An Examination of Government Street as a Green Street

by

Cameron Scott

B.Sc., Royal Roads University, 2001

Research Project Submitted in Partial Fulfillment of the Requirements for the Degree of Master of Urban Studies

in the Urban Studies Program
Faculty of Arts and Social Sciences

© Cameron Scott 2014
SIMON FRASER UNIVERSITY
Summer 2014

All rights reserved. However, in accordance with the Copyright Act of Canada, this work may be reproduced, without authorization, under the conditions for “Fair Dealing.” Therefore, limited reproduction of this work for the purposes of private study, research, criticism, review and news reporting is likely to be in accordance with the law, particularly if cited appropriately.
Approval

Name: Cameron Scott
Degree: Master of Urban Studies
Title: An Examination of Government Street as a Green Street

Examining Committee: Chair: Karen Ferguson
Meg Holden
Senior Supervisor
Associate Professor, Urban Studies
and Geography
Peter V. Hall
Supervisor
Associate Professor
Cynthia Girling
External Examiner
Professor
School of Landscape Architecture
University of British Columbia

Date Defended: April 29, 2014
Partial Copyright Licence

The author, whose copyright is declared on the title page of this work, has granted to Simon Fraser University the non-exclusive, royalty-free right to include a digital copy of this thesis, project or extended essay[s] and associated supplemental files (“Work”) (title[s] below) in Summit, the Institutional Research Repository at SFU. SFU may also make copies of the Work for purposes of a scholarly or research nature; for users of the SFU Library; or in response to a request from another library, or educational institution, on SFU’s own behalf or for one of its users. Distribution may be in any form.

The author has further agreed that SFU may keep more than one copy of the Work for purposes of back-up and security; and that SFU may, without changing the content, translate, if technically possible, the Work to any medium or format for the purpose of preserving the Work and facilitating the exercise of SFU’s rights under this licence.

It is understood that copying, publication, or public performance of the Work for commercial purposes shall not be allowed without the author’s written permission.

While granting the above uses to SFU, the author retains copyright ownership and moral rights in the Work, and may deal with the copyright in the Work in any way consistent with the terms of this licence, including the right to change the Work for subsequent purposes, including editing and publishing the Work in whole or in part, and licensing the content to other parties as the author may desire.

The author represents and warrants that he/she has the right to grant the rights contained in this licence and that the Work does not, to the best of the author’s knowledge, infringe upon anyone’s copyright. The author has obtained written copyright permission, where required, for the use of any third-party copyrighted material contained in the Work. The author represents and warrants that the Work is his/her own original work and that he/she has not previously assigned or relinquished the rights conferred in this licence.

Simon Fraser University Library
Burnaby, British Columbia, Canada

revised Fall 2013
Abstract

This project examines the potential for Government Street to be transformed from a transportation focused major road to a multi-functional green street. Potential interventions are assessed through a green street lens with a focus on enhancement of Government Street’s environmental performance, walkability, identity and livability. A review of literature focused on green street concepts, an examination of physical conditions on Government Street, an analysis of relevant policy, and an exploration of case studies in Seattle and Portland are used to develop a design concept for Government Street.

Findings indicate the study area is lacking in features that are associated with green streets, but significant potential exists for transformation based on physical conditions. The study suggests that meaningful green street interventions require a reduction of vehicle carrying capacity, to enable a significant increase in space for landscape elements, cycling facilities and pedestrian realm improvements. The proposed design seeks to redefine Government Street as a multi-modal corridor with a vital public realm and green identity supported by urban forest, landscape and stormwater management elements.

Keywords: green street; Government Street; street design
# Table of Contents

Approval ............................................................................................................................. ii
Partial Copyright Licence ................................................................................................. iii
Abstract ................................................................................................................................ iv
Table of Contents .............................................................................................................. v
List of Tables .................................................................................................................... vii
List of Figures .................................................................................................................. viii

1. **Introduction and Research Question** ................................................................. 1
   1.1. Introduction ........................................................................................................... 1
   1.2. Study Area .......................................................................................................... 3
   1.3. Project Rationales .............................................................................................. 4
   1.4. Research Questions ............................................................................................ 6
   1.5. Research Limitations and Parameters ............................................................... 7

2. **Theoretical Background and Analytical Framework** .......................................... 8
   2.1. Literature Review ............................................................................................... 8
       2.1.1. Environmental Context ............................................................................... 8
       2.1.2. Sustainable Urbanism .............................................................................. 9
       2.1.3. Nature and Natural Processes in Cities .................................................... 11
       2.1.4. Role and History of Urban Streets ........................................................... 12
       2.1.5. Urban Design of Streets ......................................................................... 15
   2.2. Green Street Analytical Framework .................................................................. 17
       2.2.1. Green Street Concepts ............................................................................ 22
            Environmental Performance ........................................................................ 22
            Walkability .................................................................................................... 23
            Identity ........................................................................................................... 26
            Livability ....................................................................................................... 27
       2.2.2. Green Street Performance Measures ....................................................... 29

3. **Research Design** ................................................................................................. 32
   3.1. Positionality of the Researcher ......................................................................... 32
   3.2. Research Objectives ......................................................................................... 32
   3.3. Research Methods ............................................................................................. 33

4. **Analysis of Government Street Policy Context** ................................................. 35
   4.1. Rock Bay .......................................................................................................... 36
   4.2. Government Street ......................................................................................... 38
   4.3. Green Street Objectives .................................................................................. 41
   4.4. Street Design Elements ................................................................................... 41
   4.5. Greenways ....................................................................................................... 43
   4.6. Policy Summary ............................................................................................... 45
5. **Physical Assessment of Government Street** ..................................................... 46
   5.1. General Study Area Characteristics ............................................................. 46
   5.2. Land Use ....................................................................................................... 49
   5.3. Transportation .............................................................................................. 52
   5.4. Infrastructure ................................................................................................ 55
   5.5. Landscape / Urban Forest ........................................................................... 56
   5.6. Urban Design ................................................................................................ 60
   5.7. Summary of Assessment ............................................................................ 63

6. **Case Study Analysis** .................................................................................... 64
   6.1. Introduction ................................................................................................... 64
   6.2. City of Portland ............................................................................................ 65
   6.3. City of Seattle ............................................................................................... 70
   6.4. Case Study Green Streets ........................................................................... 76
       6.4.1. Rationale for Selection ......................................................................... 76
       6.4.2. Southwest Montgomery Green Street – Portland, Oregon .............. 76
       6.4.3. Southeast Clay Green Street – Portland, Oregon ............................... 81
       6.4.4. Planning Considerations ..................................................................... 86

7. **Approaches for Converting Government Street to a Green Street** .......... 89
   7.1. Objectives for Government Green Street .................................................... 89
   7.2. Analysis of Vehicle Capacity Reduction on Government Street ............... 90
   7.3. Design Concept for Government Green Street .......................................... 97
   7.4. Discussion and Analysis ............................................................................ 101
   7.5. Summary of Key Design and Policy Recommendations .......................... 118
   7.6. Conclusions and Further Research ............................................................. 120

References ........................................................................................................... 123
List of Tables

Table 1: Green Street Analytical Framework ................................................................. 21
Table 2: Relationship between Objectives and Methods ............................................. 33
Table 3: Official Community Plan – Urban Place Designation for Rock Bay ............... 37
Table 4: Government Street Right of Way Dimensions ................................................. 48
Table 5: Government Street Block by Block Characteristics ....................................... 48
Table 6: Level of Permeable Surfaces in Study Area .................................................... 55
Table 7: Downtown Seattle Green Streets Design Features ....................................... 74
Table 8: Comparison of Case Study Streets and Government Street ......................... 87
Table 9: Relationship between Government Street Objectives and Concepts from Green Street Analytical Framework ................................................................. 90
Table 10: Traffic Volumes on Major North-South Downtown Core Area Streets ......... 95
Table 11: Proposed Right of Way Dimensions for Design Concept ............................ 99
Table 12: Assessment of Performance Measures in Design Concept ......................... 102
Table 13: Comparison of Existing Government Street Conditions with Green Street Design Concept ............................................................................................................... 103
List of Figures

Figure 1: Government Street Study Area within the Context of Rock Bay ................. 4
Figure 2: Government Street Mall in Historic Core of Downtown Core Area ............ 39
Figure 3: Images of Government Street Study Area .................................................... 40
Figure 4: Government Street Study Area .................................................................... 46
Figure 5: Images of Government Street Right of Way ................................................ 47
Figure 6: Typical Street Cross-Section in Government Street Study Area ................. 48
Figure 7: Study Area Zoning Designations ................................................................. 49
Figure 8: Residential Development Capacity (number of units) based on existing zoning .................................................................................................................................. 51
Figure 9: Illustration of Potential Pedestrian Couplet in Downtown Core Area ............ 54
Figure 10: Example of Existing Street Trees on Government Street ............................ 57
Figure 11: Existing Trees in Rock Bay Area ................................................................. 57
Figure 12: Existing Canopy Cover in Rock Bay Area .................................................. 58
Figure 13: Tree Canopy Cover in the City of Victoria .................................................. 59
Figure 14: Government Street in Chinatown and Old Town Districts ............................ 60
Figure 15: Aerial view of Government Street in Downtown Core Area ....................... 61
Figure 16: Relationship of Building Footprints (gray) and Open Space on Government Street ......................................................................................................................... 62
Figure 17: Green Stormwater Infrastructure Benefits Identified by City of Seattle ........ 71
Figure 18: Example of Street Edge Alternative Project in Seattle ................................. 72
Figure 19: Pedestrianized Section of SW Montgomery Green Street ......................... 77
Figure 20: Stormwater Feature on SW Montgomery Street ........................................ 78
Figure 21: Southeast Clay Green Street ....................................................................... 82
Figure 22: Public Art on SE Clay Green Street ............................................................. 85
Figure 23: Policy Focus of Major North-South Downtown Arterial Street ...................... 92
Figure 24: 24 Hour Traffic Volumes on Major North-South Downtown Streets .......... 93
Figure 25: Vehicle Volume Data on Major Roads South of Bay Street ....................... 94
Figure 26: Hourly Traffic Volumes on Government Street South of Bay Street .......... 96
Figure 27: Overview of Features of Government Green Street Design Concept .......... 98
Figure 28: Typical Government Street Right of Way with New Design Concept ........... 99
Figure 29: Existing Pocket Park and Potential Expansion to Create Gateway Feature .......................................................................................................................... 108
Figure 30: Downtown Core Area Districts containing Government Street .................... 109
Figure 31: Existing Street Trees located on Property Line on Government Street, South of Bay Street .................................................................................................................. 113
Figure 32: Example of Planter used to Separate Cycle Track from Traffic – Vancouver, BC ................................................................................................................................. 115
1. Introduction and Research Question

1.1. Introduction

The development of human settlements has historically been predicated on natural processes and constraints. In the last century, community design has shifted towards discounting these natural influences. In the North American context, there has been a tendency to develop in a more diffuse, infrastructure inefficient manner largely based on cheap energy considerations. As a response to the challenges posed by climate change and energy security, urban planning has increasingly begun to focus on intensifying city cores. This reconsideration of urban form endeavours to address many of the concerns around energy use, transportation and infrastructure efficiency. Given this transition to intensifying neighbourhoods, there is a need to optimize space within cities. A clear source of inefficiency is streets, which occupy 20-30% of land within cities (Girling & Kellett 2005), but often are designed solely with the intention of filling a narrow transportation role.

Green streets present an alternative avenue for street design that embraces a more holistic and multi-functional approach. Overall, green street design focuses on integrating natural processes, creating quality public spaces and ameliorating negative impacts commonly associated with major roads. Green streets are often defined by on-site stormwater management, designs favourable to walking and cycling, and attractive streetscapes that enhance neighbourhood livability (City of Portland 2007a). Streets that integrate green features have the potential to improve outcomes with respect to a number of key urban issues, including: promotion of walking and cycling; improvement of water quality; enhancement of infrastructure sustainability; reduction of the urban heat island effect; the addition of open space; and, enhancement of neighbourhood livability.
The focus of the project is Government Street, which is a major urban street in Victoria, British Columbia, Canada. Government Street is the spine of the Rock Bay District, which is identified in the City of Victoria’s Official Community Plan as an area of significant future change, with aspirations to become an eco-district (City of Victoria 2012a). An eco-district emphasizes technological and planning innovation and district-scale best practices to create neighbourhoods that have elevated environmental performance and increased resiliency to influences such as increased energy prices or changing climatic conditions.

In the Victoria context, an example of an eco-district can be found across the harbour from the Rock Bay District in the Dockside Green development. As a comprehensively planned project with a sustainability focus, Dockside Green is intended to house 2,500 residents and a range of commercial and industrial businesses. Key features of the Dockside development include complete stormwater management within the district, an onsite renewable biomass plant, complete on site liquid waste management and building energy performance that far exceeds conventional practice. The Rock Bay District looks to translate many of the district approaches of the Dockside Green development in an established area with a dense street network and a multi-owner property environment. A critical differentiation between the two areas is the amount of space occupied by right of ways (much higher in Rock Bay) and the presence of Government Street as a central spine of the Rock Bay District. In this respect, the role of streets is elevated in terms of ensuring they contribute to the environmental and social performance of the area. This project seeks to develop approaches to convert Government Street from a transportation focused major road to a multi-functional green street, serving as a spine to support a transition to a future Rock Bay eco-district.

In this study, concepts related to green streets are initially explored to develop a comprehensive analytical framework that identifies and elaborates on fundamental components of green streets. This framework is then used to analyze existing policy, assess physical conditions in the study area and evaluate case study cities and streets. Based on findings from the policy review, study area analysis and case studies, the analytical framework is then adapted to create a contextual set of objectives to guide the development of policy and design approaches for a Government Green Street.
1.2. Study Area

The subject of this study is a five block stretch of Government Street from Chatham Street to Bay Street located in the Downtown Core Area of the City of Victoria. Government Street is a major road that serves as an entry point into the Downtown Core Area. The land use context is primarily industrial and commercial, transitioning into a mix of residential and commercial uses at the southern end of the study area. Overall, this stretch of Government Street is notable for its lack of streetscape features and significant expanse of paved areas which dominate the nearly 30 metre right of way. This is in direct contrast to the stretch of Government Street to the south of the study area, which serves as the City’s major pedestrian street.

The Government Street study area is located within the Rock Bay District, which is situated at the north end of the Downtown Core Area. Figure 1 shows how Government Street serves as the central spine of the Rock Bay District. The District is largely industrial and commercial and includes active waterfront industrial properties. Three major roads run north-south through Rock Bay (Government Street, Douglas Street and Blanshard Street) and are the primary means for inter-municipal traffic to enter the Downtown Core of Victoria. Rock Bay is anticipated to undergo significant change over the next number of years and has been identified in City plans, including the Downtown Core Area Plan and Official Community Plan, as an area for employment intensification based on a green infrastructure approach (City of Victoria 2012a).
1.3. Project Rationales

The primary rationales for the project and study site are:

**The ability to investigate green street policy and design solutions on a major road in an urban area** – The majority of green street projects in other jurisdictions have been focused on low traffic environments, often in low-density residential areas. The Government Street study area provides an opportunity to examine the feasibility of green street implementation in a high traffic volume corridor and challenging land use context.

**The opportunity to explore a broader green street concept** - This study will help to explore a broader approach to green street design. Many green street projects have a
green infrastructure mandate that narrowly focuses on maximizing opportunities for stormwater management. This project seeks to synthesize existing literature and lessons learned from past green street projects to develop a more holistic green street framework that could be applied to a range of contexts and meet a broader set of objectives.

**The anticipation of significant land use change in the Rock Bay District** – The Downtown Core Area is anticipated to experience significant population and employment growth, including a tripling of residential population in the next 30 years (City of Victoria 2011). Rock Bay is an under-developed area that has been identified in City plans for employment growth based on a green infrastructure approach. Government Street is the central spine of the Rock Bay neighbourhood and will have the potential to set the tone for future land use and infrastructure changes.

**The physical properties of Government Street** – Government Street currently has a right of way of 90 feet. This greatly exceeds the requirements of its current role, which is primarily to circulate traffic as a secondary arterial in the City of Victoria’s transportation network. This indicates that space is likely available for purposes other than vehicle travel. Additionally, much of the adjacent land base is occupied by buildings that are near the end of their life cycle and likely to experience future redevelopment, allowing for a comprehensive land use and transportation redevelopment strategy. These two factors provide conditions that are conducive to an innovative, multi-functional street redesign.

**An advanced approach to green street development in Seattle and Portland** - These two case study communities provide excellent comparators as they have significantly developed green street programs. Additionally, they are both located in the Cascadia region and have similar climatic conditions which make approaches readily transferrable to Victoria.
1.4. Research Questions

The exploration of the research topic involves the investigation of a broad overarching research question, in conjunction with four more detailed research questions.

**Broad Research Question**

Based on theoretical, policy, and design research, what is the range of green street approaches, and how they can be applied to transform Government Street from a one-dimensional urban arterial to a multi-functional green street?

**Detailed Research Questions**

1. Are there design interventions that can be effectively applied to urban arterial streets to enhance environmental performance with respect to stormwater, landscape, and transportation outcomes?

2. What suite of design criteria could be used to assess the environmental performance of streets and what specific measures could be suggested to improve conditions?

3. What design techniques and policy preconditions would be most effective in converting the Government Street study site to a green street?

4. Based on sustainable neighbourhood design principles and practices, what neighbourhood land use, infrastructure, and transportation conditions would best support green street design and implementation?
1.5. Research Limitations and Parameters

The limitations of this project are primarily related to the small geographic scope of the study, the complexity of the study area and the technical nature of many of the elements involved in green street design.

The geographic extents of the study are limited to a five block stretch of Government Street that primarily focuses on interventions within the public right of way (property line to property line). This focus involves only a limited consideration of land use impacts on a green street design. While street network connections and building-street interfaces are considered in a limited way, there is no in depth exploration that examines how adjacent land uses could support a green street concept.

The study area is a built up urban area that has established infrastructure, land use patterns and transportation realities. Consideration of potential design approaches would require an in-depth understanding of the range of perspectives and view of individuals who have interests in the corridor. This would allow some of the data to be contextualized within stakeholder perspectives and potential issues to be identified. The scope did not include informant and stakeholder interviews as the project is primarily based on developing conceptual approaches, as opposed to detailed design solutions.

The exploration of green streets enters into material that is highly technical and requires professional analysis to accurately assess potential implications. In examining the efficacy of proposed green street design interventions, landscape architects and civil engineers would be required to assess stormwater management techniques, urban foresters and landscape architects would be needed to assess soil volumes and tree species optimization, and transportation engineers would be needed to assess design standards and model potential traffic impacts. In this respect, this study, which doesn’t take a pre-determined technical specialization approach, provides an opportunity to examine a range of multi-disciplinary considerations in a balanced fashion. However, the project is limited by the lack of technical expertise to provide a detailed assessment of stormwater, transportation and landscape outcomes associated with design concepts.
2. Theoretical Background and Analytical Framework

2.1. Literature Review

This component of the research project establishes the theoretical and conceptual bounds of the project and how it will fit into the larger body of knowledge that has been established for green streets and street design. The literature review initially looks at broad concepts around sustainable urbanism, natural processes in cities, street design and urban design. The review then transitions to a more focused inquiry of green streets, specifically looking at delineating the elements and applications that have been researched and where there are potential gaps. A key area of focus will be developing a green street framework to help assess case study cities and Government Street.

The characteristics of the study site help to focus the literature review. Government Street is an urban arterial in a dense city centre. Given these conditions, the literature review will contemplate research that looks at urban areas and arterial streets to a greater degree. This is noteworthy, as much of the green street research and practice has been conducted on residential streets in lower density neighbourhoods.

2.1.1. Environmental Context

The functioning of cities within environmental constraints is a topic that has been considered as countries become more urbanized and the majority of residents live within cities. Key issues like population growth and climate change have highlighted the need to acknowledge and respond to the limits of natural systems to buffer the impacts of human settlement practices.

A concept which helped to illustrate that North American cities in their current form and function are living beyond the earth’s environmental capacity is illustrated in the ecological footprint. Wackernagel and Rees (1996) describe the ecological footprint as an accounting tool that allows an estimation of resource consumption and waste assimilation requirements of a population based on a corresponding productive land area.
Major elements of the ecological footprint are transportation, waste production, resource use, and food production. The ecological footprint (the demands humans make on nature) of the average Canadian was 7.25 hectares in 2005. This is in contrast to the available global biocapacity of 1.90 hectares per person based on 2005 population levels (Anielski and Wilson 2005). This is a clear indication that Canadian patterns of human settlement and consumption are unsustainable.

Therefore the way we develop our cities, neighbourhoods, buildings and streets needs to change to reduce our impacts on the natural environment. Kenworthy (2006) suggests that the current highly auto-dependent, resource-consuming cities require remedial actions on an unprecedented scale. Beatley (2011) asserts that sustainable cities will require a significant shift in thinking about cities not as linear resource extracting machines but as complex metabolic systems with flows and cycles where things that had been viewed as negative outputs are re-envisioned as productive inputs to satisfy other urban needs.

While green streets have the potential to introduce nature into the city, promote smart growth, and improve environmental health conditions, their role in rethinking infrastructure delivery is perhaps most important. It is estimated that the current municipal infrastructure deficit in Canada is $123 billion (Federation of Canadian Municipalities 2007). The transportation component of this deficit is $21.7 billion. This clearly indicates that the current approach to infrastructure planning is flawed and financially unsustainable. The street right of way is a major component of a city's infrastructure and a largely uninventive model that serves as a corridor for utilities and vehicle traffic. Conceptualizing the street as a location to incorporate natural processes that are able to perform services that are currently provided by conventional infrastructure (i.e. stormwater conveyance and treatment), would help to facilitate a shift to a green infrastructure planning approach.

2.1.2. Sustainable Urbanism

The rationale for green streets draws on a number of philosophical perspectives rooted in redesigning cities to minimize their negative impacts on human health and natural systems, restore connections to natural processes and improve livability.
Sustainable development has emerged as a framework looking to reconcile human settlement practices and integrate social, economic, and environmental considerations into city planning. Maclaren (1996) summarizes a number of elements that are mentioned frequently in literature and policy documents in defining urban sustainability. These items are intergenerational equity, protection of the natural environment (living within carrying capacity), minimal use of non-renewable resources, economic vitality and diversity, community self-reliance, individual well-being, and satisfaction of basic human needs.

Many sustainability objectives are best addressed in an urban setting, as population densities allow for more efficient infrastructure delivery, reduced energy consumption and travel more conducive to alternative modes. Kenworthy (2006) asserts that making existing cities and new urban development more ecologically based and liveable is an urgent priority for global sustainability. Public streets and roads cover up to one-third of the land area in urban landscapes making their planning a key element of dealing with sustainability challenges (Metro Portland 2002).

The basis for sustainable urbanism is a synthesis of urbanism – the millennia old tradition of human settlement – with modern day environmentalism (Farr 2008). Historically, nature focused environmentalists and human focused urbanists have been at odds over appropriate ways to address environmental issues and build sustainable communities. Many ecological planning concepts, including those advanced by McHarg (1969) in his book *Design with Nature*, were a harsh reaction to pollution and a lack of green space in cities. While the focus on natural systems was laudable, human social systems were largely ignored and the results were often well landscaped, auto-dependent suburbs. More recent planning movements such as Smart Growth and New Urbanism have taken a more comprehensive approach to community design and integrated economic, social and environmental reforms (Farr 2008).

Farr (2008) puts forward a framework for sustainable urbanism as walkable and transit-served urbanism integrated with high performance buildings and high performance infrastructure. He also identifies sustainable urbanism as embracing compactness (density) and biophilia (human access to nature) as core values and drawing attention to
the enormous opportunity to redesign the built environment in a manner that supports a high quality of life and promotes a healthy and sustainable lifestyle.

While many sustainable planning theories focus on energy or environmental conservation, the idea of Biophilic Cities advanced by Timothy Beatley (2011) ties the argument for green cities and green urbanism (the connection with and designing in of nature in cities) more directly to human well-being than to energy or environmental conservation. He argues that the vision of green cities is not especially green with emphasis on things like renewable energy, transit and energy-efficient building systems. In Beatley’s (2011) vision, biophilic cities contain abundant nature and natural systems that are visible and accessible to urbanites and include a creative mix of green urban design and commitment to outdoor life and green infrastructure.

As noted by Kenworthy (2006), the city for many people will remain an object of ambivalence unless it can be seen that cities can be genuinely “green”. Beatley (2011) identifies the choice between nature and city as a false choice and an outdated dichotomy. This clearly identifies that for a green street design to truly embrace sustainable urbanism philosophies, there will need to be tangible green elements that provide access to nature and a visual green identity. Many of the strategies for urban greening and enhancing urban ecology also address infrastructure service objectives such as conserving water and managing stormwater run-off. This integration of more green in denser urban areas also provides an alternative to suburban development, which is at the foundation of many environmental issues and results in the inefficient delivery of infrastructure and automobile dependent land use patterns (Duany, Plater-Zyberk, & Speck, 2001).

### 2.1.3. Nature and Natural Processes in Cities

A major emphasis of progressing cities towards better performance within environmental constraints involves the reintegration of natural processes into city functions. Hough (1995) posits that the often unrecognized natural processes occurring within cities provide us with an alternative basis for their evolution and form. He notes that based on the assumption that diversity is ecologically and socially necessary to the health and quality of urban life, then we must question the values that have led to the current
interpretation of nature in cities. Roseland (2005) states that greening the city means combining urbanism and nature to create healthy, civilizing, and enriching places to live. An urban ecology approach involves using land for multiple functions such as food production, wildlife habitat, recreation, and beautification to achieve environmental benefits such as a reduction in the heat island effect, energy conservation, and cleaner air.

In the movement towards more naturally focused cities, Beatley (2011) argues that we must overcome our bias that cities are biologically and biophilically impoverished places. He further asserts that cities should foster a closeness to nature through protecting and nurturing what exists, while also actively restoring and repairing, and finding new and creative ways to inject nature into streets, buildings and outdoor living environments. Studies have indicated that an increased exposure to green space and nature leads to higher levels of physical and mental health (Devries et al 2003) and stronger nature protective behaviours (Kals, Schumacher and Montada 1999).

An example of a planning approach that has attempted to fully incorporate a natural systems approach into city building is the Lloyd’s Crossing Sustainable Urban Design Plan developed by the Portland Development Commission (2004). This plan uses the natural processes and pre-development environmental conditions as the basis for neighbourhood design. The overall goal of the plan is to reduce the net overall impact of anticipated development in the study area over the next 45 years to an absolute level approaching that of pre-development conditions on the site. Key objectives of the plan are to restore habitat and tree cover and to live within the annual average rainfall that falls on the site for potable water consumption (Portland Development Commission 2004). This approach is a bold attempt at not only acknowledging, but actually operationalizing theories of natural processes.

2.1.4. Role and History of Urban Streets

Understanding the role and function of streets throughout planning history is critical to understanding the barriers and opportunities that influence green street design. The social conditions and theories of the day have helped influence street design and entrench
certain practices. A breadth of literature is examined to trace the historical role of streets and transportation networks and how thinking around their role and function has evolved.

Many of the early 20th century street designs and city layouts in North America were in response to overcrowding and sub-standard social conditions. The garden city movement, started by Ebenezer Howard (1902), was largely a response to the sub-standard living conditions of the early 20th century. The result was a planning theory which rejected the street as a primary place of social activity in favour of internalized green spaces. Furthermore, buildings were divorced from the street, further demarcating the street as the domain of the automobile.

From 1950 onwards, transportation planning developed within the engineering profession, with the focus largely on the efficient, free, and rapid flow of traffic and the prevention of traffic accidents and casualties (Southworth and Ben-Joseph 1995). Street design was viewed in a narrow functional way, and often equated to the provision of other city services, such as gas and water (Norton 2008). The standards that were developed in this era have been accepted as a professional framework for street design and perpetuated in subsequent design documents. The standards are often interpreted as absolute and indisputable, leaving new design approaches difficult to implement.

Beginning with Jane Jacobs (1961), urban planners have argued for narrower, shorter, more enclosed, more active and more interconnected streets. Hutabarat Lo (2009) notes that only in the post-modernist planning era, beginning in the latter part of the 20th century, has walkability again been identified as an important component of efficient, accessible, equitable, sustainable and livable communities in North America. In many respects, this is indicative of how urban planning was historically undertaken before the use of the automobile was commonplace, with land use patterns framed by walking distances to service centres or public transit stops. The renewed focus on walkability and better accommodation of alternative modes of travel has been further advanced by planning movements such as New Urbanism and Smart Growth.

Southworth and Ben-Joseph (1995) reject the engineering based approach and assert that streets must be re-examined as complex community settings that serve a variety of functions, as opposed to simply channels for moving traffic. Vuchic (1999) also
posits that the existing urban transportation system is flawed and needs to be based on a systems based approach that integrates different modes. He identifies consideration of impacts of different modes on the man-made and natural environment, recognition of social equity and capacity to enable and stimulate the creation of human-oriented urban areas as key factors that need to be considered in the design of transportation networks.

Selberg (1996) explores the role and function of urban streets and how they are developed and interpreted through both a functional hierarchy (transportation and access) and visual hierarchy (design and readability). He notes the conflict between functional and visual approaches and introduces the notion that street performance could be measured through examining environmental capacity. Environmental capacity is defined as: "that which people, nature and artifacts can tolerate of influences from road and road traffic without being depreciated" (Selberg 1996, page 13).

Selberg (1996) notes that three primary factors influence environmental capacity are ability, load and interaction. Ability is defined as the capacity of the individual street section to absorb traffic, and is largely influenced by design. Load refers to the amount of impact or stress that street section is exposed to and includes things such as traffic or visual intrusions. Interaction is explained as the relationship between physical form and functions. Ultimately Selberg (1996) identifies four strategies for modifying environmental capacity: reduce traffic, reduce street traffic speed, increase environmental capacity, and change the user groups and physical design. The environmental capacity concept has potential utility for designing green streets, but needs to be further enriched with urban design and urban ecology considerations.

Conventional engineering practice has also begun to adapt a more multi-functional approach to street design. The Complete Streets movement suggest a new approach that bases street design on a broader set of community values and goals. Complete Streets are defined as streets that are planned, designed, operated, and maintained to provide safe mobility for all users, including bicyclists, pedestrians, transit riders, and motorists (MacDonald, Sanders, & Anderson, 2009). The Institute of Transportation Engineers’ (2010) context sensitive solutions to street design address a range of objectives for streets, including walkability, multimodal choices, improved compatibility with adjacent
land uses, provision of high quality space for activity and aesthetic values, enhanced quality of life and protection of environmental quality. While this illustrates a more nuanced approach to transportation projects, the maintenance of an adequate level of vehicle service remains a primary focus, limiting potential design interventions.

### 2.1.5. Urban Design of Streets

The guiding force in street design has been the street’s transportation function. However, urban design theories and practices that emphasize the role of the street right of way for people and social activities has also been a strong influence. Alan Jacobs (1993), in his book *Great Streets*, notes that streets need to operate beyond their functional purpose. He provides an analysis of the elements of great streets around the world and notes that streets are often studied solely for transportation and access because these attributes are easily measured. Other less quantifiable, but equally important urban design elements are often ignored. He identifies key elements of successful streets as places that encourage participation in the community and socialization, locations of public expression, physically comfortable and safe environments, and areas that are able to create and leave lasting impressions.

Historically, 20th century western urban design of public spaces has focused on two primary traditions. The visual-artistic tradition focused on the visual and aesthetic qualities of the space, while the social usage tradition focused on the social qualities of people, places, and activities (Carmona 2003). Largely following the social usage tradition, Alan Jacobs and Donald Appleyard (1987) developed an urban design framework of things that are essential for a good urban environment. These goals are liveability; identity and control; access to opportunities, imagination, and joy; authenticity and meaning; community and public life; and an environment for all.

Hough (1995) argues that conventional approaches to urban design have largely focused on aesthetic conventions, as opposed to biophysical processes as the determinants of urban form. This has resulted in urban conditions that do consider natural resource flows or broader environmental impacts of impermeable landscapes. He notes that things such as well-drained city streets have resulted in impacts that have been
externalized to other areas and contributed to erosion, flooding and poor water quality. This approach to urban design that has disregarded natural processes is considered by him to be environmental degradation by design.

A street design approach that accommodates transportation functions, contemplates social and cultural values, and incorporates natural processes is in keeping with sustainable development. Carmona (2003) identifies a number of objectives that could be used to help develop and guide a sustainable development design approach, including: freedom from pollution; biotic support (maintain biodiversity); resource conservation (water, topsoil, minerals, and energy); resilience (ability to adapt to changing conditions); permeability; vitality; variety; legibility and distinctiveness.

Kenworthy (2006) identifies additional urban design elements that are critical eco-city dimensions and place an emphasis on the public realm. He notes that a high-quality public realm is a critical tool to express a public culture, community, and equity. He asserts that the natural environment should permeate a city’s spaces. He also highlights the importance of public environments that are highly legible, permeable, varied and designed for human needs. Additionally, he identifies a linkage between economic performance and the environmental and social quality of the city’s public spaces.

The evolution of urban design to better consider sustainability objectives has resulted in street designs that are more multi-functional and incorporate green features. Girling and Kellett’s (2005) book *Skinny Streets and Green Neighbourhoods* provides an excellent overview of green street design practices and applications. They examine a number of relevant topics ranging from urban forest as green infrastructure, planting green streets, stormwater as a civic amenity, and urban water strategies. The book highlights a number of benefits of green streets, including water treatment, heat island mitigation, habitat creation, pollutant removal and soil enhancement capabilities of streets.

An increasing number of green design elements are being utilized in cities to improve street right of ways. Common design elements include street trees, permeable pavements, rain gardens, bioswales, infiltration trenches, and street tree wells. The focus with these design interventions is primarily stormwater. Further integrating multi-modal transportation and landscape elements would help to enrich these design approaches.
2.2. Green Street Analytical Framework

Timothy Beatley (2011) suggests roads could be profoundly reconceived and re-imagined through a biophilic lens. A green street approach looks to provide a framework to enable this re-assessment of street design and suggest potential approaches to improve the functional and aesthetic role of streets. As noted by Beatley (2011), streets are a key area to deliver environmental improvements, as street rights of way are controlled by a single entity and are often under-utilized public spaces.

The primary goals of New Urbanism and other current planning philosophies are centred around the idea that denser, less car dependent and infrastructure inefficient land use patterns are the key to meeting sustainability and community objectives. The integration of nature and natural processes in urban areas is not a central theme. Rather, the argument is that by densifying existing built-up areas, farmland and natural areas in the hinterland will be preserved and less subject to urban sprawl. In contrast, Beatley’s (2011) goal of biophilic cities which focuses on abundant nature and natural systems that are visible and accessible to urbanites is much more focused on the integration of nature within urban settings.

In many ways, the notion of a biophilic city is somewhat romantic given the realities and constraints of urban settings. However, a drawback of New Urbanism approaches is that there is often not a meaningful integration or recognition of natural processes and constraints, resulting in a less consumptive variant of the existing model of urbanization. Biophilic cities in many ways take a longer range view of sustainability and put forth a fundamental reorganization of urban settlement that acknowledges and addresses natural resources and provides connections to nature in an urban setting.

The development of a green street approach has the potential to meaningfully address both New Urbanism and biophilic city objectives. Through creating more livable environments, people are encouraged to live in denser, more transportation efficient locations, while adding green space and greening infrastructure will help to address environmental considerations. However, the implementation of improvements within the street right of way involves a complex set of circumstances and competing interests. Farr (2008) identifies today’s highly complex right of way and utility systems as an accretion of
centuries of after-the-fact infrastructure patches. While many of the higher level goals around street design and sustainable communities are important to defining a green street, one must consider the application at the street level and the need to balance existing demands (traffic, utilities), environmental considerations and placemaking objectives.

In assessing how green streets are conceptualized and defined in the literature, a key area of exploration is green infrastructure. Green streets are seen as an element of a broader green infrastructure approach and in many respects, the green street discourse closely aligns with the broader discussion around green infrastructure. Mell (2013) notes that ambiguity exists with respect to the definition of green infrastructure and that the literature suggest a range of themes, including climate change adaptation, ecological value, stormwater management and landscape design.

Keeley (2011) offers a more conventional green infrastructure definition as “vegetation, soils and bio-engineered systems, which provide ecological services such as microclimate regulation, air quality improvements, habitat provision, stormwater management and aesthetic amenities”. This definition places a strong emphasis on functional performance, however, the discourse is evolving to move beyond solely interpretations of physical characteristics, but also examining the role of green streets in promoting sustainable development (TCPA 2004).

Green infrastructure development and its conceptual underpinning have shown differences in European and North American contexts, with European work focusing on investments in green resources that provide ecological, economic and social benefits, while North American research has focused on engineered water management (Mell 2013). In North America, civil engineering practices have largely dictated that water is a central component of landscape management and associated green infrastructure projects (Benedict and McMahon 2006).

A more broad-based application of green infrastructure to street design is reflected in recent street design standards. An excellent example is the Los Angeles County Model Design Manual for Living Streets (2011). This manual incorporates environmental, social and economic considerations and has primary goals of: providing transportation options for people of all ages, physical abilities, and income levels; improving people’s health;
creating livable neighbourhoods; reducing the total amount of paved area; reducing streetwater runoff into watersheds; maximizing infiltration and stormwater reuse; reducing greenhouse gas emissions and other air pollution; reducing energy consumption; increasing civic space; and encouraging human interaction. This reflects not only functional environmental performance objectives, but also a more complex understanding of the range of human health and community considerations vital to a livable community.

Mell (2010) offers a definition of green infrastructure as “the resilient landscapes that support ecological, economic, and human interests by maintaining the integrity of, and promoting landscape connectivity, whilst enhancing the quality of life, place and the environment across different landscape boundaries.” Further, Mell (2013) identifies two types of green infrastructure based in conceptual and implementation narratives:

- Type 1: Visually (and ecologically) green resources (i.e. parks, trees)
- Type 2: Infrastructure characterized as sustainable (i.e. cycle paths, stormwater management)

The green street definition used in this project looks to incorporate both narratives, as well as a broader understanding of sustainable urbanism concepts, to establish an analytical framework to assess green streets. In his extensive work exploring the application of green infrastructure concepts, Mell (2010) argues that the process of selectivity in defining green infrastructure might actually produce greater value, as developments can be targeted to meet appropriate local needs. Therefore, the analytical framework identified for this project has a number of elements that are elevated in importance due to the study area context.

My proposed Green Street Analytical Framework (Table 1) draws upon the literature to highlight four key green street concepts of environmental performance, walkability, identity and livability, as well as associated objectives, design elements and performance measures. Environmental performance is a fundamental element of all green infrastructure or green street projects in other jurisdictions. Walkability is vitally important for inclusion, as it reflects the core function of Government Street and provides a linkage to broader sustainability objectives. Identity refers to the need to have a clear green visual identity for this street. As noted by Beatley (2011) there is a need for more
tangible green elements that provide access to nature and a visual green identity to truly move towards a sustainable approach. Lastly, the inclusion of livability reflects the need to include elements that improve human health and wellbeing and create a socially dynamic place. As noted by Kenworthy (2006), green approaches too often focus on physical and biological systems, forgetting that cities have been created to enrich humankind. The integration of livability ensures human well-being is included as a key consideration.
<table>
<thead>
<tr>
<th>CONCEPT</th>
<th>OBJECTIVES</th>
<th>ELEMENTS</th>
<th>PERFORMANCE MEASURES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environmental Performance</td>
<td>Climate change adaptation</td>
<td>• Urban forest</td>
<td>• % Permeability</td>
</tr>
<tr>
<td></td>
<td>Biodiversity</td>
<td>• Street trees</td>
<td>• Tree canopy cover</td>
</tr>
<tr>
<td></td>
<td>Water quality</td>
<td>• Plant and animal habitat</td>
<td>• % green space</td>
</tr>
<tr>
<td></td>
<td>Stormwater management</td>
<td>• Vegetated areas</td>
<td>• % stormwater treated within right of way</td>
</tr>
<tr>
<td></td>
<td>Environmental quality</td>
<td>• Permeable surfaces</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Stormwater management infrastructure (rain gardens, swales)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Walkability</td>
<td>Public health</td>
<td>• Sidewalks</td>
<td>• % of right of way dedicated to pedestrian realm</td>
</tr>
<tr>
<td></td>
<td>Climate change mitigation</td>
<td>• Engaging pedestrian environments</td>
<td>• Separation of sidewalks from traffic</td>
</tr>
<tr>
<td></td>
<td>Environmental quality</td>
<td>• Buffering from vehicles</td>
<td>• Quality of walking environment</td>
</tr>
<tr>
<td></td>
<td>Economic development</td>
<td>• Pedestrian comfort and safety</td>
<td>• Greenness of walking environment</td>
</tr>
<tr>
<td></td>
<td>Community building</td>
<td>• Network connections</td>
<td>• Network connectivity and route options</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Pedestrian crossings</td>
<td>• Legibility</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Public spaces</td>
<td>• Supportive land uses</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Cycling facilities</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Pedestrian-oriented land uses</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Visual complexity</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Identity</td>
<td>Social well-being</td>
<td>• Visible green features</td>
<td>• % green space</td>
</tr>
<tr>
<td></td>
<td>Quality of life</td>
<td>• Generous pedestrian realm</td>
<td>• % of right of way dedicated to pedestrian realm</td>
</tr>
<tr>
<td></td>
<td>Connection to history of area</td>
<td>• Street trees</td>
<td>• Green appearance (qualitative)</td>
</tr>
<tr>
<td></td>
<td>Economic development</td>
<td>• Urban design elements (i.e. paving, signage)</td>
<td>• Reflection of heritage of area</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Opportunities to connect to nature</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Interpretive elements</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Livability</td>
<td>Public health</td>
<td>• Views to natural features</td>
<td>• % of right of way dedicated to pedestrian realm</td>
</tr>
<tr>
<td></td>
<td>Environmental quality</td>
<td>(i.e. views to water)</td>
<td>• Separation of sidewalks from traffic</td>
</tr>
<tr>
<td></td>
<td>Community building</td>
<td>• Street trees</td>
<td>• Tree canopy cover</td>
</tr>
<tr>
<td></td>
<td>Economic development</td>
<td>• Pedestrian comfort and safety</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Public realm quality</td>
<td>• Beauty</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Natural / green space</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Points of interest</td>
<td></td>
</tr>
</tbody>
</table>
2.2.1. Green Street Concepts

The following section provides an overview the four core concepts that comprise the green street framework in this project. An elaboration of each concept is provided, focusing on key elements highlighted in the literature, the contribution to a green street approach and potential benefits. This section also provides background on appropriate performance measures that can be used to help assess the potential application of each concept within the study area.

Environmental Performance

Enhanced environmental performance is a fundamental component of green street programs in most cities, with an overall objective of improving the management of resources and enhancing environmental quality. Kenworthy (2006) highlights environmental technologies commonly associated with green streets as a critical element needed to move to cities to closed loop infrastructure systems where ecosystem demands are met by the natural capital of their own bio-regions.

Stormwater is the most common focus for streets that seek to contribute to the enhanced environmental performance of a city. The Living Streets Manual (Los Angeles County 2011) identifies that water is the fundamental ingredient for a streetscape ecosystem with key objectives being to maximize the benefits of rain and its by-product, stormwater. A critical contributor to environmental impacts related to stormwater is the preponderance of impermeable surfaces in urban environments. Impermeable surfaces, such as roads, encourage rainwater to flow as surface runoff, rather than allowing it to infiltrate into the ground (Stovin et al. 2008). Impervious surfaces alter native hydrology, cause erosion, concentrate flooding and water pollution and contribute to the urban heat island effect (Farr 2008). Vegetative cover, including trees, helps to intercept rainfall and to reduce and delay surface runoff.

Sustainable approaches to stormwater treat it as a resource and incorporate techniques that cleanse, diffuse, infiltrate and absorb water. This philosophy looks to manage rainfall at its source, and use appropriate technological options, maximizing the potential to achieve water quantity, quality and amenity objectives simultaneously (Stovin et al. 2008). While conventional engineering practices move water off-site as quickly as
possible, sustainable approaches seek to use and store water on-site so absorption and infiltration can clean it naturally and use it as a resource (Los Angeles County 2011).

In the management of stormwater, bioretention techniques are often utilized. Bioretention allows for the collection of stormwater run-off and the removal of contaminants and sedimentation and includes techniques such as raingardens and bioswales. Stormwater management can also be enhanced by dense, deep rooted vegetation that aids in the removal of pollutants and infiltration (Farr 2008).

Street trees are a design element that can provide a wide range of functional and aesthetic benefits. From a stormwater management perspective, a typical medium-sized tree can intercept as much as 2380 gallons (9000 litres) of rainfall per year (Stovin et al. 2008), which when assessed in a variety of conditions was found to equate to interception of 10-40% of total annual precipitation. The environmental benefits of urban trees include protection of the land from soil erosion, habitats for wildlife, filtration of air pollutants, improvements in local air quality, reductions in the urban heat island effect, and energy savings by providing shading and insulation (Brack 2002; Dwyer, Schroeder, & Gobster, 1991; McPherson et al. 2005; Nowak, Crane, & Stevens, 2006; Pandit & Laband, 2010; Simpson 1998).

While a primary concern of green street performance relates to management of water, another key consideration is the maximization of value achieved from landscapes and street trees. Randall et al (2003) assert that key objectives of neighbourhood greening should be the addition of productive components to green space. Examples of improving the productivity of landscaped spaces include the addition of food production areas or the enhancement of plant and animal habitat. A challenge in urban environments with introducing these more complex landscape spaces is ensuring safety, liability and maintenance issues are addressed.

**Walkability**

While green streets have typically focused on stormwater management and other environmental metrics, walkability is an often overlooked factor that truly addresses social, economic and environmental objectives. The walkability of an environment is generally
indicative of the quality of the overall environment. As noted by Beatley (2011), a biophilic city is an outdoor city, a city that makes walking and strolling and daily exposure to the outside elements and weather possible and a priority.

The presence of green space has been demonstrated to be a vital component of an attractive walking environment. One study indicated that people are three times more likely to walk along landscaped, high greenery pedestrian routes (Ellaway, Macintyre, and Bonnefoy 2005). The presence and number of street trees has also been found to positively influence the likelihood of people to walk along a street (Lee & Vernez Moudon 2006). Borst et al. (2008) indicated positive associations between older adults’ perceptions of attractiveness for walking with the presence of trees, front gardens and parks. Street trees also enhance walkability by creating sheltered micro-climates that are ideal locations for people to gather or walk (Los Angeles County 2011). Many of the complementary benefits of walkable communities, such as improved health outcomes (Frank et al., 2006), have not been considered fully in the development of street designs.

Significant literature exists that attempts to identify the core attributes of a walkable environment. Southworth (2005) identifies six attributes of walkability as: connectivity; linkages to other modes; fine-grained and varied land use patterns; safety; quality of path; and path context (e.g. visual interest, landscaping, spatial definition, etc.).

While a number of quantitative studies have been undertaken to identify the influence of various factors, many urban design theorists have utilized more qualitative criteria and analyzed walkability from the perspective of user satisfaction with places. Kevin Lynch (1984) described performance dimensions of cities in general, and pedestrian spaces by extension. These dimensions encompass vitality, sense, fit, access and control, with efficiency and justice as meta-criteria for good urban spaces. Additional qualitative factors that have been suggested include: enclosure or definition by buildings or trees, availability of route choice, variation in orientation and character of public spaces, presence of a buffer zone between sidewalks and moving vehicles, level of lighting and presence of shade trees (Hutabarat Lo 2009).

Hutabarat Lo (2009) completed a comprehensive review of the factors that influence walkability and states that there is some convergence of opinion and research
on land use and streetscape factors that influence the quality of the pedestrian environment and the quantity of pedestrians using the space. These factors include:

- Presence of continuous and well-maintained sidewalks;
- Universal access characteristics;
- Path directness and street network connectivity;
- Safety of at-grade crossing treatments;
- Absence of heavy and high-speed traffic;
- Pedestrian separation or buffering from traffic;
- Land-use density;
- Building and land-use diversity or mix;
- Street trees and landscaping;
- Visual interest and a sense of place as defined under local conditions; and,
- Perceived or actual security.

The design of supportive land uses also has a significant impact on walkability, with Jacobs (1961) highlighting the importance of an intricate and close-grained diversity of primary land uses and enterprises such as buildings that do not turn their backs or blank sides to the street in influencing the quality of the pedestrian environment. While the scope of this study does not examine alternative approaches for land uses and the urban design of buildings, it is important to acknowledge the role buildings, site layout and design have in supporting a walkable environment.

A study that has particular relevance to linking walkability and green streets was completed in Portland, Oregon and combined environmental audits and a survey-based respondent mapping tool to test the influence of micro-scale built environment characteristics, including 'green street' storm water management features, on resident perceptions of walking environment attractiveness (Adkins et al. 2012). The study examined over 50 physical characteristics and their influence on the general attractiveness of walking routes.

As part of this analysis, the influence of implemented green street projects were tested. In Portland, two distinct types of green street facilities, a “deluxe” version with
more extensive planting and a “basic” version with lawn and young street trees were installed (Adkins et al. 2012). The study found that the deluxe green street installations were one of the strongest predictors of attractiveness for walking, while basic green streets did not have a significant effect. The insignificance of the basic green street facilities indicates that for green streets to improve walkability, they must have distinct, high-quality design elements, such as an attractive mix of plantings. Of all the factors examined in the study, well-designed green streets, separation from vehicle traffic, pedestrian network connectivity, parks and ‘bounded openness’ contributed the most significantly to attractiveness of walking environments (Adkins et al. 2012).

Identity

The green street framework for this project includes identity as a vital element to consider in the evaluation of design alternatives. Identity relates not only to the visual impact of street trees and green space, but also the role it plays in highlighting Government Street as Victoria’s primary pedestrian street and Rock Bay District as a green district.

At the core of developing a green identity is increasing the overall quantity of green space, providing opportunities for connections to nature and creating linkages to broader sustainability goals. Kenworthy (2006) suggests the city will remain an object of ambivalence unless it can be seen that cities can be genuinely green. This highlights the suburban / urban divide and the viewpoint from many people in rural or suburban environments that cities are grey areas where natural systems have been completely suppressed. Creating a green identity will involve a redesign of cities, as human settlement has tended to suppress nature and daily contact with natural systems (Farr 2008).

Beatley (2011) emphasizes beauty, pleasure and enjoyment provided by public spaces as key elements that are missing from functional models or monetary evaluations. In developing an environment that is in alignment with a biophilic city that places value on both the form and function of green spaces, Beatley (2011) identifies a number of conditions and characteristics. Components that have relevance to a green street approach include: places of easily accessible and abundant nature; celebration of unique nature and biodiversity; connection to the climate; and priority placed on ecological
restoration and repair. While these are laudable goals, the extent to which they can achieved in a complex urban environment will be significantly constrained.

The creation of identity for a neighbourhood or corridor is seen as a key way to advance sustainability objectives through enhancing citizen awareness and sense of responsibility. The Charter for New Urbanism suggests that bounded neighbourhoods that form identifiable areas encourage citizens to take responsibility for their maintenance and evolution. Farr (2008) also posits that a bounded neighbourhood should play a key role in localizing broader environmental objectives. He offers an example of localization as a neighbourhood commitment to filter all stormwater within the neighbourhood.

In seeking to catalyze the redevelopment of Rock Bay into a sustainable community, Government Street can play a role as the spine of the district and a vital public space. Kenworthy (2006) notes that the economic performance of the city and employment creation are maximized through innovation, creativity and the uniqueness of the local environment, culture and history, as well as the high environmental and social quality of the city’s public environments. Creating a distinct identity for Government Street and high quality public space will help to support economic revitalization.

Livability

Livability is identified as a concept in the green street framework, as the quality of an environment for humans is an essential component of creating successful places. Livability is essentially the sum of the factors that add up to a community’s quality of life. The incorporation of this concept attempts to address the shortfall of many sustainable city approaches, which focus on physical and biological systems, forgetting that cities have been created to enrich humankind and enable its progress (Kenworthy 2006). For the purposes of this study, the integration of livability as a consideration will primarily focus on the role that green elements can play in making a street and community more livable.

A vital component of enhancing livability is ameliorating the impacts of motor vehicles. Creating places that are environmentally and socially attractive will not be possible if automobiles dominate the public realm and create undesirable environmental conditions for pedestrians. Beatley’s (2011) conception of the biophilic city highlights the
sounds and textures of nature as therapeutic and pleasurable elements of urban living, offsetting auditory impacts of automobiles. While this may be difficult to achieve in practice in urban areas, the degree to which traffic impacts an area has a significant bearing on the quality of an urban environment.

Allan Jacobs (1993) in his book *Great Streets*, studies and assesses a range of streets that are recognized as exceptional and provide a high degree of livability. In his analysis he notes that there are no specific physical qualities of a Great Street, as socioeconomic factors and context play into the success of a street. Jacobs identifies a Great Street as one that fosters community and people interacting, is physically comfortable and safe, encourages participation, and leaves strong lasting impressions. A key physical quality he identifies is elements that engage the eyes, which is often provided by visual complexity, such as that provided by trees, as they are dynamic elements that constantly change with weather and seasons.

The presence of street trees or greenery is a key factor that can enhance the quality of someone’s experience in a public place. Analysis shows that increasing the trees or greenery in front of buildings significantly changes people’s perception concerning environmental quality and pleasantness of a space (Asgarzadeh 2010). Urban trees also provide cultural and health benefits that improve the quality of urban life, as they make a city neighbourhood seem more scenic, provide privacy, shelter residents from negative effects of undesirable land uses, and improve retail areas by creating environments that are more attractive to consumers (Dwyer, Schroeder, & Gobster, 1991; Ellis, Lee, & Kweon, 2006; Sheets & Manzer, 1991; Wolf, 2005). Street trees have also been shown to increase property values, further indicating the value people place on them as a quality of life element. A study in Australia (Pandit et al. 2013). demonstrated a 4.27% increase in house sale price based on the presence of a mature boulevard tree, while in Portland, Oregon street trees were shown to increase median house sale price by 3.0% (Donvana and Butry 2010). Despite the multitude of benefits, the implementation of street trees and green spaces need to consider potential negatives such as solar access, safety issues, visibility of commercial establishments, and maintenance costs.
Streets with green elements have also been shown to have elements that contribute to improved human health and general city functioning. Frank et. al. (2006) provide empirical evidence of the positive health impacts that can be experienced in communities that have built environments that promote active transportation. Takano (2002) provides evidence of human health benefits of living near streets with green features, particularly trees.

A further rationale for enhancing quality of life relates to the role a quality urban environment plays in economic development. This is particularly relevant in the study area, where Rock Bay is seeking to transform into a high technology precinct that would endeavour to attract skilled and highly mobile workers. Richard Florida’s (2002) work indicates that the urban lifestyle preferences of the new creative class of employees dictate, to some extent, where certain desirable kinds of companies locate, according to the quality of life being offered by the city. This provides an additional rationale to create streets that are vibrant, liveable and walkable places.

2.2.2. Green Street Performance Measures

In determining performance measures to help evaluate potential green street approaches on Government Street, the concepts of environmental performance, walkability, identity and livability are considered. Beatley (2011) notes that while there is probably no single measure that captures all the pieces of a green and natural city, some proxy measures such as tree canopy cover or imperviousness are commonly used. An important factor in selecting performance measures is choosing criteria that address multiple concepts and outcomes.

When examining sustainable cities literature, many potential measures are related to analysis and evaluation at the citywide or neighbourhood scale. Beatley (2011) posits a comprehensive set of indicators of a biophilic city, with a number that have relevance to evaluation of a green street. The indicators of percentage of population within 100 metres of a park or greenspace and percent forest cover in the city are quantitative measures that could be assessed at the street level. Other criteria, such as extent and number of green features (e.g. green rooftops, green walls, trees) and number of city-supported biophilic
pilot projects could provide the basis for qualitative criteria that assess the extent and visual impact of biophilic interventions.

Approaches used to assess environmental performance on development sites can be used to inform the development of performance measures used to evaluate green street concepts. In Germany, an approach called Green Area Ratio is used that largely focuses on various surface types (Keeley 2011). Analysis of environmental performance is based on five parameters: (1) capacity to evapotranspirate water; (2) ability of landscape elements to hold and bind airborne particulates; (3) capacity to retain and infiltrate stormwater; (4) potential to maintain and support natural soil functions; and (5) availability as plant and animal habitat (Keeley 2011). In this approach vegetated areas are given the highest rating as they are able to address each parameter. Contrary to this approach, De Vries et al. (2003) argue that any kind of greenery in the urban environment has almost the same influence on humans and that designers should think of the quantity of greenery in urban areas rather than the kind.

A wide range of different actors are involved in the discourse that seeks to measure walkability, resulting in a range of potential criteria (Hutabarat Lo 2009). In practice, most conventional street designs place greater importance on vehicle function over pedestrian realm conditions. The engineering measure of pedestrian level of service is focused on personal space that each pedestrian has on the sidewalk, speed of pedestrian flow, and ratio of sidewalk volume to capacity. Hutabarat Lo (2009) argues that this is a mechanistic formula that lacks consideration of contextual factors such as building form, land use context, street connectivity, amenities or vitality. In developing performance measures it is important to include criteria that consider the impacts of motor vehicles on the pedestrian realm, as well as the amenity conditions of the walking environment.

Hutabarat Lo (2009) identifies common walkability criteria used in US cities. While some of these criteria relate to the overall pedestrian network design, a number of them are relevant at the corridor level. The criteria that have particular relevance to a green street are: presence and continuity of sidewalks and pedestrian routes; accessibility of facilities to people with different abilities; visual interest; and perceived or actual security.
Part of the problem of developing aesthetic metrics for walkability is that design criteria are subjective by definition. This is also the case for the identity and livability elements, which lend themselves much better to qualitative evaluation. Given the scope of the study that only assesses design possibilities within the street right of way, many socio-economic factors that influence walkability, identity and livability also cannot be adequately addressed.

The performance measures identified for the identity and livability components of the framework are largely the same as the measures identified for walkability and environmental performance. This highlights the importance of interventions, such as street trees, that address multiple objectives. In a broader sense, achievement of identity and livability components will largely be based on supportive land uses and the quality of urban design in new development. Additionally, a complex range of socio-economic factors, future changes in the Rock Bay District and the design of the broader street network will all have significant influence on the degree to which identity and livability goals can be fulfilled.
3. Research Design

3.1. Positionality of the Researcher

The examination of a Government Street as a green street first came to my attention as part of my role as a Planner with the City of Victoria. The broader Rock Bay District was identified as an area of the City that would likely experience substantial growth and change in the near future. The wide scale redevelopment of this area was seen as a rare opportunity to experiment with innovative green infrastructure at a district-scale and create a unique area of the Downtown Core. My project examines the Government green street as a potential component of a future Rock Bay district. The street was chosen as the scale of analysis, as it represented a manageable scope of work and provided the opportunity to elucidate potential interventions that could contribute to an innovative green district.

3.2. Research Objectives

In order to understand which green street policies and actions are most appropriate for Government Street, four objectives were established to guide my research.

The four objectives are:

**Objective 1:** Gain an understanding of the theoretical and technical boundaries of green street design and practice

**Objective 2:** Understand policy and design parameters influencing Government Street study site

**Objective 3:** Understand green street policy and design best practices

**Objective 4:** Develop green street policy and a design concept for the Government Street study site

In order to achieve these objectives, I engaged in a literature and technical review of green street approaches, examined case studies, and analyzed policy and design conditions relevant to the study site. Table 2 shows the relationship between the objectives and methods.
Table 2: Relationship between Objectives and Methods

<table>
<thead>
<tr>
<th>Objective</th>
<th>Source Data</th>
<th>Methods</th>
<th>Outcome data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green street theoretical &amp; technical understanding</td>
<td>Academic journals, technical standards &amp; guidelines, policies and plans</td>
<td>Literature review, technical review</td>
<td>Green street definition, analytical framework</td>
</tr>
<tr>
<td>Understand policy /design parameters of study site</td>
<td>Municipal, regional, and provincial plans, policies, standards &amp; guidelines; property, infrastructure, and operations data</td>
<td>Document and data review and analysis, street surveys</td>
<td>Summary of study site physical data; policy summary; SWOT analysis</td>
</tr>
<tr>
<td>Policy &amp; design best practice understanding</td>
<td>Review of documents and plans; journal articles</td>
<td>Literature review; case study analysis</td>
<td>Comparable analysis, lessons learned for Victoria</td>
</tr>
<tr>
<td>Policy &amp; design concepts for study site</td>
<td>Data surveys; document reviews; case studies</td>
<td>Site analysis; development of design checklist; design concept; policy drafting; feasibility analysis</td>
<td>Design considerations and policy options for Government St. study site</td>
</tr>
</tbody>
</table>

3.3. Research Methods

This research project is based on an extensive review of journal articles, plans, policy documents, and web-based information on green street theory and street design approaches. To fulfil the research objectives and examine the questions asked in Section 1, a number of data collection and analysis activities are undertaken. The research activities were designed to first gain a sense of green street theory and practices, and then gain an understanding of the Government Street study site and the factors influencing its potential redesign. This is supplemented by an investigation of case study cities approaches and practices. Finally, all this information is synthesized into design solutions for a Government Green Street.
The analysis of the Government Street policy context involved a comprehensive review of City of Victoria policy documents and bylaws and regional policy documents. Documents were analyzed and directions were extracted that established a policy framework for assessing opportunities and constraints related to the implementation of a green street along Government Street.

The physical assessment of the study area was achieved through accessing public available data. The primary source of information used to complete this analysis is the City of Victoria’s mapping system (VicMap), which provides a range of raw data, information layers and aerial photographs. Complementing this analysis, site visits were undertaken to observe and document site conditions. In addition, City of Victoria and Capital Regional District reports and data were accessed and analyzed to provide supporting information related to traffic volumes, development capacity, established standards and land use trends.

The case study analysis was undertaken through accessing publically available documents. Information on green street programs in Seattle and Portland was obtained through reviewing policy documents, web content and journal articles. A set of lessons learned was developed for each city that could be used to inform the Government Street design concept. Analysis of comparable streets was achieved through a review of design documents, an assessment of physical conditions using online mapping information, and a review of web-related content.
4. **Analysis of Government Street Policy Context**

In the assessment of potential futures for Government Street it is important to consider existing policy direction, both broadly in terms of objectives related to street design and also with respect to Government Street and the Rock Bay District. Of particular significance to consider is the land use vision for properties surrounding Government Street identified in the Official Community Plan. Policy designations support a more than threefold increase in density over current uses for the majority of properties in close proximity to Government Green Street study area. This fact highlights the likely wide scale redevelopment of the area, which could combine with the Government Green Street interventions to create a more comprehensive vision of urban sustainability.

In Victoria in the past five years, a number of policy documents have been adopted, bringing new perspective and guidance to potential options in the Government Street study area. The following documents were reviewed to establish the policy framework for assessing opportunities and constraints related to a Government Green Street:

- Official Community Plan (OCP) (2012)
- Downtown Core Area Plan (DCAP) (2011)
- Greenways Plan (2003)
- Urban Forest Master Plan (2013)
- Bicycle Master Plan (1996)
- Pedestrian Master Plan (2007)
- Regional Pedestrian and Cycling Master Plan (2011)
- Economic Development Strategy (2012)

The various policy directions, which have implications for the study, are grouped into categories to help provide a comprehensive sense of overall direction. The categories relate to both geographies (Rock Bay, Government Street) and design considerations (green street objectives, design elements, greenways). At a high level, the most significant policy themes are the reinvention of Rock Bay as a high technology / green infrastructure district and the change in street design philosophy to integrate a complete street, urban forest and green infrastructure considerations.
4.1. Rock Bay

The Government Street study runs through and serves as the spine of the Rock Bay District, which is primarily comprised of commercial, light industrial and heavy industrial land uses. As the north end of the Downtown Core Area, Rock Bay is seen as an emerging area that has potential to transform its character and significantly intensify its employment role in the city. The City of Victoria OCP and Downtown Core Area Plan both identify a new identity and land use future for the area, as well as key considerations for future planning. While the underlying commercial and industrial uses will be largely maintained in the future, the nature of those uses are anticipated to change with respect to development and employment intensity, building form and character, and environmental features in a way more consistent with a walkable, urban core.

The OCP identifies an objective that “Rock Bay develop as an area of intensive employment specialized in the incubation, growth and retention of advanced technology and green enterprise” (City of Victoria 2012a). Table 3 identifies land management guidelines in the OCP to assist in evaluating future land use decisions in Rock Bay. Key considerations for this study include the primacy of employment, the potential for density and height intensification, the inclusion of green infrastructure and a shift in focus to placemaking considerations.
Table 3: Official Community Plan – Urban Place Designation for Rock Bay

<table>
<thead>
<tr>
<th>Built Form</th>
<th>Place Character Features</th>
<th>Uses</th>
<th>Density</th>
</tr>
</thead>
<tbody>
<tr>
<td>Buildings up to approximately 10 storeys.</td>
<td>Buildings set close to the street, wide sidewalks, regularly spaced tree planting</td>
<td>Mix of predominantly industrial, light industrial, high technology, marine industrial, research and development, commercial, office and complementary retail.</td>
<td>Total floor space ratios up to approximately 3:1</td>
</tr>
<tr>
<td></td>
<td>and active uses at grade where appropriate.</td>
<td>Residential mixed-use, work/live and commercial, including office, hotels and other visitor accommodation, located between Douglas Street and Blanshard Street.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Green infrastructure.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Large parcels / lots.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Institutional and industrial buildings with common courtyard open grounds internal to the site.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Landscape screening for service and parking areas.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: City of Victoria 2012a

The land use future for Rock Bay is further elaborated in the Downtown Core Area Plan with a focus on environmental and economic considerations. A key objective is to improve the environmental conditions of the Rock Bay District through the integration of green and innovative infrastructure, site planning, uses and building technology. From an economic perspective, a focus is to attract and maintain a range of commercial and light industrial businesses to locate within the Rock Bay District. An additional economic objective is to develop an employment-based environment that attracts new and emergent employment sectors such as high-tech (City of Victoria 2011).

As part of land use changes, OCP policy direction suggests the development of a new identity for Rock Bay through the “growth of advanced technology and green industry supported by green infrastructure, high performance building systems, district energy, industrial heritage retention and rapid transit service” (City of Victoria 2012a). Government Street, as the spine of the Rock Bay District and within the public domain, has enormous potential to initiate this transformation. The redesign of Government Street could accentuate Victoria’s key competitive advantage in attracting technology professionals, which is quality of life and recreational opportunities. Further, one of the Economic Development Strategy’s (2012b) key directions, the positioning of Victoria as a uniquely
green and healthy community, could be supported on Government Street through the implementation of green infrastructure and green design features. This would enhance the role of the street as a green gateway to the Downtown Core Area, and add innovative features in an area where economic growth is desirable.

In policy documents it is acknowledged that improvements need to be made to the public realm in Rock Bay. The Downtown Core Area Plan (City of Victoria 2011) specifically identifies the following improvements:

- the development of additional public parks and open spaces to provide public amenity space within the Rock Bay District; and
- the development of a detailed public realm improvement plan for the Rock Bay District which addresses opportunities for sidewalk widening, distinctive paving materials; and human-scale public amenities.

Rock Bay has been identified as the first priority for local area planning in Victoria, reflecting the level of change that is anticipated in this area. The OCP identifies key objectives of future Rock Bay planning will be to “support its transformation into an intensive employment district that includes the incubation, growth and retention of advanced technology and green enterprise supported by sustainable infrastructure, green buildings, renewable and district energy, rapid transit service, and complementary industrial properties” (City of Victoria 2012a). In addition, the DCAP highlights that a component of the local area plan will be the use of development standards and other regulatory tools to improve the overall environmental conditions in the Rock Bay District (City of Victoria 2011). This indicates that design solutions highlighted on Government Street could have a broader application to other areas of Rock Bay.

4.2. Government Street

Currently Government Street has three notable transportation designations: a secondary arterial street, a truck route and a greenway. Secondary arterial streets are designated to carry 5,000 to 20,000 vehicles a day and are important traffic arterials (City of Victoria 2014b). Parallel arterial streets, Douglas Street and Blanshard Street,
designated to carry the majority of north-south traffic. Government Street’s designation as a truck route has implications with respect to functional requirements that will need to be considered in street design. Finally, Government Street’s designation as a greenway highlight its role as a primary walking and cycling route.

The character of Government Street is quite different south of the study area. The Government Street Mall anchors the City’s historic core and is a pedestrian priority street that has a distinct character from other main streets in the City (Figure 2). Wide pedestrian areas, street furniture, curbless streets, unique pavement treatments and active building frontages that provide a sense of enclosure all help to make this a desirable pedestrian space. In contrast, Figure 3 illustrates the current conditions on Government Street within the Rock Bay District.

Figure 2: Government Street Mall in Historic Core of Downtown Core Area

Note. Photo C. Scott, 2013
The OCP provides policy direction to “enhance the pedestrian corridor along Government Street Mall through the extension of public realm improvements northward to Pembroke Street, and street or pathway connections to nearby public spaces” (City of Victoria 2012a). The DCAP builds on this by providing direction to “Develop a comprehensive streetscape plan for the extension of the Government Street Mall that focuses on improving the pedestrian and cycling environment and contains a consistent streetscape treatment throughout the entire length”. Elements noted in the DCAP for the Government Street Mall are connections to nearby public spaces, the provision of active street-level commercial uses along Government Street, pedestrian priority elements, generous tree planting and green infrastructure features (City of Victoria 2011).

The comprehensive directions for the Government Street Mall in the DCAP clearly emphasize the importance of this street and its special role in the image and identity of the city. While policy direction only indicates that the pedestrian priority mall would be extended to Pembroke Street (half way through the study area), the Street’s greenway designation and the potential to create a cohesive identity for the spine of the Rock Bay District provide rationales to extend this unique pedestrian character through the entire Rock Bay District.
4.3. Green Street Objectives

At a high level, Victoria has indicated support for a new approach to conceptualizing and designing streets. Objectives have been articulated with respect to elements that are integral to a green streets approach. The following OCP (City of Victoria 2012a) policies show support for central elements of green street design:

- **Transportation and Mobility** – As a conceptual framework for transportation planning, modes are ranked in the following order of priority (highest to lowest): pedestrians, cyclists, transit, commercial vehicles, and single occupancy vehicles.
- **Stormwater Management** – Support is expressed for an integrated watershed planning approach that comprehensively manages surface water, rainwater, and groundwater resources to promote healthy aquatic ecosystems, resilience to climate change and the maintenance of hydrological functions.
- **Urban Forest** – Direction is provided for management of the urban forest as green infrastructure to enhance ecological services such as rainwater treatment, carbon sequestration, air purification and maintenance of biodiversity.
- **Infrastructure Asset Management** - Forward looking consideration of climate change and energy resiliency in infrastructure asset management with respect to maintenance, repair and replacement over time.
- **Ecosystem Enhancements** – Goal to improve connectivity between areas of natural habitat through strategic greenway and neighbourhood urban forest enhancement initiatives.
- **Air Quality** – Direction for improved air quality by identifying and integrating actions into broader community planning initiatives, such as encouraging low emission transportation options, and increasing urban forest.

4.4. Street Design Elements

Numerous City of Victoria policy plans highlight street design elements that could be considered as a component of a green street. Government Street’s designation as a greenway elevates its importance as a street that could be designed with “green”
elements. Two critical components to consider here are the design elements that improve the environmental performance of the street, but also those that reinforce its green identity and role as an anchor of the Rock Bay District.

The City of Victoria Bicycle Master Plan and the Regional Pedestrian and Cycling Master Plan (PCMP) both identity Government Street as part of the cycling network. The recommendation in these plans is for on-street bicycle lanes. While Government Street has been identified for on-street bike lanes, the PCMP identifies more progressive approaches, including physical separation from vehicles, that could be used to advance green street design. From a pedestrian perspective, the OCP identifies design elements to increase pedestrian safety and comfort on major roads including through the use of curb-side parking, green edges, street furniture and street tree planting for separation from traffic.

A number of policy directions highlight considerations for street design that would allow for more substantial integration of green infrastructure and the urban forest. The OCP includes a direction to coordinate the urban design and green infrastructure benefits of public realm improvements on major roads, while the DCAP includes direction to ensure that infrastructure upgrades consider the integration of green infrastructure, and that storm water management and urban forest management considerations are incorporated into street redesign projects (City of Victoria 2011). The City of Victoria Urban Forest Master Plan (2013a) contains a number of considerations for the provision of landscaping and street trees within the street right of way. These include increasing the use and diversity of native and climate change adapted species, maximizing green infrastructure and other benefits and minimizing maintenance costs.

Public realm enhancements are a key component of building a green street, both with respect to the creation of a social space for people to enjoy and as a mechanism to build an identity for an area. The OCP provides direction to:

- enhance the design of the public realm to acknowledge the importance of streets and other public spaces to the social life of the city;
- contribute to place character in the design of sidewalks, streets, and other public spaces;
• foster social vibrancy and strengthen human scale design of buildings, streetscapes and public spaces;
• enhance local area distinctiveness through design of the public realm with features that contribute to a sense of place, such as landscaping, street furniture, pedestrian-scale lighting, or art in public places; and,
• animate the pedestrian realm through urban design considerations, such as local gateways, sidewalk cafés, landscaping, street furniture and art in public places.

(City of Victoria 2012a)

4.5. Greenways

Government Street’s designation as a greenway in the 2003 Greenways Plan, combined with more recent thinking around greenways highlights its potential role as a green street. The Greenways Plan identifies the foundation for the purpose and design for greenways, while recent policy in the Official Community Plan identifies the changing perception and role of greenways and perhaps their evolution into green streets.

The City of Victoria Greenways Plan, which identifies Government Street as a shared greenway, outlines a set of aspirations and design standards for greenways. In general, there is inconsistency between the stated role of greenways and design standards and implementation practices. The goals of the City of Victoria Greenways Plan are to: establish a human-powered transportation network; restore native, aquatic and cultural habitats; and, provide opportunities for recreation (City of Victoria 2003).

The Greenways Plan notes that Victoria is an urban context where greenways will largely be established on streets that provide a superb, human-scaled, people friendly environment for pedestrians and cyclists. However, on the City of Victoria greenways webpage the stated definition of a greenway is “a corridor of protected open space that is managed for conservation and/or recreation” (City of Victoria 2013b). This illustrates the confusion and sometimes incongruence between transportation and open space objectives of Greenways. Different communities identify different roles for greenways, with a general lack of consistency in definitions in different jurisdictions. For communities with established green street programs that focus more on the environmental performance
of streets, the purpose of greenways is to facilitate walking and cycling. Portland and Seattle are examples of communities that have a clear distinction between greenways and green streets. The dissociation of the two primary objectives of environmental performance and walking and cycling promotion may be a consideration for Victoria to create more realistic expectation of design possibilities and provide a more efficient implementation of street improvements.

The portion of Government Street within the study area is identified as a Shared Greenway. The definition of a shared greenway is that it is designed for bicycles and other non-motorized rolling traffic and motorized vehicles (City of Victoria 2003). Design elements identified for Shared Greenways include bike traffic on the road and separated from pedestrians; planted boulevards and traffic bulbs to green the routes; and large canopied trees where possible.

Shared greenways identify a minimum 1.5 metre sidewalk. 2-3 metre boulevard and 1.2 to 1.8 metre bike lane. Additional greenway enhancements identified in the plan are public art, large canopy trees, signage, special landscaping and different surface treatments. However, no direction is provided on how anything other than transportation facilities are to be integrated. Overall, the design criteria are focused on transportation-related elements and provide no basis to develop a street that is “greener” than any other street in the city.

The OCP identifies how thinking around greenways has evolved over the past 10 years and illustrates a way forward to transition some greenways to green streets. From a cycling perspective, there is an acknowledgement that higher quality facilities are needed, including consideration of separated bicycle facilities along Shared Greenways and in high volume routes (City of Victoria 2012a). The OCP also clearly identifies improvement of greenway identity and enhancement of environmental performance as key elements to focus on when the Greenways Plan is updated. Additionally, from a public realm perspective, integrating elements that reflect unique neighbourhood character and identity and create interest for pedestrians are highlighted as a key priority.
4.6. Policy Summary

The policy directions identified in the various documents, most notably the OCP and DCAP, provide a broad scope to enable implementation of a green street approach along Government Street. The multitude of green infrastructure, alternative transportation and public realm objectives, combined with the intention of creating an identity for a green employment district in Rock Bay signal this as an excellent location to push the envelope with respect to green street design. As a design concept is developed, the policy context laid out in this section will be used to frame the options and ensure a comprehensive and realistic approach is articulated.
5. Physical Assessment of Government Street

The purpose of this section is to provide an inventory, assessment and analysis of the existing conditions on and adjacent to the Government Street study area. The specific focus is to examine the baseline conditions to assess their current performance and potential for incorporation of green street elements. The primary source of information used to complete this analysis is the City of Victoria’s mapping system (VicMap), which provides a range of raw data, information layers and aerial photographs. Complementing this analysis, site visits were undertaken to observe and document site conditions.

The physical assessment is organized around the topics of land use, transportation, infrastructure, landscape/urban forest and urban design. The assessment includes an overview of existing conditions and an analysis of the area’s strengths and weaknesses to assess potential barriers or opportunities for green street implementation.

5.1. General Study Area Characteristics

The study area stretches five blocks along Government Street through the Rock Bay District in the City of Victoria. Figure 4 shows the study area with block numbers that are referenced in various parts of this section.

Figure 4: Government Street Study Area

Source: VicMap, City of Victoria (2014a), modified by C. Scott
The conditions within each block of the study area are relatively consistent, with a right of way width of approximately 27.5 metres, with four travel lanes, two parking lanes, two bike lanes, and sidewalks on each side of the street. The images included in Figure 5 illustrate typical right of way and land use conditions along the corridor. Table 4 displays the approximate right of way dimensions for each block of Government Street in the study area, while Figure 6 illustrates a typical street cross-section. Finally, Table 5 illustrates design elements of each block, specifically identifying the number of existing trees, type of bike facilities and dominant land use.

Figure 5: Images of Government Street Right of Way

Note. Photos C. Scott, 2013
Table 4: Government Street Right of Way Dimensions

<table>
<thead>
<tr>
<th>Block</th>
<th>Block length</th>
<th>ROW Width</th>
<th>Curb to curb</th>
<th>Curb to Property Line (west)</th>
<th>Curb to Property Line (east)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2300 North</td>
<td>155m</td>
<td>27.8m</td>
<td>18.1m</td>
<td>3.5m</td>
<td>6.2m</td>
</tr>
<tr>
<td>2300 South</td>
<td>n/a</td>
<td>27.4m</td>
<td>21.2m</td>
<td>3.5m</td>
<td>2.7m</td>
</tr>
<tr>
<td>2200</td>
<td>66m</td>
<td>27.4m</td>
<td>20.0m</td>
<td>3.7m</td>
<td>3.7m</td>
</tr>
<tr>
<td>2100</td>
<td>75m</td>
<td>27.4m</td>
<td>20.0m</td>
<td>3.6m</td>
<td>3.8m</td>
</tr>
<tr>
<td>2000</td>
<td>75m</td>
<td>27.4m</td>
<td>20.0m</td>
<td>3.7m</td>
<td>3.7m</td>
</tr>
<tr>
<td>1900</td>
<td>75m</td>
<td>27.2m</td>
<td>20.7m</td>
<td>3.1m</td>
<td>3.6m</td>
</tr>
</tbody>
</table>

Figure 6: Typical Street Cross-Section in Government Street Study Area

Table 5: Government Street Block by Block Characteristics

<table>
<thead>
<tr>
<th>Block</th>
<th># of trees WS</th>
<th>Trees ES</th>
<th>Bike facilities</th>
<th>Dominant Land Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>2300</td>
<td>9</td>
<td>5</td>
<td>Bike lanes</td>
<td>Industrial</td>
</tr>
<tr>
<td>2200</td>
<td>5</td>
<td>4</td>
<td>Bike lanes</td>
<td>Commercial</td>
</tr>
<tr>
<td>2100</td>
<td>2</td>
<td>3</td>
<td>Bike lanes</td>
<td>Industrial</td>
</tr>
<tr>
<td>2000</td>
<td>4</td>
<td>4</td>
<td>Bike lanes</td>
<td>Commercial</td>
</tr>
<tr>
<td>1900</td>
<td>7</td>
<td>5</td>
<td>Bike lanes</td>
<td>Commercial</td>
</tr>
</tbody>
</table>
5.2. Land Use

The study area is mostly comprised of commercial and industrial businesses in variety of forms, ranging from street-oriented businesses to active industrial operations. Notable businesses along Government Street includes two breweries (Phillips Brewery and Vancouver Island Brewery), a cement operation (with frontage and main access point off of Bay Street), an organics collection business, a contaminated site undergoing remediation and smaller scale commercial storefronts. The southern two blocks have buildings set close to the street, providing more of an urban scale, while the northern three blocks have mostly land uses that do not have a strong street presence.

The land uses fronting Government Street are mostly either service commercial or light industrial. Of significance, a few of the larger parcels west of Government Street are critical locations for harbourfront industrial operations. The existing zoning for the area is almost exclusively industrial (Figure 7), with properties on the east side of Government Street largely zoned for light industrial / commercial (M1, M2) and the properties on the west side zoned for a mix of light and heavy industrial (M3).

**Figure 7: Study Area Zoning Designations**

![Zoning Designations Map](source: VicMap, City of Victoria (2014a))
Existing, long-standing industrial uses are a key defining feature of this area. While they are not inherently incompatible with a green streets approach, operational requirements regarding access, site design and noise and air pollution could inhibit more aggressive green street approaches in the short term. However, this is partially mitigated by the fact that major industrial businesses on Government Street have frontages on multiple streets, with primary their access points off the other street.

A number of the existing uses provide valuable employment and industrial land in an area that has limited potential for conflicts with residential uses. Industrial land in the region is limited, has low vacancy rates (Capital Regional District 2009) and faces increased competition from residential and commercial uses. This area of industrial land is strategically located from a regional perspective, as it is in close proximity to population and commerce centres.

From a land utilization perspective, virtually all parcels fronting Government Street are underutilized based on existing zoning entitlements and adopted policy. Figure 8, derived from a Land Inventory and Capacity Analysis Study (City of Victoria 2010), indicates that this area has significant capacity for residential development. In addition, there exists significant potential for additional commercial and industrial development based on existing zoning.

The area is lacking on overall amenity space, with no proximate parkland or significant community facilities close by to the study area. The lone exception is a small pocket park at the northwest corner of Government Street and Bay Street that is lightly used and highly impacted by traffic.
The Official Community Plan indicates that this area will continue to accommodate uses that have an employment focus. Past planning approaches have focused on screening industrial and commercial uses from the streetscape environments and designing areas from a functional traffic perspective. As Rock Bay is envisioned to have a future focus on technology and other light industrial uses which have limited negative externalities, there is an opportunity for better integration with the public realm. Specifically, these uses are much more likely to have street-oriented buildings that support the pedestrian realm and would benefit from green street design features.

The development of a green street on Government Street could be seen as an asset that supports the economic development of Rock Bay and its transition into a green infrastructure, high technology district. As noted in the City of Victoria Economic Development Strategy (2012b) knowledge based companies are flexible in where they locate and a healthy natural environment and attractive and amenity rich urban
environment will be key competitive advantages that Victoria can use to attract coveted employment sectors such as high technology. This is particularly applicable in the Rock Bay District, as the area is intended to support industries that are environmentally conscious. The development of a green street could create an identity for the area and catalyze future land use changes.

Potential land use change is highly likely as, based on both existing zoning and designations in the Official Community Plan, the majority of the sites along Government Street are underdeveloped. Additionally, a Residential Land Inventory and Capacity Analysis Study identified a number of parcels as suitable for near term redevelopment based on factors such as site coverage, available capacity under zoning and year of most recent improvements (City of Victoria 2010). Redevelopment in this area would allow the land use context to be transformed in a manner that supports and reinforces a green street approach.

5.3. Transportation

Government Street is a major north-south road that serves as an entry point into the Downtown Core Area. In the study area, it is characterized by four vehicle travel lanes, two parking lanes and a bicycle lane on either side of the street. Time-limited free parking is available on both sides of the street for most of the study area.

Government Street experiences heavy traffic volumes at the north end of the study area (25,000 to 30,000 vehicles a day) which quickly diminish and filter throughout the downtown via a well-connected street network. Traffic volumes two blocks south of the study area are less than 10,000 vehicles a day (Capital Regional District 2014b). No transit buses currently travel along Government Street, with Douglas Street one block to the east serving as the primary transit corridor in the region. Government Street is designated as a secondary arterial street, designed to carry from 5,000 to 20,000 vehicles a day (City of Victoria 2014). The current volumes exceed what is ideal for a street of this type, and when combined with the lack of an attractive streetscape, create a challenging pedestrian environment.
Sidewalk facilities are largely basic with limited pedestrian amenities and utility poles and street trees providing obstructions at numerous locations. A large number of driveway accesses break up the pedestrian environment. Bike lanes are relatively narrow (1.3 metres) and are not physically separated from vehicle traffic. A study completed in Vancouver that analyzed various cycling route types and rider preferences indicated that bike lanes on major streets with parked cars were not desirable to most cyclists and ranked 11th out of 16 treatments that were studied based on user preference (Winters and Teschke 2010). The treatment, combined with the lack of features that soften or add interest, make Government Street a less than inviting cycling route. This is reflected in relatively low bicycle counts. The most recent counts were completed in May 2013 and counted bicycle volumes at the intersection of Government Street and Bay Street. For the periods of 7-9am and 4-6pm, the cumulative cycling volumes were 500-750 bikes/day (Capital Regional District 2013).

The conversion of Government Street to a green street will depend on the ability to change the fundamental transportation role of the street by reducing the dominance of motor vehicles and converting road right of way space to uses other than travel lanes. As Douglas and Blanshard Streets serve as the primary parallel corridors for transit and vehicle traffic, flexibility is available to design Government Street to give priority to cyclists and pedestrians. The existing right of way on Government Street is relatively wide (27 to 30 metres), providing opportunities for a variety of design possibilities. A bicycle lane runs the length of Government Street and provides a connection to the Downtown Core. The Street’s designation as a Greenway and Bikeway highlights its role as a vitally important transportation corridor.

A number of surrounding conditions and proposed projects provide indications that the study area is a vital future link in a pedestrian priority network. As the residential population of the Downtown Core Area is anticipated to triple in the next 30 years, there will be an increased premium placed on walkability, particularly in areas such as Rock Bay that identified as high growth areas (City of Victoria 2011). Government Street, south of the study area is largely recognized as the primary pedestrian street in Victoria. This is reflected not only in pedestrian volumes, but also in very wide sidewalks, high quality paving treatments and urban design improvements. The existing character of
Government Street to the south and planned intensification of Rock Bay represents an exceptional opportunity to carry on this pedestrian priority on the northern stretch of Government Street and make physical improvements that prioritize walkability.

Another factor reinforcing the development of a more walkable environment on Government Street is the Harbour Pathway, which will provide a continuous waterfront route through the Downtown Core Area, running from the James Bay neighbourhood to the Selkirk Waterfront. Parts of the pathway are in place at present, with plans to complete the majority of the route in coming years. From a pedestrian perspective, Government Street could form a couplet (Figure 9) that complements the planned Harbour Pathway directly to the west and provide a pedestrian and cycling amenity that could further support Victoria’s tourist industry and position Victoria as an active transportation leader.

**Figure 9: Illustration of Potential Pedestrian Couplet in Downtown Core Area**

Source: VicMap, City of Victoria (2014a), modified by C. Scott
A last consideration from a transportation perspective is industrial businesses that rely on heavy truck traffic as a component of their operations. Any green street design will need to be compatible with the continued operation of industrial uses on and in close proximity to Government Street. As Rock Bay is a relatively small industrial area and not a thoroughfare for truck traffic, the primary consideration here is the maintenance of circulation, as opposed to facilitating a steady flow of traffic.

5.4. Infrastructure

Water, sewer and stormwater mains run along Government Street. With respect to green street design, stormwater infrastructure is the most relevant and often the fundamental rationale for implementation of a green street design. No stormwater management infrastructure other than traditional storm drains are present in the study area. Rain water falling within the study area drains into the Victoria Harbour which is located just to the west of the study area. The right of way imperviousness ranges from 92-99% depending on the block (Table 6) and is generally characterized by limited green space.

Table 6: Level of Permeable Surfaces in Study Area

<table>
<thead>
<tr>
<th>Block</th>
<th>Total Area (m²)</th>
<th>Pervious Area (m²)</th>
<th>% Pervious</th>
<th>% Impervious</th>
</tr>
</thead>
<tbody>
<tr>
<td>2300</td>
<td>4030m²</td>
<td>160m²</td>
<td>4%</td>
<td>96%</td>
</tr>
<tr>
<td>2200</td>
<td>1672m²</td>
<td>90m²</td>
<td>5%</td>
<td>95%</td>
</tr>
<tr>
<td>2100</td>
<td>2014m²</td>
<td>30m²</td>
<td>1%</td>
<td>99%</td>
</tr>
<tr>
<td>2000</td>
<td>2000m²</td>
<td>26m²</td>
<td>1%</td>
<td>99%</td>
</tr>
<tr>
<td>1900</td>
<td>2020m²</td>
<td>165m²</td>
<td>8%</td>
<td>92%</td>
</tr>
</tbody>
</table>

The area is fully serviced by water, sewer and storm infrastructure. While infrastructure needs to be upgraded, capacity exists within the network to accommodate growth anticipated in the area. No green infrastructure exists within the right of way, with conventional infrastructure exclusively servicing the area. The sites surrounding Government Street have a high level of imperviousness and do not include building systems that incorporate green technology.
The primary opportunities associated with infrastructure upgrading relates to the degree of change anticipated in this area. An upgrade of infrastructure and a street redesign are ideally planned together to maximize potential efficiencies. Street trees and stormwater management areas require subsurface space to function effectively. In the case of street trees, adequate soil volumes are required for success and canopy development. Appropriate technologies, such as structural soil cells, can be used to provide soil volumes and reduce conflicts with underground infrastructure (City of Victoria 2013, US EPA 2013).

Implementing green stormwater management infrastructure requires careful design and ongoing maintenance. Securing adequate right of way space is essential to ensuring enough space is available to implement technologies that have a tangible impact on environmental performance. At present most trees are planted in hardscaped areas and boulevard areas are very limited. The integration of stormwater management areas, such as rain gardens, would be reliant on the conversion of paved areas.

5.5. Landscape / Urban Forest

From a green space perspective, the Rock Bay area is very limited. One of the most striking features of the northern portion of Government Street is the expanse of pavement that is created by a wide road surface and private properties with virtually no landscape features. An effort has been made to plant trees fairly regularly along Government Street and it is one of the more treed streets in Rock Bay. However, trees are often given limited rooting space and are placed quite frequently in the middle of sidewalk areas (Figure 10).
At a broader level, the Rock Bay District is largely devoid of trees or significant landscape features. A number of street trees exist along Government Street, but they are predominantly columnar and provide limited tree canopy cover. Figure 11 shows existing street trees along Government Street, while Figure 12 shows tree canopy cover in the broader area.

**Figure 11: Existing Trees in Rock Bay Area**

Source: VicMap, City of Victoria (2014a)
The overall design and aesthetic of the area is dominated by wide expanses of pavement. Street trees are the only significant landscape feature within the right of way, but contribute relatively little to the overall tree canopy. The lack of landscape features in the right of way is exacerbated by private sites adjacent to Government Street that have virtually no landscape features and often surface parking lots at the front of buildings. Street tree planting is generally irregular depending on the block and many times has resulted in effective sidewalk widths of as little as one metre, which is inadequate based on City of Victoria standards (1.5 metre clear area). No parks or public spaces exist along the corridor outside of a small pocket park at the north end of the corridor. In the absence of a quality park or public space, there is no location in the study area where the impacts of traffic noise are diminished and a brief respite from the asphalt-intensive, high traffic volume environment can be achieved.

As an emerging portion of the Downtown Core Area, Rock Bay has the potential to adopt a character that distinguishes it from the historic Downtown Core. The historic core is characterized by heritage buildings set close to the street and hardscaped public spaces and streetscapes. Figure 13 shows the tree canopy cover in the City of Victoria.
In general, the Downtown Core Area is devoid of any significant tree canopy. While maintaining a primary pedestrian orientation, there is potential to create an urban design theme that incorporates a greater emphasis on green landscape elements and introduce tree canopy cover into the Downtown Core Area, where it is currently lacking.

**Figure 13: Tree Canopy Cover in the City of Victoria**

Expansion of the landscape emphasis on Government Street is largely dependent on two factors: the development of an overall right-of-way concept that reallocates space from traffic lanes to green space; and, the redevelopment of private sites to provide improved landscaping at the street interface. The two items would functionally expand the area available and make possible a broader range of street tree and landscape interventions that would have a greater impact with respect to tree canopy cover, permeability and overall aesthetic. An inability to convert right of way would significantly constrain landscape options.
5.6. Urban Design

The existing urban design conditions along Government Street are largely focused on the movement of vehicles, with pedestrian, landscape and cycling facilities largely an afterthought. There are no unifying design features and limited pedestrian amenities within the right of way, creating an uninteresting and uninviting public realm. This is in stark contrast to portions of Government Street directly to the south, which are recognized as some of the most successful pedestrian spaces in the City. The three block stretch south of the study area (Chatham Street to Pandora Street) falls within the Chinatown precinct and has specific urban design treatments related to light standards, street furniture, wayfinding and sidewalk pavement treatments. From Pandora Street to Humboldt Street, the Government Street Mall in the Old Town District has a unique design that allocates the majority of right of way space to pedestrians. Figure 14 shows photos of Chinatown and Old Town Districts and Figure 15 shows an aerial vantage point of Government Street through the Downtown Core Area.

Figure 14: Government Street in Chinatown and Old Town Districts

[Images of Government Street in Chinatown and Old Town Districts]

Note. Photos C. Scott, 2013
Generally, there is a lack of urban design quality in the area, with the streetscape and buildings designed primarily to service the functional needs of the businesses and vehicular movement. Streetscape treatments are relatively inconsistent and pedestrian amenities or points of interest are largely lacking. Figure 16 shows the relationship between buildings and open space. As noted on the map, a number of the buildings are set far back from the street, increasing the visual width of the street and creating a less inviting public realm.
Existing street trees do provide an element of character, while some buildings at the southern end of the study area have a good pedestrian orientation with smaller setbacks and inviting entrances. The block pattern is conducive to an interesting and connected urban environment and provides a good range of opportunities for eastward connections.

In terms of physical characteristics, the presence of shorter blocks (65-75 metres) for a number of the blocks fronting Government Street provide a number of urban design opportunities to create points of interest at corner sites and also shift access points for commercial or industrial operations to side streets. An additional characteristic that is potentially beneficial is proximity to the harbour and the potential to create view corridors from public spaces.
The creation of a new urban design identity is working against a longstanding industrial and service commercial identity for the area. Improvements to the public realm will not fully be able to be appreciated until associated land changes are undertaken. In the short term, this may create an incongruence between street design and supporting land uses. However, the establishment of a green identity and the enhancement of livability conditions could help to improve the likelihood of redevelopment.

5.7. Summary of Assessment

The review of physical conditions of Government Street indicates very few existing elements that are consistent with a green street design. The area is currently characterized by wide expanses of pavement, high traffic volumes and a generally unattractive public realm. A range of industrial and commercial land uses, that generally becomes less pedestrian oriented towards the northern end of the study area, are present along Government Street. A six-lane cross section accommodates high vehicle volumes and parking on both sides of the street, with sub-standard bike lanes and an inconsistent pedestrian realm. The area is approximately 95% impervious and contains no green infrastructure elements. Street trees are more prevalent on Government Street than other areas of Rock Bay, but provide limited canopy cover and are often planted in ways that conflict with sidewalk areas.

While existing conditions provide little in the way of advancing a green street concept, a number of other factors highlight the potential for the evolution of the street in a way in which environmental performance, walkability, identity and livability can be enhanced. The anticipated land use transformation of Rock Bay creates an opportunity to reconstruct the streetscape and alter the context that frames Government Street. The presence of two major roads parallel to the area and directly to the west could allow for the shifting of vehicle traffic, enabling the conversion of right of way space to other functions. The addition of landscape and stormwater management elements and improved pedestrian and cycling facilities could shift the identity of Government Street to align with the green focus of a future eco-district. The achievement of a green street vision for is dependent on reducing the dominance of vehicles and with substantially increasing street trees and plantings to create a more livable street.
6. Case Study Analysis

6.1. Introduction

The case study analysis component of this report involves examining green street approaches in Seattle and Portland to assess potential applications that may be relevant in the Government Street context. By assessing program goals and structure, design approaches and planning considerations, insights can be gained into best practices and potential design elements. The selection of case study communities was based on a scan of literature to assess communities in North America with established green street programs. Seattle and Portland were selected as case study cities, as they have long-established green street programs that are progressive in the North American context. Additionally, both Seattle and Portland are in the same region as Victoria and have similar climatic conditions. Therefore, landscape and stormwater management treatments will be relatively transferrable to the Victoria climate.

Two specific green street projects in Portland, Southwest Montgomery Street and Southeast Clay Street, are also reviewed in depth to analyze specific approaches used in green street design. These two green street projects were selected for more detailed exploration as they are both within dense urban contexts, address a comprehensive set of goals, are seen as key elements to define their neighbourhoods and integrate innovative design approaches. Collectively, the analysis of other jurisdictions and projects provides a set of planning considerations that will inform the selection of design approaches on Government Street.
6.2. City of Portland

Overview

The City of Portland has one of the most comprehensive and long-standing green street programs in North America. As of 2010, over 500 individual green street facilities had been installed in Portland (Dill et al. 2010). Initial green street applications were focused solely on stormwater management. However, this approach has evolved into an integrated application that provides multiple benefits, such as green space and habitat connectivity, enhancement of the bicycle and pedestrian environment, and neighborhood livability. In Portland’s Green Street Policy a green street is defined by the following characteristics:

- Handles stormwater on site through use of vegetated facilities;
- Provides water quality benefits and replenishes groundwater;
- Creates attractive streetscapes that enhance neighborhood livability by enhancing the pedestrian environment and introducing park-like elements into neighborhoods;
- Serves as an urban greenway segment that connects neighborhoods, parks, recreation facilities, schools, main streets, and wildlife habitats; and
- Meets broader community goals by providing pedestrian and, where appropriate, bicycle access.

(City of Portland 2007a)

Overall guidance for Portland’s Green Street approach is provided by Portland’s Comprehensive Plan, which includes direction for protection of natural resources, improvement of the quality of water resources and the enhancement of neighbourhood livability through the design of stormwater facilities. While the primary environmental purpose of Portland’s green street program is stormwater management, a number of additional environmental objectives are integrated into green street designs, including: reducing the amount of water that is piped directly to streams and rivers; incorporating a visible component of a green infrastructure into the aesthetics of the community; and making the best use of the street tree canopy for stormwater interception, temperature mitigation and air quality improvement (City of Portland 2006).
A number of green street projects have been installed throughout Portland, and more are being planned as retrofits for existing neighborhoods. Portland has seen the value in starting small with demonstration projects. Implementing pilot projects has allowed the City to monitor practices and modify the designs for improved function and effectiveness before being implemented more widely (Water Environment Research Foundation 2014).

**Green Street Program Structure**

The initial driving imperative behind Portland’s Green Street Program was stormwater management. Portland receives an average of 37 inches of rain a year, has many combined sewer overflows and experiences poor water quality in the receiving environment. These factors, combined with the fact that 66% of the City’s total stormwater runoff is collected from streets and rights of way, provided a sound rationale for the establishment of a green street approach (City of Portland 2006).

Portland’s stormwater program began in the early 1990s in response to the National Pollutant Discharge Elimination System. Early work included the development of a stormwater management plan, best management practices and policy and code statements (Water Environment Research Foundation 2014). In 2005, city staff began to explore options to improve implementation of green street elements as a component of street projects and to increase feasibility by identifying solutions to current implementation issues and challenges (City of Portland 2006).

The result of this work was the adoption of a green street policy in 2007. The policy requires all City of Portland development, redevelopment or enhancement projects to incorporate green street facilities. If a green street facility is not incorporated into an infrastructure project, or only partial management is achieved, then an off-site management fee will be required (City of Portland 2007a). Collectively, these policies ensure green street considerations will be a component of all major street redesign projects.

While a solid approach to green streets has been established, approaches continue to evolve based on learning from the design, construction and monitoring of
existing projects. New design approaches that work towards the achievement of the goals of neighborhood livability, sustainable development, increased green spaces, stormwater management, and groundwater protection are continually evolving. Through learning from pilot projects, standards and guidelines are regularly updated to include more progressive elements. An extensive monitoring program in place for over ten years has evaluated performance of green street facilities and provided valuable information to adapt approaches (City of Portland 2007b).

Design Elements

The goals of the Portland green street program largely shape the design elements, with specific elements varying depending on context. Building from the primary goal of stormwater management, vegetated facilities that handle stormwater on site are a core element of every green street. The goal of providing pedestrian and bicycle access through attractive streetscapes and urban greenways also impacts street design and often results in design elements such as street trees, street furniture and extensively landscaped areas.

A number of successful green street design variations exist with approaches adapted based upon specific site circumstances (City of Portland 2007b). As part of a process to determine design elements, a standard scope of work is used to assess green street projects. Key steps include: assessing the condition of existing infrastructure (streets, sidewalks, pipes, planting strips); assessing land use for existing and potential development; assessing hydrologic conditions and stormwater run-off characteristics based on storm events; and reviewing code requirements and site conditions to determine appropriate design specifications (City of Portland 2007b). These steps provide a clear indication of opportunities and constraints and inform the development of a design that will be suited to the context.

Standardized designs for green street facilities are being developed, and new and innovative types of green street facilities that best fit certain conditions (e.g., the amount of available right of way and the ability of the soil to infiltrate rainwater) are being tested. Currently, detailed planting guides are provided for a range of soil conditions, sun exposure and aesthetic considerations. Additionally, detailed specifications are provided
for street trees based on a range of conditions, including planting depths, soil volumes, plant species selection (with and without power lines), soil materials, and placement if sidewalk, trees, swales (Water Environment Research Foundation 2014).

Planning Considerations

The green street approach in Portland is very comprehensive and applied in a range of contexts. The overall philosophy and types of streets where projects have been implemented provide an extremely relevant comparison for Government Street. While environmental performance has been a fundamental component of green street projects in Portland, elements related to walkability, identity and livability are beginning to be integrated in a more meaningful way. Detailed case studies of SE Clay Green Street and SW Montgomery Green Street covered later in this section highlight specific measures taken to address these complementary elements of green street design.

The experience in Portland provides a variety of lessons that can assist in informing the development of a successful green street program. A key lesson noted by Portland staff was that the right of way is already within a city's authority, making projects like green streets easier to control and implement (Water Environment Research Foundation 2014). While the right of way is within their control, there are also challenges associated with accommodating an expanding range of objectives in this space. Accommodating vehicular circulation, parking, pedestrians, bicycles, transit, street trees, stormwater, utility locations, and livability amenities within a right of way often constrains possibilities and requires trade-offs (City of Portland 2006).

Portland has seen the value in starting small with demonstration projects. Implementing a few pilot projects allowed them to monitor the practices and modify the designs for improved function and effectiveness before implementing these more widely. These pilot projects have benefited from a multi-disciplinary approach that involves landscape architects, engineers, planners, reviewers, department heads, and watershed managers. Based on some of the pilot projects, the need for up-front technical guidance was identified as a key factor to speed up the design development, create more certainty and condense time frames (City of Portland 2006).
Another finding of Portland’s program is that when comprehensive, multi-objective planning is used, the costs to implement Green Streets can be reduced. Where stormwater facilities are required, designing and constructing Green Streets over traditional underground systems can be less costly or amount to only an incremental cost (City of Portland 2007). In some cases, the costs of materials and installation of green street features are marginally more expensive. These initial upfront higher costs will be largely offset over time by reduced long term maintenance costs, the reduced cost of additional infrastructure to handle stormwater and the reduced cost of compliance with stormwater and environmental regulatory requirements (City of Portland 2007).

While the Portland approach is firmly grounded in addressing acute problems related to the management of stormwater, an overall ethic of maximizing public value within street right of ways has enabled the program to become a key element in redefining the urban form of the City. Despite the successes achieved by the program, there are still advances that are yet to be achieved. For example, the majority of the green street projects have occurred in areas where traffic volumes are low and a relatively pleasant urban environment already exists. Tackling higher volume roads with significant traffic volumes would allow for the true transformation of urban environments and provide an opportunity to address the fundamental conditions of urban sustainability.

The Portland experience demonstrates the importance of piloting new approaches to better deliver services and optimize use of public spaces. In the initial stages the program had a relatively narrow focus on stormwater management, which limited the overall potential gains of projects. Through political commitment, a multi-disciplinary approach and a culture of learning, Portland has been able to evolve their green street program to better address a comprehensive range of sustainability objectives.
6.3. City of Seattle

Overview

A Green Street is defined by the City of Seattle (2014) as “a street right-of-way that, through a variety of design and operational treatments, gives priority to pedestrian circulation and open space over other transportation uses”. The purpose of a Green Street is to enhance and expand public open space, and to reinforce desired land use and transportation patterns. Seattle’s Green Streets Program was initially created in part due to recognition that land available for green spaces in downtown Seattle was minimal and that any land that was available was more expensive than the City could reasonably afford (Scheer 2004). Seattle has two types of green streets: Downtown Green Streets and Neighbourhood Green Streets.

The original designation and mapping of Green Streets occurred in the City of Seattle 1985 Land Use and Transportation Plan for Downtown Seattle. Subsequent neighbourhood plans identified additional green streets. Currently, 17 green streets are located in Downtown Seattle, with all allowing vehicular traffic. Additionally, 15 Neighbourhood Green Streets exist, with another 41 recommended in neighbourhood plans (City of Seattle 2014).

Downtown Green Streets are on select non-arterial downtown streets in residential or mixed-use areas and are designed to provide exceptional pedestrian environments and include wider sidewalks, street trees, landscaping, and appropriate street furniture emphasizing pedestrian movement (City of Seattle 2005). Landscaping, historic character elements, traffic calming, and other unique features distinguish Green Streets from other streets (City of Seattle 2014). A primary purpose identified for green streets relates to walkability, seeking to create a vibrant pedestrian environment and enhance pedestrian circulation. Another primary purpose is to add green space and livability features, including through maximizing opportunities for trees and other landscaping to create high quality open space in medium to high density residential areas. Other green street purposes include supporting economic activity in Downtown neighborhoods by creating an attractive and welcoming “front door” for pedestrians.
Neighborhood Green Streets are on non-arterial streets adjacent to residential and commercial land uses and have an emphasis on pedestrian amenities, street trees and landscaping. The purposes of Neighborhood Green Streets are different from Downtown Green Streets, as the lower traffic volume residential context enables the application of different design features. The creation of these streets is largely in response to a local community’s desire to target specific streetscapes for a pedestrian or open space enhancement.

In addition to projects directed at creating green streets, Seattle has also undertaken a number of projects which looked to incorporate green stormwater management infrastructure within the street right of ways. These projects are a component of a comprehensive green stormwater infrastructure program that looks to manage runoff using natural drainage systems. Green stormwater infrastructure is designed to mimic natural ecological function by cleaning, slowing, and/or reducing runoff close to where it falls as rain (Seattle Public Utilities 2013). Green stormwater infrastructure in Seattle is designed to ensure drainage systems can adapt to climate change, provide water system and community livability benefits (Figure 17).

Figure 17: Green Stormwater Infrastructure Benefits Identified by City of Seattle

![Figure 17: Green Stormwater Infrastructure Benefits Identified by City of Seattle](source: Seattle Public Utilities 2013)
A number of green stormwater infrastructure projects have been completed within City right of ways. An initial pilot project, Street Edge Alternatives (SEA Streets), was completed in 2001 and designed to provide drainage that more closely mimics the natural landscape prior to development. The retrofit of the right of way reduced impervious surfaces to 11 percent less than a traditional street, provided surface detention in swales, and added over 100 evergreen trees and 1100 shrubs. Monitoring has shown that the total volume of stormwater leaving the street has been reduced by 99 percent (Seattle Public Utilities 2014).

Most green stormwater infrastructure is focused in creek basins as a way to protect those waterways from the damaging effects of stormwater. These projects reduced negative impacts to the creeks by 74 to 99 percent. This was primarily achieved through narrowing streets and adding extensive vegetation and stormwater management facilities (See Figure 18). The landscape elements serve an important role in both providing an aesthetic benefit as well as contributing to the management of rainfall. Trees will help to restore more of the evaporation and transpiration that was present before development (Seattle Public Utilities 2014).

**Figure 18: Example of Street Edge Alternative Project in Seattle**

![Example of Street Edge Alternative Project in Seattle](source: Seattle Public Utilities 2014)
Green Street Program Structure

New green street designations are achieved through a land use ordinance. A number of criteria are established to help identify potential green street locations. Criteria include streets located in medium to high density areas with limited open space, streets within pedestrian-oriented commercial areas, streets at critical locations in redeveloping areas, streets that provide critical connections to neighbourhood destinations, streets that have a special character and streets that are within designated open space and are undeveloped (Scheer 2004).

In 2013, City Council passed a resolution stating that green stormwater infrastructure should be used to manage run-off wherever possible. To support this direction, a set of standard concept design and standards have been developed for residential streets (Seattle Public Utilities 2013). This new direction may represent an opportunity to bridge the more pedestrian and public space oriented green streets program, with the environmental focus of green stormwater infrastructure projects to create a more comprehensive approach to green streets.

Design Elements

Four key design principles are identified for green street projects in Seattle. The first principle is to emphasize pedestrians and open space over other street functions. This is based on the idea that streets should be gathering places and pedestrian corridors. The second principle is that design should complement and enhance adjacent land uses. The third principle is to keep traffic speeds and volumes low. This principle corresponds to the Seattle approach of designating non-arterial streets that don’t serve a primary traffic carrying role. The fourth principle is to respond to site specific conditions. This is related to the idea that green streets are conceived under a unified design concept that reflects the unique character of the site and is applied at every block.

In the City of Seattle (2014) Right of Way Improvement Manual, a number of design features are identified for both Downtown Green Streets and Neighbourhood Green Streets. For the purposes of this study, only the Downtown Green Street design features are included as they are more directly comparable to Government Street. Table 7
identifies the range of design features on a Downtown Green Street. Elements that improve the quality of the pedestrian environment, such as wide sidewalks and planting strips, street trees, pedestrian scaled lighting, and weather protection are emphasized in this design framework.

**Table 7: Downtown Seattle Green Streets Design Features**

<table>
<thead>
<tr>
<th>Street Design Feature</th>
<th>Character</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roadway Section</td>
<td>1-3 travel lanes</td>
</tr>
<tr>
<td>Curb bulbs</td>
<td>Use in combination with on-street parking to support pedestrian activity at corners, shorten crossing distances and slow speeds for turning vehicles.</td>
</tr>
<tr>
<td>Bus bulbs</td>
<td>Appropriate in locations with high transit ridership. Impacts to on-street parking should be considered.</td>
</tr>
<tr>
<td>On-street parking</td>
<td>On-street parking may be appropriate to support short-term customer access, but should be limited to allow for pedestrian facilities.</td>
</tr>
<tr>
<td>Bicycle routes</td>
<td>Bicycles share the road with motor vehicles on these slow speed, non-arterial streets.</td>
</tr>
<tr>
<td>Sidewalks</td>
<td>Wide sidewalks support pedestrian activity and are a high priority.</td>
</tr>
<tr>
<td>Street trees and landscaping</td>
<td>Wide planting strip or double rows of street trees with mature street trees and landscaping enhance the street for pedestrians, while maintaining adequate and comfortable sidewalk width.</td>
</tr>
<tr>
<td>Pedestrian scaled lighting</td>
<td>Pedestrian scaled lighting that lights the sidewalk and provides a consistent vertical design element to the streetscape.</td>
</tr>
<tr>
<td>Street furniture</td>
<td>Benches, bus shelters, bicycle parking and signs and maps (wayfinding) are all encouraged to support pedestrian activity and comfort. Consistent design among street furniture elements can enhance the streetscape and should be considered.</td>
</tr>
<tr>
<td>Driveways</td>
<td>Driveways that cross the sidewalk are not encouraged.</td>
</tr>
<tr>
<td>Awnings or other weather protection</td>
<td>Appropriate in locations where adjacent land uses support high pedestrian volumes, including transit zones.</td>
</tr>
</tbody>
</table>

Source: City of Seattle 2014
Planning Considerations

The application of green street practice in Seattle is based on a clear division between those streets that are focused on environmental performance (stormwater) and those that seek to integrate green elements to reinforce walkability, identity and livability. While there is some cross-over between these two streams of street design, the outcomes largely respond to the primary objectives. Recent political direction to use a broad-based green approach to stormwater management may lead to a green street approach that is more consistent with the framework outlined in the Government Street Study.

Green streets in Seattle have been implemented for decades and have produced a large number of completed projects. This has enabled the observation of challenges to implementation. Scheer (2004) notes that initial implementation of green streets was impacted by transportation officials who were resistant to major changes to streets due to potential traffic flow impacts. Additionally, he notes that adding trees to streetscapes has encountered substantial resistance from utilities, as trees present logistical challenges. Also, the implementation of pervious streets has met resistance, due to concern about durability and maintenance costs (Scheer 2004).

While many of the green stormwater infrastructure projects demonstrate the application of a wide range of innovative approaches, their application in lower density residential areas with limited conventional infrastructure does not provide relevant context to compare to Government Street. Government Street’s heavily urbanized setting which will continue to have infrastructure, traffic and land use demands restricts the application of a narrowly focused approach only looking at green stormwater management. However, the range of benefits associated with these projects (Figure 17) reinforces the range of outcomes that can be achieved through the application of a green infrastructure approach.

While the green street and green stormwater infrastructure approaches in Seattle have yielded impressive examples of innovative stormwater management, their applicability for comparison with Government Street is limited. The lack of an approach that comprehensively addresses the four key themes of the study’s analytical framework (environmental performance, walkability, identity and livability) and the limited application to arterial streets results in no specific streets where a direct comparison can be made.
6.4. Case Study Green Streets

6.4.1. Rationale for Selection

Two green street projects in Portland, Oregon have been chosen for comparison with Government Street. Green street projects in Portland represent an appropriate comparator, as the City has numerous projects that have been developed in similar urban contexts to Government Street that have addressed a comprehensive range of considerations.

Southwest Montgomery Green Street was selected as it is recognized as the boldest green street project in Portland for its broad focus on alternative transportation, stormwater management, placemaking and land use relationships. The project is award-winning, having received recognition from the American Society of Landscape Architects. This project has utilized innovative approaches and adopted an aggressive approach to stormwater management. Southeast Clay Street was chosen as an additional comparison, as it as an urban street that runs through an industrial / commercial area, which is a very similar context to the Government Street study area.

6.4.2. Southwest Montgomery Green Street – Portland, Oregon

SW Montgomery Green Street is identified on the City’s website as the boldest green street project to date in Portland. A primary objective of the project was to demonstrate how in even the most urban conditions, downtown streets can be vibrant pedestrian spaces that fully manage stormwater runoff. This project is seen as way to connect neighbourhoods to the city centre and activate an emerging neighbourhood. The project was a collaborative effort that drew on stakeholders with a range of expertise and capacity to implement. Key partners involved in the project were the Portland Development Commission (PDC), Bureau of Environmental Services (BES) Portland State University (PSU), and Gerding Edlen Development, Inc (Nevue Ngan Associates 2009). Figure 19 shows an example of a pedestrianized section of SW Montgomery Green Street with stormwater planters.
The project has a number of goals related to both citywide and neighbourhood revitalization objectives. At a citywide level, a key goal is to enhance Portland’s reputation as an incubator for innovative sustainable design. Additionally, the green street represents an opportunity to develop a model for incorporating sustainable stormwater management approaches in a manner that fosters a vibrant urban environment. The street improvements will also foster connections among amenities, to the university and between the Willamette River and the West Hills (Nevue Ngan Associates 2009).

At the neighbourhood level, SW Montgomery Green Street is seen as a key catalyst to the development of an eco-district. The green street is intended to activate the neighbourhood, enhance the pedestrian experience, foster sustainability, and continue to build a community culture. The introduction of a landscaped stormwater planter that acts as a “stormwater spine” will serve as a common identifiable feature that will be repeated through every block of the study area (Figure 20). The overall design includes curbless streets with one lane of traffic, one lane of parking and wider sidewalks supported by active retail provides conditions that supports a neighbourhood high street.
The project provides an excellent comparable to help inform the development of an approach on Government Street. The four key elements of the green street analytical framework (environmental performance, walkability, identity and livability) are comprehensively addressed in the design of SW Montgomery Green Street. The following text explores how each of the analytical framework elements are addressed.

**Environmental Performance**

From an environmental performance perspective, the primary focus of the SW Montgomery Green Street is innovative stormwater management. A central element of this focus is extensive urban rain gardens that also serve the street as a placemaking amenity. The stormwater facilities incorporate seating and bridges for pedestrians and beautify the street with extensive planting, unique water features and interesting materials for dams, bridges and grates.
Within the street right of way stormwater enters into planters and is infiltrated into 36" of growing medium before being disposed through infiltration at the bottom of the planter. At many locations there exists additional capacity to treat stormwater from adjacent streets or private sites. Design work has been completed for each block of study area that identifies stormwater catchment areas, planter sizes, general sizing criteria (based on 10-year storm event), and whether the green street elements have additional capacity to accept stormwater from future redevelopment activity (Nevue Ngan Associates 2009). In general, full stormwater infiltration within the project site has been achieved through dedicating 11% of the right of way to stormwater management. While all blocks still serve as transportation corridors, the degree of stormwater management varies depending on the characteristics of each block including the amount of right of way space dedicated to vehicles.

Planted areas along the SW Montgomery Green Street occur within stormwater planters or in tree wells along the roadway. Native trees and plant species are used extensively to help attract native wildlife and provide a connection to larger native ecosystems. The urban forest provides a range of benefits, including trees shading the street and buildings and native plants supporting bio-retention and habitat value. An important stormwater reduction strategy is “interception”: the ability of plants to capture and hold rainfall before it hits the ground surface. Native conifers are used in this project, as their large size and fine texture are highly effective in intercepting stormwater (Nevue Ngan Associates 2009).

Structural soil is used as a technique to improve environmental performance in an urban context. Structural soil is a designed medium which can meet or exceed pavement requirements while remaining root penetrable and supportive of tree growth (Grabosky and Bassuk 1995). In the Southwest Montgomery context structural soil cells have been integrated to support driving and parking while also providing a large volume of uncompacted soil for growing trees and detaining stormwater. Soil cells are placed under sidewalks and parking zones to treat large quantities of stormwater and nurture a healthy urban forest (Nevue Ngan Associates 2009).
Walkability

The overall design of the green street has a distinct emphasis on pedestrian spaces. The starting point for implementation was a low traffic route with distinct features and amenities. Therefore, pedestrian improvements largely focused on further enhancing this already excellent route. The curbless street creates a soft transition between pedestrian and vehicle spaces and effectively acts to calm traffic in the area. Bike racks and bike parking areas reinforce the pedestrian realm and bike use of the corridor and diminish the dominance of motor vehicles. Generous pedestrian spaces supported by active retail allow pedestrians to move through café tables, benches and planters. Bridges across stormwater planters provide frequent opportunities for people to cross (Nevue Ngan Associates 2009).

A key element of the street is its flexibility to expand as a pedestrian space. The curbless streets can be transitioned to a pedestrian-only condition that supports special events by providing a seamless transition between sidewalk and road areas. Bollards define the driving and parking surface and allow pedestrians to cross mid-block or bikes to pull off and park easily. Additionally, the parking zone is designed to incorporate moveable furnishings to create a new place for cafe seating, further animating and expanding the pedestrian environment.

Identity

The Southwest Montgomery Green Street seeks to incorporate unique elements that provide an identity for the street and overall area, while also reflecting the unique context of each block. Water is the integrating theme and is reflected as a recurring physical element that is brought to the surface. A string of existing fountains along the street help create an identity for the entire district and provide active water nodes and elements for people to gather around and enjoy. The stormwater spine introduced as part of the green street redesign connects these nodes of water and conveys stormwater. During intense rain events the stormwater spine is fully activated, providing a connection to nature and natural processes to users of the street. Native plant species further reinforce this connection to nature by providing a strong connection to the overall bio-region and native ecosystems (Nevue Ngan Associates 2009).
Certain design elements also help to unify the blocks into a legible corridor. The stormwater spine is the primary feature that accomplishes this, but paving material also reinforces the street’s identity. The pavement colour and texture act as a wayfinding tool for pedestrians and cyclists. Some paving elements repeat along the entire corridor to create the feel of an interconnected pedestrian streetscape. Additionally, a family of materials and furnishings create a distinct sense of place.

The overall design embraces the diversity of each block and allows for elements that reflect the specific context. Public art, interpretative signage, and entry features are examples of the types of features that highlight a particular block. Design elements are repeated within stormwater planters to create a theme and provide an identifiable element that is common through each each block in the study area (Nevue Ngan Associates 2009).

Livability

The quality of the pedestrian environment and public spaces is a primary concern of the green street design. The street’s range of conditions, including many pedestrian-only sections truly provides an environment where cars do not dominate. Additionally, the diversity and range of adjacent land uses provides for an interesting urban fabric for pedestrians.

A number of existing assets in the form of public spaces and landmarks are enhanced, with a focus on improving the quality, size and connectivity of these spaces. Rather than prescribe one design solution for all the blocks, the Green Street design responds to and enhances the places that already exist. The enlargement and enhancement of pedestrian spaces is achieved through the addition of permanent elements like the curbless streets and a continuous stormwater spine, and flexible elements such as movable street furnishings and planters that help to animate the area and provide flexibility to adapt to a range of circumstances.

6.4.3. Southeast Clay Green Street – Portland, Oregon

The Southeast Clay Green Street project is 12 blocks in length and runs through the Central Eastside Industrial District. The Central Industrial District is a key employment
centre in Portland and has been the focus of significant urban renewal efforts (City of Portland 2009). SE Clay Green Street is a 2 lane road with parking and sidewalks on both sides of the street. The overall right of way width is 60 feet. The project area stretches from the Willamette River at the west to established residential neighbourhoods to the east. Providing a safe bicycle and pedestrian connection from residential neighbourhoods to the river is seen as a key objective of the project, hence the Route to the River project brand.

Overall the improvements in the corridor are designed to manage stormwater, enhance east/west pedestrian and bicycle connections, and increase the urban street tree canopy while maintaining the business and freight needs of the industrial district. The proposed improvements will add 23 new green street facilities to manage run-off from approximately 2 acres of roadway, 96 new street trees, public art, and innovative bike striping (City of Portland 2009). Figure 21 shows an image of SE Clay Green Street where enhancements have been implemented.

**Figure 21: Southeast Clay Green Street**

The study area presents significant challenges for green street implementation, as it is within an active industrial area that has truck and rail traffic. From a functional perspective, the maintenance of business use and freight needs and minimization of parking loss are key elements needed to maintain the financial viability of the industrial
district. This provides an excellent comparable to Government Street, due to the similar land use context. The SE Clay Green Street project works within this context and produces a design that improves the environmental performance, walkability, identity and livability of the area.

**Environmental Performance**

The SE Clay Green Street project will dramatically enhance stormwater management in this area. The project involves the construction of 21 green street facilities, mostly vegetated curb extensions and parking strip planters to manage stormwater. The new green streets will remove an average of 1.6-million gallons of stormwater runoff annually from the combined sewer system (City of Portland 2013). The addition of street trees is also seen as a key mechanism to improve storm water and environmental quality in the area. By adding 96 street trees, impervious surfaces like asphalt and concrete can be removed, reducing run-off and providing a variety of other benefits.

The SE Clay Green Street project is supported by a number of complementary initiatives that enhance the overall environmental performance of the area. Portland Community College’s central campus, which is directly adjacent to SE Clay Street, has implemented an interpretive stormwater education plaza. The plaza showcases stormwater management technologies and provides public information about green streets and stormwater management. Additionally, an existing building in the study area implemented improvements that collect stormwater runoff from the building’s roof, parking lot and adjacent roadway and treats it in vegetated stormwater planters and swales (City of Portland 2009).
Walkability

The proposed green street enhancements will improve safety for pedestrians, as well as improve aesthetics. Freight trucks and railroad cars that frequently deliver goods to the study area dominate the existing street network and create challenges for pedestrians. The Route to the River concept implements physical changes that will achieve a high quality pedestrian route through the area.

Current routes through the industrial district and to the river are significantly impacted by vehicle traffic and sub-standard infrastructure. Improved walkability conditions are achieved in this project by upgrading sidewalks, adding curb ramps, crosswalks, and directional signage. A number of curb extensions have been added that shorten crossing distances and improve pedestrian visibility. Benches have been added to provide resting spots and support businesses. From a cycling perspective, bike markings on the pavement have been added to indicate proper positioning of cyclists in a shared lane.

Identity

Creating an identity that provides interest for pedestrians and highlights the industrial character of the area is a key focus of this project. A key element of identity is the use of materials, forms, and signage that reflect the area’s industrial identity. Wider 12 inch curbs that use a railroad rail reflect the industrial identity of the area and allow for passage of run-off into stormwater facility. Where possible, the use of recycled materials, or pre-cast elements that already exist in the industrial marketplace, will be used to reflect the neighborhood’s industrial character (City of Portland 2009).

A combination of art and design establishes the Route to the River and creates continuity. A six-foot steel sculpture titled “Eye River” has been developed as a centrepiece of the street (Figure 22). The sculpture was inspired by the six-inch steel spikes, known as log dogs, once used to tie log rafts. In the early 20th century, one of Oregon’s largest sawmills operated near the study area and processed logs that arrived floating on the Willamette River tied together in huge rafts. Two more sculptures will be installed along SE Clay Street in stormwater facilities, thereby providing art at each end
and the centre of the Green Street (City of Portland 2013). The log dogs give direction while referencing water, flow and the district’s history (City of Portland 2010).

**Figure 22: Public Art on SE Clay Green Street**

![Public Art on SE Clay Green Street](image)

*Note. Photo C. Scott, 2014*

**Livability**

The improvement of livability along the street centres on improving the safety of walkers and cyclists and building a connection to the industrial lineage of the area. Sidewalks that are separated from traffic, bike markings and green elements all serve to highlight the street as a location for multiple modes and activities. The addition of street trees in particular was seen as a critical element to improve livability, as they provide psychological and visual comfort.

Through adding points of interest that highlight the historic significance of the area, a more engaging public realm is created and social activity will be encouraged. To celebrate movement along the streetscape, signage along the route will describe various facts about movement of goods and people throughout Portland. Metal grate benches and seats, and historic railroad ties will be installed in some of the vegetated curb extensions (City of Portland 2013).
6.4.4. Planning Considerations

Each of the case study streets provide a range of lessons learned that can be used to inform the design of Government Street. Southwest Montgomery Street is significant, as it includes leading edge street design elements that reflect potential aspirations for green street projects. SE Clay Street also provides a useful comparison as it works within a land use and mobility context that constrains design possibilities. It could be argued that each of the green street projects did not change the fundamental character of the street, but rather integrated greener elements within the overall context. In contrast, this study looks to identify measures that would fundamentally redefine the role and identity of Government Street.

The comparison of each street to Government Street needs to take into account the range of street characteristics. Specifically, Government Street has a wider right of way and serves a more significant role in carrying traffic. Table 8 identifies some of the key characteristics of each green street (Government Street and two case studies).
Table 8: Comparison of Case Study Streets and Government Street

<table>
<thead>
<tr>
<th></th>
<th>Government Street</th>
<th>SE Clay Street</th>
<th>Southwest Montgomery Street</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Number of blocks</strong></td>
<td>5 blocks</td>
<td>12 blocks</td>
<td>9 blocks</td>
</tr>
<tr>
<td><strong>Typical Right of way width</strong></td>
<td>27.4 metres</td>
<td>60’ (18 metres)</td>
<td>Variable (approx. 18 metres in vehicle areas)</td>
</tr>
<tr>
<td><strong>Land Use Context</strong></td>
<td>Industrial / Commercial</td>
<td>Industrial</td>
<td>Commercial / Residential / Institutional</td>
</tr>
</tbody>
</table>
| **Primary Purpose of Green Street Project** | - Create identity for future eco-district  
- Enhance conditions for walking and cycling  
- Improve environmental performance  
- Add green space  
- Improve livability | - Connect neighbourhoods to Willamette River  
- Provide link to industrial heritage  
- Strengthen employment centre  
- Improve walking and cycling  
- Stormwater Management | - Activate neighbourhood and eco-district  
- Develop Pedestrian high street  
- Demonstrate Innovative stormwater management  
- Connect areas of the city |
| **Theme**                      |                   | Route to the River | Water |
| **Typical cross section**      | 4 travel lanes and 2 parking lanes | 2 travel lanes, 2 parking lanes | Range of conditions from no car traffic to 1 traffic lane and 1 parking lane |

A common theme of both case study projects is an advanced approach to stormwater management. Portland’s well developed green street program is reflected in the detailed analysis of stormwater performance in each site. A key factor in achieving this performance was securing adequate right of way space for stormwater facilities to enable infiltration and retention. In the SW Montgomery context, full stormwater within the project site was generally achieved through dedicating 11% of the right of way to stormwater management. This additional right of way space dedicated to stormwater management also enabled the addition of street trees and planted areas.
Another commonality of both projects was their prominence in providing an identity to the broader neighbourhood where they existed. In the SW Montgomery Street context, the green street and stormwater spine were key representations of an emerging eco-district and innovative environmental practice. In the case of SE Clay Street, public art, pedestrian improvements and reflections of industrial heritage were seen as key tools to help foster economic development and build connections to other parts of the city.

Both streets demonstrated the value in having a flexible design approach to help foster outcomes that reflect an area and also work towards broader citywide goals. The more aggressive pedestrianization approaches used in SW Montgomery Street, such as curbless streets, were well suited to a low traffic volume, medium density district. Conversely, the more conservative interventions on SE Clay Street still yielded outcomes that maintained the functionality of the area for businesses. Both case studies provide insights that will help to inform the design of Government Street and the redesign of the broader study area.
7. Approaches for Converting Government Street to a Green Street

7.1. Objectives for Government Green Street

The purpose of this portion of the study is to synthesize theoretical research, policy analysis, physical assessments and case study findings into a design concept that achieves green street elements on Government Street in a manner that responds to the context and realities of the study area. A green street analytical framework (Table 1) is established in the initial sections of this study. This framework helps to define a green street and serves as a tool to help evaluate current policy and practice in the City of Victoria and learn from green street approaches in Seattle and Portland.

The analytical framework serves as a useful tool to help broadly evaluate green street projects, however, a more contextual set of goals is established to help to develop an appropriate Government Street design. As noted in the case studies, design approaches used in green street projects are highly context dependent. Table 9 shows the Government Green Street objectives and indicates the relationship with the green street analytical framework. The objectives comprehensively address the core green street concepts, but also identify more specific objectives that are priorities in the Government Street context.

An additional important consideration for establishing the Government Green Street objectives is existing and future land use conditions. Based on the vision and policies in the City of Victoria OCP, the area surrounding the study area is anticipated to undergo comprehensive redevelopment and intensification based on a green infrastructure approach. While the uses (industrial, commercial) will largely be maintained, it is anticipated that the building stock will be renewed in a way that could complement and support the implementation of a green street and the development of district-scale environmental innovations.
<table>
<thead>
<tr>
<th>Objective</th>
<th>Environmental Performance</th>
<th>Walkability</th>
<th>Identity</th>
<th>Livability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Redefine the role of Government Street as a multi-modal street</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Create a linear “park-like” space and amenity to elevate and</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>improve the attractiveness of the Rock Bay District</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Create an exceptional pedestrian environment and public realm</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Retain and reinforce role of industrial and commercial land uses</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Significantly Increase the Urban Forest and Landscaped Areas</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Manage stormwater within the right of way</td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
</tr>
</tbody>
</table>

In the development of a design concept, the Government Green Street objectives contained in Table 9 guide the identification of components. In order to accurately assess possibilities, the critical question of whether vehicle lanes can be removed from the right of way is first addressed. This analysis helps to frame the development of the design concept and the subsequent discussion that explores the achievement of each of the objectives. To conclude the discussion and project, implications for green street research are identified and recommendations for implementation of a green streets approach in Victoria are identified.

### 7.2. Analysis of Vehicle Capacity Reduction on Government Street

A critical component of exploring options for the Government Street redesign is assessing the potential for right of way space to be converted from vehicle travel space to landscape, pedestrian realm or cycling space. Currently, Government Street has four travel lanes throughout the study area and parking on both sides for the majority of the corridor. The street’s primary roles are to convey traffic to and from the Downtown Core.
and provide convenient access to businesses. Figure 6 shows a typical existing cross section of Government Street.

The assessment of vehicle capacity reductions on Government Street involves consideration of existing traffic volumes and the role and function of the broader street network. To understand potential implications of lane reductions on Government Street, it is important to look at parallel north-south streets in the Downtown Core Area. Douglas Street and Blanshard Street are the two parallel major streets to the east of Government Street and play a key role in facilitating inter-municipal travel. Both streets are arterial roads and are designated to carry 18,000 + vehicles a day. Government Street is designated as a secondary arterial that is to carry 5,000 – 20,000 vehicles a day (City of Victoria 2014b).

The role of each street in a multi-modal network is further defined through policy designations. Douglas Street is designated as a future Regional Rapid Transit Route and currently functions as the main transit spine in the region. Blanshard Street has a limited transit role and primarily carries private motor vehicles. Government Street is designated as a Greenway and Bikeway and is intended to play a role as an important cycling and pedestrian corridor. Additionally, the southern portion of Government Street in the Downtown Core is a pedestrian priority street with an expansive pedestrian realm and limited one-way traffic flow. Figure 23 shows the future role, and to some degree the existing role, of each of the three main streets.
Figure 23: Policy Focus of Major North-South Downtown Arterial Street

Through examining traffic volume data, the impacts of reducing vehicle travel space on Government Street can be assessed. Available traffic data is relatively limited for each of the major roads, with 24 hour traffic counts available east of Bay Street (entry point to Downtown Core Area) and North of Pandora Street (the heart of the Downtown Core Area). With respect to the Government Street study area, these counts are at the northern end of the study area and two blocks from the southern boundary of the study area. Figure 24 shows the most recent 24 hour traffic data on each of the major north-south streets.
Only two data points exist for Government Street in the study area. These counts, south of Bay Street, are a 24-hour count from 1989 and a week’s worth of 24-hour count data from November 2010. Adverse weather conditions, including snow were noted at the time of the 2010 counts and may have impacted their accuracy. More data points exist for Douglas Street and Blanshard Street and generally indicate a downward trend in vehicle volumes entering the Downtown Core Area. Figure 25 shows traffic count data and overall trends for each of the three major north-south streets at the entry point to the Downtown Core.
If the Government Street traffic volume data is accurate, it highlights the need for design responses that align its function more closely with aspirations expressed in policy and street designations. Douglas Street and Blanshard Street are both designated as arterial streets and designed to carry higher traffic volumes than Government Street, which is designated as a secondary arterial street (maximum of 20,000 vehicles a day). Additionally, Government Street’s greenway designation directs the street to be a priority street for pedestrians and cyclists, which is challenging in a high volume traffic environment. Further, the Downtown Core Area Plan suggests the extension of a pedestrian priority treatment into the southern part of the study area (City of Victoria 2011). The extension is intended to encompass the two southern blocks of the Green Street study area and would effectively create a pedestrian priority treatment in all but four blocks of Government Street in the Downtown Core Area, limiting its appeal for general purpose traffic.

The removal of vehicle lanes on Government Street would restrict traffic capacity and impact overall vehicle volumes by decreasing the level of service on Government Street and increasing the relative attractiveness of parallel routes. This would help to reduce the existing volumes of close to 30,000 vehicles a day to the desired 5,000 to
20,000 vehicles a day identified by the secondary arterial classification. Also, as noted in Table 10, parallel streets have historically accommodated greater traffic volumes.

### Table 10: Traffic Volumes on Major North-South Downtown Core Area Streets

<table>
<thead>
<tr>
<th>Location</th>
<th>Year</th>
<th>Year</th>
<th>Year</th>
<th>Year</th>
<th>Change from initial count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Government Street</td>
<td>18,210</td>
<td></td>
<td>23,818</td>
<td></td>
<td>29,818</td>
</tr>
<tr>
<td>Douglas Street</td>
<td>23,808</td>
<td>23,500</td>
<td></td>
<td>22,600</td>
<td></td>
</tr>
<tr>
<td>Blanshard Street</td>
<td>39,016</td>
<td>35,800</td>
<td></td>
<td>37,000</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Location</th>
<th>Year</th>
<th>Year</th>
<th>Year</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Government Street</td>
<td></td>
<td></td>
<td></td>
<td>9,000</td>
</tr>
<tr>
<td>Douglas Street</td>
<td>29,540</td>
<td></td>
<td>22,500</td>
<td>21,200</td>
</tr>
<tr>
<td>Blanshard Street</td>
<td>37,280</td>
<td></td>
<td>28,700</td>
<td>24,500</td>
</tr>
</tbody>
</table>

Source: Capital Regional District 2014a and City of Victoria 2014c

A final consideration for the reallocation of road space relates to the provision of parking. Currently, approximately 80% of the study area has on-street parking on Government Street. This parking is an asset for existing street-oriented businesses, providing a buffer from traffic and helping to animate the street. A possible approach for on-street parking is to restrict parking at certain times of the day when traffic volumes are highest (typically 7-9am and/or 3-6pm). This provides a parking a resource for the majority of the day, but also accommodates traffic flows at the highest volume times. Figure 26 shows that southbound traffic volumes are relatively consistent on Government Street throughout the day, while northbound volumes experience a pronounced increase in the afternoon (1-5 pm). This would suggest the possibility of restricting parking on the eastside of the street in the afternoon rush hour period as one measure to reduce overall traffic flow impacts.
The development of a green street concept on Government Street hinges on the reallocation of right of way space from vehicle traffic to walking, cycling, and landscape spaces. The reduction of traffic capacity will have significant impacts for the overall vehicle flows in the street network. However, three key factors mitigate the potential impacts. Firstly, Douglas Street and Blanshard Street provide viable alternatives to absorb additional traffic volumes on routes that are intended to be primary traffic carrying streets. Secondly, Government Street is not a street that carries transit vehicles and therefore changes would not have impacts on transit viability. Lastly, overall trends indicate a reduction vehicle volumes entering Downtown Victoria on major routes. The re-allocation of space on Government Street would allow for the implementation of walking and cycling infrastructure that would help to further support these trends towards increased mode shares for walking, cycling and transit.

Source: Capital Regional District 2014a
7.3. Design Concept for Government Green Street

The development of a design concept for Government Street draws on earlier parts of this study to develop an approach that translates to the specific conditions of Government Street. The analysis and discussion highlight the green street objectives and key trade-offs that were made to determine the proposed approach. Potential courses of action are assessed through the lens of Government Green Street objectives that are established at the beginning of this section.

The proposed design looks to dramatically change the form and function of Government Street. It responds to the land use context and attempts to create a distinctive identity for the area. Figure 27 illustrates some of the overall design features and concepts. Figure 28 illustrates the proposed cross sections for the study area, with Table 11 indicates general cross-section dimensions for north and south segments.
Figure 27: Overview of Features of Government Green Street Design Concept

Source: VicMap, City of Victoria (2014a), modified by C. Scott
Figure 28: Typical Government Street Right of Way with New Design Concept

Table 11: Proposed Right of Way Dimensions for Design Concept

<table>
<thead>
<tr>
<th>South End (Chatham St.-Pembroke St.)</th>
<th>width (m)</th>
<th>North End (Pembroke St.-Bay St.)</th>
<th>width (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>W/S</td>
<td></td>
<td>W/S</td>
<td></td>
</tr>
<tr>
<td>Sidewalk</td>
<td>2.5</td>
<td>Sidewalk</td>
<td>2.5</td>
</tr>
<tr>
<td>Boulevard</td>
<td>3</td>
<td>Boulevard</td>
<td>2.75</td>
</tr>
<tr>
<td>Cycle Track</td>
<td>2</td>
<td>Cycle Track</td>
<td>2</td>
</tr>
<tr>
<td>Planter</td>
<td>0.5</td>
<td>Planter</td>
<td>0.5</td>
</tr>
<tr>
<td>Travel Lane</td>
<td>3</td>
<td>Travel Lane</td>
<td>3</td>
</tr>
<tr>
<td>Planted Median</td>
<td>3</td>
<td>Median / Turn lanes</td>
<td>3</td>
</tr>
<tr>
<td>Travel Lane</td>
<td>3</td>
<td>Travel Lane</td>
<td>3</td>
</tr>
<tr>
<td>E/S</td>
<td></td>
<td>E/S</td>
<td></td>
</tr>
<tr>
<td>Parking</td>
<td>2.5</td>
<td>Travel / Parking Lane</td>
<td>3</td>
</tr>
<tr>
<td>Planter</td>
<td>0.5</td>
<td>Planter</td>
<td>0.5</td>
</tr>
<tr>
<td>Cycle Track</td>
<td>2</td>
<td>Cycle Track</td>
<td>2</td>
</tr>
<tr>
<td>Boulevard</td>
<td>3</td>
<td>Boulevard</td>
<td>2.75</td>
</tr>
<tr>
<td>Sidewalk</td>
<td>2.5</td>
<td>Sidewalk</td>
<td>2.5</td>
</tr>
<tr>
<td>Total</td>
<td>27.5</td>
<td>Total</td>
<td>27.5</td>
</tr>
</tbody>
</table>
The proposed design concept differs slightly for the southern two blocks and the northern four blocks of the study area. This variation is in response to the different land use conditions. The southern two blocks are predominantly comprised of commercial establishments which are set close to the street creating a pedestrian-oriented feel. The northern four blocks contain active industrial uses, which are typically less street-oriented and place a premium on vehicle access and movement. This distinction between the two areas is reflected in the design by the retention of left turn bays and the ability to have an additional eastbound vehicle lane in the PM peak in the northern portion of the study area.

Key features of the design concept include a landscaped median, gateway elements at either end of the study area, pocket parks and the creation of a fully separated cycle track. The landscaped median was selected as opposed to creating wider landscaped boulevard areas, as it provides an opportunity to create a distinct design feature that is unique from other parts of Government Street. Additionally, the median provides space for landscaping and stormwater management and creates an opportunity for an almost continuous canopy cover when combined with street trees on the boulevard. A continuous median throughout the study area is not part of the design concept, as left turn bays are retained where they currently exist to enable circulation and access for current businesses in industrial areas.

The identity of the area is not only enhanced by the addition of a landscaped median, but also gateway features and potential future connections to the shores of Rock Bay. Locations for gateway features exist at each end of the study area and provide opportunities for public art or other features that create a sense of entry into the area. Pocket parks provide an opportunity to locate recurring elements that highlight this identity. A unique opportunity exists to create a water feature that links Rock Bay to Government Street. Rock Bay was originally located adjacent to Government Street before it was filled to expand the land area (D’Ambrosio Architecture + Urbanism 2011). An opportunity exists to re-establish this connection perhaps through a storm water feature or extensive native plantings.

The separated cycle track is a high quality facility that creates additional buffer space for the pedestrian realm. Boulevard areas allow for planting of canopy trees and
and installation of green stormwater infrastructure, while sidewalk spaces are significantly separated from traffic and are supported by substantial boulevard plantings and new pocket parks.

The design concept provides critical foundational elements that are required to transform Government Street into a green street. Much of the detailed work, including the selection of tree and understory planting species, the design of gateway elements, and the selection of pavement treatments and street furniture will truly give meaning to the high level design directions. Additionally, land use changes and new development which adopts a similar green ethos could help to amplify the Government Street design interventions and create an identity for the Rock Bay District.

7.4. Discussion and Analysis

The purpose of this section is to explore and discuss how well the proposed design approach fulfills the context-specific Government Green Street objectives. For each of the objectives, a brief overview of relevant research findings is provided before discussing how the design addresses the objectives. Additionally, performance measures that were identified as part of the analytical framework are used to provide a high level comparison between existing conditions and the proposed design concept.

Green Street Performance Measures

The analytical framework identifies a number of performance measures that could be used to assess how well a green street addresses the areas of environmental performance, walkability, identity and livability. Table 12 provides a summary of how all performance measures (qualitative and quantitative) are addressed in the design concept. Table 13 provides estimates of performance of quantitative measures in design concept, when compared with the existing situation on Government Street.
Table 12: Assessment of Performance Measures in Design Concept

<table>
<thead>
<tr>
<th>Performance Measure</th>
<th>Related Analytical Framework Concepts</th>
<th>Description of Design Concept Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Permeability</td>
<td>Environmental Performance</td>
<td>Through reducing travel lanes, more space is available for permeable landscape areas in boulevards and median.</td>
</tr>
<tr>
<td>Tree canopy cover</td>
<td>Environmental Performance Livability</td>
<td>The expansion of boulevard areas and introduction of a median allows adequate soil volumes to produce street trees with a significant canopy. Soil cells under cycle tracks and sidewalks allow for the further space for tree roots. Over time, median trees could combine with boulevard trees to create a near continuous canopy.</td>
</tr>
<tr>
<td>% green space, Greenness appearance (qualitative)</td>
<td>Environmental Performance Identity Walkability</td>
<td>Five bands of green space are introduced to produce a strong “green” visual identity. These include a median and boulevards and planters on each side of the street.</td>
</tr>
<tr>
<td>% stormwater treated within right of way</td>
<td>Environmental Performance</td>
<td>Landscape areas added in median and boulevard areas provide in excess of the 10-15% total right of way area identified in the literature as required for comprehensive stormwater management.</td>
</tr>
<tr>
<td>% of right of way dedicated to pedestrian realm</td>
<td>Walkability Identity Livability</td>
<td>Sidewalks areas have been expanded with additional space provided for pedestrian amenities such as benches available in boulevard areas and pocket parks.</td>
</tr>
<tr>
<td>Separation of sidewalks from traffic</td>
<td>Walkability Livability</td>
<td>Sidewalks are not only separated further from traffic in the design concept, but nature of separation will be improved through more intensive landscaping.</td>
</tr>
<tr>
<td>Quality of walking environment</td>
<td>Walkability</td>
<td>The reduction of travel lanes and increase in landscaping will minimize the impacts of traffic on pedestrian areas. Future public realm enhancements and redevelopment of adjacent properties will further enhance the pedestrian realm.</td>
</tr>
<tr>
<td>Network connectivity and route options</td>
<td>Walkability</td>
<td>The existing street pattern is relatively fine-grained with good routes options. The design concept proposes the introduction of connections to the future Harbour Pathway to improve network connectivity.</td>
</tr>
<tr>
<td>Legibility</td>
<td>Walkability</td>
<td>Green elements and cycling facilities clearly demarcate Government Street as an identifiable spine of the Rock Bay District. It provides a landmark that can serve as reference point as land uses changes proceed in surrounding area.</td>
</tr>
</tbody>
</table>
Performance Measure | Related Analytical Framework Concepts | Description of Design Concept Features
--- | --- | ---
Supportive land uses | Walkability Livability | Comprehensive direction for land use is not included in the design concept. However, it is suggested that new buildings be set close to the street with small setbacks to provide space for seating, displays, etc. Additionally new pocket parks will expand public space available in the area and encourage the introduction of active uses.

Reflection of heritage of area | Identity | Basic operational requirements around vehicle circulation and access are maintained. Suggestions are made that public art or public realm treatments could reflect the industrial heritage in the area. Water feature connection to Rock Bay allows for a clearer link to areas natural heritage.

Table 13: Comparison of Existing Government Street Conditions with Green Street Design Concept

<table>
<thead>
<tr>
<th>Performance Measure</th>
<th>Existing</th>
<th>Design Concept</th>
</tr>
</thead>
<tbody>
<tr>
<td>Permeability</td>
<td>1-8 %</td>
<td>21-27%</td>
</tr>
<tr>
<td>Tree Canopy Cover</td>
<td>3-8%</td>
<td>20-50%</td>
</tr>
<tr>
<td>% stormwater treated within the right of way</td>
<td>0%</td>
<td>100% target (subject to technical analysis)</td>
</tr>
<tr>
<td>% of area as green space</td>
<td>1-8%</td>
<td>25-30%</td>
</tr>
<tr>
<td>% of ROW dedicated to pedestrian realm</td>
<td>12-15%</td>
<td>18%</td>
</tr>
<tr>
<td>Separation of sidewalks from moving traffic</td>
<td>4 - 6 metres</td>
<td>5-8 metres</td>
</tr>
</tbody>
</table>
Objective 1 - Redefine the role of Government Street as a multi-modal street

Converting Government Street to a street that prioritizes pedestrians and cyclists is an enormous challenge given its existing design and the land use context. In many ways Government Street is a contradiction. Its designation as an arterial street and truck route is at odds with its designation as a greenway and bike route. This is manifested in a physical design which accommodates, but does not welcome pedestrians and cyclists.

Ample policy direction highlights that the time is right to rethink the transportation role of this stretch of Government Street. The City of Victoria’s (2012a) transportation planning framework elevates pedestrians and cyclists as the priorities in transportation planning and points to the need to redesign environments, such as Government Street, to become more multi-modal. The pedestrian priority role of Government Street has also been advanced in the Downtown Core Area Plan through direction to extend the pedestrian priority Government Street Mall into the southern two blocks of the study area.

In comparison to green street projects in Seattle and Portland, the green street on Government Street is relatively unique in its current traffic carrying capacity. In this respect, it entails far more dramatic interventions to create adequate space for green features and reduce the dominance of motor vehicles. While the improvements will create a substantially different urban environment, the resultant street environment will be quite different than many green streets in other jurisdictions, which are on quiet, low volume residential streets and have significant habitat elements. In contrast, Government Street is an arterial street in an industrial area. Green street programs in Portland and Seattle both have a focus on improving streetscapes, enhancing neighbourhood livability and giving priority to pedestrians. In the case of Seattle a key objective is to provide exceptional pedestrian environments, including wider sidewalks, street trees, landscaping, and appropriate street furniture emphasizing pedestrian movement (City of Seattle 2005). A key focus for any green street project is creating adequate pedestrian space and reducing the dominance of motor vehicles.

A critical advantage of creating better walking and cycling conditions on Government Street is the absence of transit vehicles at present or in future plans. This makes road diets, where the number of traffic lanes are reduced, more practical as other
alternative transportation goals are not diminished. Additionally, there are no encumbrances on public space with respect to bus stops or shelters. From a safety perspective, Huang and colleagues (2002) and Knaap and Giese (2001) have shown road diets improve traffic safety and decrease traffic collisions as lanes are eliminated. The proposed design concept significantly reduces road capacity to bring the design more in alignment with greenway and bikeway designations, the primary pedestrian role Government Street plays in the City, and the future green orientation of the Rock Bay district.

The design concept dramatically improves cycling facilities. The current facilities, which are 1.3 metre painted bike lanes, are sub-standard based on the City standard of 1.5 metres. Additionally, the bike lanes are located in high traffic volume environment with no separation from moving traffic. The proposed design concept suggests 2 metre cycle tracks on both sides of the street and separated from traffic by a planter. The planter adds an additional green element to the street cross-section.

These facilities are considered the highest level facility, or Class 1, in the Capital Regional District Pedestrian and Cycling Master Plan (See Error! Reference source not found.). While this route is only designated for bike lanes in the regional plan, the cycle tracks provides a clear upgrade and a facility that is suitable for a wider range of cyclists. Additionally, a recent study by Winters and Teschke (2010) clearly indicated a strong user preference for separated cycling facilities (cycle tracks) on major roads when compared with conventional bike lanes. The cycle tracks require more right of way space that could be used for landscape or pedestrian space. However, the cycle track also buffers the pedestrian realm and reinforces the identity of Government Street as a multi-modal street.

**Objective 2 - Create a linear “park-like” space and amenity to elevate and improve the attractiveness of the Rock Bay District**

The Rock Bay District contains no substantial park space and there is no significant green space within 500 metres of the study area. The area’s lone park space is indicative of how the provision of green space is largely an afterthought. The park space, at the corner of Bay Street and Government Street is at the intersection of two major roads, has a concrete wall separating it from surrounding land uses and is landscaped primarily to
prevent undesirable activity. The area’s streetscapes are largely devoid of significant trees or landscape features.

Figure 12 shows designated park spaces and tree canopy cover in proximity to the study area. The development of a green street on Government Street provides an opportunity to address this deficit and introduce a linear park-like space to provide an amenity for workers, residents and visitors in the area.

In the Seattle experience, one of the primary impetuses for the creation of the Seattle Green Street Program was recognition that land available for park space in the Downtown was limited and costly to acquire (Scheer 2004). Green streets were seen as a way to provide a park-like feature in a neighbourhood. Further, the City of Seattle (2014) locates green streets in redeveloping areas to provide an amenity for new development and provide direction for desirable changes in land use patterns. Key factors in achieving a park-like environment on Government Street are traffic impact mitigation, significant landscaping and high quality pedestrian spaces.

Government Street provides a unique test case to see if the habitat, recreation and mobility goals of the greenway network can be implemented on a major street. While a number of arterial streets are designated as greenways in Victoria, no meaningful advancement towards the core goals of the Greenways Plan has been demonstrated on these streets. In most instances, the traffic carrying role of the street precludes any consequential changes. In Victoria, greenways are typically located on low volume residential streets with established street tree canopies and well-landscaped properties with sizable setbacks. In many ways, the upgrade of these routes directs resources to areas where private outdoor space is plentiful and streets already have design elements that are conducive to walking and cycling. In contrast, the proposed Government Green Street addresses an area where there is virtually no public or private green space or high quality recreational walking or cycling corridors. In this sense, the development of a green street on Government Street provides an opportunity to dramatically enhance the urban fabric of the city by addressing a lack of “green” amenity space in denser urban areas.

The design concept attempts to incorporate elements to achieve a park-like setting on Government Street primarily through increasing space available for landscaping. In
addition to increasing green space, a primary mechanism to achieve a park-like space is through the creation of a significant buffer between moving traffic and pedestrian space, as a means to limit the auditory and visual impacts of moving traffic. Lastly, the introduction of landscaped medians would help to visually break up the paved area, improve tree canopy cover and provide a distinct gateway feature to signal entry into a “green” area of Government Street.

Another way to help people experience the area as a park-like setting is through design elements that unify the blocks into a connected space. In the Portland example of SW Montgomery Green Street, a continuous stormwater planter is the primary feature that accomplishes this, but paving material also reinforces the street’s identity. On Government Street to the south of the study area, distinct pavement treatments are used in both Chinatown and the Historic Core to reinforce the identity of the area. A unique pavement treatment or landscape feature could be used throughout the study area to help it as a read more as a cohesive park-like space.

The development of a park-like space requires the support of surrounding land uses. The design concept proposes the development of modest pocket parks to optimize the landscaped spaces on Government Street, and provide more significant opportunities for green spaces and public gathering locations. An existing pocket park at the northwest corner of the study area could be expanded by removing the right turn lane on Bay Street and serve as a gateway feature for vehicles entering the Downtown Core Area and Rock Bay District (Figure 29). At the north end of the Government Green Street a gateway feature or work of public art on the median is proposed to create a sense of entry into the Rock Bay District.
Part of creating an exceptional public realm is creating a theme or identity for an area, often with recurring design features that create a sense of place. The Portland case study streets both have distinct design features that unify the multi-block green street and distinguish it from other streets in the city. In the Government Green Street, the landscaped median, continuous cycle track and stormwater management features are critical defining elements that are unique for a major arterial in Victoria and are uniquely different than the largely hardscaped Downtown Core Area. Further detailed design elements such as street furniture, signage, and pavement treatments could reinforce the area’s identity and enhance the quality of the public realm.

Objective 3 - Create an exceptional pedestrian environment and public realm

Government Street plays a special role in creating an iconic identity for the City of Victoria. Connecting to the Inner Harbour and running through an intact historic Old Town area, Government Street serves as the primary area of pedestrian activity and a prominent tourist stretch in the City. Moving northwards from Old Town, Government Street runs
through the oldest Chinatown in Canada, which is a unique and special place in the city. The establishment of a Green Street identity for the portion of Government Street in the Rock Bay District will extend this pedestrian identity, unify new and old parts of the Downtown Core Area and help imbue an identity upon the Rock Bay District. Figure 30 shows Government Street in relation to the Historic Core, Chinatown and Rock Bay Districts.

**Figure 30: Downtown Core Area Districts containing Government Street**

In assessing elements that are associated with more walkable environment, the analytical framework section of this study identifies a number of factors that positively influence walkability and encourage pedestrian activity. The key factors identified include: enclosure or definition by buildings or trees, a buffer zone to separate pedestrians from traffic, overall network connectivity; street trees and landscaping, visual interest;
continuous and well-maintained sidewalks; and land use density and diversity (Southworth 2005, Hutabarat Lo 2009, Adkins et al. 2012).

Further, the case study analysis identifies elements of green streets that are incorporated to support walkability. Seattle green street design principles emphasize pedestrians and open space over other functions and highlight the value of keeping speed and traffic volumes low. Specific elements identified in Seattle to improve overall walkability include historic character elements, wide sidewalks and planting strips, street trees, pedestrian scaled lighting, and weather protection (City of Seattle 2014). Elements that have been integrated to enhance the walkability of SE Clay Street and SW Montgomery Street in Portland include bike parking areas to buffer the pedestrian realm, spaces for café seating, curbless streets, and curb extensions to shorten crossing distances and improve pedestrian visibility.

The functional connectivity of the street network can be improved by making Government Street an attractive route, providing enjoyable cycling and walking connections through a more challenging part of the city. The introduction of the landscaped median and reduction of the travel lanes would allow for safe and easy crossing anywhere in the study area, dramatically improving connectivity within the Rock Bay District. Additionally, visual and physical connections can be made to the Harbour, which is less than 100 metres away from the central portion of the study area. This would provide a link to the shores of Rock Bay, the most prominent environmental feature in the area. Pathways could be constructed that include native vegetation and stormwater channels, exposing people to area biodiversity, connecting them with the harbour environment and providing a clear link to the receiving environment for stormwater run-off. This would also provide a link to the proposed Harbour Pathway and a future park site on the water.

The design concept proposed for Government Street reduces the visual impact of the road through interspersing green space throughout the cross-section in the form of a landscaped median, boulevards and planters. Also, through the reduction of traffic lanes and the introduction of more complexity and visual interest, traffic volumes and speeds will be reduced. This will reduce air pollution, auditory impacts and create a more
comfortable urban environment. Sidewalks areas, while not dramatically enhanced in width will be buffered from traffic by five to eight metres through boulevard areas, cycle tracks and vehicle parking in some locations. This will have a improve conditions in the pedestrian realm and allow landscaping in the boulevard and street frontages to be the dominant influence on the public realm. The addition of street furniture and distinct paving treatments will help to reflect elements included on other portions of Government Street, but in a manner that reflects the identity of this new district.

A key influence on the overall look and feel of the street is the lack of buildings or trees with significant scale to provide a sense of enclosure. This is particularly evident in the northern part of the study area, where large setbacks, wide paved areas and a lack of significant trees combine to visually widen the already significant right of way. The design concept looks to address this through the introduction of a median to break up paved areas and the addition of boulevards that allow sufficient planting space for large canopied street trees to flourish. A sense of enclosure is enhanced by smaller setbacks and the inviting entrances of buildings in the southerly two blocks of the study area. Over time, a better sense of enclosure will be provided as street trees mature, buildings move closer to the street and parking and service areas are relocated at the rear of sites. This change will largely occur through redevelopment guided by new design guidelines for the Rock Bay area, but will also be supported by enhancements included in this design concept.

Objective 4 - Retain and reinforce role of industrial and commercial land uses

The future of Government Street will include industrial businesses. A green street approach that has a context specific design will be critical to respecting this reality. A critical focus of the Rock Bay District is retaining and enhancing industrial and commercial employment. Long standing businesses require easy circulation in the street network and have uses that require space for storage, processing or other industrial related operations. The study area contains two distinct segments with respect to land use – the two southerly blocks are street-oriented commercial businesses, while the northerly four blocks contain a mix of heavy industry, light industry and commercial uses. The design concept responds to this distinction and creates different design concepts for each of these sub-areas.
The case study of SE Clay Green Street in Portland provides an excellent comparator to assess approaches used for green streets in industrial areas. In this case study, the financial viability of the industrial district was a key objective and included the maintenance of freight needs and minimization of parking loss. Pedestrian conditions were dramatically improved through sidewalk upgrading and the addition of landscaped corner bulges. Further, extensive green stormwater management infrastructure was implemented with minimal right of way changes. An interesting aspect of this project was the celebration of the area’s industrial heritage, which provided interest for pedestrians and highlighted the industrial character of the area. This included the use of materials, public art sculptures and signage that reflect the area’s industrial identity.

The design concept reduces the number of travel lanes on Government Street, but retains all existing left turn lanes. While the retention of turn lanes limits the extent of potential green street interventions, it respects the needs of industrial operations for easy circulation. Parking is also largely maintained, with the area dedicated to parking reduced to one side of the street. Drawing on the example of SE Clay Green Street, a key element of the Government Street implementation will be the celebration of the industrial history of the area. The use of materials in public realm design treatments, public art and wayfinding will help to establish the identity of the area and emphasize that this area will continue to be an industrial and employment centre in Victoria.

The Rock Bay District is expected to see a transition in the type of businesses as redevelopment occurs in the study area. High technology is identified in the City of Victoria’s Official Community Plan as the primary focus of employment growth in the Rock Bay District. This land use change will likely result in street-oriented buildings that can help to further reinforce the public realm and strengthen the green street focus. Meanwhile, the design concept suggests street trees can be used to help buffer more impactful industrial operations and further “green” the street right of way. In this scenario, trees are planted on private property adjacent to the right of way to screen industrial operations or parking and enhance the pedestrian realm. An excellent example of this condition exists at the north end of the study area (Figure 31).
Objective 5 - Significantly Increase the Urban Forest and Landscaped Areas

Landscape areas are critical to the achievement of the green street vision, as they provide space for street trees, stormwater management, and native plantings. These improvements are intended to provide ecosystem services, contribute to walkability and livability and help shape the identity of the area. As noted by Allan Jacobs (1993), given a limited budget, the most effective expenditure to enhance a street would be trees.

In the Portland case study of the industrial SE Clay Green Street, the addition of street trees in particular was seen as a critical element to improve psychological and visual comfort in an active industrial area. At present, the Government Street study area has limited landscape areas and approximately 95% impermeability. Street trees, while regularly planted along Government Street have a limited impact and generally do not provide a significant contribution to canopy cover. As a whole, the Downtown neighbourhood has only 3.4% tree canopy cover, well below the 18% citywide average (City of Victoria 2013a). Further, industrial/commercial areas in Victoria only have a 2.3% tree canopy cover. By contrast, Seattle targets 8% canopy cover in industrial/employment areas and 9% in downtown areas (City of Victoria 2013a). Given that many industrial and
commercial businesses have high lot coverage or operational requirements that limit tree planting and landscape opportunities, the integration of tree canopy within the right of way is all the more imperative to improve tree canopy cover in the Rock Bay District.

The overall approach of the design concept is to provide additional space that will allow for a range of opportunities to introduce street trees, stormwater management areas and plantings. Currently the percentage of the right of way that is covered by landscaped area is approximately 5%. This area is predominantly comprised of grass with street trees. The proposed design concept introduces five bands of green space within the right of way, with slightly different treatments in the north and south segments of the study area. The outer bands, which are adjacent to the sidewalk are boulevard areas which range in width from 2.75 to 3.0 metres. These areas will be able to support significant street trees, understory plantings that focus on native species, and stormwater management areas. In addition, the boulevard areas can accommodate street furniture, bike racks and other amenities that support activity in the public realm. The next bands of green are the planters that separate the cycle track from the travel or parking lane (Figure 32). While these do not provide a significant benefit in terms of environmental performance, they visually break up the street, provide a high quality cycling facility and add to the green identity of the area. The last band of green is the landscaped median, which is three metres wide and will be utilized for stormwater management and street trees. A key differentiation in the design concept is that while there is a continuous median in southern two blocks, the northern four blocks maintain left turn lanes and therefore have a reduced landscaped median.
In the case of SW Montgomery Green Street in Portland, landscaped areas are used for both extensive planting and stormwater management. Plantings of native trees and plant species provide a connection to larger native ecosystems and occur within stormwater planters or in tree wells along the roadway. In the Government Street Green Street, specific design response would be dictated by the location of underground utilities, soil conditions and other technical issues. Overall, the design concept seeks to achieve 25-30% green space and 21-27% permeability within the right of way. This represents a significant increase over the existing 5% green space / permeability in the study area.

The design concept also enables a significant increase in the number of street trees and overall canopy cover through providing a larger area of uncompacted soil. As noted in the Urban Forest Master Plan, the achievement of significant environmental benefits from streets trees requires sufficient uncompacted soil volumes (City of Victoria 2013). The size of a tree and the amount of healthy leaf area equates directly to the benefits provided to the community. A 75cm tree in Toronto intercepts ten times more air pollution, can store up to 90 times more carbon and contribute up to 100 times more leaf area to the tree canopy than a 15cm tree. (City of Toronto 2013).
Both boulevard areas and the median in the design concept allow for significant space for street tree planting. According to the US EPA (2013) 1,000 cubic feet of soil is needed to achieve a tree with a 30 foot (9.1 metre) canopy, or 500 cubic feet of soil to achieve a 20 foot (6 metre) canopy (US EPA 2013). This translates to a typical planted area of 6 metres x 5 metres and 4 metres x 4 metres, respectively. Depending on the constraints, structural / engineered soil can be used to increase root space and water capacity. In the design concept, planting space provided in the boulevard could potentially be supported by uncompacted areas underneath cycle tracks and sidewalks. With driveway accesses moved to side streets, the total width of uncompacted area available for planting would be approximately seven metres. Based on the US EPA data and the boulevard and median areas provided in the design concept, a 50% tree canopy is achievable for the majority of Government Street.

**Objective 6 - Manage stormwater within the right of way**

Stormwater management is a primary focus of many green street projects. In the case of the City of Portland (2006), the rationale for the establishment of a green street approach was based on the need to address stormwater quantity and quality issues and the fact that 66% of the City’s total stormwater runoff is collected from rights of way. Green stormwater management is primarily achieved through the introduction of treatment facilities, expansion of permeable surfaces to allow for infiltration of rainwater and the addition of street trees to intercept and slowly release rainfall. At present, stormwater is managed through conventional infrastructure on Government Street and in the Rock Bay District. The study area’s approximately 95% imperviousness and lack of street trees and landscape features impact the quality and quantity of stormwater entering the Victoria Harbour.

The Downtown Core Area Plan contains policy direction to improve the environmental conditions of the Rock Bay District through the integration of green and innovative infrastructure (City of Victoria 2011). At the street scale, the key infrastructure element that can be addressed is stormwater. This is particularly important in the Rock Bay District, as the sites surrounding Government Street have a high level of
imperviousness and in many instances, high building site coverage resulting in little infiltration within the area.

The two case study green streets examined in this study provide examples of street design changes that effectively manage stormwater within the right of way. For SW Montgomery Green Street, stormwater planters and tree wells were used to manage stormwater. These are used in combination with coniferous street trees that intercept rain before it hits the ground, and structural soil cells that are placed under sidewalks and parking zones to expand stormwater management and root zones (Nevue Ngan Associates 2009). This suite of techniques provides additional capacity to not only treat rainwater falling within the right of way, but also stormwater from adjacent streets or private sites. The other case study street, SE Clay Green Street, relies upon 21 green street facilities, mostly vegetated curb extensions and parking strip planters to manage stormwater.

The amount of right of way space required to effectively treat stormwater within the right of way varies depending on soil conditions and management techniques utilized. In the SW Montgomery Green Street example, full stormwater infiltration within the project site was generally achieved through dedicating 11% of the right of way to stormwater management. Cahill et al. (2011) suggest the footprint of the stormwater planters needed typically ranges from 4% to 15% of the impervious surfaces draining to it. Farr (2008) assessed various standards, and identifies an area of 10-15% of overall site area as appropriate for stormwater facilities.

The design concept greatly expands the permeable area within the right of way, providing a significant area to locate stormwater management facilities. The introduction of a three metre landscaped median provides an ideal location for stormwater management facilities. An expanded tree canopy cover would intercept a large amount of rainfall and greatly contribute to reducing the volume and rate of stormwater to be managed within the right of way. Stovin et al (2008) highlight a study that looked at effects of increased tree cover in five residential blocks and identified that a 25 to 50% increase in tree cover could reduce annual runoff from 10-20%. Boulevard and median areas could
potentially be supported by stormwater management facilities in pocket parks, which are introduced at various locations along the corridor.

The design concept allocates 21-27% of the right of way to landscape spaces that would be suitable for stormwater management facilities. This provides flexibility to achieve the 10-15% of the total right of way identified in the literature as sufficient to fully manage stormwater. In addition, it allows flexibility to avoid conflicts with utilities, integrate public spaces and address poor soil conditions.

Another unique opportunity identified in the design concept is creating a linkage to the receiving environment (Victoria Harbour), which is less than 100 metres away from parts of Government Street. This provides not only an opportunity for a pathway linking the Harbour Pathway to Government Street, but also a potential stormwater channel to create a connection between Government Street and the marine environment. Native plants and harbour restoration could further emphasize this connection and provide a strong link to natural areas and amenities. Additionally, this would support the ongoing $32 million dollar restoration of Rock Bay (Capital Regional District 2014b).

7.5. Summary of Key Design and Policy Recommendations

The following summarizes key policy and design directions needed to implement the proposed design concept for Government Green Street:

**Street Design**

- Reduce vehicle capacity by removing travel lanes on Government Street to enable the improvement of walking and cycling facilities, the enhancement of landscaping and the extension of the pedestrian orientation of Government Street
- Introduce a treed median to create a clearly identifiable green feature for this segment of Government Street, expand tree canopy cover and provide space for stormwater management facilities
- Introduce fully separated cycle tracks to provide a high quality cycling facility that attracts a wide range of cyclists
Urban Design

- Add pocket parks throughout the corridor to create more public spaces and provide opportunities for more substantive landscape features
- Focus public realm improvements in proximity to pocket park locations and locate pedestrian-oriented uses fronting the pocket park
- Integrate gateway features in public spaces located at entry points into Government Green Street as a measure to promote the identity of the street and the greater Rock Bay District
- Incorporate design elements that reflect the industrial heritage of the area as a means to clearly signal that the area will continue to have an employment focus
- Introduce paving elements that reinforce overall pedestrian identity of the street and provide a linkage to southern portions of Government Street
- Introduce wayfinding to help brand the area and provide linkages to nearby destinations

Environmental Features

- Target 100% on-site management for all rainwater that falls within the right of way
- Explore opportunities to create a prominent stormwater feature and open space connecting Government Street to Rock Bay. This would connect the area to the most prominent environmental feature in the area, provide a linkage to the Harbour Pathway and offer an opportunity for a significant restorative element in an environmentally deteriorated area.
- Select native tree and plant species in boulevard, median and park spaces that reflect the historical ecosystems

Land Use

- For commercial uses, as properties redevelop, move buildings closer to the street with small setbacks to allow for an effective expansion sidewalk areas to enable seating, signage and displays.
- For industrial uses with greater visual impacts include significant tree planting at the property lines to screen activities and enhance tree canopy cover in the area

### 7.6. Conclusions and Further Research

The goal of this research was to assess potential approaches for transforming Government Street from a one-dimensional urban arterial street to a multi-functional green street. The green street analytical framework incorporated the concepts of environmental performance, walkability, identity and livability to guide the development of green street policy and design approaches on Government Street.

The research revealed that a green street approach in Victoria is in the early stages of development. The existing policy framework advances the importance of many of the elements of a green street approach, but does not articulate a comprehensive approach. From a sustainability perspective, many of the advances made by Victoria with respect to compact land use patterns, high walking, cycling and transit mode shares and well-designed public spaces have not been reconciled with creating urban environments where nature and natural processes are integrated into urban environments.

City cores are increasingly densifying in an effort to address many environmental, economic and social imperatives, including improving resiliency to climate change, promoting land use patterns that preserve natural areas and farmland, and delivering infrastructure and services more efficiently. This densification often results in greater building site coverage, the loss of green space, increased imperviousness and a loss of tree canopy, thereby degrading the environmental performance of areas and the presence of visible green elements. Street right of ways, which occupy 20-30% of land within cities (Girling & Kellett 2005) are an under-utilized asset that can be used to offset these impacts, provide tangible green elements and enhance overall livability of high density areas. Government Street represents an opportunity to build an urban fabric that has better environmental performance, connects citizens to nature, and generally enhances livability for residents, workers and visitors. A progressive approach to street design would establish a unique condition in Downtown Victoria and create an identity for an emerging Rock Bay eco-district.
The study proposes a design that effectively transitions a major urban street, dominated by paved surfaces, into a street that achieves a level of environmental performance and establishes a “green identity” for an area of the city where economic development based on a green infrastructure approach is the stated intention. In this respect, it highlights the use of public rights of way as a way to interject green space into dense urban areas with high land values. In the design concept, pocket parks provide a supportive element to enable substantive public spaces. The study also expands upon the primary focus of most green streets, stormwater management, to a more holistic approach that places a higher priority on the human experience and capacity for landscape to influence well-being and provide a connection to nature.

While the proposed concept has the potential to improve a number of outcomes, there are also a number of associated limitations and potential implications. A primary limitation is a lack of detailed coordination with future land use changes. The existing land uses are not consistent with the attributes of a green street and in the short-term would not reinforce proposed changes. While City policy supports the development of a future eco-district in Rock Bay, detailed economic and technical analysis has not been completed that indicates proposed land use and infrastructure changes are financially and technically feasible. Additionally, many of the green street design concepts have not subjected to detailed technical analysis related to soil conditions and infrastructure conditions, which could constrain possibilities. The proposed design changes have potential implications for industrial businesses and the future viability of the area as an industrial district. A reduction in traffic capacity and change in street character could have operational impacts, as well as setting up potential conflicts between low impact light industrial and commercial operations and longstanding heavy industrial uses.

A key lesson learned for other projects is to challenge the assumption that maintenance of traffic capacity is a starting point for analysis for street re-design projects. Only through a more sustainable balance between vehicles spaces, cycling facilities, the pedestrian realm and landscape spaces are meaningful interventions that begin to change the character of a street achievable. This is particularly the case on major roads which have widths that make the development of a pedestrian-oriented scale more challenging.
In the Government Street case study, the assertion is that broader transportation network conditions and trends indicating reduced traffic volumes support a more dramatic change.

One area of suggested further research is the exploration of the ability of green street enhancements to influence economic development or positive land use changes. While research has been conducted that assesses the impact of green street elements on walkability, health outcomes and real estate values, a more expansive analysis that seeks to determine the role of green streets in driving land use change or overall economic development would be useful to help build the case for future street improvements.

Further initiatives that would help Victoria build on insights gained from this analysis include:

- Update Greenways standards to more meaningfully integrate a comprehensive approach to street design that move beyond solely walking and cycling improvements and incorporates stormwater management, landscape and public realm elements;
- Assess potential ways in which green street concepts and performance measures used in this study can be applied to the broader Rock Bay District to support its transformation to an eco-district;
- Explore opportunities for road diets in areas lacking tree canopy cover or deficient in park space as a means to achieve green amenity space with limited capital investment; and,
- Develop evaluation criteria for street re-design projects to help more broadly assess opportunities with respect to stormwater management, urban forest, landscaping, public realm and mobility objectives.
References


Capital Regional District. (2011). *Regional Pedestrian and Cycling Master Plan*. Victoria, BC.


124


City of Victoria (1996) *Bicycle Master Plan*. Victoria, BC


