

*Copies of this Report
and its companion
Medium-range Transportation Plan
to the year 2006 can be obtained
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A Long-Range Transportation Plan for Greater Vancouver



September, 1993

CONTENTS

Executive Summary	i
Preface	1
TRANSPORT 2021 and its Objectives and Related Plans	1
About This Report	1
Steering Committee and Acknowledgements	3
A. Where Are Current Trends Leading?	5
Today's System	5
Expectations and Goals for the Transport System	6
"Business As Usual" Consequences	7
B. How Can the Trends Be Changed?	12
1. Control Land-use	13
Livable Region Strategy for Growth Management	14
Neighbourhood Land-use Strategy	16
Land-use Policies Endorsed by TRANSPORT 2021	19
2. Apply Transport Demand Management	20
Transportation Demand Management	21
Recommended Policies	24
3. Adjust Transport Service Level	26
Recommended Service Level Policies	27
4. Supply Transport Capacity	28
Transport Supply Strategies	28
Transport Supply Policy Recommendations	32
Recommended Future System Maps	34
C. What Will The Plan Achieve?	39
A Numerical Assessment of the Plan's Performance	39
Capital Costs and Affordability	45
D. Keeping Options Open	53
Surprises Since 1960	53
Sources of Uncertainty	54
Coping With Uncertainty	56
E. What Commitments Are Required—By Whom?	59
Appendix 1: Public Communications Programme	61
Appendix 2: Publications	64
Working Papers	65

Preface

TRANSPORT 2021 and its Objectives

This Report is part of the output of TRANSPORT 2021, a joint, two-year project funded equally by the Province of British Columbia and the Greater Vancouver Regional District (GVRD).

The objective of the TRANSPORT 2021 project is:

"based on
the GVRD's Creating Our Future action plan,
its Regional Strategic Plan and
the mission statements of the Ministry of Transportation and
Highways and B.C. Transit,
to recommend,
by the end of 1993,
a long-range transportation plan for Greater Vancouver,
with associated policies, demand management measures
and priorities for transportation investment."

The project is guided by a Steering Committee of senior staff officials from provincial and local governments, with observers from the federal government and neighbouring regions.

Related Strategic Plans

The GVRD's Regional Strategic Plan for managing growth is incorporating the TRANSPORT 2021 Long-range Plan as its transportation component. The two plans are concurrent and interactive; in particular they consider the interaction of land-use patterns and transportation services. The two projects also conduct a joint public communications programme.

A province-wide transport plan is being assembled by the Government of B.C.; the TRANSPORT 2021 long-range plan contributes to its B.C. Lower Mainland portion.

Also concurrent is the GVRD's Air Quality Management Plan, which shares analysis and findings with TRANSPORT 2021.

About This Report

This Report presents all the elements of a 30-year transportation plan for Greater Vancouver. It contains the principal findings and long-range recommendations of its authors, the TRANSPORT 2021 Steering Committee.

Addressed to the GVRD and the Province of B. C. as the project's joint sponsors, this Report is also a public document intended for all

Contents

groups interested in the future of the transportation in the B.C. Lower Mainland.

First, the Report provides a snapshot of the region's transportation system as it exists today. It explains **why** action is necessary. It finds that the system is following undesirable trends—i.e. increasing dependence on the automobile coupled with sprawling urban growth— which lead away from the region's declared values and aspirations. Next, the Report outlines in detail **how** an alternative future can be achieved. It presents methods for governments to swing the current trends around to a more desirable direction. It recommends a strategy, in the form of transportation policies and capital improvements (such as transitways, high-occupancy vehicle lanes and new road links) expected to be needed within 30 years.

The Report then describes **what** would be the result of such a strategy over the next 30 years—i.e. as measured by transport service, cost and livability parameters, and demonstrates that the plan is a preferable direction. The analysis is based on the project's research program guided by regional and provincial goals. The result is presented both as a transportation vision and as a target for the year 2021.

Note that the Report does **not** identify **when** actions should be taken. This report describes an "end state" and makes no comment on priority or timing. Investment priorities and phasing recommendations are presented in the project's **medium-range** plan. [18]¹

Nor does the Report detail changes in the **institutional** framework which would be required to make the plan function effectively—though it does indicate areas where improved coordination will be essential; it concludes by identifying **who** will have to act; it lists the commitments required from partner agencies in order to bring the Long-range Plan to reality.

Finally, the Report does not present a **financial** plan, although it does estimate **capital** costs and indicates the **affordability** of its recommended future transport system.

Public communications

Public communications activities undertaken in the course of the project are described in Appendix 1. Appendix 2 contains a list of publications, including a series of technical papers and research documents.

¹Square brackets [] contain the number of a TRANSPORT 2021 Working Paper which contains more details. Working Papers are listed at the end of Appendix 2.

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A. Where Are Current Trends Leading?

Today's System

A Day's Travel
Currently, on a typical day the people of Greater Vancouver journey
3 1/2 million times (or 83%) by PRIVATE CAR ,
1/3 million times (or 9%) by PUBLIC TRANSIT
and nearly 1/3 million times (or 8%) by FOOT or BICYCLE .
Travel is uneven throughout the day, with the
morning peak period (6 to 9 a.m.) and the afternoon peak period (3 to 6 p.m.)
together accounting for over 40% of all vehicle trips.

Today 1.6 million people and 1 million motor vehicles—cars, buses, trucks, trains and vessels—circulate over Greater Vancouver's 10,000 km network of roads, trackage, and ferry lanes.

The system permits people to reach work, school, shopping, recreational, cultural and sports events, and to visit friends and family; employers to access a supply of labour; and goods to be sent and received in the course of domestic and international trade.

A transport system is basic to any urban area. Along with the telephone system and other means of communication, it makes possible constant exchanges of goods, services, and information among people—planned and unplanned—which are the essence of a city. The benefit and very purpose of a transport system is to make such exchanges possible.

The benefit is very large and hard to measure. However, it comes at a cost, at least part of which can be measured.

For instance, in the B.C. Lower Mainland, the current cost to vehicle owners of owning and operating the 1 million vehicles is about \$4.3 billion per year.

The additional cost of providing "free" parking for them at residences, work places and other locations is about \$600 million per year; roads cost some \$600 million annually to build and maintain; and the "external" costs of accidents, air and other pollution have been estimated at a further \$2 billion per year. This excludes the value of land occupied by the roads and other rights-of-way and the value of the personal time that people spend in travelling about.

One estimate [11]³ places the full annual cost of transporting people within the B.C. Lower Mainland at nearly \$14 billion (of which \$5 billion is the value of personal time), a figure which includes tangible and intangible costs borne by users and non-users.

Most of this is accounted for by the car and other private motorized transport. Public transit accounts for about \$1 billion of the total

³Square brackets [] contain the number of a TRANSPORT 2021 Working Paper which contains more details. Working Papers are listed at the end of Appendix 2.

annual economic costs. Non-motorized transport (by cyclists, pedestrians and telecommuters) represents a tiny proportion of the total.

In addition, the cost of moving **goods** within the region—primarily by truck—is about \$2 billion annually. [7]

Trade Gateway Function

The region is B.C.'s main provincial distribution centre and is home to Canada's primary airports and seaports for Pacific Rim trade. Other regions in the Province and other areas of Canada depend on parts of Greater Vancouver's transportation system for their livelihood. Effectively, the region sells transport as a service to customers outside its boundaries.

This gateway function directly employs 30,000 people; when indirect and induced employment are added in, it generates some 60,000 to 90,000 jobs in the region, or roughly 8% to 12% of total regional employment. [8]

The region's role as a gateway therefore represents both an obligation and an opportunity for its economy.

Expectations and Goals for the Transport System

As one of the vital organs of the region, the transport system is expected to help achieve the region's values and aspirations. [1]⁴

For instance, it is expected to provide the required mobility and accessibility for the economy, while simultaneously reducing its negative impacts on livability and the environment. It is asked to:

- support the regional economy by providing a **wide range of effective, efficient, safe and reliable** transportation services for goods and people; and, in particular,
- **serve a rapidly growing and diverse population** which is spreading south and east up the Fraser Valley away from the metropolitan core; and
- **limit disruption** of neighbourhoods caused by through-traffic; **minimize intrusion** of new roads into agricultural land and other green spaces; and **cut down polluting emissions** into the atmosphere.

Further goals and objectives for the transport system are to:

- help **contain urban sprawl**, shape urban structure and conserve the land resource;
- **offer equitable service** to all citizens in all geographic areas; and

⁴The TRANSPORT 2021 Working Paper titled "Goals, Objectives and Criteria for Developing a Long Range Transportation Plan for Greater Vancouver" contains a comprehensive statement of these objectives, based on the GVRD's Creating Our Future statements and the mission statements of the Ministry of Transportation and Highways and BC Transit.

- **generate public-sector revenues**, reduce subsidies, live within tight public-sector financial constraints, and ensure that limited capital resources are deployed most effectively.

The above goals and objectives represent what is at stake—**why** transport policy makers pay attention to the transport system. This Report recommends **how** it could be changed to achieve the goals.

But first, to place the current system in context, it is useful to explore:

- what will happen **if no changes are made**, i.e. under current trends, policies, habits and practices;

and, in particular,

- whether the goals and objectives can be achieved **without** a change in direction.

Population growth: basic force

One of the most basic forces propelling change in the B.C. Lower Mainland is growth of population.

According to census data, in the 20 years between 1971 and 1991:

- the region's total population grew by nearly 50%, with slower growth in the City of Vancouver than in other parts of the region and
- families shrank in size: the average number of people per household dropped by nearly 20%. That means that the number homes was growing faster than the number of people.

South-eastward sprawl

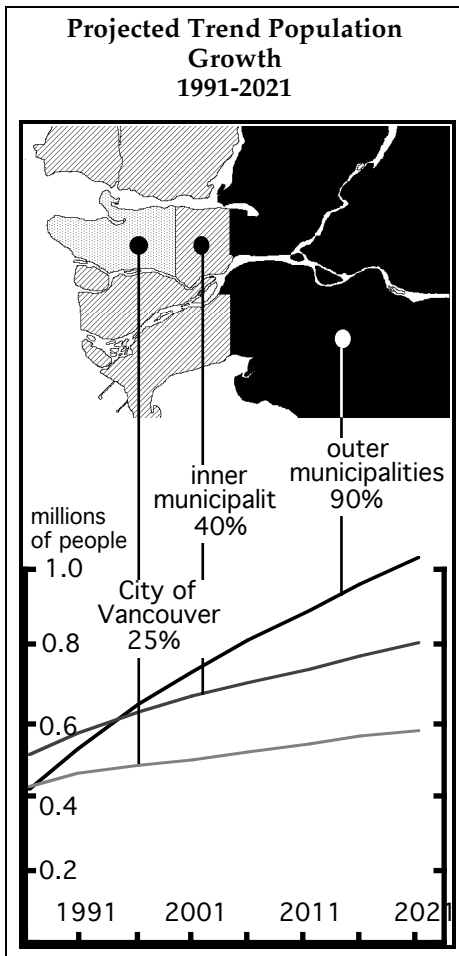
In more recent times, heavy growth has been seen in outer suburbs such as the North East Sector⁵, Surrey, Delta, White Rock, Langley, and Fraser North⁶. In the 5 years through 1991, their population grew at 2 to 4 times the rate of the inner areas such as Vancouver City, the North Shore, Burnaby and New Westminister.⁷

In the 30 years ending in the year 2021, the population of the B.C. Lower Mainland is expected to grow by a further 70% to reach nearly 3 million. Unless current travel habits change, the number of road vehicles will double to 2 million.

If trends continue, by 2021 the outer municipalities will see population growth of over 90%, the more mature inner municipalities of

"Business As Usual" Consequences

The "Do Nothing" Option



⁵In this Report, the term "North East Sector" means the municipalities of Coquitlam, Port Coquitlam, Port Moody and the Villages of Anmore and Belcarra.

⁶"Fraser North" means that part of the B.C. Lower Mainland to the east of the Pitt River and north of the Fraser—including Pitt Meadows, Maple Ridge and Mission.

⁷1992 Greater Vancouver Travel Survey.

40% and the more densely-settled City of Vancouver by 25%—i.e. a major decentralization of homes.⁸

Trends in employment

In the 20 years between 1971 and 1991:

- the number of people available for paid work (i.e. the labour force) grew by 72%—faster than the population in the same period, due in part to the greater participation of women.
- the number of actual jobs (i.e. employment) grew even faster, by 84%. That means that the demands on the transportation system—from people travelling to work—also increased faster than the population.

Suburbanization of jobs

More recently, the wave of employment growth is also spreading south and east, but it is behind the wave of population growth. In the five years through 1991:

- the fastest job growth was recorded in Richmond, the North East Sector, Surrey, Delta and White Rock and Burnaby, all of which saw 30% to 50% increases; while
- Vancouver City, the North Shore and Fraser North saw almost no increase in jobs.

Common to other metropolitan areas

Greater Vancouver is not alone in experiencing suburban growth; the pattern is well established in many similar-sized and larger metropolitan regions in North America, being typically more advanced than in Greater Vancouver.

In some regions with lower regional growth pressures (e.g. Montreal), the urban core and inner suburbs are actually de-populating in absolute terms even as the suburbs grow; this is partly caused by the shrinking size of families, which therefore occupy a larger number of homes.

Employment projection

Under current trends, the number of jobs in the Lower Mainland is expected to rise nearly 90% from 0.77 million in 1991 to 1.45 million in 2021.⁸

Service sector jobs are expected to grow fastest; for instance, finance, insurance and real estate and commercial services are forecast to increase by 100% to 120%; primary industry and manufacturing jobs are projected to grow more slowly, in the 30% to 60% range over the 30-year period.

Recent travel patterns

The GVRD conducted surveys on travel in the region in 1985 and 1992. There were notable changes in the critical morning peak pe-

⁸GVRD Strategic Planning Department. Population, Household, Labour Force and Employment Projections for the Metropolitan Vancouver Region: 1991 to 2021.

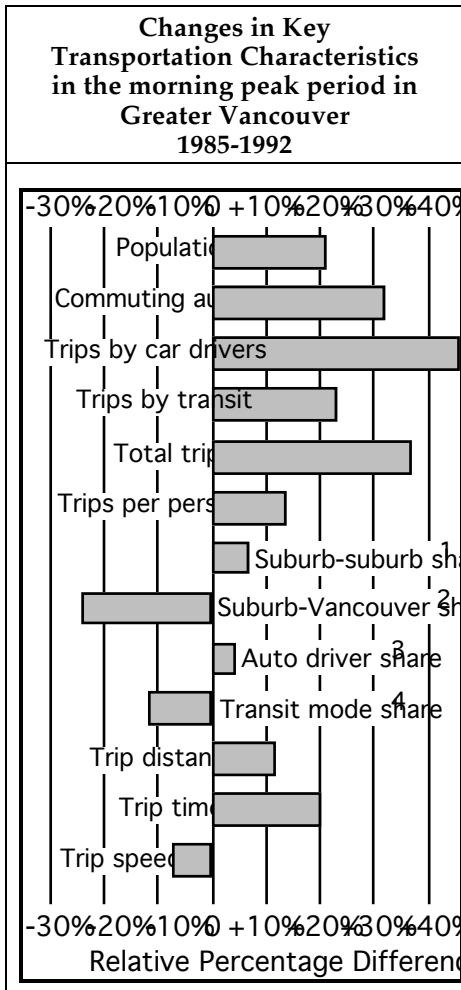
riod (6 a.m. to 9 a.m.), partly the result of the demographic trends described above.

In the period 1985 to 1992:

- **travel grew faster than population:** although population grew by 21%, the number of trips made in the peak period grew by 37%;
- **transit lost ground:** transit's region-wide share of the travel declined by 1.3 percentage points (from 11.2% to 9.9% of the total number of peak period trips); for the portion of travel ending in downtown Vancouver, where transit is traditionally strongest, transit's share dropped proportionately more, by 2.2 percentage points (from 35.3% to 31.2%);
- **automobile dependence increased:** the share of all trips represented by automobile drivers increased by 2.3 percentage points (from 54.3% to 56.6%), while the share of trips represented by automobile passengers fell by 0.2 points (to 16.7%). That means that the average number of people in a car went down. The number of automobiles registered with the Insurance Corporation of B.C. for commuting to work grew by 32%—or one-and-a-half times the rate of growth of the population;
- **suburb-to-suburb travel dominated further:** trips with suburban destinations gained 4 percentage points to 64.4% of total trips in the region; trips with suburban origins to the City of Vancouver declined by 2.9 points, to 12.0% of the total trips in the region; and
- **people travelled further and slower:** the average trip distance to work increased 12% to 14.0 km; the average trip speed declined by 7% to 34.7 kph; and the average trip time increased by 20% to 24 minutes.

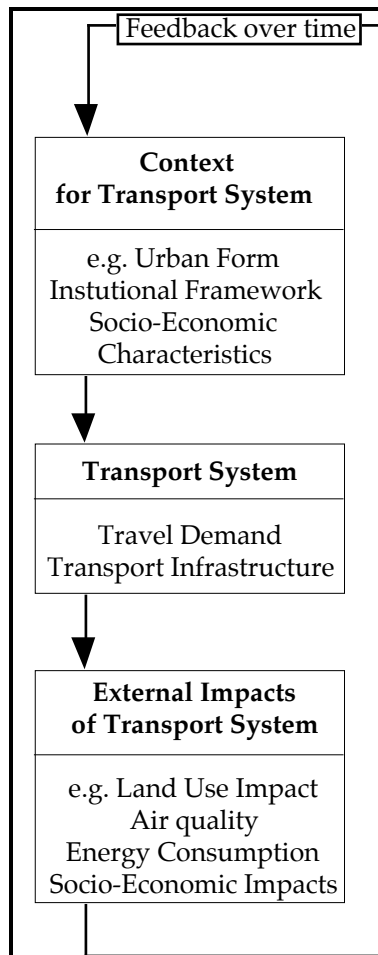
Outlook for travel patterns

- Based on survey results, the long-range pattern of suburbanization of homes continues to alter travel into a **less-focused travel pattern**, which is more difficult to serve with conventional core-oriented transit services. Despite major transportation infrastructure investments in the 1985-1991 period, transit usage has not kept pace with automobile usage. The region **remains automobile-dependent, and that dependency is growing.**
- In 30 years, trends point to many **more unfocused suburb-to-suburb** trips which are difficult to serve well with conventional public transit.
- Computer simulations of travel patterns reveal that current demographic trends, land development and transportation policies will further **erode transit's market share, for a drop of**



1. Change in the share of total trips which begin in one suburb and end in another.
2. Change in share of total trips which end in Vancouver City.
3. Change in the share of total trips which are undertaken by car drivers.
4. Change in the share of total trips which are undertaken by transit passengers.

Source: 1992 Greater Vancouver Travel Survey—Comparisons of Travel Demand Characteristics, 1985-1992.



Air quality trends

several more percentage points over the next 30 years, with a corresponding increase in the share of the automobile.

- To keep congestion at bay under trend conditions, a **large road building programme will be required**. One measure of the increase is the number of traffic lanes required on bridges and tunnels to cross the region's major water bodies. Computer simulations indicate this number would increase from the current 47 road lanes of capacity to a total of 85 lanes by 2021. [13]

In reality, such trends are unlikely to continue unchecked. The people and the institutions of the region will adapt and intervene to cause changes in direction to occur.

This self-correcting process is illustrated on the left. The physical, social, environmental and economic context within which the transportation system operates is itself changed over time by the external impacts of transportation.

This Long-range Plan is itself part of the feedback loop, identifying the conflicts with society's goals and proposing changes to the system and the context in which it operates.

Conflict with Goals

The goals of the region expressed in the GVRD's "Creating Our Future" programme call for more reliance on walking, cycling and transit, and place the automobile lowest in priority.⁹

The loss of transit share, increase in auto dependence and implications for major road building is **contrary to those goals**. The current trends were discussed and rejected at a public conference held in May 1992.

Air pollution is one of the external impacts which TRANSPORT 2021 is specifically asked to address in its terms of reference.

The GVRD "Creating Our Future" goals call for a reduction of 50% in the emitted tonnage of five named atmospheric pollutants by the year 2000 (compared with a base year of 1985). Based on emissions calculation undertaken for TRANSPORT 2021, this goal is within sight.

Motor vehicles currently account for 2/3 of total emissions of five major **local air pollutants** (oxides of nitrogen, oxides of sulphur, volatile organic compounds, carbon monoxide and particulate matter). Two of these—oxides of nitrogen and volatile organic compounds—are precursors to the formation of smog. Motor vehicle emissions of particulate matter and carbon monoxide are also of concern to the region's air quality.

⁹GVRD. Creating Our Future, 1993 (adopted by the GVRD Board of Directors on 26th February, 1993)

Despite traffic growth, the offsetting effects of less-polluting and more fuel-efficient new vehicles will cause a net decline in emissions; in particular, the AirCare emission inspection and maintenance program and cleaner fuels will cause total emissions to decline, even under trend conditions—i.e. without the TRANSPORT 2021 recommendations being implemented (which, as shown later in this Report, would reduce them further).

Technical breakthroughs (e.g. replacing gasoline engines with electric batteries or fuel cells) will help further. [17]

Accordingly, the total tonnage of the five major local air pollutants (mostly carbon monoxide, but including the smog-forming compounds) from vehicles in 2021 will be lower than they are today.

10

In addition, vehicles contribute a share of **global air pollutants** known as "greenhouse" gases, such as carbon dioxide (of which motor vehicles contribute a quarter of the total emitted, Canada-wide) and chlorinated fluorocarbons. Carbon dioxide emissions from vehicles will parallel total consumption of carbon-based ("fossil") fuels such as gasoline, diesel fuel, natural gas, propane and others, and is expected to see a net increase.

In summary

Overall, the **region is on a development path that carries it away from, rather than towards, its own declared goals.**

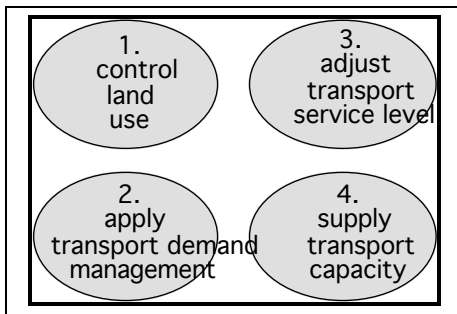
The trends are already established and have considerable momentum. They have been assisted by the existing transportation system, which has increased the accessibility among the various parts of the region over the past 30 years.

Changing direction will require significant changes in real estate development and investment patterns, in the behaviour of people and households, and in the priorities for public infrastructure.

¹⁰Estimates provided by GVRD Air Quality and Source Control Department based on traffic projections provided by TRANSPORT 2021.

B. How Can the Trends Be Changed?

The Transport Policy Levers



Four transport policy levers are available to steer the transport system away from current trends onto a more desirable path.

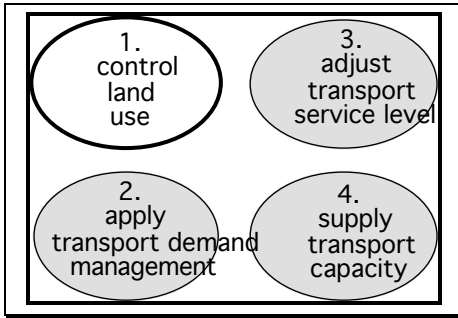
They are:

1. **Control Land-use** through planning and zoning regulations, which shape a compact urban form, resist urban sprawl, and foster pedestrian- and transit-friendly neighbourhood design.
2. **Apply Transport Demand Management**, which comprises a variety of new techniques to make better use of the existing transport system, encourages off-peak travel and discourages single-occupant vehicles, and incorporates measures such as tolls, gas taxes and parking management.
3. **Adjust Transport Service Level**, allowing more congestion for single-occupant automobiles, but making improvements in the speed and convenience of public transport and shared private transport such as car- and van-pools.
4. **Supply Transport Capacity**, by investing capital with a bias towards public transport and shared private transport, both in construction and in continuing operation, and by locating it to improve selectively the accessibility of growth centres.

The task of producing a long-range plan amounts to finding the optimal setting of these four policy levers in order to meet best the goals and objectives of the transport system.

There are **trade-offs** possible among these levers. For instance, if more money is spent on transportation capacity (lever 4), congestion could be reduced and service levels improved (lever 3). Or, if strong intervention to reshape travel behaviour is used (e.g. in lever 2 by road tolls), then investment in new capacity (lever 4) could be postponed or reduced.

This section describes the results of the TRANSPORT 2021 research program to determine **how** the levers should be used to effect a desirable shift away from adverse trends. The project has established that **all the levers must be used in a coordinated way** to be successful [14]. This Report deals with the four levers in turn.



Land-use Defined

1. Control Land-use

"Land-use" means "how the land is used" and in particular what human activities, if any, are conducted in what location.

A "land-use plan" states what land is planned to be left undeveloped (e.g. in a "green zone") and what is planned to be developed or re-developed.

Knowledge of the geographical settlement pattern of people and economic activity is crucial to transport planning. It is one of the most important **drivers of the demand for travel**—how much travel is desired between any two points.

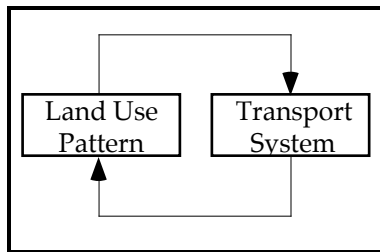
In turn, transportation investment is believed to influence land-use, by directing growth to areas which become more accessible via the new transport links. Transport shapes land-use by **selectively providing access**—good access to some areas but not to others.

Transportation is properly **only one consideration** in the development of the desired urban form. The land-use pattern is fundamental to achieving a wide range of regional objectives **other** than transport. These include preservation of open space and the land's physical characteristics such as slope and soil stability.

A city's reliance on different modes of transport is related to its **population density**. Less dense, sprawling cities (e.g. in the south and western U.S.) are more on automobile-oriented, while compact cities (e.g. in Asia and Europe) are more transit-oriented.

Compared with other areas in the world, Greater Vancouver is not very densely populated. Today, the region has an average of 5 people per hectare. However, particular areas within the region have higher density; for example, the City of Vancouver at 35 people per hectare is as dense as some European cities.

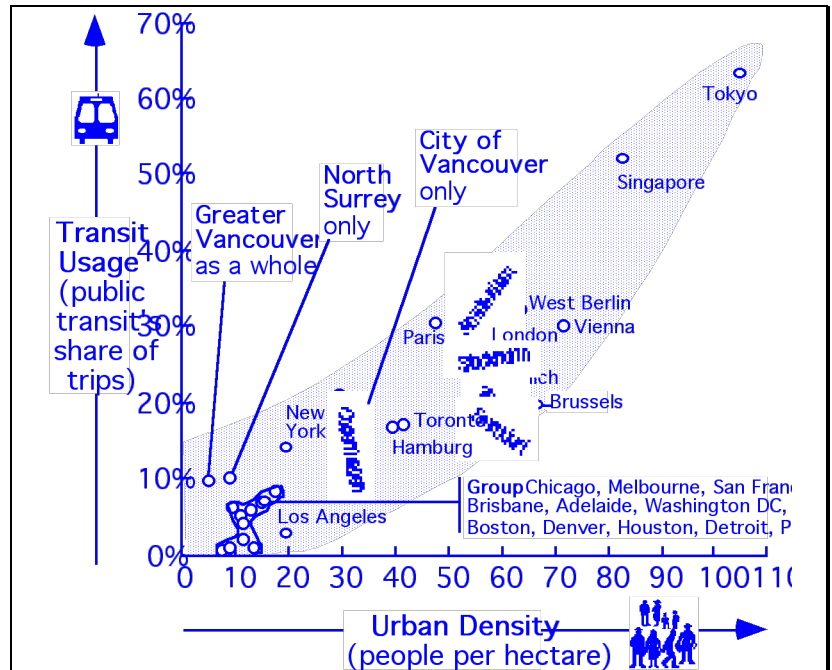
Given its low density, Greater Vancouver has **relatively high transit usage**, especially when compared with U.S. cities. However, the chart below strongly suggests that **greater transit usage** (i.e. moving up the chart)—which is one of the region's objectives—requires **greater density** (i.e. moving to the right).



Relationship Between Urban Density and Mode of Transport

Transit Usage and Urban Density for selected cities in developed countries

Source: Adapted from "Greenhouse, Oil and Cities", Peter Newman, "Futures and 1990s supplement" with data from TRANSPORT 2021 and the Greater Vancouver Livable Region Strategy, 1993.



Livable Region Strategy for Growth Management

"Manhattan", "Bi-Polar", "Beads on String", and other options for urban structure.

Proposed more compact region

During 1992 and 1993, the GVRD developed a land-use strategy to help manage growth in Greater Vancouver. During the evolution of the strategy, the question of density came to the fore.

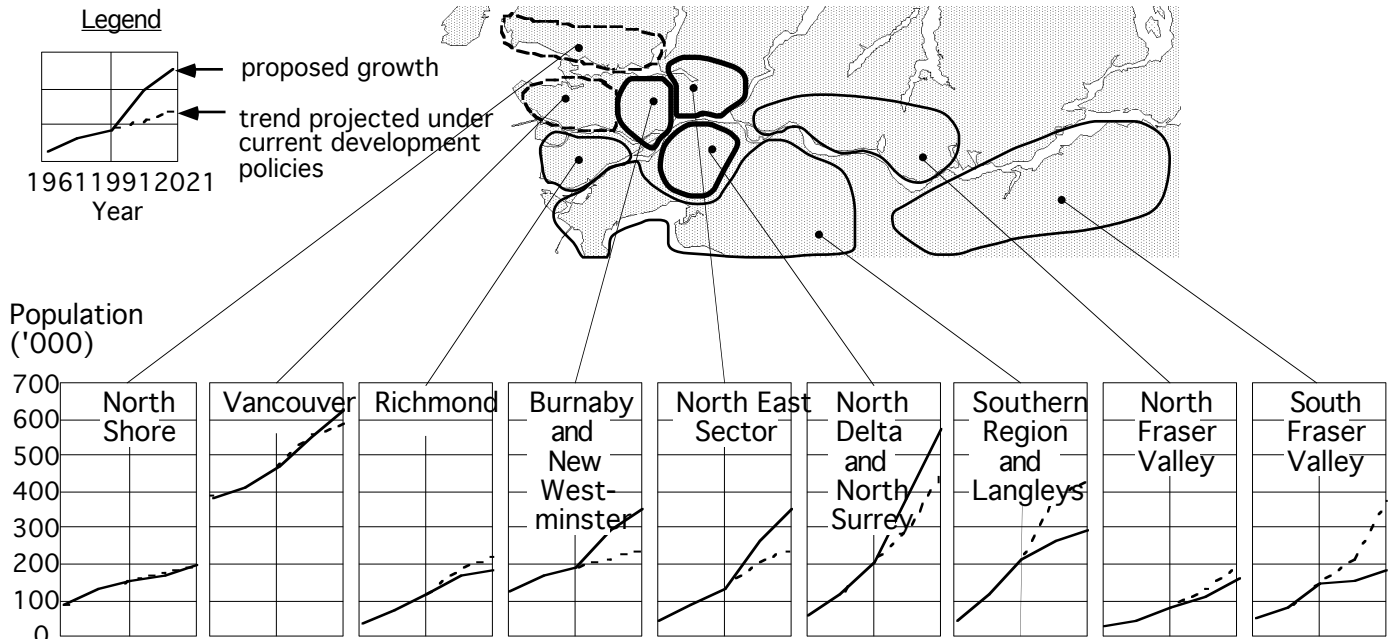
Initially, some seven options for urban structure were reviewed, each with very different transportation implications. For instance, the "Manhattan" option featured a single, very powerful centre in downtown Vancouver requiring much core-focussed travel. Another called for a "bi-polar" region, with a strong Vancouver and Surrey. A third featured a series of more equal centres, "beads on a string" stretching along a southeasterly transportation corridor. Another saw self-sufficient or complete communities with relatively little interchange among them.

The list was pared to three options which were analyzed more deeply: Current Trends and Development Policies; Fraser North Corridor; and Compact Metropolitan Area¹¹. These were discussed at a public conference held in Richmond, B.C., in November, 1992. While opinions were diverse, the Compact Metropolitan Area received the greatest support. Current Trends was least favoured.

Following a series of refinements, cross-checks, and further consultations, a proposal for a more compact region emerged.

¹¹GVRD Strategic Planning Department. Vancouver Metropolitan Region: Options for Growth Management, 1992.

**GVRD Livable Region Strategy Proposals, 1993
proposed population growth compared with trend**



Data source: GVRD Livable Region Strategy, July 1993

This structure has the following features¹²:

- population growth is **close to the "business as usual" trend** for the North Shore and the City of Vancouver;
- growth is **above trend** in Burnaby and New Westminster, the North East Sector and North Delta and North Surrey;
- growth is **below trend** in Richmond, South Delta, South Surrey, the Langleys, the North Fraser Region, Abbotsford, Matsqui and Chilliwack;
- in sub-areas (analyzed in finer detail than shown on the map), population and jobs are **clustered in higher densities** than under the current trend. They are sited near regional activity centres of various sizes, and sited along transport corridors. This concentration helps to make them more effectively serviced by transit; and
- the land-use plan strives for a **balance between work force and jobs** in each sub-region, to give people an opportunity to live close to work so that the need for long-haul commuting can be reduced.

TRANSPORT 2021 long-range plan assumes proposed Livable Region Strategy is implemented

The long-range transport plan is intended to serve and support this compact urban structure. It assumes that the proposed growth

¹²Greater Vancouver Regional District, Livable Region Strategy Proposals—A Strategy for Growth Management and Environmental Protection, 1993.

pattern will be achieved through the combined effect of forces including:

- physical constraints such as mountains and water-bodies;
- the operation of the marketplace in the land development business;
- the availability of land for development, determined by coordinated changes to Official Community Plans and attendant zoning regulations of municipalities, with such coordination being sustained over several decades; and
- coordinated transportation investments and policies, also over a long period.

Neighbourhood Land-use Strategy

Local urban form and street design are keys to encouraging pedestrian and bicycle modes of travel and giving them an opportunity to take hold. [15]

Greater Vancouver's best example of pedestrian-friendly design is the downtown peninsula, where 60% of the people who live and work there actually walk to work and school. In contrast, in a typical suburban municipality, fewer than 15% walk.

Making neighbourhoods more friendly requires new approaches to neighbourhood planning. Three possible ideas are "neotraditional" town planning in new areas, "intensification" of existing urban areas and "calming" of traffic. These offer practical methods of reducing the region's dependence on the automobile. They would make transit, bicycle and pedestrian travel more attractive, not only for commuting but also for recreation, shopping and other journeys.



Town planning

In addition, social and aesthetic benefits can follow from these approaches. They help to create neighbourhoods which many consider more pleasant, healthier and more "livable", with a keen sense of community, and where non-drivers (notably the young and the old) and those who do not own a car are not so disadvantaged as to personal mobility. Typically in North America, about 1 in 8 households do not own a car, and some 30% of the population in all countries is either too young or too old to drive.

Neotraditional town planning aims to place small-town landscapes in new suburban areas—a return to some of the human-scale features of the pre-automobile era.

In this approach, residential areas are not widely separated from stores and services, but surround them. There is a mixture of housing forms with moderate but not high-density housing clustered around a neighbourhood commercial core. Commercial buildings are closely spaced and front directly onto streets and sidewalks, not set back for parking.

The goal is to maximize travel by foot for routine neighbourhood trips, while downgrading priority for vehicles. Access to local amenities is provided by a grid of relatively narrow streets, allowing vehicle and foot traffic many route choices, and slowing autos. Block faces are short; buffer zones between potentially compatible land-uses and different housing densities are removed.

Examples of benefits reported for this urban form, which can have a regional impact, are:

- 17-23% fewer vehicle trips generated than in current suburban developments;
- lower auto use (64% of trips by auto versus 86% in typical suburbs) and higher walking (17% vs. 8%) and transit shares (17% vs. 3%); and
- shorter trips: 12% fewer vehicle miles travelled with the same number of trips; 40% fewer with the reduced number of trips. [15]

There are potential obstacles to success: plans may fail if not all elements of the comprehensive package are present; suburbanites may not adopt the new form of community; safety implications of narrow streets and parked cars are not clear; existing suburban residents may oppose innovative forms of development; and housing prices in such neighbourhoods may be relatively high.

Intensification

Residential intensification aims for a moderate and marginal increase in population density of **existing low-density neighbourhoods**.

Approaches include: lowering minimum lot sizes for detached housing; allowing a second dwelling to be built (e.g. in a large back yard with access onto a back lane); allowing building right up to lot line; relaxing the forced segregation of housing types (e.g. single family homes set apart from multiple family); allowing secondary suites in single family districts; and main street intensification.

Potential regional benefits include fewer and shorter trips, and lower (by 50%) vehicle costs for households.

Intensification also faces obstacles: in particular, single-purpose suburban zoning prohibits diverse housing forms, and attempts to change it often encounter opposition from existing residents.

Both intensification and neo-traditional planning take time to have their impact. The opportunity for immediate change is limited. The majority of housing and commercial structures in the region in 30 years' time is already on the ground today.

Traffic Calming

Traffic calming is a technique is to modify the street and its regulations to **slow down traffic**¹³. Automobiles are not treated as the primary and most important user of road space in urban residential areas.

In Europe, road widths and clearances are reduced, obstacles are sited to cut down the straight-line path, and speed limits are reduced (e.g. by 50%). On-street parking is used as a buffer between moving cars and pedestrians.

Among reported benefits of traffic calming are a greater sense of community among residents, lower accident rates, education of drivers to the needs of other road users, and more business for small-scale local retail and public services.

The range for comfortable cycling is 5-10 km; its potential to replace automobile trips is even greater than for walking, since most shopping, social and recreational destinations are found within this range.

When combined with public transit, **cycling extends the catchment areas of transit stations**. Bike-and-ride services expand the potential market further, especially if bicycles are allowed on buses, trains and ferries, when they can be ridden at both ends of a trip.

A major problem preventing improvements in cycling is a poorly adapted system: roads and bridges do not accommodate cyclists. Many destinations have no secure bicycle storage, with no change rooms, showers or lockers.

While suburbs have quiet streets suitable for cycling, these are often not well connected. Bicycle path connectors to join these quiet streets to shops, jobs and transit stops could induce a larger portion of the population to cycle.

Those modern western cities which have successfully adapted their road systems to accommodate cycling have shown that bicycle travel can become an important component of the transportation system and may reduce the number of motor vehicles on the roads (see table, left).

Several initiatives are underway by governments in Greater Vancouver to promote cycling: for instance, the City of Vancouver has opened the Adanac Bikeway. The B.C. Ministry of Highways has produced an Interim Cycling Policy: cycling is to be integrated into all stages of provincial road planning and alternative routes are to be provided when bicycle use cannot safely be built in.

It is not the purpose of the regional long-range transport plan to recommend the design of particular centres and neighbourhoods. However, the TRANSPORT 2021 Steering Committee commends

Walking and Bicycling



Percentage of Total Daily Trips By Bicycle	
Groningen, Netherlands	50%
Delft, Netherlands	43%
Erlangen, Germany	26%
Davis, California, USA	25%
Odense, Denmark	25%
Copenhagen, Denmark	20%
Basel, Switzerland	20%
Hanover, Germany	14%

Source: Lowe, M. *The Bicycle: Vehicle for a Small Planet* (1989)

Requirements for the long-range transport plan

¹³The West End in the City of Vancouver provides a local example of traffic calming.

these principles of local urban design to local authorities in the region. They can have significant regional benefits.

Accordingly, the long-range transport plan assumes that local governments will act to ensure that (a) new urban development will be designed to favour short trips by foot and bicycle, rather than by automobile, and (b) existing urban areas are adapted to better accommodate the non-motorized modes of travel.

Without the coordinated control of land-use through government planning and zoning regulations, transport policies and initiatives will be compromised and cannot be effective.

Because they are so central to achieving other transportation goals and objectives, these policies are fully endorsed by the TRANSPORT 2021 Steering Committee:

Land-use Policies Endorsed by TRANSPORT 2021

GVRD's Livable Region Strategy

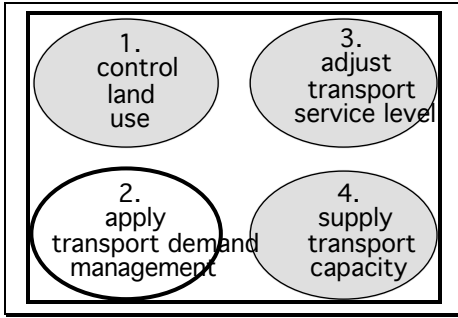
- 1.1 **The GVRD should pursue the completion of its Livable Region Strategy as a reference point for all public and private sector agencies which have an influence over urban development.**
- 1.2 **The Strategy should allocate growth and concentrate development in multi-use activity centres and high-density development corridors.**
- 1.3 **The Strategy should define areas of higher density which will be targeted for intensive transit service by the transport plan.**
- 1.4 **The Strategy should identify towns outside the urban area which are (a) intended to become more complete and self-sufficient and therefore (b) through transportation and other policies, to be discouraged from becoming suburban "bedroom communities" with easy commuting into the metropolitan core.**

Local friendliness to walking, cycling and transit

- 1.5 **Near and within all activity centres, the Strategy should propose a range of housing, within a pedestrian- and bicycle-friendly urban design, both by construction of new centres and by re-development of existing ones.**
- 1.6 **Municipalities should provide a transit-friendly local street pattern allowing transit routes to pass within walking range of a large proportion of dwellings, job sites, schools, shops and other activity centres.**
- 1.7 **Municipalities should develop bylaws and guidelines to help attain long-range transport goals at both regional and local levels, including retrofitting neighbourhoods which currently have street patterns which are difficult to serve by transit.**

Coordination of Official Community Plans

- 1.8 **Governments should provide a framework whereby municipal land-use plans are effectively coordinated in a sustained fashion over several decades, using the GVRD's Livable Region Strategy as reference point; neighbouring regions and their member municipalities should be included in this process.**



Layers of Travel Demand

2. Apply Transport Demand Management

Transportation demand management (or TDM) is the second lever available to policy makers. It comprises a variety of techniques to change the behaviour of travellers in order to make better use of the existing transport system. It encourages off-peak travel and discourages single-occupant vehicles, incorporating measures such as tolls, gas taxes and parking management.

The project divides the travel demand in Greater Vancouver into three layers, being:

Three Layers of Transport Demand In Greater Vancouver
<p>TOTAL DEMAND FOR TRANSPORT IN GREATER VANCOUVER</p> <p>EQUALS:</p> <p>Layer A: inter-regional</p> <p style="padding-left: 40px;">the movement of people and goods originating from and/or destined to places outside the region (e.g. goods from the U.S. into B.C.; air passengers travelling to the airport; goods transferred at the waterfront from ship to truck; ferries to and from Vancouver Island and the Sunshine Coast)</p> <p style="text-align: center;">PLUS</p> <p>Layer B: regional</p> <p style="padding-left: 40px;">the movement of people and goods internal to the region (e.g. commuters from Surrey to Downtown; goods from North Shore to New Westminster)</p> <p style="text-align: center;">PLUS</p> <p>Layer C: local</p> <p style="padding-left: 40px;">the neighbourhood movement of people and goods, either accessing the regional and inter-regional system or circulating entirely within a small area of the region.</p>

Aimed at Peak Period Demand

TDM is aimed primarily at peak period, regional passenger travel (part of layer B). This is the demand component which tests the overall passenger-moving capacity of the transport system most severely.

Transportation Demand Management

most promising public policy lever

Research points to transportation demand management (TDM) as a promising public policy lever to change travel behaviour and help solve urban transport problems. Though no panacea, it can postpone capital investment and reshape travel demand to boost transit and carpool use. [2]

Changes which can be effected by TDM fall into three types:

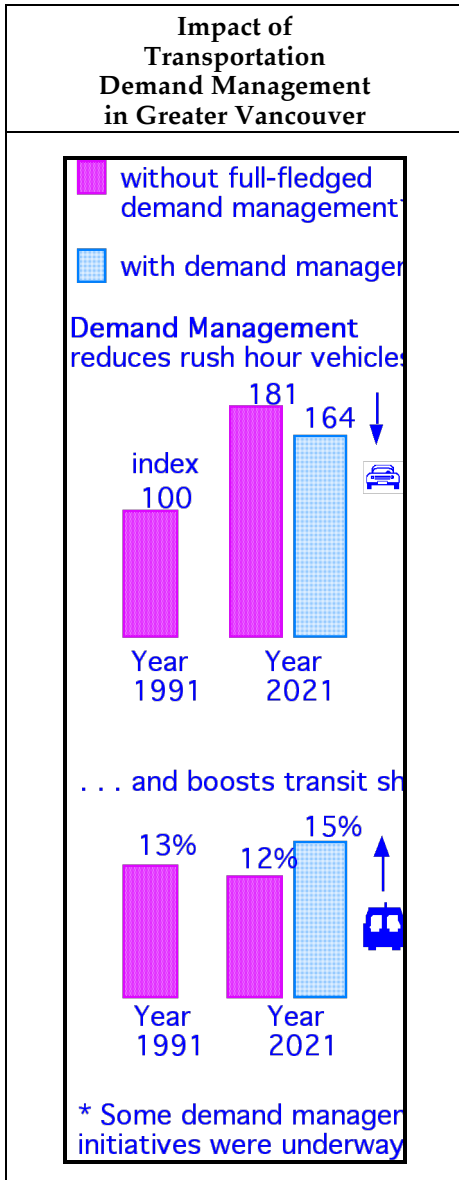
Three Changes Effected through Demand Management
<p>1. Change <u>A</u>mount of Travel <i>to cut the number of trips made, e.g. by promoting:</i></p> <ul style="list-style-type: none"> • telecommuting from home or remote work centres • the "compressed work week" (e.g. nine day fortnight with longer days) <p>2. Change <u>M</u>ode of Travel <i>to switch away from solo-commute trips to public transit, car pools, van pools, bicycles and walking, by</i></p> <ul style="list-style-type: none"> • providing dedicated "diamond lanes" to allow high-occupancy vehicles (HOVs) such as buses and carpool vehicles to move faster than others • giving buses priority over other traffic, e.g. at bridges, congested intersections and traffic signals • promoting car- or van- pools by putting carpoolers in touch with each other, priority parking, or changing the way carpools are financed or regulated • increasing the relative cost and inconvenience of solo auto driving by limiting the supply or increasing the cost of parking, increasing fuel taxes, or charging tolls for the use of the road network. <p>3. Change <u>T</u>ime of Travel <i>to travel during off-peak periods, e.g. by:</i></p> <ul style="list-style-type: none"> • further promoting flex-time working • imposing peak hour tolls and structuring parking rates to discourage peak travel.

By 2021, TDM and toll-financing will probably be commonplace in the developed world, being regarded as cost-effective ways to

combat urban traffic congestion and pollution and support transport investment.

TRANSPORT 2021's long-range plan is based on the assumption that Greater Vancouver will be no exception to this.

The project has identified a package of measures aimed at managing travel demand: [2] [6]



- Proposed Package: Transportation Demand Management Measures**
- "Carrots"**
1. promotion of telecommuting;
 2. steps to encourage medium-sized and large employers to help cut vehicle trips to their worksites;
 3. application of bus priority measures;
 4. installation of high-occupancy vehicle lanes;
- "Sticks"**
5. higher and more broadly applied parking charges (e.g. 50% increase of average all-day parking charges in the downtown core, and increases in all-day parking at other major town centres to equal 3/4 of today's downtown levels);
 6. higher fuel prices, through higher fuel taxes (e.g. a 50% increase in the real price of gasoline); plus
 7. downtown cordon/bridge tolls (e.g. \$2 peak hour toll on all bridges leading into Burrard Peninsula).

Research shows that the most effective measures are not the "carrot" but "stick" variety. To be successful, TDM requires a package of mutually supportive "carrot" and "stick" measures.

10% vehicle reduction estimated

A strategy combining "carrot" and "stick" in a significant package of TDM measures could produce about a **10% reduction** in the number of peak hour vehicle trips in 2021, compared with the "base case" trend forecast for 2021. It would shift some travellers from solo-commute driving into carpools and transit, resulting in **transit ridership some 25% higher** than it would otherwise be—provided that transit services are available to receive the additional riders.

Depends on degree

The actual traffic reduction achieved will depend on the degree of intervention (e.g.: in the case of tolls, the dollar amount). An aggressive, dramatic application of TDM might achieve an even higher reduction in vehicle trips. [3]

Link to user pay

Currently, urban transportation is underpriced, i.e. users pay less than the economic cost of the facilities and services they use. According to one estimate, travellers on all modes of transport combined pay only 2/3 to 3/4 of the full costs¹⁴. [11]

In the long run the prices paid by users should approach the underlying costs they impose, otherwise over-use tends to result.

Accordingly, research supports a policy of generally increasing the price of transport by all modes, consistent with the use of increases in prices as a TDM measure.

Implementation is the key

For the long-range plan, exact TDM measures and settings do not have to be specified in detail. This is because of the level of uncertainty involved in long-range plans, and the probability that underlying attitudes and behaviours and the responsiveness of individuals will change over time¹⁵. The actual effect of TDM may depend much on how it is introduced, publicized and coordinated. [4] [5]

Link to financing and the public purse

TDM measures which raise revenue (e.g. parking fees, bridge tolls, gas taxes) could support financing of capacity (e.g. build bridges) and/or services and other travel options (e.g. by funding transit revenue shortfall).

A prime reason for implementing TDM is economic efficiency. TDM is cost effective because it helps to make better use of the existing system and postpones or reshapes growth in transport supply (e.g. new roads) otherwise needed to alleviate congestion, and move towards a more efficient allocation of resources and lower total costs.

However, public transit currently receives a higher **financial** subsidy from government (in percentage terms) than does private vehicle transportation. Private vehicles, in contrast, receive a higher percentage subsidy in **non-financial or hidden** costs which they impose on society as a whole.

¹⁴Depending on whether the value of personal time is included as a cost to the user.

¹⁵There are significant issues to be resolved as to how, when, and by whom TDM should be implemented. To test its current acceptability to the public. TRANSPORT 2021 undertook a region-wide opinion survey, which provides guidance for the project's medium-term plan recommendations on the introduction of TDM.

This suggests that as TDM increases demand on transit, greater demand on the public purse will follow if those services continue to be subsidized financially as they have been in the past.

Unless revenues are captured from private transportation, and to the extent that current financing and pricing policies are continued, the net result of TDM could be a shift in financial responsibility away from private sources to public sources.

Recommended Transport Demand Management Policies

General demand management policies

- 2.1 Governments should regard Transportation Demand Management (TDM) strategies as an integral part of transport planning in the B.C. Lower Mainland.
- 2.2 Governments should use TDM as the primary public policy instrument to restrain growth in travel by the single-occupant automobile.
- 2.3 Governments should wherever possible exempt urban goods movement, which has no practical choice other than truck, from the policy of auto restraint.
- 2.4 Neighbouring local governments which feed traffic into Greater Vancouver should be asked to respect and support the TDM policy by encouraging transit and carpool traffic, and discouraging single-occupant commuter traffic into/out of Greater Vancouver.
- 2.5 Governments should generally use "carrot" measures (persuasion and incentives) to achieve objectives before using "sticks" (penalties and disincentives); however, since "carrot" measures alone are not likely to effect significant change, "stick" measures will be required.
- 2.6 Governments should encourage businesses to adopt telecommuting by devising a framework of fiscal incentives, justified on the basis of saved or postponed infrastructure investments that would otherwise be required.
- 2.7 A regional agency, to be identified, should foster employer trip reduction programs, which look to medium and/or large-scale employers to take action to reduce the number of commuter vehicles serving their worksites. The agency should provide support by information and public awareness campaigns, a regional ride-share match-up programme, and other advisory services which encourage employers to participate.
- 2.8 Governments should leave voluntary the employers' participation in trip reduction programs, i.e. not require it by law, to avoid regulatory imposition on employers and associated public sector administrative costs (with the exception of policy 2.16 below).
- 2.9 Governments should recognize provision of HOV lanes and bus priority measures as necessary and mutually reinforcing with TDM, to provide more time-competitive alternatives over the single-occupant vehicle.
- 2.10 The Province should introduce road pricing measures or tolls structured to reduce congestion, provide clearer price signals to users for the costs they incur and impose on others, and raise revenue for transportation improvements.

Telecommuting

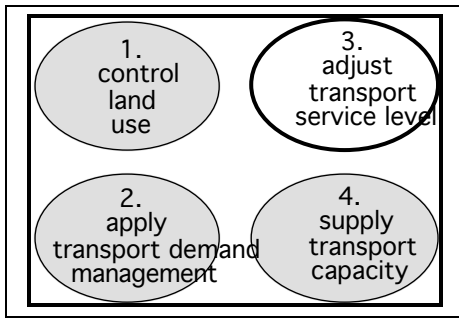
Employer trip reduction

HOV/Bus priorities

Road pricing, tolling and gas tax



- 2.11 The Province should apply road pricing/tolls with the long-run purpose of shaping travel demand in addition to obtaining revenues. The Province should not remove tolls unless it is clear that the external costs of the automobile have otherwise been accounted for and are recognized by the user.
- 2.12 The Province should dedicate toll revenues to system-wide transportation improvements, including transit/HOV improvements, retrofitting infrastructure to withstand earthquakes, rehabilitation of deteriorating facilities and construction of new facilities.
- 2.13 Governments should institute methods of converting fixed costs of auto ownership/operation to variable costs, where practical (e.g. pay-as-you-drive insurance).
- 2.14 The Province should increase gas prices, though these are a "blunt" instrument with more merit as a revenue-generating measure than as a demand management measure.
- Parking management*
- 2.15 Governments should use parking management as a TDM instrument; the provision of parking should be coordinated throughout the urban area, e.g. through a regional focal point recommended under "coordination" below; a comprehensive parking strategy is required covering short and long term, park-and ride, public and private, supply and price considerations.
- 2.16 Governments should phase out subsidized parking for commuters, e.g. through municipal bylaws requiring employers who wish to provide free or subsidized parking to employees also to offer those employees the option of the equivalent value in cash and/or travel subsidy.
- Coordination*
- 2.17 Governments should identify a regional focal point for coordinating TDM. This focal point, which could be a coordinating committee of principal agencies, should function with a mandate to monitor impacts, detect conflicts and coordinate TDM in the region among the agencies responsible for implementing the measures.



3. Adjust Transport Service Level

Importance of Service Level

Service level means the **quality of the service** experienced by the traveller or freight being transported. Aspects of service level include speed, convenience, frequency of service, comfort and other qualities.

Service level is a **key competitive factor** among modes of transport. Passengers will change their choice of travel mode because of service levels. For instance, many travellers will not ride transit, regardless of the fare, because it is not quick and convenient enough compared with the auto. A proportion of single-occupant auto drivers will change to carpooling when they observe fast-moving carpool traffic passing them in dedicated lanes.

Selectively improving the relative service levels of the different modes or in different places can cause shifts in travel patterns. For instance, better service on transit, coupled with congestion for solo-driver commuters, will shift some into transit at the margin.

Congestion is usually considered an evil; however, allowing congestion to deteriorate for single-occupant vehicles is a practical method of promoting transit and carpools. More congestion for single-occupant vehicles would magnify the impact of some TDM. For instance, buses/carpools in HOV lanes will gain an edge since the relative time saved by escaping lineups will be greater.

Caution

This is a policy lever that requires **cautious use**. The value of personal time spent in travelling in the BC Lower Mainland was \$5 billion in 1991, being more than half of the total of all other costs (operating costs, land and infrastructure, accidents, environmental and other hidden costs) combined [11]. Degradation of service therefore carries with it costs in the form of longer travel times. As the system moves into a general state of gridlock, these costs escalate steeply.

Problem of insufficient congestion to give carpools lanes time advantage

Currently in most (not all) corridors in the region the level of service to mixed traffic is too high to make HOVs attractive through time savings. This suggests that for HOV lanes to be utilized, congestion would have to be allowed to accumulate in the mixed-traffic lanes alongside. There must be a tangible benefit to HOV users (most likely in terms of net travel time savings) in order to attract their use.

Cost truck congestion

The estimated cost of delays to Lower Mainland truck traffic (i.e. additional time spent on the road beyond that which would be spent in free flow conditions) is \$110 million per year [7]. As explained later in this Report, this figure will nearly triple over the next 30 years. This cost is the rationale for permitting truck traffic to bypass congestion wherever feasible.

Similar concerns apply to other commercial vehicles (e.g. small pick-up trucks carrying goods in private service, light vans and couriers, cars of commercial travellers and others). This market segment will grow with economic activity and is unlikely to respond to demand management.

Opportunities for separating the flow of trucks and other commercial vehicles may be limited (e.g. to border crossings or local access to industrial facilities such as port areas).

Recommended Service Level Policies

Single-occupant Vehicles

3.1 Until road pricing or an extensive tolling system is instituted, governments may have to accept worse congestion for single-occupant vehicles in the peak period as a necessary evil to encourage other travel options, notably transit and carpooling.

Trucks

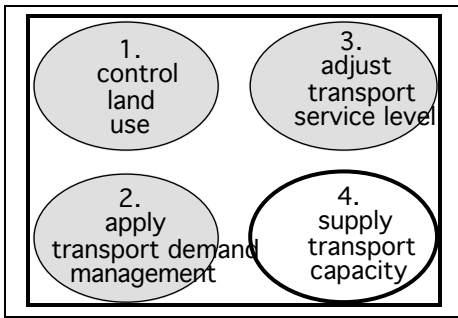
3.2 Governments should permit truck traffic to escape the auto congestion/auto restraint policy wherever feasible by separating truck flows from auto flows, consistent with cost effectiveness.

3.3 Governments should develop minimum service level standards for major truck links to trigger action for improvement if service drops below the accepted level.

Long-haul and inter-regional traffic

3.4 Governments should maintain a high level of service for traffic moving between the Lower Mainland, the U.S. and other parts of B.C. This will require a lower level of service for long-haul commuters by car into the urban area by restricting their access to inter-regional facilities.¹⁶

¹⁶This subject is explored further under policy lever 4 - Supply Transport Capacity, following.



4. Supply Transport Capacity

Transport Supply Strategies

How much?

Given that the three preceding policy levers are used as recommended—i.e. that demand management is in place, that a more compact urban form is supported by municipal land-use controls, and that a policy for acceptable congestion has been adopted—the question remains: how much, what type and where should **additional physical transport capacity** be supplied?

A key constraint is money. How should the plan deploy limited resources more effectively to meet the defined goals and objectives of the transportation system?

Building new capacity can be expensive. For instance, in the ten years ending in 1992, capital investment by municipal and provincial government in transportation facilities (roads and transit only) in Greater Vancouver totalled \$3.3 billion in 1992 dollars, or \$330 million per year. [12]

Public Sector Capital Expenditures on Transportation in Greater Vancouver 1983-1992		
	in current dollars	in constant 1992 dollars
	billions	
Transit Capital	\$1.3	\$1.5 (45%)
Provincial Road Capital	\$0.9	\$1.0 (30%)
Municipal Road Capital	\$0.8	\$0.9 (26%)
Total	\$3.0	\$3.3 (100%)

some totals do not add due to rounding

Further, spending on transportation may not be as affordable in the future as it was in the past, given the current financial circumstances of governments.

In Greater Vancouver, the majority of the **transit** capital above was financed through long term debt; to continue the pattern of the last decade would imply mounting levels of debt for the coming decades. The **road** investments were made from their respective governments' annual expenditure budgets; there are indications that funds from this source too may be harder to find in future. The issue of affordability is explored more deeply in the next chapter of this Report.

One parameter of interest is the **split between investment in capacity for public transit versus capacity for private transport**. Currently public transit handles 9% of the daily person trips in the region, whereas the private automobile handles over 80%. In the last decade, 45% of capital expenditures went to transit, 55% to roads (which carry cars, trucks and public transit buses). Should future investment be split in similar proportions?

What type and where?

Several types of transportation **technology** are available.

For instance, for **transit** there is local bus, express bus, busway (i.e. a separate roadway or guideway), commuter rail, and several variations of rapid transit, such as conventional light rail (found in Edmonton and Calgary), intermediate capacity rail (such as the local SkyTrain) and heavy rail or subway systems (e.g. found in Toronto or New York). **Roads** vary by width and spacing of access points, range from narrow local streets with frequent intersections to multi-lane freeways with widely spaced interchanges.

Each type of facility has its own cost, capacity, life-cycle, performance and other characteristics. Which type of capacity best fits in what location? What new technologies will be available over the next 30 years, with improved characteristics?

These are complex questions. Many different transport networks could serve a given pattern of transport demand. Unfortunately, there is no simple mechanical, computerized method available for adding new "optimal" links to the existing system.

The project's long-range plan is intended to provide a vision of the transport system in 2021, based on what is known today. The balance of this chapter explains how the project approached the questions of how much, what type and where new transport capacity should be supplied. It concludes with a description of the proposed system concept.

How the Project Identified the Proposed System: An Explanation

The project team approached the problem in four steps.

Step 1. The team built a large **inventory** of potential transport improvements (e.g. new or widened roads, transit links of various types). It included links previously considered in other studies, plus entirely new ideas thought to have potential.

Scenario approach

Step 2. The team constructed "**supply scenarios**" for the year 2021 from this inventory. The number of scenarios was limited to three—judged to represent reasonable extremes. The scenarios amounted to different mixtures of the different modes of transport:

- Scenario A, "**road oriented**", relied on road investment, using carpool lanes and mixed-traffic road capacity, with only enough transit to handle a moderate transit demand. It was thought that this would minimize operating costs and capital investment.
- Scenario B, "**lean and mean**", saw very little road development (for either carpools or mixed traffic), but added a significant level of transit service. The idea was to rely on the "push" of transport demand management and the "pull" of much better transit to handle travel needs. It was expected that this would result in road congestion and poor performance for goods traffic.
- Scenario C, "**balanced**", added some high-occupancy vehicle lanes to the scenario B, intended to relieve some of the pressure on the roads.

The scenarios had some common elements. They all aimed to:

- support the **land-use** plan for a more compact region;
- be consistent with applying **transportation demand management**;
- match **transit** passenger demand with capacity and service levels which at a minimum meet the projected demand in each corridor;
- accommodate **international, interprovincial, and inter-regional** passenger traffic and goods movement; and
- restrain the **solo driver** by supplying little or no additional capacity for this mode except in areas of rapid growth.

Step 3. The team **measured** the scenarios against a list of "measures of effectiveness" or criteria (both quantitative and qualitative). These criteria came from the project's formal goals and objectives for the transport system. For instance, travel speeds and congestion, system capital and operating costs, time lost for goods movement, the degree of automobile dependence, atmospheric emissions, amount of farmland consumed, and other factors were estimated for each scenario.

The team gained insights into the trade-offs involved by comparing one scenario to another (e.g. capital cost vs. performance, travel time vs. transit orientation). [9]

Step 4. Based on these insights and on guidance of the Steering Committee, the team **constructed a preferred scenario D**, which aimed to combine the best features of the initial scenarios. This was

refined with further work, and became the proposed system concept illustrated in the accompanying maps. [10]

How well the proposed system concept rated is discussed in the next chapter "What Will the Plan Achieve?" There follows a description of the concept itself.

Proposed System Concept

Transit in dense urban areas

The relatively high target population densities within the Burrard Peninsula, the North East Sector and North Surrey create an opportunity for transit. The concept for the year 2021 features a transit system less oriented to downtown Vancouver; it has a greater presence over the denser areas; it links regional centres and permits travellers to connect between several origins and destinations without having to travel via the downtown hub.

The system shows more intensive transit services in the Burrard Peninsula, the North East Sector, and in North Surrey and North Delta.

HOV network

A network of **High-occupancy Vehicle (HOV) lanes**, offering travel time advantages for HOVs, together with queue-jumping facilities to give priority at bridge heads, is also warranted.

Note that each specific application of HOV facilities will require a further, complete assessment in order to determine (a) its physical/operational feasibility (e.g. in light of limited room and complex weaving patterns of different traffic streams) and (b) the best arrangement to ensure the person-carrying capacity (as opposed to the vehicle-carrying capacity) is optimized.

Limited additional capacity for mixed traffic in compact area

New capacity for HOVs would be required to penetrate across bridges into the Burrard Peninsula, but virtually no additional capacity for intra-regional **mixed traffic** would be required. The choke points of the bridges and tunnels across the Fraser River and across Burrard Inlet would be used to "draw the line" and limit access to the single-occupant vehicle.

In areas of rapid population growth, considerable new local and arterial road construction will be necessary to accommodate mixed traffic. These roads will have to be carefully designed to facilitate transit, walking and bicycling.

The long-haul vs. commuter traffic conflict

A problem is occurring on roads intended as long-haul links with other parts of the Province—such as the Trans Canada Highway between the Port Mann Bridge and Chilliwack. These roads are **acting as conduits for urban sprawl and are increasingly losing their function for long-haul traffic**. They are instead providing commuter capacity for outlying areas where there is affordable housing, but this is occurring through the pre-emption of long-haul transport capacity provided at the provincial taxpayer's expense and that of the overall economy.

*Deterring solo-commuting
from valley towns*

Some roads (such as the King George Highway in Surrey, or the Lougheed Highway through Burnaby) have already reached the point where they have lost their original function and have been surrendered to local or intra-regional traffic. But it is not too late to protect critical sections (e.g. of the Trans Canada Highway) which lie outside the currently urbanized area.

The proposed solution to this problem is to **restrain tightly all single-occupant vehicles commuting from the valley towns** (such as Langley, Abbotsford, Matsqui, Maple Ridge, Mission and Chilliwack) into the urban area. Long-haul road capacity should be rationed by limiting access onto the inter-regional links, e.g. by:

- charging deterrent tolls at or near on-ramps at the valley towns, large enough to cut down demand; and/or
- restricting access through computerized, coordinated traffic lights at on-ramps; these would feed vehicles into the traffic flow at a rate which maintains travel speeds and prevents congestion from developing on the long-haul facility.

This approach represents a dramatic reversal of past practice, which would typically suggest a major widening of roads such as the Trans Canada Highway for mixed traffic, and improving interchanges to give better access to the rapidly growing valley towns.

Such an approach is also consistent with a policy of using transportation to help shape the target land-use plan, since it reduces in relative terms the accessibility of areas—the valley towns—which the growth management proposals suggest should follow a less-than-trend growth rate.

It is important to note that the proposed solutions will fail unless the change in supply policy is enunciated clearly, applied consistently for decades, and backed by parallel municipal land-use controls, acre-by-acre, in the valley towns.

*Corridor protection will be
needed*

Considering the high cost of acquiring continuous rights-of-way through developed areas, existing corridors (including rail rights of way being abandoned by rail carriers, hydro rights of way and other potential transport and communications corridors) should be protected from development.

Transport Supply Policy Recommendations

Transit

- 4.1 **Transit providers should add high quality, fast, frequent services linking facilities linking regional town centres.**
- 4.2 **Transit providers should offer a family of local transit services, including para-transit and flexible-route transit services, to serve demand for different time periods and different markets.**
- 4.3 **Transit providers should place priority on improving local transit services in designated urbanized and denser-developed areas within the compact metropolitan area.**
- 4.4 **To make best use of existing investment, the governments should re-allocate existing roadway capacity to maximize**

*High-occupancy vehicle
(HOV) and bus priorities*



people-carrying capacity, not vehicle-carrying capacity, and take into account the expected number of passengers per vehicle rather than the number of seats.

- 4.5 In particular, where congestion is not serious and where operationally feasible, the governments should provide HOV capacity by removing mixed-traffic or parking lanes from the existing system; where this is not operationally feasible, it will be necessary to construct new HOV facilities.
- 4.6 The Province and municipalities should install bus/HOV priority measures, wherever an advantage for transit can be demonstrated, and accept that a time penalty to other road users may occur.
- 4.7 On regional roads intended for inter-regional and regional traffic as opposed to local traffic, the Province should provide new capacity preferably by new HOV facilities, recognizing some mixed-traffic capacity expansion may be necessary.
- 4.8 The Province and municipalities should consider opening HOV lanes to trucks and other mixed traffic in the off peak period, provided that the performance or safety of transit is not compromised.
- 4.9 The Province and municipalities should follow a single-occupant vehicle restraint strategy, consistent with the regional objective of reversing the past priorities among the transport modes, increasing the choice of modes available, complementing the TDM policy and allowing investment in transit to be maximized.
- 4.10 In particular, on regional facilities within the urban area, the Province and municipalities should not increase mixed-traffic peak hour capacity, except for the limited increase resulting from displacement of HOVs into new exclusive HOV lanes.
- 4.11 The Province and municipalities in both the GVRD and neighbouring regions should do everything within their power to limit the use of inter-regional, long-haul roads for commuting, which may involve restriction at the point of access from valley towns onto the long-haul facilities.
- 4.12 Governments and transit providers should facilitate the transfer of passengers between long-haul transport and regional transit services to promote the movement of passengers by non-auto modes (e.g. buses to airport, ferry terminals, bus priorities internally).
- 4.13 The Province should designate inter-regional roads which are to be protected from congestion by long-haul commuter traffic.
- 4.14 The Province should make the necessary legislative changes to permit transportation corridors to be reserved, especially for the purposes of inter-regional travel.

Single-occupant vehicle restraint

Inter-regional road traffic and goods movement

Recommended Future System Maps

The following two maps and lists of new or improved transport connections, taken together, are recommended as best satisfying the transport system's goals and objectives.

Note that:

- exact alignments or facilities are **not** implied by the maps.
- the maps show connections intended to deal with **only the first two layers of demand**, i.e. inter-regional and regional travel demand.
- not shown is the supply response to the **third** layer, i.e. local demand, i.e. local bus routes, and local feeder and access roads which would require considerable expansion in tandem with the first two layers.
- **rapid transit lines** which are shown would typically have to cater to demands in the range of 5,000 to 10,000 people per hour in each direction. To achieve capacities at this level will require dedicated transit facilities. These may be provided by dedicated bus-way or rail transit. The exact technology to be used will depend on the physical feasibility and most cost-effective technical solution.

Long-range System Concept - Transit (Map #1)

A. Provide Intermediate Capacity Transit System from:

1.	Richmond to Vancouver Central Business District
2.	Lougheed Municipal Centre to the Vancouver Broadway business district
3.	Existing SkyTrain Line and Coquitlam Town Centre
4.	Surrey City Centre south to Newton and Surrey Municipal Hall
5.	Surrey City Centre east to Guildford Municipal Centre

B. Provide bus lanes along the:

6.	Broadway Corridor - UBC to Vancouver-Richmond Rapid Transit
7.	Hastings corridor - North Burnaby to Vancouver Central Business District
8.	Trans Canada Highway corridor - 200 Street to Guildford Municipal Centre

C. Provide bus lanes across the:

9.	Middle Arm of the Fraser River - Vancouver International Airport to Richmond Rapid Transit
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10.	Main Arm - Maple Ridge to Trans Canada Highway
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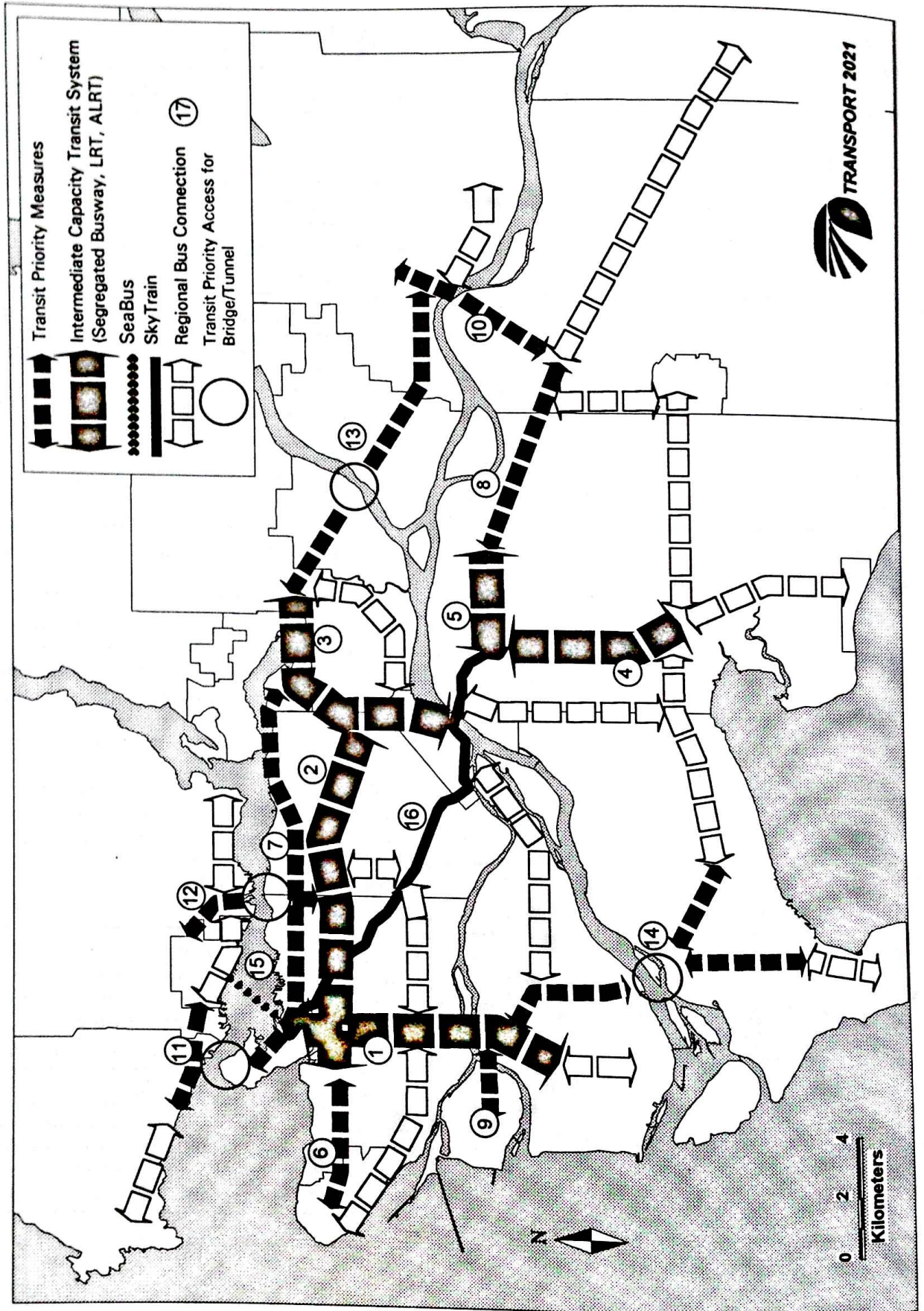
D. Apply bus priority treatment across:

11.	Burrard Inlet at or in the vicinity of First Narrows Bridge
12.	Burrard Inlet at or in the vicinity of Second Narrows Bridge
13.	the Pitt River in the vicinity of the Pitt River Bridge - Fraser North to Coquitlam Town Centre
14.	the South Arm of the Fraser in the vicinity of the Highway 99 corridor- Ladner to Richmond

E. Provide other additional transit:

15.	Add SeaBus capacity across Burrard Inlet
16.	Increase the existing SkyTrain capacity
17.	Increase main-line and feeder bus coverage and service hours

Map #1 Long Range Transportation System Concept - Transit



**Long-range System Concept -
High-occupancy Vehicle and
Mixed-traffic Improvements
(Map #2)**

F. Provide HOV lanes in the vicinity of the:

21.	Barnet-Hastings corridor - Northeast Sector to Boundary Road
22.	Lougheed corridor - Highway 7 to Trans Canada Highway
23.	Trans Canada Highway and Grandview Highway corridor - Cape Horn Interchange (North of the Port Mann Bridge) to Clark Drive
24.	Trans Canada Highway corridor - 200 Street to the Cape Horn Interchange (North of the Port Mann Bridge)

G. Provide HOV lanes across the:

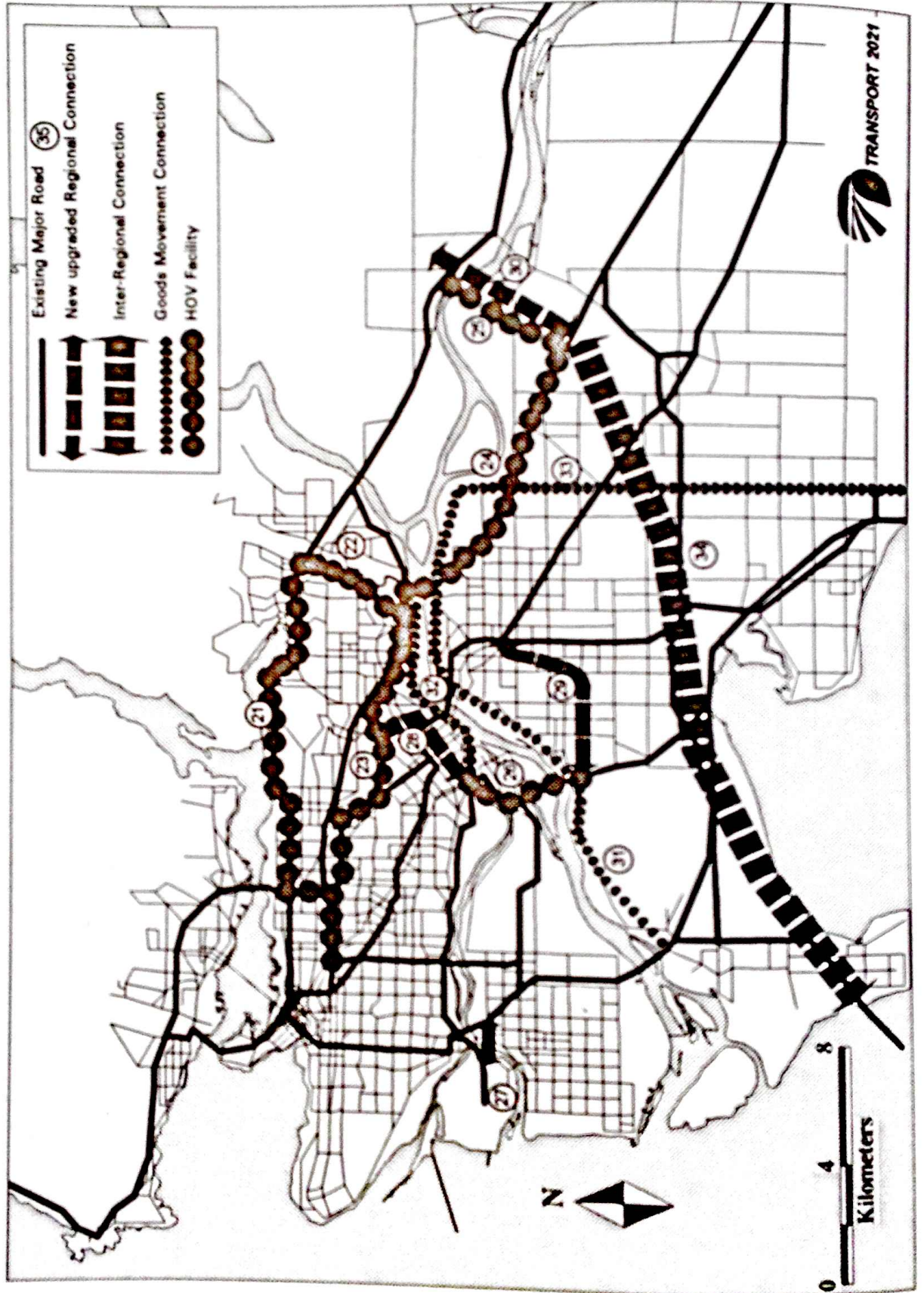
25.	Fraser River at or in the vicinity of the new river crossing between Maple Ridge and Surrey
26.	North Arm of the Fraser River at or in the vicinity of the Alex Fraser Bridge-Queensborough Bridge corridor

H. Provide other improved connections as follows:

27.	Provide an improved Moray Channel Bridge and associated roadway improvements - Highway 99 to the Vancouver International Airport
28.	Improve north-south connections from Pattullo Bridge and Marine Way to Trans Canada and Lougheed Highways
29.	Improve road access from Highway 91 at Nordel Way to the Surrey City Centre
30.	Provide a new river crossing over the Main Arm of the Fraser River from Fraser North to Fraser South
31.	Improve east-west connection from Highway 17/99 to Highway 15/Highway 1 (South Perimeter Road)
32.	Improve east-west connection Southeast Port Road - Mary Hill Bypass/Highway 1 to Queensborough Bridge/Marine Way
33.	Improve Highway 15 from Trans Canada Highway to the Canada U.S. border
34.	Provide east-west highway connection from Highway 17 to Trans Canada Highway
35.	Provide new arterials and widen existing arterials to serve development.

*Item numbers are keyed to
Map #2 and do not indicate
priority*

Map #2
Long Range Transportation System Concept - HOV and Mixed Traffic



C. What Will The Plan Achieve?

A Numerical Assessment of the Plan's Performance

The key elements of the long-range transport plan are the policy recommendations listed under the policy levers—including the investment in physical facilities of the type and location shown on the associated maps.

This section describes **what** can be achieved by such a plan, i.e. by using the policy levers as recommended. Does the plan achieve the goals and objectives set for it?

The section compares numerically the projected results of the plan with (a) the situation today and (b) what is otherwise expected to happen by 2021, under "business as usual" trends.

The data presented below stems from extensive numerical analysis of many possibilities. The analysis uses the art and science of computer modelling. It is internally consistent and draws on surveys of past traffic patterns and behaviours in the B.C. Lower Mainland. Readers should interpret the data as indicating the magnitude and general direction of change, and should not attach great significance to the apparent precision of the figures. [10]

The projected growth in population and the economy between 1991 to 2021 means more traffic of all types, in absolute terms. The plan cannot eliminate growth of travel—rather, it reduces its rate and shapes its pattern, as described below.

Passenger Transport

Changes in urban density and transit usage

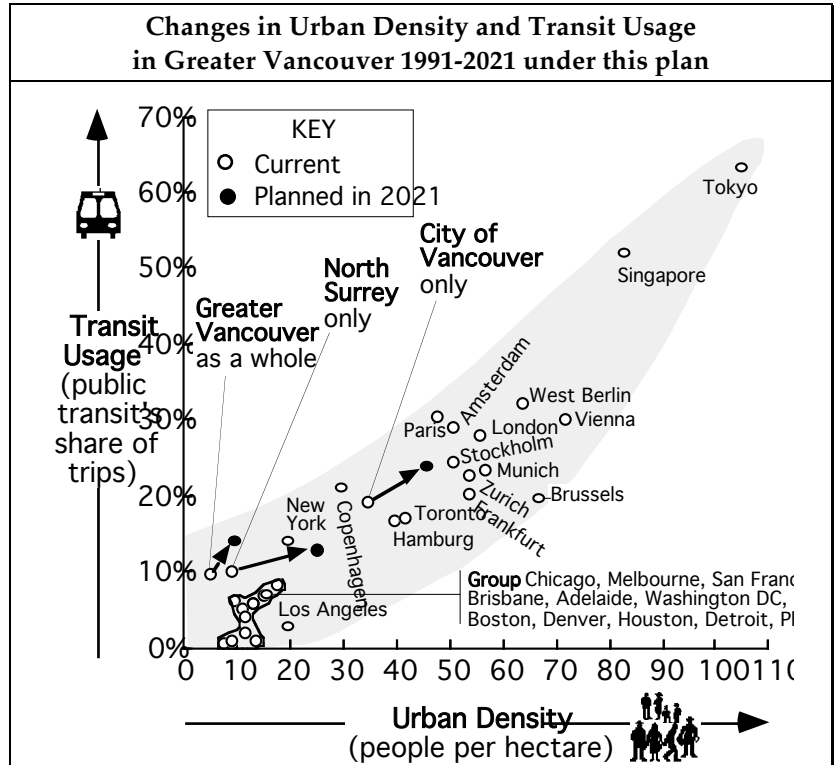
For the region as a whole, urban density would not be sufficient to bring transit usage into the range experienced in Europe or Asia today.

Parts of the region (e.g. North Surrey and Vancouver City) would see higher densities and transit usage, with the City of Vancouver reaching transit usage comparable with some European cities today.

Source: Adapted from "Greenhouse, Oil and Cities" by Peter Newman, in "Futures", May 1991, supplemented with data from TRANSPORT 2021 and the Greater Vancouver Livable Region Strategy, 1993.

Under the Livable Region Strategy and TRANSPORT 2021 proposals, as Greater Vancouver grows it would become more transit-oriented. For the region as a whole, transit would achieve a share of the travel market comparable to that reached today in cities such as Sydney and Toronto.

The City of Vancouver would reach densities and transit usage comparable with those found in cities such as Stockholm, Zurich and Munich today.



Under the recommended plan for the morning rush hour in 2021:

- the total number of people travelling by all modes would be nearly 700,000, which is 80% higher than in 1991. This figure is slightly lower than trend for 2021 (by 1%), due largely to telecommuting.
- the number of people driving in rush hour would grow more slowly, being 350,000 in 2021 which is 60% higher than in 1991 but lower than the trend for 2021 by some 13%.
- the number travelling as car passengers would double to 140,000 in 2021, which is 3% higher than trend (but notable because there are 13% fewer cars for them to ride in, compared with trend).
- the number of transit riders would be 130,000, 160% higher than 1991 and 59% higher than trend in 2021.

Recommended Plan vs. Current Trends for 2021	In 1991	In 2021		
		Current Trends	The Plan	Change from trend*
Person Trips in Morning Rush Hour (millions)				
Total by all modes	.39	.70	.70	-1%
As car drivers	.22	.41	.35	-13%
As car psgrs (non-drivers)	.07	.14	.14	+3%
As transit riders	.05	.08	.13	+59%
Transit's Share of Person Trips in Morning Rush Hour				
For people travelling:				
- to downtown peninsula**	37%	37%	48%	+30%
- to 6 regional town centres	13%	15%	29%	+93%
- within region overall	13%	11%	18%	+64%
Average Number of People in A Car in the Morning Rush Hour				
For people travelling:				
- to downtown peninsula**	1.36	1.35	1.42	+5%
- to 6 regional town centres	1.30	1.29	1.40	+9%
- within region overall	1.34	1.33	1.40	+5%
Total Distances Travelled in the Morning Rush Hour (million km)				
By all vehicles	3.1	5.6	4.8	-17%
By transit passengers	0.6	1.1	1.8	+62%

*Differences are due to rounding of numbers in columns to left
 **Includes central business district plus "West End" residential area

These figures can also be expressed as changes in the *growth which would otherwise occur*. For instance:

Cuts car growth a third

- the growth in car drivers which would have been 190,000 (.41 minus .22 million) is cut back to 130,000; i.e. the plan would reduce the 30-year growth in the number of rush hour car drivers by a third.
- the total distance driven by all vehicles combined, which would have risen from 3.1 million km today to 5.6 in 2021, is cut back by 17% to 4.8, with the 30-year growth being reduced by a third.
- the growth in transit riders which would otherwise have been 30,000 is increased to 80,000; i.e. the plan would increase the 30-year growth in rush hour transit ridership by 166%.

Increases transit growth by over 150%

Therefore, the plan increases the share of the total travel market held by transit:

Reverses transit decline

- the share of the total rush hour travel served by transit, projected to decline under trend conditions by 2 percentage points, would be higher by 7 percentage points, for a total of 18% of the market; i.e. the plan would reverse a projected decline in transit's share of the total travel market.
- in certain sub-markets—to downtown Vancouver and to regional town centres—the plan would raise transit's share significantly above the "business as usual" trend.

The plan would also increase the **average number of people riding per car**:

More people per car instead of less

- the average number of people riding per car, projected to decline by 0.01 people/car region-wide under trend conditions, would rise by 0.07 to 1.40; i.e. the plan would reverse a projected decline in the number of people carried per car in the morning rush hour.

Reduces car dependence

The region would become **less dependent on the automobile**. The car would continue to be the largest single mode of transport, but the proportion of journeys taken by car would drop; the percentage of car drivers is projected to fall from 59% under current trends to 50% under the long-range plan.

More homes near rapid transit

Access to transit service would be improved, with four times the length of rapid transit services in place; 30% of the population would live within 1 km of a rapid transit line compared with 8% today.

Emissions of local air pollutants down

There are different outlooks for local and global **air pollutants**:

- Five **local** air pollutants (carbon monoxide, oxides of nitrogen and sulphur, particulate matter and volatile organic compounds) originate **mainly from motor vehicles**. The GVRD's goal is to cut these emissions to 1/2. Total emissions from vehicles are actually projected to **decline more than this**—to 1/3 of current amounts by 2021—due mainly to better engine technology and enforcement, and partly to a reduction in automobile dependence under this plan.

Emissions of greenhouse gas up

- All fossil-fuelled engines also emit carbon dioxide (CO₂), generally accepted to cause **global** warming. The provincial and national target is to stabilize CO₂ emissions from all sources (home heating, transportation, power generation, waste incineration, etc. combined) at 1990 levels by the year 2000. Transportation is **not the primary source** of CO₂, emitting less than a sixth of province-wide or a quarter of Canada-wide CO₂.

Vehicles in the BC Lower Mainland will themselves **not achieve the CO₂ target** for all sources combined; their CO₂ emissions will likely rise 10% in the 1990s and climb thereafter: a 15% to 20% increase between 1991 and 2021 is projected



under this plan, compared with 25% to 30% under trend conditions¹⁷.

Congestion worse

Congestion will worsen on the roads. While average speeds would decline somewhat (by 3%), the congestion seen today would be more widespread, affecting more roads.

Goods Transport

Inevitably, **trucks will be caught** in the greater congestion which will occur in the region in the future; the extra congestion costs for trucks in the Lower Mainland would be \$185 million per year or some \$70 per capita per year—a cost which truckers can be expected to pass on to their customers where they can.

To provide better service for trucks would require more roads. Only with a completely separate circulation system, which would be difficult to justify economically, would the goods movement system be unaffected by congestion in general purpose traffic.

Trucks face more, but tolerable, delay

The **cost of truck delays** due to congestion would increase from 20% of truck running costs in 1991 to 27% in 2021.

These costs are significant, but they are not intolerable. They would be worse if measures recommended elsewhere in this plan were not put in place, i.e.:

- demand management to limit automobile traffic which competes for road space;
- system management to preserve the flow of traffic on major truck corridors such as the Trans Canada Highway;
- a policy of admitting trucks to high-occupancy lanes where possible and appropriate; and
- specific road improvements directed at assisting the flow of truck movement.

¹⁷Estimates provided by GVRD Air Quality and Source Control Department based on traffic projections generated by TRANSPORT 2021.

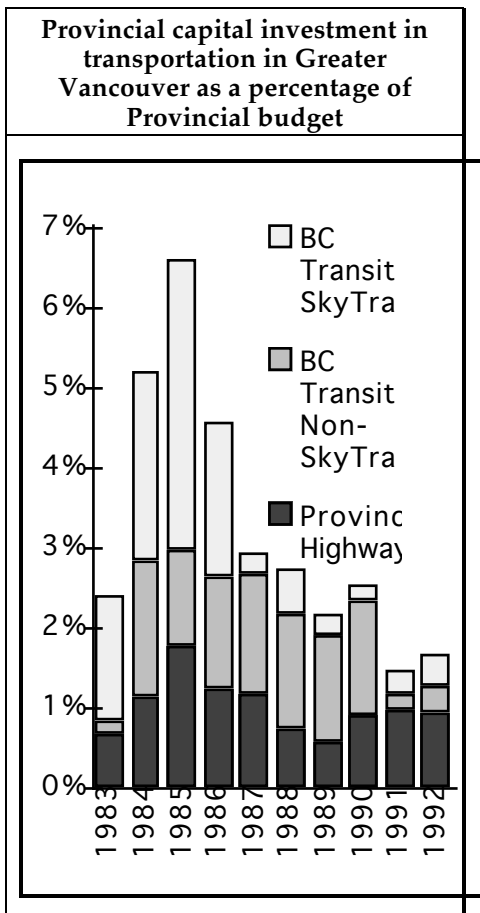
Additional Parameters of the Recommended Plan	Current 1991	Plan 2021	Change %
Livability and Amenity Factors			
Emission of local air pollutants ('000 tonnes/year of 5 pollutants)	380	130	-66%
Emission of "greenhouse" gas ('000 tonnes/year of carbon dioxide)	4900	5700 - 5900	+15% to 20%
New roads in protected areas (lane-km)	na	150	na
Route-km of rapid transit	23	99	+330%
High-occupancy vehicle/bus lanes (lane-km)	mar- ginal	180	na
Percentage of total population close to transit service (in census metro area):			
- within 400 metres of a bus route	87%	90%	+3%
- within 1 km of rapid transit line	8%	30%	+22%
Congestion Factors			
Cars: rush hour avg speed (km/h)	38.5	37.5	-3%
Trucks:			
- 24 hr avg truck travel speed (km/h)	53.0	49.0	-8%
- cost of congestion delays (\$m/yr)	\$110	\$295	168%
- total truck running costs (\$m/yr)	\$525	\$1100	110%
Other System Measurements			
Number of vehicle-hours of operation (million vehicle hrs/yr):			
- for automobiles	290	443	+53%
- for buses	86	148	+72%
- for rapid transit	12	88	+633%
- for SeaBus	1	2	+100%
- for trucks	10	22	+120%
Annual vehicle km travelled (billion)	11.1	16.6	+50%

Capital Costs and Affordability

An important test of reasonableness of the transport plan is affordability¹⁸.

The estimated capital cost of expanding the transportation system under this plan through to the year 2021 is estimated at \$10.0 billion in 1992 dollars. Note that this is an approximate cost intended for broad evaluation of the plan, not for project budgetting purposes. [10]

Public Sector Capital Expenditures on Transportation in Greater Vancouver (in billions of 1992 dollars)		
Period	Actual	This Plan
	over 10 years 1983-1992	over 28 years 1993-2021
Transit Capital	\$1.5 (45%)	\$3.6 (36%)
Provincial Road Capital	\$1.0 (30%)	\$3.9 (39%)
Municipal Road Capital	\$0.9 (26%)	\$2.5 (25%)
Total	\$3.3 (100%)	\$10.0 (100%)



How such future capital expenditures could be paid for, and by whom, is a large topic for further research.

Urban transportation financing is currently being re-thought in many jurisdictions; this is partly due to escalating demands for transportation capital when the traditional sources of funds—government budgets—are being pre-empted by educational, health, and other social programs.

Governments in other provinces of Canada and in other countries are turning to private sources of capital, using tolls or other user charges dedicated to help fund transportation infrastructure. The Government of British Columbia has announced the formation of a Transportation Financing Authority with similar features.

Preparing a financial plan goes beyond the terms of reference for TRANSPORT 2021. However, indicators of affordability of the project's recommendations are available. This section presents two tests of affordability:

Affordability Indicator #1:

Comparison of future vs historical rates of capital spending.

Affordability Indicator #2:

Prospects for new dedicated transportation revenue adequate for financing future capital expenditures.

¹⁸ Not addressed in this discussion are Federal Government expenditures; historically, these have been concentrated in airport and seaport infrastructure, with certain contributions to urban transport capacity (e.g. capital contribution of \$60 million BC Transit for SkyTrain development and construction of the Arthur Laing road bridge between Vancouver and Richmond in the vicinity of the international airport). Also not considered are private investments in the vehicle fleet (cars and trucks) and private parking facilities, and investments by BC Ferries and BC Rail.

Affordability Indicator #1

In the past in British Columbia, road and rapid transit facilities have been paid for in different ways: [12]

- **Road** building has been paid for through current expenditures, both at provincial and municipal levels. Roads have not been capitalized or financed by raising debts tied to the road assets, so no interest costs are recognized for road investment.
- **Rapid transit**, on the other hand, has been financed through debt. In the 10 years ending in 1992, 82% of all transit capital expenditure was for rapid transit (i.e. SkyTrain).

Therefore, for consistency of comparison, all figures below exclude the interest costs on the transit debt.

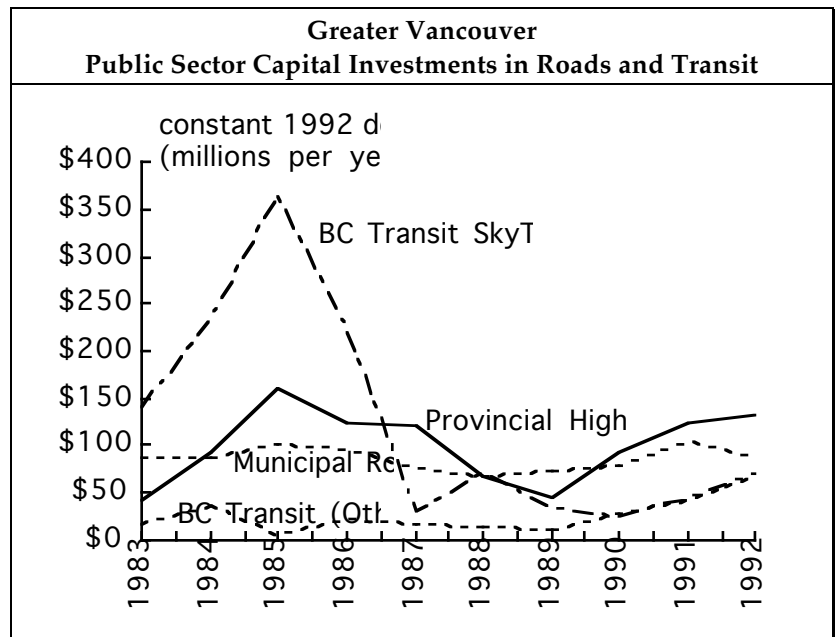
For the provincially funded facilities, transportation capital expenditures in Greater Vancouver averaged 3.23% of total provincial budget for the ten-year period, with a downward trend from 1985 (see chart, previous page).

Historical Capital Expenditure

The historical capital expenditure on transport in the GVRD by both provincial and local government combined is shown below.

The Provincial government peaks in 1985 result from the construction of major road facilities such as the Alex Fraser bridge and related Annacis Island road system and SkyTrain and in the early and mid-1980s,.

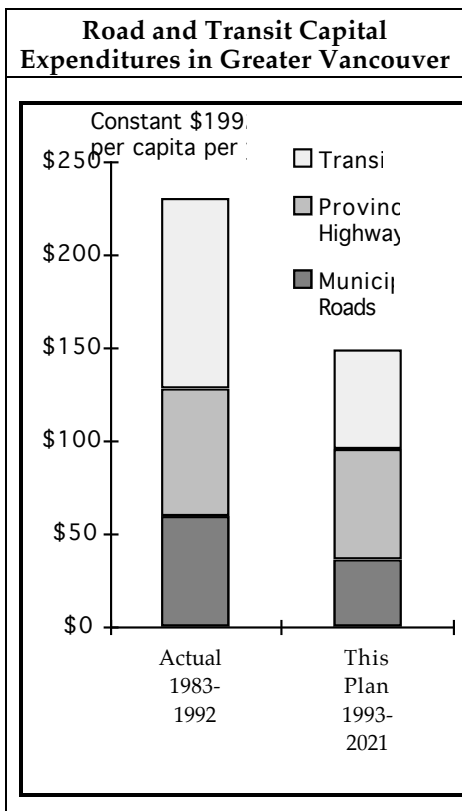
Municipal expenditures are relatively stable, and reflect steady expansion in local road networks to access new development areas and to accommodate general increases in traffic.



A useful measure of the transport investment is the annual capital expenditure for each resident of the region, in real terms, as follows.

About 35% lower per capita rate of capital spending in real terms would have to be sustained to 2021.

Average Annual Per Capita Public Sector Capital Expenditures on Roads and Transit in Greater Vancouver			
Period	Over 10 years 1983-1992	This Plan: over 28 years 1993-2021	Difference
Transit Capital	\$103	\$54	-48%
Provincial Road Capital	\$69	\$59	-15%
Municipal Road Capital	\$59	\$37	-37%
Total	\$231	\$149	-35%



Operation and maintenance expenditures

To pay for the total \$10 billion in future transport investment identified above, the plan would require a smaller amount— \$149 per capita per year , or 35% lower than past spending rates—to be sustained through the period 1993-2021.

This suggests that the magnitude of capital investment is not unreasonable—one indicator of affordability.

Affordability Indicator #2

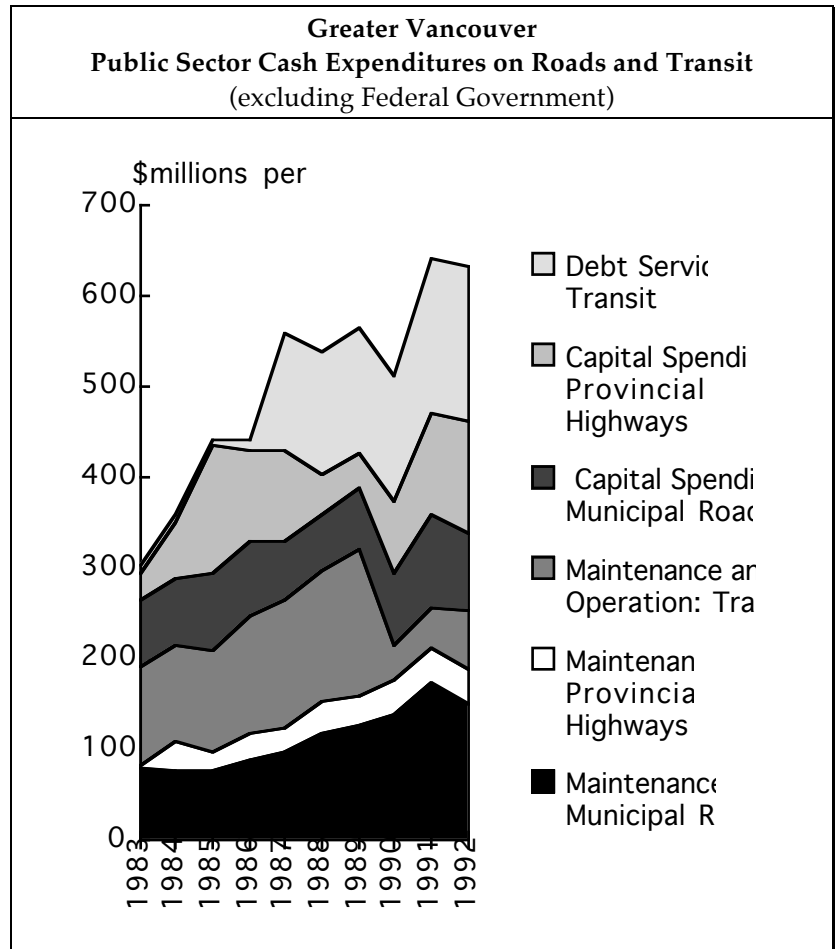
However, it can be argued that the benchmark for indicator #1—past total rate of capital spending (roads plus transit in the last decade)—is not sustainable in any case. In particular, the 1980s saw an obligation assumed (the SkyTrain debt), which will require servicing for decades to come with cash from future budgets. To repeat that 1980s pattern of spending would mean escalating debt and corresponding service charges.

Further, the portion of capital expenditures not funded by debt but from current budgets in the last decade—roads, both provincial and municipal plus the non-SkyTrain portion of transit—may not be sustainable, due to other spending priorities.

Could future capital expenditure in Greater Vancouver be financed through new revenues generated from the transportation system, e.g. as a result of the demand management measures—tolls, gas taxes and parking taxes? This question requires a discussion of other expenditures and other revenue sources.

In addition to capital expenditures, the public sector applies its revenues to maintaining the transport system, through general maintenance and operating expenditures. These expenditures are

totalled with capital expenditures in the chart below. To portray cash flow as experienced by the public sector, transit debt service charges are used, rather than capital investment in transit.¹⁹



Existing Revenue Sources

Today, public sector revenues associated with transportation come from several sources.

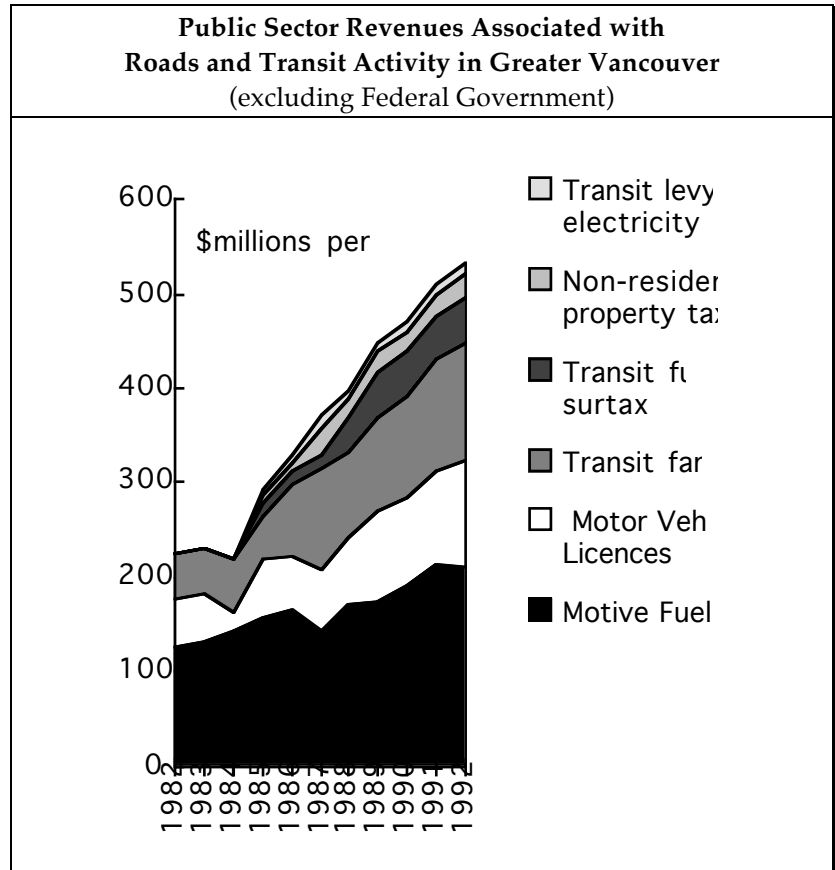
Some revenues are not generated by transportation activity but are earmarked for spending on transportation (e.g. BC Hydro levy). Others have the opposite features: historically, they are generated by transport activity but have not been earmarked for transportation (e.g. fuel tax).

In order of dollar importance (highest first) the revenue sources associated with roads, transit and automobiles in Greater Vancouver are:

- province-wide fuel taxes collected within Greater Vancouver;
- licenses and permits for motor vehicles in Greater Vancouver;

¹⁹Administrative overheads are excluded from expenditures .

- BC Transit fuel surtax (collected in a defined transit service area);
- transit fares from fare box;
- Non-residential property tax for transit; and
- BC Transit levy on BC Hydro power bills.



These revenues are relatively stable and can be expected to continue to climb with transportation activity and inflation.

A comparison of revenues and expenditures (see previous page), indicates that, for the Province and municipalities combined:

- public sector cash expenditures in Greater Vancouver have exceeded revenues in Greater Vancouver in every year;
- if the debt service expenses (for transit) are removed, there is a rough balance between revenues and expenditures; and
- if all capital-related expenditures are removed (i.e. road capital as well as transit debt service), then total revenues are more than sufficient to pay for the operation and maintenance of the system.

If future capital expenditures were to be covered by new sources of revenue, it is reasonable to assume that future operation and

New Sources of Revenue

maintenance expenditures would be covered by the existing revenue base.

Three potential new sources of revenue are the result of the proposed transportation demand management measures:

- bridge tolls;
- higher fuel taxes, dedicated to roads and transit; and
- parking taxes structured to raise parking charges.

Using traffic volumes projected in the year 2021, but at current dollar prices, and given that demand management measures are implemented as shown, one estimate of the revenue generated is as follows:

Bridge tolls: assuming a 24-hour toll is implemented in both directions on all major bridges into the Burrard Peninsula.

Annual auto volume (millions)	270
Annual revenue in 2021	\$540 m

Gas Tax: assumes a doubling of the motive fuel tax to increase the operating cost of autos from 8.15 cents/km to 10.86 cents/km.

Annual vehicle-km travelled (millions)	17, 830
Annual revenue in 2021	\$483 m

Parking Charges: assumes an increase in long-term parking (work trips) in the central business district by 50%, and raising parking charges in regional town centres to an average \$3 per day. More revenue would be raised if charges were applied to short-term parking.

Annual revenue in 2021	\$65 m
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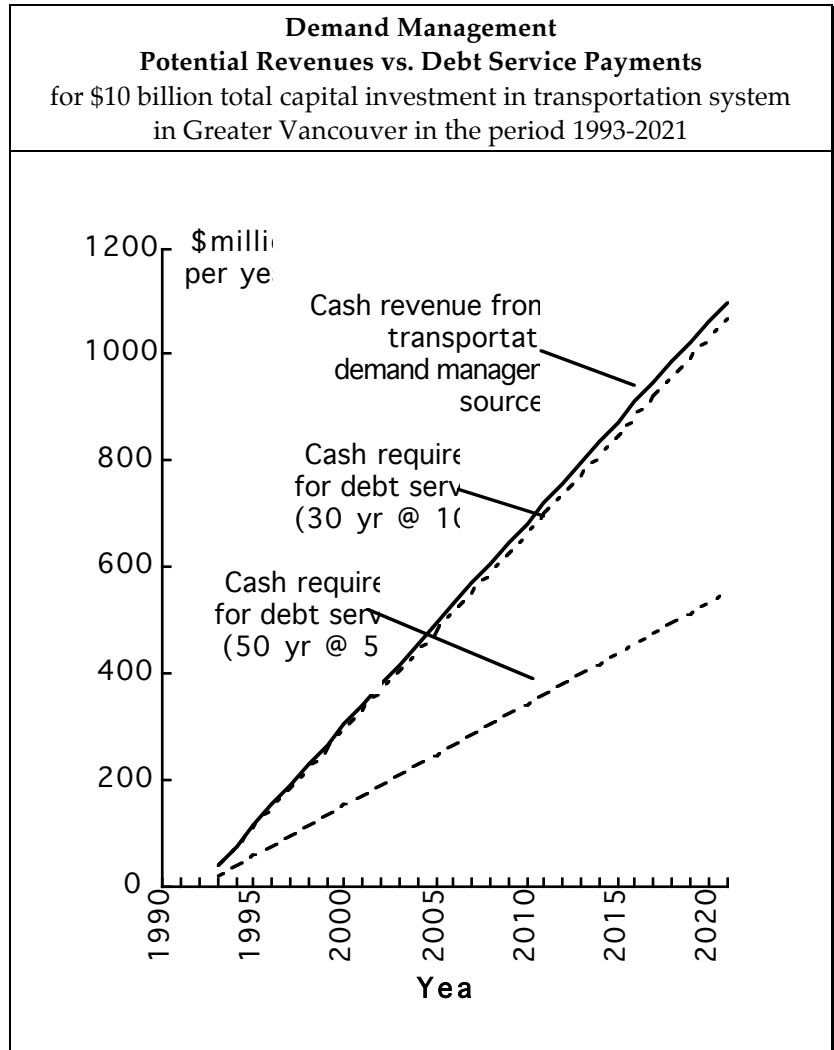
The total annual revenue potential in 2021
therefore approximates in \$1992 **\$1.1 bn**

This revenue is sufficient alone to fund the estimated \$10 billion capital cost of the proposed transportation system capital cost, as follows.

Assuming for the purposes of illustration that:

- transport demand management pricing measures are phased in over the period to the year 2021 in such a way that additional annual revenue climbs from zero in 1992 to \$1.1 billion in 2021;
- capital expenditures are made uniformly in equal amounts per year over the same 28-year period, to total \$10 billion by the year 2021 (being an investment of \$345 million per year);

then the debt service charges are less than the projected revenues in any given year. Shown below are two calculations of debt service: one for a relatively short amortization period and high real interest rate (30 years at 10% per year), which places debt service charges about equal to revenues in any given year; and one at a longer period and lower rate (50 years at 5%), which places them at about half of revenues.



This is the second test of affordability of the plan, which suggests that all of the capital cost of the proposed new transportation facilities could be financed from alternative revenue sources.

Conclusion

In conclusion, the recommended long-range transport plan is considered to meet its own objectives. Forecasts indicate that the plan will serve the 30-year increase in travel needs for people and goods while:

- reducing the growth in the number of rush hour drivers by one third;
- reversing the projected decline in the average number of people per car, i.e. reducing solo-commuting;
- increasing transit ridership four times from today's level;
- increasing transit's share of the travel market, reversing the projected decline;
- providing convenient access to rapid transit to a larger proportion of the population;
- seeing a 2/3 decline in the vehicle emissions of five major local air pollutants, and limiting increases in the emissions of the greenhouse gas carbon dioxide which would otherwise occur;
- limiting increases in congestion for passenger and goods movement to acceptable levels; and
- requiring a level of capital investment which appears to be affordable.

The plan is projected to turn the transport system and the service it provides in a more desirable direction, as measured by the parameters described in this section.

Finally, it is important to remember that these results require that all policy levers operate successfully and in mutual support of each other. How to cope with the uncertainty attached to this requirement is addressed in the next section.

D. Keeping Options Open

The long-range transport plan represents a vision of the transportation system in 2021 which best meets the system's goals and objectives as they are seen today.

It is impossible to predict all the conditions under which the transportation system will operate in 30 years' time. Unexpected and unforeseeable developments will occur. The Plan contains many underlying assumptions which may not hold true over 30 years. It will have to be revised periodically for a course correction.

In addition, the plan looks forward only 30 years. Beyond that time, initiatives may be required which are not recommended or even considered here.

Further, events which foreclose options are certain to occur. For instance, land values escalate. It becomes too costly to acquire property for transport infrastructure after the fact. Continuous corridors may be permanently blocked by land development.

This chapter makes recommendations for keeping options open so that the plan can be as flexible and robust as possible, and that the region's transportation system can adapt to an uncertain future.

A glance backwards over the past 30 years reveals shifts which urban transport planners of the early 1960s might have missed or could not foresee. For instance:

- many more **women** joined the paid workforce from the 1960s onwards, changing the amount and type of travel needed—especially the desire for quick, convenient transport;
- the size of **family units** shrank—so that the demand for housing grew faster than the population;
- the heavy **road and bridge construction** phase of the 1950s ended in the early 1960s. The Lower Mainland Regional Planning Board's 1963 "Choice and Challenge" strategic transport plan envisaged an extensive freeway grid of roughly 10-mile spacing throughout the Burrard Peninsula and Fraser Valley to support large new towns, but this did not come to pass. This was in part due to policy choices made in the 1970s under the "Livable Region Plan";

Surprises Since 1960

- western Canada's natural resource industries enjoyed a boom in **international trade** from the late 1960s to the early 1980s; and **commercial aviation** across continents and oceans became both affordable and common. Both helped establish Greater Vancouver as a trade and transportation gateway of global importance;
- the **environmental protection** movement grew strongly from the 1970s on; concern about air pollution in many countries, and crises in the supply of petroleum fuels in the 1970s, caused cars to be re-engineered for fuel economy, efficiency and low emissions;
- in B.C., **agricultural land**, which was not protected in 1960, was increasingly seen as a valuable resource; today its protection is generally taken as a given, and the location of urban development and transport corridors are constrained by an Agricultural Land Reserve; and
- cheap, much more powerful **computers** and related communications technology became widely available by the early 1980s—and with it the ability to monitor, measure, and manage transportation activity both remotely and automatically.

Sources of Uncertainty

Several **future developments** could affect the development of the region and its transport system compared to that identified in this long-range plan. For example, natural disasters, social or political disturbances, technological breakthroughs, or changes in community values or attitudes could all change the future as it appears today.

The **long lead times** (e.g. 10 years) required to install major pieces of transport infrastructure magnify the uncertainties, because of the need to plan far ahead.

Unanticipated shifts in immigration policy, birthrates and housing preferences (e.g. ground-oriented vs. apartments) and other **demographic** variations could move the actual travel demand pattern away from that projected for the year 2021.

If the underlying assumptions of the plan do not hold true, then the transport plan will have to be modified.

There are limits on the ability to model human behaviour, preferences and values; for instance, although the plan requires changes in travel behaviour, there may be *unanticipated* degrees of change in:

- the social acceptance of use of **automobile**;
- the image of **public transit, bicycling and walking**; and
- how people value their **travel time**.

All of these could affect people's choice of transport mode in ways not predicted in the plan.

Uncertainty in Underlying Assumptions

Human behaviour variables and the response of the system

Changes in daily routines or work practices and other factors could mean that the **morning peak hour**, modelled as the key demand component in the TRANSPORT 2021 research program, may not be as important in the future as it is today. Other time periods with other characteristics may be more important.

How people respond in a **more congested transport** system is also a variable, as well as the response of the system itself. Some considerations relating to congestion are as follows:

- in a more congested system, the response to clearing up **blockages** caused by stalls and accidents will become more critical if reliability of service is to be maintained;
- if congestion reaches a point where rush hours occupy six to eight hours per day on extensive sections of the road network, the **cost of rehabilitation and maintenance** for the system rises unacceptably (since contractors' crews must be mobilized work for only short off-peak periods), and/or excessive delays are caused for road users when work is done in busy traffic conditions;
- the response of **truckers** to more congestion will depend on how successfully they can be insulated from its effects through separate facilities or use of HOV lanes; and
- **transit** service will face greater challenges to achieve the higher service levels called for in the plan while operating buses on busier streets.

Assumptions for success in implementation

Among the most crucial assumptions of the plan are that (a) future decision makers will adopt the policies recommended by the plan and that (b) these policies will actually work. The plan requires a number of mutually reinforcing actions to be taken; it will not function on a "pick and choose" basis. Success in one area depends on that in another.

In particular, the plan assumes that

- **urban growth will be managed** based on the Livable Region Strategy's land-use pattern of population and employment throughout the B.C. Lower Mainland, which by choice is quite different from the "business as usual" or trend option.

Success in zoning controls is also assumed at the local level. This is the key to preventing urban sprawl from clogging long-haul provincial transport corridors, which may otherwise become local roads (as for example has already happened on the Kingsway, King George, Lougheed, and Barnet corridors).

- **transport demand management** will be successfully implemented, which is the key to reducing automobile dependence.

If the targets for growth management and demand management are missed, the system would default towards the "business as usual"

or trend option, i.e. towards more suburban and ex-urban development, less transit use, more automobile dependence with more congestion and hence the need for more roads.

The plan also assumes that more detailed studies (e.g. for feasibility and functional design of facilities where operational considerations become important) will not result in a complete re-think of the strategy, but rather an adaptation of it.

Coping With Uncertainty

The TRANSPORT 2021 Steering Committee proposes that the long-range plan be flexible and robust with respect to both types of uncertainty. These qualities are incorporated by two means.

First, options to use transport corridors not in the long-range plan must be kept open.

Corridor preservation

The Steering Committee recognizes that the agencies responsible for supplying transport, notably the Ministry of Transportation and Highways, should continue to plan and investigate, respond to changing conditions and preserve options for routes and corridors, as they see fit within the limits of their responsibilities and powers.

This is a fully legitimate activity of agencies charged with responsibility to provide for the long term needs of the region and the Province. This activity is not a commitment to construct and does not conflict with the Committee's long-range transport plan.

Long-range highway options

In particular, Ministry of Transportation and Highways has identified several long term corridor options for investigation:

- an east-west North Fraser Freeway through the northern portion of Pitt Meadows, Maple Ridge and Mission;
- an additional crossing of the Pitt River as an extension of the North Fraser Freeway to either David Pathan Way or the Trans Canada Highway;
- additional capacity over both the South Arm and North Arm of the Fraser River; and
- a third crossing of the Burrard Inlet near Burns Point to provide a north-south connection between David Pathan Way and Highway 1 onwards to both the Annacis system and King George Highway.

In addition, the Ministry has made other observations relating to more detailed planning:

- on the Massey Tunnel where the counter-flow lane may prove operationally unsatisfactory over an extended period and may require new solutions;
- on the Trans Canada highway to support its provincial and national role; and



- other strategies for infrastructure which may emerge as investments are required for seismic security (earthquake-proofing) and major rehabilitation.

Further, there have been discussions with regions neighbouring Greater Vancouver on the merits of an additional link from the east of the Fraser Valley, being:

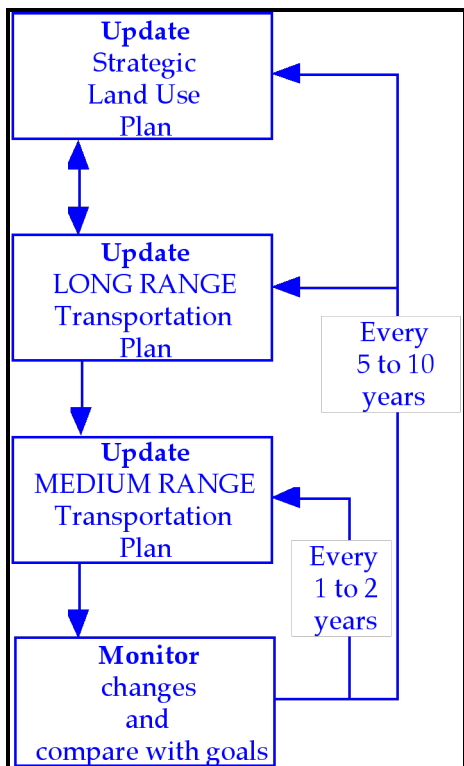
- an east/west corridor parallel to the US border linking Abbotsford/Matsqui and Highway 99 near Boundary Bay to allow for a future high-speed link (not necessarily a freeway) between Vancouver International and Abbotsford airports.

Treatment of Long-range Options: not recommended in 30-year horizon under this plan

While this Report does not recommend that facilities be built in such corridors, they may be needed in light of all the above uncertainties, either within the 30-year horizon or beyond it. The Steering Committee does not recommend the construction of facilities in the above corridors within the 30-year planning horizon because:

- under the assumptions of the long-range plan, they are not required to serve demand before the horizon year; and
- all the corridors, if put into operation, work against the proposed land-use objectives and the pro-transit orientation of the GVRD Livable Region Strategy which the transport plan is intended to reinforce.

Stable planning cycle



The second method of coping with uncertainties is to make it a "living document", regularly updated. This means establishing a regional transport planning cycle and a responsible body, able to recognize and respond to structural changes and surprise events. The planning cycle would:

- cover all modes of transportation, goods and passengers;
- integrate land-use planning with transportation planning, with the transport planning being based on local, regional, provincial and national transport goals and objectives;
- be methodical and have continuity, being able to monitor the transport system and maintain records of data, past strategic thinking and decisions; and
- be associated with a sustained, predictable funding basis to support the required capital projects.

The responsibility for monitoring the condition, usage and operation of the transportation infrastructure, maintaining these records as a database, tracking performance measures against past strategic thinking and decisions would naturally fall to the agencies which are charged with the delivery of this plan and its operational components.

Such a regime does not exist today. The TRANSPORT 2021 project has some of the above attributes but is a single-shot program.

**Recommendations to Keep
Options Open**

- 5.1 All parties should regard the preservation of future potential corridors, even though such corridors are not recommended for functioning transport facilities under this long-range plan, as a fully legitimate activity of responsible agencies, in order to keep options open and deal with the uncertainties of the future.
- 5.2 The agencies responsible for transport facilities should continue with those activities required to define, assess and protect long-range options in support of continuous planning.
- 5.3 The Province and local governments should establish a stable planning cycle covering all modes of transportation, passenger and goods movement, which fully recognizes the interaction between land-use and transportation.



E. What Commitments Are Required—By Whom?

Unprecedented levels of cooperation and coordination will be required to implement this plan successfully.

Because the policies are interdependent, it will be important that each group be able to act with confidence that partner groups are committed to parallel supporting actions.

The long-range plan does not recommend what mechanisms should be used to achieve the plan, but it does list the main items on which a commitment is required from the main parties.

For **local governments**, the most important commitment is to make coordinated changes to local community plans and zoning practices to manage and shape the location of growth within the region. In addition, the local road network for which they are responsible will have to be developed in accordance with the plan.

For the **Province of B.C.** the most important actions are to commit to develop the transportation system to support the proposed Livable Region Strategy, to introduce transportation demand measures (including "sticks" or penalties) and to supply management at the region-wide level.

The following table summarizes the policy commitments required of the partner agencies in order to realize the TRANSPORT 2021 Long-range Plan. Since the TRANSPORT 2021 medium-range plan [18], published under separate cover, deals with timing matters, the table does not answer the question of when these actions should be taken.

The policies are roughly divided into three areas—policy and coordination items, legislative and regulatory items, and finance and implementation items. Some of the policies could be listed in more than one of these areas.

Every recommended policy is keyed to relevant policy numbers {in brackets} in the preceding sections. The table covers all recommended policies—none has been omitted.

	Policy and Coordination	Legislation and Regulation	Finance and Implementation
Provincial	• Designate inter-regional	• Change collection of	• Create fiscal incentives to promote tele-



Appendix 1: Public Communications

Introduction

In the spring of 1992, a joint communication plan was launched for the TRANSPORT 2021 project and the GVRD's Livable Region Strategy. The plan was delivered jointly by the GVRD Communications and Education Department, TRANSPORT 2021 and the GVRD Strategic Planning Department. It was designed to ensure that public information and consultation was integrated and occurred at appropriate stages.

Below are the joint communication activities carried out during the TRANSPORT 2021 project in the period September 1991 through August 1993.

Shaping Our Communities: The Challenges of Regional Growth and Transportation May 1992

This conference provided an opportunity for over 300 residents, private sector stakeholders and decision-makers to examine the implications of current development trends and policies and to discuss the key choices that can shape Greater Vancouver's future settlement pattern and transportation network. Participants included municipal councillors and senior staff, representatives from business, professional organizations, community and special interest groups, and provincial and federal government agencies as well as private citizens.

Transportation Think Tank Seminar September, 1992

Fifty individuals, including members of the TRANSPORT 2021 Steering Committee, the real estate development industry, members of the academic community, and the transportation and communications industry attended an invitational seminar held at New Westminster, B.C. Its purpose was (a) to broaden the project by exploring what areas merit more attention and (b) to narrow the wide range of scenarios the project should test, by offering informed judgments on how strongly the policy levers might realistically be pulled, and opinions on the practical tradeoffs among them.

Shaping Our Communities: Critical Choices Conference November 1992

Over 450 stakeholders, community leaders, elected officials and members of the public attended the second major conference. This conference provided an opportunity for participants to consider the implications of alternative ways to share growth among communities and to discuss a preferred direction for regional land-use and transportation planning.

**Choices Bulletins
May 1992 to August 1993**

Five public information bulletins produced between May 1992 and August 1993 provided progress reports. The bulletins were circulated to community leaders, stakeholders and members of the public.

**Transport 2021 Focus Group
February 1993**

Two focus groups were conducted with randomly-selected residents of the GVRD to assess public acceptability of transportation demand management measures.

**Council of Councils Meeting
March 1993**

A half-day Council of Councils meeting was held to discuss growth management challenges facing the region. Attendance (119 people) included elected officials, municipal staff and members of the public from throughout the region.

**Public Opinion Survey
April 1993**

A public opinion survey (with a sample size of 1200 to produce statistically significant results) was conducted to test public acceptability of transportation demand management measures.

**Creating Our Future: Critical
Choices Consultation
May 1993**

The Critical Choices consultation gave residents the opportunity to learn about all of the GVRD's programmes—including land-use and transportation—and to provide input to the GVRD Board on the affordability and priority of these programmes. More than 2000 residents participated by completing a questionnaire included in a newspaper insert, by viewing the consultation on cable television or by attending one of six public forums held simultaneously in different locations in the region on May 15. The consultation for growth management and transportation asked participants how they would design their community to reduce sprawl, protect the green zone and help to maintain the livability of the region.

**Council of Councils Meeting
June 1993**

A half-day Council of Councils meeting was held to discuss Livable Region Strategic Plan Proposals and the Transport 2021 proposals for the long and long-range transportation plans. A total of 76 elected officials attended, in addition to municipal staff and members of the public.

**Pacific National Exhibition (PNE)
Display
August and September 1993**

The long-range transportation plan proposals and Livable Region Strategic Plan proposals were highlighted in a land-use and transportation display at the Pacific National Exhibition (PNE). PNE management targeted for 1.1 million visitors to the PNE.

The display was designed for use after the PNE at other appropriate venues to promote the plan proposals.

Presentations and Interviews

Members of the Steering Committee and the Project Team provided briefings, presentations, interviews or speeches at the invitation of these groups during the life of the TRANSPORT 2021 project.

Association of Professional Economists of BC
 BC Agricultural Land Commission
 BC Chamber of Commerce
 BC Energy Council
 BC Liberal Caucus Committee on Land-use and Transportation
 BC Mortgage Investors' Association
 BC New Democratic Party Lower Mainland MLAs
 Calgary-Vancouver Transport Corridor Business Group
 Canadian Federation of University Women, North Vancouver
 CBC French Language Television News
 CBC Radio Morning Show
 CBC Television Evening News
 CFVR 850 (Abbotsford) Radio
 Chartered Institute of Transport-B.C and Yukon Section
 City of Richmond Planning Dept.
 CKNW Bill Good Radio Show
 CKNW Fanny Keefer Radio Show
 Delta Chamber of Commerce
 Dewdney Alouette Regional District
 Dewdney Alouette Regional District Transportation Task Force
 Fraser Cheam Regional District Transportation Task Force
 Fraser Valley Liberal Riding Association
 GVRD Air Quality Advisory Committee
 GVRD Regional Engineers' Advisory Committee
 GVRD Strategic Planning–Technical Advisory Committee
 Institute of Transportation Engineers, Vancouver
 Institute of Transportation Engineers, Victoria
 Richmond Chamber of Commerce–Transportation Committee
 Squamish-Lillooet Regional District Transportation Task Force
 Sunshine Coast Regional District Transportation Task Force
 Surrey Chamber of Commerce–Transportation Committee
 Transportation Ass'n of Canada-Urban Transportation Council
 Tri Cities Chamber of Commerce
 Urban Development Institute
 UTV Evening Television News
 Vancouver Board of Trade
 Vancouver City Plan Ideas Fair
 Vancouver Courier Newspaper
 Vancouver Electric Club
 Vancouver International Airport Authority Management
 Vancouver International Airport Transportation Seminar
 Vancouver Port Corporation Municipal Liaison Committee
 Vancouver Province Newspaper
 Vancouver Quilchena–Community Forum on Transportation
 Vancouver Sun Newspaper
 Weather Network Television
 Z95.3 FM and CISL 650 Radio Environmental Show

Publications can be obtained from
**GVRD Communications and
 Education Department**
 4330 Kingsway
 Burnaby, B.C., V5H 4G8
Tel: (604) 432-6339
Fax: (604) 432-6399

Proceedings of Public Conferences
*(held jointly with the GVRD's Strategic
 Planning Department)*

Appendix 2: List of Publications

First Conference:

Shaping Our Communities: The Challenges of Regional
 Growth and Transportation
(held May 23, 1992 in Surrey, B.C.) July 1992

Second Conference:

Shaping Our Communities: The Critical Choices
(held November 28, 1992 in Richmond, B.C.)
 February 1993

Third Conference:

Creating Our Future: Critical Choices
(held May 15, 1993
simultaneously in six locations in the region)
 June 1993

Council of Councils Meeting:

(held March 27, 1993 in Delta, B.C.) May 1993

Council of Councils Meeting:

Creating Our Future: Critical Choices
(held June 12, 1993 in New Westminster, B.C.)
 June 1993

"Choices" Bulletins

*(eight-page bulletins published jointly with the
 GVRD's Strategic Planning Department)*

1. "Preparing for the 21st Century" *May 1992*
2. "Conference Rejects Business As Usual Planning"
September 1992
3. "Critical Choices" *November 1992*
4. "Building A Livable Region" *March 1993*

Newspaper Inserts

*(distributed in community and/or region-wide
 newspapers)*

- "Critical Choices"
 A sixteen-page newspaper insert *May 1993*
- "Greater Vancouver into the 21st Century"
 A four-page newspaper insert *August 1993*



Working Papers*(published by TRANSPORT 2021)**Working Papers are referenced by their number in square brackets [] in the body of this Report.***Objectives**

[1] Goals, Objectives and Criteria for Developing a Long-range Transportation Plan for Greater Vancouver
May 1993

Demand for Transportation

[2] Transportation Demand Management Measures and Their Potential for Application in Greater Vancouver
January 1993

[3] Transportation Demand Management: A Forecast Modelling Approach
February 1993

[4] A Qualitative Research Study on Transportation Demand Management Measures
March 1993

[5] Public Opinion Surveys on Transportation Demand Management
July 1993

[6] Parking, Mobility and Accessibility in Greater Vancouver
May 1993

[7] Trucking in Greater Vancouver: Demand Forecast and Policy Implications
August 1993

[8] Urban Access to Gateways - Seaports, Airports, and Major Routes into and out of the British Columbia Lower Mainland
March 1993

Supply of Transportation

[9] Evaluation of Three Transportation Supply Scenarios for Greater Vancouver
July, 1993

[10] Derivation of a Long-range Transportation Supply Strategy for Greater Vancouver
August 1993

Transportation Costs

[11] The Cost of Transporting People in the British Columbia Lower Mainland
March 1993

[12] Historical Public Transportation Expenditures in the BC Lower Mainland
August 1993

Land-use and Transportation

[13] Transportation Implications of Regional Growth Options in Greater Vancouver
March 1993

[14] Transportation Implications of a Compact Metropolitan Growth Option
May 1993

[15] Regional Transportation Implications of Neighbourhood-Level Planning Initiatives
August 1993

Other Topics

[16] Economic Development Perspectives on Transportation Planning
October 1992

[17] New Transportation Technologies and Their Implications for Greater Vancouver
February 1993

[18] A Medium-range Transportation Plan for Greater Vancouver
September, 1993