



100 YEAR SUSTAINABILITY VISION

Prepared by **THE DESIGN CENTRE FOR SUSTAINABILITY**
For the **CITY OF NORTH VANCOUVER**

MAY 2009

WRITTEN BY:

Patrick Condon, Sara Muir Owen, Nicole Miller with Richard White
and Suzanne Smith and assistance from Jackie Teed
Graphic layout by Inna Olcholovski and Sara Fryer

This publication is available on the City's website at:
www.cnv.org/100YearVision



Back row (left to right): Councillors Clark, Keating, Fearnley, Heywood. Front row (left to right): Councillor Trentadue, Mayor Mussatto, Councillor Bookham



The Corporation of the City of North Vancouver
The Office of Mayor Darrell Mussatto

May 2009

On behalf of North Vancouver City Council, I am pleased to present the *100 Year Sustainability Vision*, developed in cooperation with the District of North Vancouver and in celebration of the City's 100th anniversary in 2007. Prepared by the Design Centre for Sustainability at the University of British Columbia, with input from community stakeholders, other government and non-government agencies and City staff, this study begins the enquiry into how the City will change in the coming century, and indicates potential opportunities for enhancement. Our world, and our City within it, will face many challenges over the coming decades. It is important that we are well informed when it comes to facing these challenges and that we do so at our earliest opportunity. Environmental issues are and will continue to be of great concern to the City and the global community; and this is why the implications of climate change, while not yet fully realized, have formed the basis for this current work. I would like to express City Council's appreciation to all of the dedicated people who participated in this project. I am sure that the *100 Year Sustainability Vision* will provoke much thought and discussion in the coming years as the City continues to build upon our welcoming, sustainable community.

A handwritten signature in black ink, appearing to read 'D. Mussatto'.

Darrell R. Mussatto
Mayor

ACKNOWLEDGEMENTS

100 YEAR SUSTAINABILITY VISION PROJECT TEAM:

CITY OF NORTH VANCOUVER

Richard White, Director, Community Development
Suzanne Smith, Planner, Community Development
Isabel Gordon, Director, Finance
Hilda Tam, Office Coordinator, Community Development

DESIGN CENTRE FOR SUSTAINABILITY

Core Project Team:

Professor Patrick Condon, Principal Investigator
Sara Muir Owen, Project Manager
Nicole Miller, Project Coordinator
Jone Belausteguigoitia, Researcher
Susan Milley, Researcher
Sigrid Grünenberger, Researcher
Inna Olchovski, Research Assistant

Other DCS Contributors:

Elisa Campbell, Executive Director
Rachael Cabrera, Operations Manager
Sara Fryer, Researcher
Dave Flanders, CALP, UBC
Liz Johnston, Director
Colin O'Byrne, Researcher
Daniel Roehr, Assistant Professor, greenskinsLAB, UBC
Stephen Sheppard, Professor, CALP, UBC
Jackie Teed, Senior Manager

UBC FACULTY & STUDENTS

Duncan Cavens, Post-Doctoral Fellow, UBC
Kari Dow, MLA Candidate, UBC
Courtney Miller, Researcher, MASA, UBC
Jon Salter, PhD Candidate, UBC

SUB CONSULTANTS

Graham Barron, Graham Barron Design
Colin Cathcart, Kiss + Cathcart Architects
Jay Hiscox, Senior Associate, Stantec
James Tuer, JWT Design
Erick Villagomez, Metis Design-Build

Cover image by Daniel Roehr

STAKEHOLDER PARTICIPANTS

Glenn Stainton, LEC Manager
 Tyke Babalos, Property Owner, Sugar Bowl Holdings Ltd.
 James Fox, Developer, Wedgewood Ventures
 Al Saunders, Harbourview Projects Corp.
 Annwen Loverin, Executive Director, Silver Harbour Senior Centre
 Ian Abercrombie, Director of Facilities & Planning, School District # 44
 Dominica Babicki, Supervisor, Sustainability Research, DNV
 Sheryl Fisher, Communication Officer, Squamish Nation
 Robyn Wark, Senior Key Account Manager, BC Hydro
 Chris Dorais, Chair, North Vancouver School Board
 Pam Horton, Community Accessibility
 John Watson, Marine Drive Resident's Association
 Rosario Setticasi, Real Estate
 Tamin Raad, Manager, Project Planning, Translink
 Gil Yaron, Business Owner, Frogfile
 Sarah Dal Santo, Section Manager, Policy Planning, DNV
 Ian Forsythe, Director, North Vancouver Office of Cultural Affairs
 Jennifer Sanguinetti, Stantec
 Victoria Smith, BC Hydro
 Melanie Marchand, Chair, Advisory Planning Commission
 Susan Haid, Manager, Sustainable Community Development, DNV
 Margo Gram, Cultural Services Coordinator, Centennial Theatre
 Mike Hunter, Manager, Parks & Environment
 Dave Hutch, Landscape Architect
 Cheryl Kathler, Community Planner
 Dragana Mitic, Asst. City Engineer, Transportation
 Gary Penway, Deputy Director, Community Development
 Phil Sanderson, Economic Development Manager
 Don Sigston, Manager, Lands
 Ben Themens, Vice-President Finance & Corporate Affairs, LEC
 David Sprague, Property Owner
 Ivan Leonard, North Vancouver City Coalition of Community Associations
 Caroline Jackson, Environmental Coordinator
 Naomi Yamamoto, Chamber of Commerce

100 years ago, the founders of the City of North Vancouver established a plan for the City. This plan provided an enduring framework for development, with a logical arrangement of major streets, minor arterials, industrial zones, parks, and protected natural areas. Sited ideally on the crest of a south facing slope, Lonsdale Avenue became the backbone of the City.

100 years later, we live in a profoundly different world. Yet, the original City plan still endures, and in many ways is finally coming to completion. A new century faces the City—one with challenges that the founders probably could not imagine. Chief among these challenges is long term sustainability, and the City's positive contribution to the long range sustainability of the region, the country, and in no small part, the world. The City has established a reputation in the region and beyond for leadership in sustainability. From a green purchasing program to the construction of the country's first modern era municipal district heating system, the City and its citizens are working to create a greener, more sustainable future.

On the 100th anniversary of its founding, the City has embarked on an ambitious challenge, asking citizens and the region, province, and country: Is it possible for a City to adjust development practices such that in 100 years it will have zero impact on the environment, and eliminate greenhouse gas (GHG) emissions production?

This document contains the best available answers to those questions, given that 100 years in the future is a very long time, with many unforeseen conditions and consequences.

The good news is that eliminating the production of GHG emissions, though immensely challenging, is not impossible. During the period of intense consultation with citizens, experts, City officials, and facilitators a plan emerged for the City of North Vancouver that looks remarkably like the City of today only, in the minds of many participants, better. This report shows a City that continues to grow—from about 45,000 people at the time of this report to nearly 140, 000 by 2107 - by adding density and a more robust mix of land uses throughout the City.

In addition to these land use changes, a city-wide commitment to the implementation of new building energy performance and intensive building retrofits means every future City resident could produce considerably less GHG emissions. Our estimates suggest the Vision can result in more than 50% per capita reductions in energy consumption for building heating and cooling and automobile travel, if land use changes and intensive building energy performance and retrofits are implemented city-wide. If these changes are reinforced by an aggressive expansion of a reduced carbon district heating system, transit electrification, and building performance the 80% per capita GHG reduction will also be in reach. At the same

time, the visual change to the City over that 100 years could in fact be incremental and modest, allowing this same City to maintain its character even as its population may triple.

Space for an additional 60,000 jobs in the city would insure that citizens continue to have jobs close to home and continue to provide jobs for people in nearby municipalities. A more even and accessible distribution of land uses, most notably the allowance for neighbourhood commercial space within a five minute walk of all citizens, will dramatically reduce the need to use personal vehicles, and increase the viability of frequent bus, trolley bus, and streetcar systems. The framework for a highly efficient system to condition buildings in the most intensely utilized areas of the City already exists: the Lonsdale Energy Corporation (LEC). Through intensive expansion of the district energy system and by serving all buildings within system service areas, the LEC can both provide and share energy with efficiencies many times higher than with individual heating and cooling plants. The LEC system also has the capacity to transition to GHG neutral or “green” energy sources over time.

An expanded, low-GHG LEC system, combined with a gradual increase in City and provincially mandated building efficiency and technologies, existing building retrofits, and reduced automobile travel as fostered by the choices made by participants in this project, put the City well on its way to achieve the Province’s 2050 goal: reducing GHG emissions by 80%.

Finally, through further shifts away from private vehicle use, and with continued improvements in technology and additional low-GHG energy sources for transportation (such as electrification of cars and buses) and buildings (such as solar panels on a percentage of all south facing surfaces) meeting the ultimate goal of GHG neutrality by 2107 is possible. What’s important is that the choices that the City makes today are designed to support such a 100 year vision as outlined in this report.

None of the participants in this event assume that the vision they have collectively produced provides anything like an exact plan for a definite future. Far too much is unknown and contingencies and circumstance are always the driving feature of democratic society. But what it does provide is the confidence that the City is on the right track, and with continued leadership, the City of North Vancouver can continue to provide a path to a better future for our children, our grandchildren, and our great grandchildren.

Patrick Condon, Senior Researcher
Design Centre for Sustainability, UBC

A LETTER FROM THE MAYOR
 ACKNOWLEDGMENTS
 FOREWORD

PART ONE:	
THE 100 YEAR SUSTAINABILITY VISION AND GHG REDUCTION MEASUREMENTS	3
1.0 INTRODUCTION	5
2.0 SCOPE AND PROCESS	9
2.1 Development of the Vision	11
2.2 Turning the Vision into Reality	17
3.0 THE 100 YEAR SUSTAINABILITY VISION	19
3.1 Painting the Picture	21
3.2 The Major Green Infrastructure, Mobility and Land Use Moves	23
3.3 Measuring Land Use Change	25
3.4 Measuring Energy and GHG Emissions	29
PART TWO:	
PRINCIPLES, GOALS, AND DESIGN STRATEGIES TO ACHIEVE THE 100 YEAR SUSTAINABILITY VISION	35
4.0 GREEN INFRASTRUCTURE	37
4.1 Green Infrastructure Principles and Goals	39
4.2 Green Infrastructure Design Strategies	41
5.0 MOBILITY NETWORK	63
5.1 Mobility Network Principles and Goals	65
5.2 Mobility Network Design Strategies	65
6.0 HOUSING AND JOBS	81
6.1 Housing and Jobs Principles and Goals	83
6.2 Housing and Jobs Design Strategies	83
7.0 CONCLUSION	107
8.0 APPENDICES	
Appendix One - The 100 Year Sustainability Vision Charrette Process	109
Appendix Two - Key Framing Issues	113
Appendix Three - Preliminary 2107 Low-GHG Diagram Assumptions	119
Appendix Four - Preliminary 2007, 2050, 2107 Energy and GHG Studies	131
Appendix Five - GHG Measurement and Mapping Technical Paper Abstract	141
REFERENCES	145

PART ONE:

THE 100 YEAR SUSTAINABILITY VISION AND GHG REDUCTION MEASUREMENTS

Part One provides an introduction to the City of North Vancouver *100 Year Sustainability Vision*, outlines the project scope and process, and details the charrette results, including a general description of the Vision. It provides descriptions of major land use, mobility and green infrastructure design decisions developed during the charrette as well as the land use measurements of these key design decisions. Finally, Part One provides an overview of the GHG measurements from the charrette results, and outlines the extent to which the project achieves the 80% GHG emissions reduction by 2050 meta-target and GHG neutrality by 2107. Part One is comprised of three sections:

Section 1.0: Introduction provides an introduction and summary of the City of North Vancouver planning origins, sustainable development successes and how the *100 Year Sustainability Vision* came to be.

Section 2.0: Project Scope and Process outlines the scope, meta-targets and principles for the Vision. It provides an overview of the project process including descriptions of the workshops, background research and the charrette event. Finally, it suggests a context for the Vision in terms of the City's conventional planning activities and intergovernmental coordination.

Section 3.0: 100 Year Sustainability Vision describes the illustrative plan, including its major green infrastructure, mobility and land use framework. It also outlines the Vision's land use designations and densities, and related energy demand and GHG emission reduction estimates.

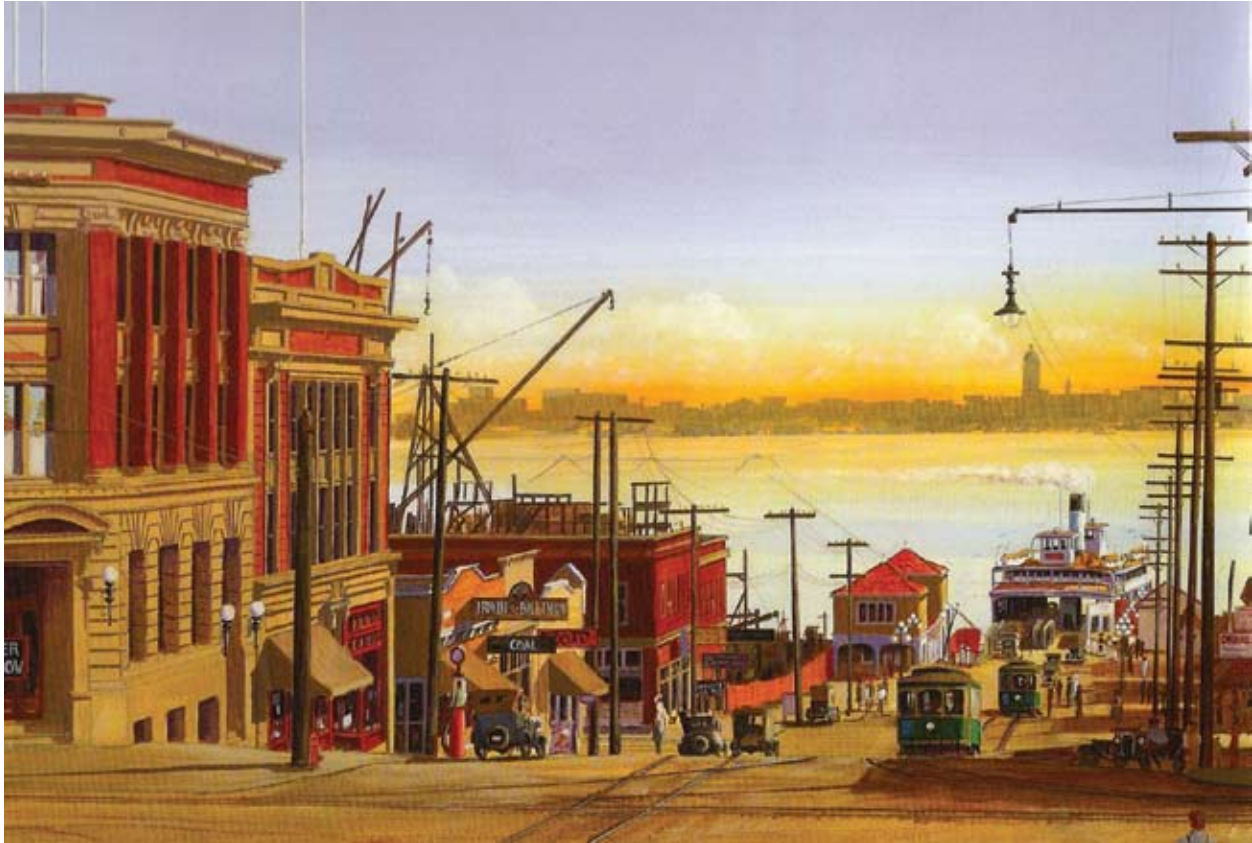


Figure 1.1 “From the time of its inception North Vancouver had a strong sense of its own identity and an indestructible confidence in its own future” - Image courtesy of: Sommer, Warren. *The Ambitious City: A History of the City of North Vancouver*. Harbour Publishing 2007.

Over 100 years ago, the North Vancouver Land and Improvement Company outlined their expectations to develop the City of North Vancouver as a highly livable, urban municipality. In a 1908 brochure the Company announced: “efforts have been made to plan the original town site so as to secure permanently the greatest physical good to the community at large.” As a result of these early planning efforts, the then budding Lower Lonsdale town centre—planned around a “quadrangle of boulevards” with traditional streetcars—became known as “The Ambitious City.”

True to The Ambitious City’s origins, the City’s first Official Community Plan (1980) placed an emphasis on quality of life considerations above others and sought to create a diverse, healthy and livable community. Metro Vancouver recognized the renewed strength and vitality of Lower Lonsdale by designating it as a Regional Town Centre in the 1996 Livable Region Strategic Plan. In 2002, the City updated its OCP around the theme of sustainability, creating a far more comprehensive plan than a traditional land use document, that included an innovative OCP Targets, Indicators, and Monitoring System (TIMS) to track its implementation. In 2005, the City received the annual Energy Aware Award, recognizing the City’s outstanding efforts to reduce greenhouse gases through its comprehensive Greenhouse Gas Action Plan. In 2007, the Province of BC awarded the City the inaugural Green City Award for progress made towards a complete, compact community as outlined in its OCP.

The City has been an active advocate of working towards the region’s Livable Region Strategic Plan goals. The city’s topographic character and relatively small land base results in a more compact urban form than found in other Metro Vancouver municipalities. As a result, the city has higher residential densities and a lower proportion of single-family residential development than other communities in the region. Furthermore, it has one of the lowest rates of car use in Metro Vancouver.

In 2004, the City established a district heating system through the Lonsdale Energy Cooperation (LEC), an independent utility owned, operated and regulated by the municipality. At the time of this report, the system provides heat and hot water to eleven higher density developments with a mix of commercial, residential and institutional land uses within the service area. A City bylaw requires that all new multi-family, commercial, industrial and institutional buildings in the service area connect to the LEC’s system. In 2008, the City installed 120 rooftop solar hot water panels. By 2010, the district energy systems will serve an additional nine new developments.

By 2007, the City’s 100th year, most of its 11 sq km (4 sq mi) land base was developed with the remainder reserved for parks and open spaces. Yet, the city will continue to experience sustained growth over the next 20, 50 and 100 years. This growth is due to the city’s very advantageous location across the harbour from downtown Vancouver, the attractiveness of the community, the city’s accessibility to services and the desirability of this area as a place to live and work. In the initial workshop for this study, community stakeholders agreed that population might continue to grow at 1% per year, meaning

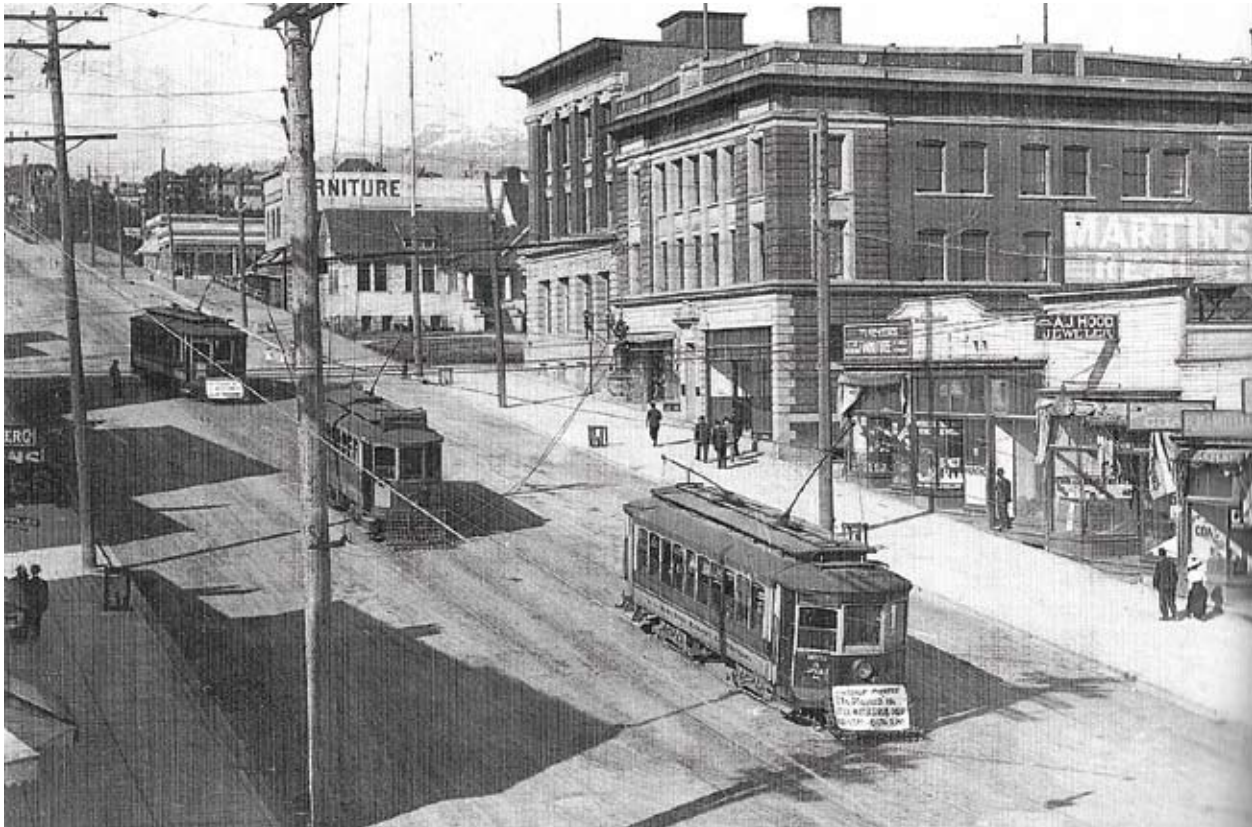


Figure 1.2 Streetcars running along Lonsdale Avenue, between Esplanade and First c. 1913 - Image courtesy of: Sommer, Warren. *The Ambitious City: A History of the City of North Vancouver*. Harbour Publishing 2007

a tripling of the population by 2107 (1% annual growth compounded). With this added growth, development pressure will continue or even intensify.

The issue of housing affordability will likely continue to be a key challenge for the City. Growing recreational demands will impact parks and open space resources. Aging municipal and regional infrastructure, including transportation routes, water systems and waste facilities, will require replacement over time. Furthermore, energy consumption will increase with population, putting greater demand on the district energy system and regional energy infrastructure. As the community places increasing emphasis on greenhouse gas (GHG) reduction, cleaner energy sources for all utilities will be of particular concern.

This future growth, unlike patterns of the past, will occur through redevelopment and densification of existing neighbourhoods, corridors and Lower, Central and Upper Lonsdale. What will this redevelopment and densification look like? How can redevelopment and retrofitting contribute to mitigating the city's GHG emissions? Can the city continue to grow as expected and simultaneously reduce its carbon footprint and increase its livability? Based on the research associated with this study and the collective knowledge and experience of the stakeholders, the answer is "yes."

In keeping with its Ambitious City tradition, the City brought local contributors, City staff, outside agencies and researchers together in an intensive visioning charrette. These participants worked collaboratively to consider the changes

that will occur during the coming century and to develop design and planning strategies with which to respond. Reflecting the aim of the original Ambitious City, participants have worked to create solutions that "secure, permanently, the greatest physical good to the community at large" while keeping in mind key, if less tangible, elements that contribute to community well-being through policy development (e.g. how to accommodate seniors and persons with disabilities). The *100 Year Sustainability Vision* is an innovative approach to informing urban planning and policy that provides a framework for dramatic greenhouse gas reductions, achieving BC's 80% GHG reduction target by 2050 and carbon neutrality by 2107.

City Council invited the District of North Vancouver to participate in this integrated planning and design exercise. The District with the UBC Design Centre for Sustainability conducted an exercise on a smaller scale for portions of the District adjacent to the City. Both charrettes occurred in the same venue at the same time to facilitate cooperative progress through the sharing of ideas.

We are confident the results of this charrette advance the City's long-term planning efforts and, as a Sustainability by Design (SxD) case study, serve to benefit others in the region, province and nation.

A design charrette is a multi-stakeholder event in which participants work towards consensus on complicated questions in a very short amount of time. It is unique in its ability to bring citizens and officials from all walks of life to participate effectively and efficiently in a creative, collaborative design process. The Design Centre for Sustainability at UBC has tested and refined the charette method over 15 years, and has used it with scores of stakeholder groups.

For the City of North Vancouver the charrette method was particularly appropriate. On the 100th anniversary of the City's founding, the City proposed creating a vision for the following 100 years—a vision for a sustainable city that uses drastically less energy and has net zero greenhouse gas emissions as a core goal. Planning officials, in concert with elected leaders, embarked on an exploration of what would be required to realize this community.

But reality grounded this visioning session. The contemporary city structure and regional policies formed the basis for the charrette, as did the existing arrangement of land uses, roads, technologies and ecological systems. The real world trends for population and job growth were also crucial. Thus, the fundamental question became “can we organically grow a truly sustainable city from what we have now and, if we did, what could it look like?”

2.0 SCOPE & PROCESS

9

A successful public planning process is invariably grounded in a strong and reasonable set of principles. In this work the City accepted the logic of the six fundamental principles for sustainable development that had been established by the Design Centre for Sustainability's ongoing regional project: Sustainability by Design. These principles represented simple but highly informative rules for the design of cities in our region: access to linked public places, parks and natural areas; green, durable, timeless infrastructure; mixed-use corridors accessible to all; five minute walking distance to commercial services and transit; appropriate housing for all; and, good and plentiful jobs close to home. An additional principle was added because of the compelling environmental circumstances recognized by the City: adapt to climate change. These principles are each distilled from the large body of publicly approved municipal, regional and provincial policies, further substantiating and contextualizing this project.



Charrette Day One. Participants discuss future visions for the city. Notes and rough drawings record the conversations.



Charrette Day Two. The design team compiles the results of day one's discussions into a diagram to help frame the discussions on day two.



Charrette Day Three. The team presents the work of the first two days to the public at an evening mid-course correction. The team incorporates public comments and discussions on the final two days.



Charrette Day Four. The charrette team prepares the results of all charrette discussions for the final public presentation on the evening of day four.

Figure 2.1 Images from the charrette event

2.1 DEVELOPMENT OF THE VISION PROJECT SCOPE

The City of North Vancouver visioning charrette was a multiphase, stakeholder-driven, design-based initiative aimed at developing a *100 Year Sustainability Vision* in the form of a citywide concept plan. Guided by the Province's recently introduced Greenhouse Gas Reduction Targets Act (November 2007) to reduce GHG emissions by 80% below 2007 levels by 2050, the project approaches sustainability through the lens of climate change and the City's commitment to address it.

The following Vision, meta-targets and principles provided the framework to support discussion and decision-making at the workshops and charrette event.

PROJECT VISION

To be a vibrant, diverse, and highly livable community that provides for the social and economic needs of our community within a carbon neutral environment by the City's 200th Birthday in 2107.

PROJECT META-TARGETS

- To achieve zero net greenhouse gas (GHG) emissions by 2107
- To reduce GHG by 80% below 2007 levels by 2050 (Greenhouse Gas Reduction Target Act, Province of BC, November 2007)

PROJECT PRINCIPLES

1. Access to linked public places, parks and natural areas
2. Green, durable, timeless infrastructure
3. Climate change adaptation
4. Mixed-use corridors accessible to all
5. Five minute walking distance
6. Appropriate housing for all
7. Good and plentiful jobs close to home

PROJECT PROCESS

The *100 Year Sustainability Vision* is a collaborative, multistage project that involved local and regional community stakeholders, City staff, utilities representatives, researchers and others working together over a series of months. The City's Community Development Department provided guidance and necessary background information and data, while the Design Centre for Sustainability (DCS) project team provided management, facilitation, research, and report preparation.

Through Phase One, the DCS project team reviewed and prepared background research, identified key framing issues (see Appendix Two) and developed supporting goals, objectives, and design strategies to frame the project vision. This Phase was comprised of two important project stakeholder events. The first event, *Workshop One: Framing*, took place in April 2008. This half day session enabled participants to refine the Sustainability by Design principles, revise goals and develop specific supporting objectives for the future Vision.

In this first workshop, participants assembled

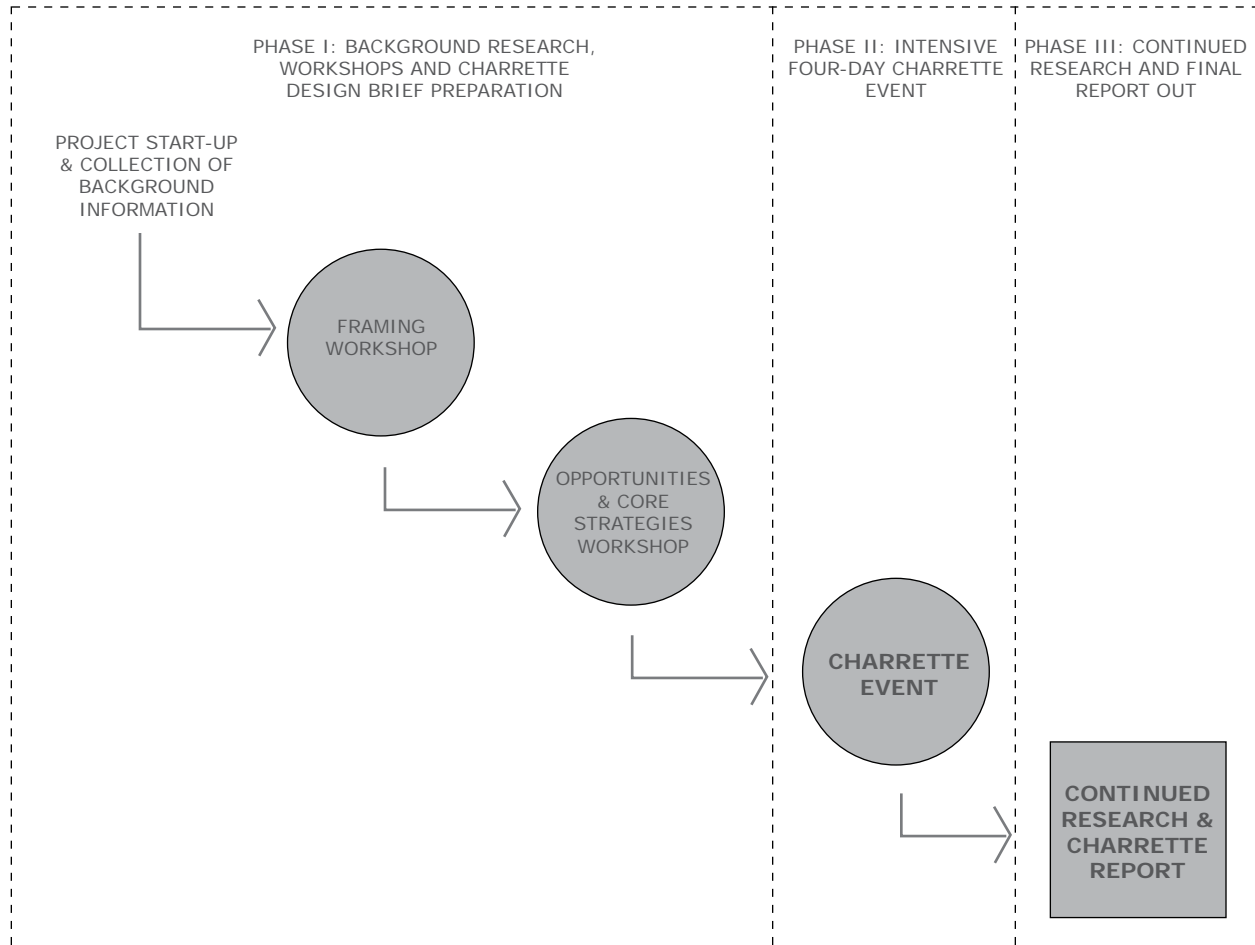


Figure 2.2 Project Process. Key events mark the project timeline: the Framing workshop; the Opportunities and Core Strategies workshop; and, the Charrette itself. Key deliverables include: a Goals and Objectives document; an Opportunities and Core Strategies document; a Design Brief; and, this Charrette report. Throughout the process, the DCS team developed GHG estimates for existing conditions and the *100 Year Vision* (see Appendix One: *Charrette Process* for a more detailed diagram of the project process).

in three teams to determine appropriate goals and objectives to frame design solutions for issues related to transportation and mobility (the Go Team); parks, open space networks, green infrastructure and climate change adaptation (the Green Team); and, housing and employment (the Home/Work Team). Together, the teams developed a core set of goals and corresponding objectives to frame the project and guide future discussion. In addition, the teams agreed upon assumptions regarding population (a tripling of the population) and the number of jobs (1.5 per household) anticipated by 2107.

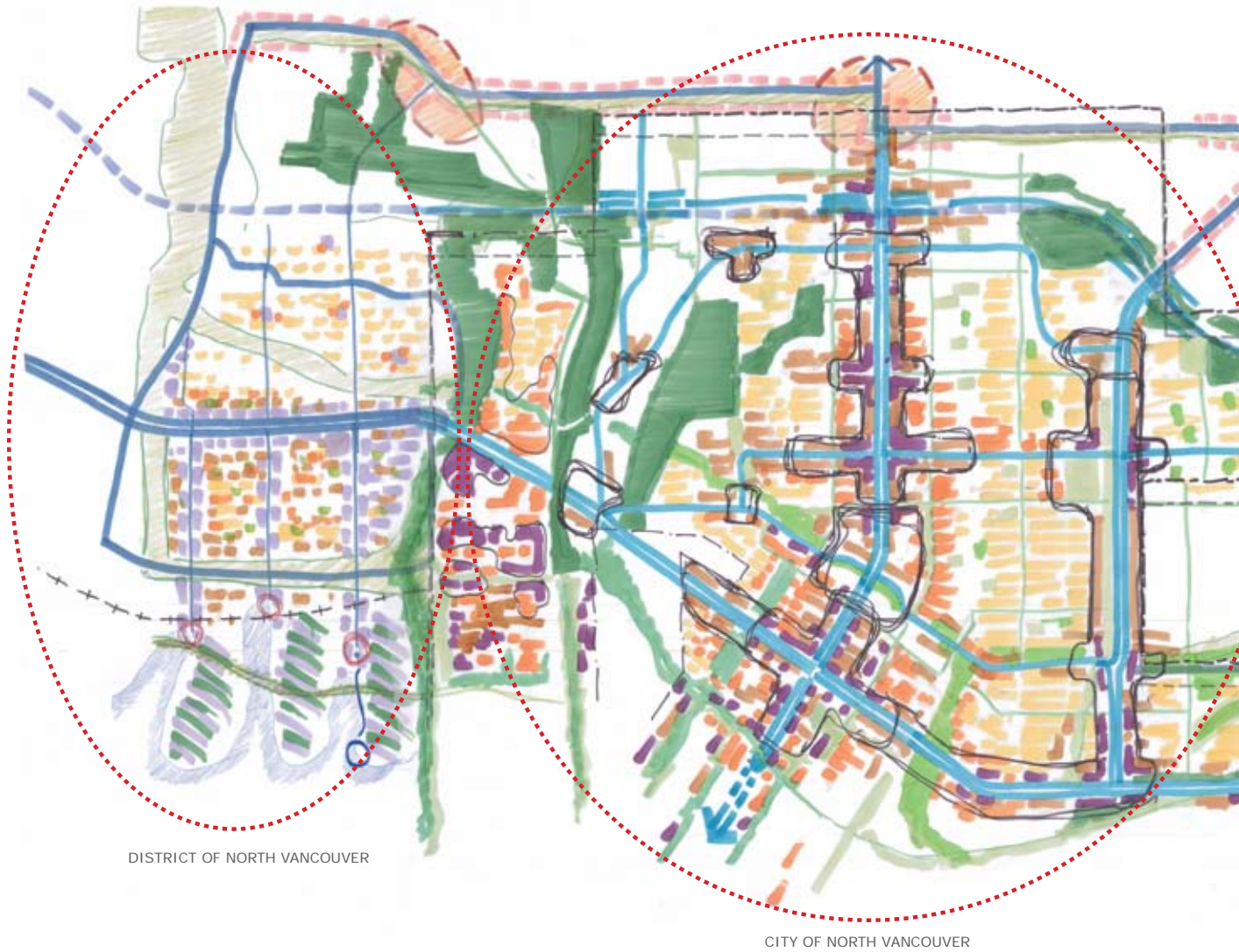
The second stakeholder event, *Workshop Two: Opportunities and Core Strategies* took place in June 2008. At this workshop stakeholders reviewed and revised a preliminary, low-GHG diagrammatic plan. The project team prepared this diagram based on goals and objectives from workshop one. Using a language of major, minor and neighbourhood nodes, as well as corridors and infill areas, participants referred to their Go, Green and Home/Work teams to identify areas of change and intensification. The workshop resulted in revisions to the low-GHG 2107 diagram that served as the base plan for further discussion, analysis and design at the charrette.

During the course of Phase One, in addition to the stakeholder workshops, the research team explored methodologies and underlying assumptions needed to evaluate community-wide GHG emissions per capita and estimate future reductions. Appendix Three includes a summary of this research methodology and approach. The City team shared information with the District of North Vancouver and several staff from the District participated in the phase one exercise. Phase Two began shortly after the second

stakeholder workshop and cumulated in the four-day charrette event from September 8-11, 2008. The intensive four-day commitment created fertile ground for the opportunity to “talk, doodle and draw.” The teams further refined the preliminary, low-GHG diagram core strategies and reviewed the underlying research assumptions. The teams met in plenary each day of the charrette to determine consensus on core strategies. The designated charrette “drawing hands” from each team further developed and refined these strategies into design solutions.

These detailed design solutions address issues ranging from infill in single-family areas to expansion of the district energy service area, and at a citywide scale they form the illustrative *100 Year Sustainability Vision*. In addition, the DCS project team prepared a rough evaluation of the charrette outputs, including people, jobs and GHG estimates, to quantify the extent to which the resulting 2107 Vision achieved the 80% GHG emission reduction by 2050 and the 2107 zero net GHG emission target.

At a mid-course correction event on the evening of Day Two, the teams presented preliminary design solutions to members of the public. The feedback gathered at this event further informed the issues, challenges and strategies developed over the remaining days. On the evening of Day Four, the charrette team presented final charrette results. Figure 2.2 illustrates the charrette process from project start-up to the final charrette report.



DISTRICT OF NORTH VANCOUVER

CITY OF NORTH VANCOUVER



Figure 2.3 Within the first two days of the charrette, the City and District teams produced a concept diagram that illustrated core design strategies determined by consensus amongst the Go, Green and Home/Work teams. The diagram outlines major transit routes, land use allocation and intensities along Lonsdale Avenue, other corridors and within the single-family neighbourhoods. It also illustrates the open space system and linked green network connections from school sites, parks and other green infrastructure elements. Image drawn by Colin Cathcart and team designers.



Figure 2.4 Esplanade Avenue at Lonsdale Avenue looking east, 2008.

2.2 TURNING THE VISION INTO REALITY

This *100 Year Sustainability Vision* is only useful if it actually assists the City to achieve the project's principles, targets, and goals. The intent of the Vision is to serve as a useful, illustrative image of what the future might look like in context of these fundamental framing elements. The Vision also intends to guide land use and planning decision-making and possibly other relevant local and regional government actions by informing future policy recommendations and implementation.

The effectiveness of the design strategies that comprise the Vision will rely on consistency with the City's planning tools such as the Official Community Plan (OCP) and Local Area Plans, as well as other regulatory aspects such as zoning bylaws, subdivision bylaws, development permit areas and guidelines, development incentives and other regulations and programs. These planning tools and land use regulations must work within the context of the principles and goals of the Vision, as well as supporting greenhouse gas reduction targets and core design strategies. Intergovernmental coordination with the District of North Vancouver, Squamish Nation, Metro Vancouver and the Province is also important to support the local and regional implications of this Vision.

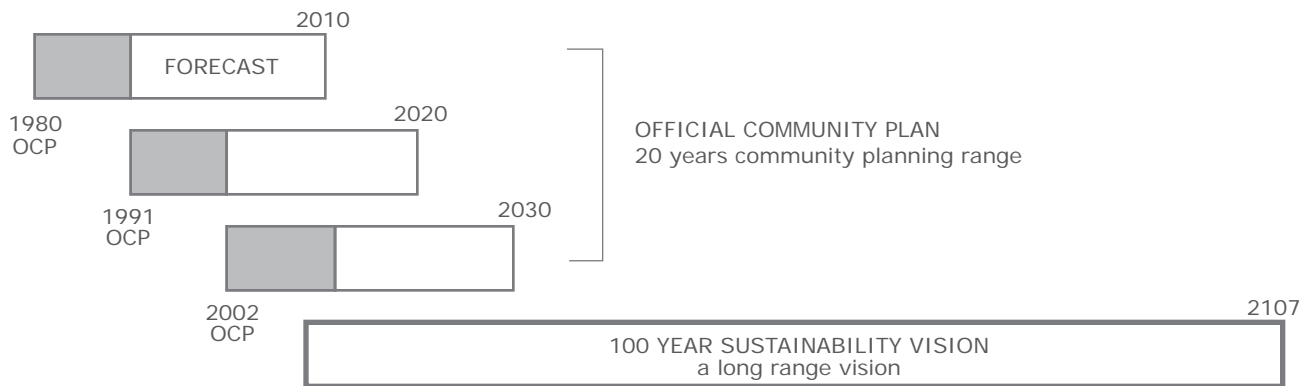


Figure 2.5 The Official Community Plan (OCP) is a planning document envisioning community planning within a twenty year planning period. In contrast, the *100 Year Sustainability Vision* is a planning and design exercise that examines sustainable development issues citywide, and provides a guide for future sustainable city decision-making over the next 10, 20, 50 and even 100 years.

The *100 Year Sustainability Vision* is a consensus plan that captures the best efforts of participants to consider North Vancouver a century from today. This plan does not aim to detail every potential change in the community. Rather, it provides a guide for future sustainable city decision-making over the following ten, twenty, fifty and even 100 years. While the resulting city may not look exactly like the one depicted herein, it will meet the vision, principles and goals of the City and its citizens.

The Vision describes what the City of North Vancouver could look like and how it may function in the future with triple the number of jobs and population. This future city resembles the current one, albeit even more vibrant and efficient. The original city plan has the capacity to absorb this new activity without major changes to community character or assembling land into large parcels. The Vision anticipates intensifying Lonsdale Avenue as the key corridor. Single-family neighbourhoods remain visually similar, accommodating gradual infill while providing continuity in the local sense of place.

3.0 THE 100 YEAR SUSTAINABILITY VISION

To both rationalize and simplify the analysis of parcels citywide, the city was organized into a set of urban patterns. These are not conventional planning divisions; each pattern represents areas with recognizable character, land use and street configurations. The urban patterns are tools for understanding the greenhouse gas emission performance of existing neighbourhoods, and they facilitate the consideration of how the city could organically transform over time to meet GHG reduction goals.

The *100 Year Sustainability Vision* describes a city that reaches the 80% GHG reduction target by 2050 and continues to employ green, clean energy services and increase transportation and building efficiencies to achieve net zero GHG emissions by 2107. Key to the success of this Vision are a new distribution of neighbourhood commercial services and an intensified local transit system. Additional density, the inclusion of an adequate number of jobs and a more even distribution of commercial land uses enables reductions in vehicle use. Our estimates suggest that land use changes outlined in this report and intensive citywide building energy retrofits can result in more than 50% per capita reductions in energy consumption for building conditioning and automobile travel.



100 Year Sustainability Vision - City of North Vancouver



LEGEND

	Mixed-use/ Commercial
	Medium-density
	Low-density
	Light Industrial
	Industrial
	Office
	Open Space and Parks
	Natural Features
	Transit Corridor
	Transit Route

Figure 3.1 The Vision describes a sustainable urban form that reduces GHG emissions per capita. It shows where nearly 3 times as many people will live and work without major changes to the community character. Higher density is focused along Lonsdale Avenue and other major corridors. Single-family areas experience gradual infill while maintaining a local sense of place. Key to the success of the Vision are a new distribution of neighbourhood commercial services, intensified industrial sites and a comprehensive local transit network. These elements are surrounded by a framework of green infrastructure systems, including green streets, linked parks and open space and a naturalized, accessible waterfront. Drawn by Colin Cathcart, Patrick Condon, James Tuer, Daniel Roehr, Nicole Miller, Sara Muir-Owen and additional team designers.

3.1 PAINTING THE PICTURE

On Day Four of the charrette event the team created a final Concept Plan for the City's *100 Year Sustainability Vision*. This Vision resulted from blending the design strategies of the three teams into a comprehensive picture of what the city could look like when framed by the Sustainability by Design principles: access to linked public places, parks and natural areas; green, durable, timeless infrastructure; climate change adaptation; mixed-use corridors accessible to all; five minute walking distance; appropriate housing for all; and, good and plentiful jobs close to home.

Framed by these principles and guided by the goals and objectives developed in the workshops, the team applied design strategies for land use, building form and density, mobility and green infrastructure citywide. The team also identified strategies that require intergovernmental coordination and regional scale implementation. The resulting plan exhibits sustainable urban form that serves to reduce GHG emissions, accommodate climate change adaptation, incorporate stormwater management and enhance livability. The Vision paints a picture of the new building and transportation infrastructure required to accommodate a tripling of the population and 1.5 jobs per household. By responding to and building upon the City's original "quadrangle of boulevards," the Vision supports a comprehensive local and regional mobility network. It maintains or intensifies existing commercial, residential and industrial areas. Finally, the Vision expands an integrated network of parks and open space, including a naturalized and widely accessible waterfront.



100 Year Sustainability Vision - City of North Vancouver



Figure 3.2 Concept plan indicating major moves agreed upon by all three teams at the end of the charrette event. Drawn by Colin Cathcart and team designers.

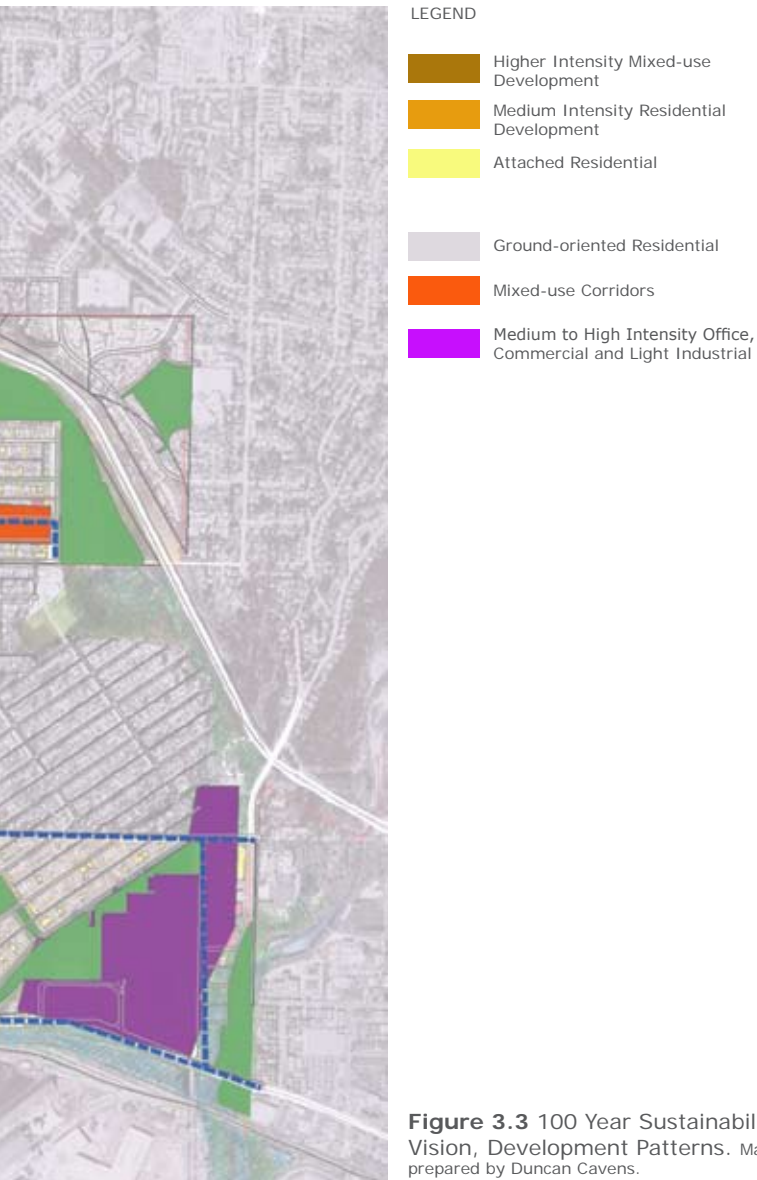
3.2 THE MAJOR GREEN INFRASTRUCTURE, MOBILITY AND LAND USE MOVES

By Day Three of the charrette, participants had decided on the major moves of the future plan. The mobility network and urban form responds to an increase in parks, greenway connections and green streets, as well as a rehabilitated naturalized, widely accessible open space and waterfront system. Mixed-use residential, commercial and office development extends along key transportation corridors to connect homes to jobs, goods and services, support a viable transit system and facilitate vibrant street life.

Major routes with key transit hubs form an integrated network throughout the city. The transit network further connects to a comprehensive North Shore-wide system. Higher intensity development centres along Lonsdale Avenue with major nodes at the Upper Levels Highway, around Central Lonsdale and at Lower Lonsdale. These nodes are comprised of mixed-use buildings, high-rise and low-rise apartments and some standalone commercial and industrial uses. Medium-density development extends east and west approximately one to one-and-a-half blocks from this central spine.

The residential land use between corridors intensifies over time. The majority of single-family parcels also intensify to include coach houses, row housing, small apartments and some mixed-use residential and commercial where appropriate.





3.3 MEASURING LAND USE CHANGE

The research team determined land use allocation and intensity using a “development pattern” approach that attributes parcel-level and building performance details (such as number of residential units and commercial floor area) to a mix of designated uses with a defined area. This information enables the team to estimate relatively quickly how many people and jobs the allocated land uses will support (see figure 3.3 for the projected distribution of jobs and people). The measurements indicate that the future Vision supports a tripling of the population to 140,000 people in 2107 and provides the targeted 90,000 jobs. This can be achieved through:

1. Higher intensity mixed development along Lonsdale Avenue (brown) with a total average floor area ratio (FAR) of 3.5.

- 10% high-rise multi-family (>10 storey; 5.5 FAR)
- 25% mid-rise (4-8 storey; 3.0 FAR)
- 10% mixed-use (2.2 FAR)
- 12% commercial and office
- 35% public right-of-way
- 7% designated open space

Table 3.1 Population and Employment Comparison, 2007 and Charrette Scenario

	2007 Baseline	Charrette 2107 Scenario
Population	46311	141270
Employment Population	31760	94490
Population Density (persons/hectare)	39	119
Total Households	22098	79563
<i>detached single family</i>	4927	762
<i>attached duplex and rowhouse</i>	2274	3575
<i>apartment <5 stories</i>	10261	45223
<i>apartment >5 stories</i>	4636	30005
Residential Density (units/hectare)	19	67

2. Medium intensity residential development one to two blocks east and west of Lonsdale Avenue and along Marine Drive (orange) with an average FAR of 2.2.

- 12% mid-rise multi-family (3.0 FAR)
- 30% mid-rise (4-8 storey; 2.2 FAR)
- 10% apartments (4-5 storey; 1.3 FAR)
- 33% public right-of-way
- 15% designated open space

3. Attached residential (yellow) with a total average FAR of about 1.0.

- 25% attached housing (2-3 storey row houses and/or townhouses; 0.8 FAR)
- 12% multi-family residential (3-4 storey apartments; 1.3 FAR)
- 10% mixed-use (1.0 FAR)
- 33% public right-of-way
- 20% designated open space.

4. Ground oriented residential (white) with a total average FAR of 0.8.

- 20% detached single-family housing (with and without secondary suites and/or coach houses)
- 13% duplexes and row houses (0.8 FAR)
- 5% multi-family (3-4 storey apartments 2.2 FAR)
- 2% mixed-use residential and neighbourhood commercial or office services (FAR 1.3)
- 27% public right-of-way
- 33% designated open space

5. Mix use corridors (red) with a total average FAR of about 2.2.

- 35% mixed-use residential and commercial (4-5 storey; 2.2 FAR)

- 20% multi-family residential apartments (2.2 FAR)
- 10% higher density multi-family apartments (10 storeys; 3.0 FAR)
- 10% higher density multi-family apartments (3-4 storey; 1.3 FAR)
- 26% public right-of-way

6. Medium intensity office, commercial and light industrial (purple) with a total average FAR of 2.3.

- 25% medium-density commercial and office building (average 1.3 FAR)
- 11% commercial/industrial/office (FAR 3.2)
- 18% medium-density multi-family (2.2 FAR)
- 5% higher density multi-family apartments (12+ storey 5.5 FAR)
- 8% mixed-use residential apartments (2.2 FAR)
- 23% public right-of-way
- 10% designated open space.

7. High intensity office, commercial and light industrial (dark purple) with a total average FAR of 3.5.

- 25% higher density commercial, office and industrial building types (average 3.2 FAR)
- 10% is a highly intensive commercial/industrial/office building form (FAR 5.0)
- 18% medium-density multi-family (3.0 FAR)
- 5% higher density multi-family apartments (12+ storey; 5.5 FAR)
- 8%) is mixed-use residential apartments (2.2 FAR)
- 23% public right-of-way
- 10% designated open space



3.4 MEASURING ENERGY & GHG EMISSIONS

The City of North Vancouver is one of the first municipalities in British Columbia to investigate the feasibility of meeting the Provincial GHG emission target (80% GHG emission reduction from 2007 levels by 2050) established by the 2007 Greenhouse Gas Reduction Targets Act. Through this unique Vision, the City illustrates how an 80% GHG reduction target might be met and explores how the City will move towards net zero GHG emissions by its bicentennial in 2107.

The Vision suggests land use, building form, transportation and infrastructure choices can contribute significantly to reducing energy consumption and GHG emissions while supporting additional green infrastructure, mobility and urban form goals. Yet, what level of GHG emission reductions can be achieved through this Vision? Can the provincial targets actually be met? How much of this reduction is a result of urban form decisions?

To better understand the GHG impacts of the *100 Year Sustainability Vision*, the DCS team created GHG emission estimates for both the 2107 Vision and the 2007 baseline conditions. Researchers used “development patterns” to create computer-based scenarios representing both the form of the City in 2007 and the integrated building, transportation and infrastructure strategies proposed for the Vision by project stakeholders. Geographic Information System (GIS) analysis, along with building energy and transportation data, generated both quantitative GHG emission estimates and spatial “GHG maps.” More details are provided in Appendix Four: *Preliminary 2007, 2050 and 2107 Energy and GHG Studies*.



Figure 3.4a - A “case” and “development pattern” based methodology estimating the current condition (2007 scenario) per unit energy demand. Maps prepared by Duncan Cavens.



An overview of the GHG measurement and mapping approach is outlined in Appendix Five: *City of North Vancouver 100 Year Sustainability Vision: GHG Measurement and Mapping Technical Paper Abstract*.

GHG emission estimates for the Vision indicate that the City can achieve approximately 31% reduction in energy (on a per capita basis) through changes in density, form and location of urban development. This reduction includes both savings from residential building heating and cooling requirements and reduced automobile travel. Furthermore, through additional improvements in new building energy performance and intensive building retrofits, the City could see total per capita reductions in energy of over 50%. Assuming similar fuel sources, GHG emission reductions would be approximately equivalent; switching to renewable low-carbon energy sources would support even greater GHG reductions.



Figure 3.4 A “case” and “development pattern” based methodology estimating 100 Year Vision (2107 scenario) per unit energy demand. Both current and 2107 scenarios were spatialized illustrating a much “greener” city. Maps prepared by Duncan Cavens.

Table 3.2 Energy and GHG Emission Estimates, 2007 and Charrette Scenario

	2007 Baseline	Charrette 2107 Scenario		
	46000	141000		
Population				
Mitigation Strategies	n/a	none	urban form (density + land use mix)	urban form + intensive energy efficient building technologies
Per Capita Energy (GJ/person)	68	68	47	32
<i>residential buildings</i>	26	26	21	6
<i>transportation</i>	42	42	26	26
Per Capita GHG (tonnes/person)	3.7	3.7	2.5	1.8
<i>% Change</i>	<i>n/a</i>	<i>0%</i>	<i>-30%</i>	<i>-50%</i>
Total GHG (tonnes)	170000	523000	353000	254000
<i>% Change</i>	<i>n/a</i>	<i>200%</i>	<i>110%</i>	<i>50%</i>

Of course, per capita emissions reductions are only part of the story. With a tripling of population over the same time period, total emissions for the City would still increase roughly 50% from 2007 levels, even with 50% per capita reductions (Table 3.2). However, this reduction estimate is based on urban form changes and building efficiency improvements alone. Emissions can be further reduced not only through the application of new and developing technologies, but also in large part through lifestyle and behavioural changes for individual residents, including choices on residential energy use, travel and other types of consumption.

It must be noted that time constraints and the uncertainty of technological change made it impossible to arrive at a detailed consensus outlining specific building scale technologies. This uncertainty clouds our ability to provide specific numerical projections for building scale GHG reductions over the long-term. However, our preliminary work, included in Appendix Four: *Preliminary 2007, 2050 and 2107 Energy and GHG Studies*, is suggestive and optimistic. With an aggressive expansion of the City's district energy system, a switching over of the system to low to no GHG sources, and lifestyle changes in transportation, the City could meet its 2050 reduction target, dropping per capita GHG emissions by 80% or more. With the addition of a reasonable amount of on-site generation technologies such as solar panels the City could also meet its 2107 target of a 100% reduction.

PART TWO:

PRINCIPLES, GOALS AND DESIGN STRATEGIES TO ACHIEVE THE 100 YEAR SUSTAINABILITY VISION

Part Two provides an overview of the SxD principles, supporting goals and a summary of the design strategies developed during the charrette. Goals refine the overall aspiration of the Vision and root the concept plan in the SxD principles. Design strategies define the means and initiatives required to achieve the goals that together result in a highly liveable and more efficient community. Each strategy relates a particular SxD principle and goal to a specific place, site and/or building design. The strategies are documented in the details of the Vision's illustrative plan, as well as supporting drawings, cross sections and diagrams.

While the origin of goals and strategies was workshops one and two, they could only be fully defined through the design ideas generated at the charrette event. They are organized under the seven project principles in three key sections:

Section 4.0: Green Infrastructure

considers the parks, trails, riparian areas and stormwater systems that comprise the Vision. It outlines strategies for green streets, waterfront rehabilitation, and opportunities for local food production, as well as a climate change mitigation and adaptation strategies.

Section 5.0: Mobility Network focuses on the movement of people, bikes, cars, trucks, buses and boats within the city, across the North Shore community and, to the extent applicable, throughout the region.

Section 6.0: Housing and Jobs documents goals and design strategies related to location, building types and density ranges of future homes and workplaces.

While the imperative to cut greenhouse gases to meet Provincial policy provided a core issue for exploration, it did not exclude other crucial sustainability issues from consideration. In particular, three of the seven principles address working with, not against, green systems in the city.

Green infrastructure strategies fall into five categories: 1. physically and functionally integrate durable and timeless city infrastructure into the surrounding ecosystems; 2. knit together the presently incomplete green systems in the sub region; 3. maximize the inherent capacity of buildings and sites to reduce energy use, and to increase local food production; 4. recycle and reuse site generated energy; and, 5. use ecological strategies to mitigate sea rise.

The *100 Year Vision* integrates the form and function of city infrastructure with surrounding ecosystems through a green street network. Green streets reduce the cost of building and repairing roadways while mitigating the downstream consequences to receiving streams. Maintaining the integrity of stream corridors and green networks also creates biking and walking opportunities. Degraded corridors cost money to repair and are unlikely to attract recreational users or encourage alternatives to automobile use.

The repaired and restored green network represents an amenity that is not fully appreciated today. However, the city with triple the current population in 2107 will exert additional pressure on green spaces. Properly designed, the sub regional green system of streams and estuaries is robust enough to meet both ecological and recreational demands. The green infrastructure strategy provides the overall plan and detailed technologies to affordably realize these needs.

4.0 GREEN INFRASTRUCTURE

Over the next 100 years the Vision takes advantage of the latent food production and energy capacity of homes, parcels and buildings. The plan strategically locates plant material for summer shading and winter wind protection. Food production takes place on local lots, continuing a trend already underway in some neighbourhoods. Building-scale solar panels take advantage of access to sunlight on rooftops, eventually supplying a large part of the much reduced energy demand.

Energy production is not exclusive to parcels. Other opportunities are implemented at the sub region scale. Between the new sewage treatment plant in the Lions Gate area, the waste-to-energy plant proposed for the Maplewood area of the District and the potential for major expansion of the City's district energy system, tremendous efficiencies are possible for providing, sharing and effectively using energy that is now or could be wasted. A distributed system shares energy from all three sources to provide the proper energy at the proper time throughout the sub region.

Finally, despite global efforts, some degree of sea level rise is now inevitable. The Vision calls for careful reconsideration of shoreline regulations by integrating protective estuary systems at stream outflows to both expand the biodiversity of the site and mitigate storm surges. These natural strategies are often as effective as engineered barriers, although the latter may be required as well. Building policies for the shoreline can require waterfront development to incrementally incorporate flood protection in an unobtrusive way.

The Green Infrastructure design strategies are framed by Sustainability by Design Principles:

- 1. ACCESS TO LINKED PUBLIC PLACES, PARKS AND NATURAL AREAS;**
- 2. GREEN, DURABLE, TIMELESS INFRASTRUCTURE;**
- 3. CLIMATE CHANGE ADAPTATION.**



Figure 4.1 A concept sketch of the city's waterfront and nearby neighbourhoods, illustrating a significant increase in green space and green infrastructure, including an interconnected system of parks, "green streets," increased urban forestry, green roofs and new greenways along the waterfront. Drawing by Daniel Roehr.

4.1 GREEN INFRASTRUCTURE PRINCIPLES AND GOALS

The strategies described in this section aim to promote sustainability by achieving three goals:

1. Ensuring access to an attractive, safe, and interconnected public realm for all citizens. Sustainable, low-GHG communities promote a public realm that celebrates the natural environment and that is designed to enhance and connect the community. A high quality public realm includes attractive streetscapes, public gathering places and natural areas that are functional for all who use and move through them, including seniors, youth, families and those with disabilities. It facilitates a multi-cultural, multi-generational and diverse community. Carefully designed higher densities integrated with the public realm enhance vibrancy, safety and sense of place by providing activity, enclosure, eyes on the streets and spaces people can readily access and use.

Protecting, preserving and linking natural areas with parks and public spaces promotes recreation, healthy living and a connection with nature. A linked network also maintains and restores ecosystem functions within the community and beyond, accommodates habitat and sequesters GHG emissions. An interconnected public realm supports energy efficiency by providing new, low-impact opportunities to move through the city while creating stormwater management and other green infrastructure possibilities. The Green Necklace is an example of a continuous system of parks that links major public destinations throughout the city. Its planning demonstrates an awareness of the significance of current and future passive and active recreation needs.

2. Providing buildings and infrastructure that have longer lifecycles and a reduced impact on the environment. Sustainable, low-GHG communities balance the economic, social and ecological impacts of buildings and infrastructure. Longer lifecycles and innovative development standards preserve and enhance the use of both private and community resources. Commitment to this goal increases energy efficiency, reduces GHG emissions and minimizes the costs of development and infrastructure. Green buildings and community energy systems further support the reduction of GHG emissions. Natural areas, parks and other open spaces, in addition to green streets and on-site stormwater management practices, contribute to flood prevention and improve overall water quality.

3. Ensuring adaptation and resiliency to potential challenges while maintaining citizens' quality of life. The City must plan for the mitigation of climate change as well as increase community adaptability. This goal supports urban systems that are resilient to climate change impacts while enhancing the quality of life for residents. Potential consequences of climate change in BC's Lower Mainland in the next 50 years may include sea level rise, increased storm intensity, increased precipitation in winter, decreased precipitation in spring and summer and higher temperatures. To address changes communities will require many adaptation measures: land use changes and habitat restoration along waterfronts and creeks; naturalized stormwater networks; demand management for the possibility of reduced reservoir capacity; and, prevention of erosion and landslides. Future resiliency necessitates the development of local, renewable energy and food systems, as well as the incorporation of sustainability into all planning and development initiatives.

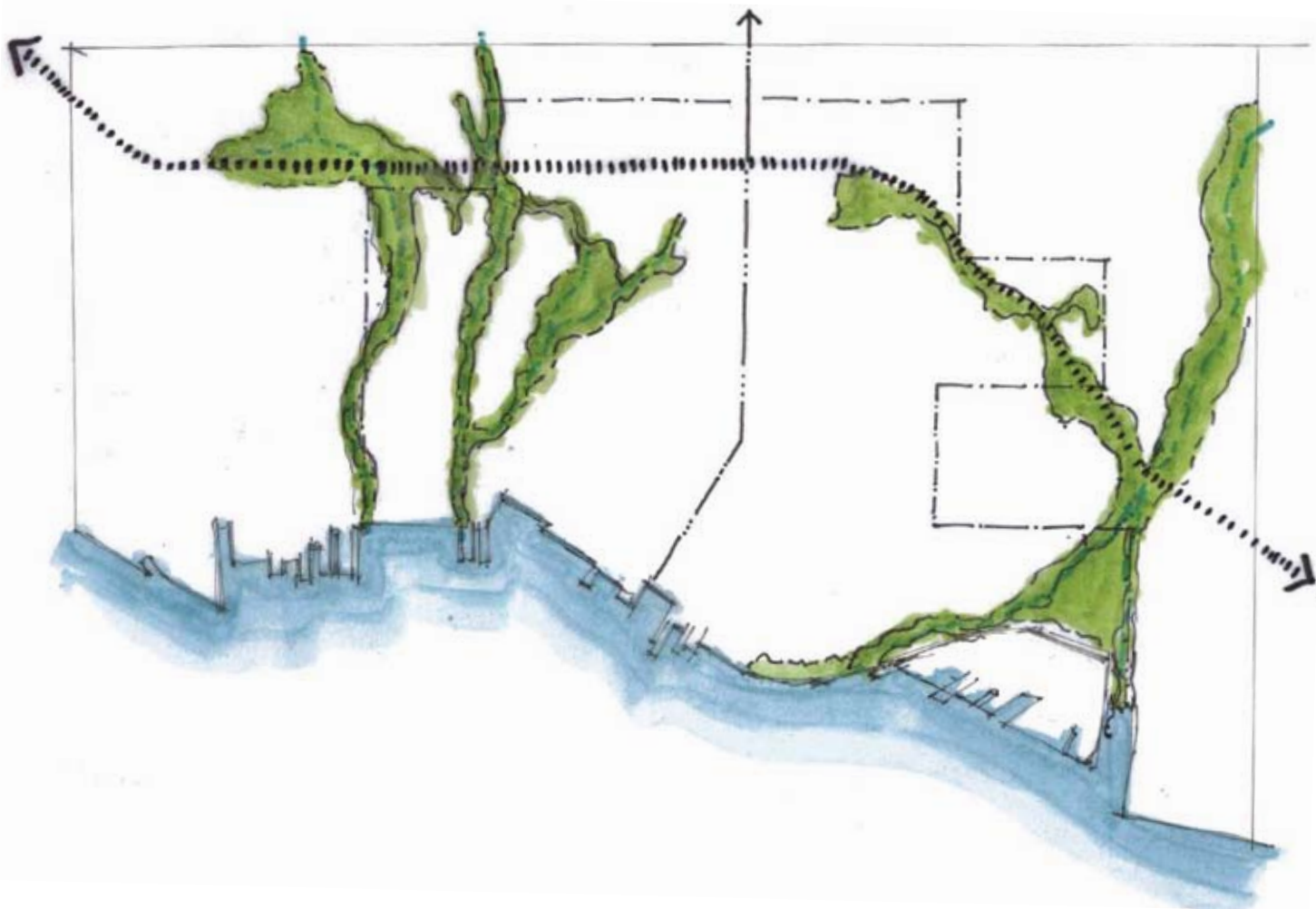


Figure 4.2 A diagram of intensified and interconnected greenspaces running north-south through the city. The areas are improved over time, becoming multi-functional green infrastructure by directing stormwater, providing habitat and creating new paths through the city. Drawing by Erick Villagomez.

4.2 GREEN INFRASTRUCTURE DESIGN STRATEGIES

Creating a green network interconnected with the functions and services of the city can reduce the impact of human activities on the surrounding environment while improving the livability of the region as a whole (see figure 4.2). The strategies in this section address many of the current opportunities and constraints related to realizing a green infrastructure, as well as identify additional risks presented by changing climatic conditions.

The following strategies require planning and implementation across several scales in order to be successful. While the City can pursue some actions alone, others require cooperation and support from neighbouring North Shore municipalities or from the region as a whole. Strategies requiring intergovernmental cooperation are noted accordingly.

Green infrastructure strategies will have substantial influence at the local scale. Citywide, they affect how we build and use streets, design buildings and understand the urban environment. But most of all, these design strategies help define what kind of the community the city will be in 2107.

PRINCIPLE 1: ACCESS TO LINKED PUBLIC PLACES, PARKS AND NATURAL AREAS



Figure 4.3 An early diagram of ecological connections across the North Shore region. Strategies depicted include intensified and interconnected riparian areas around streams, highly connected urban parks, “green streets” and publically-accessible open space along the waterfront. Drawing by the District of North Vancouver 100 Year Visioning Charrette team designers.

REGION-WIDE DESIGN STRATEGIES:

- 1. Protect the natural character of the region.** Preserve significant habitat throughout the region in a variety of park types, based on their ecological sensitivity and recreational value.
- 2. Build a green network.** Connect major riparian corridors, trails (including the Spirit Trail) and greenways with local parks, school sites and public gathering spaces to create an overall District, City and regional green network. Integrate the City's Green Necklace with this region-wide system.
- 3. Re-integrate riparian areas.** Promote the daylighting of historical streams across the North Shore to restore, rehabilitate and enhance ecological performance and habitat value. Use naturalized engineering strategies to address the larger, more frequent storms and higher risk of flooding anticipated in the future.
- 4. Link and protect the waterfront.** Keep waterfront areas as a public resource, protected from intensive infrastructure development, while providing creek systems a natural and celebrated outlet to the sea.



PRINCIPLE 1: ACCESS TO LINKED PUBLIC PLACES, PARKS AND NATURAL AREAS



CITY-WIDE DESIGN STRATEGIES:

5. Increase and diversify green space.

Provide increased walkable, diverse, interconnected public and private green spaces throughout the city. Use new and existing green spaces to facilitate pedestrian and bicycle movement and recreation, as well as for food and energy production, and water and waste management. School sites, neighbourhood and pocket parks, and public and private green space provide multi-generational activities for an aging population and young families.

6. Utilize natural stormwater assets.

Preserve major open spaces, primarily running north-south, to facilitate storm water management, control overland flow and minimize adverse effects on streams.

Figure 4.4 (left) - The *100 Year Sustainability Vision* preserves major linear open spaces running north-south through the city and enhances them as key stormwater corridors and habitat areas.

Figure 4.5 (right) - The city accommodates a diversity of green spaces and building forms, protecting park blocks along Grand Boulevard and enhancing open space along the Upper Levels Highway. New “green streets” connect these areas at multiple points, creating opportunities for pedestrian and bicycle movement through the city.

Drawings by Colin Cathcart, Patrick Condon, James Tuer, Daniel Roehr, Nicole Miller and Sara Muir-Owen.

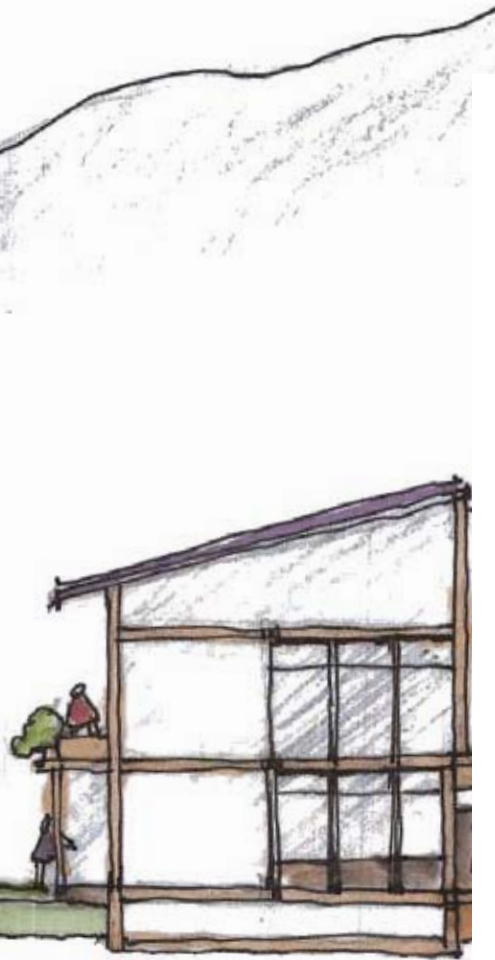
PRINCIPLE 1: ACCESS TO LINKED PUBLIC PLACES, PARKS AND NATURAL AREAS



Figure 4.6 A section through one of the city's residential areas illustrating how increased green space can integrate with development intensification. New green corridors become places for stormwater management and urban agriculture, while increased urban forestry reduces urban heat islands, filters runoff and improves air quality. Drawing by Susan Miley.

CITY-WIDE DESIGN STRATEGIES:

- 7. Frame future development around green space.** Ensure that new, higher density development fronts onto green spaces, where appropriate, providing residents with recreation opportunities and enhancing livability. Support climate change adaptation by requiring buffers along streamside areas and siting development sensitively if proximate to waterways.
- 8. Promote urban agriculture.** Encourage new developments to include community gardens and/or areas for urban agricultural production. Such activities can take place in pocket parks, court yards and roof top gardens of the development.
- 9. Plant for climate change.** Encourage urban forestry along streets and within open space to help moderate local temperatures, improve air quality and provide habitat.

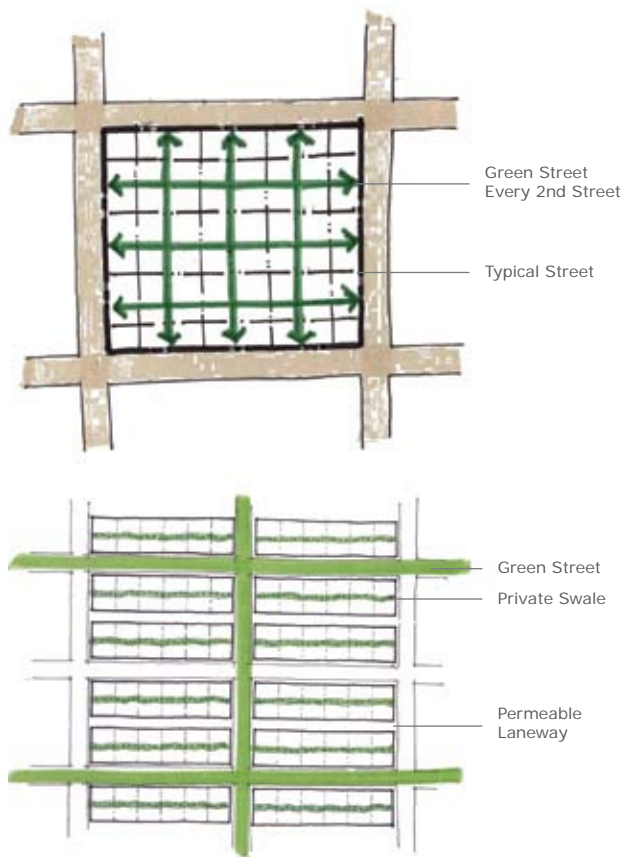


PRINCIPLE 1: ACCESS TO LINKED PUBLIC PLACES, PARKS AND NATURAL AREAS



Figure 4.7 Plan detail of the charrette's "green the grid" strategy. This strategy overlays green infrastructure, including bikeways and trails, stormwater management and energy distribution over the existing public street system. "Greened" right-of-ways balance mobility needs with other service opportunities and increase connectivity between local parks, schools and other civic amenities. Drawings by Colin Cathcart, Patrick Condon, James Tuer, Daniel Roehr, Nicole Miller and Sara Muir-Owen.

Figure 4.8 (below) - Concept diagrams illustrating the application of “green streets” to the City’s right-of-ways. Greening infrastructure strategies are applicable for both local streets and lanes. Drawing by team designers.



CITY-WIDE DESIGN STRATEGIES:

- 10. Green the City’s right-of-ways.** Re-purpose some streets and lanes for stormwater management, community gardens, and/or non-motorized transportation and trails. Integrate with parks, school sites and other green spaces in local neighbourhoods. Balance the re-purposed streets with mobility needs as neighbourhoods increase in intensity.
- 11. Green the grid.** Design north-south green streets to facilitate stormwater infiltration and other ecological functions. Design east-west greenways to provide accessible pedestrian and bicycle routes connecting public gathering spaces and parks.
- 12. Link parks and green streets.** Link neighbourhood parks through interconnected pathways, including pedestrian and bike paths, incorporated into a grid of green streets.

PRINCIPLE 2: GREEN, DURABLE, TIMELESS INFRASTRUCTURE

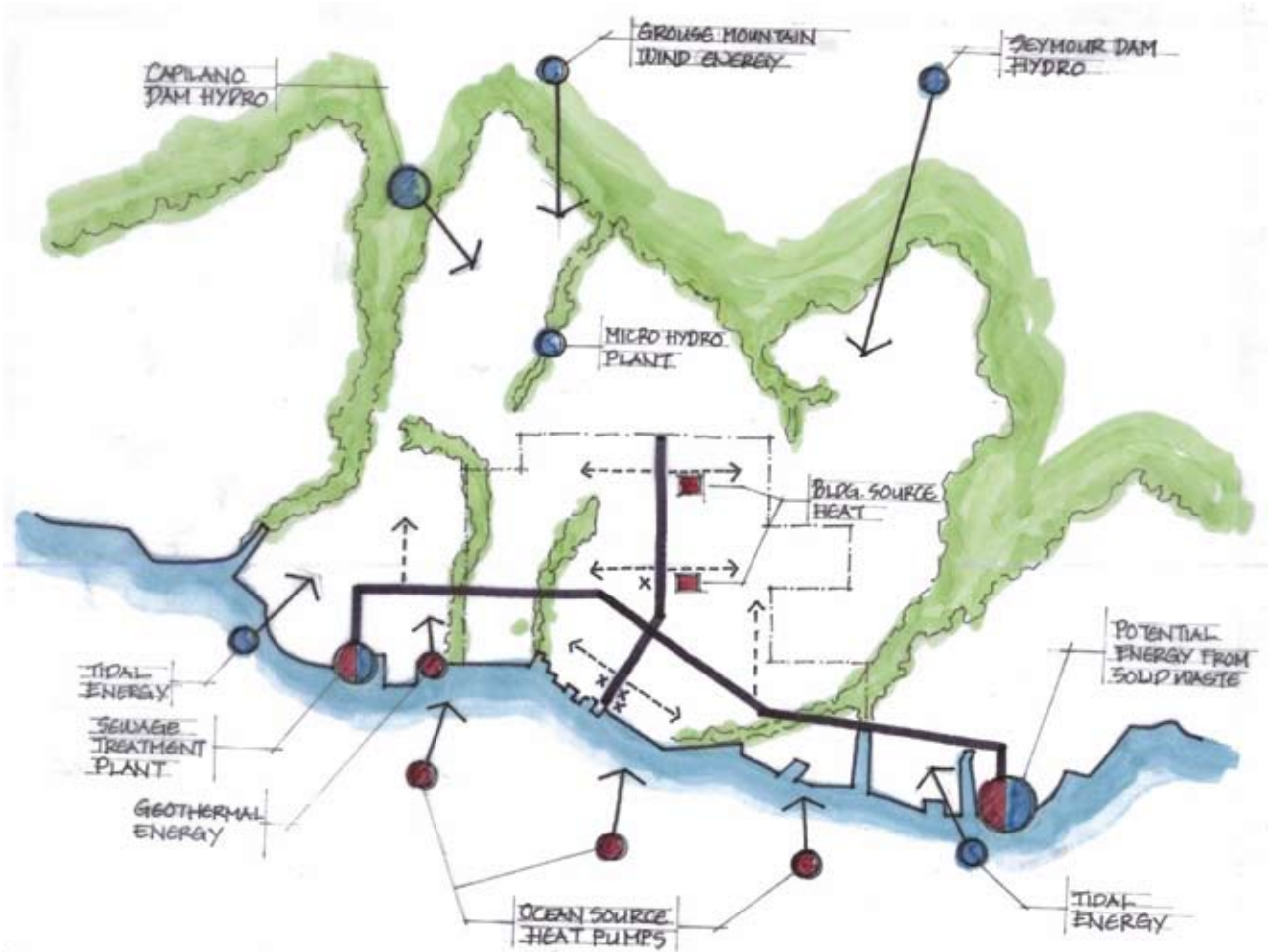


Figure 4.9 Potential energy sources across the City and District, including waste heat opportunities from regional solid waste plants and building sources, ocean and tidal energy, hydro electricity and wind power. Many of these sources could link directly to an expanded Lonsdale Energy Corporation district energy system. Drawing by Erick Villagomez.

Figure 4.10 (below) - Concept diagram illustrating the potential range for the expansion of the Lonsdale Energy Corporation district energy system. The Vision assigns increased densities to these areas, including new commercial and mixed-use districts. Most are proximate to Lonsdale Avenue or the waterfront. Drawing by team designers.



REGION-WIDE DESIGN STRATEGIES:

1. **Work with natural systems.** Coordinate the City's and District's engineering efforts to better incorporate existing and restored riparian corridors and green open space to improve the use and function of local green infrastructure. Provide east and west greenway connections between the creeks that border the City and along the waterfront.
2. **Identify and explore feasibility of renewable energy sources and sites.** Consider varied energy sources, including biomass/biogas combined heat and power, micro-hydro stations, wind, solar, tidal and geothermal systems located within the North Shore region. Distribute through new infrastructure under existing right-of-ways. Continue coordination efforts involving the City and District, First Nations, BC Hydro, Lonsdale Energy Corporation (LEC), Solar BC and other key agencies to explore the feasibility of decentralized, renewable energy systems.
3. **Consider the proposed solid waste plants as renewable heat and energy sources.** Explore the feasibility of harnessing energy and heat from the solid and liquid waste plants located east and west of the City (in the District) for use by the Lonsdale Energy Corporation. Address infrastructure needs, including pipelines, to connect these sources to a flexible energy distribution network such as the LEC .

PRINCIPLE 2: GREEN, DURABLE, TIMELESS INFRASTRUCTURE

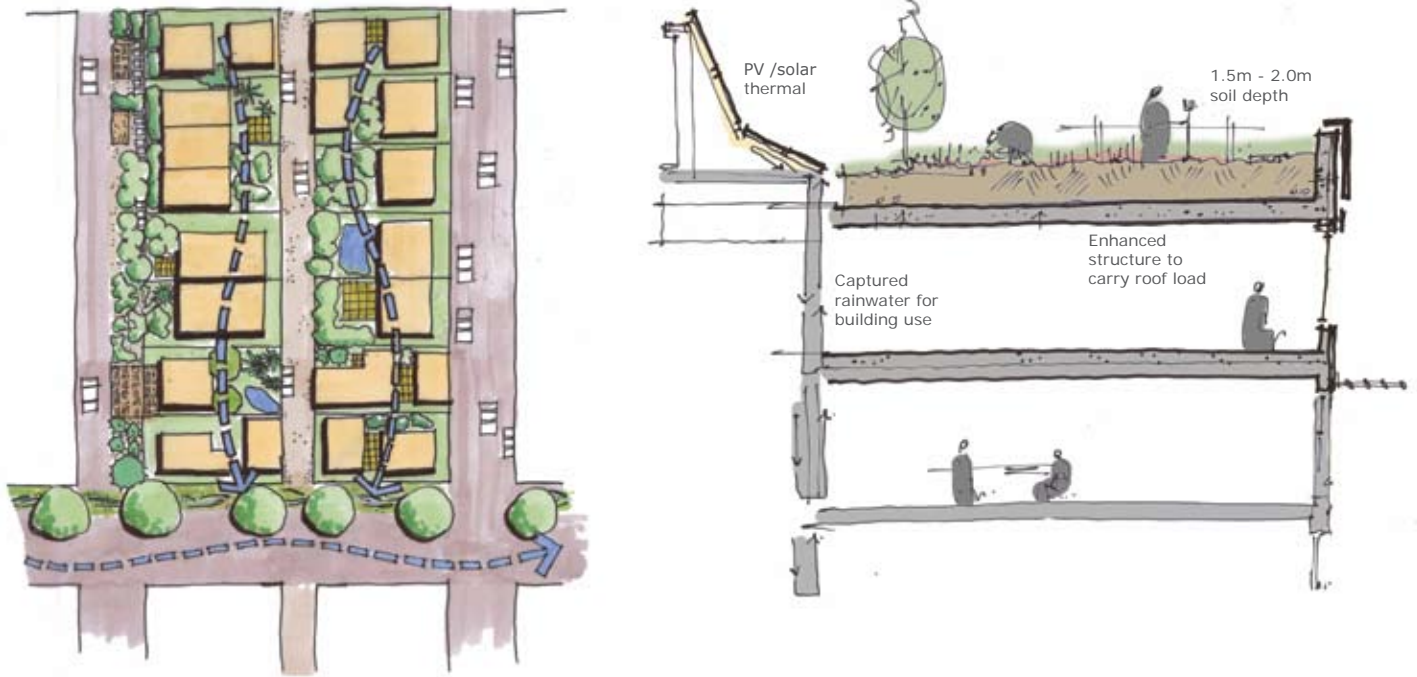


Figure 4.11 (left) - Within residential areas, parcel-scale infiltration strategies such as rain gardens and pervious paving handle most stormwater on-site. Overflow from intense storm events flows to adjacent “green street” stormwater infrastructure that minimizes run-off, erosion and water pollution. Drawing by Dave Flanders.

Figure 4.12 (right) - New building scale design strategies support localized stormwater infiltration through the use of green roofs. These rooftops should also orient to capture solar energy for passive or active purposes including electricity generation, hot water heating and urban agriculture, particularly along south-facing slopes. Drawing by team designers.

CITY-WIDE DESIGN STRATEGIES:

Figure 4.13 (below) - Concept sketch illustrating new buildings along Lonsdale Avenue designed for solar access. Solar panels on the south side of rooftops and terraced south-facing rooftop gardens provide increased opportunities for urban agriculture and renewable energy. Drawing by Jay Hiscox.



4. **Use topography as an asset.** Capitalize on the predominantly south-facing slopes of the city through the design and orientation of green streets, buildings and open spaces.
5. **Design for solar access.** Employ site and building design strategies that take advantage of south slopes and solar exposure for passive and active solar gain. Consider on-and-off-site landscape elements to shade and shelter structures requiring less solar energy. Develop policy and guidelines that are sensitive to views, while ensuring solar access for new and retrofit development.
6. **Localize infiltration.** Promote local infiltration for stormwater collection to minimize the impact of heavy rainfall events, including erosion, landslides and flooding. Consider cisterns and green roofs for on-site water management strategies.

PRINCIPLE 2: GREEN, DURABLE, TIMELESS INFRASTRUCTURE

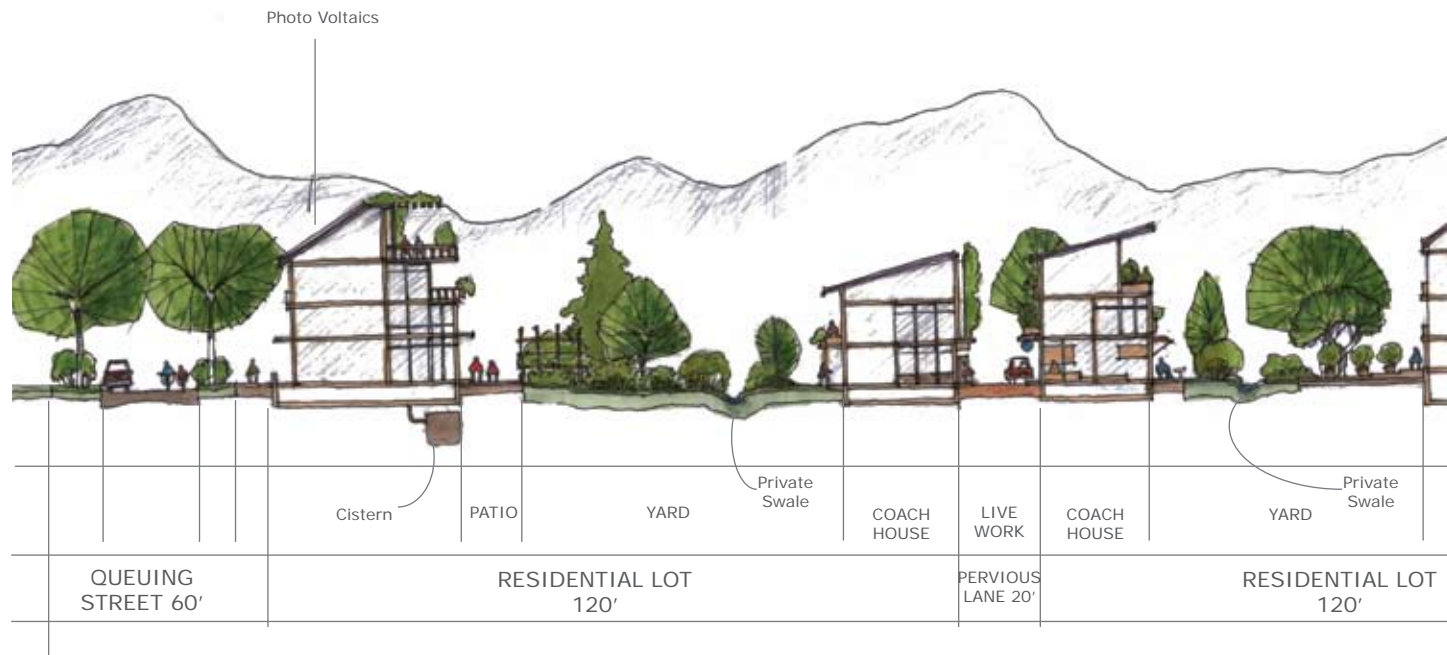
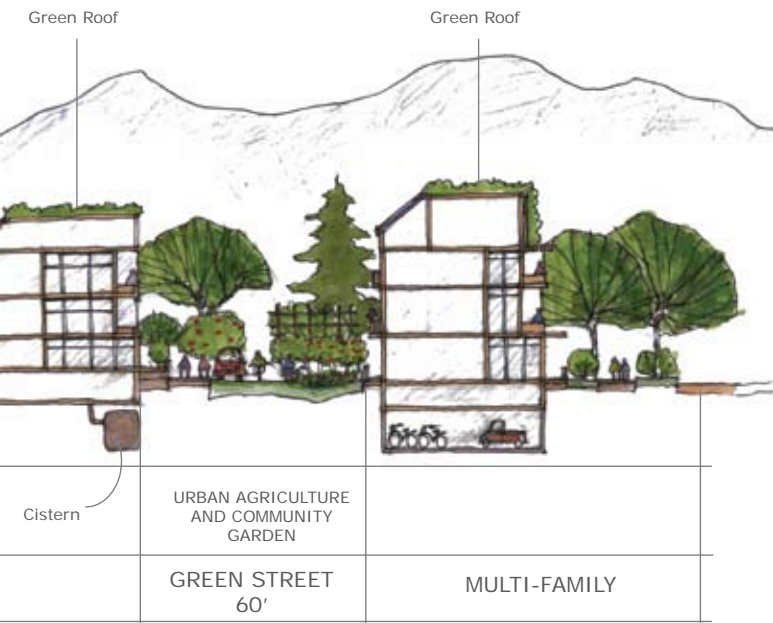


Figure 4.14 A section through one of the city's residential areas illustrates the multi-functional urban fabric. Streets and lanes facilitate the water infiltration and renewable energy networks, while green spaces and private yards accommodate water collection infrastructure and community gardens. Drawing by Susan Milley.

CITY-WIDE DESIGN STRATEGIES:

7. **Identify commercial, industrial, institutional and civic sites for potential energy production.** Use school sites, park space and other civic lands to support geothermal, solar and other energy systems. Large commercial and industrial sites can also provide building heat recovery opportunities for proximate residential development. Consider energy source opportunities with all new and retrofit public and private development. Develop policies to support innovative technologies that utilize efficient, renewable energy sources.
8. **Build multi-function school sites.** Create multi-function school sites that facilitate community services outside of school hours and support additional uses, including food production. Ensure sites capitalize on additional infrastructure opportunities such as stormwater management and renewable energy generation.
9. **Use streets as energy corridors and lanes as drainage ways.** Expand Lonsdale Energy Corporation distribution pipes within existing street right-of-ways. Reinforce current service use of laneways, while enhancing their capacity as stormwater drainage systems.



PRINCIPLE 2: GREEN, DURABLE, TIMELESS INFRASTRUCTURE

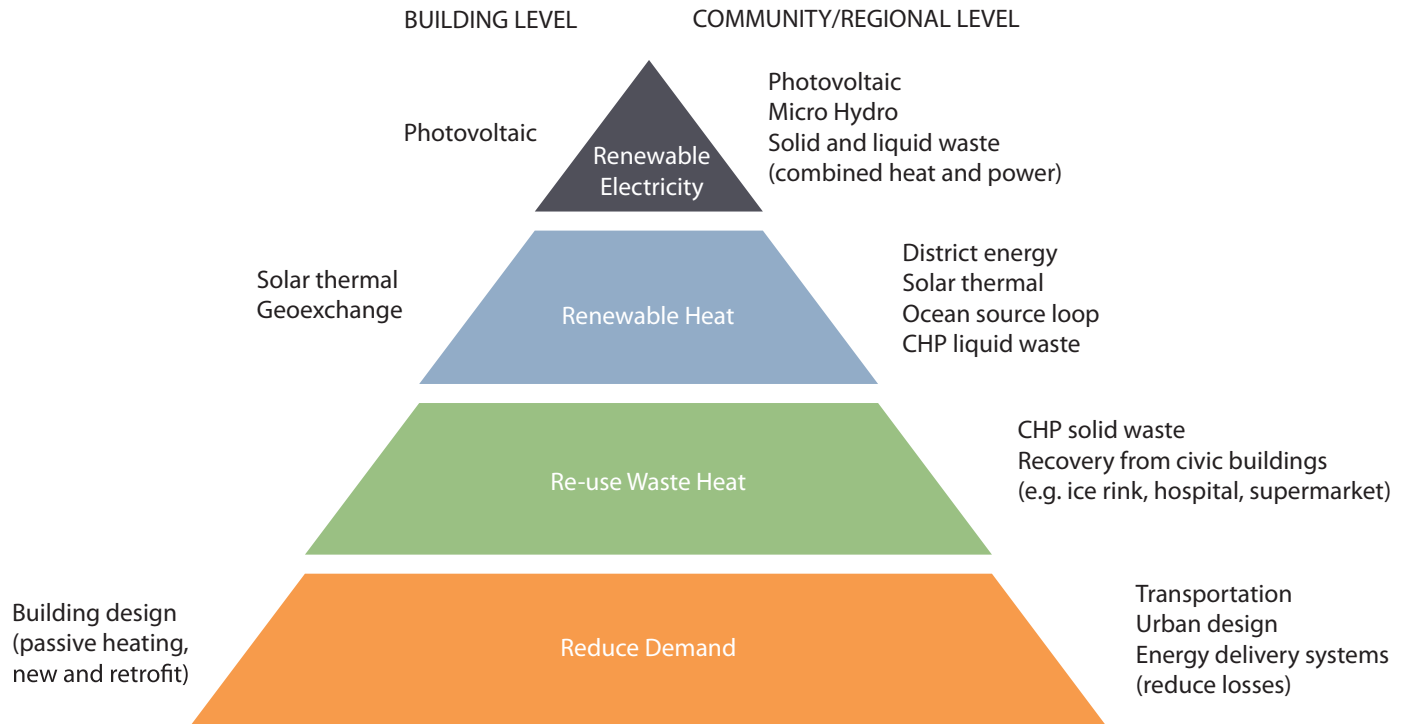
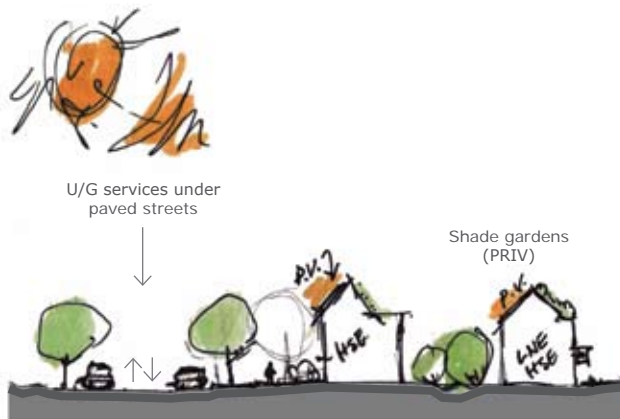


Figure 4.15 A charrette adaptation of a BC Hydro energy hierarchy. The diagram illustrates strategies to mitigate energy-related contributions to GHG emissions. The area of each triangle segment represents the relative priority of each strategy, with demand reduction representing the “big move” and successive segments showing smaller, but still significant, reduction possibilities. This diagram formed the framework for energy discussions during the charrette. The left hand side shows potential efforts at the building scale. The right hand side shows strategies at the city scale as well as approaches that require regional cooperation. Prepared by Jon Salter based on concept diagram provided by Robyn Wark.

Figure 4.16 (below) - Concept sketch illustrating renewable energy strategies in lower-density residential neighbourhoods. In areas where waste heat and district energy are not feasible, other renewable energy such as geothermal and solar hot water significantly reduce the off-site energy demand. Drawing by team designers.



CITY-WIDE DESIGN STRATEGIES: *Better technology and building practices*

10. Use urban form to reduce energy demand. Increase density along corridors, at major nodes and in close proximity to district energy systems to improve energy efficiency and promote lively neighbourhoods. Design compact communities around viable transit networks to reduce transportation energy demand. Promote green buildings and efficient technologies, including efficient local energy delivery systems, to minimize transmission and distribution losses.

11. Re-use waste heat. Identify and utilize waste heat sources throughout the city, such as heat from industrial, commercial and infrastructural processes, heavily cooled facilities such as ice rinks, and wastewater heat to supplement heat for buildings and hot water. Using these energy sources will reduce the need for fossil fuels and new technology investments for heating services.

12. Expand district heat and energy systems. Build on the success of the Lonsdale Energy Corporation district energy system by incorporating “zero waste” resource recovery options as well as solar and geothermal technologies. Use new, low-GHG fuel sources to reduce emissions.

PRINCIPLE 2: GREEN, DURABLE, TIMELESS INFRASTRUCTURE

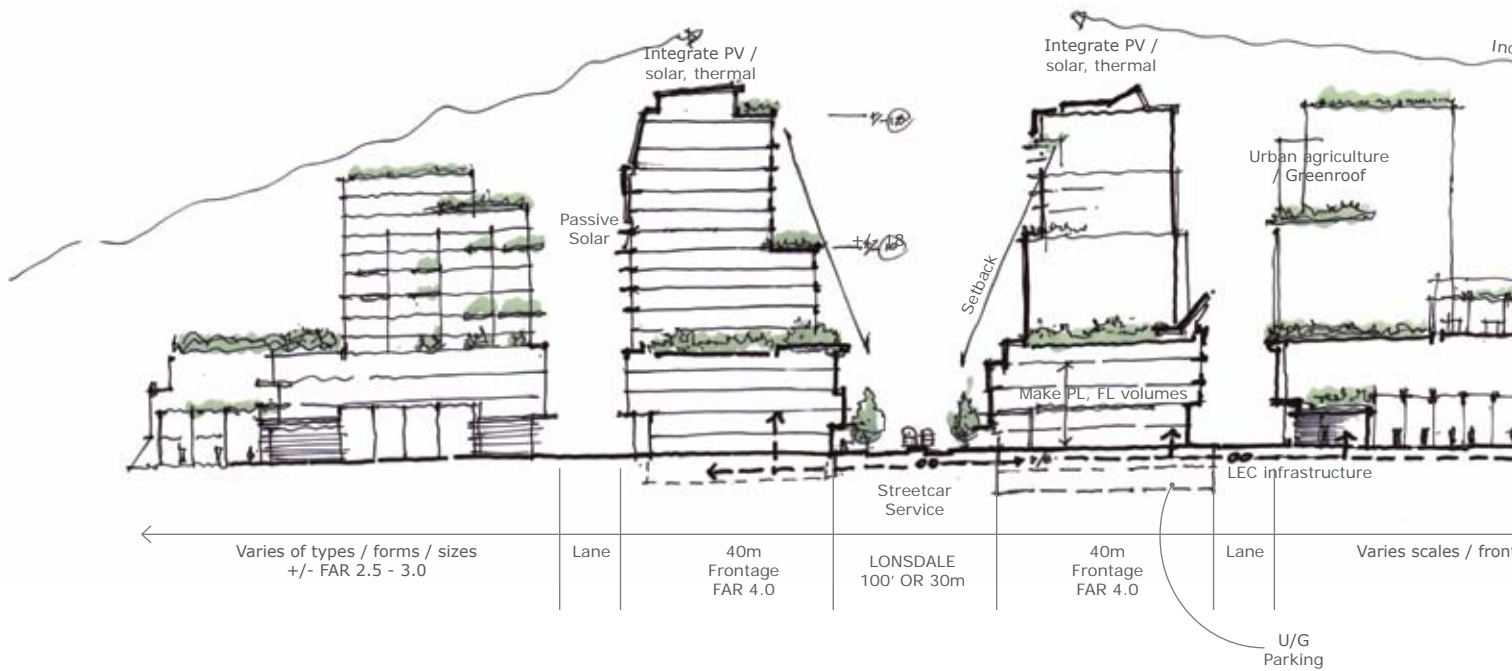


Figure 4.17 Section through Lonsdale Avenue illustrating several renewable energy technologies on new and existing buildings. Photovoltaics and solar thermal occupy available rooftops, while expanded district energy infrastructure runs through the public right-of-ways. New, intensified building forms designed to capitalize on solar access paired with improved, highly-energy efficient construction standards substantially reduce energy consumption and GHG emissions. Drawing by team designers.

CITY-WIDE DESIGN STRATEGIES:
Better technology and building practices

13. Improve building practices. Encourage innovative building types and improved design and construction practices to reduce energy consumption through increased building durability and minimized operational energy demand. Design adaptable and reusable buildings to reduce waste and lifecycle costs. Explore and develop appropriate policy and guidelines to promote efficient infrastructure, such as renewable energy options, decentralized heat and energy systems and adaptable technologies.

14. Incorporate new technology. Support the use of new technologies at the building, neighbourhood and municipal scales for energy efficiency and alternative energy options. At the building level, solar thermal, geo-exchange and heat exchange can provide renewable heat sources for hot water. Explore geothermal, sewage/heat recovery, district energy and other options at larger scales.



PRINCIPLE 3: CLIMATE CHANGE ADAPTATION



Figure 4.18 The principles of climate change adaptation must be applied throughout the city, and it requires a variety of strategies, ranging across all other SxD principles to be successfully implemented. Drawings by Colin Cathcart, Patrick Condon, James Tuer, Daniel Roehr, Nicole Miller and Sara Muir-Owen.

CREATING RESILIENT COMMUNITIES:

In the face of climate change and amidst great uncertainty regarding specific impacts and costs of this change, resilient and adaptive communities must have the capacity to respond to a variety of situations. Specifically, climate change adaptation involves strategic planning for potential hazards and extreme events, but also requires that communities reduce vulnerability by ensuring that basic services, such as food, energy, water and transportation are available locally. Necessarily, the strategies involved in achieving climate change adaptation are highly integrated and span a wide variety of issues.

For this reason, strategies for Principle 7: *Climate Change Adaptation* are inclusive of the strategies developed for each of the six other SxD principles, as these are the principles that directly address the provision of local services and the mitigation of extreme events. Rather than re-listing strategies, this report reviews the ways in which the aspects of open space, energy, transportation, food and water can address other principles that also directly impact climate change adaptation.

Open Space. Strategies for increasing and diversifying open space create improved opportunities for stormwater infiltration, food production and other potential natural functions as climatic conditions change. Preserved open space, and urban forestry in particular, can help to mitigate rising temperatures and reduce air pollution. Strategically protected or restored open spaces, such as riparian corridors, can help to protect other land uses from flooding or sea level rise and protect water sources from run-off and pollution.

Energy. Strategies for reducing energy consumption and generating local, renewable energy decrease dependency on fossil fuels, increase options for alternative fuel sources and fuel switching and save high-quality sources of energy for their best, most efficient uses. Distributed energy systems can continue operating when part of the system fails, providing more continuous service to residents in extreme conditions.

Transportation. Diverse mobility opportunities provide a majority of people with a variety of ways to move around the city, including walking, cycling and public transit. Increased provisions of public transit and reduced needs for private automobiles also reduce dependency on fossil fuels.

Food. Strategies supporting local and urban agriculture enhance the efficiency and resiliency of food supplies for the region. Using public open space for community gardens and increasing the number of green roofs with agriculture potential may decrease dependency on certain types of imported foods and reduce energy consumption from food transportation.

Water. Local water management strategies, particularly stormwater collection and infiltration, minimize the risk of flooding, erosion and water pollution. Careful land use and development planning, as well as habitat restoration along the waterfront and streams, can help to reduce the impacts of flooding and sea level rise. Collection of rainwater and grey water from buildings can supplement potable water supplies for many water uses, particularly during dry seasons.

Ensuring that mobility is not dependent on automobiles is key to realizing a sustainable community. Right-of-ways should accommodate a range of transportation modes. These corridors, streets and lanes should efficiently move people and goods from origin to destination while enhancing the areas through which they pass. Without widespread adoption of low-emission means of travel, the City cannot meet its GHG reduction targets. The mobility principles: mixed-use corridors accessible to all; and, a five minute walking distance to commercial services and transit, recognize that a range of social, economic and environmental measures fundamentally change when a community is structured by an inclusive mobility network.

The historic, urban grid largely aligns the City of North Vancouver today with these principles. Major corridors, with Lonsdale Avenue primary among them, locate commercial services and employment proximate to housing. Higher densities along these streets allow many residents to be within a five minute walk or convenient bus service from these retail streets. Residents further removed from Lonsdale are less likely to walk to local services or utilize transit for daily trips. Citywide, transit service has not dramatically changed since the introduction of the SeaBus over 30 years ago. Translink, the regional transportation authority, recently prepared a revised transit plan, although at the time of this report it had not yet been distributed. With population growth and sustained municipal efforts to encourage a full range of transportation modes, improvements to the North Shore public transportation system are warranted.

The *100 Year Sustainability Vision* shifts mobility away from energy consumptive transportation choices incrementally with the growth of the city. Mixed-use infill along existing transit corridors enables the population to support more frequent, efficient and thus more attractive transit service. New businesses occupying these buildings bring services closer to residents of outlying neighbourhoods with the goal that every resident will

5.0 MOBILITY NETWORK

eventually be within a five minute walk of their basic daily needs. Improved transit better connects residents to urban hubs defined by concentrations of commercial and retail space. By 2107, most discretionary trips—those not to work—can be made without the use of an automobile. Longer trips continue to be necessary, since some services and jobs will remain further from home. But transportation options expand with three systems improving connectivity to the region.

First, an enhanced SeaBus connects the City with Vancouver’s downtown and rail hub. A robust system of rail and transit connections at both terminals filter passengers between the water crossing, destinations in the City and locations around the region.

Second, high-speed transit along two primary east-west routes, the Upper Levels Highway and Marine Drive / 3rd Street / Main Street corridor, improves connections across the North Shore. The highway gradually accommodates a regional system connecting the City, destinations to the north-west and across the water to Vancouver, Burnaby and Surrey. Higher density, mixed-use nodes develop around Upper Lonsdale and Keith Road overpasses, reintegrating areas severed by the highway. On 3rd street, high-speed transit connects the City to the District and West Vancouver. A primary role of this system is to cultivate the pedestrian quality of these streets and to foster community identity. Trolley buses, express buses or trams with signal priority may be appropriate.

Third, the community requires connections to the regional transit network. An enhanced system of walkways and bikeways throughout the city provides attractive and efficient access to local, community and regional transit from all neighbourhoods. As growth proceeds, new residents and jobs support more cost effective transit and improved pedestrian and cycling networks.

The Mobility design strategies are framed by Sustainability by Design Principles:

4. MIXED-USE CORRIDORS ACCESSIBLE TO ALL

5. FIVE MINUTE WALKING DISTANCE



Network of walkable, transit supportive, safe, accessible and highly liveable corridors.

Higher density development around transit hubs with regional and local connections

Figure 5.1 A vision for the mobility network based on transit-supportive, mixed-use corridors. Drawings by Colin Cathcart, Patrick Condon, James Tuer, Daniel Roehr, Nicole Miller and Sara Muir-Owen; Mobility network overlay by the District of North Vancouver 100 Year Visioning Charrette team designers.

5.1 MOBILITY PRINCIPLES AND GOALS

The strategies described in this section aim to promote sustainability by achieving two goals:

1. **Provide walkable, transit-supported, safe, accessible and highly liveable mixed-use corridors.** The *100 Year Sustainability Vision* capitalizes on public infrastructure by supporting mixed-use, multimodal corridors encompassing the street and adjoining blocks. These areas accommodate higher density populations and jobs, conversely supporting effective local and regional transit. They bolster energy efficiency and contribute to reduced community GHG emissions by providing safe and effective transportation choices for walking, cycling, transit, commuter vehicles and goods movement. Mixed-use, multimodal corridors enhance transportation, circulation, and accessibility throughout the City and neighbouring municipalities.
2. **Ensure citizens live within walking distance to jobs, goods, services, and open space.** The Vision is comprised of compact neighbourhoods where people, jobs, goods, services and open spaces are located within walking distance. The mix and balance of land uses allow all residents to live within 400 metres—corresponding to the average 5-minute walking distance—of their daily needs. Promoting walkability, increasing accessibility and reducing automobile dependency minimizes the impact on the environment. The traditional, small block street grid interconnects neighbourhoods through multimodal corridors designed for walking, cycling, access for people with disabilities, transit use and cars. The grid also supports the City's district energy system.

5.2 MOBILITY NETWORK DESIGN STRATEGIES

The Mobility Network includes region-wide and city-wide design strategies. Region-wide mobility strategies will require the cooperation and support of other stakeholders, including other North Shore municipalities, Metro Vancouver, Translink and the Province.

Enhanced connectivity between City and region is key to achieving the Vision. An improved frequent transit network connects community hubs within the City to hubs located in neighbouring North Shore communities. Expanded SeaBus capacity and additional east-west water transit services connect to downtown Vancouver. Medium to high-density development around transit corridors and hubs supports viable local and regional transit service.

At the city scale, promoting active transportation is key to achieving the Vision. A network of attractive, safe and interconnected local green streets and multimodal collector corridors promote effective pedestrian, bicycle and vehicular mobility. This network connects to schools, community centres, services and transit throughout the city. Mixed-use, higher density development along corridors citywide and concentrated at nodes locates residents within walking distance to daily needs. Streetscapes compliment the natural amenities that make the City an attractive place to live, work and play.

PRINCIPLE 4: MIXED-USE CORRIDORS ACCESSIBLE TO ALL

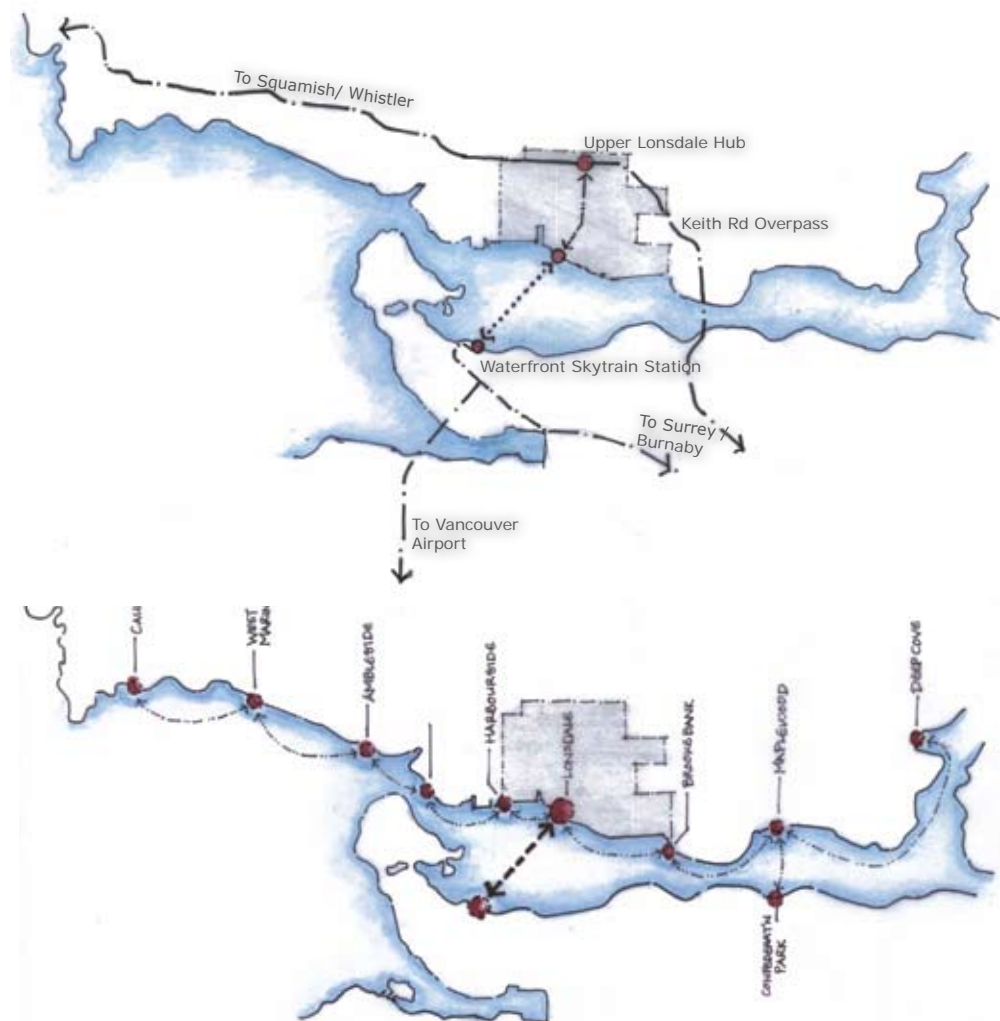


Figure 5.2 (top) Regional rapid transit along the Upper Levels Highway has stops at the Upper Lonsdale hub and the Keith Road overpass. (bottom) Expanded water transportation provides additional east-west water connectivity with expanded SeaBus capacity connecting the City to downtown Vancouver and neighbouring communities. Drawings by Erick Villagomez.

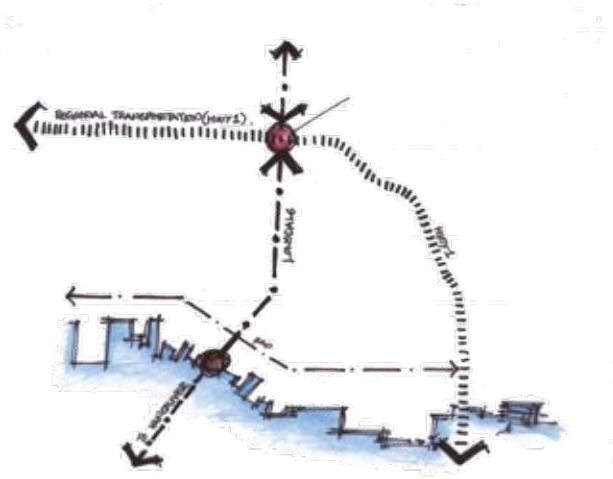


Figure 5.3 (above) A second rapid transit route along Marine Drive / 3rd Street / Main Street and improved frequent transit along Lonsdale Avenue connect the City to regional transit stops and the SeaBus. Drawings by Erick Villagomez.



Figure 5.4 (above) The Upper Lonsdale Avenue land bridge spans the Upper Levels Highway connecting the City to the District and creating a higher density, transit-oriented development at the regional rapid transit stop. Drawing by Colin Cathcart.

REGION-WIDE DESIGN STRATEGIES:

1. **Develop a regional high speed transit route.** Locate regional high speed transit along the Upper Levels Highway with stops at the Upper Lonsdale urban hub, and the Keith Road overpass. Use the Upper Lonsdale urban hub to bridge the highway and connect the City to the District.
2. **Provide frequent regional transit service.** Link residents to high speed and rapid transit at Lower Lonsdale and the Upper Levels Highway. Develop enhanced SeaBus and east-west water transit service to connect the City to adjacent North Shore communities, downtown Vancouver, and the region.
3. **Provide rapid bus or rail.** Develop east-west service along Marine Drive / 3rd Street / Main Street to link the City with adjacent North Shore communities and the surrounding region. Provide service every 15 minutes throughout the day and evening, during the week and on the weekend.
4. **Enhance the east-west freight route.** Accommodate the movement of goods between the City and region along the Low Level Road and on expanded and improved rail service. Whenever possible use the inlet for the movement of bulk goods as well.

PRINCIPLE 4: MIXED-USE CORRIDORS ACCESSIBLE TO ALL

The Vision includes a Lonsdale Avenue transit corridor with greater intensity of mixed-use development at key intersections. These nodes accommodate employment, recreation and living within walking distance to transit services and other daily needs. The Lonsdale transit corridor includes dedicated lanes for a streetcar type transit system, two directions of travel lanes, bike lanes and wide sidewalks for pedestrians.

Diverse commercial employment services concentrate along the corridor and reflect the historical role of Lonsdale as a shopping destination. This further identifies the corridor as a vibrant commercial "heart."



Figure 5.5 (above) Section of the Lonsdale Avenue transit corridor. Drawing by Susan Milley.

Buildings along the transportation corridor incorporate green technologies that capitalize on renewable sources, contribute to improved air quality, reduce heating and cooling requirements and enhance aesthetic value.



CITY-WIDE DESIGN STRATEGIES: *Density and mixed-use for transit*

5. **Locate higher density mixed-use development along transit corridors.** Use corridors to locate goods, services and transit within a five minute walk of residents, including those in the surrounding lower density residential neighbourhoods.
6. **Create distinctive mixed-use nodes along transit corridors.** Develop urban hubs on Lonsdale Avenue at its Lower, Central and Upper areas. These nodes integrate living, employment, shopping, recreation and culture at key points along the city's central core. Extend daily services to Queensbury and other key neighbourhood corridors through unique "character nodes" that respond to the qualities of the surrounding neighbourhood.
7. **Locate new intensified hubs along major east-west corridors.** Create new employment destinations along Marine Drive, 3rd Street, Esplanade Avenue and Keith Road transit routes.

PRINCIPLE 4: MIXED-USE CORRIDORS ACCESSIBLE TO ALL



Lonsdale Avenue at 8th Street
2007



2050



2107

Figure 5.6 Lonsdale Avenue will develop gradually over the 100 year timeframe. Higher density, mixed-use infill over the first 50 years increases employment and population density to a level sufficient to introduce rapid bus service. By 2107, this higher density can support reintroduction of local street cars. Photomontage prepared by Courtney Miller.

Figure 5.7 (below) Revitalized streetscapes with wider sidewalks, cycling and vehicle lanes improve safety and comfort, and increase accessibility. Street trees improve air quality, buffer traffic noise and offer shade.

Drawing by Susan Milley.



CITY-WIDE DESIGN STRATEGIES:

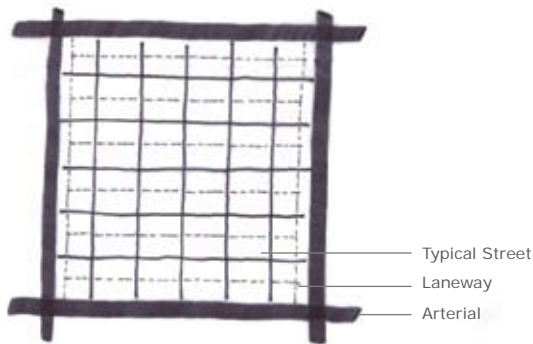
- 8. Revitalize key City streets.** Redesign the 30.0 metre (approximately 100 foot) right-of-ways (ROW) of Lonsdale Avenue, Grand Boulevard and Keith Road to accommodate pedestrians, cyclists, transit, vehicles and persons with disabilities.
- 9. Create lively streetscapes.** Enhance streets with wide, tree-line sidewalks, a pedestrian scale street-width-to-building-height ratio, rain shelters, and opportunities for sidewalk activity such as outdoor cafes. Encourage density to develop over time to support lively street activity and frequent transit service.

PRINCIPLE 5: FIVE MINUTE WALKING DISTANCE

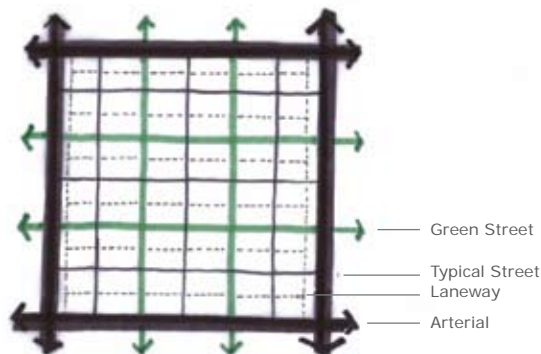


Figure 5.8 Mid-block pedestrian connections. Drawing by James Tuer.

Figure 5.9 (top) The existing street pattern in the City of North Vancouver includes arterial streets, residential streets and laneways. (bottom) In the 2107 Vision every second street becomes a green street. Drawings by Erick Villagomez.



City Street Network 2007



City Street Network 2107

CITY-WIDE DESIGN STRATEGIES:

1. **Create direct connections.** Design pedestrian, bicycle and vehicle routes to improve connectivity between homes, transit, parks and other services and amenities.
2. **Create mid-block pedestrian routes.** Reconfigure blocks and parcels to provide new paths and improve connectivity for pedestrians and casual cyclists. East-west connectivity is particularly key given the city's north-south slope.
3. **Green streets and enhanced lanes.** Design lanes and traffic-calmed streets to become significant contributors to the pedestrian, bicycle and vehicle network, in addition to functioning as stormwater management and urban agriculture systems.

PRINCIPLE 5: FIVE MINUTE WALKING DISTANCE



Figure 5.10 The existing City of North Vancouver street network is ideal for cycling and walking, but steep north-south slopes may be a challenge for accessible mobility. The enhanced green street network with particular emphasis on east-west connectivity increases the viability of active transportation modes. Drawings by Colin Cathcart, Patrick Condon, James Tuer, Daniel Roehr, Nicole Miller and Sara Muir-Owen.

CITY-WIDE DESIGN STRATEGIES:

- 4. Enhance east-west mobility.** Ensure development responds to accessibility and mobility challenges created by the city's topography by locating important commercial, civic, institutional and office services along east-west corridors passing through Lonsdale Avenue nodes.
- 5. Create interconnected, accessible walking and biking routes.** Encourage active transportation throughout the city by providing interconnected, pedestrian-oriented streets that accommodate all residents, including young people, the elderly and persons with limited mobility.

PRINCIPLE 5: FIVE MINUTE WALKING DISTANCE



Figure 5.11 Gradual vertical densification creates the opportunity to enhance the green network by providing funds for amenities while leaving land area for parks and open space. Further, this development realizes densities that support district energy and more frequent transit service. Pedestrian greenways that include habitat and stormwater management provide an alternate walking route and help connect urban parks and open space. Drawing by Jay Hiscox

Figure 5.12 Greenways and existing open spaces are improved as multimodal, interconnected routes across the city. Drawing by the District of North Vancouver 100 Year Visioning Charrette team designers.



CITY-WIDE DESIGN STRATEGIES:

- 6. Locate higher density development around parks and open space.** Provide easy access to recreation and nature for residents, especially neighbourhood children and elders. Close proximity to parks and school sites increases opportunities to play, exercise and relax near home.
- 7. Improve connections between natural areas.** Create greenways that provide access to the city's widespread natural amenities to encourage walking and cycling for transportation, active lifestyles, and maximize the finite amount of greenscape within the city.
- 8. Establish multimodal recreation routes.** Enhance the North Shore Spirit Trail, the Green Necklace, and design additional greenways. Accessible grades and surfaces make these recreation routes an integral part of the overall mobility network.

PRINCIPLE 5: FIVE MINUTE WALKING DISTANCE

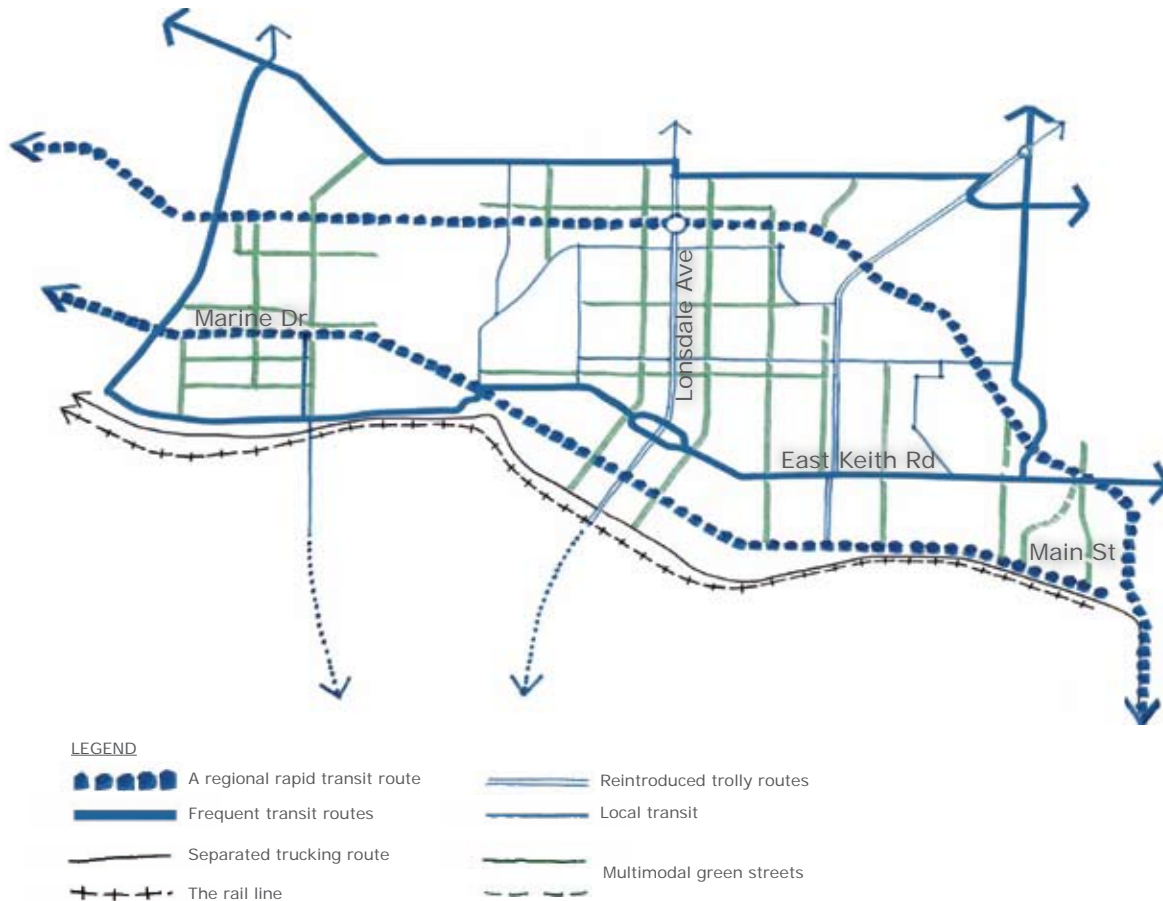


Figure 5.13 Local transit and reintroduced trolley routes connect residents throughout the community and to the region. Frequent community transit connects to the Upper Levels Highway regional rapid transit line at Upper Lonsdale Avenue and Keith Road overpasses. Multimodal green streets provide connectivity between residential areas and transit routes.

CITY-WIDE DESIGN STRATEGIES:

9. Reintroduce streetcars or trolleys. Create an interconnected trolley network along Lonsdale Avenue, Grand Boulevard to Lynn Valley Road, Keith Road, and 15th Street north of Marine Drive (east of Mahon Park) that links neighbourhoods to regional transit hubs.

10. Establish a local shuttle bus service. Provide local shuttle service along the “green street” network to connect all neighbourhoods to community services and regional transit routes.

Figure 5.14 (below) Section of multimodal transit corridor with streetcar service. Drawing by Susan Milley.



The height, massing, use and design of buildings shape the identity of the city. Acknowledging this central role, two of the seven principles directly relate to their character and quality of buildings: appropriate housing for all; and good and plentiful jobs close to home. Intimately related to the underlying pattern of streets and parcels, buildings are also a primary influence of community energy consumption and related GHG emissions. While access to housing and employment is important to every municipality, it is fundamental to the City's consideration of a net zero GHG emissions future. Providing residential density in proximity to jobs and services can substantially reduce GHG emissions per capita. The *100 Year Sustainability Vision* focused primarily on three key zones: Lonsdale Avenue Corridor; single-family neighbourhoods; and the waterfront.

The founding plan for the city conferred special stature to Lonsdale Avenue, although the early aspirations for this corridor are only now being realized. Most major activities in the city occur along this vital spine and, over the next century, this corridor will become even more significant. The City continues to concentrate new services and higher density buildings along Lonsdale. The *100 Year Vision* builds on this strategy, emphasizing the development of a variety of housing and jobs within this emerging corridor fabric. Lower Lonsdale continues the existing trend toward higher density, with mid-rise structures (6 to 12 stories) along the major axis. A second, higher density node centres where upper Lonsdale crosses Highway 1. This development strengthens the connection to the city of neighbourhoods severed by the highway and engages the regional mobility opportunities at the location. Mid-rise density is continued along the Lonsdale corridor between the lower and upper nodes. This new activity will facilitate the more efficient operation of the existing district heating system and reduce the energy costs for heating each unit. New jobs and services on the corridor allow residents to find employment opportunities and meet their daily needs within walking distance.

The city's stable and attractive single-family neighbourhoods present a very different opportunity. The *100 Year Vision* anticipates a gradual transformation of these areas without changing parcel configuration or neighbourhood character. Single-family home areas can evolve slowly over decades by first integrating secondary suites, then duplexes and finally a third unit to existing parcels. The number of dwelling units per parcel may triple on many blocks without changing the nature of the neighbourhood. At these new densities it becomes more economically feasible to expand the district energy system and achieve greater efficiency on a per unit basis. Similarly, density makes more frequent transit viable, encouraging residents to use public transportation and regional authorities to provide improved service.

Identifying opportunities to provide basic commercial services within a five minute walk of all homes is key. It is also difficult, since anxiety about integrating commercial uses into purely residential neighbourhoods is common. Strategies to create small commercial use embedded in compatible residential buildings forward solutions to this potential conflict. Transformed single-family areas also serve a social need by creating dwellings that are often more affordable and better suited to smaller families anticipated in the future. Finally, gradual development provides the mechanism for greening the streets. New infrastructure standards transform neighbourhood streets into a more environmentally productive, pedestrian focused and aesthetically pleasing network.

By 2107 the waterfront is a diverse and ecologically rich tapestry of job sites, integrated residential use, compatible energy generation and environmental restoration. This mix of elements is the primary strategy for the Vision to meet job targets, restore foreshore function, protect against storm surges and sea-level rise, and provide recreational amenities in this key zone of the city.

The Housing and Jobs design strategies are framed by Sustainability by Design Principles:

6. APPROPRIATE HOUSING FOR ALL

7. GOOD AND PLENTIFUL JOBS CLOSE TO HOME



Figure 6.1 Perspective view of the city in 2107. Drawing by Daniel Roehr.

6.1 HOUSING AND JOBS PRINCIPLES AND GOALS

The strategies described in this section aim to promote sustainability by achieving two goals:

1. Providing a range of housing types in every neighbourhood. The Vision plans for the City's population to triple (1% annual growth compounded), growing from 45,000 in 2006 to roughly 135,000 in 2107. A diverse set of housing types are envisioned to provide suitable options to the broadest range of age, family structure and income of residents. To achieve this goal, the City in 2107 is comprised of neighbourhoods designed to minimize GHG emissions while offering a mix of housing choices varied by type, tenure, affordability and accessibility. The Vision estimates 65,000 housing units in the City with an average occupancy of 2.1 persons per unit. Innovative housing types, some introducing smaller unit sizes and flexible building spaces, assist in meeting diverse housing needs over time. The mix of dwelling types and tenures, both market and non-market, foster affordability in the community. Also, locating housing close to shops and services reduces GHG emissions by minimizing residents' dependency on the car. Energy efficiency is considered for neighbourhoods at every scale, whether through district energy or renewable energy sources, to reduce residential GHG emissions further.

2. Maximize the number and types of jobs throughout the community. The Vision maximizes employment opportunities for City, North Shore and regional residents by supplying 1.5 jobs for every dwelling unit. Employment opportunities should be easily accessible through

walking, cycling and transit. The City strives to be a complete community supported by a strong and diverse economy. Locating good and plentiful jobs close to home reduces commute times and related GHG emissions by supporting walking and cycling as viable transportation options.

6.2 HOUSING AND JOBS DESIGN STRATEGIES

The strategies identified in this section outline how and where to increase the number of residential units and suggests appropriate densities. They also consider single-family neighbourhood transition to a greater diversity of housing types, emphasizing the promotion of green building practices and inclusion of plentiful, quality amenity space such as public and semi-public courtyards, rooftops and community gardens.

The strategies further address the city's continuing role as a major employment centre in the region. They outline an increase in mixed-use, commercial and industrial development along Lonsdale Avenue and the waterfront, with two key employment nodes east and west of the city. Although many of these ideas may be implemented citywide, cooperative planning with First Nations, District of North Vancouver, Port Authority and other intergovernmental entities is required to ensure an appropriate job balance in the community and region.

PRINCIPLE 6: APPROPRIATE HOUSING FOR ALL

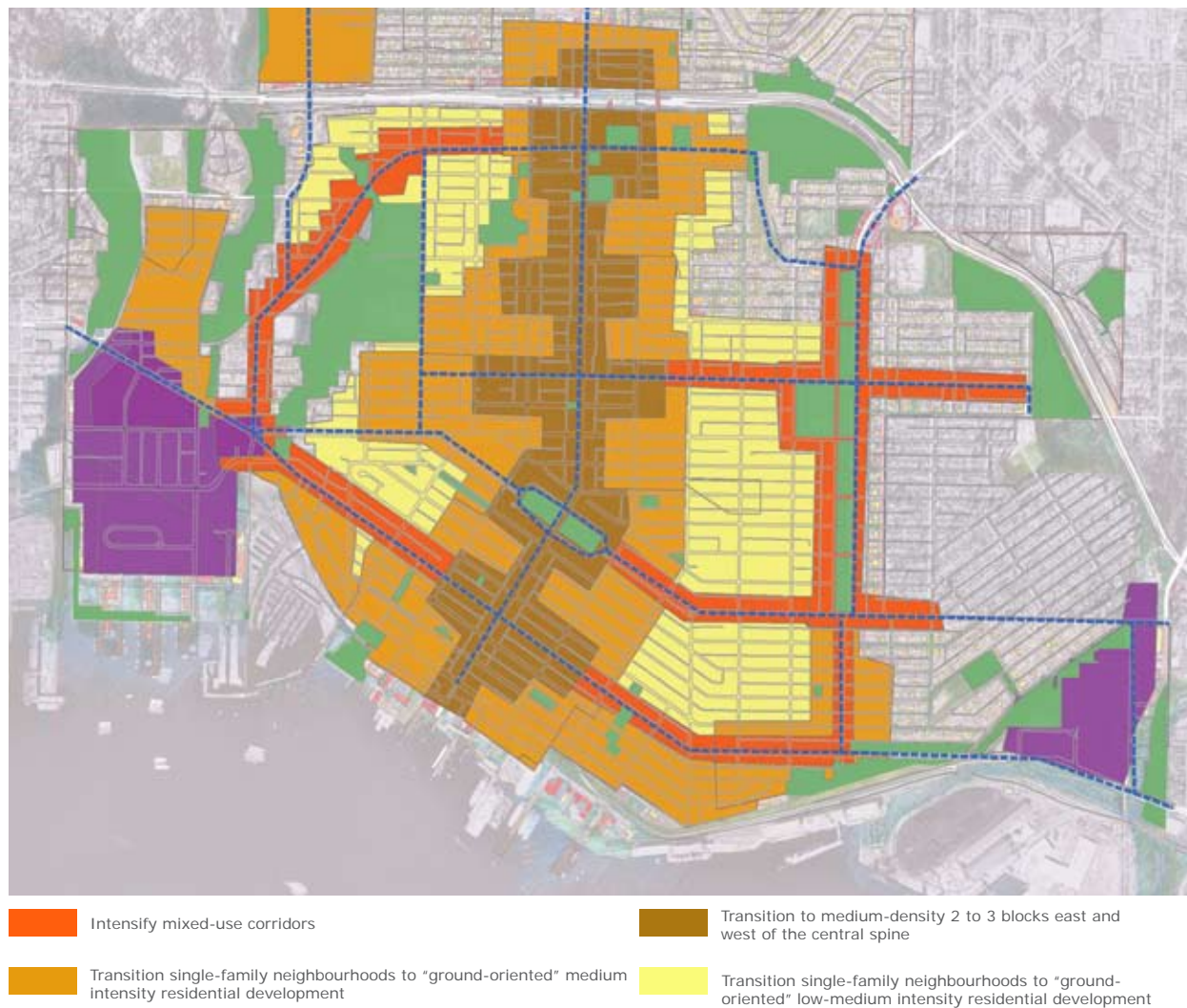


Figure 6.2 Key corridors in the City of North Vancouver. Map prepared by Duncan Cavens

Figure 6.3 The Lonsdale Corridor. Drawing by Colin Cathcart, Patrick Condon, James Tuer, Daniel Roehr, Nicole Miller and Sara Muir-Owen.



CITY-WIDE DESIGN STRATEGIES:

- 1. Provide a wide range of housing types through the City.** Locate new high density residential development along Lonsdale Avenue, with a transition to medium density 2 to 3 blocks east and west of this central spine. Intensified, mixed-use corridors follow Keith Road and 3rd, 15th and 23rd Streets. Single-family areas transition to medium density, ground oriented dwellings. Supporting the needs of a growing population, the Vision outlines a wide spectrum of housing forms: low-rise, mid-rise, and high-rise apartments at key nodes and along corridors; and, duplexes, rowhouses, and multi-plexes in residential areas. Increased density throughout the city supports transit and commercial services within a five minute walk of homes, while the range of unit types and sizes supports an aging population, families with children and opportunities for affordable housing.
- 2. Locate highest density along corridors.** Plan higher density development along corridors first. Developing density along major circulation routes reinforces their importance to the community and serves as a catalyst for additional development. Increasing the population along these corridors supports improved transit and commercial services.

PRINCIPLE 6: APPROPRIATE HOUSING FOR ALL



Figure 6.4 High density towers in Lower Lonsdale intensify the area, creating a vibrant hub of residential, commercial and office use. The buildings incorporate new technologies including green roofs and walls. Drawing by Susan Milley.

CITY-WIDE DESIGN STRATEGIES:

- 3. Cluster towers at Lower Lonsdale.** Create an intensive mixed-use residential, office and commercial area at the city's southern boundary at Lower Lonsdale. High-rise (greater than 10 stories) building forms with a net average floor area ratio (FAR) of up to 5.5, and mid-rise buildings, 4 to 8 stories in height and a range of 2.2 to 3.0 net average FAR comprise the Lower Lonsdale area.



PRINCIPLE 6: APPROPRIATE HOUSING FOR ALL

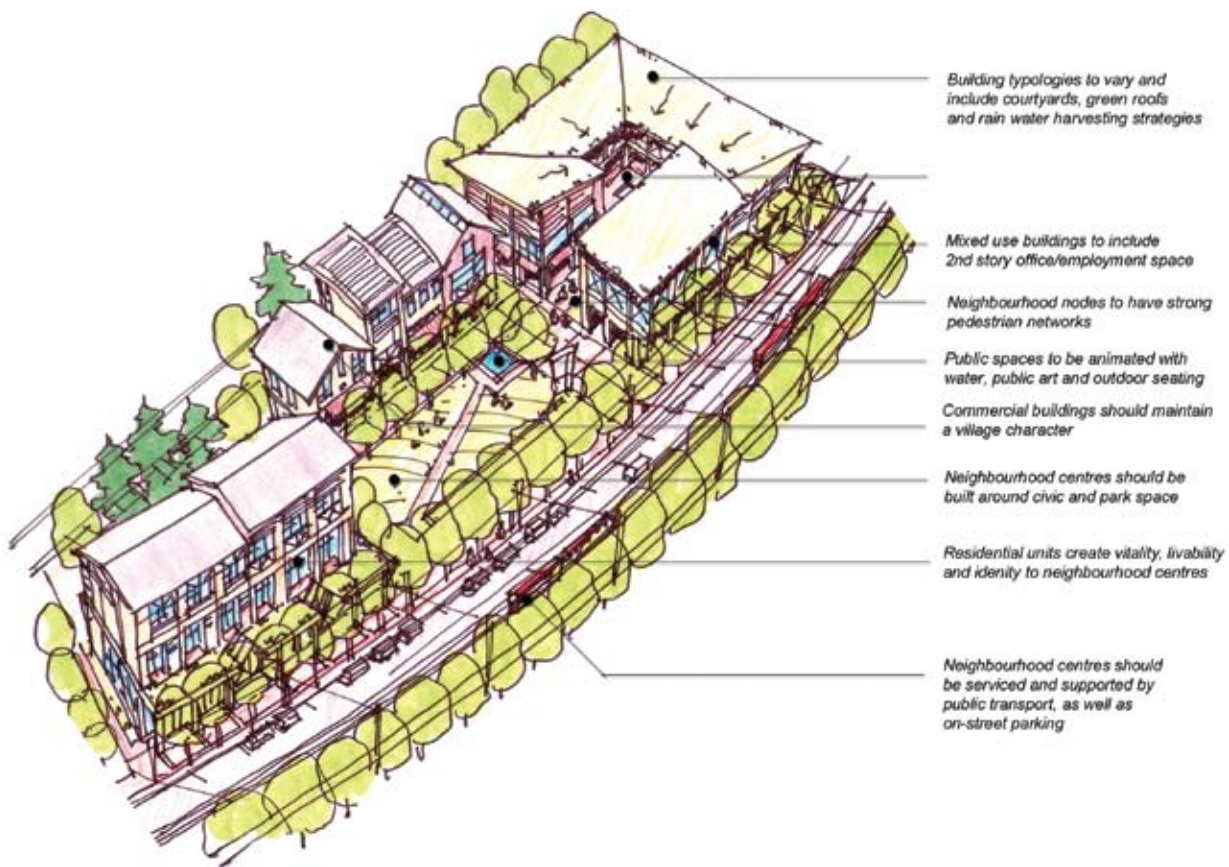


Figure 6.5 Medium to high density development at the Central Lonsdale node. Drawing by James Tuer.

Figure 6.6 Intensified development at Upper Lonsdale.
Drawing by Jay Hiscox



CITY-WIDE DESIGN STRATEGIES:

4. **Include mid-rise buildings along Lonsdale Avenue.** Use areas between high density nodes along Lonsdale Avenue for the development of mid-rise buildings, up to 8 stories in height and approximately 2.2 net average FAR. These buildings can be mixed-use commercial, office and residential, residential only or standalone office.
5. **Intensify development at Upper Lonsdale.** Redevelop Upper Lonsdale with a cluster of towers along a four-block land bridge that spans the rapid transit service incorporated into the Upper Levels Highway. Create a major mixed-use residential, office and commercial node anchored by the regional transit station. High-rise (10 plus stories) building forms with a FAR up to 5.5 comprise the Upper Lonsdale core node. Mid-rise buildings (up to 10 stories in height) and a range of 2.2 to 3.0 average FAR extend north and 3-4 blocks south of this major node.

PRINCIPLE 6: APPROPRIATE HOUSING FOR ALL

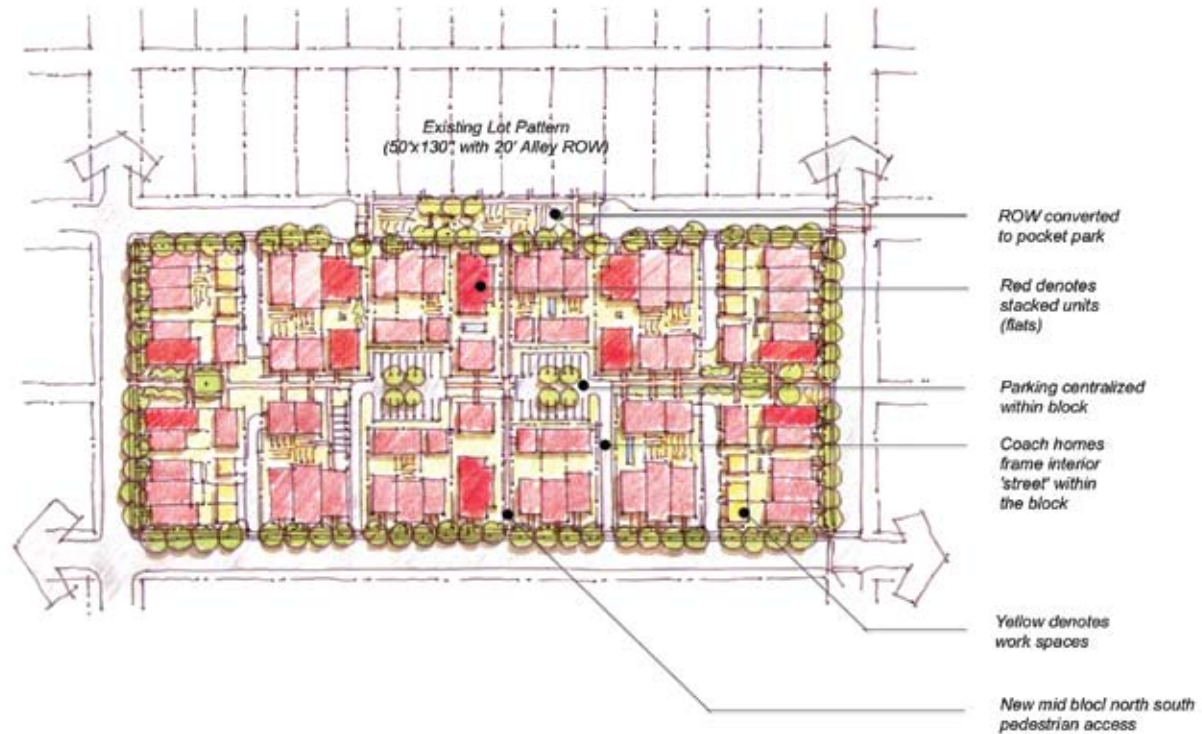
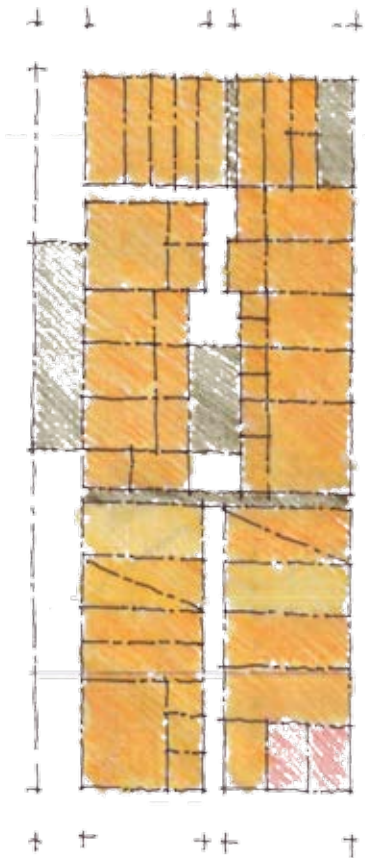


Figure 6.7 Gradual transformation of the block accommodates diversity of residential units with private and public open space and pedestrian access. Drawing by James Tuer.

Figure 6.8 Parcel reconfiguration facilitates an increase in density and diversity in residential units. This organization suggests opportunities for through block pedestrian and cycling access. Drawing by James Tuer.



CITY-WIDE DESIGN STRATEGIES:

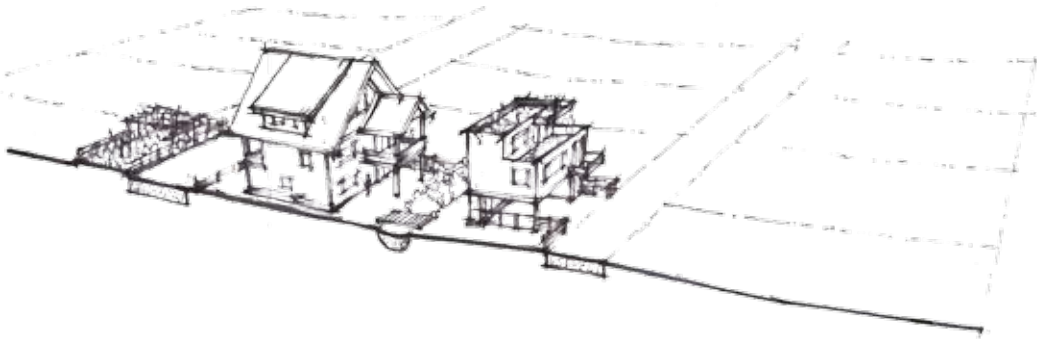
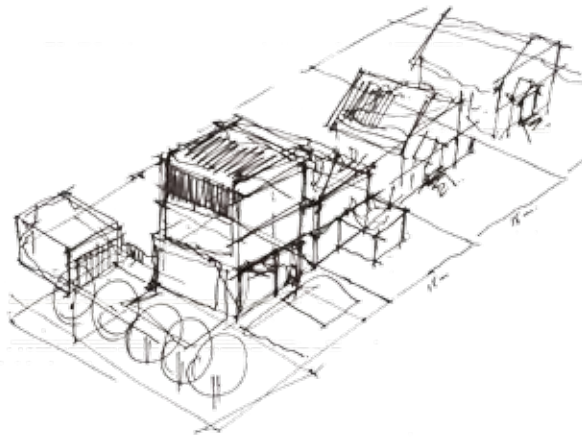
- 6. Transition single family neighbourhoods to “ground-oriented” low-medium and medium density over time.** Gradually transition predominately single-family neighbourhoods into multi-family on a lot-by-lot basis. Traditional single-family character is maintained despite increased density by incorporating sensitive, multi-family residential infill. Incremental change helps to maintain continuity in existing neighbourhoods. In areas proximate to key corridors and neighbourhood nodes, 3-4 storey residential apartment units are introduced, raising the average FAR to 0.8 to 1.0.

PRINCIPLE 6: APPROPRIATE HOUSING FOR ALL



Figure 6.9 Transition single-family neighbourhoods to “ground-oriented” low-medium to medium density areas through single-family residential infill. Density is achieved by incorporating duplex, tri- and fourplex housing. Attention to building form and facade reduces the mass of larger building types and helps to maintain the high quality single-family character of the city’s core neighbourhoods. Drawing by James Tuer.

Figure 6.10 Sketches exploring alternatives for infill housing in predominantly single-family areas. Drawings Jay Hiscox and Erick Villagomez.



CITY-WIDE DESIGN STRATEGIES:

- 7. Use diverse strategies for infill.** Infill single-family neighbourhoods through development of duplex, tri- and fourplex units on a single parcel and introducing coach houses off lanes. This provides a diversity of smaller, more energy efficient and more affordable housing. The number and type of units within each neighbourhood block, or even on a single parcel, may be increased 3 to 4 times while maintaining similar scale and form.
- 8. Preserve single family character.** Respect the single-family scale, character and quality of the neighbourhood. Building design elements such as roof pitch and planes, dormers, windows and front doors facing the street, reduce the apparent building mass of larger structures, helping to maintain a residential neighbourhood character.

PRINCIPLE 6: APPROPRIATE HOUSING FOR ALL



CITY-WIDE DESIGN STRATEGIES:

9. Utilize corner lots for intensification.

Redevelop homes reaching the end of their projected lifespan as duplexes, tri- or fourplexes. Some parcels incorporate neighbourhood mixed-use commercial and/or small office use. These options are particularly encouraged on corner lots of neighbourhood blocks or where lots front community open spaces.

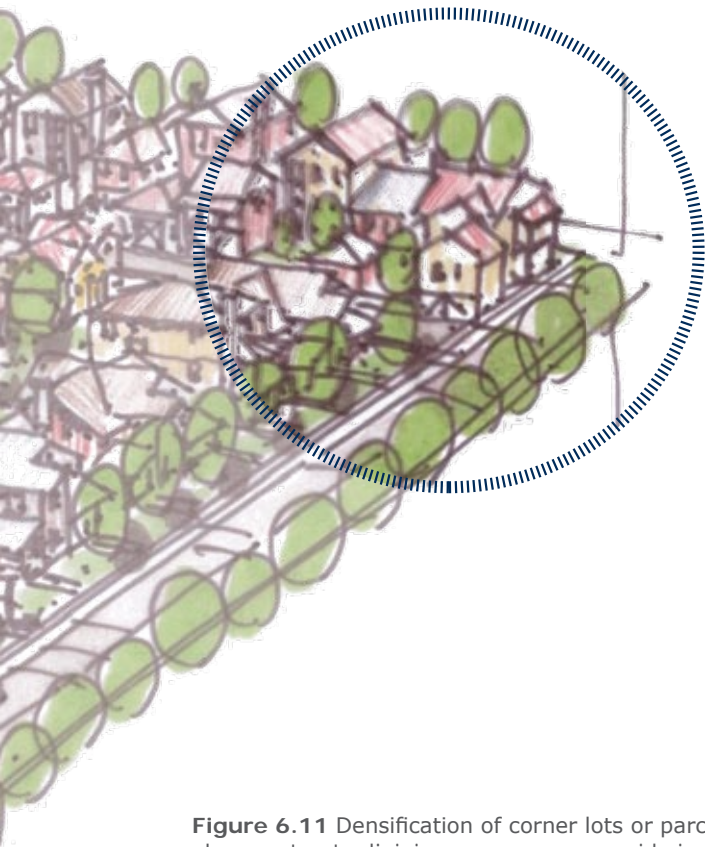


Figure 6.11 Densification of corner lots or parcels along a street adjoining open space, provide increased range of unit size, tenure statuses and affordability options, while integrating neighbourhood commercial and office use into the residential fabric. Drawing by James Tuer.

PRINCIPLE 6: APPROPRIATE HOUSING FOR ALL



Figure 6.12 Providing diversity of private, semi-public and public open space through creative design approaches such as a modified grid, greening of laneways and allocation of space for community gardens.

Figure 6.13 (below) Medium to high-density developments incorporate courtyard spaces for public gathering, community gardens and green infrastructure systems. Drawing by James Tuer.



CITY-WIDE DESIGN STRATEGIES:

- 10. Provide both public and semi-public amenities.** Ensure all buildings provide viable public and semi-public amenities in the form of rooftop gardens, accessible courtyards and/or public park space. Courtyards are built over parking to create publicly-accessible “interior” rooms between residential, office and commercial buildings. Green walls and roofs enhance stormwater retention on-site and create opportunities for food production and gardens.
- 11. Incorporate community gardens.** Incorporate community gardens into building podiums, on green roofs and in courtyards of higher to medium-density developments. In residential neighbourhoods, pocket parks and community gardens are included within the block and/or along converted public right-of-ways. All community spaces and parks are connected by greenways to the City’s “Green Necklace” and regional park network.

PRINCIPLE 6: APPROPRIATE HOUSING FOR ALL

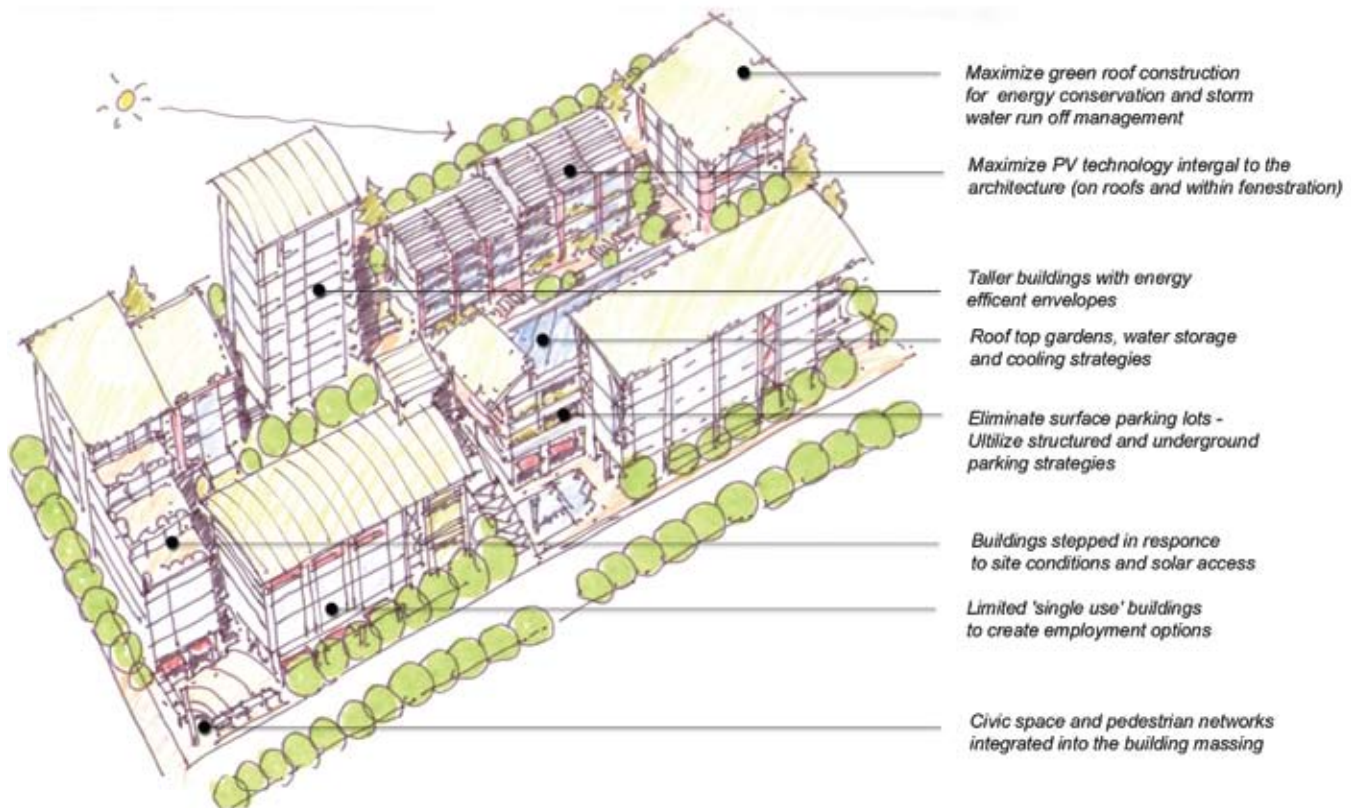


Figure 6.14 Development capitalizes on the south-facing slope for passive solar gain and penetration. Designs also incorporate green roofs and other on-site storm water management practices. Drawing by James Tuer.

Figure 6.15 (below) Concept sketch of new, green construction along Lonsdale Avenue utilizing passive and active solar gain as well as green roofs. Drawing by Jay Hiscox.



CITY-WIDE DESIGN STRATEGIES:

- 12. Capitalize on passive solar gain and solar penetration.** Where appropriate, step new development down the slope and orient to capitalize on passive solar gain. New buildings have limited depth to enable solar penetration. Require solar pre-wiring or solar piping for future construction.
- 13. Encourage smaller units and shared walls.** Support intensive development that includes smaller apartment units as well as duplexes and row housing. Ground-oriented housing with shared walls and apartments with smaller units conserve energy by reducing heating demands and offer more affordable housing choices.
- 14. Encourage green building design and construction.** Incorporate green building practices and materials in all new development. Green building design and construction reduces energy demand and reuses waste heat for hot water and space heating.
- 15. Incorporate green roofs, patios and walls.** Include green roofs, patios and walls as integral components of the building. Green roofs capture stormwater and reduce peak flows.

PRINCIPLE 7: GOOD AND PLENTIFUL JOBS CLOSE TO HOME

CITY-WIDE DESIGN STRATEGIES:

- 1. Increase the proportion of jobs along Lonsdale.** Accommodate 160 jobs per hectare in medium to high-density mixed-use commercial and office buildings along Lonsdale Avenue.
- 2. Develop two new employment nodes to the east and west of Lonsdale.** Create 190 jobs per hectare in two major employment nodes comprised of medium and high-density office, commercial and light industrial. One node is located at the City's south western boundary between the waterfront and 3rd Street. The second is located at the southeastern edge between Keith Road and 3rd Street.



Figure 6.16 A significant concentration of jobs are located along the Lonsdale Corridor. Two key medium and high-density office, commercial and light industrial nodes provide for a high proportion of new jobs. Drawing by Colin Cathcart, Patrick Condon, James Tuer, Daniel Roehr, Nicole Miller and Sara Muir-Owen.

PRINCIPLE 7: GOOD AND PLENTIFUL JOBS CLOSE TO HOME











Figure 6.17 Neighbourhood-scale mixed-use commercial and office are integrated into the primarily residential fabric. Employment opportunities are located close to home, accessible through public transit and the trail network. Drawing by Colin Cathcart, Patrick Condon, James Tuer, Daniel Roehr, Nicole Miller and Sara Muir-Owen.

CITY-WIDE DESIGN STRATEGIES:

3. **Increase jobs within the neighbourhood fabric.** Fifty to eighty jobs per hectare are created within the residential fabric along the commercial and mixed-use corridors and in the neighbourhood nodes. A percentage of jobs are anticipated within homes due to development of building types that accommodate home-based businesses and work/live options.
4. **Provide neighbourhood commercial services.** Locate neighbourhood-scale commercial and mixed-use nodes at key intersections and along corridors within the residential fabric.



LEGEND

	Mixed-use / Commercial		Office
	Medium-density		Open Space and Parks
	Low-density		Natural Features
	Light Industrial		Transit Corridor
	Industrial		Transit Route

PRINCIPLE 7: GOOD AND PLENTIFUL JOBS CLOSE TO HOME

Figure 6.18 Concept diagram for waterfront redevelopment. Drawing by Colin Cathcart, Patrick Condon, James Tuer, Daniel Roehr, Nicole Miller and Sara Muir-Owen.

CITY-WIDE DESIGN STRATEGIES:

5. **Increase the shoreline.** Increase the total amount of shoreline by dredging additional inlets (with consideration to environmental impacts) so that Port activity, including shipping traffic capacity, is maintained and enhanced. As the implications for climate change and sea level rise are better understood, adjust geodetic height of Port infrastructure to maintain the viability of this resource, ameliorate environmental impacts and improve original fill conditions.
6. **Provide more jobs at the waterfront.** Maintain and intensify port activities on less land extensive parcels. Reconfigure land and intensify use to maintain functionality while providing additional land area for other uses.
7. **Add light industrial functions.** Maintain and enhance light industrial uses at the waterfront. Retain existing industrial capacity and create additional jobs to provide more residents access to diverse employment opportunities.



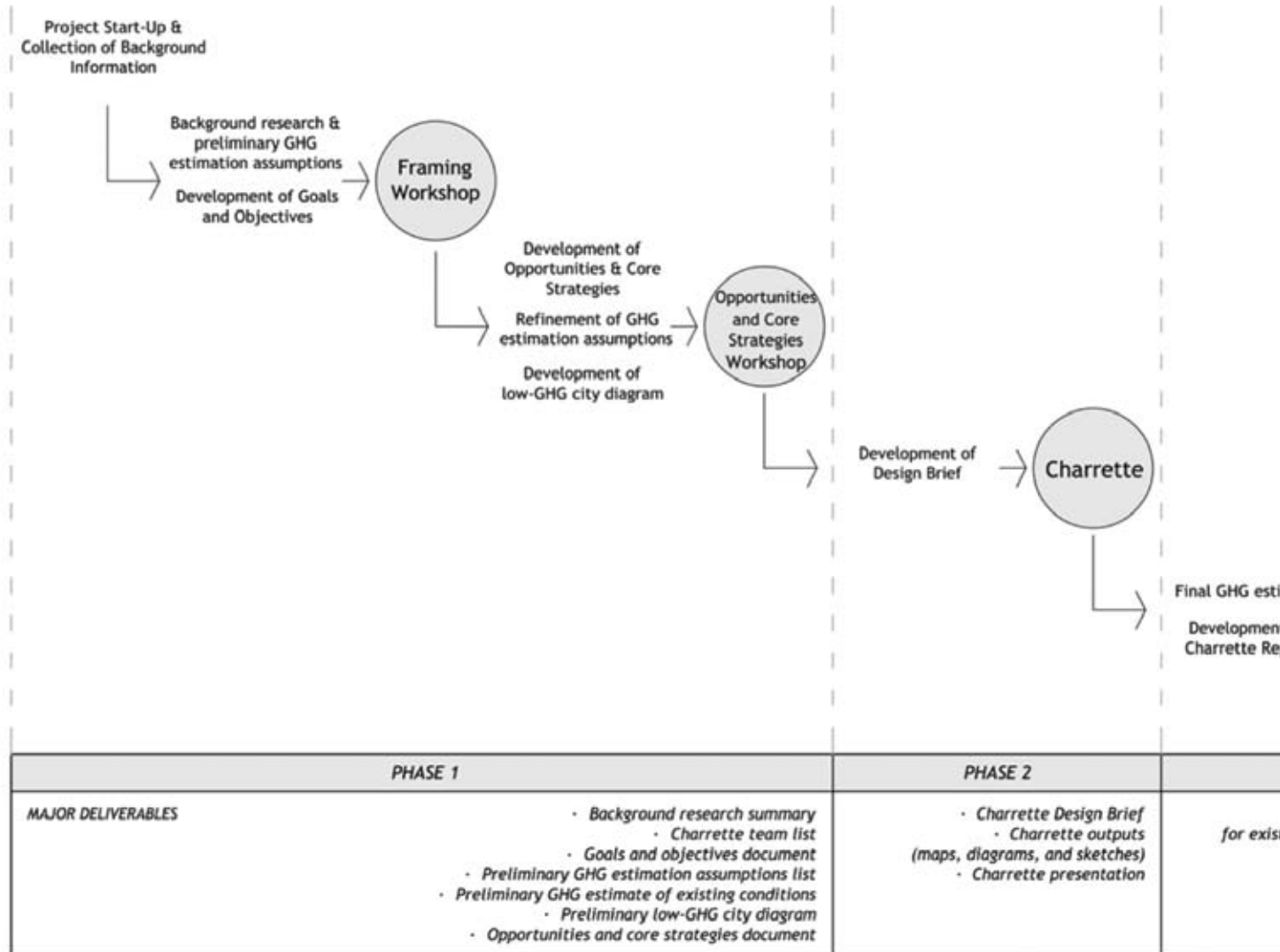
This Vision resulted from a diverse group of residents and collaborators exploring the possibility of the community reaching zero net GHG emissions. It illustrates a future for the City that is even more liveable and complete than today. The Vision presents a community in which the increased convenience of shops and services close to neighbourhoods and better opportunities for walking, cycling and transit also reduce the City's contribution to the adverse effects of climate change. The city in 2107 will be different, as it necessarily responds to both anticipated and unknown challenges in the future. It is the intention that, by engaging the Vision today, these changes represent real opportunities for an improved community. This complete, green and accessible city is not unrecognizable. It is rather the continuation of many of the City's enduring values of both today and a century past.

But this report does not attempt to provide an exact picture or describe a certain future. Rather, it shows one vision of what such a sustainable city might look like and identifies a clear direction. It helps us consider the first steps we can take on our collective journey and frames the key questions along this future path: what are the land use changes we can set in place; what transportation decisions will start us on the right track; how can we imagine our greenways and streamways as the ecological underpinnings for our city's health; and how should we change our road building standards so our streets will be greener?

It shows what can happen as the result of thousands of small, evolutionary changes to all the commonplace elements of our urban landscapes. A planted swale, the local grocer down the street, an electric tram connecting homes to work, or a neighbour's caretaker suite is each a thoughtful step on its own. Together they create a sustainable city for future generations and ensure another century of progress for the City of North Vancouver.

APPENDIX ONE: THE 100 YEAR SUSTAINABILITY VISION CHARRETTE PROCESS

PROJECT PROCESS, EVENTS, AND MAJOR DELIVERABLES



PROJECT PROCESS

The project consisted of three phases. Figure A1.1 outlines the phases and describes major deliverables.

This document fulfills phase three - the Charrette Report, as well as the GHG estimate for existing and future conditions. The aim of the report is to inform future policy recommendations and implementation strategies required to turn the *100 Year Sustainability Vision* into reality.

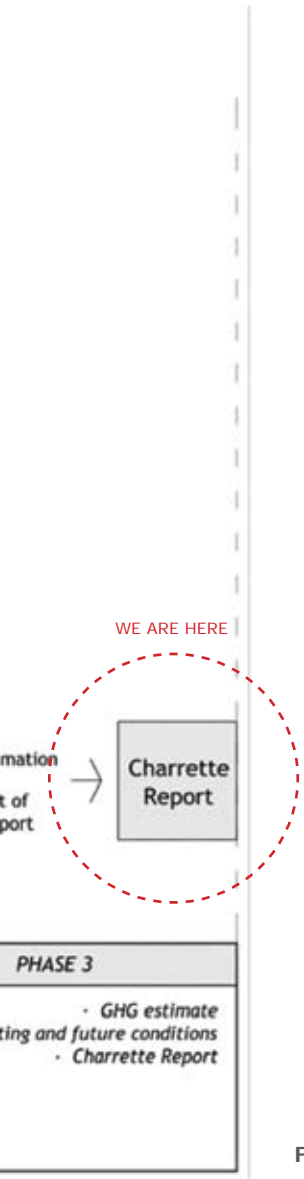


Figure A1.1 Charrette Process

APPENDIX TWO: KEY FRAMING ISSUES

KEY FRAMING ISSUES

CURRENT GHG EMISSIONS

Estimates for the City of North Vancouver's 2007 greenhouse gas (GHG) emissions are approximately 245,000 tonnes. Sources of emissions by sector indicate transportation is the main contributor, accounting for more than 50% of total emissions, followed by the building sector and, to a much lesser extent, solid waste. Team researchers analyzed current (2007), and generated preliminary 2050 and 2017, energy consumption and GHG contribution estimates to explore the changes required to achieve GHG emissions targets. These are included in Appendix Four.

POPULATION

The City's 2006 population was 45,165. Considering growth rates during the last five and ten years, the population by 2107 will be between 75,000 and 105,000. However, at the Opportunities and Core Strategies Workshop, stakeholders determined that the City, as a leader in sustainable urban development, should strive to accommodate triple the current population by 2107 (1% annual growth compounded). This suggests a figure of approximately 135,000 people by 2107. It is impossible to predict the city's population in 100 years. However, setting a high target provides a greater challenge to researchers and stakeholders alike: improving liveability and achieving carbon neutrality while considering a dramatic population change.

EMPLOYMENT

The city currently employs 26,695 people (2001 data)—just over one job per household. At the Opportunities and Core Strategies Workshop, stakeholders determined that the city, as a complete, sustainable community, should strive to accommodate a balance of 1 job per working person, which for purposes of the *100 Year Sustainability Vision* is estimated at 1.5 jobs per dwelling unit. This is also a challenging figure, but might reflect the city's growing role as the centre of North Shore commerce and service.

LAND USE MIX

In order to accommodate triple the population, reduce GHG emissions to net zero and enhance liveability, the city's land use mix and density will change dramatically. The preliminary 2107 low-GHG diagram implies a densification of all neighbourhoods in the city with a greater concentration of density in nodes and corridors. The Preliminary 2107 low-GHG diagram assumptions outlined in Appendix Three provide proposed land use distribution and densities.

TRANSPORTATION MODES

Over 50% of the city's GHG emissions result from transportation. In order to reduce GHG emissions to zero by 2107, travel behaviour of residents will have to change dramatically, with walking, cycling and transit replacing automobile use. The goals and objectives and core strategies workshops resulted in a preliminary scenario of proposed transit routes, increased densities supportive of frequent transit

use and a wider distribution of employment and services as shown in the overview of preliminary 2107 low-GHG diagram. Changes to urban form and transportation service will assist in limiting automobile use, reducing energy consumption, and promoting alternative modes of transportation.

OPEN SPACE AND PRIVATE & PUBLIC REALM

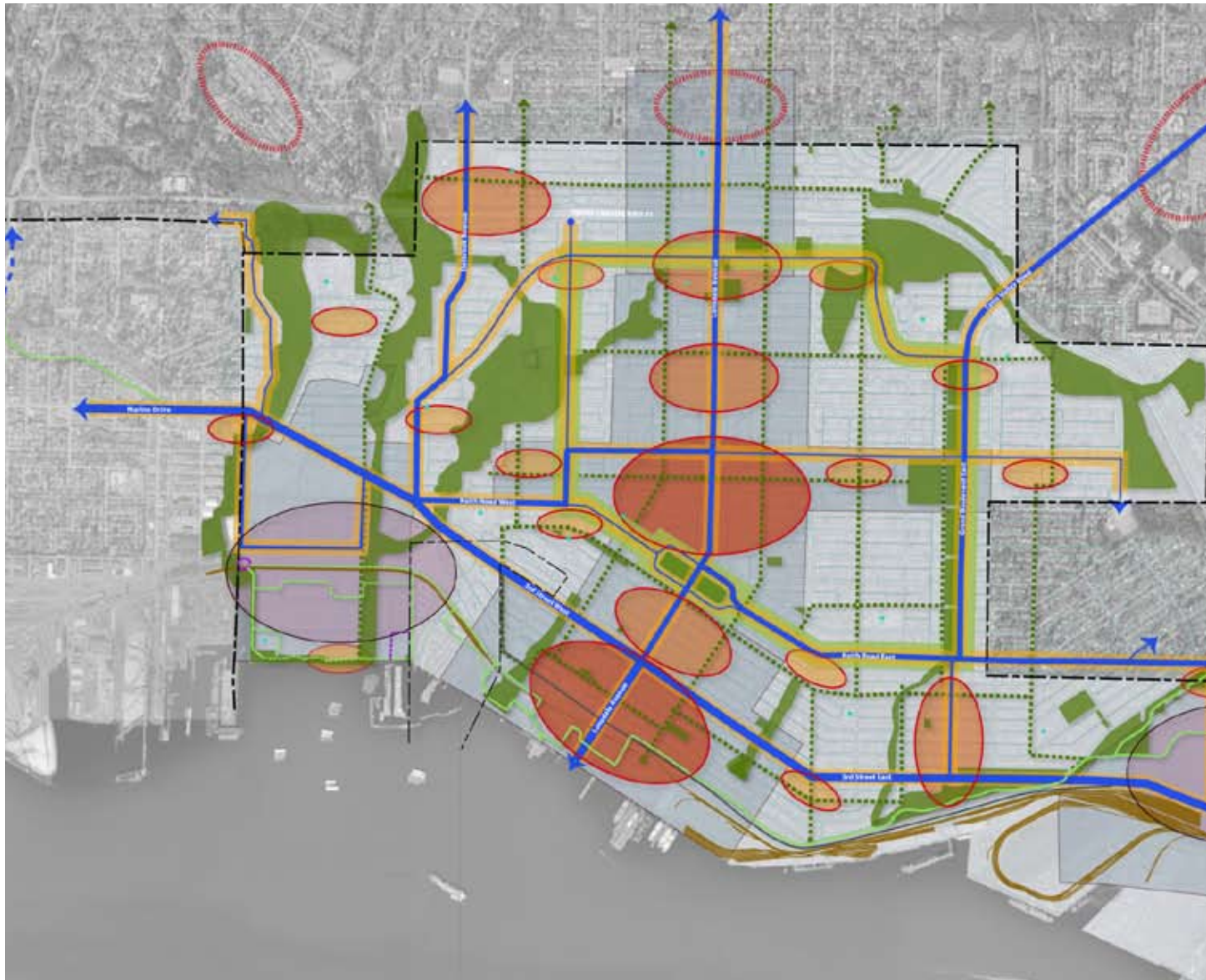
The city has a number of outstanding natural and historic attributes: the waterfront, hills, streams, mountain views, sloping southern exposure and distinct central core. The current compact size of the City and grid street pattern facilitates access to the Town Centre, parks and natural areas. The overview of the preliminary 2107 low-GHG diagram assumptions presented in Appendix Three outlines proposed park expansions, greenway connections and green streets aimed at capturing and filtering stormwater.

INFRASTRUCTURE

Today, many buildings and infrastructure are constructed with short life cycles and negative impacts on the environment (water, air, energy and soil). Almost 40% of the City's GHG emissions result from buildings (residential and commercial). Increased development that continues conventional practices such as expansive site cover with impervious surfaces is not practical, particularly considering the risks of climate change. Significant changes that accommodate the projected population while ensuring longer life cycles, energy conservation, water quality, flood prevention and a positive contribution to the environment are required.

ANTICIPATED AND UNANTICIPATED IMPACTS OF CLIMATE CHANGE

Anticipated impacts of climate change include sea level rise, increased storm intensity, increased precipitation in winter, decreased precipitation in spring and summer, and higher temperatures. The city's urban form, public realm and infrastructure (water and energy) should be able to adapt to uncertain future conditions in a manner that does not compromise the quality of life of the projected population.



100 Year Sustainability Vision - City of North Vancouver

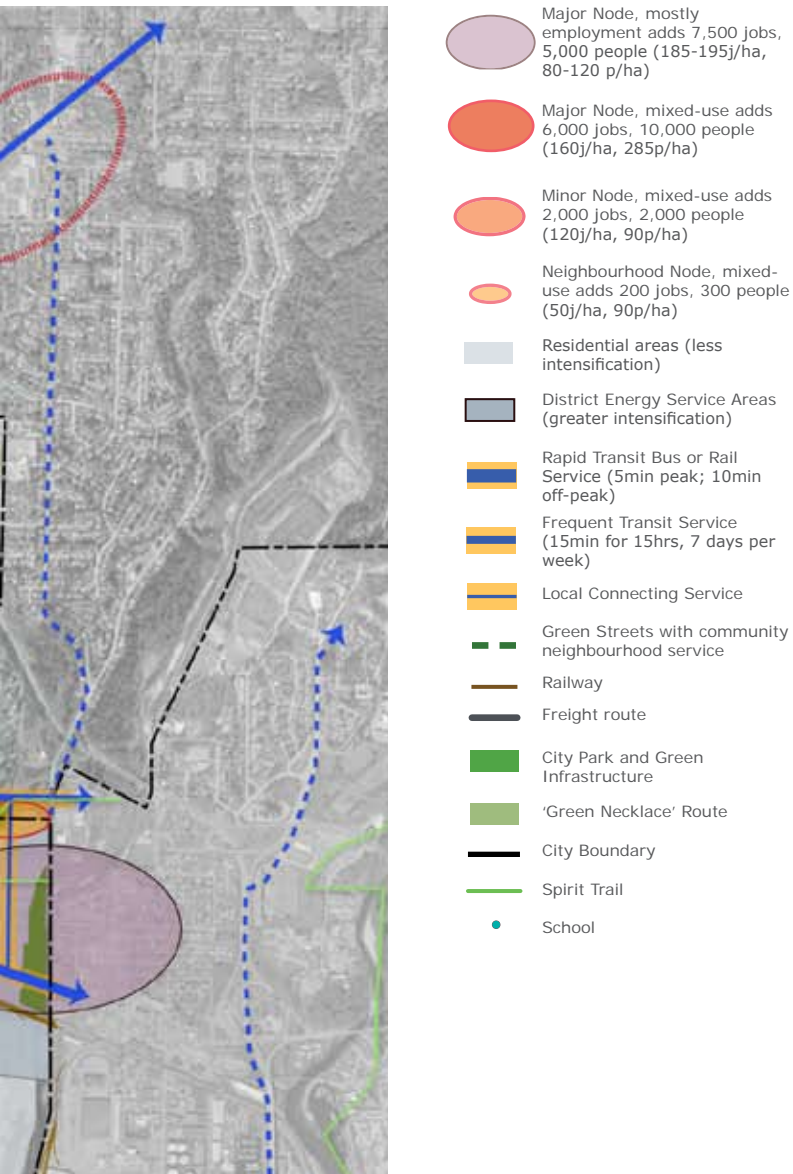
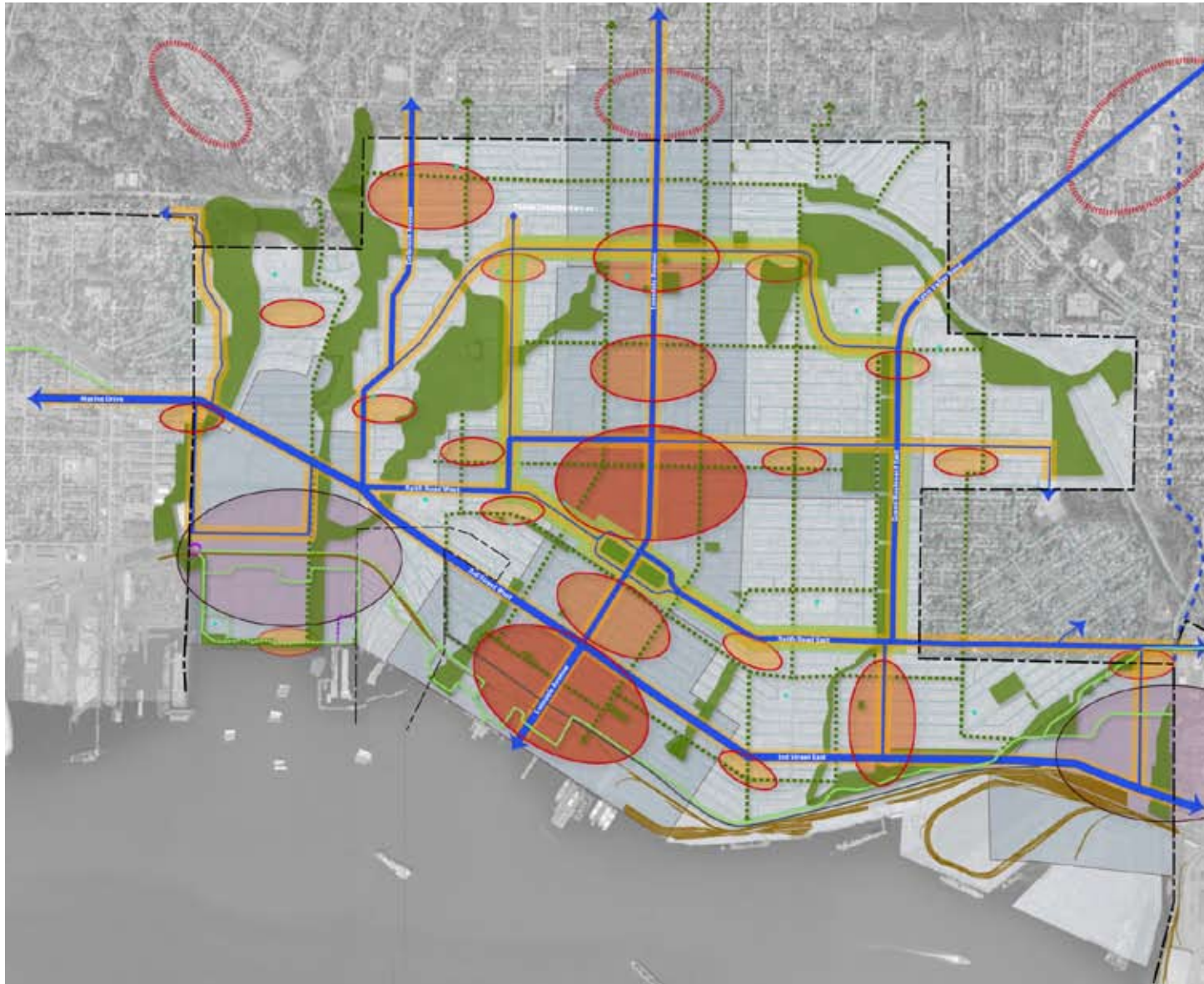


Figure A2.1 The 2107 low-GHG diagram is a spatial representation of the goals and objectives developed by stakeholders at the first City workshop. DCS and City staff created the first draft which stakeholders revised at the second workshop. The intent of the diagram is to identify the “big moves” that were considered and detailed at the charrette. Developing the low-GHG diagram enabled team members to test the feasibility of population, employment and GHG emissions targets prior to the charrette event, while framing more detailed discussions on design strategies related to land use allocation and mix, parks designation and green infrastructure systems, and feasible transit routes during the charrette.

APPENDIX THREE: PRELIMINARY 2107 LOW-GHG DIAGRAM ASSUMPTIONS



100 Year Sustainability Vision - City of North Vancouver

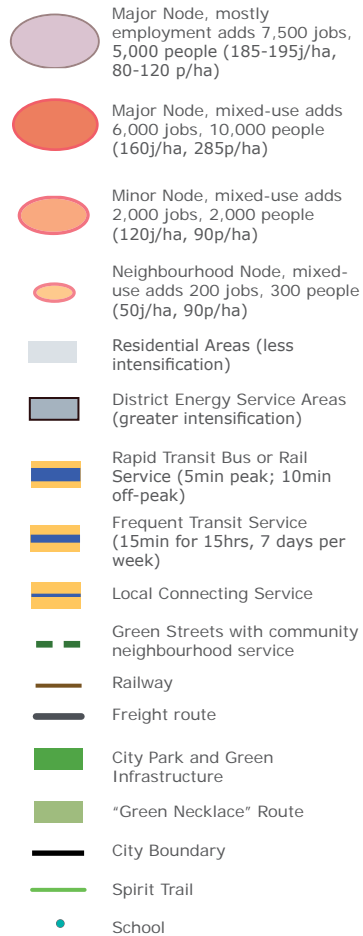


Figure A3.1 Preliminary 2107 low-GHG diagram.

PRELIMINARY 2107 LOW-GHG DIAGRAM ASSUMPTIONS

WHAT IS THE 2107 LOW-GHG DIAGRAM?

The 2107 low-GHG diagram is a spatial representation of the goals and objectives developed by stakeholders at the first City workshop. The intent of the diagram was to identify the “big moves” to be carried forward and detailed at the charrette. DCS and City staff created the first draft which stakeholders revised at the second workshop held in June, 2008. Developing the low-GHG diagram enabled team members to test the feasibility of population, employment and GHG emissions targets prior to the charrette event and was defined a starting point for more detailed design conversations during the charrette.

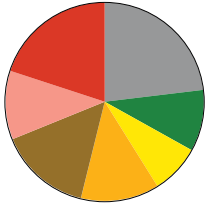
WHAT DOES THE DIAGRAM TELL US?

With a simple language of nodes and corridors, the diagram identifies areas of intensification throughout the city in order to accommodate triple the population over the next 100 years. Underlying each color-coded area is a set of more detailed land use assumptions described on the following pages. These assumptions provided points of discussion, evolving over the course of the charrette.



MAJOR NODE, MOSTLY EMPLOYMENT - WEST

PROPOSED LAND USE PROFILE:



DENSITY:
 65 - units/hectare
 120 - people/hectare
 195 - jobs/hectare
 1.5 - average net FAR

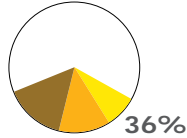
Key assumptions:
 Major node on west side of city, with possible connections to District.

Increased capacity for office and retail uses.

Supporting medium to high-density residential uses included (up to 5 stories).

All residents are in walking distance to transit, shopping and employment.

RESIDENTIAL AND MIXED-USE



ATTACHED HOUSING:
 rowhouses,
 2-3 stories
 0.8 FAR



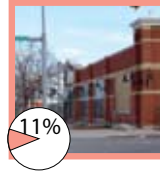
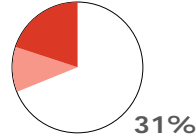
APARTMENTS:
 4-5 stories
 2.2 FAR



Mixed-use:
 4-5 stories
 2.2 FAR



COMMERCIAL AND INDUSTRIAL



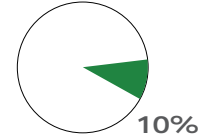
LOW-DENSITY COMMERCIAL:
 retail, office, 1-2 stories
 0.7 FAR



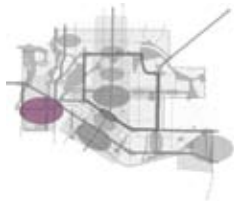
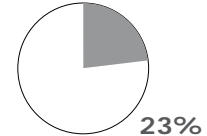
MID-DENSITY COMMERCIAL:
 mostly office,
 3+ stories
 1.3 FAR



CIVIC AND OPEN SPACE



PUBLIC R.O.W



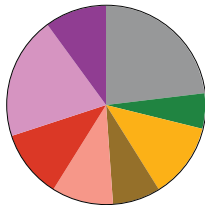
The above graphs show the comparative distribution of land uses assumed for this area of the 100 Year Vision for the City.

Intended for discussion purposes.



MAJOR NODE, MOSTLY EMPLOYMENT - EAST

PROPOSED LAND USE PROFILE:



DENSITY:

- 45 - units/hectare
- 80 - people/hectare
- 185 - jobs/hectare
- 1.2 - average net FAR

Key assumptions:

Major node on east side of city, with possible connections to District.

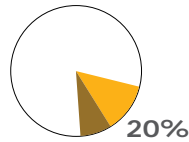
Increased capacity for office, retail and industrial uses.

Supporting medium to high-density residential uses included (up to 5 stories).

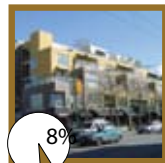
All residents are in walking distance to transit, shopping and employment.



RESIDENTIAL AND MIXED-USE



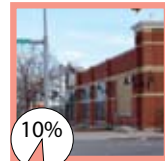
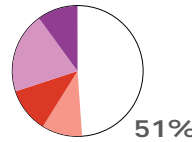
APARTMENTS:
4-5 stories
2.2 FAR



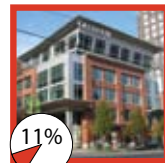
Mixed-use:
4-5 stories
2.2 FAR



COMMERCIAL AND INDUSTRIAL



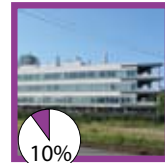
LOW-DENSITY COMMERCIAL:
retail, office, 1-2 stories
0.7 FAR



MID-DENSITY COMMERCIAL:
mostly office, 3+ stories
1.3 FAR



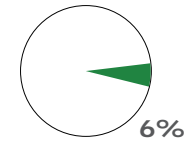
LOW-DENSITY INDUSTRIAL:
1-2 stories
0.3 FAR



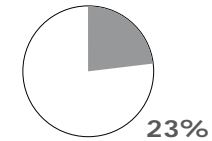
MID-DENSITY INDUSTRIAL:
3+ stories
1.5 FAR



CIVIC AND OPEN SPACE



PUBLIC R.O.W



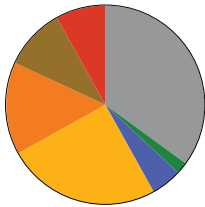
The above graphs show the comparative distribution of land uses assumed for this area of the 100 Year Vision for the City.

Intended for discussion purposes.



MAJOR NODE, MIXED-USE

PROPOSED LAND USE PROFILE:



DENSITY:
 170 - units/hectare
 285 - people/hectare
 160 - jobs/hectare
 2.8 - average net FAR

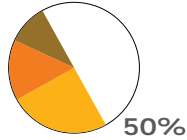
Key assumptions:
 Major, mixed-use nodes located along Lonsdale Avenue.

Mix of high-density land uses (residential, commercial, mixed-use) including some high-rise development directly adjacent to corridor.

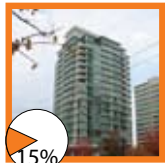
All residents are in walking distance to transit, shopping and employment.



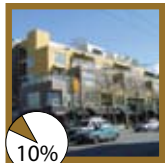
RESIDENTIAL AND MIXED-USE



APARTMENTS:
 4-5 stories
 2.5 FAR



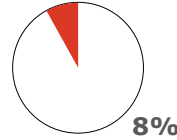
HIGH-RISE APARTMENTS:
 10+ stories
 4.0+ FAR



Mixed-use:
 4-5 stories
 2.2 FAR

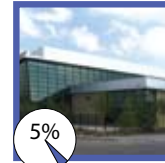
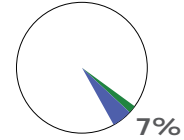


COMMERCIAL AND INDUSTRIAL

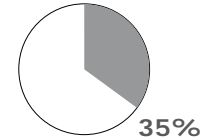


HIGH-DENSITY COMMERCIAL:
 retail, office,
 4+ stories
 2.5+ FAR

CIVIC AND OPEN SPACE



PUBLIC R.O.W



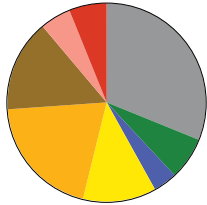
The above graphs show the comparative distribution of land uses assumed for this area of the 100 Year Vision for the City.

Intended for discussion purposes.



MINOR NODE AND NEIGHBOURHOOD NODE (GREATER DENSITY)

PROPOSED LAND USE PROFILE:



DENSITY:

- 75 - units/hectare
- 145 - people/hectare
- 90 - jobs/hectare
- 1.6 - average net FAR

Key assumptions:
Smaller-scale nodes located at key intersections.

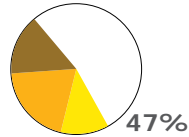
Includes commercial and mixed-use parcels.

Lower density residential (i.e. rowhouses) enables blending into surrounding residential areas.

All residents are in walking distance to transit and shopping.



RESIDENTIAL AND MIXED-USE



ATTACHED HOUSING:
rowhouses,
2-3 stories
0.8 FAR



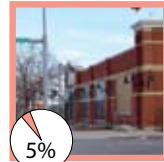
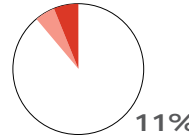
APARTMENTS:
3-4 stories
2.0 FAR



Mixed-use:
4-5 stories
2.2 FAR



COMMERCIAL AND INDUSTRIAL



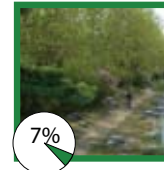
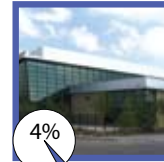
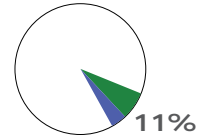
LOW-DENSITY COMMERCIAL:
retail, office, 1-2 stories
0.7 FAR



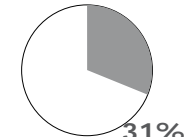
MID-DENSITY COMMERCIAL:
mostly office,
3+ stories
1.3 FAR



CIVIC AND OPEN SPACE



PUBLIC R.O.W



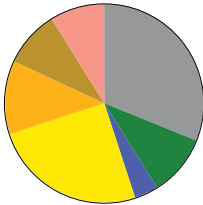
The above graphs show the comparative distribution of land uses assumed for this area of the 100 Year Vision for the City.

Intended for discussion purposes.



NEIGHBOURHOOD NODE (LESS DENSITY)

PROPOSED LAND USE PROFILE:



DENSITY:
 40 - units/hectare
 80 - people/hectare
 50 - jobs/hectare
 0.9 - average net FAR

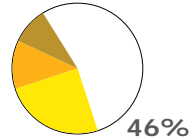
Key assumptions:
 Smaller scale nodes
 with reduced intensities
 to address context
 of specific residential
 areas.

Lower profile, lower
 density building types
 reduce visual impacts
 and enable blending
 into surrounding
 residential areas.

All residents are in
 walking distance to
 transit and shopping.



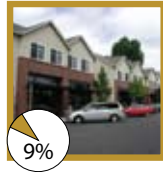
RESIDENTIAL AND MIXED-USE



ATTACHED HOUSING:
 duplexes,
 rowhouses,
 2-3 stories
 0.6 FAR

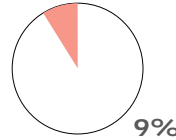


APARTMENTS:
 3-4 stories
 1.3 FAR



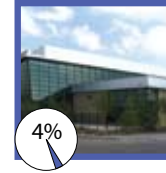
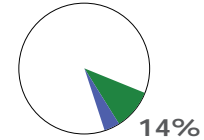
Mixed-use:
 2-4 stories
 1.5 FAR

COMMERCIAL AND INDUSTRIAL

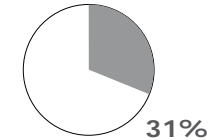


LOW-DENSITY
 COMMERCIAL:
 retail, office, 1-2
 stories
 0.7 FAR

CIVIC AND OPEN SPACE



PUBLIC R.O.W



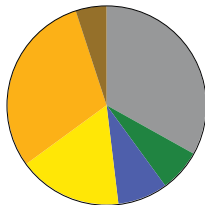
The above graphs show the comparative
 distribution of land uses assumed for this
 area of the 100 Year Vision for the City.

Intended for discussion purposes.



DISTRICT ENERGY SERVICE AREA (GREATER INTENSIFICATION)

PROPOSED LAND USE PROFILE:



DENSITY:

95 - units/hectare
 175 - people/hectare
 15 - jobs/hectare
 1.7 - average net FAR

Key assumptions:

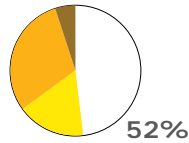
Designated areas, in addition to nodes, to be served by district energy system.

Medium to high-density residential uses meet thresholds for district energy feasibility.

Limited commercial uses due to proximity to designated mixed-use and employment nodes.



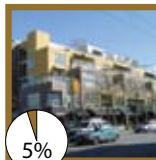
RESIDENTIAL AND MIXED-USE



ATTACHED HOUSING:
 rowhouses,
 2-3 stories
 0.8 FAR

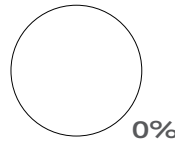


APARTMENTS:
 4-5 stories
 2.2 FAR

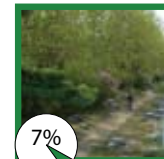
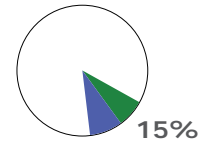


Mixed-use:
 4-5 stories
 2.2 FAR

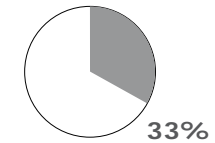
COMMERCIAL AND INDUSTRIAL



CIVIC AND OPEN SPACE



PUBLIC R.O.W



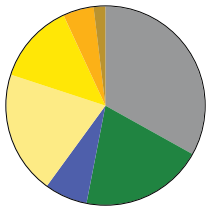
The above graphs show the comparative distribution of land uses assumed for this area of the 100 Year Vision for the City.

Intended for discussion purposes.



RESIDENTIAL AREA (LESS INTENSIFICATION)

PROPOSED LAND USE PROFILE:



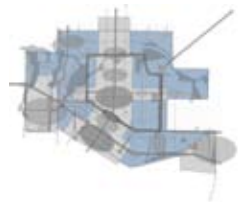
DENSITY:
 30 - units/hectare
 60 - people/hectare
 7 - jobs/hectare
 0.7 - average net FAR

Key assumptions:
 Areas outside district energy service areas.

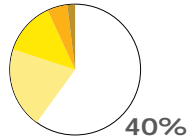
Lower density, primarily residential functions.

Land uses remain primarily ground-oriented, but intensify to free land for increased open space functions.

Most detached housing supports accessory units.



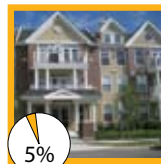
RESIDENTIAL AND MIXED-USE



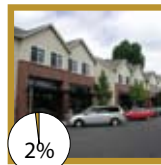
DETACHED HOUSING:
 single-family, standard and narrow lots, secondary suites
 0.4 FAR



ATTACHED HOUSING:
 rowhouses, 2-3 stories
 0.8 FAR



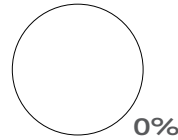
APARTMENTS:
 3-4 stories
 2.0 FAR



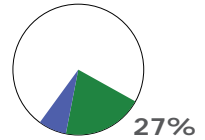
Mixed-use:
 2-3 stories
 1.0 FAR



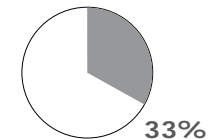
COMMERCIAL AND INDUSTRIAL



CIVIC AND OPEN SPACE



PUBLIC R.O.W

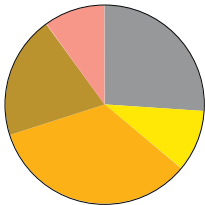


The above graphs show the comparative distribution of land uses assumed for this area of the 100 Year Vision for the City.

Intended for discussion purposes.

TRANSIT CORRIDOR

PROPOSED LAND USE PROFILE:



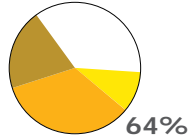
DENSITY:
 85 - units/hectare
 160 - people/hectare
 80 - jobs/hectare
 1.2 - average net FAR

Key assumptions:
 Low to high-density residential and commercial development located along bus routes to increase transit viability.

Mix of densities vary streetscape for context specific design.



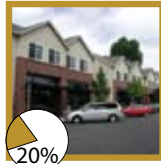
RESIDENTIAL AND MIXED-USE



ATTACHED HOUSING:
 rowhouses,
 2-3 stories
 0.8 FAR

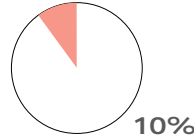


APARTMENTS:
 3-4 stories
 1.3 FAR



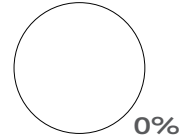
Mixed-use:
 2-4 stories
 1.3 FAR

COMMERCIAL AND INDUSTRIAL

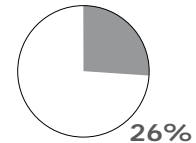


LOW-DENSITY COMMERCIAL:
 retail, office, 1-2 stories
 0.7 FAR

CIVIC AND OPEN SPACE



PUBLIC R.O.W



The above graphs show the comparative distribution of land uses assumed for this area of the 100 Year Vision for the City.

Intended for discussion purposes.

APPENDIX FOUR: PRELIMINARY 2007, 2050, 2107 ENERGY AND GHG STUDIES

PRELIMINARY ENERGY AND GHG STUDIES

The *100 Year Sustainability Vision* project forwards that the challenges of achieving an 80% reduction in GHG emissions by 2050 and a shift to net-zero GHG emissions by 2107 are potentially achievable. Preliminary studies produced for the *100 Year Sustainability Vision* underscore the need to consider substantial changes to all three community emissions sectors: buildings, transportation and waste. In order to achieve these GHG targets the City must address two crucial issues:

1. Significant reduction in energy consumption from both buildings and transportation.
2. Significant shift to renewable, low-carbon energy sources.

These issues, in turn, are affected not only by the urban form decisions envisioned by this project, but also by investments in efficient technology and appropriate lifestyle changes.

WHY EXPLORE ENERGY CONSUMPTION AND GHGS BEFORE THE CHARRETTE?

The challenge considered by the *100 Year Sustainability Vision* is to triple the population of the city while increasing sustainability and liveability, including a shift to net zero GHGs by 2107. Generating estimated energy and emission profiles for 2007, 2050 and 2107 prior to the charrette created the early ability to investigate the feasibility, opportunities and constraints of the City's challenging GHG reduction targets. These preliminary studies were a key input to the charrette. They were not prescriptive scenarios, but rather information on the magnitude of change required.

WHAT DO THE ENERGY AND GHG STUDIES TELL US?

The energy and emission estimates indicate that the targets set for 2050 and 2107 GHG reductions are very challenging, but potentially achievable. The 2050 and 2107 profiles underscore the need to consider substantial changes to all three key community emission sectors—buildings, transportation and waste—in order to meet the Vision's emission targets while upholding the project's seven Sustainability Principles. The estimates further illustrate the importance of defining ways not only to reduce energy consumption from buildings and transportation, but also to develop new, clean sources of energy for the city.

WHAT ASSUMPTIONS WERE MADE AND WHAT SOURCES WERE USED?

The GHG studies combined a variety of data sources, including the city's emissions inventory and land use, population, employment, transportation and energy data to understand how different areas of the city contribute to total city GHG performance. While long-term assumptions about technology, behaviour and energy sources are not certain, they do enable the preliminary studies to illustrate the intensity and type of changes required to meet long-term GHG targets.

Whenever possible, the charrette used data and assumptions specific to either the City or the Lower Mainland. A significant amount of building energy and technology data for the Lower Mainland was drawn from BC Hydro's *2007 Conservation Potential Review* to develop the charrette profiles. Many long-term assumptions on energy conservation and technologies were developed from *Kyoto and Beyond*, a report from the David Suzuki Foundation on Canada-wide energy and emission reductions for 2030. For 100 year assumptions, little information was available, and many assumptions are conservative "best-guesses" in the absence of better data. The energy and emission profiles on the following pages provide more detailed lists on assumptions. Page 150 offers a complete list of project references.

Residential Buildings

- Residential densities significantly increase particularly in areas designated for district energy in identified nodes and corridors.
- Most single-family homes add secondary suites
- Residential areas are densified in such a way that additional land is made available for increased open space and green infrastructure.
- Residential units/buildings built before 2050 are retrofitted or replaced
- Single-family and attached units use an average 66% less energy for heating and ventilation (based on average 2007 performance)
- Household hot water requirements are reduced 50%
- Mechanical space cooling is eliminated
- Appliances are high-efficiency, and reduce household appliance energy consumption 50%
- Lighting consumes 66% less energy
- Residential units located within designated district energy areas (70% of attached and low-rise apartment units and 100% of high-rise apartment units) are connected to the system for heating, hot water and electricity.
- Residential units located outside of district energy areas utilize passive heating strategies with supplemental heat and electricity from low-GHG sources.

Commercial, Institutional, Industrial Buildings

- Commercial densities significantly increase, particularly in areas designated for district energy and identified nodes and corridors.
- Commercial, institutional and industrial buildings built before 2050 are retrofitted or replaced
- Commercial and industrial buildings use an average 70% less electricity and 95% less heating energy (based on average 2007 performance).
- Commercial, institutional and industrial buildings are connected to the district energy system for heating, hot water and electricity.
- Commercial, institutional and industrial buildings located outside district energy areas generate or purchase energy from low-GHG sources.

Energy Systems

- District energy system expands to designated areas throughout the city, co-generate electricity using a diversity of low-GHG sources.
- Low-GHG energy is generated throughout the city where feasible and appropriate through a variety of technologies
- Locally generated energy is supplemented by regional and provincial low-GHG energy supplies

Transportation

- Average vehicle energy improves 60% from 2007 levels
- Per capita vehicle kilometers traveled are reduced 50% from 2007 levels, particularly from commuting and shopping trips which are accommodated by walking, cycling and transit
- Public transit replaces fossil fuels with a diversity of low-GHG energy sources
- All energy for personal vehicles is supplied by low-GHG sources

Waste

- Emissions from solid waste are eliminated through a combination of strategies, including waste avoidance, recycling, composting and waste to energy systems.

Table A4.1 2107 Preliminary Study Assumptions

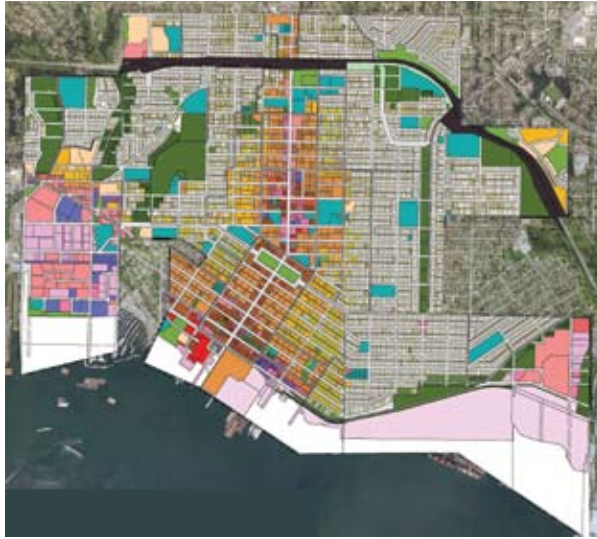


Figure A4.2 2007 land use mapping by parcel



Figure A4.3 Analysis of 2007 development patterns

2007 SPATIAL MAPPING AND ANALYSIS

City of North Vancouver and Provincial GHG emissions inventories provide valuable information on the total amount of energy consumed by the community's buildings and vehicles and the total GHGs produced by the community's building, transportation and waste sectors. The 2007 baseline energy and emission estimates generated for the *100 Year Sustainability Vision* use this data combined with a variety of land use, population, employment and transportation data to understand how different areas of the city contribute to total city GHG performance. Initially, the DCS team mapped parcel-level land uses, building types, and associated population and employment densities across the city. This mapping divided the city into a set of "development patterns," each representing a particular mix and proportion of land uses, configuration of streets, and population and job density. The team assessed these patterns for a variety of factors, including building energy consumption, availability of transit and proximity to services to determine and represent the per capita GHG contributions for each development pattern in the city. Pages 28 and 30 feature the resulting 2007 and 2107 (respectively) GHG contribution maps.

2007 BASELINE ENERGY AND EMISSION FIGURES

COMMUNITY PERFORMANCE:

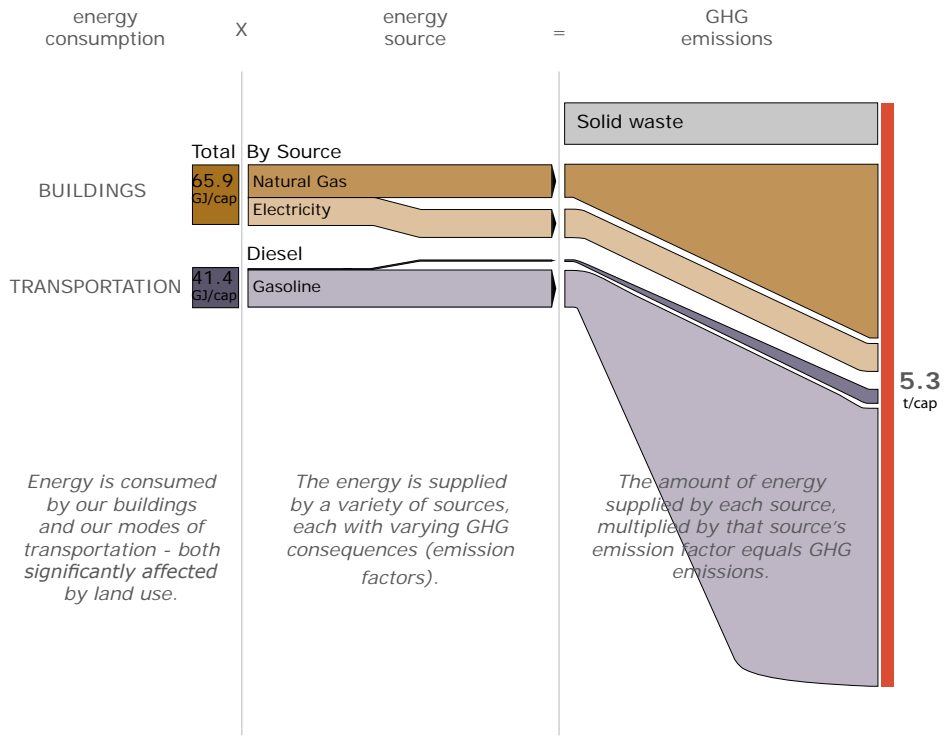
Population: 47,000
 Employment: 32,000
 Households: 22,000

Total Energy: 5 million GJ
 Total Emissions: 245,000 tonnes

The 2007 baseline for energy and emissions synthesizes a variety of inputs to better understand how current GHG emission levels, as inventoried by the City and Province, are impacted by land use and planning decisions.

The baseline incorporates census and assessment data on population and employment, residential unit types, commercial and industrial floor areas, and respective locations in the city, along with data on current energy sources and travel behaviour for the City and region, to characterize the land use and transportation contributions to GHG emissions.

Creating an emission baseline calibrated to current land use and transportation conditions allows for future land use and policy changes (such as those developed in the 100 Year Vision) to be assessed for their relative impacts on GHG mitigation in comparison to the baseline scenario.



natural gas	49
electricity	0.0001
diesel	68
gasoline	73
green (various sources)	0

The above graphs show the comparative distribution of land uses assumed for this area of the 100 Year Vision for the City.

Intended for discussion purposes.

2050 MEET PROVINCIAL TARGET TO REDUCE TOTAL 2007 COMMUNITY EMISSIONS BY 80 PERCENT

COMMUNITY PERFORMANCE:

Population: 72,000
 Employment: 47,000
 Households: 35,000

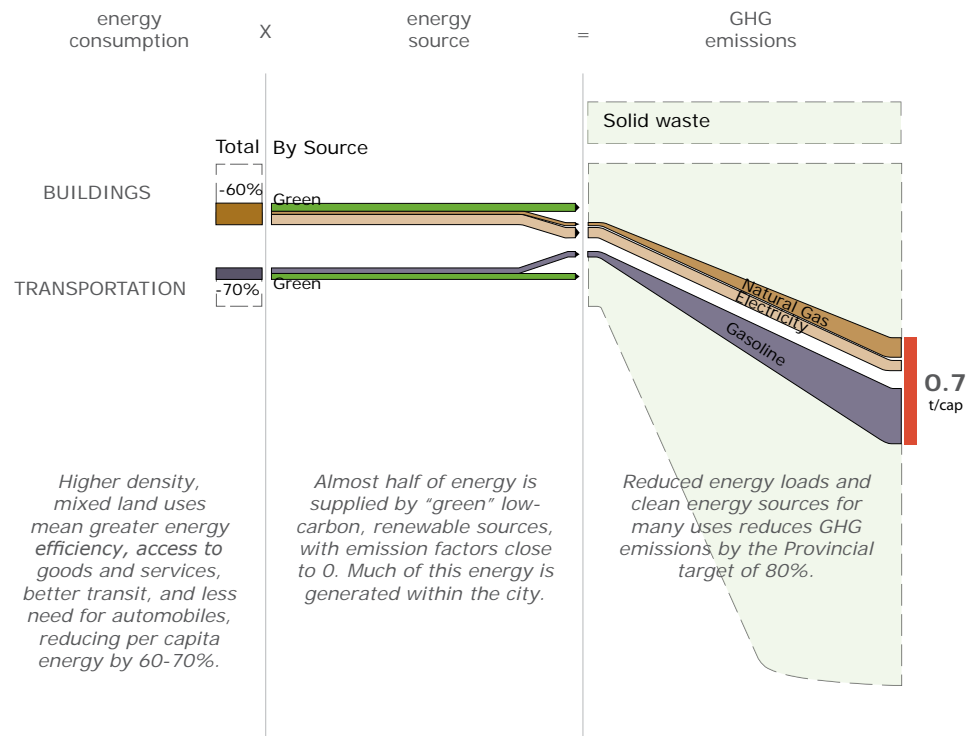
Total Energy: 2.5 million GJ
 Total Emissions: 49,000 tonnes

The 2050 energy and emissions estimate considers the City's ability to meet the Province's target to reduce total 2007 community emissions by 80% on the path to the *100 Year Sustainability Vision*.

Land Use Implications

For 2050, the city accommodates a growing population through densification by increasing the proportion of land and energy efficient building forms (attached and stacked building types). Additional energy savings are achieved through building retrofits and energy efficient new construction (Kyoto, 2002) for a total reduction of 60%. Increased density enhances the feasibility of district energy, so that approximately 40% of energy is assumed to be supplied by "green," low-carbon sources through the district energy system.

New mixed-use nodes and corridors enable most residents to walk, bike or bus for work and errands, reducing kilometers driven by 40%. Additional energy is saved through 50% fuel efficiency gains (Kyoto, 2002) for a total reduction of 70%. Fifty percent of energy is assumed to be supplied by a combination of "green," low-carbon sources.



Higher density, mixed land uses mean greater energy efficiency, access to goods and services, better transit, and less need for automobiles, reducing per capita energy by 60-70%.

Almost half of energy is supplied by "green" low-carbon, renewable sources, with emission factors close to 0. Much of this energy is generated within the city.

Reduced energy loads and clean energy sources for many uses reduces GHG emissions, by the Provincial target of 80%.

Emission Factors (kg CO₂e/GJ)

natural gas	49
electricity	0.0001
diesel	68
gasoline	73
green (various sources)	0

The above graphs show the comparative distribution of land uses assumed for this area of the 100 Year Vision for the City.

Intended for discussion purposes.

2107 MEETING THE 100 YEAR SUSTAINABILITY VISION TARGET TO REDUCE COMMUNITY EMISSIONS TO ZERO

COMMUNITY PERFORMANCE:

Population: 138,000
 Employment: 78,000
 Households: 75,000

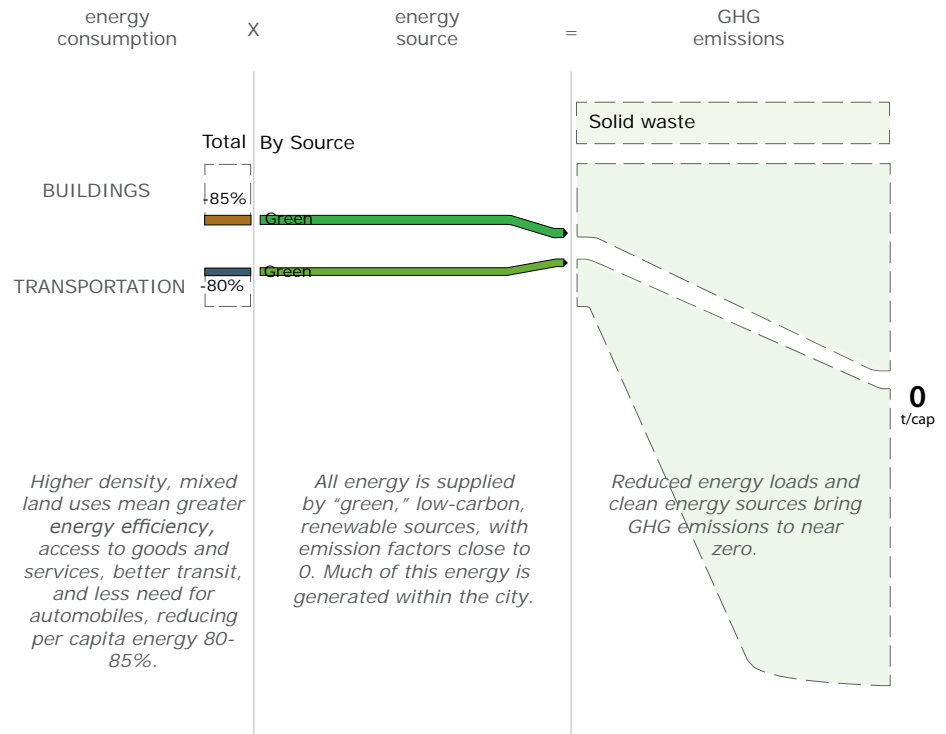
Total Energy: 2.4 million GJ
 Total Emissions: 70 tonnes

The 2107 energy and emission estimate considers the City's ability to be a net-zero GHG city for the *100 Year Sustainability Vision*.

Land Use Implications

For 2107, the city accommodates a tripling of population by maximizing the proportion of attached and stacked building types, which are more land and energy efficient. Additional energy savings continue to be gained through building retrofits and energy efficient new construction. Total building energy is assumed to decrease by 85% from 2007 levels. All energy is assumed to be supplied by "green," low-carbon sources, including combined heat and electricity from the district energy system, other local sources such as photovoltaics, and regional low-carbon sources.

Continued development of mixed-use nodes and corridors throughout the city enables all residents to be within walking and cycling distance of employment and shopping. A reduction in driving of 50%, plus continued efficiency improvements yield a total energy reduction of 80%. All energy is assumed to be supplied by a combination of "green," low-carbon sources.



Emission Factors (kg CO2e/GJ)	
natural gas	49
electricity	0.0001
diesel	68
gasoline	73
green (various sources)	0

The above graphs show the comparative distribution of land uses assumed for this area of the 100 Year Vision for the City.

Intended for discussion purposes.

APPENDIX FIVE: GHG MEASUREMENT AND MAPPING TECHNICAL PAPER ABSTRACT

ABSTRACT

The City of North Vancouver *100 Year Sustainability Vision* is one of the first projects in British Columbia to consider, at the municipal scale, the feasibility of meeting the challenging GHG emission targets established by the 2007 Greenhouse Gas Reduction Targets Act. Like many other municipalities, the City faces this challenge within the context of significant population growth over the next several decades, resulting in potentially a doubling—or tripling—of population in certain areas. Consequently, the project addresses the question of what specific decisions for land use, building form, transportation and infrastructure will contribute to reducing energy consumption and GHG emissions while supporting other environmental, social and economic goals. The potential to achieve the project's GHG emission targets was explored through a public, stakeholder-driven process culminating in a four-day design charrette, during which project participants generated a long-term, low-GHG vision for the City. To evaluate the energy and GHG implications of the urban form decisions made during this process, researchers used a “case” and “development pattern” based methodology integrating building, transportation, infrastructure and technology options to quickly assemble and evaluate scenarios representing baseline 2007 conditions and the 100-year vision developed by stakeholders. GIS analysis was used to generate both quantitative

GHG emissions estimates and spatial “GHG maps” of existing and future conditions in the city. Results of this analysis indicate that approximately 31% of the targeted emission reductions, on a per capita basis, can be achieved through urban form decision alone. With complimentary policy strategies, investment in appropriate technologies and cooperation from the regional, provincial and federal governments, full realization of the targets may be feasible.

City of North Vancouver 100 Year Sustainability Vision: GHG Measurement and Mapping

Technical Paper, prepared for the Ministry of the Environment CEEI Working Group
December, 2008

Authors:

Nicole Miller, Design Centre for Sustainability,
School of Architecture and
Landscape Architecture,
University of British Columbia

Duncan Cavens, Collaborative for Advanced
Landscape Planning
School of Architecture and
Landscape Architecture,
University of British Columbia

A digital copy of this report can be retrieved from the Ministry of the Environment web site at <http://www.env.gov.bc.ca/epd/climate/pdfs/ceei-nvan.pdf>

REFERENCES

BC Industries Climate Action Legislation. BC Office of the Premier Ministry of Environment News Release, 2007.

Buchsbaum, Steve. "Real Estate Home Sales" <www.bchomesales.com/northvan.htm>

City of North Vancouver. *A 2006 Community Profile, North Vancouver, British Columbia*, based on 2006 Census, Statistics Canada, 2007.

City of North Vancouver. *CNV Community Emissions Data*. 2007.

City of North Vancouver. "Current LEC Projects." 2007 www.cnv.org/server.aspx?c=2&i=241.

City of North Vancouver. *Environmental Protection Program, North Vancouver, Summary Document*. 2000.

City of North Vancouver. *Official Community Plan*. 2002

City of North Vancouver. *Parks Master Plan 2006 - Background Document*. 2006

City of North Vancouver. *Transportation Plan - Interim Report: Transportation System Goals & Key Issues, Final Draft*. 2007.

Compass Resource Management, Ltd. *A Strategic Energy Analysis for the Proposed Norquay Village Neighbourhood Centre: Technical Appendix*. Prepared for the City of Vancouver, 2007.

Greater Vancouver Regional District. *Census Bulletin#1, Population and Dwelling Counts*. Based on 2006 Census, Statistics Canada, 2007 <www.gvrd.bc.ca/growth/pdfs/Census2006_PopanDwel_Bulletin_1.pdf>

Greater Vancouver Regional District. *Livable Centres - Lonsdale Jobs* <www.gvrd.bc.ca/livablecentres/lonsdalejobs.htm>

Greater Vancouver Regional District. *Key Facts, Jobs to Employment Labour Force Ratio for GVRD Municipalities, 1991 and 2001* ,www.gvrd.bc.ca/growth/keyfacts/jobsbymuni91-01.htm>

Greater Vancouver Regional District. *GVRD Liquid Waste Management Plan, February 2001* <www.gvrd.bc.ca/sewage/lwmp_feb2001lwmp_plan_feb2001.pdf>

Hyla Environmental Services, Ltd. *North Vancouver City Preliminary Community Energy and Greenhouse Gas Emissions Inventory*. Prepared for the BC Ministry of the Environment, 2005.

Institute for Local Self-Reliance. *Stop Trashing the Climate: Full Report*. 2008.

Lonsdale Energy Corporation. *Lonsdale District Heating System-Connecting North Vancouver, one step at a time*. <<http://cdeamap.navlar.com/cases/lonsdale.pdf>>

Marbek Resource Consultants, Ltd. *BC Hydro Conservation Potential Review: The Potential for Electricity Savings 2006-2026, Residential, Commercial and Industrial Sectors in British Columbia*. Prepared for BC Hydro, 2007.

Miller, Nicole and Duncan Cavens. *City of North Vancouver 100 Year Sustainability Vision: GHG Measurement and Mapping Technical Paper*. Prepared for the Ministry of the Environment CEEI Working Group, 2008 <<http://www.env.gov.bc.ca/epd/climate/pdfs/ceei-nvan.pdf>>

Natural Resources Canada. *Clean Energy Project Analysis: RETScreen Engineering and Cases Textbook, Third Edition*. 2005.

Pembina Institute. *Mind the Gap: A Blueprint for Climate Action in British Columbia, Full Report*. 2007.

Sheltair Group. *City of North Vancouver Greenhouse Gas Local Action Plan Final Report*. Prepared for the City of North Vancouver, 2005.

Sheltair Group. *City of North Vancouver Municipal and Community Greenhouse Gas Inventory*. Prepared for the City of North Vancouver, 2006.

Torrie Smith Associates. *Kyoto and Beyond: The Low-Emission Path to Innovation and Efficiency*. Prepared for the David Suzuki Foundation and the Climate Action Network Canada. 2002.

Town and Country Planning Association. *Sustainable Energy By Design: A "By Design" Guide for Sustainable Communities*. 2006.



Recycled

Supporting responsible use
of forest resources

www.fsc.org Cert no. SW-COC-001563
© 1996 Forest Stewardship Council

