



## A Downtown Streetcar for Vancouver; Transit Trend or Transit Need

Ivy Tzur

Professional Project Report  
School of Community and Regional Planning



**A DOWNTOWN STREETCAR FOR VANCOUVER:  
TRANSIT TREND OR TRANSIT NEED?**

**by**

**Ivy Tzur**

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## ABSTRACT

The modern streetcar is making a comeback throughout North America as an attractive mode of transit with claims to both reduce congestion and shape land-use. As the City of Vancouver plans for a streetcar in the downtown core, this professional project sets out to objectively inform the public of factors that necessitate consideration when pursuing this type of urban rail system. A discussion of the project proposal, related literature, and local context together provide a perspective of what these considerations are for the City of Vancouver.

This report was formulated after an examination of research which reveals ridership levels and capital costs being discrepant to initial estimations in light rail systems currently operating. Literature also reveals that the development and land-use benefits that attract cities to pursue fixed rail systems are attributed more directly to the land-use measures that support them than the transit system itself.

Streetcar infrastructure continues to be pursued, however, in dozens of North American cities for its ability to attract patrons, catalyze development and direct urban growth. Because a streetcar system is a significant public investment, the potential benefits must be weighed against the high costs. Most importantly, the citizens of Vancouver should understand the risks as well as the benefits accrued from the proposed system within a broader transportation context.

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**GLOSSARY OF ACRONYMS**

<b>BRT</b>	Bus Rapid Transit
<b>CBD</b>	Central Business District
<b>DTP</b>	Downtown Transportation Plan
<b>FCF</b>	False Creek Flats
<b>GVRD</b>	Greater Vancouver Regional District
<b>GVTA</b>	Greater Vancouver Transportation Authority
<b>LRSP</b>	Livable Region Strategic Plan
<b>LRT</b>	Light Rail Transit
<b>RAV</b>	Richmond – Airport – Vancouver
<b>RFP</b>	Request for Proposal
<b>SEFC</b>	South East False Creek
<b>SWOT</b>	Strengths, Weaknesses, Opportunities and Threats
<b>TYP &amp; TYO</b>	Three Year Plan & Ten Year Outlook
<b>VCC</b>	Vancouver Community College

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## CHAPTER 1 – INTRODUCTION

### 1.0 A CITY WITH A STREETCAR HISTORY

For five cents a ride, Vancouverites were able to board the electric streetcar that was the City's first transit system introduced in 1890. What started as 9.6 kilometres of track that hosted 6 streetcar vehicles became 232 streetcar vehicles which travelled throughout the neighbourhoods of Downtown, Kitsilano, Mt. Pleasant and as far as North Vancouver and New Westminister by 1914. The streetcar continued to expand throughout the 1920's and was an important source of mobility after the onset of The Great Depression. As the population grew, however, developments were built in areas further away from the central transit service core hence buses were purchased in order to save on costly streetcar extensions.

Typical to many North American cities, the streetcar began to be completely replaced by buses after the Second World War. The ageing Vancouver streetcar fleet, equipment and track were far too expensive to upgrade and renew. The streetcar system was competing not only with more affordable buses, but with the private automobile as cars were becoming more accessible. In April of 1955, Vancouverites saw the last streetcar route run its course as the entire transit system was converted from electric streetcars to electric rubber tired buses; known as the project called "From Rails to Rubber".<sup>1</sup>

The impact of the streetcar, however, still remains apparent today. The downtown commercial spines along Davie, Denman and Robson Streets, for example, represent the way in which the streetcar lines influenced development and enabled high density in the West End neighbourhood. Vancouver's streetcar era spatially defined corridors of

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<sup>1</sup> British Columbia Electric Railway Company (BCER), the governing authority over Vancouver's transit system at the time, called their program to modify the entire transit system "From Rails to Rubber."

service activities as well as neighbourhoods such as Kerrisdale and Dunbar.

After more than four decades of being 'streetcar-less', the City of Vancouver is well underway in pursuing opportunities to bring a streetcar system back into its' downtown core.

## **1.1 BACKGROUND**

The last two decades have seen both historic and modern streetcars being reintroduced to city streets throughout North America. Between 1984 and 1992, passenger miles on light rail transit (LRT) saw a 71 percent increase in those eight years alone (Zaretsky, 1994). The trend of implementing fixed 'light rail' infrastructure in downtown areas is one that is perceived to bring cities various degrees of mobility, neighbourhood revitalization and a modern urban image. While many proponents of downtown streetcars have claimed that these light rail systems are "An affordable investment that yield high returns" (Denver, 2001), others claim that their exorbitant capital expenditures do not justify the benefits they may offer.

Light Rail is a generic term that refers to a range of electrically powered systems that run on steel rails. The key difference between light rail systems is their purpose. Traditional streetcars are at the lighter end of the range, generally focused on serving local transportation needs on a neighbourhood level. While they benefit from exclusive right-of-ways and signal priority (to improve speed and service efficiency), streetcars are typically designed to operate on streets mixed with vehicular traffic. Stations are spaced close together and connect to higher capacity services.

At the heavier end of the range are light rail systems which serve higher order transit needs that often operate as a regional trunk line with

services feeding into it. A light rail line is typically segregated from vehicular traffic and operates ten to twenty miles beyond the perimeters of a downtown area at higher speeds and with higher capacity than streetcar services.

Portland, Oregon's downtown streetcar and light rail MAX (Metropolitan Area Express) line, for example, are both light rail systems with a distinct purpose. The MAX line is commonly utilized for bringing people into Portland's downtown where patrons then can use the streetcar to get around the downtown.

To date, there are approximately 43 streetcar lines in the United States and Canada that are in the planning or construction phase of development (APTA, 2004). These systems are being built because rail is seen as the best alternative to attract car users; reduce air pollution and traffic congestion; and direct urban growth (Newman and Kenworthy, 1999).

Those systems that are currently built and operating reveal a broad range of successes and failures. Some cities are reaching their ridership projections and recovering costs from construction and operations, while many struggle to gain patronage being left with a price tag that far exceeds costs originally anticipated (Hensher, 1999; Richmond, 1998; Pickrell, 1992).

### ***1.1.1 A Light Rail Debate***

Literature reveals that a debate exists regarding light rail transit in urban centers. Authors either strongly oppose or strongly defend the light rail trend. The majority of feasibility studies conducted by cities considering a form of light rail seem to have their minds made up; that light rail would greatly benefit their downtowns and ridership fares will cover the costs of operating the system. Animated planning processes begin and optimism

for this additional mode of transit supersedes concerns for cost recovery and overruns.

Literature that reflects opposition to light rail infrastructure is written mostly by academic researchers, economists and non-profit organizations. Their arguments generally take the position that light rail investments are too frivolous and shouldn't be a priority when other transit needs are more pressing. That trolley buses can provide the same service for a fraction of the cost creates a large amount of debate in the literature over whether LRT or bus transit are optimal modes for mobility.

The Light Rail Transit Association<sup>2</sup> published an online article which asserts that "Economy usually takes second place to fashion and public transport trends are no exception" (Andrews, 2004). In the same way that streetcars were removed to make room for the more affordable trolley bus and the accessible private automobile after World War II, streetcars and light rail transit are in the spotlight and making their way back into downtown centres.

Proponents argue that the following additional benefits may be a result of the implementation of streetcar rail transit in downtown cores:

- Shaping land-use and directing urban growth when used with complimentary initiatives;
- The increase in urban development leading to a gain in capital from property taxes of increased land values;
- Destinations may gain a stronger identity when associated with a fixed rail mode of transit;
- An enhanced public realm is possible in conjunction with urban design and pedestrianisation schemes;
- Citizen satisfaction due to the perception that streetcars are a favoured mode of public transit;
- Avoidance of a stigma associated with bus transit.

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<sup>2</sup> A web-based organization that advocates and campaigns for streetcar and light rail systems to promote better urban transit. Website located at: <http://www.lrta.org>

Critics, however, argue that streetcar transit may not be the best alternative to achieve various transportation goals. The following attributes reflect possible risks and detriments from the implementation of streetcar transit in a downtown core:

- Achieving a successful land-use / transportation connection requires a host of parallel measures that may be applied with a less cost intensive mode of transit;
- The financial and human resources required to implement a streetcar system may shift priorities away from other public transit needs;
- Capital expenditure for streetcar transit tends to be frontloaded with capital costs;
- Ridership forecasts of similar light rail projects have been found to be inflated in order to obtain support and capital for the project;
- Streetcar routes often connect significant visitor destinations to one another, but may not provide viable origin-destination links for residents;
- The costs per rider on a streetcar system are higher than on other forms of transit;
- Fixed rail transit is not as flexible to physical and social change as other modes of transit.

There are many positive and potentially negative attributes that a streetcar system may present as a transit service. In order to ensure that a streetcar is a suitable technology for serving the goals of a city centre, it is necessary to examine these benefits and risks against other transit technologies within the city's context.

## **1.2 PLANNING VANCOUVER'S STREETCAR**

A planning process for Vancouver's downtown streetcar began with the decision to have streetcar rail technology. It is therefore perceived that the City of Vancouver has a *vision* for streetcar transit in

the downtown core, as opposed to a transit problem looking for resolve through a more objective analysis of options.

The *vision* may be motivated by notions that are commonly associated with modern transportation projects:

- The transit system as a global cachet; a distinct and memorable piece of infrastructure in the city;
- A symbol of modernity and keeping with a current streetcar trend;
- A city image that identifies with progressive decision making and long term investment;
- A desire to expose this image and identity to tourists and visitors.

Employing a streetcar project based on a *vision* could provide a degree of mobility and perhaps fulfill the general prescriptions of regional and citywide policy. Some have suggested that this streetcar line is the seed for a more extensive citywide streetcar system which at this point has not been evaluated. The streetcar *vision*, however, more directly addresses city image and tourism needs. This creates a problem when the streetcar proposal claims that the purpose of the system is to help shape land-use, reduce congestion and provide better access to transit.

### **1.3 PROBLEM STATEMENT**

The City of Vancouver has a vision for streetcar transit in the downtown core. Consequently, the proposal is not supported by an objective analysis of the pros and cons of streetcar development and alternative modal options. As a result, the current planning process is revealing the following areas of conflict:

- Public consultation has been limited to an initial attempt in 1998 that presented the preliminary schematic streetcar plan. The absence of follow-up suggests a lack of transparency in the project;

- The streetcar project may divert attention and resources away from existing transit problems within the city which the proposed streetcar route does not address;
- The proposed route seems to offer a path of least technical resistance for streetcar implementation, rather than a route that provides optimal social benefits.

## **1.4 PROJECT OBJECTIVES**

The purpose of this report is to objectively inform the public of the pros and cons of streetcar development and provide recommendations for the current project and process. This report will enable a better understanding of the streetcar proposal by presenting the following information:

- A review of Vancouver’s regional and local transportation policy and trends to understand a local project within a regional context;
- A review of various issues identified with streetcar transit projects that are expressed in literature;
- A critical analysis of the City’s goals for a downtown streetcar through a SWOT (strengths, weaknesses, opportunities and threats) method of analysis;
- Recommendations that strive to improve the current project and process.

### ***1.4.1 An Objective Analysis for the Public***

This report is being supported by the Vancouver Area Transit Plan Public Advisory Committee. The committee is comprised of community members that represent the greater public to provide advice on what infrastructure the City should be investing in, as well as to engage in discussions on general transportation issues.

As the City of Vancouver continues to explore opportunities for a downtown streetcar, the SWOT analysis strives to objectively inform citizens of the following questions:

- *What are the strengths and weaknesses in the city's proposal to provide streetcar service in Vancouver's downtown core?*
- *What opportunities are presented in Vancouver's context that would aid a downtown streetcar in being a successful mode of transit; and what are the threats that would hinder it from being a successful mode of transit?*

## 1.5 ANALYSIS FRAMEWORK AND CRITERIA

Employing a new transit mode is a complex endeavour that necessitates a strategic approach. Because the success of this project depends on the subjective variables of how and where implementation occurs, a SWOT (strengths, weaknesses, opportunities and threats) analysis was chosen as an evaluation framework (see Figure 1 below). Conducting a SWOT analysis will assess the proposal's strengths, weaknesses, opportunities and threats which highlight the advantages and obstacles presented in this attempt to add a viable transit mode into Vancouver's current transportation system.

The 'strengths' and 'weaknesses' of a SWOT analysis regard those factors that are internal to the project, e.g., decisions made about streetcar routing, technology and integration with other modes of transport (controlled factors). The 'opportunities' and 'threats' regard those factors that are external to the project, e.g., Vancouver's urban geography, demographic and transportation policy (existing factors).



**Figure 1.** Source: NetMBA <http://www.netmba.com>

The analysis criteria chosen to build the SWOT analysis are the economic, environmental and social principles of sustainable development (WCED, 1987).<sup>3</sup> Each principle can be evaluated on factors that are both internal and external to the streetcar project. These principles strongly influence the success of transit projects at both the planning and implementation stages, and each of the three principles will undergo an analysis within the SWOT framework for this report.

The benefits of these sustainability principles as they relate to Vancouver’s downtown streetcar proposal are listed in the table below:

SOCIAL	ECONOMIC	ENVIRONMENTAL
Mobility, access and urban liveability	Commercial enhancement, tourist appeal and property development	Reduced pollution, improved air quality and noise pollution

These criteria set up the specific sub-questions that will be answered thru an examination of the total context and revealed in the analysis (in Chapter 5):

**Social:** Will the streetcar increase mobility and connectivity, be an accessible transit mode and enhance urban liveability?

**Economic:** Will the streetcar be a viable investment that will attract patrons, enhance pedestrian activity and be a catalyst for shaping land-use and development?

**Environmental:** Will the streetcar achieve reduced congestion and contribute to a reduction in air quality and noise pollution?

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<sup>3</sup> The 3 pillars of sustainability developed in the Brundtland Report which was published by the World Commission on Environment and Development (WCED).

## 1.6 PROFESSIONAL PROJECT SCOPE

In acknowledging the City of Vancouver's desire for a downtown streetcar (City of Vancouver, 1999), this report does not attempt to produce an analysis of whether or not the streetcar project should be employed. It instead strives to enlighten the process by identifying key issues pertinent to the planning for a downtown streetcar. These key issues will be translated into recommendations, i.e., areas of concern will be highlighted and suggestions for intervention will be offered; as areas to capitalize on will be highlighted and offered suggestions to optimize benefits.

Vancouver City Council has recently authorized a second consultant study<sup>4</sup> to provide updated and more in-depth ridership projections for the downtown streetcar. To date, both the financing and the governance for the proposed streetcar system are unknown. This report recognizes the importance of the implications related to 'who' operates this transit mode and 'how' it will be financed. These implications will not be discussed in detail for this report because they have yet to be resolved in the streetcar proposal.

## 1.7 PROFESSIONAL PROJECT STRUCTURE:

This report progresses as follows:

**Chapter 2** provides the transportation planning context that is the backdrop to the streetcar project.

**Chapter 3** familiarizes the reader with the City of Vancouver's proposal for a downtown streetcar.

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<sup>4</sup> The first consultant study was released in 1999 which covered cost analysis, potential ridership, alignment options and phasing.

**Chapter 4** provides a review of the major arguments that regard implementing streetcar infrastructure; as well as an in depth discussion of each argument as it relates to the context of Vancouver.

**Chapter 5** performs a SWOT analysis based on the information presented in the previous chapters.

**Chapter 6** offers recommendations that are intended to aid the current planning process and project.

**Chapter 7** concludes with a reflection on some of the central arguments presented in this report.

## CHAPTER 2 – REGIONAL AND LOCAL TRANSPORTATION PLANNING CONTEXT

### 2.0 INTRODUCTION

An understanding of the area's transportation makeup on a regional and local level is required in order to develop an effective analysis for a potential new mode of transit. It's at the crossroad between transportation governance and policy, existing travel patterns, urban geography and recent trends that this report contextualizes the implications of the downtown streetcar proposal.

This chapter provides information on the following elements and examines how the downtown streetcar project fits into them:

- THE GREATER VANCOUVER REGIONAL DISTRICT
- TRANSLINK
- THE DOWNTOWN TRANSPORTATION PLAN
- LOCAL TRAVEL TRENDS
- CURRENT AND UPCOMING EVENTS

### 2.1 THE GREATER VANCOUVER REGIONAL DISTRICT: THE LIVABLE REGION STRATEGIC PLAN AND TRANSPORT 2021

With over two million people residing in the Vancouver metropolitan area and three million expected by 2013, a governing body was necessary to facilitate a synthesis amongst the municipalities. The Greater Vancouver Regional District (GVRD)<sup>5</sup>, a partnership of the 22 municipalities that make up Vancouver's metropolitan area, is a regional authority that oversees common services such as housing, water, sewage, regional parks and transportation. In 1996 the GVRD adopted the *Livable Region Strategic Plan* (LRSP), a growth management strategy that provides a framework for making transportation and land-use decisions. The following key strategies guide the LRSP:

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<sup>5</sup> See map of GVRD in Appendix A

- Protecting the green zone;
- Building complete communities;
- Achieving a compact metropolitan area;
- Increasing transportation choices.

Each strategy is inter-related, and adding a new transit mode needs to fundamentally support all four strategies. For example, a transit system would not be successful without the population densities necessary to creating compact neighbourhoods; just as protecting the green zone would be difficult without containing residential growth within concentrated areas to achieve these compact communities.

With the goal of curbing automobile dependence, the LRSP looks to partner with local governments to pursue transportation initiatives that encourage the use of public transit as well as walking and cycling before accommodating the private automobile. The “Transportation Choice Policies” in the LRSP are directions that the GVRD board pursues in order to work towards the strategy goals. While all the policies correlate to any transit decision, the following are those that most directly correspond to the streetcar proposal:

- 16.2 - to provide a variety of local transit services and networks with the flexibility to serve different demands in support of the complete communities and the compact metropolitan region;
- 16.3 - to assign priority for increased roadway capacities first to high occupancy vehicles, goods movements, inter-regional movements and then single-occupant automobiles;
- 16.4 - to enhance and/or retrofit local streets and infrastructure to favour transit, bicycle and pedestrian uses;
- 16.6 - to plan and implement transportation services and facilities with priority given to areas identified for above-trend population and employment growth  
(LRSP, 1996)

These Transportation Choice Policies in the LRSP are grounded in conjunction with Transport 2021, a long term regional transportation strategy that was approved by the GVRD board in 1994. *Transport 2021* was a joint project between the GVRD and the province of British Columbia. The proposed downtown streetcar, a mode of transit that implies and necessitates all of the above policy directions, theoretically conforms well to both the LRSP and Transport 2021.

## **2.2 TRANSLINK: THREE YEAR PLAN & TEN YEAR OUTLOOK**

To meet the transportation objectives of the province and the GVRD, an agency was created to give the region funding and planning responsibility for regional transportation services and infrastructure, including transit. The Greater Vancouver Transportation Authority (GVTA), better known as TransLink, was established in April of 1999. As the provider of transit services that cover the 1800 square kilometres of the region, TransLink strives to provide a transportation system that is effective and supportive of transportation infrastructure based on the foundation of the LRSP.

In order to define the region's various transportation needs and prepare initiatives for both the short and long term, TransLink has recently created an intermediate plan within *Transport 2021* that details implementation to 2013. *The 2005 – 2007 Three Year Plan & Ten Year Outlook* (TYP & TYO) was approved in December of 2003 by the GVRD. This document proposes detailed transit expansion strategies in the *Three-Year Plan*, and presents a vision of where the region could potentially be in 2013 in the *Ten Year Outlook*.

Essentially, the TYP & TYO is a priority list of necessary transportation projects over the next ten years that at an estimated cost of \$4 billion dollars. The downtown streetcar is not on TransLink's agenda at the

present time. This plan, however, expresses transportation objectives that a streetcar service may be able to fulfill if added at a future date.

Objectives such as:

- Reduction of greenhouse gases due to increased transit usage and decrease in automobile traffic;
- Expanding transit service in order to reduce congestion, encourage transit usage and allowing for a better flow of people and goods;
- A commitment to an annual funding for transit priority measure to improve the efficiency of transit services.

Although TransLink has yet to be actively involved in the planning for the streetcar project, there has been a degree of dialogue between the City of Vancouver and TransLink staff (City of Vancouver, 2003). It is recognized by City staff that in order to integrate the streetcar efficiently with the Downtown's other transit modes, TransLink's involvement in this project will be necessary (DTP, 2002).

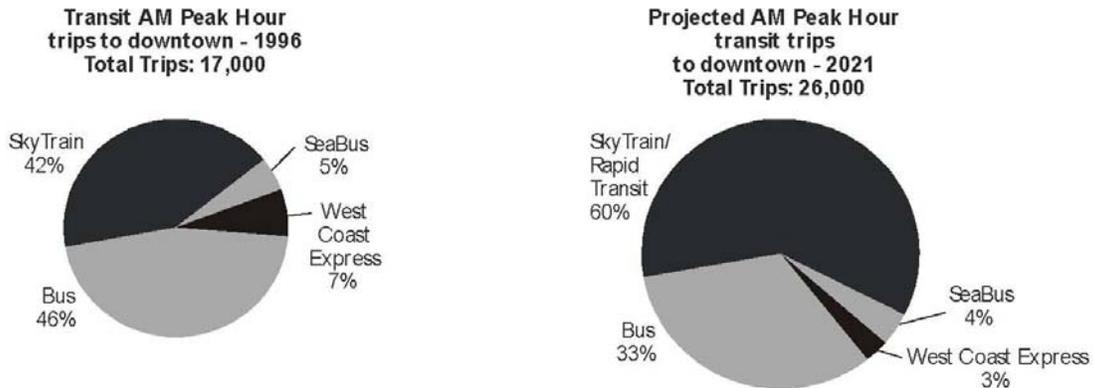
### **2.3 VANCOUVER: DOWNTOWN TRANSPORTATION PLAN**

The City of Vancouver approved the *Downtown Transportation Plan* (DTP)<sup>6</sup> in July 2002. Founded on the policies and directions of the LRSP, Transport 2021, TYP & TYO and other policy documents, the premise of the DTP is based on a commitment to accommodate pedestrians, cyclists, and an enhanced public transit system. Without adding any new road capacity, the DTP strives to improve mobility within a downtown core that has doubled its residential population in the last 15 years and is expected to increase 31% more by 2021.

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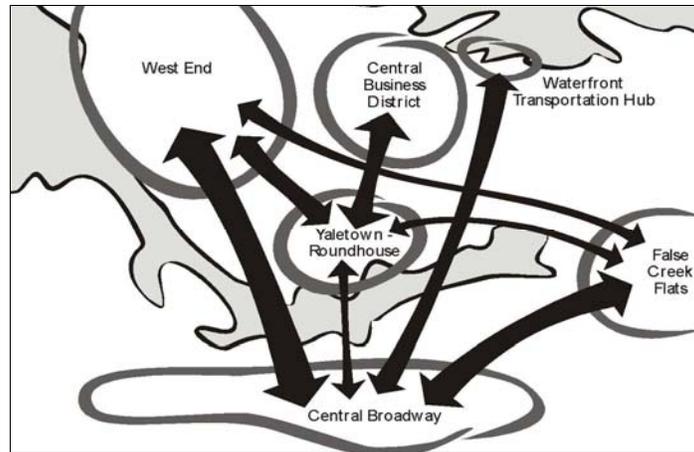
<sup>6</sup> See map of Vancouver Metropolitan Area in Appendix B

By 2021 the City expects to see a 45% increase in total number of transit trips to downtown. An increase in transit supply to accommodate new demand is necessary in order to support growth. Figure 2 depicts the City of Vancouver’s public transit ridership projections.



**Figure 2. Transit AM Peak Hour Trips (DTP, 2002)**

Plans for a downtown streetcar are explicitly referenced in the DTP. That the city of Vancouver has built itself out to the edges of Burrard Inlet and North False Creek (areas that are densifying and now in need of more public transit), is a strong motivation to add a new layer of transportation to the existing network (DTP, 2002). As various tourist destinations and activity nodes exceed comfortable walking distances, the streetcar system is intended to provide connectivity to these locations, as well as link to employment nodes, neighbourhoods and other transit services (e.g. SkyTrain, trolley bus, SeaBus and West Coast Express). Figure 3 shows the areas that are currently not well connected by transit.



**Figure 3. Poorly Served Transit Connections (DTP, 2002)**

The DTP recommends adjustments to the streetcar concept plan and consultant study that Council approved in 1999 to reflect a more current configuration. Station location changes, route adjustments and a greater commitment to have the streetcar run, where possible, on a segregated right-of-way (ROW) are the suggested alterations from the original study.<sup>7</sup>

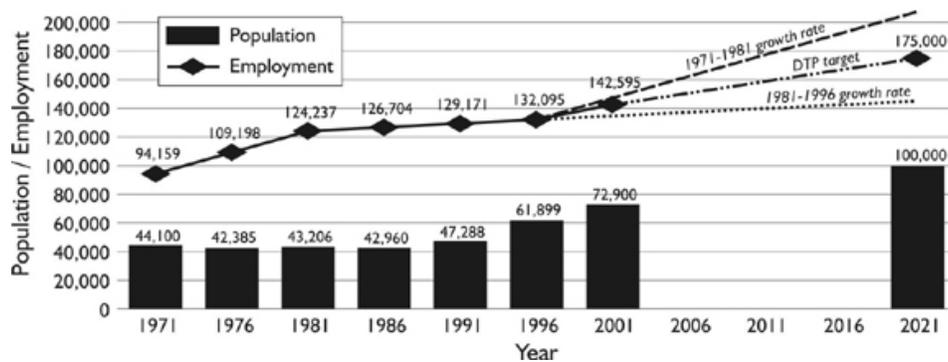
## 2.4 CURRENT TRANSIT TRENDS

The region has a high transit modal split, 10%, which is fairly impressive in relation to other Canadian cities (considering that the GVRD's transit service area is comparatively much larger). That said, numerous goals have yet to be achieved. The TYP & TYO anticipated a 17% modal split by 2006 which is an 85% increase from the current a.m. peak hour transit mode split. Transport 2021 aims for a bus fleet of 1,800 by 2006, and currently the region is stocked with 1,200 buses. Bus service, especially within the City of Vancouver where public transit use is high, calls for a need for improved transit priority measures in order to avoid congestion and provide residents with an efficient public transit service.

<sup>7</sup> Original proposal and current changes described in more detail in Chapter 3

Vancouver has doubled its downtown residential population from 40,000 to 80,000 in the last 15 years, and will reach 110,000 within the next decade. By refraining from adding new road capacity in the downtown while attracting more people to live and work in the city, automobile traffic coming onto the peninsula has not increased significantly in 30 years. The downtown core continues to densify in both daytime employment and residential population. The peninsula amounts to 5% of the city's land area (560 hectares) and receives 21% of the city's trip destinations (DTP, 2002). While development is building out to the peninsula's geographic perimeters, optimizing transportation in the Central Area entails managing the increased travel demand over the next two decades. The City's goal for year 2021 is to have 32% of all trips taken by transit, which is a 70% increase from our current situation.

Having a high concentration of residents and employment in the downtown core (13% and 39% respectively) is a promising attribute to work with when trying to implement transportation policies that accommodate residents' travel needs. Figure 4 shows current population and employment patterns as well as future goals.



**Figure 4. Population and Employment Patterns (DTP, 2002)**

Significant transit service expansion is necessary over the next two decades, and the downtown streetcar is being sought out by the city as part of the solution to reach this ambitious goal.

## **2.5 CURRENT & UPCOMING EVENTS IN VANCOUVER**

Transportation planning is impacted greatly by events that occur within the region, especially those that present a drastic shift in land-use, infrastructure and transit patterns. The streetcar needs to be examined in the context of these events.

### ***2.5.1 Winter Olympics 2010***

The International Olympic Committee announced that Vancouver was chosen as the city to host the 2010 Winter Olympics in July of 2003. In the nine months since, great efforts have been put towards preparing the city for these two weeks of international athletic events. Upgrading the Sea-to-Sky Highway, venue renovations and new infrastructure for the events are all currently underway.

#### ***2.5.1.1 South-east False Creek as 'Olympic Village'***

Along the Southeast rim of False Creek lies 20 hectares of public land (50 acres) between Cambie Street Bridge and Science world. This area is being planned and designed as an environmentally sustainable development community that will eventually house 15,000 residents. Prior to becoming a new residential community, it will serve as an athletes' village during the Olympic Games. With the intention of making little to no modifications after the Olympics are over, the South East False Creek (SEFC) community is a showcase project to exemplify strategies and innovations for building a sustainable city.

Accommodating ten hectares of designated parks, ground-source heating schemes and solar designs are some of the sustainable features being implemented in Olympic Village that will convert into rental housing, condominiums and social housing. The streetcar routing is planned to pass directly through Olympic Village, providing a transit

system segregated from traffic which fits in with the sustainable goals of Olympic Village.

The SEFC Transportation Study regards the proposed streetcar as a “Significant transit amenity to residents and employees of SEFC” (SEFC, 2003). The SEFC Policy Statement (1999) maintains restrictive parking standards for the area as well as a maximum of one car per unit which will reduce reliance on the private automobile. Residents will be a short distance by foot and bicycle from downtown (across Cambie Street Bridge) and transit opportunities by ferry, streetcar and rapid transit (RAV) can provide an array of transit options for SEFC residents.

A range of sustainable transportation strategies best suited for SEFC will reduce the potential trips generated based on population, residential units and commercial/office space on the site. If the streetcar project gets supported to the final stages of planning, it will be developed in time for the 2010 Winter Olympics.

### ***2.5.2 Heritage Streetcar Demonstration Line***

The City of Vancouver purchased a part of the Canadian Pacific False Creek rail site between Cambie Street and Granville Street in 1996. This was a very important first step as it created a demonstration line for the eventual proposal of a downtown streetcar.

This purchase currently provides a 1.5 kilometre corridor for two heritage streetcars that have been restored and running since 1998. Operating between Granville Island Market and Science World during summertime weekends, the Heritage Streetcar sees a total of 20,000 riders per season. Securing this corridor and running a demonstration line has allowed the City to seek expansion opportunities from this location.



**Figure 5. The Heritage Streetcar Route is Phase 0 of proposed Downtown Streetcar.**

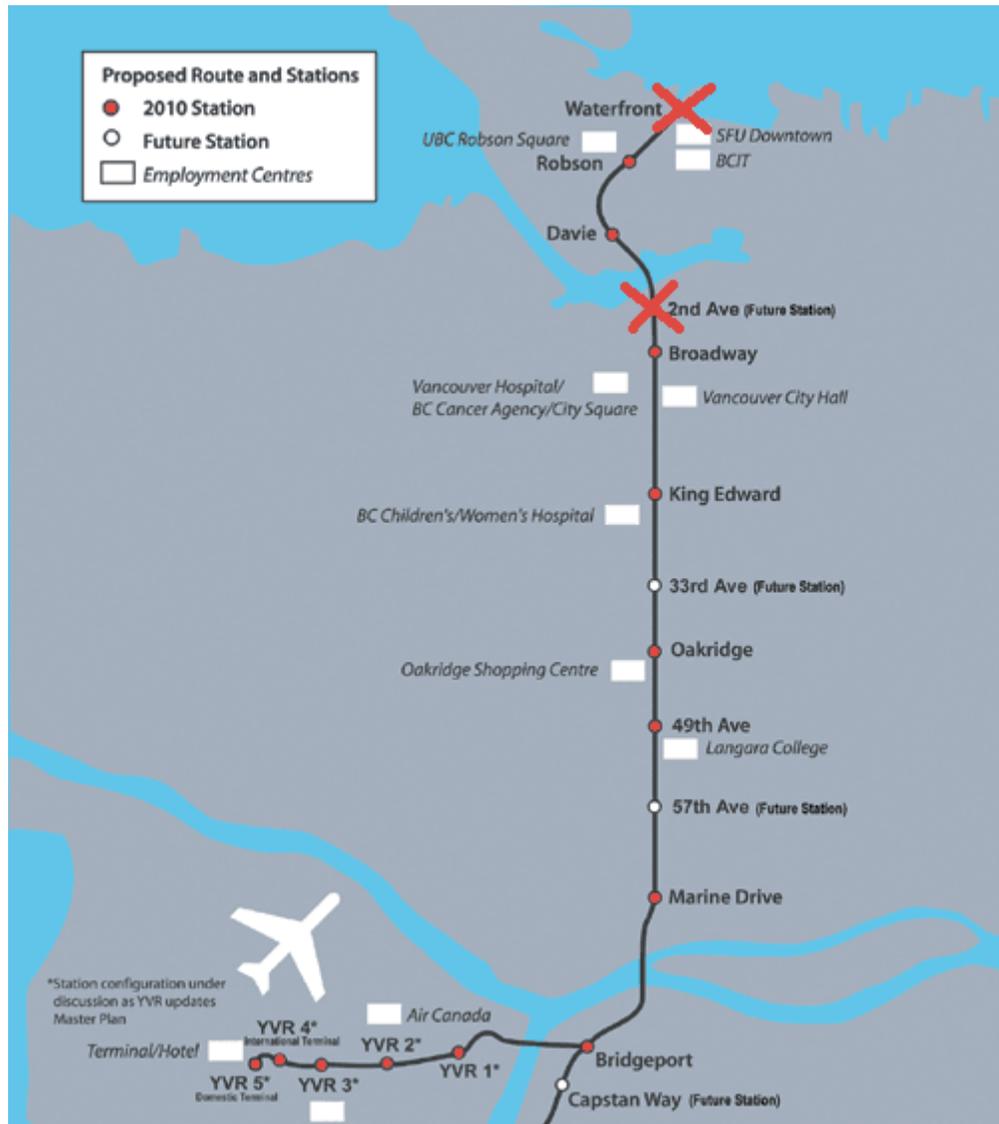
This Demonstration line is the initial phase of the proposed streetcar route (Phase 0). Because the technology of the streetcar differs from the heritage vehicles currently running, the existing track will need to be modified as well as the wheels on the heritage vehicles if they were to remain in use.

### ***2.5.3 Richmond – Airport – Vancouver (RAV) Rapid Transit***

The region is in the midst of a planning process for a rapid transit line that would potentially connect with the streetcar at two station points. This regional transit subway referred to as RAV (Richmond-Airport-Vancouver) is estimated for completion by 2009 and would link Vancouver to the Vancouver Airport as well as Richmond Centre. RAV, a \$1.6-billion transit line, proposes to travel along Cambie Street and consists of 18 stations along 20 kilometres of track and will be capable of handling 100,000 passengers a day.

If both the RAV line and the downtown streetcar project get built, the two station points in which they may integrate are important intersection areas for the streetcar (marked with an 'X' on figure 5). The southern station (2<sup>nd</sup> Ave. at Cambie Street) will allow streetcar patrons to access a direct route north to downtown on RAV, or to the

neighbourhoods south of downtown leading to the airport. RAV patrons will be able to access the streetcar and its destinations in the same way at the system intersection points. The northern intersection, Waterfront Station, is a major transportation hub where most of the City's transit modes are available for transfer.



**Figure 6. Proposed RAV Transit Route**

*Waterfront station is currently a transit intersection point for SeaBus, SkyTrain, West Coast Express, buses and trolley's. The station and surrounding area is undergoing a planning process that hopes to integrate the additional existing services of seaplanes, helijets, cruise ships and potentially the proposed Downtown Streetcar.*

Recently, however, RAV board members are looking for ways to reduce the cost of this project. Because the 2<sup>nd</sup> Avenue and Cambie Street station was proposed after the budget was established, this station might be removed from the route. Removal of this route will reduce the efficacy of the streetcar as a service to patrons from the RAV line travelling into or out of the city.

## **CHAPTER 3 – THE CITY OF VANCOUVER’S PROPOSAL FOR A DOWNTOWN STREETCAR**

### **3.0 INTRODUCTION**

Implicit goals and objectives are embedded in the Vancouver Downtown Streetcar Study (1999), various planning documents<sup>8</sup> and the DTP (2002). Although they are not explicitly listed in any of these documents, they were consolidated for the purpose of this report.

This chapter will summarize the information presented by the City of Vancouver on the planning and implementation of the proposed streetcar project.

### **3.1 GOALS AND OBJECTIVES OF STREETCAR PROPOSAL**

A downtown streetcar has been proposed by the City of Vancouver in order to meet the following objectives:

- Sustain a reduced level of automobile usage in the Central Business District (CBD)-
  - Provide transit to destinations that are currently lacking transit service, and are not well connected by transit;
  - Provide an attractive transit system that will encourage riders who otherwise would use private automobiles;
  - Provide a transit system that contributes to efforts towards a reduction in both air and noise pollution.
  
- Shape land-use and development-
  - Provide a transit system that supports investment in areas of new development, as well as areas of revitalization;

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<sup>8</sup> See City of Vancouver Administrative Report documents dated 1999, 2002, 2003 and 2004.

- Provide a transit system that both enhances and creates vibrant pedestrian streetscapes, contributing to an area's desirability as a place to live and/or work.
- Connectivity and accessibility-
- Create a distinct connection between tourist destinations and downtown neighbourhoods that are currently under-serviced by transit and not well linked to one another;
  - Provide residents and visitors with a well integrated transit mode that conveniently links riders to other modes of transit.

### 3.2 PROJECT TIMELINE

- In 1994 Vancouver City Council approved the preservation of the old Canadian Pacific False Creek rail site for the use of a streetcar line.
- The right-of-way was purchased in 1996 and the demonstration streetcar line was officially opened in July of 1998 running two restored interurban rail vehicles.
- In 1997, City Council approved funding for a consultant study to provide a cost analysis, ridership projections and possible alignment opportunities for streetcar extensions into the downtown.
- Public process events were held in 1998 which presented citizens and stakeholders with potential streetcar alignments for them to review and express preferences for.
- In 1999, council endorsed the first and second routing phases (described in the following section) that were presented in the consultant report titled *Vancouver Downtown Streetcar Study*, conducted by Baker, McGarva, Hart Architecture

(now VIA Architecture) and the City of Vancouver (Engineering and Planning departments).

- In July of 2004, City Council awarded a \$60,000 consultant contract to Mustel group to perform a Downtown Streetcar Market Research Study. These studies are currently underway (City of Vancouver, 2004*a*).
- A Request for Proposals (RFP) was made public in August of 2004 for submissions of design, track layout and ridership studies (City of Vancouver, 2004*b*). The City of Vancouver is currently in the process of choosing one of three proponent submissions. Proponent and submission information is not yet available.

### 3.3 ROUTING

The streetcar study conducted by the City of Vancouver (with VIA architecture as consultants) initially began with over twenty alignment concepts for a streetcar in the downtown core. After considering public input and various downtown opportunities and constraints, thirteen optimal alignments were modeled and assessed according to ridership potential and implementation costs.<sup>9</sup> Each of the thirteen alignments included the existing rail segment between Granville Island and Science World ('Phase 0' of the project), and were considered as potential extensions from Science World into the downtown core.

Using local transit data, ridership forecast modeling, tourism statistic numbers and projected populations in developing neighborhoods, the first and second phases of the downtown streetcar were determined and are described below. A 7.5 kilometre single-track perimeter route was

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<sup>9</sup> It should be noted that some of the assumptions incorporated into the modeling techniques was a GVTA fare structure of \$1.50 per boarding to evaluate revenue, as well as ten minute frequencies during peak hours.

favoured in the end for its ability to connect areas of high visitation, employment nodes and neighbourhoods while providing views of False Creek, the downtown skyline, Burrard Inlet and the mountains. All data (unless otherwise noted) has been extracted directly from the Downtown Streetcar Study (1999).



Figure 7. Proposed Streetcar Route (DTP, 2002)

### 3.3.1 Phase 0

From Granville Island to Science World, the streetcar with its phased extensions will travel east along 1<sup>st</sup> Avenue and head north on Quebec

Street. This segment will pass through the neighbourhoods of False Creek South, Southeast False Creek (SEFC) and False Creek North Citygate community.

The transit nodes along this segment will provide connections to the ferries (Aquabus and SeaBus) at Granville Island, the RAV line at the proposed 2<sup>nd</sup> Avenue and Cambie Street station, and the SkyTrain at Main Street station.

Streetcar stations will be located at Granville Island, at the intersections of 6<sup>th</sup> Avenue/Alder, 6<sup>th</sup> Avenue /Heather, 1<sup>st</sup> Avenue/Yukon and at Science World.

### ***3.3.2 Phase I***

Phase I will provide linkages to Chinatown, Gastown, the Granville corridor and the Convention and Exhibition Centre. The streetcar will travel north on Quebec to Columbia Street, then east on Cordova Street.

The segment from Science World to Waterfront Station was chosen for Phase I because it performed best in opening day conditions and cost recovery based on the computer modeling.

The transit nodes along this segment will be along bus routes through Chinatown and Gastown with a major transit hub link at Waterfront station (with available transfers to buses, SkyTrain, West Coast Express, SeaBus and RAV rapid transit).

Streetcar stations will be located at the intersections of Quebec/Pacific, Quebec/Keefer, just east of Abbot/Cordova intersection for direct access to Blood Alley, and in front of Waterfront Station on Cordova Street.

Based on opening day riders evaluated with the EMME/2 model (a transportation demand modeling software) and tourist data, Phase 0 and

I annual ridership was projected to be 3.42 million, with 77% operational cost recovery.

### **3.3.3 Phase II**

From Science World to Granville Street, Phase II will provide linkages to GM Place, BC Place Stadium, Plaza of Nations, Roundhouse Community Center, the Yaletown neighbourhood, North False Creek neighbourhoods and the Granville corridor. From Quebec Street the streetcar will travel west and south on Pacific Boulevard, then west on Drake Street and terminate at Granville Street.

The main transit node along this segment will be at the Granville Street terminus providing bus connections.

Four streetcar stations will be located at the Quebec/Pacific intersection; between GM Place and BC Place Stadium on Pacific; under the Cambie Bridge on Pacific; and at the Pacific/Davie intersection.

Based on opening day riders evaluated with the EMME/2 model and tourist data, Phase 0 and II annual ridership was projected to be 2 million, with 36% operational and capital cost recovery.

### **3.3.4 Potential Extensions**

Alignment extensions beyond the Phase 0, I and II segments are being considered for the long term to pursue better access both within the Central Business District (CBD) and beyond.

- Waterfront Station to Stanley Park would provide links to waterfront amenities, SeaBus and the Burrard Landing employment node. This extension receives a great deal of attention in the proposal because ridership forecasts were high, making it a likely consideration. It requires that Cordova Street is extended west of Burrard Street.

- Utilizing the Arbutus corridor from Granville Island would provide access to the Broadway arterial and the neighbourhoods of Fairview, Kitsilano, Shaughnessy and Kerrisdale.
- Granville Island to Vanier Park could provide access to the Kits Point destination as well as the neighbourhood of Kitsilano.
- Science World to Vancouver Community College SkyTrain station would service various uses proposed within the False Creek Flats. An education hub along Great Northern Way as well as an extension into the terminus of the Millennium SkyTrain line are the current uses this extension would access.
- North/South extension possibilities in the CBD is on Granville Street. East/West possibilities are the Robson and Alberni corridors.

### ***3.3.5 Employment Nodes***

The predominant employment nodes serviced by this perimeter route are Granville Island, GM Place/BC Place/Plaza of Nations, Yaletown, the Convention and Exhibition Centre, West Hastings corridor and the Central Waterfront District. Downtown employment is expected to increase 30% by 2021 (DTP, 2002).

## **3.4 SYSTEM CONSIDERATIONS**

### ***3.4.1 Right-of-Way***

The City of Vancouver has expressed a commitment to running the streetcar segregated from other traffic where possible. The proposal recognizes that having the streetcar on its own right-of-way with signal priority at intersections impacts congestion, trip time and appeal for patrons. The right-of-way for the streetcar along each segment is still being examined, but proposed for the majority of the route.

### ***3.4.2 System Integration***

Because it has been identified through modeling that riders on the streetcar will likely be boarding or disembarking from another mode of transit, it is a goal to provide a fluid transfer system from one mode to another. Being balanced with other transportation modes includes operating safely with pedestrians and cyclists. Integration will necessitate the City of Vancouver to work closely with TransLink and the system operator.

### ***3.4.3 Track***

Track gauge is being considered to reduce obstruction for cyclists so that the groove in the road surface will not be a hazard. Materials, such as grouts that embed the tracks and wheels with internal rubber layers are being explored to reduce noise and vibration in sensitive neighbourhood areas.

### ***3.4.4 Costs***

The original estimation for the streetcar implementation and operation was projected to be \$65 million CAD, with almost full operational and capital cost recovery for Phases I and II. Recommended changes from the 1999 study have been made and are expressed in the DTP (2002) that will heighten costs significantly:

- Streetcar stations have been added;
- Station locations are being subject to change;
- The technology originally desired was a less-expensive replica heritage style streetcar on a single track system. The City of

Vancouver now desires modern low-floor light rail vehicles<sup>10</sup> on a double track system for better efficiency.

A more detailed and updated cost-analysis is being performed currently to better understand both capital costs, operating costs and cost recovery of the proposed system.

### ***3.4.5 Route Redundancy***

The Vancouver Downtown Streetcar Study emphasizes the intention to avoid route redundancy with existing bus routes on the system. The #50 bus route,<sup>11</sup> however, is the one line that may cease if the streetcar system goes forward because of redundancy. The daily boardings for the #50 bus are fairly low (4,220), and patrons dependant on this route will not be significantly compromised.

The #50 bus travels across the Granville Bridge which the streetcar does not, yet patrons will be able to access the bridge from the same stations with other buses that stop there. The #50 bus route also reaches the downtown east-side via the Granville Bridge, which the streetcar serves, but may add a few minutes to trip time.

If the proposed streetcar route and potential extensions cause other bus routes to be re-considered, the City will need to be aware of existing bus patrons and their destinations before making changes to service that might have a negative impact.

## **3.5 RIDERSHIP**

The Vancouver Downtown Streetcar Study identifies three categories of patrons that the streetcar will serve:

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<sup>10</sup> A low-floor vehicle design regards the curb level entrance of a bus and the lack of stairs, providing ease of access for boarding.

<sup>11</sup> See Appendix C for map of #50 bus route

- Commuter riders:
  - Residents traveling to and from work within the downtown
- Downtown tourist riders:
  - Tourists staying in the downtown area
- Lower Mainland recreation riders:
  - Tourists and residents staying outside the downtown

A projection of approximately 5,000 patrons per day (1.8 million annual boardings) was evaluated for Phase 0 and I, using the EMME/2 model for residents as well as data from Tourism Vancouver for visitors. These estimates assume system maturity (2-5 years of operation) and a full build out of the downtown. These projections were performed with many factors still undecided. Further ridership analysis is currently being carried out to retrieve more accurate and detailed data.

City Council did endorse Phase I and Phase II based on the original routing, costs and ridership projections prior to any future changes. The initial decisions and estimates are therefore relative to this analysis.

## CHAPTER 4 –A DISCUSSION OF THE ECONOMIC, SOCIAL AND ENVIRONMENTAL FACTORS FOR STREETCAR IMPLEMENTATION

### 4.0 INTRODUCTION

This chapter will review the dominant perspectives in literature regarding the use and investment in fixed rail as a new mode of public transit, and discuss how it pertains to Vancouver’s proposal. What becomes apparent when examining these various viewpoints is that to define the success of rail projects becomes a subjective and ambiguous definition for public transit investment. There are many factors and opinions that correspond to choosing fixed rail infrastructure, hence the discussions in this chapter relate specifically to the City of Vancouver’s goals for the Downtown Streetcar.

### 4.1 ECONOMIC FACTORS

“One of the main goals of this study has been to determine cost-effective streetcar routes that implement City policy in terms of land use, development, and transportation... We now have a fairly complete picture of what the downtown may look like in 25 years. It is therefore possible to consider connections and services between existing, developing, and future downtown neighbourhoods” (City of Vancouver, 1999).

#### ***4.1.1 Fixed Rail Investment to Shape Land Use and Development***

A considerable amount of literature speaks of fixed rail transit modes as a catalyst for residential and commercial development. Every streetcar feasibility study examined for this report claims that the stimulation of development is a central objective for the investment in streetcar transit<sup>12</sup>.

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<sup>12</sup> See references for Savannah, Seattle, Miami streetcar feasibility studies in References.

The permanence of streetcar infrastructure is what has shown to create the active relationship between land-use and rail transit. Buses take people over a wide geographic area to where their destinations and activities occur (Paaswell and Berechman, 1982), whereas streetcar service is a fixed, permanent system that can generate both residential and commercial development which depends on, and interacts with fixed rail mode. High residential densities and mixed land uses along streetcar corridors can then help to bring patronage during off peak hours as well as contribute to general commercial vitality.

The City of Portland is most often used as an example for a successful streetcar service. The system was introduced as part of a planning strategy to accommodate an influx of residents in their downtown core. Using modern streetcar vehicles along a 4.8 mile loop (covering 2.4 miles of area), the Portland Streetcar is credited with being an instrumental tool for shaping the \$1.3 billion in new development since the decision was made to build the line. It runs through established commercial districts with high pedestrian activity, as well as two downtown neighbourhoods that are planned to accommodate one-fifth of all the new jobs in the downtown and half of the new residences.

Streetcar advocates argue that the bus is a mode that does not have profound effects on development. Advocates also see the fixed rail trend as a situation where all stakeholders win: City governments gain capital from property taxes of increased land values and receive a boost for revitalization in areas of blight; developers receive clientele at their doorstep and the community gets access to employment, recreation and residence (Newman and Kenworthy, 1992).

From this perspective, streetcars can be perceived as a kind of 'selling point' to get the attention of developers for cities considering this mode of transit in their urban areas. Although the costs for a streetcar

system are relatively expensive (Portland's 7 streetcars, 2.4 miles of service area and infrastructure cost approximately \$74mil CAD), advocates deem the development benefits in economic vitality to be well worth it.

The City of Vancouver is not expressing an interest in a streetcar for the sole purpose of catalyzing development. Although there is a goal to shape land-use and development, the housing and commercial markets in the downtown area have seen a healthy amount of development activity without the introduction of rail on city streets. However, the streetcar routing is travelling through areas that are undergoing revitalization, such as Gastown on the east side of the peninsula. The streetcar is also passing through areas that are undergoing significant land-use changes, such as the residential development being constructed in False Creek North near BC Place Stadium.

The Downtown Streetcar can economically benefit these areas by making them more appealing for potential investments and future residents. The Vancouver Downtown Streetcar Study, however, does not depict the streetcar project as one that is necessary in order to shape land-use and development.

#### ***4.1.2 Costs of public transit systems***

As far as streetcars serving as both a mobility and land-use development tool, opponents argue that the high costs of rail make fixed rail infrastructure an unnecessary expenditure when a bus can potentially serve the same purpose. In order for this project to be justified on an economic basis, it is beneficial to show that another system is not capable of providing the same benefits as a streetcar system. Because the City of Vancouver has identified a route that necessitates better public transit and connectivity, it is assumed that bus transit service will be pursued if a rail system presents too many obstacles.

#### ***4.1.2.1 A Definition of Bus Right-of-Ways***

A Bus right-of-way is a broad term that describes a variety of ways in which a bus can be operated. It can refer to a Bus Rapid Transit (BRT) system that travels in High Occupancy Vehicle (HOV) lanes on a dedicated freeway corridor. It also refers to dedicated busway lanes throughout the city so where the bus remains predominantly segregated from other vehicle traffic. The latter operation, with low-floor electric trolley vehicles that utilize onboard and off board technology, is the way in which a bus can be effectively compared to the kind of streetcar system the City of Vancouver is interested in implementing.

Dedicated busway lanes within a city's core provide for the efficiency of movement, speed and service frequency that streetcar rail corridors accommodate. The appearance, fuel and capacity of trolley bus vehicles can be found in a range of possibilities that resemble light rail vehicles.<sup>13</sup> System technology such as traffic signalling priority and fare collection contributes to an accelerated travel and boarding process in the same fashion that light rail systems operate.

#### ***4.1.2.2 A Cost Comparison***

To conduct a cost comparison of light rail and bus, it is important to contrast similar types of service to consider the performance of two technologies. The recent models of articulated electric trolleybuses allow for equivalent patron capacities as streetcar vehicles. Often when light rail is being compared to bus, there is a failure to contrast vehicles of similar performance. Light rail vehicle capacity numbers have been used to argue that costs per passenger per kilometre are lower on light rail systems compared to bus systems (Hensher, 1999). Without comparing

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<sup>13</sup> The Federal Transit Administration (FTA) has a website dedicated to providing information on bus transit systems, vehicles and technologies that operate as many light rail vehicles do.

similar vehicles based on the required demand, a proper comparison can not be achieved.

In order to use real numbers that are founded on existing demand, Appendix D shows a basic cost comparison based on the existing #6 Davie/Downtown bus route. Using an actual route where the daily passenger boardings, revenue hours and length of the route are already known creates for a realistic test environment to compare two technologies. The following is a list of equivalent operations for both systems:

- Both electric trolley buses and electric streetcars are zero-emission vehicles that necessitate power from an overhead wire.
- Articulated trolley buses can accommodate similar rider capacity to a streetcar vehicle.
- Both technologies have the ability to operate at the same speed hence provide the same headway along the route.
- Both technologies can be provided with a segregated right-of way on the road network where desirable.
- Both systems can be implemented with the policy measures that create an apparent relationship between land-use and public transit (densities, mixed uses and pedestrianisation schemes).

The cost comparison in Appendix D shows that even though a streetcar vehicle may have twice the lifespan of a trolley bus (30 vs. 15 years) as well as have 50% more riders because of the tourist attraction, the cost per passenger ratio still equates to being 3.5 times greater for a streetcar system than for a bus-based system.

Streetcar proponents argue that the comprehensive benefits and advantages of fixed rail systems are difficult to measure (e.g. shaping land-use), and accrue over time. That buses don't have an impact on land-use is not entirely correct, "It is the accessibility premium that attracts

real estate development, not the type of transit equipment” (Cervero, 1998, p.412). Bus transit systems in Ottawa, Canada and Curitiba, Brazil have shown significant developments occurring in their transit corridors while being much more cost-effective than fixed rail projects (Hensher and Waters, 1994).

#### ***4.1.3 Patronage***

To reduce a transit efficiency argument to a fixed rail system versus a bus-based system undermines the issues around public transit investments. Promoting a transit system that accommodates the needs of a transit dependant population, attracts new patrons and invigorates surrounding land-uses is a commendable endeavour. Too often, however, transit mobility and accessibility are made second to development ambitions. “The appreciation of land values and the agglomeration of activity close to stations should not be seen as of higher priority in an overall metropolitan strategy, in contrast to improving mobility and accessibility” (Hensher and Waters, 1994, p.152).

Portland, Oregon’s Metropolitan Area Express (MAX) light rail system, for example, is considered to be an unprecedented success. If public transit success is defined by the instigation of economic development and commercial vitality solely, then it is challenging to argue the reputation MAX has achieved. Tri-Met officials have estimated over \$700 million in development has occurred since light rail came (Arrington, 1996).

The majority of MAX riders, however, are ‘choice’ riders, i.e., those who own private automobiles but choose to use MAX for certain destinations. Tri-Met (the public agency that provides mass transit to the Portland area) shows on their website that only 17% of MAX riders are

using the system for essential work trips which means that 83% are on MAX for shopping and recreational reasons.

Tri-Met's MAX-only riders average eight trips a month on MAX, 76% own private automobiles and the median income is \$64,000 U.S annually. Tri-Met's bus-only riders average twenty-one trips a month, don't have access to a private vehicle (captive riders) and depend on transit for essential work trips. This demonstrates that MAX has been somewhat successful as being a mode that attracts patronage from their cars for shopping and recreational trips for a particular socio-economic sector of the population, and most successful in the economic development that it helped to attract along its corridors.

The City of Vancouver is striving to accommodate residents travelling to and from work with the Downtown Streetcar. Careful planning should be done to serve essential work trips as well as recreational and tourist travel. When large amounts of scarce subsidy benefit 'choice riders' and private enterprise predominantly, the goal of improving mobility and accessibility for those dependant on public transit will not be achieved.

The proposed streetcar route travels through areas of development, revitalization and established neighbourhoods while connecting various recreational destinations. As a perimeter route, Phases I and II are not travelling along corridors of high pedestrian activity. Because a streetcar is a pedestrian amenity that is accessed by foot as well as other modes of transit (as opposed to accessing the streetcar via a park and ride lot), it is expected to enhance the public realm and help create a pedestrian environment along its corridors in conjunction with the city's pedestrian and urban realm plans.

## 4.2 SOCIAL FACTORS

“The recommended routes are planned to provide increased accessibility between existing and developing neighbourhoods as well as with existing destination points” (City of Vancouver Council Report, 1999).

### 4.2.1 Increase Accessibility and Improve Connectivity

The proposed streetcar perimeter route connects areas of high visitation by tourists and recreational residents, as well as neighbourhoods and employment nodes. The downtown residential and employment populations in these areas are expected to see significant growth by the year 2021. Figures 8 and 9 below illustrate growth projections by neighbourhoods.

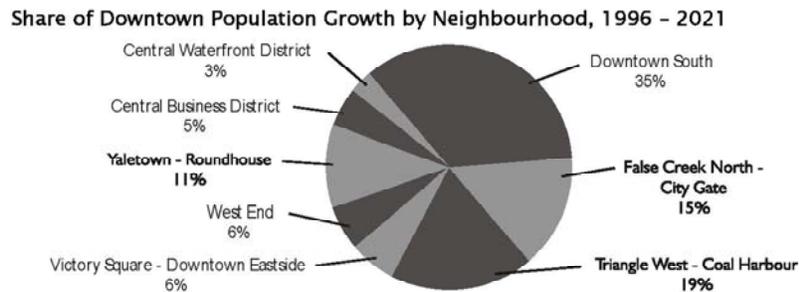


Figure 8. (DTP, 2002)

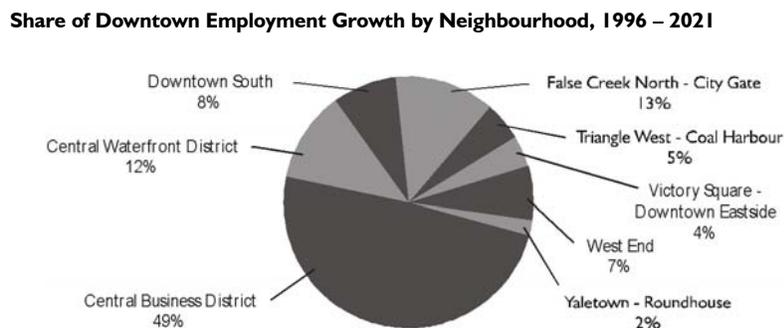


Figure 9. (DTP, 2002)

Of the residents living downtown, 45% commute to workplaces off the peninsula mainly in private vehicles (DTP, 2002). The streetcar can serve these residents after work and on weekends to reach downtown destinations if they reside in proximity to the new system. The remainder of the residents will be served by the streetcar for essential work trips only if the origin-destination links offered by the perimeter route will match their places of employment and residence. Otherwise, the streetcar will provide them transit for recreational use as well as connections to other modes of transit.

For residents and tourists staying outside the downtown peninsula, the streetcar will serve as a mode of transit depending on whether they are arriving to the City by private automobile or by public transit. It is possible that the proposed RAV transit line, which intersects with the streetcar at two nodes, could bring more visitors (who would otherwise use a private automobile) into the downtown making the streetcar a viable transit option for them.

For tourists staying within Vancouver's downtown, the streetcar is intended to provide an attractive mode of transit to reach various neighbourhoods and points of interest. Granville Island, for example, sees over ten million visitors each year, 71% of which are from outside of British Columbia<sup>14</sup>. During both the summer and winter months, over 65% of Granville Island's visitors are arriving by private vehicle. The streetcar can aid in reducing the number of vehicles used to reach this destination while offering an attractive mode of transit to get to other areas along the perimeter route.

A question commonly raised in the 1998 public process was *who is the streetcar for?* (City of Vancouver, 1999). Although the City explains that the project is intended to accommodate residents, employees and

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<sup>14</sup> Information on Granville Island accessed from the website of the Canadian Mortgage and Housing Corporation (CMHC), managers of Granville Island on behalf of the Government of Canada.

tourists, the routing may seem to better address tourism needs than those of residents and employees. Phases 0, I and II directly connect tourist destinations to each other, and offer transit connection to other modes. Transfers and transfer time is an undesirable characteristic for transit passengers, particularly residents travelling to work or school (Cervero, 1998; Hensher, 1999). Until the streetcar is built out with extensions that reach further into and away from the downtown core, the initial perimeter route may predominantly serve visitors.

Some of the initial routing options that penetrated into the downtown peninsula were eliminated due to high capital costs and technical difficulties (Vancouver Downtown Streetcar Study, 1999). Avoidance of route redundancy with other buses was also a factor that contributed to the perimeter route. The decision making framework used to put the streetcar along the perimeter seems to search for a way to link destinations to each other on a route that presents the least technical difficulty.

#### ***4.2.2 Public Realm***

Proponents of streetcar systems emphasize the positive effects this mode has on the public realm. Streetcars can adapt to streetscapes that already have bustling commercial centers as well as help to create vibrant pedestrian corridors in conjunction with complimentary initiatives (Cervero, 1998; Vuchic, 1981). Measures for pedestrianisation are seemingly easier to achieve politically with a rail line penetrating urban corridors as opposed to a bus (Hass-Klau et al, 2000).

That the upcoming neighbourhood of SEFC is being masterplanned with the inclusion of the streetcar is a great social benefit. In combination with the restrictive parking and vehicle capacity measures, residents will resort to alternate modes of transportation, including the streetcar,

instead of choosing private automobiles. The potential extension east of Science World through the False Creek Flats to Vancouver Community College SkyTrain station travels through upcoming development nodes that would increase accessibility from the station to the downtown core. It should be noted, however, that the same benefits are likely to occur if a bus with comparable service characteristics and land-use initiatives were employed.

#### ***4.2.3 Public Perception***

The social benefit that is most important is that in general, citizens respond positively to the notion and aesthetics of a streetcar travelling along their urban corridors. Some contribute this to the identity of rail transit being strong and very legible due to the permanence of their tracks (Vuchic, 1981). Others contribute it to a more symbolic meaning; an ancestral memory of a past era that recalls the exciting efficiency of the first streetcar systems (Weyrich and Lind, 2002).

There is a different kind of perception of buses that is associated with a negative stigma (Knack, 1994). This stigma, in some cases, refers to the bus as a transit mode for a lower social class (Cervero, 1994). In other cases the stigma refers to the character of a bus; too noisy, polluting and obtrusive for a pedestrianised street in comparison to light rail (Hass-Klau et al, 2000). That streetcars are perceived as being faster, quieter and more comfortable than buses make light rail projects more readily accepted by the public. The availability of modern electric trolley buses, however, allows for the remedy of the negative stigma linked to the bus.

The City of Vancouver's Downtown Streetcar Study (1999) describes a positive response from the citizens involved in the public process in February of 1998. After an initial open house, cost estimates were determined and computer modelling was performed to forecast ridership

and cost recovery. The public did initially express concerns about the costs of the streetcar compared to trolley buses, but the projections were brought back to the public and citizens were supportive.

“Forecasts are politically influential and... their accuracy is difficult or impossible to prove. They are also technically complex and difficult for the public and elected officials to understand” (Wachs, 2001, p.370).

Public support for a system is influenced by perceived impacts, ridership projections and economic forecasts. Numerous studies have shown the extent to which ridership forecasts have been inflated and costs of rail systems have been underestimated in order to get federal funding and public support to construct the system (Pickrell, 1992; Mackett and Edwards, 1998; Richmond, 2001; Flyvbjerg, 2002).

That the City is now investing in modern low-floor streetcar vehicles contributes greatly to the attractiveness, convenience and accessibility of patrons. Seniors, children, riders with strollers and the disabled will be able to board, occupy and disembark with a greater level of ease than a high floor system. Providing this kind of physical comfort enhances the image and acceptance people will have towards a mode of public transit (Topp, 1997).

The City of Vancouver needs to engage the public in further participatory processes since it has made changes to the streetcar proposal in both routing and technology (which will alter costs and ridership projections). The proposed streetcar project represents a large public investment and the actual benefits should match the expectations which led the City of Vancouver to select this mode of transit.

### 4.3 ENVIRONMENTAL FACTORS

“The complementary activities of the downtown have expanded beyond the limits of reasonable walking distance. The city is consciously seeking out attractive transportation alternatives to the private automobile, both for commuter travel and to support this array of nodes in its Central Area” (City of Vancouver Council Report, 1999).

#### *4.3.1 Noise and Air Pollution*

A goal of the DTP is to reduce traffic congestion in order to mitigate the air and noise pollution that it creates. Reducing the demand for automobile trips by providing additional transit choices, such as the Downtown Streetcar, is a strategy used as a means to this end.

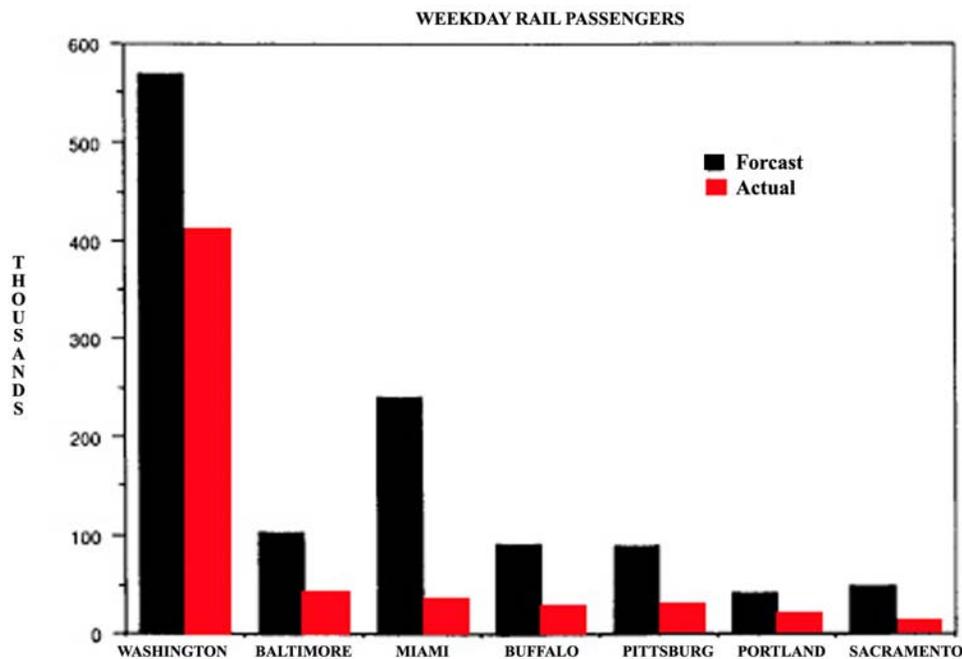
Light rail is often argued to be the best competition for the private automobile in terms of environmental sustainability. Their image is sleek; their power source is renewable; they offer smooth rides and don't make much noise in comparison to automobile traffic (Newman and Kenworthy, 1999). People find street pedestrianisation efforts are degraded by buses but enhanced by electric streetcars (Hass-Klau et al, 2000). By helping to shape land-use for more compact development, advocates further promote light rail as a mode that bestows environmental benefits. Providing high-quality, attractive rail service is seen as key to attracting riders from cars and consequently reducing congestion.

Some studies have shown, however, that light rail does not provide much improvement in congestion or air quality. After examining multiple transit systems in the U.S.<sup>15</sup>, Jonathan Richmond concluded that “with low ridership and most patrons drawn from bus transit, there is no case where new rail service has been shown to noticeably improve highway congestion or air quality” (1998).

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<sup>15</sup> Richmond investigated the public transit in 13 U.S. cities, 11 of them offering rail transit.

The number of new transit riders that a rail system draws is the main factor for its ability to abate congestion and reduce pollution. Ridership forecast levels reflect air quality benefits which lead to the justification for selecting this transit mode. If actual ridership is consistently below forecasting projections (as shown in Figure 10 below), then the air quality benefits implied when selecting light rail are consistently not being met.



**Figure 10. Weekday Rail Passengers (from Pickrell, 1992).**

That forecasts can become somewhat of an exercise in advocacy begs the question of what purpose public transit is essentially supposed to serve. "Should transit get drivers out of their cars, or should it serve people who have few transportation alternatives" (Grengs, 2002, p. 170)? These are competing objectives that find resolve in transit projects that serve both 'choice' and 'captive' riders. Electric streetcar infrastructure is a very attractive, but very expensive system. Enticing people out of their cars as a justification for the costs of rail transit is debatable when ridership levels

are only modestly being increased. High costs may exclude and take resources away from those who need transit most.

## CHAPTER 5 – SWOT ANALYSIS

### 5.0 INTRODUCTION

As mentioned in Chapter 1, a SWOT analysis was performed in order to assess the internal and external variables that reflect the conditions for the proposed streetcar project. The analysis provides information that offers the public and the City a greater understanding of the considerations involved in the implementation of a streetcar in the City of Vancouver. Most importantly, the simplicity of a SWOT analysis renders the benefit of an objective inquiry that contributes to strategy formulation to match internal resources with external characteristics; to identify threats and weaknesses in order to minimize them or convert them to opportunities and strengths.

Listed below are the SWOT elements as they relate to the social, environmental and economic principles, as well as policies and local context. There is a great deal of correlation amongst the elements, for example, an economic opportunity also defines a social strength, and an environmental threat can apply as an economic threat. The SWOT analysis as it is laid out below should be understood as an interchangeable accumulation of internal and contextual factors that regard the implementation of streetcar service in Vancouver.

### 5.1 POLICY PRINCIPLES AND LOCAL CONTEXT

#### **STRENGTHS**

- The City of Vancouver's goals for the streetcar reflect the strategies of the GVRD's LRSP and Transport 2021.
- The City of Vancouver aims to complete the streetcar project in time for the Winter Olympics in 2010 to accommodate the tourists arriving for the event.

- The City of Vancouver is connecting the streetcar route with the RAV line at two very important nodes. Both RAV and streetcar patrons will be able to access downtown destinations at these intersection points.
- The City of Vancouver will be continuing the route from the existing heritage streetcar demonstration line. Securing this corridor in 1996 and offering this service was a strategy to begin introducing streetcar service in the future.

### **WEAKNESSES**

- The City of Vancouver is proposing public transit infrastructure that is not on TransLink's agenda.
- The City of Vancouver does not explicitly illustrate the goals and objectives in the streetcar proposal.

### **OPPORTUNITIES**

- All policies including the LRSP, Transport 2021, TYP & TYO, and the DTP look to strategies that focus on developing attractive transportation services that compete with the automobile.
- The activity nodes in Downtown Vancouver have extended beyond a reasonable walking distance for visitors and residents.

### **THREATS**

- TransLink's TYP & TYO lists transit priorities over the next 10 years for transportation services in need of improvement. The streetcar project is not on their agenda. Shifting priorities to integrate the streetcar may risk that these improvements get delayed.
- The RAV station at 2<sup>nd</sup> Avenue and Cambie Street, a crucial node that intersects with the streetcar, is potentially being eliminated. The removal of this RAV station could result in the streetcar not being a viable mode to patrons trying to reach

neighbourhoods and destinations on the southern section of the streetcar route.

## 5.2 SOCIAL PRINCIPLES

### STRENGTHS

- The City of Vancouver organized a public process in 1998 that received a positive response from the citizens involved.
- The City of Vancouver is proposing a route that reaches tourist destinations and neighbourhoods that are currently not well connected to each other by transit. This will benefit both the actual and perceived connectivity of these locations and strengthen the identity of the destinations along the route.
- The City of Vancouver is proposing a modern low-floor streetcar vehicle which offers accessibility and comfort for patrons.
- The City of Vancouver is introducing streetcar transit service in the SEFC from the beginning planning stages of the neighbourhood in conjunction with measures that will ensure reduced vehicle dependence and high public transit utility.

### WEAKNESSES

- The City of Vancouver has not organized a public process since 1998. Different technologies, strategies and station locations are being considered by City staff without consultation from the wider community. Furthermore, the final report for the Downtown Streetcar Study was not made available for the public. A project that is continually inclusive of all stakeholders is likely to receive more public support.
- The City of Vancouver did not offer citizens an opportunity to choose system types. Low-floor, modern buses that are aesthetically and operationally similar to streetcar vehicles,

for example, was not presented as an option in the public process.

- The Downtown Streetcar Proposal does not provide details on origin-destination links utilized by public transit patrons who are dependant on transit. In order for the proposed system to be beneficial for commuters, this type of study should be conducted.

### **OPPORTUNITIES**

- The region has a high public transit modal split and the downtown modal split is impressively at 40%. Citizens use and depend on public transit systems in Vancouver and the streetcar will add another layer of transit options for transit users.
- Both the numbers of residents living downtown and downtown employment have seen significant increase in the past 10 years. That residents are living downtown and close to work can make the streetcar a great asset to residents.
- Citizens generally prefer a streetcar over a bus as a mode of public transport. Fixed rail transit is perceived to provide stronger legibility in routing and dependability as a system.
- Vancouver has a history of streetcar service which can strengthen its contextual identity as one that is anchored in historical significance.
- There is upcoming residential development and neighbourhood revitalization in areas along the streetcar route. These areas may be enhanced by streetcar services in creating vibrant pedestrian corridors, improving public realm and providing a viable source of mobility for residents.
- The City of Vancouver is the region's primary tourist destination and this industry is expected to grow 6% annually.

The streetcar reaches visitor destination areas that will cater to tourists and visitors.

### **THREATS**

- The TYP & TYO depicts public transit patrons in the region of which 70% are bus riders. Half of these bus riders do not have access to or own a vehicle. Shifting priorities away from improvements in bus services creates an issue of social equity.
- There is currently little or no pedestrian activity in many of the areas that the streetcar will travel through. If development and/or pedestrianisation measures in these areas get delayed, there will be few residents utilizing the streetcar system being that it is a pedestrian amenity.
- The Downtown Streetcar Proposal was a preliminary study that provided cost and ridership forecasts based on many assumptions. It compared ridership on various streetcar alignments, without considering the particular street on which the streetcar will operate. Forecasts that received public and political support may not have been representative of actual costs and ridership. Future viability of the system as well public trust may be threatened.

## **5.3 ECONOMIC PRINCIPLES**

### **STRENGTHS**

- The City of Vancouver is striving to make a strong connection between land-use and transportation by adding an attractive mode of transit to help catalyze development and shape growth.
- The City of Vancouver conducted a cost analysis that showed almost full cost recovery for the streetcar route.

### **WEAKNESSES**

- The City of Vancouver has not conducted a cost comparison between a streetcar system and a comparable trolley bus system. In a 1999 Council report, City staff outlines the intention to do so, but have yet to conduct and provide a comparison to the public.
- A simple cost comparison conducted for this report in Appendix D shows that a bus-based system is more economically viable than a streetcar system.

### **OPPORTUNITIES**

- Vancouver's economy benefits a great deal from its tourism industry. The streetcar's route addresses the role of accommodating visitors to reach popular destinations.
- Vancouver is enjoying a period of success in its economy as well as a reputation for being one of the most liveable cities in the world. This creates an opportunity to continue to develop the downtown area and invest in attractive public transit.

### **THREATS**

- The TYP & TYO lists much needed transit improvement priorities that have had long withstanding attention. Shifting financial priorities away from these improvements creates an issue of economic equity.
- A change in the economic environment of our region could cause upcoming developments to slow down or cease. Because the streetcar is serving a latent demand in patronage, there is a risk of there being little demand on the streetcar if future developments delayed.
- A change in the political environment could slow the tourist industry whose patronage is a large part of the proposed streetcar system's cost recovery.

## 5.4 ENVIRONMENTAL PRINCIPLES

### STRENGTHS

- The City of Vancouver's streetcar proposal complies with the region's goals of not increasing road capacity to reduce congestion and pollution for better air quality.
- The City of Vancouver is seeking out technology for the streetcar system implementation that is sensitive to noise pollution.

### WEAKNESSES

- The high cost of streetcar service may be difficult to justify for environmental sustainability without a comparison to another mode of public transit that does not provide the same quality.

### OPPORTUNITIES

- The GVTA clearly states in the TYP & TYO that it is committed to serving public transit patrons in zero-emission vehicles. Streetcar vehicles are zero-emission.
- All policies including the LRSP, Transport 2021, TYP & TYO and the DTP are concerned with congestion and air quality. Streetcar goals regard the incentive to reduce congestion and pollution.
- The only bus route that may have to be removed due to route redundancy with the streetcar is the #50 Waterfront Station / False Creek South line. The #50 is a diesel bus route, and it would be an environmental benefit to replace it with an electric transit mode.

## THREATS

- Congestion will not be reduced if patronage on the streetcar is low. Attracting new patrons who would otherwise use private vehicles is the main factor for the streetcar's ability to provide improvement in air and noise quality.
- The focus on increasing patronage for improved environmental quality is competing with the objective to provide mobility for populations that depend on public transit.

## 5.5 SWOT SUMMARY

Each of the social, economic, environmental and policy focused analyses indicates a substantial amount of both positive and negative attributes of a downtown streetcar in Vancouver.

The *strengths* throughout the analyses reflect the efforts and strategic decisions made by the City of Vancouver for the streetcar project. These *strengths*, as they continue to be used as a basis for developing the streetcar throughout the project process, could become stronger assets to the project as the weaknesses are minimized.

The *weaknesses* revealed in this analysis relate to the absence of certain strengths and should be minimized if possible. The majority of these weaknesses express a lack of project transparency to the public as well as a lack of comparison studies that justify the choice for a streetcar.

The *opportunities* throughout the analyses depict contextual characteristics that present favourable circumstance for a streetcar. The majority of these may be applicable to other modes of transit that are functionally comparable to a streetcar. The central *opportunity* that could not apply to any other transit mode is the public perception of, and preference for, streetcar technology.

The *threats* pertain to the unfavourable contextual conditions for a streetcar in Vancouver. A review of these threats puts the streetcar

project in a larger context where various conditions, policies and other projects may greatly impact the proposed streetcar. These threats inform the project by enforcing a perspective where greater involvement on all levels would be helpful as various other situations can affect the success of the streetcar.

## CHAPTER 6 – RECOMMENDATIONS

### 6.0 INTRODUCTION

A set of recommendations have been identified to strengthen the process of implementing a streetcar project within the context of Vancouver. The recommendations directly relate to the SWOT analysis in the Chapter 5 as well as the discussion in Chapter 4.

### 6.1 ECONOMIC

- Prepare a cost-comparison analysis of the proposed streetcar project versus other transit modes. This is a study that needs to be available to the public and one that is necessary to justify the streetcar project on an economic, social and environmental basis.
- Explore technology that reduces the cost of fixed rail investments. Portland, Oregon, for example, purchased their vehicles 'off the shelf' from a company in the Czech Republic called Skoda. The vehicles cost approximately \$2.4 million U.S each which is less than half of what many streetcar vehicles cost today. 'Off the shelf' technology can provide a lower budget for a high budget system.
- It is being recommended that a percentage of any surplus revenue generated from the streetcar project be hypothecated towards weak links in the transportation system. If scarce public resources are going to be allocated to a transit mode that may primarily serve 'choice riders' and visitors, it would be better justified if it contributed towards funds that enhanced other areas of the public transit system that are depended on by 'captive riders'.

## 6.2 ENVIRONMENTAL

- Because the streetcar project is said to fit into the sustainability framework of the SEFC neighbourhood, an opportunity is presented to build the streetcar as part of the whole region's sustainability framework.
  - Maximize environmental benefits of the streetcar by purchasing Renewable Energy Certificates, so that the electric vehicles will be powered by green resources.<sup>16</sup>
  - Attain ISO 14000 certification which is a series of standards that incorporates environmental considerations across all facets of the project. Certification would require that all manufacturer purchases be done from suppliers that are ISO certified as well.
  - Incorporate green design attributes into the streetcar system. From building a 'green' depot structure to running the track along vegetated or permeable surfaces, Vancouver has an opportunity with this project to capitalize on the environmentally conscious reputation it has been getting credit for recently.



**Figure 11. Lyon Tramway, France.**



**Figure 12. Bilbao Tramway, Spain.**

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<sup>16</sup> In April, 2004, TransLink entered into a partnership with BC Hydro and the Federation of Canadian Municipalities that helped TransLink to purchase green power certificates for their new trolleys.

### 6.3 SOCIAL

- Increase the level of public participation throughout the planning process for the streetcar project. Because expectations for proposed rail systems often do not match the actual benefits once in operation, involve the public in the assumptions that are calculated into forecasting models prior to modelling. This will not only increase public trust, but may provide effective feedback from citizens.
- Before investments are made towards extensions from the proposed route, consider incorporating an intermediate strategy where trolleys are placed first. Gauge route patronage by building up the system in which case the streetcar extension experiences less transition and receives more acceptance.
- Consider a decision making framework for future extension lines that evaluates whether it is best to service existing bus corridors with Streetcars versus corridors not currently serviced by transit. A streetcar on heavily travelled routes may provide a greater amount of mobility and connectivity for a greater amount of people.

## CHAPTER 7 – CONCLUSIONS

The City of Vancouver is seeking to bring back streetcar infrastructure to add a mode of transit that will attract patrons out of their cars and achieve both environmental benefits and a strong land-use/transportation connection. The technology chosen is one that necessitates a large public investment. The willingness to allocate such funds reflects a desire to increase and improve the mobility of citizens in the Central Vancouver Area, which has ultimately resulted in a region that has been fairly successful in overall transportation strategies.

The difference between 'choice' and 'captive' riders, however, forces us to consider the purpose of public transportation when examining projects such as the proposed streetcar. While there is a need to provide attractive alternatives to the private automobile in Downtown Vancouver, the investment in public transit systems should be cost-effective and produce maximum benefits in a socially responsible manner.

This report has attempted to reveal the various arguments surrounding the implementation of fixed rail infrastructure in urban areas. The purpose is to inform citizens of both the potential value and risk of a streetcar system that would be, as all public transit is, a public resource. The fundamental goal is to facilitate a more transparent planning process where citizens are able to ask the right questions and City officials are able to provide informative answers.

Because researchers have shown that similar systems are often not providing the impacts that were expected, designating a generous share from Vancouver's public transport budget needs to be done carefully and with meticulous analysis. In order to achieve a project that does provide the anticipated benefits and possibly more, perhaps all stakeholders should shift attention away from the technology that is being

proposed. Returning, instead, to the mobility goals that are seeking resolve in this proposal will provide a perspective that could ensure the building of a transit infrastructure that serves a transit need, not a transit trend.

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# APPENDIX A

## GREATER VANCOUVER REGIONAL DISTRICT

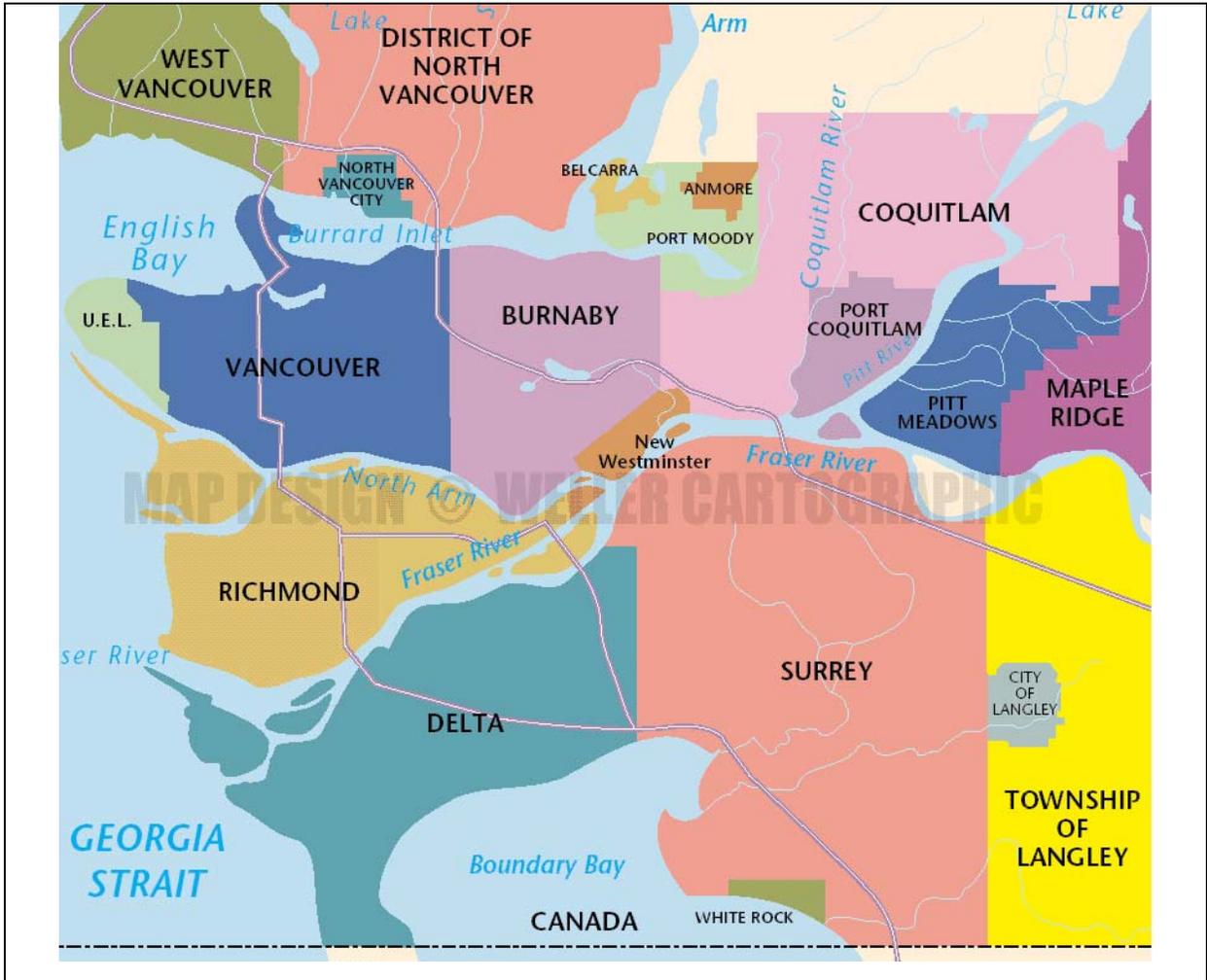
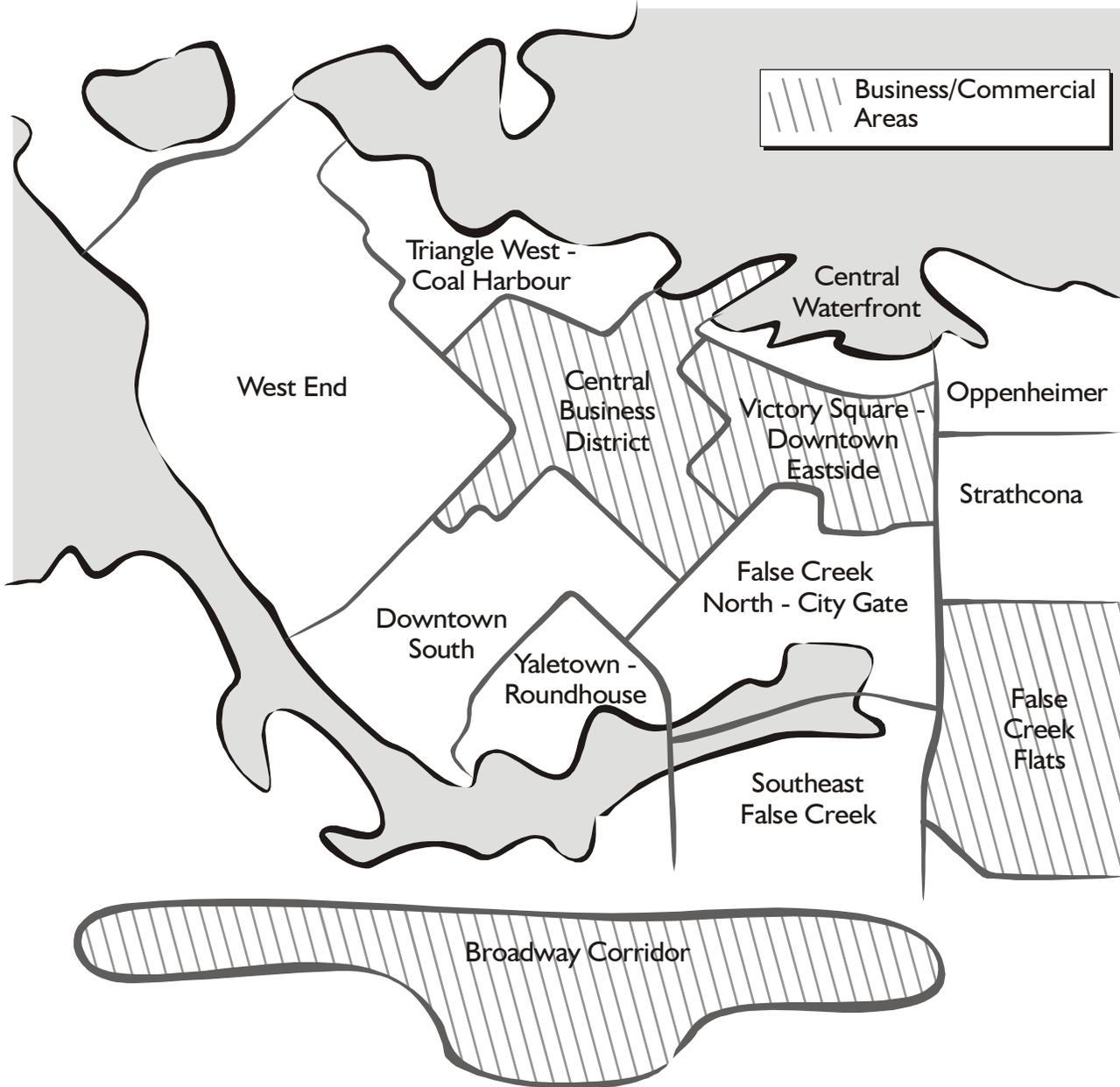


Image Source: Weller Cartographic Services Ltd.

APPENDIX B

Vancouver's Metropolitan Core



(DTP, 2002)

**APPENDIX C**

BUS ROUTE #50 – POTENTIALLY BEING DISPLACED BY STREETCAR

(Map on following page)



## APPENDIX D

### STREETCAR / TROLLEYBUS COST COMPARISON

This cost/comparison table is based on converting existing route #6 to a streetcar or articulated trolley service.

#### Assumptions:

- \*Service Operates as per Route #6

*Distance one way (km)	2.5
Capacity of Rail Vehicle <sup>1</sup>	85
Capacity of Conventional Trolley Bus <sup>2</sup>	60
Capacity of Articulated Trolley Bus <sup>3</sup>	85

#### COSTS

Street Car Capital Cost <sup>4</sup>		\$2,400,000
Trolley Coach Standard <sup>5</sup>		\$800,000
Trolley Coach Articulated <sup>6</sup>		\$1,000,000
Trolley Overhead <sup>7</sup>	per km/direction	\$250,000
Trolley Sub-station <sup>8</sup>	each	\$350,000
Streetcar track/electrical <sup>9</sup>	per km/direction	\$6,655,000
Streetcar Operating Cost <sup>10</sup>	per service hr.	\$200
Trolley Operating Cost <sup>11</sup>	per service hour	\$75

#### COMPARISON

#### Assumptions:

- Trolley busses assumed to have 15 year life
- Streetcar assumed to have 30 year life
- Assume 6% interest rate over 15 years for systems

	<b>Streetcar</b>	<b>Current trolley</b>	<b>Artic. trolley</b>
*Number of vehicles	<b>8</b>	9	<b>8</b>
Vehicle capital cost	<b>\$19,200,000</b>	\$7,200,000	<b>\$8,000,000</b>
Annualized capital cost vehicles	<b>\$3,067,594</b>	\$1,150,348	<b>\$1,278,164</b>
Track/electric cap cost	<b>\$33,275,000</b>	\$2,650,000	<b>\$2,650,000</b>
Annualized track/electrical cap cost	<b>\$6,370,489</b>	\$183,792	<b>\$229,739</b>
Total annualized capital cost	<b>\$9,438,083</b>	\$1,334,140	<b>\$1,507,903</b>
*Annual revenue hours	<b>27,351</b>	30,770	<b>27,351</b>
Annual operating cost	<b>\$5,470,222</b>	\$2,307,750	<b>\$2,051,333</b>
Total annual cost	<b>\$14,908,305</b>	\$3,641,890	<b>\$3,559,236</b>
Annual passengers	<b>4370502</b>	2913668	<b>2913668</b>
Cost/passenger	<b>\$3.41</b>	\$1.25	<b>\$1.22</b>

**Note ( streetcar demand expanded by 50% to reflect tourist ridership)**

## **SOURCES**

- 1-3: GVTA Transit Service Guidelines – Public Summary Report, June, 2004.
- 4: Based on the “off the shelf” cost of the Portland Streetcar  
Accessed from: [www.portlandstreetcar.org](http://www.portlandstreetcar.org)
- 5-8,11: Richmond-Airport-Vancouver Baseline and Best Bus Study. 1992. Undertaken for TransLink by Hamilton Associates.
- 9,10: Regional Municipality of Ottawa-Carleton Transportation Master Plan, Mass Transit Working Paper. Dillon Consulting, 1997. Technical Appendices.

