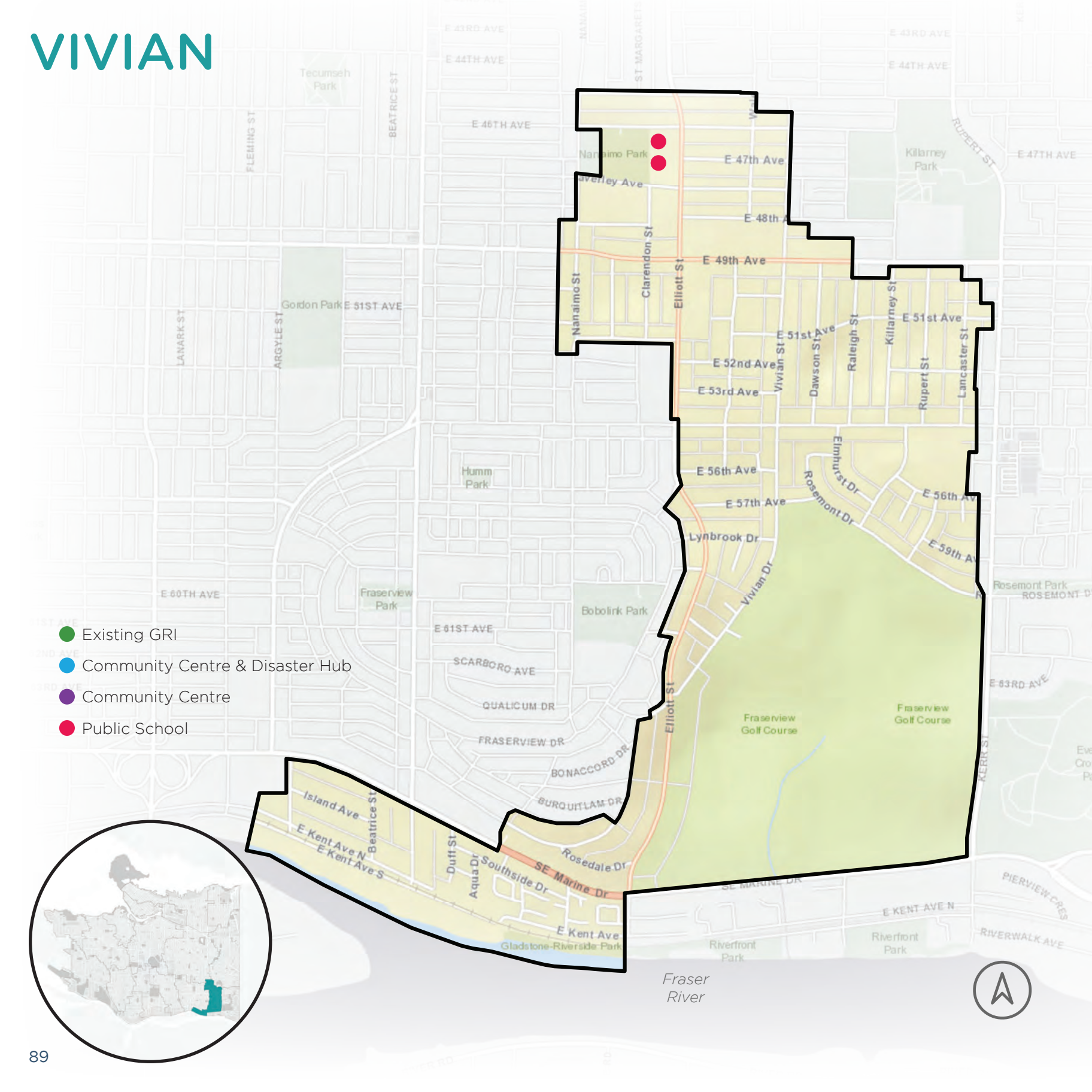
10 Elgin Street - Ross Street
11 59th Avenue - North Arm Trail
12 Borden Street
13 E 61st Avenue
14 Fraser River Trail

Priorities for this watershed

- Area is separated
- Susceptible to sea level rise in low lying areas
- Overland flow routes and surface flooding require further study
- Urban heat is an issue (42°C)
- Green space deficient
- Area vulnerable to sea level rise



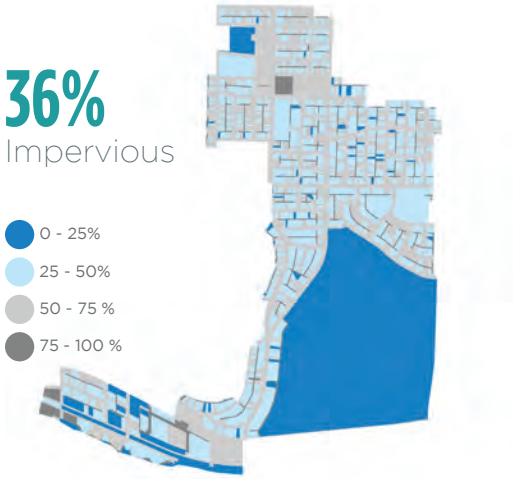
VIVIAN


Existing GRI
Community Centre & Disaster Hub
Community Centre
Public School
Tecumseh Park
E 46TH AVE
E 44TH AVE
E 43RD AVE
FLEMING ST
BEATRICE ST
Nanaimo Park
E 47th Ave
Killarney Park
RUPERT ST
E 47TH AVE
E 48th Ave
E 49th Ave
Clarendon St
Elliott St
Nanaimo St
Gordon Park
E 51ST AVE
LANARK ST
ARGYLE ST
E 51st Ave
Vivian St
Dawson St
Raleigh St
Killarney St
Rupert St
Lancaster St
E 52nd Ave
E 53rd Ave
Humm Park
E 56th Ave
Elmhurst Dr
Rosemont Dr
E 57th Ave
Lynbrook Dr
Vivian Dr
E 59th Ave
Rosemont Park
E 60TH AVE
Fraserview Park
Bobolink Park
E 61ST AVE
SCARBORO AVE
QUALICUM DR
FRASERVIEW DR
BONACCORD DR
BURQUITLAM DR
E 63RD AVE
Fraserview Golf Course
Island Ave
Beatrice St
E Kent Ave N
E Kent Ave S
Duff St
Aqua Dr
Southside Dr
Rosedale Dr
SE Marine Dr
E Kent Ave
Gladstone-Riverside Park
Riverfront Park
E KENT AVE N
PIERVIEW CRES
RIVERWALK AVE
Fraser River

At a glance...

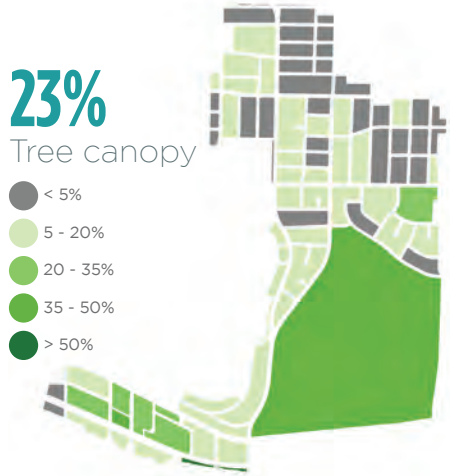
Impervious Area

36%
Impervious



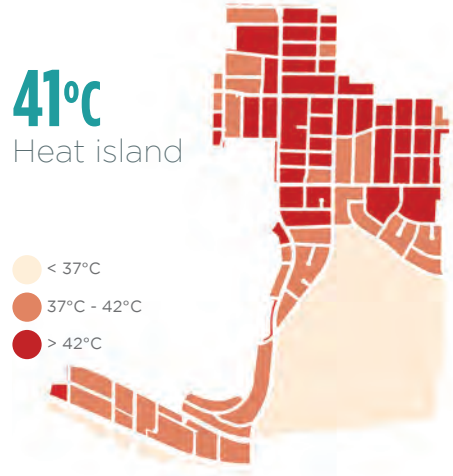
Tree Canopy Cover

23%
Tree canopy



Urban Heat Island

41°C
Heat island



Land Use

Road Network

Roads make up 22% of Vivian watershed.

Sea Level Rise and Lost Streams

About the area

The Vivian watershed is located in southeast Vancouver, and consists of the Killarney and Victoria-Fraserview neighbourhoods. The watershed is predominantly single family dwellings, with some multifamily dwellings and the 84 hectare Fraserview Golf Course. The watershed contains three parks and two schools. There are no community centres in this neighbourhood. Rainwater in this watershed drains to the Fraser River.

Population: 21,265
Density: 2,090/km^2

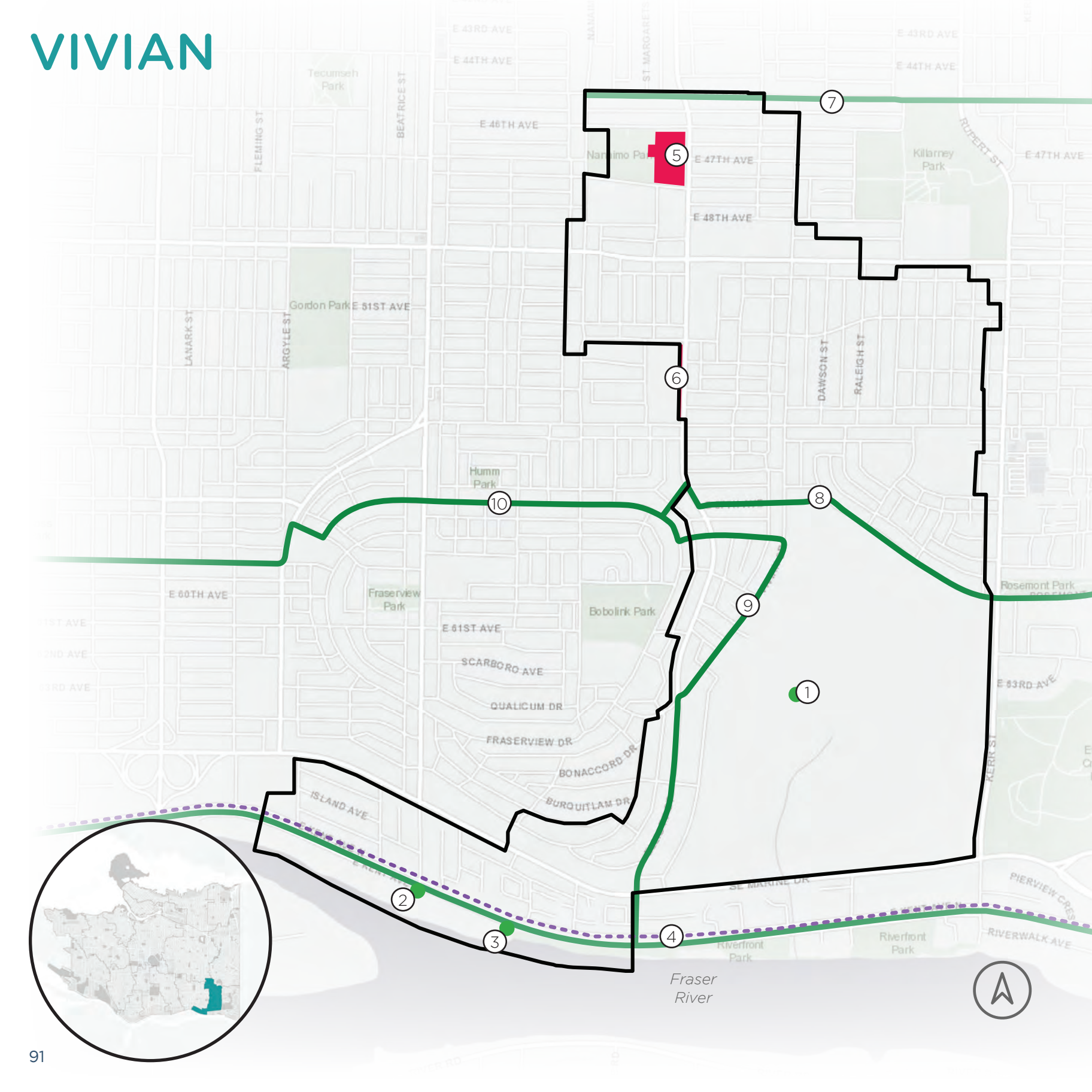
Median income: $35,709

Owner: 72%
Renter: 25%

Under 14: 15%
Over 75: 13%

Area: 274 hectares
Park space: 211 hectares

VIVIAN


E 43RD AVE
E 44TH AVE
Tecumseh Park
FLEMING ST
BEATRICE ST
E 46TH AVE
Nanaimo Park
E 47TH AVE
Killarney Park
RUPERT ST
E 48TH AVE
Gordon Park
E 51ST AVE
LANARK ST
ARGYLE ST
DAWSON ST
RALEIGH ST
Humm Park
E 60TH AVE
Fraserview Park
Bobolink Park
E 61ST AVE
SCARBORO AVE
QUALICUM DR
FRASERVIEW DR
BONACCORD DR
BURQUITLAM DR
ISLAND AVE
Rosemont Park
E 63RD AVE
KERR ST
SE MARINE DR
PIERVIEW CRES
RIVERWALK AVE
Riverfront Park
Fraser River
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Opportunities

- IRMP Opportunities
- Laneway
- Blue-green systems
- Planned Cycling Route
- Planned Cycling Upgrade
- Planned Complete Street
- Community Centre
- Public School
- Major Planning Project

IRMP Opportunities

1 Fraserview Golf Course
2 Foot of Victoria Drive
3 Gladstone Riverside Park

Transportation

4 Kent Street Upgrades

Public Facilities

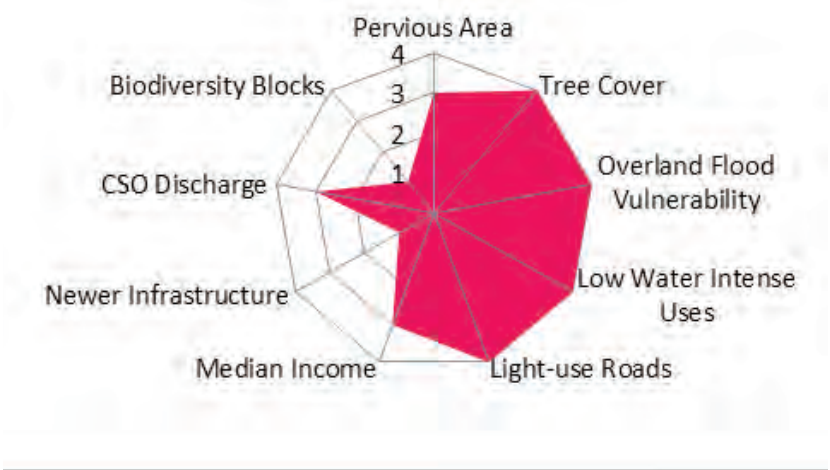
5 Waverley Annex
6 Sir Charles Kingsford-Smith Elementary School

Blue-green systems

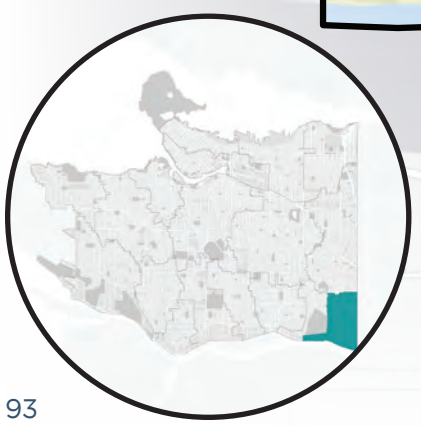
7 E 45th Avenue
8 E 57th Avenue - Rosemont Drive
9 Vivian Drive - Elliott Street
10 59th Avenue - North Arm Trail
11 Fraser River Trail

Priorities for this watershed

- 96% separated - reduce volume
- Enhance Vivian Creek
- Urban heat island (41°C)
- Vulnerable to sea level rise



CHAMPLAIN

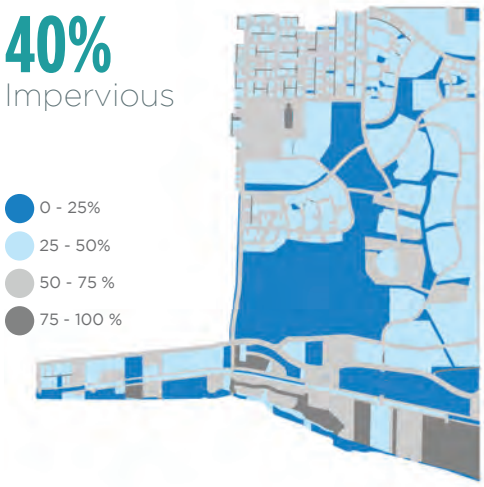


- Existing GRI
- Community Centre & Disaster Hub
- Community Centre
- Public School

At a glance...

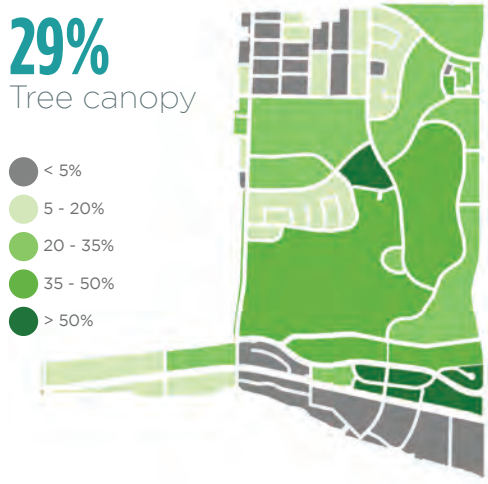
Impervious Area

40%
Impervious



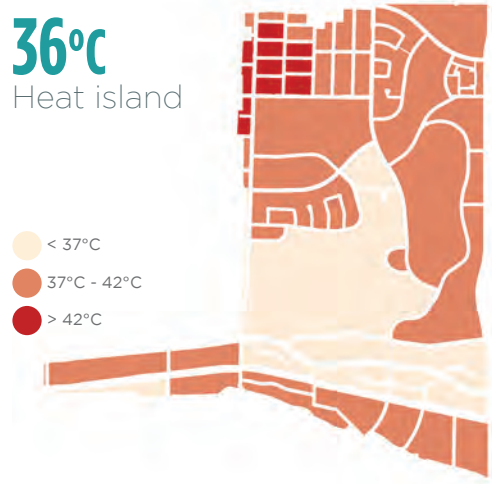
Tree Canopy Cover

29%
Tree canopy

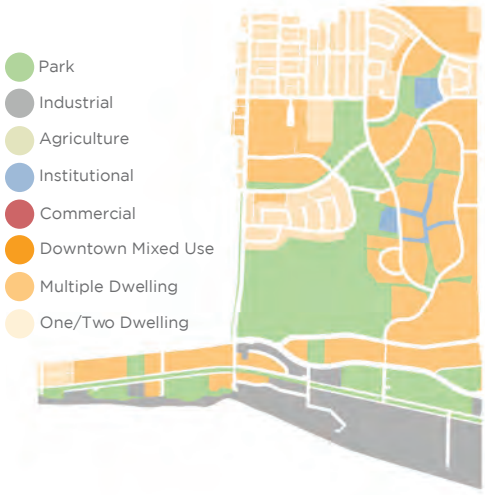


Urban Heat Island

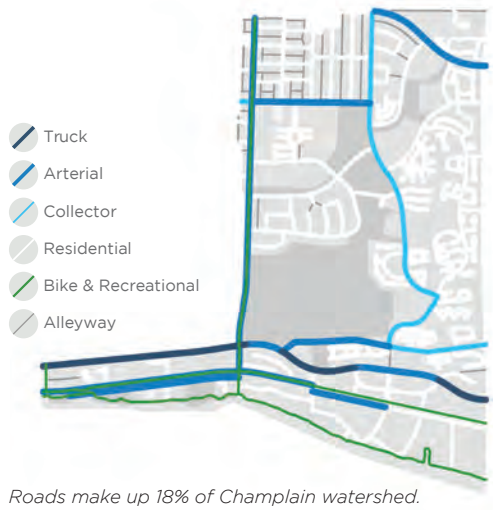
36°C
Heat island



Land Use



Road Network



Roads make up 18% of Champlain watershed.

Sea Level Rise and Lost Streams

About the area

The Champlain watershed is located in southeast Vancouver, bordering Burnaby on the east and the Fraser River on the south. The watershed consists exclusively of the Killarney neighbourhood. The watershed is primarily multi-family dwellings, with some single family dwellings throughout, and industrial areas along the Fraser River. The watershed contains 12 parks, three schools, and one community centre that is designated as a disaster hub. Rainwater in the Champlain watershed drains to the Fraser River.

Population: 15,559
Density: 4,364/km^2

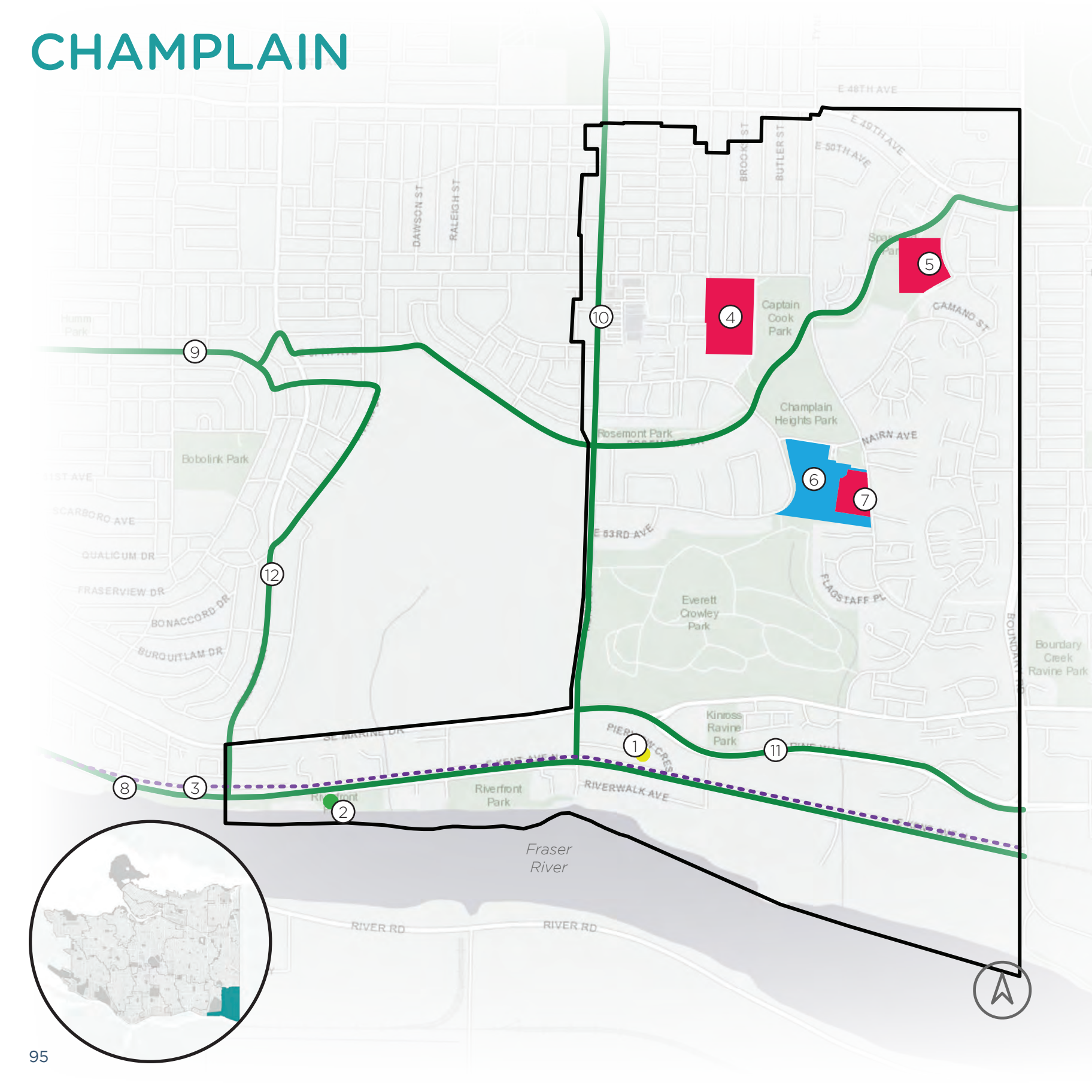
Median income: $28,646

Owner: 62%
Renter: 38%

Under 14: 14%
Over 75: 8%

Area: 357 hectares
Park space: 64 hectares

CHAMPLAIN


E 48TH AVE
E 49TH AVE
E 50TH AVE
BROCK ST
BUTLER ST
DAWSON ST
RALEIGH ST
Humm Park
Bobolink Park
Captain Cook Park
Champlain Heights Park
Rosemont Park
GAMANO ST
NAIRN AVE
FLAGSTAFF PL
E 53RD AVE
SCARBORO AVE
QUALICUM DR
FRASERVIEW DR
BONACCORD DR
BURQUITLAM DR
Everett Crowley Park
Kinross Ravine Park
Boundary Creek Ravine Park
SE MARINE DR
PIER VIEW CRES
RIVERWALK AVE
Riverfront Park
Fraser River
RIVER RD
RIVER RD
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Opportunities

- IRMP Opportunities
- Future GRI
- Laneway
- Blue-green systems
- Planned Cycling Route
- Planned Cycling Upgrade
- Planned Complete Street
- Community Centre
- Public School
- Major Planning Project

Planned GRI

1 East Fraserlands Park

IRMP Opportunities

2 Riverfront Park

Transportation

3 Kent Street Upgrades

Public Facilities

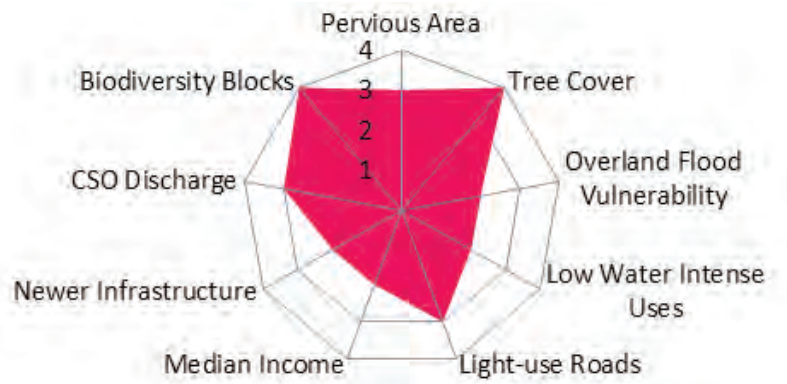
4 Captain James Cook Elementary School
5 Champlain Heights Elementary School
6 Champlain Heights Annex
7 Champlain Heights Community Centre

Blue-green systems

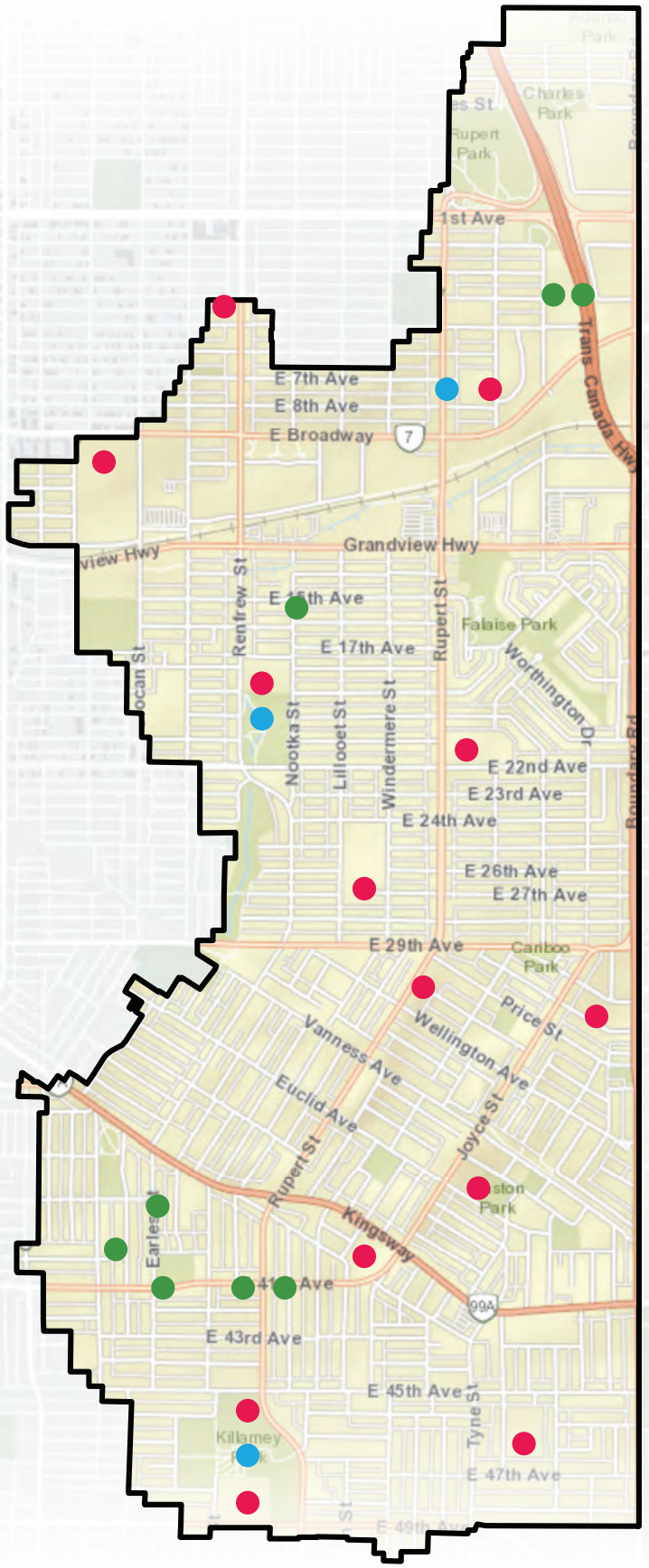
8 Fraser River Trail
9 59th Avenue - North Arm Trail
10 Kerr Street
11 Marine Way
12 Elliott Street

Priorities for this watershed

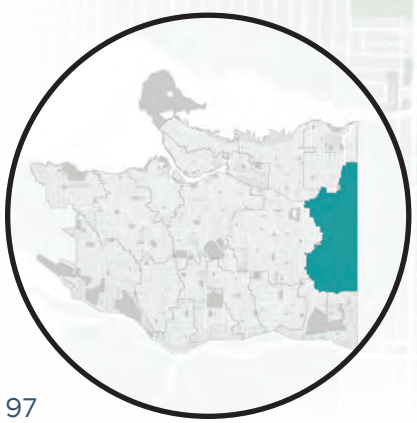
- 100% separated, cleaning urban rainwater runoff a priority
- Vulnerable to sea level rise
- Industrial areas



STILL CREEK



- Existing GRI
- Community Centre & Disaster Hub
- Community Centre
- Public School



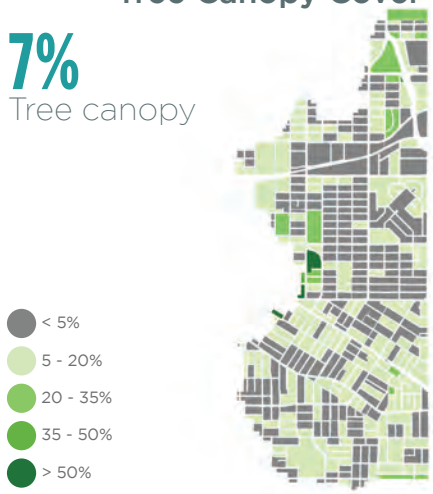
At a glance...

Impervious Area

55%
Impervious

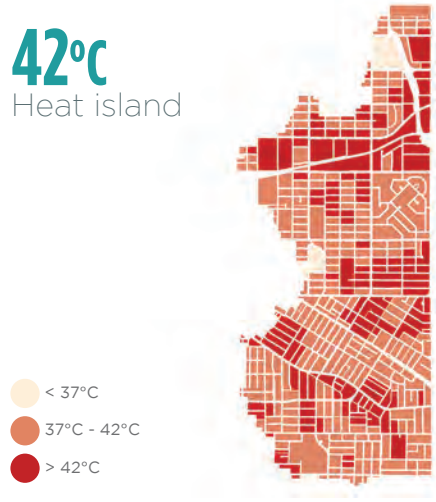
Tree Canopy Cover

7%
Tree canopy

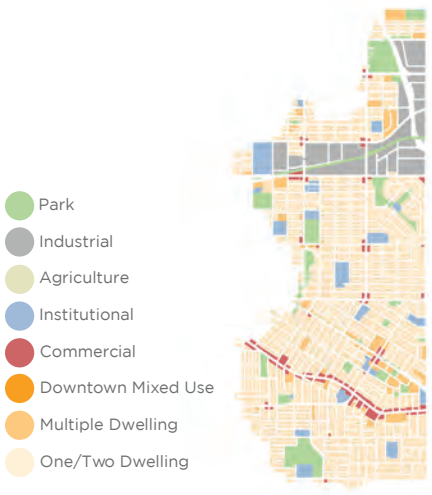


Urban Heat Island

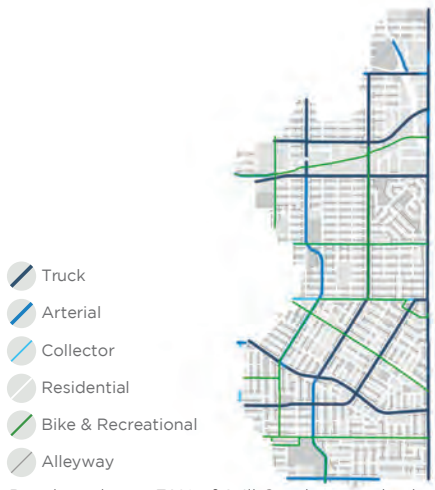
42°C
Heat island



Land Use

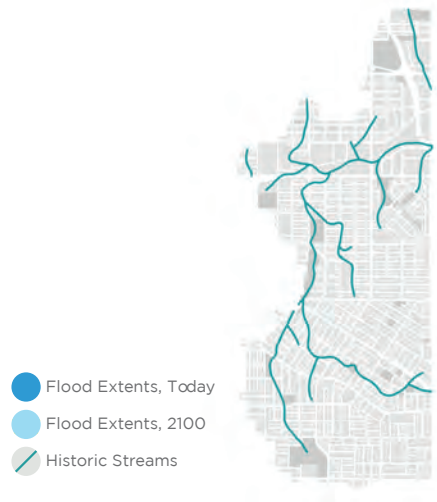


Road Network



Roads make up 32% of Still Creek watershed.

Sea Level Rise and Lost Streams



About the area

The Still Creek watershed is located in Vancouver's east side, bordering Burnaby on the east. The watershed consists primarily of the Renfrew-Collingwood neighbourhood, and portions of the Hastings-Sunrise, Killarney, and Victoria-Fraserview neighbourhoods. The watershed is primarily single-family dwellings, with commercial/mixed-use along Joyce Street and Kingsway, and industrial activity in the northern portions around Grandview Highway. The watershed contains 27 parks, 13 schools, and three community centres which are designated as disaster hubs. Due to the unique drainage circumstances of this watershed crossing municipal boundaries into Burnaby, Still Creek is subject to its own Integrated Urban rainwater runoff Management Plan (ISMP). Rainwater in this watershed drains into Burnaby Lake and ultimately to the Fraser River.

Population: 55,164
Density: 5,548/km^2

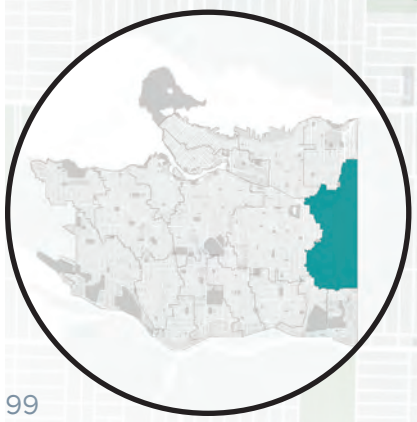
Median income: $21,670

Owner: 63%
Renter: 37%

Under 14: 13%
Over 75: 7%

Area: 994 hectares
Park space: 65 hectares

STILL CREEK



Opportunities

- Blue-green systems
- Planned Cycling Route
- Planned Cycling Upgrade
- Planned Complete Street
- Community Centre
- Public School
- Major Planning Project

Transportation

1 Duchess Street - Wales Street
2 BC Parkway Upgrades

Public Facilities

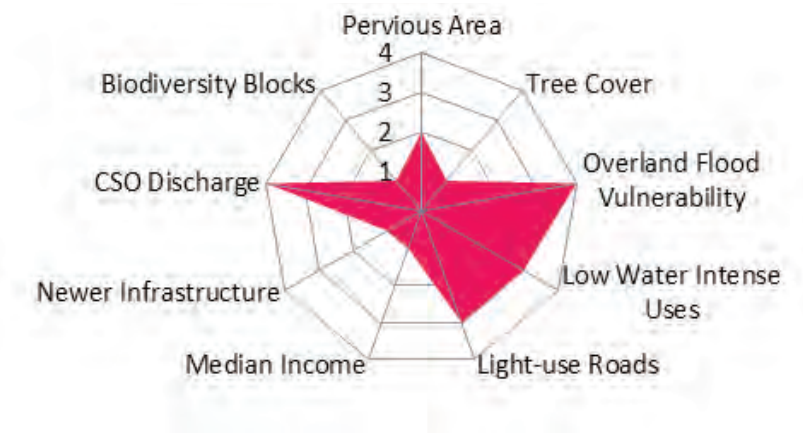
3 Thunderbird Elementary School
4 Anne Hebert Annex
5 Vancouver Technical Secondary School
6 Nootka Elementary School
7 Renfrew Park Community Centre
8 Renfrew Elementary School
9 Windermere Secondary School
10 Grenfell Elementary School
11 Bruce Elementary School
12 Collingwood Neighbourhood School
13 Sir Guy Carleton Elementary School
14 Weir Elementary School
15 Killarney Secondary School
16 MacCorkindale Elementary School
17 Killarney Community Centre

Blue-green systems

18 Central Valley Greenway
19 Nootka Street
20 Vanness Street
21 Ridgeway - Earles Street
22 E 45th Avenue
23 Rupert Street

Priorities for this watershed

- 100% separated, cleaning of urban rainwater runoff a priority
- Enhance Still Creek
- Vulnerable to sea level rise
- Industrial areas



Appendix E

Engagement Summary

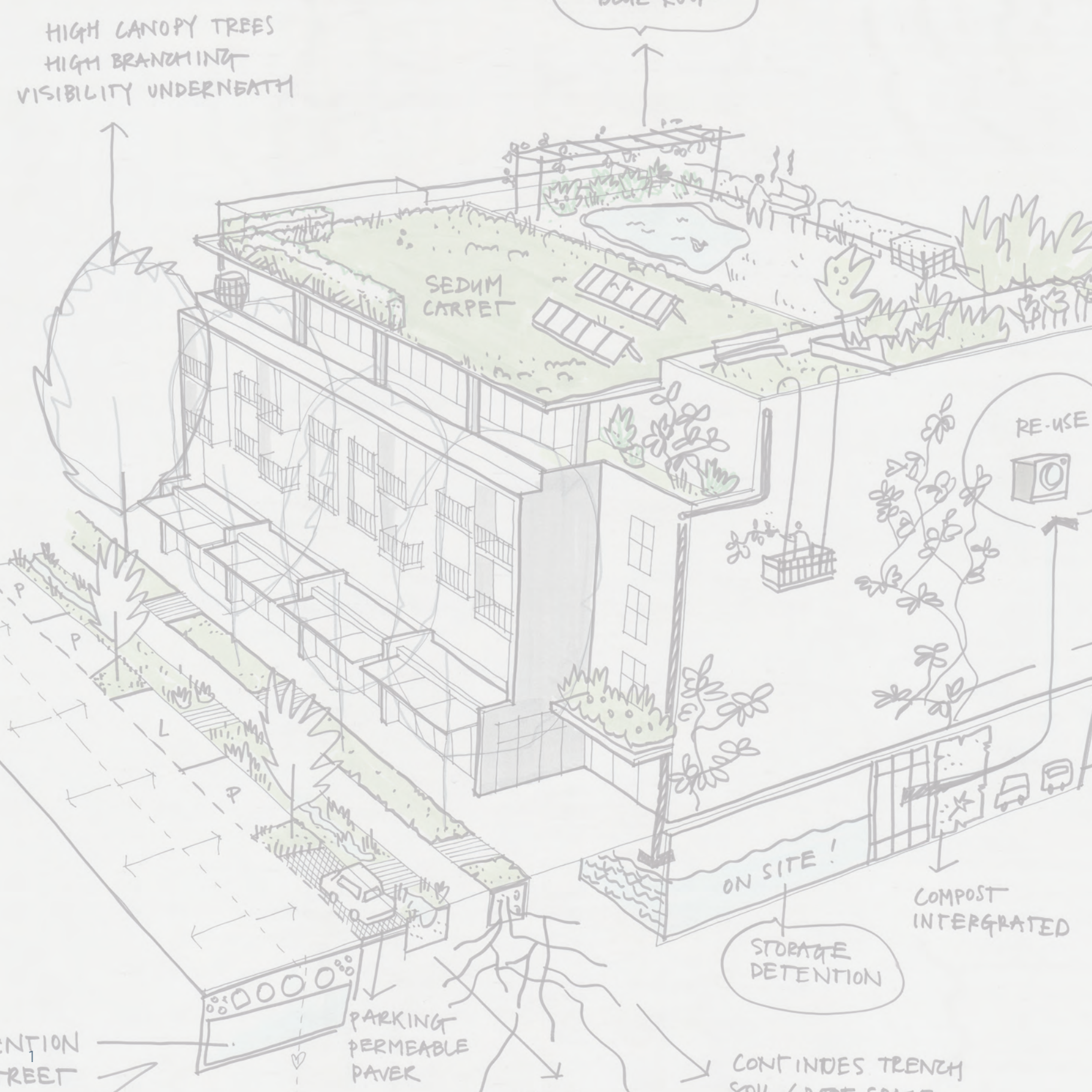
Throughout the process of developing the Rain City Strategy, residents, businesses, and industry professionals provided insights through a variety of engagement opportunities, including open houses, workshops, surveys, educational events, and expert panel meetings. The following appendix outlines these engagement events and what we learned through the engagement process.

RAIN CITY STRATEGY

Engagement Summary Report

2017 - 2019

CITY OF VANCOUVER | GREENEST CITY


HIGH CANOPY TREES
HIGH BRANCHING
VISIBILITY UNDERNEATH
SEDUM
CARPET
RE-USE
ON SITE !
COMPOST
INTERGRATED
STORAGE
DETENTION
PARKING
PERMEABLE
PAVER
CONTINUES TRENCH

EXTERNAL ENGAGEMENT

The Rain City Strategy is a high-level strategic plan, which could lead to changes in policy or regulations around the management of rainwater on private and public property, to improve water quality, increase resilience, and enhance the livability of our natural and urban ecosystems. Throughout the process of developing the Rain City Strategy, the City of Vancouver invited residents, businesses, and industry professionals to participate and provide insights through a variety of engagement opportunities, including open houses, workshops, surveys, educational events, and expert panel meetings.

The goal of the public and industry engagement for the Rain City Strategy is to inform the public on the potential of green infrastructure, and to collect input on particular goals, opportunities or barriers that should be addressed by implementation plans and programs.

Engagement Process

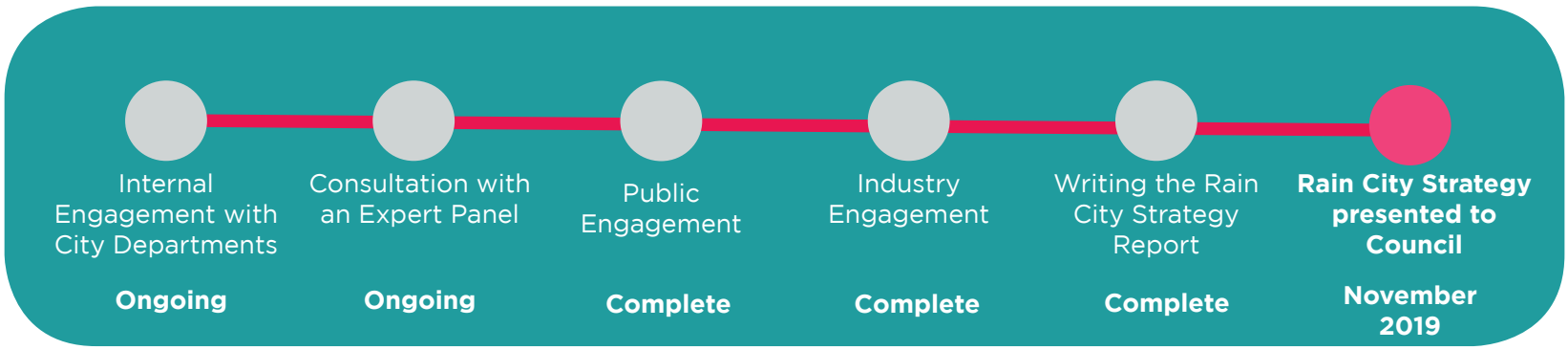


Photo: Robert Pennings

Promotion

Public and industry engagement workshops and surveys were promoted through the Rain City Strategy mailing list, the City of Vancouver website, the Greenest City newsletter, and through the newsletters and event calendars of professional associations for the various sectors of the development industry. Staff gave presentations to several key groups such as the Urban Development Institute and the Greater Vancouver Homebuilders Association to inform them on the project and invite their members to attend the workshops. The community open house and workshop was additionally promoted through environmental not-for-profit mailing lists, social media, business improvement associations, and posters in community centres, libraries, and plant nurseries. The events were further promoted through word of mouth by members of our expert panel and staff.

EVENTS WE HELD...

Community Open House and Workshop

Photo: Robert Pennings

Saturday, March 3, 2018

Large-Site Developments Industry Workshop

Photo: Alexandra Couillard

Tuesday, March 6, 2018

Small-Site Developments Industry Workshop

Photo: Alexandra Couillard

Tuesday, March 6, 2018

Three workshops and an open house in March 2018 made up the bulk of the public and industry engagement for the Rain City Strategy. The workshops explored how green infrastructure could be applied to a variety of building typologies and discussed possible opportunities and barriers for implementation. The open house provided opportunities for the public to learn more about green rainwater infrastructure (GRI) and the Rain City Strategy. A promotional video introduced the project, and information boards went into greater detail with staff on hand to answer questions. Sample green roofs, permeable pavers, and reading materials were set up in a small lounge area decorated with plants allowing visitors opportunities for further exploration.

1,250 people attended our **Open House**

55 industry professionals and **19** community members participated in a **workshop**

Industry Sectors Represented

- Architecture
- Engineering
- Planning
- Project Management
- Landscape Architecture
- Development
- Horticulture
- Student
- Construction
- Other
- Research

55 participants from 11 sectors

Public Talks and Conferences

Through 2018 and 2019, other opportunities for engagement and education offered include walking tours of the Olympic Village GRI features, lectures at conferences, pop-up events in collaboration with groups such as the Museum of Vancouver and the Places for People public space initiative, and partnerships with university classes, including Urban Forestry, Civil Engineering, Planning, Marketing, and Landscape Architecture.

Presented at **17** speaking engagements

Participated in **28** public events

12 partnerships with universities

Surveys

To widen the reach of the Rain City Strategy engagement, two surveys were administered in April 2018, one for industry professionals, and one for members of the general public. The goal of the surveys was to determine levels of familiarity with green rainwater infrastructure, and to understand the priorities of the public when it comes to sustainable rainwater management.

1,419 Responses to surveys

Photo: Places for People

WHAT WE HEARD...

Overall, there was broad support for the concept of green rainwater infrastructure as a rainwater management tool. Through discussion, several key ideas emerged around how to execute it well.

Key Ideas

Environmental Benefits

Of the co-benefits associated with GRI, community members responding to our survey identified protecting **water quality** along our shoreline, and providing **habitat** for wildlife as the two most important.

To that end, **greenery** used in GRI needs to be carefully selected. Each species of plant has particular capacity for filtering water and providing habitat, and particular needs in terms of **soil** depth and quality, **moisture**, and **sun** exposure. It is important to select plants that will survive well and create **resilient habitat**, while also providing the water retention and filtering **functionality** essential to GRI.

Through the many plants and green spaces that are added to an area when we build GRI, more habitat is provided for all sorts of wildlife, enhancing biodiversity. A greater variety or biodiversity of plants in the city will also help our green spaces adapt and survive in the context of climate change.

Economics

Costs were a major concern in workshops and surveys, with industry professionals worried about increases to building costs, and residents worried those costs would be passed on to them, making housing even less affordable.

Stewardship and maintenance of GRI tools were also identified as an essential consideration including who bears responsibility and who pays for it. However, participants also discussed how GRI can be positive for the economy. **Green jobs** in a wide variety of fields, from engineering, construction, design, and landscaping to tourism and environmental education could develop from an increase in the demand for GRI. Support to training programs and professional development opportunities could lead to a strong water management industry in Vancouver.

Education

The most common reasons industry professionals who responded to our survey hadn't built GRI on their projects were that **clients hadn't asked for it**, it wasn't required, and it **hadn't occurred to them**.

Workshop participants agreed that education about GRI is essential for its success. It's an **emerging field** and is new to many professionals, and unfamiliar to most residents. It is therefore especially important to **raise public awareness** about why rainwater management matters, the many benefits of using GRI tools, what those tools look like, and how people can get involved.

The myth of abundance of water in Vancouver is a barrier for conservation efforts, as residents often don't realize the high seasonal variation of our precipitation patterns. Industry education was also identified as important to ensure proper design, construction, and maintenance of GRI practices.

Suggested educational methods included signage identifying and explaining tools, workshops on how to build and maintain them, and **design and building guides** for industry professionals.

Photo: Robert Pennings

Photo: Alexandra Couillard

Connectivity and Integrated Water Management

Connectivity was a major theme in all discussions. To work with rainwater, a **systems-thinking approach** is needed, as water will flow from one place to another with no regard for property lines or what would be convenient. Each practice should be designed to work within the context of the rest of the property, neighbouring buildings, local streets, and the entire watershed.

From the top of a building to the bottom and beyond, there should be connectivity between GRI practices, allowing water to **overflow in a controlled way** from one practice to the next and ultimately out into the grey pipe system.

GRI requires many different professionals to work together to design and manage functional systems. To this end, connections should be fostered between sectors, **integrating the expertise** of all the professionals involved in a development project, early on in the design process.

Delivery Models and Mechanisms

Participants in both industry workshops and the survey discussed how the City can motivate the use of GRI. There was **no real consensus** on whether motivation through positive incentives or regulatory requirements was a better strategy.

In our survey, a major reason listed for why practitioners did not build GRI was that it was not required. However, regulations can also sometimes be a barrier to innovative new practices, and some industry professionals are concerned about potential over-regulation or requirements they will be unable to meet.

Suggestions for delivery models and mechanisms included exemptions from height restrictions for green roofs, incentive programs for retrofitting existing buildings, point systems, regulations and fines for non-compliance, and models to share operational costs between developers, owners, residents or possible third parties.

Efficient and Multi-Functional Use of Space

The many **co-benefits** that come from GRI are a reminder that urban spaces can serve **more than one function** for society. Green space added to neighbourhoods for GRI should provide **usable public space**, that serves many functions for residents and visitors. Beyond rainwater management, GRI can provide park space, enhance livability through access to nature, improve water quality, and increase disaster resilience.

Resiliency is the capacity to recover from difficulty or disaster. For the City of Vancouver, building the ability to recover from the impacts of climate change and disasters like earthquakes is very important. GRI tools can help provide water in post-disaster scenarios through rainwater harvest and reuse and can mitigate climate change impacts such as flooding and drought, thus boosting the resilience of the city.

Every space on a property can be designed to serve a GRI and livability function, including all horizontal, vertical, and underground space.


Photo: Robert Pennings

VISIONS YOU SHARED...

Workshop participants were asked to imagine what Vancouver could look like if all rainwater is managed where it falls. These images show some of the ideas shared on four different building typologies that are common in Vancouver.

Single-family with Laneway House

Illustration: Sam Khany

Townhouses

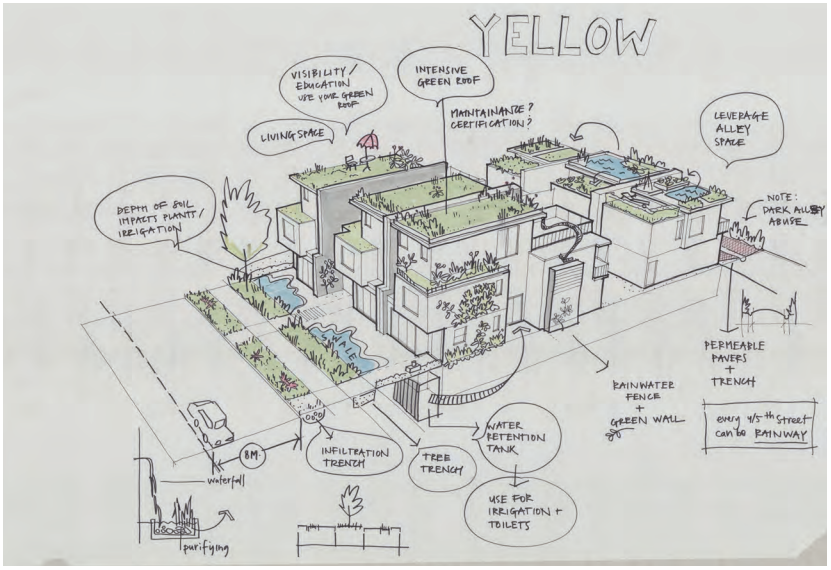


Illustration: Manon Garritsen

Townhouses

Illustration: Olusha Susan Milley

Townhouses

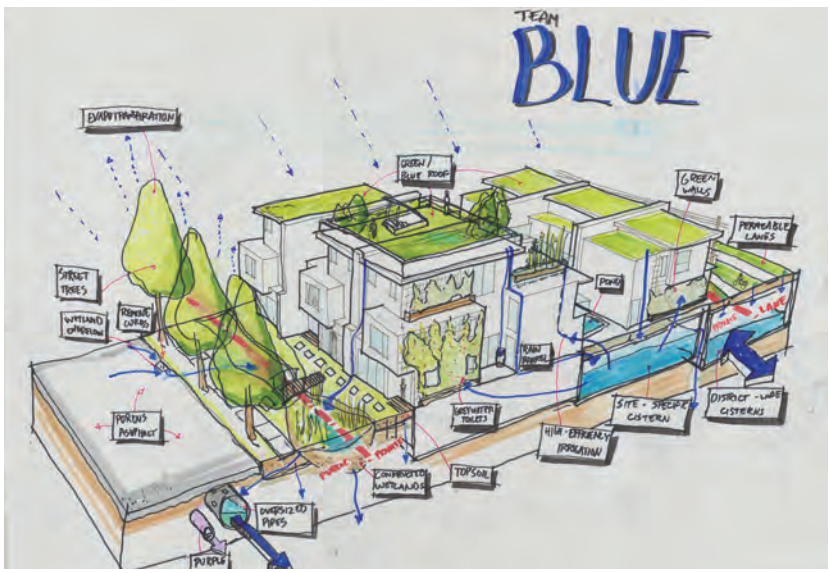


Illustration: Gavin Schaefer

Mixed-Use Commercial Building

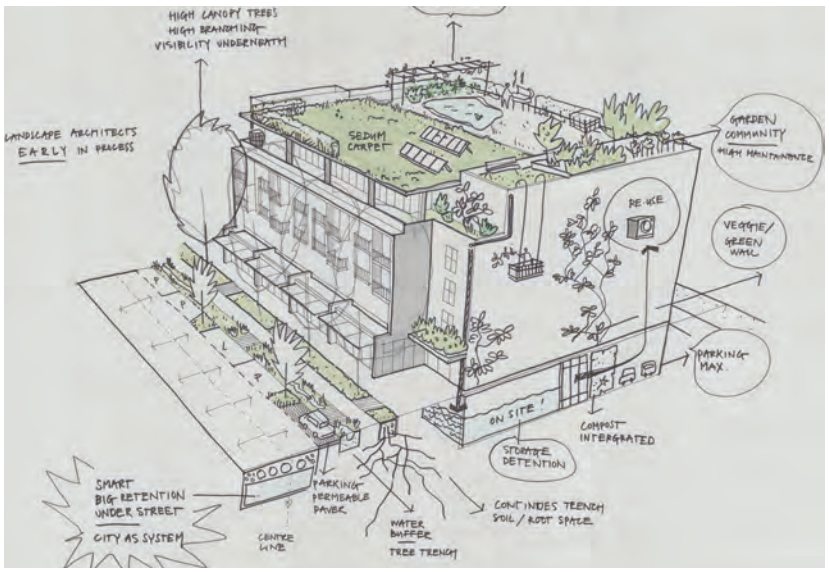


Illustration: Manon Garritsen

Mixed-Use Commercial Building

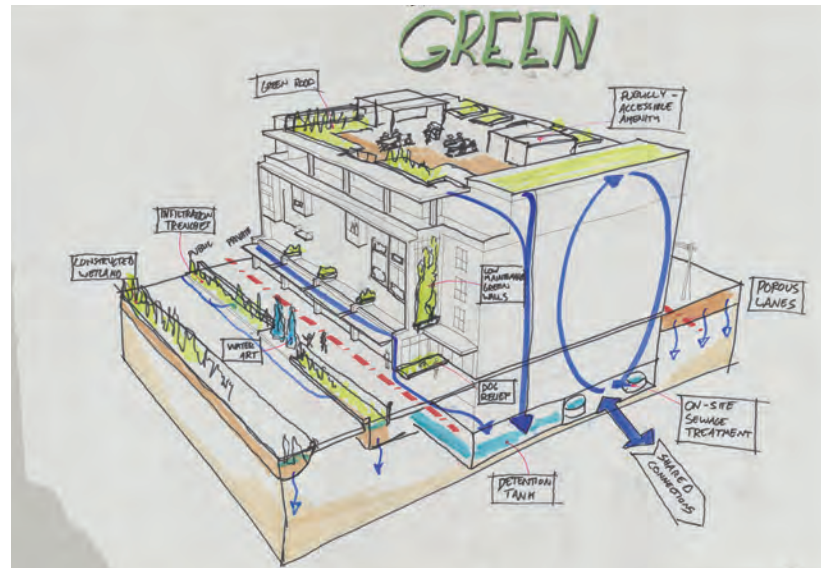


Illustration: Gavin Schaefer

High-rise Tower with Podium

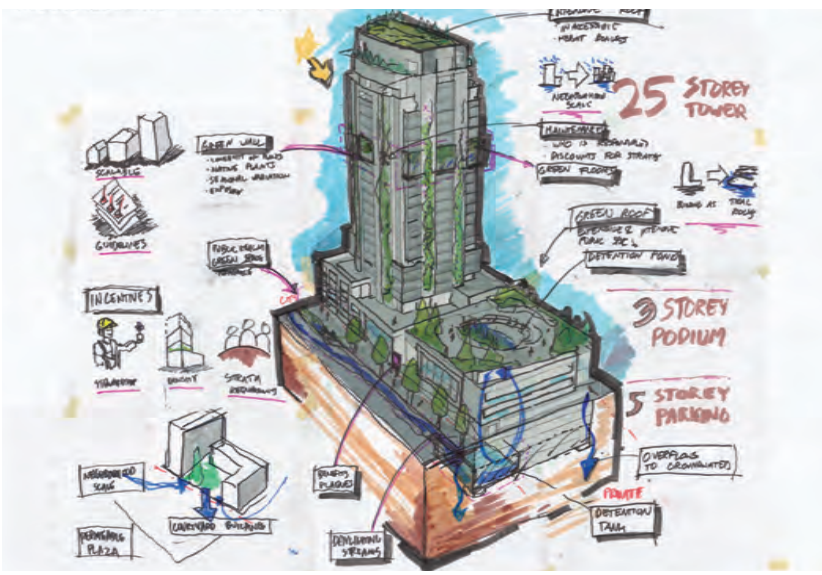


Illustration: Gavin Schaefer

High-rise Tower with Podium

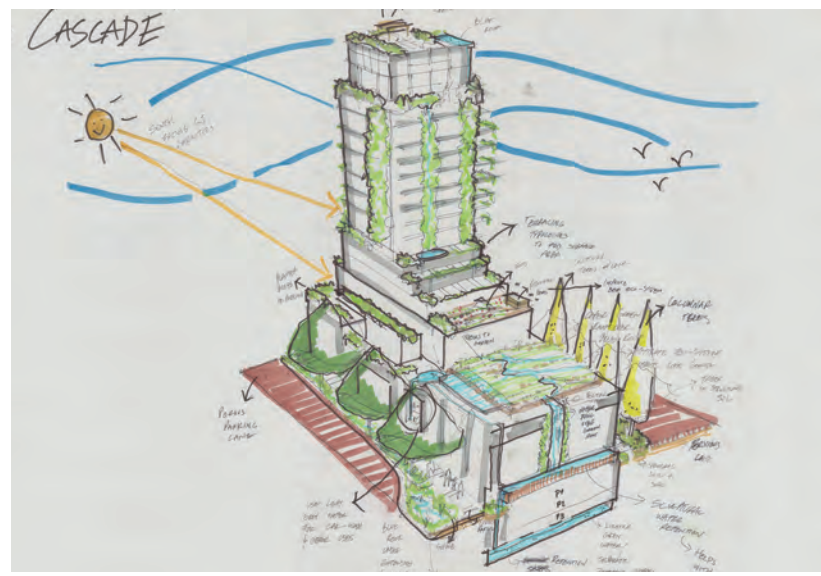


Illustration: Sam Khany

ADVICE FROM THE EXPERTS...

The Rain City Strategy Expert Panel is made up of experts from a variety of fields, including academics and researchers; industry professionals in engineering, landscape architecture and ecology; and directors and staff of environmental not-for-profit associations. Their advice and knowledge is being collected on an ongoing basis. To date, five panel meetings have been held providing guidance in the following areas.

Photo: Alexandra Couillard

Sharing Resources is an important function of the expert panel, keeping the green infrastructure team up to date on the most recent research, innovations, and new practices.

Key players identified by the expert panel formed a starting point from which to build a list of organizations and interested parties to reach out to as a part of the engagement and consultation events.

Giving feedback on the transformative directions, action plans, and structure of the report has been an essential contribution of the expert panel. Their input has helped further develop, clarify, and explore the inter-relationship of the proposed programs and sample actions of the Rain City Strategy.

Priorities for green infrastructure programs as identified by the experts, have been important in understanding the relative importance of the many potential actions and programs identified through internal and external engagement processes.

Discussion of green infrastructure tools and the land use types where they would be most appropriate provided an overview against which to calibrate later suggestions from community and industry stakeholder groups.

Public awareness and education was emphasized as a key strategy for successful implementation, as water management and infrastructure problems tend to be fairly unseen by the public.

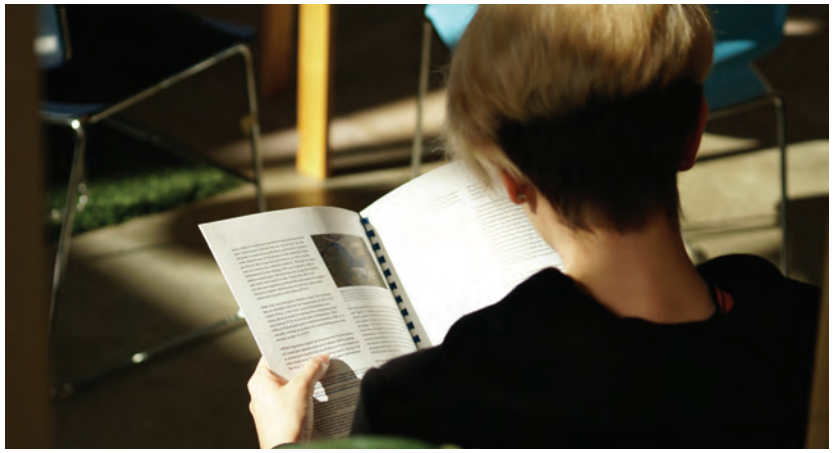


Photo: Robert Pennings

Photo: Yette Gram

Special Thanks to...

The Rain City Strategy Expert Panel:

Carlos Vargas
Carmen Rosen
Celia Brauer
Cynthia Girling
Daniel Roehr
Deborah Carlson
Gemma Dunn
Glen Shkurhan
Hans Schreier
Jack Tupper
Kathy Dunster
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Manon Garritsen
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Photographers:

Alexandra Couillard
Robert Pennings

Bruce McDonald at Sunset Nursery

Rain City Strategy

resilient by nature

vancouver.ca/raincitystrategy
rainwater@vancouver.ca
#raincitystrategy

Cover Photo: Wendy de Hoog
Inside Front Cover Illustration: Manon Garritsen
Inside Back Cover Illustration: Olusha Susan Milley

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Appendix F

Transformative Directions and Action Plans

The Rain City Strategy consists of transformative directions that are meant to be implemented in the medium and long term, with three GRI action plans that define the efforts needed in the near term. This appendix provides the Transformative Direction Action Plan and the action plans related to (1) Streets and Public Spaces, (2) Buildings and Sites and (3) Parks and Beaches. Altogether, the strategy is recommending nine transformative directions and 46 implementation and enabling programs. Sample actions are also associated in each program to support the delivery of the high-level programs and advance the implementation of GRI assets across the city.

Rain City Strategy - Transformative Directions [Directions]

Transformative Direction Details			Transformative Direction Status & Milestones			Contribution to Rain City Strategy Objectives Legend: ●○○ = low, ●●○ = medium, ●●● = high						Evaluation Legend: ●○○ = low ●●○ = medium ●●● = high		
Direction No.	Transformative Direction Title	Transformative Direction Description	Direction Status (Expand Existing Direction or New Direction)	Next Milestone	Next Milestone Year	Remove Pollutants	Reduce Volume Entering Pipes	Increase Green Area	Increase Managed Impervious Area	Mitigate Urban Heat Island Effect	Encourage Greater Harvest & Reuse	Impact	Effort	Criticality
TD-01	Strive to become a water sensitive city	Embed water sensitive values and design principles into integrated water utility planning and urban and land use planning to ensure that water is considered, managed and valued across all planning scales at sites, districts, areas and citywide. Encourage greater adoption of water sensitive design principles by incorporating water resource management as a core element of City-Wide Plan.	New Direction	Engage the City-Wide Plan Working Group to integrate water sensitive design principles into the City-Wide Plan.	2019	●●●	●●●	●●●	●●●	●●○	●●●	●●●	●●●	●●●
TD-02	Respond with urgency to climate change	Develop and adopt a more holistic way of planning, delivering and managing water resources, utilities and green rainwater infrastructure to adapt to a changing climate in accordance with city council's Climate Emergency Response, the Climate Adaptation Strategy and the Resilience Strategy. This work will include conducting a vulnerability assessment of sewer and drainage system risks, overland flood risks, economic risks, lifeline infrastructure risks, and others. It will identify priority areas to undertake GRI and other climate adaptive measures to avoid and/or mitigate negative impacts associated with frequent and intense rainfall events.	Expand Existing Direction	Convene a working group to define scope, deliverables and timelines to conduct a citywide climate vulnerability & risk assessment.	2020	●●○	●●●	●●●	●●●	●●●	●●●	●●●	●●○	●●●
TD-03	Accelerate action to protect the health and vitality of surrounding waterbodies	Revisit the City's current strategy for eliminating combined sewer overflows to assess current state and clarify goals and objectives beyond combined sewer overflow mitigation. An integrated grey and green rainwater infrastructure approach is expected to achieve improved water quality, climate resilience and social outcomes than a grey-only strategy. Research is needed to benchmark grey-green approaches by other leading municipalities, better understand the current system performance, identify gaps and evaluate the best value for money approaches to optimize existing infrastructure and deliver new infrastructure to mitigate combined sewer overflows from each of the city's watersheds.	New Direction	Convene a working group to define scope, deliverables and timelines.	2020	●●●	●●●	●●○	●●○	●●○	●●○	●●●	●●○	●●●
TD-04	Revitalize watersheds and waterfronts to enable communities and natural systems to thrive	Develop urban watershed plans for each of Vancouver's 19 urban watersheds. This analysis will include an assessment of the watershed's current land use, physical waterfront, environmental, ecological, biological, social and infrastructure characteristics. Ultimately, they will propose a suite of capital projects, programs, operational improvements, and policy recommendations that collectively meet the specific challenges and priority objectives of each watershed. Implementation of watershed plans should be prioritized based on needs such as contribution to combined sewer overflows, major urban development projects, climate adaptation, enhancing waterfront access, flood management, ecological function, equity and other needs.	New Direction	Convene a working group to define scope, identify priority watersheds and deliverables and timelines	2019	●●●	●●●	●●●	●●●	●●●	●●●	●●●	●●●	●●●

Version 1.0
Last Update October 8, 2019

Transformative Direction Details			Transformative Direction Status & Milestones			Contribution to Rain City Strategy Objectives Legend: ●○○ = low, ●●○ = medium, ●●● = high						Evaluation Legend: ●○○ = low ●●○ = medium ●●● = high		
Direction No.	Transformative Direction Title	Transformative Direction Description	Direction Status (Expand Existing Direction or New Direction)	Next Milestone	Next Milestone Year	Remove Pollutants	Reduce Volume Entering Pipes	Increase Green Area	Increase Managed Impervious Area	Mitigate Urban Heat Island Effect	Encourage Greater Harvest & Reuse	Impact	Effort	Criticality
TD-05	Shape systems to integrate and value all forms of water	Develop an integrated approach to utility planning, where all water within and around the city is treated as a valued resource for protecting and enhancing the community and the environment. An integrated water utility framework ensures that the management, construction and utilization of our water resources and infrastructure is conducted in a holistic manner, where all types of water are leveraged to achieve additional benefits. Apply the framework to develop and adopt a strategic approach to funding and financing of water utilities based on optimizing existing assets and prioritizing new capital investments to achieve the best outcomes. Integrated utility planning is a major component of watershed plans, and a step towards becoming a water sensitive city.	Expand Existing Direction	Convene a working group to define scope, deliverables and timelines	2020	●●●	●●●	●●●	●●●	●●○	●●●	●●●	●●●	●●●
TD-06	Explore intersectionality, equity, and Indigenous reconciliation through urban water management	Undertake an inclusive dialogue with a broad range of voices and to explore how reconciliation and intersectionality can guide green rainwater infrastructure policies, programs and integrated water utility investments to address historic and systemic inequality. Initiatives may be guided by the foundational components of the framework for City of Reconciliation.	New Direction	Convene a working group to define scope, deliverables and timelines.	2020	●●○	●●○	●●●	●●○	●●●	●●○	●●●	●●○	●●●
TD-07	Drive innovation and system effectiveness through data and analytics	Acquire a comprehensive understanding of rainfall patterns, water quality, green rainwater infrastructure performance and sewer and drainage system performance and the many other related systems and characteristics of the urban watersheds through monitoring, data collection, data analytics and hydrologic and hydraulic modelling.	Expand Existing Direction	Continue to expand citywide data collection, analytics, monitoring and hydrologic and hydraulic model development.	2019	●●●	●●●	●●○	●●○	●●○	●●○	●●●	●●○	●●●
TD-08	Enable a culture of collaboration	Facilitate a shift in city culture and process to enable the successful implementation of the Rain City Strategy as part of the city's transition to a water sensitive city. Encourage this shift through greater cross-departmental and cross-branch collaboration and updating internal processes to improve coordination and alignment. Staff knowledge and capacity to support the implementation of the Rain City Strategy will be strengthened through training, standards, guidelines and other approaches and tools.	Expand Existing Direction	Continue to formalize the structure and roles of the branches within the Integrated Strategy & Utility Planning division.	2019	●●○	●●○	●●○	●●○	●●○	●●○	●●●	●●●	●●●
TD-09	Invest in education, capacity-building and partnerships to mobilise action	Engage and educate industry professionals, other levels of government, not-for-profits and academia on how and why the city is shifting its approach to rainwater management through an integrated water approach and climate resiliency as part of transitioning to a water sensitive city. Use these engagements to share knowledge and build capacity of industry, government and academia to support the implementation of integrated approaches to water management, including green rainwater infrastructure, across the city. Engage with practitioners and the public to raise awareness of rainwater management, climate change and green rainwater infrastructure, empowering them to take positive actions in their community.	Expand Existing Direction	Convene a working group to define scope, identify priority watersheds and deliverables and timelines	2020	●●○	●●○	●●○	●●○	●●○	●●○	●●●	●●○	●●●

Rain City Strategy - Transformative Directions [Sample Actions]

Transformative Directions & Associated Sample Actions	
Direction and Action No.	**Transformative Directions & Associated Action Descriptions**
TD-01	**Strive to become a water sensitive city**
1.1	Engage the City-Wide Plan Working Group to integrate water sensitive design principles into the City-Wide Plan.
1.2	Develop an engagement and education plan to promote a water sensitive approach in utility plans, land use plans, urban design plans and parks plans.
1.3	Engage with stakeholders and partners to promote the city's water sensitive objectives including Metro Vancouver, Provincial and Federal Ministries and others.
TD-02	**Respond with urgency to climate change**
2.1	Convene a formal working group to define scope, deliverables, and timelines to conduct a citywide climate vulnerability & risk assessment.
2.2	Reduce rainwater and wastewater inputs to the sewer network using green rainwater infrastructure, grey infrastructure and water conservation and efficiency approaches.
2.3	Monitor, record and communicate the wider climate adaption benefits of green rainwater infrastructure.
2.4	Strategic application of green rainwater infrastructure to maintain and expand the urban forest for instance by increasing soil volumes and access to water.
2.5	Undertake a vulnerability and risk assessment (at citywide, watershed, district and site scales) to a changing climate (rainfall, heat, drought and sea level rise).
2.6	Utilize vulnerability and risk assessment data to inform built form across the city.
2.7	Continuously refine design standards (i.e., IDF curves) to account for the latest climate change projections.
2.8	Undertake research and benchmark design standards from other jurisdictions with regards to climate change projections.
2.9	Map and design a resilient lifeline infrastructure network.
TD-03	**Accelerate action to protect the health and vitality of surrounding waterbodies**
3.1	Convene a formal working group to define scope, deliverables, and timelines.
3.2	Undertake review of policy(ies) on sewer connections on private properties.
3.3	Explore and develop a restorative action plan on cross-connections for combined sewer overflow.
3.4	Explore partnership with Port of Vancouver on water quality.
3.5	Explore engagement with Vancouver Aquarium and Ocean Wise pollution tracker.
3.6	Develop an engagement strategy to communicate and engage residents on what they can do to mitigate combined sewer overflows (e.g. real-time text alerts like the NYC Wait campaign).
3.7	Undertake research and benchmark combined sewer overflow mitigation strategies in other jurisdictions.
3.8	Engage stakeholders to explore the opportunity of enhancing the treatment capability of the Iona Wastewater Treatment facility

Transformative Directions & Associated Sample Actions	
Direction and Action No.	**Transformative Directions & Associated Action Descriptions**
TD-04	**Revitalize watersheds and waterfronts to enable communities and natural systems to thrive**
4.1	Convene a formal working group to define scope and to identify priority watersheds and waterfronts, deliverables, and timelines.
4.2	Work with partners to develop and adopt a clear definition of watersheds and watershed plans.
4.3	Scope the planning, design and construction of surface water expression green rainwater infrastructure practices in relation to historic waterways and other networks (i.e. blue-green networks, bikeways).
4.4	Develop and adopt watershed-specific rainwater infiltration and detention targets and design specifications
4.5	Identify infiltration potential on a citywide scale (i.e. block by block geotechnical investigation)
4.6	Develop and adopt a watershed bylaw that would enable watershed specific targets and design specifications.
4.7	Develop and adopt a waterfront bylaw that would enable waterfront specific targets and design specifications.
4.8	Establish a pilot watershed planning approach in Oakridge Town Centre and Cambie Corridor.
4.9	Establish a pilot featuring water sensitive approaches for on-site and capital projects.
4.10	Identify and quantify biodiversity and wildlife habitat relating to green rainwater infrastructure. Set objectives for species and populations of wildlife (targets).
4.11	Delineate a citywide green rainwater infrastructure network including ecosystem hubs, sites, and corridors.
4.12	Develop an internal process for managing the planning and delivery of projects led by green rainwater infrastructure as identified through watershed plans.
4.13	Include public consultation to find creative and local ideas and flavours or collect local knowledge.
4.14	Undertake collection of data to understand watershed's groundwater characteristics (i.e., location of groundwater or soil contamination, aquifer characteristics, and other data)
4.15	Explore community outreach or educational programs to define watershed.
4.16	Identify the overland flow conveyance to receiving waterbodies including major and minor drainage systems.
4.17	Identify major public spaces, parks, schools that intersect with drainage paths.
4.18	Evaluate major drainage flow path into low lying areas that are or will become diked in the future to address sea level rise.
4.19	Reserve a proportion of land area in the community planning process for water management (i.e. 10%). The spaces set aside can be multi-functional and allow for other uses including planting either on grade or on structure.
4.20	Develop a full drainage assessment including green rainwater infrastructure tools early in community planning process to identify infiltration potential, city controlled land or right-of-way, natural topography, access to stormwater, and partnering opportunities to locate district serving stormwater assets.

Transformative Directions & Associated Sample Actions	
Direction and Action No.	**Transformative Directions & Associated Action Descriptions**
4.21	Reconcile cross-departmental definitions of terms like permeable and impermeable. (i.e., areas of soil and landscape may be classified as permeable, but permeable pavement may not in some departments).
4.22	Explore regulation options to limit impermeable areas such as paved yards, roads, sidewalks, parking spaces, and alleys by using permeable materials (i.e. AstroTurf).
4.23	Align infrastructure, utility and land use planning and include green rainwater infrastructure to ensure improvements in water quality, healthy watersheds, and water sensitive urban design.
4.24	Establish a citywide target on maximum percent impervious area requirement.
4.25	Work with external stakeholders who have jurisdiction at waterfront boundaries.
4.26	Engage and work with non-governmental organization (NGOs) to develop a comprehensive planning and designing of GRI to protect and enhance the city's waterfront.
4.27	Engage and work with Park Board to develop an integrated approach on planning and designing of GRI to help mitigate ecological threats to the city's waterfront.
4.28	Engage and work with Park Board to develop an integrated approach to restore degraded natural waterfront areas and shorefront habitats.
4.29	Improve water quality through GRI implementation that benefits natural habitats, support public space amenities, and enhance city's waterfronts.
4.30	Engage and work with federal and local agencies to improve regulation, coordination, and oversight of the waterfront and waterways.
4.31	Engage with the public to increase scientific understanding, public awareness, and stewardship of the natural waterfront.
TD-05	**Shape systems to integrate all forms of water**
5.1	Demonstrate leadership in integrated water utility planning through development of Cambie Corridor and Broadway Area Utility Plans.
5.2	Explore opportunities of managing private property runoff on streets and public spaces such as laneway storage opportunities (i.e. Flats Rainwater Management Plan)
5.3	Apply an integrated water framework to develop and adopt a strategic approach to funding and financing of water utilities based on optimizing existing assets through asset management and operation and maintenance activities and prioritizing new capital investments to achieve the best outcomes.
5.4	Undertake comprehensive review of bylaws for conflicts and alignment with the IRMP and Rain City Strategy goals and targets
5.5	Develop and adopt a rainwater bylaw that provides a framework for regulating rainwater on public and private property.
5.6	Work with others to embed an integrated water integrated water utility framework into land use planning.
5.7	Engage senior staff across city departments to inform and obtain buy-in on an integrated approach to water utility planning through the One Water Steering Committee and other governance structures.

Transformative Directions & Associated Sample Actions	
Direction and Action No.	**Transformative Directions & Associated Action Descriptions**
TD-06	**Explore reconciliation with Indigenous communities, intersectionality, and equity through water**
6.1	Listen, learn and co-create a shared understanding of equity and reconciliation with Indigenous communities, particularly as it relates to rainwater management and green rainwater infrastructure, with a variety of communities and knowledge holders.
6.2	Undertake research with thought leaders in the community and peer cities to understand how equity could be incorporated into integrated water utility services. This work inspires thinking of how equity objectives could be integrated into water and green rainwater infrastructure planning, design and implementation.
6.3	Engage with First Nations and Indigenous community to learn about local traditional ecological knowledge (TEK) and how it can inform planning, programs and implementation of GRI and integrated water utility.
6.4	Participate and help shape the development of a City-wide Equity Framework being led by Arts, Culture, and Community Services department at the City of Vancouver. Use the Equity Framework as a guide to apply intersectional equity lens in the planning, designing, and managing of integrated water utilities, including green rainwater infrastructure, across the city.
6.5	Use the City of Reconciliation framework as a guide to inform the planning, designing and managing of integrated water utilities, including green rainwater infrastructure across the city.
TD-07	**Drive innovative and system effectiveness through comprehensive data and analytics**
7.1	Continue to expand citywide data collection, analytics, monitoring and hydrological and hydraulic model development.
7.2	Update baseline data and metrics with climate change indicators.
7.3	Update baseline data and metrics with remote sensing.
7.4	Develop and adopt a flow monitoring requirement.
7.5	Develop data collection and management method to ensure that all co-benefits of green rainwater infrastructure can be effectively monitored and measured.
7.6	Develop performance audit procedure for green rainwater infrastructure practices.
7.7	Continue to develop green rainwater infrastructure monitoring program
7.8	Explore the use of smart controls and sewer system optimization to reduce the occurrence and volume of combined sewer overflows.
7.9	Develop a more comprehensive citywide hydrologic and hydraulic model.
7.10	Develop metrics and dashboards for parameters being monitored that can be used to track changes and improvements to water utilities over time.
7.11	Undertake study to better understand the connectivity of the city's impervious areas to the sewer and drainage network, including effective impervious areas across the city. Identify areas with low and high connectivity to the sewer and drainage network and use findings to inform where to prioritize green rainwater infrastructure retrofits.

Transformative Directions & Associated Sample Actions	
Direction and Action No.	**Transformative Directions & Associated Action Descriptions**
TD-08	**Enable a culture of collaboration**
8.1	Continue to formalize the structure and roles of the branches within the city's Integrated Strategy & Utility Planning Division.
8.2	Update internal processes to better enable coordination and alignment across the city's Branches, Divisions, and Departments when planning for water.
8.3	Develop or update governance structure to better support and enable cross-departmental collaboration.
8.4	Develop a change management plan to support the city staff involved in changes to their work plans and ways of doing work as part of delivering the Rain City Strategy.
8.5	Develop and adopt training of City staff for design and construction and reinstatement of existing green rainwater infrastructure practices.
8.6	Develop a community (ecosystem) of practice to improve knowledge sharing, data collection and sharing, education around implementing green rainwater infrastructure, and how industry and community can get involved and contribute to achieve the vision, goals and targets and make resilient neighborhoods.
8.7	Conduct training for City of Vancouver operations staff on green rainwater infrastructure fundamentals and on how to undertake operation and maintenance of the different types of green rainwater infrastructure assets deployed on streets and public spaces.
8.8	Organize a workshop for City Staff on erosion and sediment control on streets and public spaces, and on construction sites.
8.9	Develop communication strategy, branding, or messaging with consistent terms for green rainwater infrastructure and rainwater management.
8.10	Engage with First Nations to learn about local traditional ecological knowledge (TEK) and how it can be incorporated in the design process of green rainwater infrastructures.
8.11	Develop and/or improve existing Green Streets framework to include green rainwater infrastructure adoption or sponsorship program, with additional resources and staffing.
8.12	Undertake research on how to reach a broad cross-section of people across the city to ensure inclusive engagement.
8.13	Develop an educational material or campaign on financing green rainwater infrastructure, the associated cost, and the potential savings in streets and public spaces.

Transformative Directions & Associated Sample Actions	
Direction and Action No.	**Transformative Directions & Associated Action Descriptions**
TD-09	**Invest in education, capacity-building and partnerships to mobilise action**
9.1	Convene a formal working group to define scope and to identify priority watersheds, deliverables, and timelines.
9.2	Develop and launch a public awareness and empowerment campaign on green rainwater infrastructure and water management.
9.3	Focus the awareness and empowerment campaign on peer normalization through community based social marketing.
9.4	Improve educational and engagement approach around the role and value of nature in the city in relation to water management.
9.5	Engage with Science World about providing educational opportunities around rainwater management.
9.6	Engage with suppliers and product vendors to support a competitive green rainwater infrastructure market place.
9.7	Support regional capacity building initiatives for green rainwater infrastructure contractors, inspectors, and operators, such as the National Green Infrastructure Certification Program (NGICP) or other training programs.
9.8	Explore partnerships with post-secondary institutions on how to include green rainwater infrastructure in their course material (e.g. EGBC, UBC, SFU, BCIT etc.).
9.9	Explore how the city can facilitate capacity building initiatives for current and new practitioners such as professional development for designers and training sessions for industry professionals (e.g. industry leader talks, courses, presentations, master gardener training).
9.10	Establish a workforce development targeting local trades schools and programs in construction and horticulture.
9.11	Explore marketing strategies for real estate owners and developers related to green rainwater infrastructure assets (i.e. Salmon Safe Certification).
9.12	Undertake research to identify successful public engagement campaigns focused on what residents can do with respect to green rainwater infrastructure, water conservation and mitigating combined sewer overflows. Adapt and implement appropriate campaigns to reduce rainwater runoff, reduce discharges to the combined sewer network and mitigate combined sewer overflows (such as NYC's Wait campaign).

Rain City Strategy - Streets and Public Spaces Action Plan [Programs]

Program Details			Program Status & Milestones			Contribution to Rain City Strategy Objectives Legend: ●○○ = low, ●●○ = medium, ●●● = high						Evaluation Legend: ●○○ = low ●●○ = medium ●●● = high		
Program No.	Program Title	Program Description	Program Status (Expand Existing Program or New Program)	Next Milestone	Next Milestone Year	Remove Pollutants	Reduce Volume Entering Pipes	Increase Green Area	Increase Managed Impervious Area	Mitigate Urban Heat Island Effect	Encourage Greater Harvest & Reuse	Impact	Effort	Criticality
IMPLEMENTATION PROGRAMS														
S&PS-01	New Capital Projects Green Rainwater Infrastructure Integration Program	Expand the implementation of green rainwater infrastructure beyond the existing opportunistic approach by making its implementation standard practice by developing and adopting design standards, targets, guidelines, capital and lifecycle financial plans and internal processes. These tools shall be used to facilitate the implementation of green rainwater infrastructure in new capital projects in streets and public spaces.	Expand Existing Program	Convene a working group to define scope, deliverables and timelines.	2020	●●●	●●●	●●●	●●●	●●●	●●●	●●●	●●●	●●●
S&PS-02	Strategic Retrofits Green Rainwater Infrastructure Program	Expand the implementation of green rainwater infrastructure beyond the existing opportunistic approach by developing and adopting design standards, targets, guidelines, capital and lifecycle financial plans and internal processes to facilitate retrofitting existing streets and public spaces with green rainwater infrastructure.	New Program	Convene a working group to define scope, deliverables and timelines.	2020	●●●	●●●	●●●	●●●	●●●	●●●	●●●	●●●	●●●
S&PS-03	Blue-Green Systems that Enable Water Management and Biodiversity Program	Implement green rainwater infrastructure along streets and public spaces as an integral part of blue-green systems. These systems optimize rainwater management from adjacent streets, increase urban forest cover and provide corridors for enhanced biodiversity and wildlife connectivity. Pilot and demonstration projects will be implemented to determine how to best integrate and align these with the city's active transportation routes. The findings from these pilot and demonstration projects shall be applied to streamline the delivery of blue-green systems across the city.	New Program	Convene a working group to define scope, deliverables and timelines.	2020	●●●	●●●	●●●	●●●	●●●	●●●	●●●	●●●	●●●
S&PS-04	Permeable Pavement Program	Undertake research to assess the opportunities, barriers, lessons learned and business case for the use of permeable pavement on the city's streets and public spaces. Use research findings to develop and implement a program to facilitate the effective design, construction and maintenance of permeable pavement.	New Program	Convene a working group to define scope, deliverables and timelines.	2020	●●○	●●●	●○○	●●○	●●○	●○○	●●○	●●○	●●○
S&PS-05	Laneway Rehabilitation & Retrofit Program	Undertake research to assess the opportunities, barriers, lessons learned and financial tools and mechanisms for retrofitting laneways to enable them to manage rainwater runoff and potentially adjacent private properties. Use research findings to develop and implement a retrofit program with new laneway typologies and integrate green rainwater infrastructure into existing city rehabilitation programs.	New Program	Convene a working group to define scope, deliverables and timelines.	2020	●●○	●●●	●○○	●●●	●○○	●○○	●●●	●●●	●●○

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Program Details			Program Status & Milestones			Contribution to Rain City Strategy Objectives Legend: ●○○ = low, ●●○ = medium, ●●● = high						Evaluation Legend: ●○○ = low ●●○ = medium ●●● = high		
Program No.	Program Title	Program Description	Program Status (Expand Existing Program or New Program)	Next Milestone	Next Milestone Year	Remove Pollutants	Reduce Volume Entering Pipes	Increase Green Area	Increase Managed Impervious Area	Mitigate Urban Heat Island Effect	Encourage Greater Harvest & Reuse	Impact	Effort	Criticality
S&PS-06	Green Rainwater Infrastructure Pilot and Demonstration Project Program	Implement innovative green rainwater infrastructure practices at select locations in streets and public spaces. Document lessons learned during the design and construction of the practices as well as performance monitoring data and incorporate learnings as part of an adaptive management process to enhance the ongoing delivery of green rainwater infrastructure.	Expand Existing Program	Existing demonstration projects are being monitored and evaluated while new demonstration projects are being built, including new stormwater tree trench designs for bikeways, dry wells, and updated bioretention corner bulge designs. Evaluations and monitoring will be reported on regularly with the next report coming in 2020.	2020	●●○	●●○	●●○	●●○	●●○	●●○	●●●	●●○	●●○
S&PS-07	Streets and Public Spaces Adjacent to Schools Green Rainwater Infrastructure Retrofit Program	Work with School District and Schools to explore potential opportunities for engaging students to learn and be part of the water cycle by implementing and maintaining green rainwater infrastructure on streets and public spaces adjacent to school grounds.	New Program	Engage with school district to explore synergies and opportunities for green rainwater infrastructure implemented on streets and public spaces adjacent to schools.	2020	●●○	●●○	●●○	●●○	●●○	●○○	●●●	●●○	●●○
S&PS-08	District Scale Non-potable Water Systems Program	Undertake research to assess the business case, opportunities and barriers for district scale non-potable water systems in Vancouver. Develop and modify policies to enable the development of safe and well-regulated district scale non-potable water systems.	New Program	Convene a working group to define scope, deliverables and timelines.	2020	●●○	●●○	●○○	●○○	●○○	●●●	●●○	●●●	●●○
S&PS-09	Green Rainwater Infrastructure Asset Management Program	Clarify green rainwater infrastructure asset management roles and responsibilities with partners, including asset stewardship and maintenance responsibilities. Identify sustainable funding mechanisms and develop plans to finance the management of assets over their life cycle. Streamline internal processes and adopt standards to facilitate the management of green rainwater infrastructure assets to preserve and optimize their service life.	Expand Existing Program	The Asset Management & Infrastructure Planning Project, which began in May 2019 and will continue into 2020, is evaluating asset management department-wide. The project consultant will have an additional focus on how green rainwater infrastructure assets can be most effectively managed among the branches with shared responsibilities.	2020	●●○	●●○	●●○	●●○	●●○	●●○	●●○	●●●	●●●

Program Details			Program Status & Milestones			Contribution to Rain City Strategy Objectives Legend: ●○○ = low, ●●○ = medium, ●●● = high						Evaluation Legend: ●○○ = low ●●○ = medium ●●● = high		
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S&PS-10	Green Rainwater Infrastructure Operation and Maintenance Program	Work with partners to investigate service delivery models for green rainwater infrastructure operation and maintenance, including the potential for a stewardship-based model. Identify sustainable funding mechanisms and develop plans to finance operation and maintenance activities. Select the preferred service delivery model and streamline internal processes to enable the effective operation and maintenance of green rainwater infrastructure that preserves and extends their level of service.	New Program	Develop options for sustainable funding mechanisms to support ongoing operation and maintenance activities & trial maintenance procedures with appropriate operation branches and formalize into standard operating procedures.	2020	●●○	●●○	●●○	●●○	●●○	●●○	●●○	●●●	●●●
S&PS-11	Sediment Management and Source Control Program	Work with partners to develop and adopt a holistic program for limiting and managing sediment deposited on streets and public spaces and captured by green rainwater infrastructure practices, drains, catch basins and sewers. Identify potential sources and 'hot spots' for sediment and how to better manage these to protect sediment accumulation on streets and public spaces and to ensure that green rainwater infrastructure practices are protected from heavy sediment loads.	New Program	Engage the Solid Waste Program Management branch to create an integrated approach including street sweeping, catch basin cleaning, erosion and sediment control and green rainwater maintenance sediment removal to improve system performance and reduce pollutant discharge to receiving waterbodies.	2020	●●●	●●○	●○○	●●○	●○○	●○○	●●○	●●○	●●○
ENABLING PROGRAMS														
S&PS-12	Citywide Green Rainwater Infrastructure Financial Planning and Sustainable Funding Program	Identify sustainable sources of long-term funding for green rainwater infrastructure, including funding sources associated with pollutant generation. Use funding source(s) to develop and implement a holistic financial plan that encompasses capital costs, asset management and operation and maintenance to enable green rainwater infrastructure implementation in capital projects and retrofits in streets and public spaces. Undertake research to develop a business case to identify funding requirements to manage these assets to preserve and extend their service life and level of service.	New Program	Convene a working group to define scope, deliverables and timelines.	2020	●●●	●●●	●●●	●●●	●●●	●●●	●●●	●●●	●●●
S&PS-13	Research and Innovation Program	Continuously improve ways of managing rainwater by undertaking research and keeping up-to-date on innovations in the green rainwater infrastructure sector. Contribute to industry best practice and innovations in the sector by reporting monitoring data and analysis and lessons learned at conferences and workshops.	Expand Existing Program	Engage local academic institutions and other external partners to identify opportunities and synergies.	2020	●●○	●●○	●●○	●●○	●●○	●●○	●●○	●●○	●●○

Program Details			Program Status & Milestones			Contribution to Rain City Strategy Objectives Legend: ●○○ = low, ●●○ = medium, ●●● = high						Evaluation Legend: ●○○ = low ●●○ = medium ●●● = high		
Program No.	Program Title	Program Description	Program Status (Expand Existing Program or New Program)	Next Milestone	Next Milestone Year	Remove Pollutants	Reduce Volume Entering Pipes	Increase Green Area	Increase Managed Impervious Area	Mitigate Urban Heat Island Effect	Encourage Greater Harvest & Reuse	Impact	Effort	Criticality
S&PS-14	Shift in City Process & Capacity Building	Facilitate a shift in city culture and process to enable the successful implementation of green rainwater infrastructure. Encourage this shift through greater cross-departmental collaboration and updating internal processes to improve coordination and alignment. Staff knowledge and capacity to support the implementation of green rainwater infrastructure will be strengthened through training, standards, guidelines and other approaches and tools.	Expand Existing Program	Convene a working group to define scope, deliverables and timelines.	2020	●●●	●●●	●●●	●●●	●●●	●●●	●●●	●●●	●●●
S&PS-15	Industry Capacity Building & Public Engagement	Facilitate capacity building amongst developers, designers and contractors to share knowledge regarding the City's design standards, guidelines and industry best practices for implementing green rainwater infrastructure in the City's new capital projects. Engage with practitioners and the public to raise awareness of rainwater management, climate change and green rainwater infrastructure, empowering them to take positive actions and be environmental stewards in their community.	New Program	Engage local academic institutions and other external partners as well as developers, designers and contractors to identify practitioner needs, opportunities and synergies.	2020	●●○	●●○	●●○	●●○	●●○	●●○	●●●	●●○	●●●
S&PS-16	Water Quality Monitoring Program	Work with partners to continue and enhance stormwater and combined sewer overflow monitoring for quantity and quality across the city and use the data to prioritize and inform green rainwater infrastructure implementation and other water quality initiatives.	Expand Existing Program	Convene a working group to define scope, deliverables and timelines.	2020	●●●	●●○	●●○	●○○	●●○	●○○	●●○	●●○	●●○

Rain City Strategy - Streets and Public Spaces Action Plan [Sample Actions]

Programs & Associated Sample Actions	
Program and Action No.	**Programs & Associated Sample Action Descriptions**
IMPLEMENTATION PROGRAMS & ASSOCIATED SAMPLE ACTIONS	
S&PS-01	**New Capital Projects Green Rainwater Infrastructure Integration Program**
1.1	Develop and adopt design standards, guidelines, and internal processes on how to integrate green infrastructure planning and design in public transit construction, coastal flood protection, overland flood routes, safe routes to school, greenways, bikeways and pavement to plaza projects.
1.2	Develop and adopt design standards, guidelines, and internal processes to facilitate the integration of green rainwater infrastructure in city strategies and plans.
1.3	Undertake research to identify barriers to green rainwater infrastructure in existing city policies, regulations and standards and facilitate changes to policies, regulations and standards to streamline the implementation of green rainwater infrastructure.
1.4	Ensure that green rainwater infrastructure cost is incorporated in Municipal Road Network (MRN) projects.
1.5	Continuously reuse material with Kent Services, including recycled aggregate and pavement grindings.
1.6	Identify the roles and responsibilities of teams involved in planning and designing green rainwater infrastructure.
1.7	Undertake review of current service delivery methods. The current service delivery model is for primarily for GI Branch to do current design in house. Alternative delivery models to consider are embedding GI design with other branches and external delivery options.
1.8	Specify appropriate level of service for all green rainwater infrastructures in streets and public spaces.
1.9	Investigate the appropriate design storm event for peak flow control, volume control, and water quality.
1.10	Undertake research to establish the appropriate runoff coefficient for green roof and permeable pavement.
1.11	Investigate the potential modification of IRMP performance standards to reflect 2100 precipitation patterns and to consolidate the standard to a single volume managed to meet both water quality and volume control.
1.12	Develop and adopt design specifications for permeable area coverage and topsoil depth requirements to ensure that the pervious areas can capture 48mm in 24 hours.
1.13	Develop and adopt protocol for green rainwater infrastructure that safely allows infiltration in or around contaminated soils and groundwater contaminant plumes.
1.14	Establish a city-wide geotechnical investigation protocol for green rainwater infrastructure.

Programs & Associated Sample Actions	
Program and Action No.	**Programs & Associated Sample Action Descriptions**
1.15	Compare City of Vancouver IRMP targets and design specifications with other environmental certification standards (e.g. LEED, Salmon Safe) to determine if they can be deemed to meet the IRMP requirements.
1.16	Update Rainwater Management Bulletin to better explain how to implement green rainwater infrastructure to meet IRMP targets and specifications.
1.17	Modify and adopt a utility corridor standard that includes green rainwater infrastructure that accommodates trees and all utilities for a variety of street typologies. Ensure Utility Standards to include offset requirements and tolerances between utilities and UMB.
1.18	Investigate the use of an orifice control incorporated in the design of green rainwater infrastructure. (E.g. applying a 10-15mm orifice on the sub-drains of green rainwater infrastructure).
1.19	Develop and adopt a rainwater management checklist for new capital projects. Checklist to include items such as targets and design specifications, design review stages and construction inspection protocols, construction checkpoints, post-construction assumptions, and handover acceptance. Explore handback requirements for Final Acceptance at the end of the warranty period of green rainwater infrastructure and identify who performs the final acceptance and end of warranty management in streets and public spaces.
1.20	Develop a policy that requires new capital projects being delivered to meet rainwater management targets and design specifications in streets and public spaces. Policy should assess the feasibility and impacts of a pay-in-lieu system to cover instances where rainwater management targets cannot be met, or can only be partially met. Pay-in-lieu assessment to include identifying the source of pay-in-lieu funds, and the party(ies) collecting and managing the pay-in-lieu funds.
1.21	Formalize green rainwater infrastructure design standards for commonly used assets (i.e., corner bioretention bulge, stormwater tree trenches, infiltration trenches and soakaways, and permeable pavement)
1.22	Develop technical reports, memos, and factsheets addressing common concerns of green rainwater infrastructures including but not limited to health & safety, insect vectors, collection of heavy metals in soils and plants, and non-potable water safety.
1.23	Develop and/or modify right-of-way design standards for various street types to allow for the appropriate green rainwater infrastructure options.
1.24	Include inlet capacity evaluation into right-of-way green rainwater infrastructure designs to maximize runoff capture and minimize bypass.
1.25	Organize a workshop that communicates how to comply with IRMP targets and design specifications using green rainwater infrastructure standards, and the processes developed through this program.
1.26	Leverage large sites and capital projects to enhance the delivery of green rainwater infrastructure in streets and public spaces (i.e., exceed targets and design specifications and/or implement pilots and demonstration projects)

Programs & Associated Sample Actions	
Program and Action No.	**Programs & Associated Sample Action Descriptions**
1.27	Develop design standards for green rainwater management infrastructure to go 'above and beyond' existing targets and design standards in streets right-of-way. (i.e., increase capture target to 48mm in 24 hours) and provide clear guidance on how to implement standard within streets and public spaces.
1.28	Modify the Guide to Boulevard Plantings to include appropriate planting and care for bioretention bulges and other green rainwater infrastructure located in the boulevard.
1.29	Monitor and improve the sustainability of material flow and management practices relating to urban excavated soil.
1.30	Investigate and develop a strategy to mitigate green rainwater infrastructure encroachment issues by homeowners on boulevards.
1.31	Identify mechanisms to enforce conformance to IRMP targets and design standards using green rainwater infrastructure.
1.32	Develop a strategy for implementing green rainwater infrastructure in areas with geotechnical challenges.
1.33	Explore the legal considerations for changing groundwater regimes.
1.34	Co-locate green rainwater infrastructure with waste, recycling and composting bins to reduce the potential for litter to be deposited in green rainwater infrastructure assets.
1.35	Develop and adopt green rainwater infrastructure design standards for developer-delivered green rainwater infrastructure assets delivered in streets and public spaces.
1.36	Explore opportunities to minimize impervious areas through the use of green rainwater infrastructure, de-paving, and other initiatives in streets and public spaces.
1.38	Develop and adopt green rainwater infrastructure best practices that support and enhance biodiversity in the city. Work in partnership with the Vancouver Park Board to create blue-green systems that provide water management and enhance biodiversity across the city and use the Park Board Biodiversity Strategy as a guide to enhance biodiversity.
S&PS-02	**Strategic Retrofits Green Rainwater Infrastructure Program**
2.1	Utilize watershed plans to identify and prioritize streets and public spaces to retrofit with green rainwater infrastructure that are linked to watershed specific targets.
2.2	Undertake an economic appraisal of green rainwater infrastructure retrofit opportunities identified through watershed plans and other mechanisms. Use appraisal to prioritize strategic retrofits that provide the greatest benefits for the least cost.
2.3	Identify areas where there is an alignment of goals amongst partners with green rainwater infrastructure retrofits on streets and public spaces, such as with infrastructure renewal needs, public safety improvements, and urban forestry targets.
2.4	Work with partners to develop and continuously improve internal processes for facilitating green rainwater infrastructure retrofits.
2.5	Modify right-of-way design standards for various street types to identify green rainwater infrastructure retrofit options.

Programs & Associated Sample Actions	
Program and Action No.	**Programs & Associated Sample Action Descriptions**
2.6	Identify green rainwater infrastructure retrofit options for City of Vancouver's existing curbless residential streets and laneways.
2.7	Develop a strategy for using green rainwater infrastructure retrofits to help manage areas with geotechnical challenges (i.e., reduce settlement in peat areas)
2.8	Pursue projects with large scale retrofit opportunities, such as many standardized green rainwater infrastructure retrofits in one neighborhood, to achieve economies of scale and reduce implementation costs.
2.9	Co-locate green rainwater infrastructure with waste, recycling and composting bins to reduce the potential for litter to be deposited in green rainwater infrastructure assets.
2.10	Facilitate public access and enjoyment of the city's waterfront and beaches using green rainwater infrastructure assets (i.e., use green rainwater infrastructure to provide "soft" engineered transitions between land and sea as opposed to sea walls and other "hard" surfaces).
2.11	Explore opportunities to minimize impervious areas through the use of green rainwater infrastructure, de-paving, and other initiatives in streets and public spaces.
2.12	Develop and adopt green rainwater infrastructure best practices that support and enhance biodiversity in the city. Work in partnership with the Vancouver Park Board to create blue-green systems that provide water management and enhance biodiversity across the city and use the Park Board Biodiversity Strategy as a guide to enhance biodiversity.
S&PS-03	**Blue-Green Systems with Enhanced Water Management and Biodiversity Functions Program**
3.1	Identify opportunities to align the location of blue-green systems with other city and Park Board priority areas (i.e., active transportation routes, greenways, blueways, corridors providing connectivity between parks and major green spaces, and others)
3.2	Develop and adopt design standards, guidelines, and internal processes on how to integrate green infrastructure planning and design into blue-green systems.
3.3	Explore opportunities to locate blue-green systems in areas with historic watercourses. Use green rainwater infrastructure practices that manage rainwater on the surface using swales or other methods to recreate or reflect the historic watercourse.
3.4	Undertake research to determine priority streets and public spaces to integrate blue-green systems (i.e., streets with large adjacent catchment areas that could be easily connected to the practices, optimize minor and major drainage systems with capacity or growth pressures, and other items)
3.5	Implement pilot and demonstration project(s) with a monitoring program to collect and analyze data on their performance and social impacts. Use learnings to improve the delivery of ongoing blue-green systems.

Programs & Associated Sample Actions	
Program and Action No.	**Programs & Associated Sample Action Descriptions**
3.6	Explore opportunities to minimize impervious areas through the use of green rainwater infrastructure, de-paving, and other initiatives in streets and public spaces.
3.7	Develop and adopt green rainwater infrastructure best practices that support and enhance biodiversity in the city. Work in partnership with the Vancouver Park Board to create blue-green systems that provide water management and enhance biodiversity across the city and use the Park Board Biodiversity Strategy as a guide to enhance biodiversity.
3.8	Engage and work with Park Board to use park acquisition, tree planting, and the development planning process to expand and connect parks in building the city's ecological blue-green systems.
3.9	Identify opportunities for habitat restoration in boulevards, road ends and right-of-ways as part of Biodiversity Strategy goal to build the city's ecological network.
3.10	Incorporate biodiversity values into planning and designing of GRI assets for new and redevelopment projects in Streets & Public Spaces.
3.11	Update tree and plant selection, density and maintenance guidelines to increase the value of urban biodiversity for birds and other species across the city.
3.12	Use the biodiversity monitoring plan from Biodiversity Strategy to monitor and report progress of meeting biodiversity target.
S&PS-04	**Permeable Pavement Program**
4.1	Research the best practices and benchmark permeable pavement programs in other jurisdictions.
4.2	Develop design standards and guidelines to facilitate the implementation of permeable pavement.
4.3	Undertake research to identify the best locations for permeable pavement within the city's standard street typologies taking into account construction, operation and maintenance considerations.
4.4	Identify maintenance, equipment, and training requirements to enable wider deployment of permeable pavement across the city on roads, bicycle lanes, sidewalks, and parking lay-bys.
4.5	Establish a permeable pavement testing facility at a City operations yard.
4.6	Establish a pilot for new materials and construction techniques for permeable pavement on laneways, bike paths, parking lay-bys, certain boulevards, and potentially for low traffic residential streets. Explore new and improved permeable pavement options in the industry.
4.7	Undertake a lifecycle cost analysis of different types of permeable pavement materials and different locations within standard street typologies and compare to other green rainwater infrastructure practices to determine how best to implement permeable pavement in streets in public spaces.

Programs & Associated Sample Actions	
Program and Action No.	**Programs & Associated Sample Action Descriptions**
S&PS-05	**Laneway Rehabilitation & Retrofit Program**
5.1	Undertake a lifecycle cost analysis of laneway green rainwater infrastructure retrofit options (including but not limited to full-width permeable pavement, partial-width 'strip' of permeable pavement down the laneway centre, sub-surface infiltration gallery, place-making vegetated retrofits and others). Green rainwater infrastructure selection in laneways must take into consideration continual construction and cutting into laneways for utilities and other services in the laneway to ensure the practice(s) selected are appropriate.
5.2	Develop design standards and guidelines to facilitate the implementation of green rainwater infrastructure into the City's laneway reconstruction program.
5.3	Investigate the use of green rainwater infrastructure on laneways to manage rainwater runoff from adjacent private properties including the legal and cost implications of the approach.
5.4	Undertake research to identify the policies and financial tools & mechanisms needed to provide a sustainable funding source for the ongoing operation and maintenance of laneway retrofits. This research shall include laneway retrofits managing runoff from public surfaces only, private surfaces only and a combination of both public and private sources.
5.5	Develop and/or revise policies to ensure that there are mechanisms to charge developers for damage to laneway infrastructure caused as a result of redevelopment/construction activities. Ensure that restitution of damaged green rainwater infrastructure is included in policy.
5.6	Work with partners to identify typical city and third party utilities located underneath laneways and identify ways to incorporate both utilities and green rainwater infrastructure in laneways.
S&PS-06	**Green Rainwater Infrastructure Pilot and Demonstration Project Program**
6.1	Implement one or more of green rainwater infrastructure demonstration projects showcasing surface expression as part of a blue-green system in streets and public spaces.
6.2	Implement one or more green rainwater infrastructure pilot projects to mitigate settling issues on streets and public spaces with peat.
6.3	Develop reports, memos, case studies, fact sheets, presentations and other materials summarizing results and lessons learned from pilot and demonstration projects. Use materials to support green rainwater infrastructure education, outreach and capacity building.
6.4	Monitor the delivery and performance of pilot and demonstration projects and use findings to improve green rainwater infrastructure design and construction standards, as well as construction and operation and maintenance procedures.
6.5	Work with partners, including the Street Activities Branch, to monitor and analyze how residents and visitors use public spaces that incorporate green rainwater infrastructure (i.e., green rainwater infrastructure implemented as part of the pavement to plaza program).

Programs & Associated Sample Actions	
Program and Action No.	**Programs & Associated Sample Action Descriptions**
S&PS-07	**Streets and Public Spaces Adjacent to Schools Green Rainwater Infrastructure Retrofit Program**
7.1	Engage with school district to explore synergies and opportunities for green rainwater infrastructure implemented on streets and public spaces adjacent to schools.
7.2	Research and benchmark school site green rainwater infrastructure programs in other jurisdictions.
7.3	Develop a sustainable long-term funding model for green rainwater infrastructure retrofits on streets and public spaces adjacent to schools, and potentially also school sites.
7.4	Clarify roles and responsibilities for ongoing operation and maintenance and lifecycle asset management of green rainwater infrastructure constructed on or adjacent to school board property.
7.5	Develop a green rainwater infrastructure retrofit program for streets and public spaces adjacent to schools that is linked with a curriculum program.
7.6	Work with the Vancouver School Board to develop educational materials on green rainwater infrastructure in alignment with the Vancouver School Board curriculum.
7.7	Establish stewardship program within the school to help manage green rainwater infrastructure implemented on school sites and any nearby boulevards with green infrastructure.
7.8	Work with partners, including the Development and Major Projects Branch, to identify opportunities to utilize green rainwater infrastructure on new and/or redeveloping school sites across the city.
7.9	Leverage green rainwater infrastructure engagement opportunities with schools to highlight the value of the city's infrastructure.
7.10	Leverage school engagement programs to engage with school community about water management and environmental stewardship.
S&PS-08	**District Scale Non-potable Water Systems Program**
8.1	Undertake business case analysis of district scale non-potable water systems that include a variety of source waters including groundwater, stormwater, wastewater (via 'sewer mining') and building rainwater, greywater and blackwater sources.
8.2	Develop and/or modify policies and bylaws to permit the construction and long-term operation of district scale non-potable water systems
8.3	Explore district scale green rainwater infrastructure opportunities related to heat exchange
8.4	Investigate the use of 'sewer mining' to capture water for district scale non-potable water systems.
8.5	Engage Vancouver Coastal Health to support the expansion of district scale non-potable water sources and uses across Vancouver while ensuring the health and safety of water users.
8.6	Investigate different service delivery models for district scale non-potable water systems, including the creation of new city utility, regulations needed for privately managed systems, and P3 models.

Programs & Associated Sample Actions	
Program and Action No.	**Programs & Associated Sample Action Descriptions**
8.7	Identify opportunities for non-potable water use on streets and public spaces using strategic non-potable water supplies accessible by the city's fleet vehicles
8.8	Work closely with internal stakeholders to advance non-potable water regulatory regime including the number of permitted uses of non-potable water and the number of permitted sources of non-potable water.
S&PS-09	**Green Rainwater Infrastructure Asset Management Program**
9.1	Establish an identifier code to ID green rainwater infrastructure practices constructed on streets and public spaces. This code should be integrated with Hansen IDs.
9.2	Clarify roles and responsibilities for ongoing operation and maintenance and lifecycle asset management of green rainwater infrastructure constructed on streets and public spaces.
9.3	Investigate different models for green rainwater infrastructure asset management with other branches (including but not limited to a single responsible party model, multiple responsible parties, and other models).
9.4	Integrate green rainwater infrastructure into the Hansen Asset Management System.
9.5	Develop asset management strategies and processes including but not limited to asset data management (VanMAP), data collection from other branches, and data audits of historically built green rainwater infrastructures and green rainwater infrastructure in privately built right-of-ways.
9.6	Establish green rainwater infrastructure protection zones for city crews, and third parties.
9.7	Research and benchmark green rainwater infrastructure asset management programs in other jurisdictions including relevant policy(ies) pertaining to green rainwater infrastructure.
9.8	Develop a level of service standards for green rainwater infrastructure assets and create an inspection schedule. Level of service standard has been created for landscape green rainwater infrastructure assets and those assets are being inspected in bi-annually. Other green rainwater infrastructure assets need to have a level of service standard established and require inspections.
9.9	Develop and refine green rainwater infrastructure asset renewal plan. Landscape green rainwater infrastructure asset renewal program has been developed and needs refinement. Green rainwater infrastructure asset categories including sub-surface infiltration needs to be created.
9.10	Investigate maintenance agreements with new developments including who maintains and inspects green rainwater infrastructure practices that have been constructed by developers on streets and public spaces.
9.11	Identify resources required for green rainwater infrastructure inspection and enforcement.

Programs & Associated Sample Actions	
Program and Action No.	**Programs & Associated Sample Action Descriptions**
S&PS-10	**Green Rainwater Infrastructure Operation and Maintenance Program**
10.1	Modify operations and maintenance manuals including Sewer Operations Manual to include green rainwater infrastructure asset needs and considerations.
10.2	Undertake an analysis on the effect of different operation and maintenance service levels on the level of service/performance on different types of green rainwater infrastructure practices.
10.3	Undertake research to assess the costs and benefits of establishing a dedicated crew for green rainwater infrastructure operation and maintenance. Compare the costs and benefits to existing and alternative maintenance arrangements.
10.4	Undertake research to identify how social enterprises and other alternative models can operate and maintain green rainwater infrastructure practices (e.g. summer student programs and citizen science programs)
10.5	Include operation and maintenance considerations into discussions regarding green rainwater infrastructure asset management roles and responsibilities and asset management strategy. Ensure discussion includes green rainwater infrastructure assets that have been constructed both prior to and following the adoption of the Rain City Strategy.
10.6	Research and benchmark green rainwater infrastructure operation and maintenance programs in other jurisdictions.
10.7	Train operations crews on best practices and standard operating procedures for conducting the operation and maintenance of the green rainwater infrastructure practices typically implemented on streets and public spaces.
10.8	Identify opportunities for the use of City of Vancouver Modified Work Programs, to enable staff to undertake light-duty operations and maintenance tasks on green rainwater infrastructure.
10.9	Identify opportunities for green rainwater infrastructure stewardship (i.e., as part of the Green Streets Program through the Street Activities Branch)
10.10	Work with partners to identify roles and responsibilities associated with restoration of green rainwater infrastructure practices impacted by street works following their construction (i.e., new city and third party utilities crossing through green rainwater infrastructure practices)
10.11	Develop methods of estimating green rainwater infrastructure restoration costs by city crews.
10.12	Undertake research to determine rehabilitation and renewal requirements for green rainwater infrastructure, and develop and adopt a program to undertake these as part of their lifecycle asset management.

Programs & Associated Sample Actions	
Program and Action No.	**Programs & Associated Sample Action Descriptions**
S&PS-11	**Sediment Management and Source Control Program**
11.1	Support an update to the catch basin cleaning program that incorporates preventative maintenance for green rainwater infrastructure practices that use catchbasins as inlets and targets hot spot and high sediment loading areas.
11.2	Support an update to the City's Street Sweeping Strategy that includes water quality objectives, the maintenance of green rainwater infrastructure such as permeable pavement, and the requirement for regular street sweeping during active construction.
11.3	Evaluate options for sediment recovery at Vernon Grit Facility to reduce landfill use and costs.
11.4	Evaluate environmental and water quality management at the City of Vancouver Sediment Recovery Station for potential improvements.
11.5	Explore options for catchbasin cleanout alternatives that may not require the expense and equipment of a vac-truck such as catchbasin insert options.
11.6	Establish maintenance protocol for surface sediment traps, including responsible maintenance group, schedules, and alternative delivery options like social enterprise.
11.7	Establish erosion and sediment control plan enforcement and fees.
11.8	Develop and adopt policy(ies) to protect existing green rainwater infrastructure assets from nearby construction activities (including protection from equipment and from sediment). Policy(ies) to include a provision for full restoration of green rainwater infrastructure negatively impacted by nearby construction activities. During policy development, explore potential impacts of policy on where and how materials are stored during construction and who inspects the green rainwater infrastructure practices and who enforces the policy(ies) and/or administers fees.
11.9	Develop or modify existing policies to enable the expansion of sediment and erosion control requirements to include protection of green rainwater infrastructure practices.
11.10	Train inspectors on how to identify high risk sources of contaminants (including sediment from construction sites) and their potential impacts on downstream green rainwater infrastructure practices to enforce sediment and erosion control policies.
11.11	Work with the appropriate city departments to ensure that snow and ice response methods do not have significant negative impacts on green rainwater infrastructure practices (i.e., use of sand, salt, brine, etc.)
11.12	Review street de-icing practices and their potential impacts on different types of green rainwater infrastructure practices. Work with partners to explore ways to mitigate any identified negative impacts to green rainwater infrastructure practices from de-icing practices while maintaining existing street safety/service levels.

Programs & Associated Sample Actions	
Program and Action No.	**Programs & Associated Sample Action Descriptions**
ENABLING PROGRAMS & ASSOCIATED SAMPLE ACTIONS	
S&PS-12	**Citywide Green Rainwater Infrastructure Financial Planning and Sustainable Funding Program**
12.1	Undertake research to identify different internal funding models to finance green rainwater infrastructure capital costs and life cycle asset management costs that take into consideration all benefits of green rainwater infrastructure (e.g. ecosystem service approach, utility fee, user polluter pay model, capital planning, and drainage utilities). Review models amongst key internal stakeholders to develop preferred model(s) for implementing green rainwater infrastructure in streets and public spaces.
12.2	Develop an external funding model that accounts for all benefits of green rainwater infrastructure (e.g. ecosystem service approach, utility fee, user polluter pay model, capital planning) and cost levies.
12.3	Explore broader set of considerations in rate-settings for water, sewer, and stormwater.
12.4	Develop a mechanism to secure a two year funding for establishment of green rainwater infrastructure.
12.5	Undertake research of correlating cost of services and drivers around green rainwater infrastructure, drainage, and stormwater management including user-pay methods in transportation and service connection (water, sewer, and storm) fees.
12.6	Explore partnerships and grant applications related to green rainwater infrastructure in provincial and federal agenda settings.
12.7	Identify key funders (e.g. Metro Vancouver, TransLink, province and federal government) including funders based on co-benefits (e.g. VCH)
12.8	Develop incentives for using groundwater, rainwater, greywater for non-potable use (e.g. toilet flushing, irrigation) through incentive programs (e.g. grants, credit programs, tax credit, etc.)
12.9	Undertake research of different exemptions or subsidies that can be provided for stormwater fee implementation.
12.10	Develop specific tax incentive that varies depending on the neighborhood demand or specific issues to be resolved using a user-pay model.
12.11	Develop utility model for private development to have water managed in public facilities.
12.12	Identify maintenance funding within capital funding to ensure operation and maintenance funding is in place for new green rainwater infrastructure capital projects.
12.13	Explore and develop a framework for valuing green rainwater infrastructure to ensure that future investments take into account of the potential for green rainwater infrastructure to deliver economic benefits.

Programs & Associated Sample Actions	
Program and Action No.	**Programs & Associated Sample Action Descriptions**
12.14	Develop methods and tools to understand performance of green rainwater infrastructure assets (e.g. WERF study of co-benefits).
12.15	Continuously monitor and report on life cycle costs for green rainwater infrastructure assets.
12.16	Integrate green rainwater infrastructure funding in capital and O&M capital and operating budgets for each department that is responsible for implementing green rainwater infrastructure practices.
12.17	Undertake research to assess the feasibility, impacts and identify sources of additional funding to facilitate the implementation of a pay-in-lieu system. A pay-in-lieu system would apply to capital projects delivered in streets and public spaces where rainwater management targets cannot be met, or can only be partially met by the department delivering the capital project.
S&PS-13	**Research and Innovation Program**
13.1	Undertake research and develop a soil strategy that explores the effectiveness of soil moisture and structure, soil management strategies on construction sites, and new resources of high quality soil amendments (e.g. biosolids and biochar).
13.2	Undertake research on the incorporation of wastewater treatment plant biosolids into the City's soil amendments, considering potential leaching of pollutants like nutrients.
13.3	Undertake research on the performance, lifecycle costs and lessons learned implementing different types of green rainwater infrastructure practices implemented in other jurisdictions.
13.4	Undertake and develop primer on common green rainwater infrastructure concerns in streets and public spaces.
13.5	Undertake research on insurance considerations for drainage and flooding as associated with green rainwater infrastructure practices.
13.6	Explore research opportunities to enhance knowledge of the ecological health benefits of green rainwater infrastructure in streets and public spaces.
S&PS-14	**Shift in City Process & Capacity Building**
14.1	Develop and implement a comprehensive training program for city staff that encompasses the design, construction, operation and maintenance, and reinstatement of green rainwater infrastructure practices.
14.2	Conduct training for City of Vancouver operations staff on green rainwater infrastructure fundamentals and on how to undertake operation and maintenance as well as how to reinstate green rainwater infrastructure practices on assets implemented on streets and public spaces.
14.3	Organize a workshop for city staff on erosion and sediment control on streets and public spaces, and on construction sites.
14.4	Engage with First Nations to learn about local traditional ecological knowledge (TEK) and how it can be incorporated in the design process of green rainwater infrastructures.
14.5	Develop and/or improve existing Green Streets framework to include green rainwater infrastructure adoption or sponsorship program, with additional resources and staffing.
14.6	Undertake research on how to reach a broad cross-section of people across the city to ensure inclusive engagement.
14.7	Develop a change management plan to support the staff transition to greater green rainwater infrastructure implementation in new capital projects and retrofit projects.

Programs & Associated Sample Actions	
Program and Action No.	**Programs & Associated Sample Action Descriptions**
S&PS-15	**Industry Capacity Building and Public Engagement Program**
15.1	Facilitate the creation of toolkits and guidance documents as well as training and maintenance support for the general public and community groups to improve awareness of green rainwater infrastructure and encourage their stewardship on streets and public spaces adjacent to private properties.
15.2	Develop a mobile display or engagement tool to explain the connection between water cycle, water quality issues and green rainwater infrastructure.
15.3	Develop an educational program on the health and safety of green rainwater infrastructure including insect vectors, collection of heavy metals in soils and plants, and non-potable water safety.
15.4	Develop and install interpretive signage on green rainwater infrastructure locations.
15.5	Work with third party groups on options to design and build demonstration pavilion showcasing green rainwater infrastructures. The pavilion to function as a demonstration project and educational hub.
15.6	Leverage existing green rainwater infrastructure on Olympic Village as an educational tool.
15.7	Explore how to include public art in green rainwater infrastructures and the public or industry awareness and empowerment campaign.
15.8	Establish an annual Rain Paint design competition in a public space setting (e.g. playful interaction in the rain).
15.9	Establish a green rainwater infrastructure event to coincide with World Water Day (March 22).
15.10	Establish a green rainwater infrastructure event to coincide with King Tide Day.
15.11	Establish a green rainwater infrastructure event to coincide with Master Gardener day.
15.12	Establish a green rainwater infrastructure event to coincide with a Rain Barrel sale.
15.13	Develop partnership with community groups, non-profit organizations, and private businesses to implement green rainwater infrastructure.
15.14	Offer a ‘rain garden starter pack’ including care booklet and tray of native plan plugs for garden sponsors.
15.16	Engage school students on water management and environmental stewardship.
S&PS-16	**Water Quality Monitoring Program**
16.1	Continuously monitor water quality in alignment with Liquid Waste Management Plan regulatory requirements and develop Vancouver specific approach.
16.2	Recommend an alternative solution to adaptive management framework for Vancouver's piped network.
16.3	Undertake analysis of sediment loading across the city to inform a street sweeping strategy.
16.4	Develop an inventory of high pollutant generating properties to help guide the policy development process of point source control requirements.
16.5	Undertake research on the link between emerging contaminants (e.g. Fentanyl or micro plastics) in stormwater.
16.6	Perform water quality monitoring at Olympic Village constructed wetland.
16.7	Perform a study of sediment and contaminant accumulation in catchbasins.

Rain City Strategy - Buildings & Sites Action Plan [Programs and Sample Actions]

Program Details			Program Implementation Approaches & Tools				Sample Actions
Program No.	Program Title	Program Description	Regulatory Roadmap	Enabling Early Adopters	Capacity Building	Corporate Leadership	
IMPLEMENTATION PROGRAMS							
B&S-01	**Advance Rainwater Management Policies and Regulations** — ***Supporting Implementation Through New and Existing Policies and Regulations***	Facilitate the integration of green rainwater infrastructure through the refinement of existing policies and regulations such as the Green Buildings Policy for Rezonings and the Sustainable Large Developments Policy for Rezonings and through the development of additional policies and regulations.	●	●	●	○	● Provide public guidance documents, nimble tools (such as supporting calculations), templates, report examples and local case studies to support existing regulations. ● Review and refine existing regulations and standards as required to advance the integration of effective rainwater management into new developments. ● Investigate pathways for enhanced compliance, including alternative approaches (e.g., pay-in-lieu system) and potentially more robust standards for large sites. ● Develop and adopt additional regulations, such as a Rainwater Management By-law, as needed.
B&S-02	**Improve Review and Compliance of Rainwater Management Plans** — ***Bolstering the Internal Review Process to Ensure the Targets of Rain City are Being Achieved on Buildings & Sites***	Strengthen the review processes within the rezoning, development and building permit stages to ensure efficiency, validate compliance, and improve outcomes. Ensure continuity between design, construction and occupancy stages.	●	●	●	○	● Undertake research on data collection and evaluation protocols and procedures to assess existing green rainwater infrastructure assets. ● Set targets for the review process and audit completed projects to gauge policy and process refinement opportunities. ● Explore a tracking mechanism and new regulatory instruments to ensure long-term operational performance of green rainwater infrastructure. ● Investigate integrated water management opportunities through the review process, incorporating rainwater management, groundwater discharge, sewer capacity and potable water use. ● Explore the possibility of landscape inspection requirement with accompanying holdback or bond to ensure proper maintenance of green rainwater infrastructure practices (i.e.bioretention).
B&S-03	**Single Family Dwellings, Laneway Homes, and Townhouses** — ***Assessing New & Existing Building Opportunities***	Engage key stakeholders, including home builders, designers and public, to evaluate opportunities and develop incentive programs and regulations, as appropriate, to implement green rainwater infrastructure in new and existing Part 9 buildings (simple structures).	●	●	●	○	● Explore solutions, including incentives and pilot programs, for rainwater management for typical development typologies, including for laneway homes. ● Investigate alternative compliance pathways that address Council priorities for increased housing, affordability and sustainability. ● Integrate learnings from "Research and Innovation" in the development of potential programs.
B&S-04	**Mid- and High-Rise Structures** — ***Assessing New & Existing Building Opportunities***	Engage industry to evaluate opportunities and develop incentive programs and regulations to integrate green rainwater infrastructure in new and existing Part 3 buildings (complex structures) not already captured through existing policies.	●	●	●	○	● Explore solutions, including incentives and pilot programs, for rainwater management for Part 3 buildings and sites. ● Establish timelines for expectations that are cognizant of the complexities and long-term nature of development planning. ● Integrate learnings from "Research and Innovation" in the development of potential programs.
B&S-05	**Rainwater Harvesting Program** — ***Building on Existing Policy***	Implement inspections of new and existing rainwater harvesting systems under the Council-approved Operating Permit program to protect public health and verify compliance.	●	●	●	●	● Use lessons learned from inspections to potentially refine regulations. ● Review new codes and standards, and revise the Vancouver Building By-law as required.

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Program Details			Program Implementation Approaches & Tools				Sample Actions
Program No.	Program Title	Program Description	Regulatory Roadmap	Enabling Early Adopters	Capacity Building	Corporate Leadership	
B&S-06	Resilient Roofs Program	Examine policy and program options for resilient, blue-green roofs (and variations therein) for new and existing buildings, integrating learnings from "Research and Innovation." Ensure roofs are used most effectively, based on building form, use, and characteristics of the area.	●	●	●	●	● Initially, focus on research, data collection, and understanding of best practices, as well as exploring opportunities to enable early adopters. The subsequent phase will shift to policy development. Sample actions could include: ● Collect data of existing blue-green roof assets within the city. ● Conduct jurisdictional review of North American cities that have implemented green roof bylaw/requirements/incentives. ● Investigate opportunities to remove barriers to green roof implementation (such as potential warranty issues, insurance implications and competing uses). ● Research toolkits for design and maintenance. ● Develop policy and/or regulations to ensure green roofs are implemented where it makes most sense to do so, in conjunction with other roof top uses and amenities.
B&S-07	Civic Facilities *— Demonstrating Corporate Leadership*	Continue to implement innovative practices in city-owned buildings. Document lessons learned from the design, construction and operations of innovative green rainwater infrastructure already installed at civic facilities. Study performance through monitoring and incorporate learnings to enhance delivery and inform potential green rainwater infrastructure policies and programs.	○	○	●	●	Much like how City-owned buildings have led the way on energy efficiency and low greenhouse gas emissions, a similar pathway is envisioned for green rainwater infrastructure. Sample actions could include: ● Identify and implement demonstration projects at civic facilities (such as roofing projects and plaza renovations). ● Incorporate green rainwater infrastructure opportunities with city yard master plans (e.g. Manitoba Yard master plan). ● Incorporate green rainwater infrastructure opportunities with the City Hall Campus master plan. ● Incorporate green rainwater infrastructure opportunities with near-term capital projects.
ENABLING PROGRAMS							
Capacity Building and Engagement							
B&S-08	Public Engagement and Activation *— Empowering Positive Community Action*	Engage with the public to raise awareness of rainwater management, climate change and green rainwater infrastructure, empowering positive action in the community.	○	●	●	○	Public awareness, support and participation in Rain City will be critical for success, particularly on the private realm. Sample actions include: ● Consider existing participatory models (such as New York City's "Wait" pilot program). ● Investigate voluntary programs with potential incentives and technical support (such as a downspout disconnect program, contingent on geotechnical and building structural considerations).
B&S-09	Industry Capacity Building *— Fostering Industry Excellence*	Facilitate capacity building amongst developers, designers and contractors to share knowledge regarding design standards, guidelines and industry best practices for implementing green rainwater infrastructure.	○	●	●	○	It is critical that builders, engineers, architects and developers be supported to implement green rainwater infrastructure practices on their projects to meet the City's requirements. As part of this capacity-building, industry dialogue can also help inform future policies and regulations to be most effective. Sample actions include: ● Work with Metro Vancouver Stormwater Interagency Liaison Group to update the Metro Vancouver Stormwater Source Control Guide to include design guidelines for various development types in the city. ● Connect with third party certification organizations to stimulate implementing green rainwater infrastructure practices on a building level (e.g. Fraser Basin Salmon Safe Certificate). ● Engage with developers and consultants on potential approach, challenges and opportunities to build capacity for delivery of green rainwater infrastructure practices on new development.

Program Details			Program Implementation Approaches & Tools				Sample Actions
Program No.	Program Title	Program Description	Regulatory Roadmap	Enabling Early Adopters	Capacity Building	Corporate Leadership	
Monitoring and Evaluation							
B&S-10	**Monitoring, Data Analysis and Metrics** ***— Assuring an Evidence-Based Approach***	Monitor, measure and analyze data to facilitate a robust, evidence-based approach to policy and program development. Use reliable data to prioritize efforts and highlight areas for improvement. Consider neighbourhood and watershed-level metrics such as impermeable area, extent of sewer separation and degree of effective connectivity. Evaluate metrics quantifying the relative flows from Streets & Public Spaces, Buildings & Sites and Parks & Beaches to focus efforts effectively.	●	○	●	○	● Audit existing rainwater management systems ● Develop metrics specific to buildings & sites to measure progress, effectiveness and impact over time (which can serve as a dashboard for the Buildings and Sites Working Group) ● Work in partnership with Engineering to determine where green rainwater infrastructure is most needed (to inform prioritization or more robust requirements) ● Consider neighbourhood and watershed-level metrics such as impermeable area, extent of sewer separation and degree of effective connectivity to focus efforts effectively.
Research and Innovation							
B&S-11	**Infiltration** ***— Evaluating Geotechnical and Building Foundation Aspects***	Assess infiltration opportunities and barriers within the Vancouver context.	●	●	●	○	● Consider geotechnical and building code perspectives to inform potential initiatives such as infiltrating green rainwater infrastructure practices and downspout disconnection, an update to existing guidance. ● Research design standards and code requirements on setbacks from structures
B&S-12	**Resilient Roofs with Water Management Capabilities** ***— Assessing Opportunities and Barriers***	Evaluate the engineering implications, business case, opportunities, barriers and lessons learned (including actual outcomes) for resilient, blue-green roofs (and variations therein) for new and existing buildings. Consider the context of potentially competing roof-top demands such as building mechanical equipment.	○	○	●	○	● Evaluate the engineering implications of green roofs and blue-green roofs ● Measure outcomes and evaluate lessons learned from existing green roofs, focused locally but could also draw from other cities in the region and elsewhere ● Better understand warranty and insurance challenges and seek to remove or reduce these potential barriers.
LINKED (COMPLEMENTARY) PROGRAMS							
B&S-13	**Non-Potable Water Systems** ***— Assessing New Opportunities and Evaluating Public Health and Engineering Aspects***	Develop policies to facilitate the implementation of safe and well-maintained non-potable water systems in Vancouver.	●	●	●	○	● Undertake research to assess the public health implications, engineering feasibility, business case, opportunities, and barriers (such as variability in quality and supply) to expand the non-potable water uses and sources permitted in Vancouver. ● Review codes and standards implemented in other jurisdictions, and revise the Vancouver Building By-law to expand the non-potable water uses and sources permitted and improve regulation of non-potable water use in Vancouver.
B&S-14	**Reduce Sanitary Discharge to Sewer** ***— Maximizing Existing Sewer Capacity Cost-Effectively***	Continue to implement water conservation and efficiency efforts to drive down sanitary loads from building and sites. Create capacity to manage rainwater within the existing combined sewer infrastructure by reducing sanitary discharges (including groundwater, condensate, etc.).	●	●	●	○	● Conduct a cost-benefit assessment to identify the most cost effective means of reducing discharges to the sewer and drainage system from both rainwater and sanitary sewer sources on Single Family Dwellings, Laneway Homes and Townhouses. ● Develop incentive programs and/or regulations to implement the most cost-effective measures to reduce discharge to the sewer and drainage system from single family homes.

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Rain City Strategy - Parks and Beaches Action Plan [Programs]

Program Details		
Program No.	**Program Title**	**Program Description**
IMPLEMENTATION PROGRAMS		
P&B-01	**Green Rainwater Infrastructure Integration into Park Development Standards Program**	Develop new and/or modify existing Park Development Standards, Standard Technical Specifications and Best Management Practices to facilitate the integration of green rainwater infrastructure in parks, beaches and recreational spaces. Ensure that new and modified standards, specifications and best management practices adopt the provincially-mandated Citywide Integrated Rainwater Management Plan, including the IRMP's rainwater management design standard and performance target. This initiative will be guided by high-level principles, which shall be developed and adopted to inform an integrated water management approach across all parks, beaches and recreational spaces.
P&B-02	**Protect and Enhance Park Service Levels through Green Rainwater Infrastructure Retrofits**	Explore opportunities to integrate green rainwater infrastructure retrofits in parks, beaches and recreation spaces to address drainage issues and manage areas prone to surface water ponding and flooding and to enhance park biodiversity and visual amenities. Ensure that green rainwater retrofits on parks, beaches and recreation spaces protect, and ideally enhance, service levels.
P&B-03	**Non-potable Water Systems and Water Conservation & Efficiency**	Explore opportunities for the use of non-potable water systems, and water conservation & efficiency to reduce potable water use and reduce park discharges to the city's sewer and drainage system. Retrofit and new capital project opportunities to pursue include the use of non-potable water systems for irrigating parks and recreation areas, implementing re-circulating systems on splash pads and water features, and the use of smart controls to minimize discharges to the sewer system from non-critical water features during combined sewer overflows. This work shall include developing policies, design, operation and maintenance standards to ensure the safe and well-regulated use of these measures to ensure the health and wellbeing of park and recreation area users.
P&B-04	**Green Rainwater Infrastructure Integration into Playing Fields**	Undertake research to identify opportunities to update playing field design standards to incorporate green rainwater infrastructure as part of enhancing playing field drainage and improving field service levels. Retrofit an existing playing field or identify a playing field under development for a pilot / demonstration project that incorporates green rainwater infrastructure. Monitor the performance of pilot/demonstration project(s) and incorporate lessons learned to inform future playing field projects.
P&B-05	**Parks and Recreation Spaces Climate Change Adaptation Program**	Undertake research to identify risks to parks and recreation areas associated with drainage, flooding and drought and how these will be impacted by climate change. Develop and adopt more holistic way of planning, delivering and managing water resources, utilities and green rainwater infrastructure as part of achieving VanPlay's Goal #5 - adapt parks and recreation spaces to a changing climate.
P&B-06	**Create a Green Network That Will Connect Our Parks, Waterfront and Recreation Areas**	Work citywide to implement a layered green rainwater infrastructure, human, and ecological network to help achieve VanPlay Goal #6 to create a green network to connect parks, waterfronts, and recreation spaces. Utilize pilot and demonstration green network projects to determine how to best integrate green rainwater infrastructure and deliver benefits through these networks and apply findings to enhance their delivery across the city.
P&B-07	**Enhanced Urban Forest Program**	Undertake research to understand how green rainwater infrastructure can help protect, grow, and manage trees to create a diverse, resilient, and beautiful urban forest across the city. Use findings to guide the implementation of green rainwater infrastructure capital and retrofit programs that enhance the city's urban forest cover.
P&B-08	**Enhanced Park Biodiversity Program**	Undertake research to understand the biodiversity benefits associated with green rainwater infrastructure and use findings to enhance the delivery of the Park Board's Biodiversity Strategy. Green rainwater infrastructure practices shall be used as part of improving the quality of Vancouver's natural areas and to support biodiversity and increase access to nature.

Program Details		
Program No.	**Program Title**	**Program Description**
P&B-09	**Minimize Impervious Surfaces within Parks and Recreation Spaces**	In new and existing parks, implement Park Board design best practices, such as permeable pavement and other green rainwater infrastructure practices to minimize impervious surfaces and drain impervious surfaces to green rainwater infrastructure practices to enhance how rainwater is managed.
P&B-10	**Multi-stakeholder Land Acquisition for Rainwater Management and Park Use in Key Watershed Areas**	Contribute to a reduction in paved surfaces and associated rainwater runoff as well as provide a location for the management of rainwater and park amenity space through land acquisition across the city. Work with partners to find synergies for the acquisition of new land in areas with critical drainage or flooding issues, urban heat island issues and other concerns, and use this land for rainwater management and recreational use.
P&B-11	**Green Rainwater Infrastructure Operation and Maintenance and Asset Management**	Identify sustainable funding mechanisms and develop plans to finance the management of green rainwater infrastructure assets in parks, beaches and recreation areas including operation and maintenance over their life cycle. Implement an effective operation and maintenance program for green rainwater infrastructure assets that preserves and extends their level of service and their service life.
P&B-12	**Protect and Enhance Beaches and Waterfront Program**	Work in partnership with First Nations rights-holders, other levels of government and with stakeholders to protect and enhance the city's beaches and waterfront through improvements to rainwater quality and reduction of combined sewer overflows into waterways. Seek opportunities to implement green rainwater infrastructure to enhance recreational uses of beaches and the waterfront, improve aquatic habitat for fish and wildlife and help mitigate and adapt to impacts associated with climate change.
ENABLING PROGRAMS		
P&B-13	**Citywide Green Rainwater Infrastructure Financial Planning and Sustainable Funding Program**	Identify equitable sources of long-term funding for green rainwater infrastructure, including funding sources associated with pollutant generation. Use funding source(s) to develop and implement a holistic financial plan that encompasses capital costs, asset management and operation and maintenance to enable green rainwater infrastructure implementation in capital projects and retrofits in parks, beaches and recreation spaces. Undertake research to develop a business case to identify funding requirements to manage these assets to preserve and extend their service life and level of service.
P&B-14	**Research and Innovation Program**	Continuously improve ways of managing rainwater in parks, beaches and recreation spaces by undertaking research and keeping up-to-date on innovations in the green rainwater infrastructure sector. Contribute to industry best practice and innovations in the sector by reporting monitoring data and analysis and lessons learned at conferences and workshops.
P&B-15	**Shift in Park Board Process & Capacity Building**	Facilitate adaptation of Park Board processes to enable the successful implementation of green rainwater infrastructure. Encourage this shift through greater collaboration and updating internal processes to adapt to a changing environment. Staff knowledge and capacity to support the implementation of green rainwater infrastructure will be strengthened through training, standards, guidelines and other approaches and tools.
P&B-16	**Industry Capacity Building & Public Engagement**	Facilitate building capacity amongst designers and contractors by communicating Park Development Standards, Standard Technical Specifications and Best Management Practices applicable to implementing green rainwater infrastructure in new parks capital projects. Achieve the Park Board's VanPlay Goal #7 to engage with industry professionals, designers, and contractors through environmental stewardship and educational programs to build awareness on how green rainwater infrastructure integrates with wild spaces and vital biodiversity across the city's parks, beaches and recreational spaces.

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