

**TRANSIT
&
LAND USE
PLANNING**





INTRODUCTION

North American municipal and regional planning authorities are pursuing urban growth management strategies that preserve or improve urban “livability”. In the Lower Mainland, concerns about air quality and traffic congestion are central themes in regional planning, such as the GVRD *Creating Our Future* program, and the Transport 2021 project. Growing communities throughout BC share similar concerns. These studies identify a larger role for public transit as a key strategy for achieving a reduction in the number of automobile trips and an improved urban environment. Achieving higher transit ridership is a challenge in an automobile oriented society, and transit agencies should not bear this responsibility alone.



Public Transit in B.C.

Public transit is provided in over 58 municipal areas in British Columbia, including conventional, paratransit and handyDART services. BC Transit is responsible for planning, funding, marketing, and implementation of these systems. In the regions of Victoria and Vancouver, BC Transit operates these services. In other areas of the province, BC Transit works in partnership with local governments and private contractors to provide transit service.

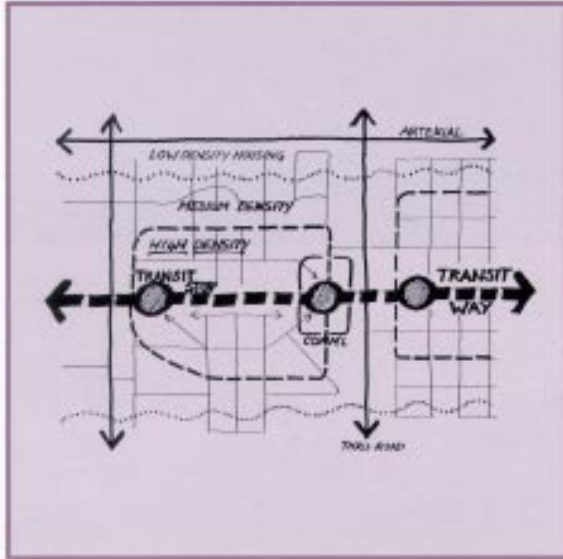


Public transit is simply the movement of people in groups, generally in large vehicles operating on fixed routes and schedules. These services are available to the public at fares that vary from community to community. The conventional bus is the most common vehicle in use in larger urban areas.

The emphasis here is on integrating conventional bus service with land use planning.



Making the Transit Connection ... to Land Use



In order to attract more transit customers, the strong influence of land use and urban design on travel behaviour needs to be recognized and utilized to the advantage of transit. Authorities that have taken this direction are promoting land use policies and development regulations that help reduce automobile traffic and increase transit use. This approach to community development is based on the philosophy of building sustainable communities, and neotraditional approaches to land use planning.¹

Better integration of land use and transit planning begins with including transit considerations in subdivision design and land use planning. Municipalities have the legal authority and regulatory instruments of bylaws to enforce transit supportive urban design. Increased emphasis on reviewing development proposals with respect to traffic generation, potential transit ridership and ease of transit operations is a key to a transit “friendlier” environment.

BC Transit is seeking more cooperation from municipalities to formulate land use policies and regulations that promote greater use of public transit and less use of automobiles. The purpose of this report is to better inform decision makers about the relationship between travel behaviour and land use, and to demonstrate transit friendly urban design features.

This report describes what transitoriented land development means in terms of urban structure, design, and road networks. The second section provides specific examples of design features which are favourable to public transit. Designing transit friendly communities can be achieved by municipalities through changes



to the bylaws and regulations governing land development.

Benefits to the Community

The benefits of less automobile travel and more travel by other modes, including public transit, are experienced by individuals, businesses and future generations. Public transit makes a positive contribution to our quality of life because it offers a safe, reliable, affordable, and an environmentally conscientious form of travel. Transit friendly translates into a pedestrian friendly environment.

In order to reduce our dependence on single occupant vehicle (SOV) use, we need to create an environment where the attractiveness of alternative modes of travel are more competitive with the automobile.

This may be accomplished if locations for new development and the design of new development give consideration to people, as well as automobiles.

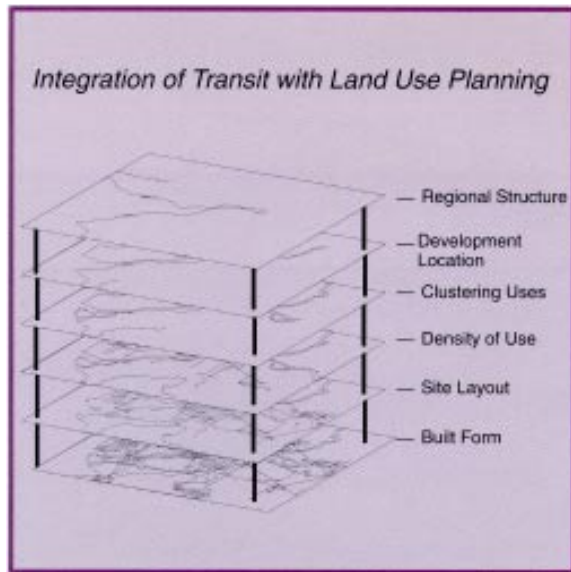
TRANSIT ORIENTED LAND DEVELOPMENT

A retrospective look at the development of older cities where transit is highly utilized finds there are common elements of urban design. These areas have features which tend to favour pedestrians, as well as street design elements which permit transit vehicles to move more freely in traffic. The density of development and proximity of mixed uses was acceptable, if not desirable, because at the time there was less access to private automobiles. Cities evolved from a series of neighbourhoods

Why Support Transit?

- Better use of land resources
- Improved environmental quality
- Better community image
- Reduced traffic congestion, and energy consumption
- Improved transportation alternatives
- Reduced parking requirements
- Reduced stress from commuting by automobile
- Improved marketability of the location
- Better return on investment in transit infrastructure
- Reduced need for expensive investment in additional roads, bridges, and parking areas.





that were fairly self-sustaining. These areas developed incrementally, at a much slower pace than today, and in smaller parcels than the large comprehensive developments and subdivisions of today. Older cities demonstrate that density, critical mass, proximity of land uses, and convenient pedestrian routes help reduce automobile dependence².

What Helps Transit Work?

Clues to designing new transit friendly areas are found by looking at what motivates individuals to use specific modes of travel, what motivates less use of private automobiles, and greater use of public transit.³

The recurring themes in transit friendly urban design include structural elements of density, land use mix, road network, as well as design to accommodate pedestrians and transit vehicles. Municipal implementation of transit friendly developments would involve a multidisciplinary team of landscape architects, architects, planners, and traffic/transportation engineers. Transportation engineering is included because the traditional engineering formula of designing streets to move vehicles exclusively is being challenged. A greater effort to design streets from a holistic perspective, taking into account the entire population of bicycles, pedestrians, and transit is required.⁴

Elements of Transit Friendly Design

- density
- land use mix
- road network
- street design
- site design
- pedestrian amenity

The qualitative experience of taking a trip is very important in mode choice. A public transit trip may be broken into three separate stages: the pedestrian experience at the beginning; the transit ride itself; and being a pedestrian again at the end of the trip.³ Clearly, the *pedestrian experience* is as important as the transit service characteristics in motivating people to use transit. Pedestrian experiences are



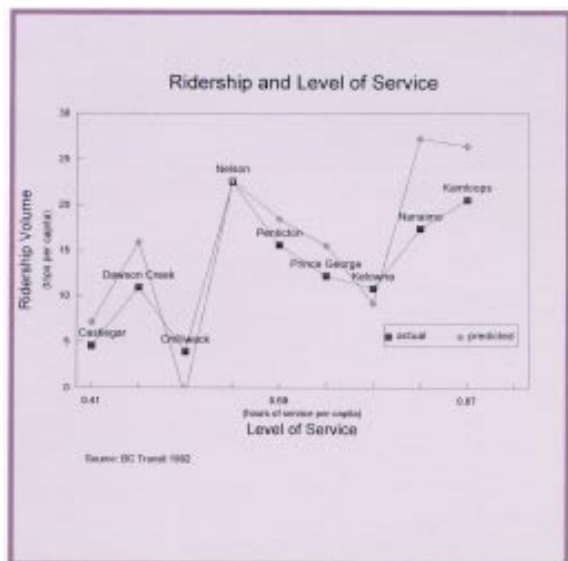
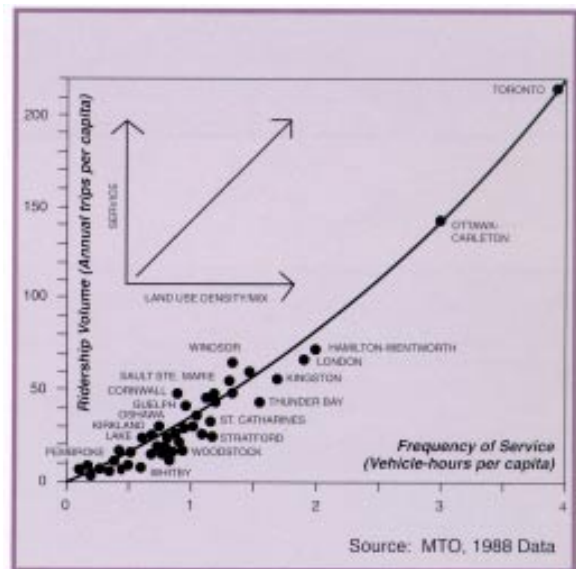
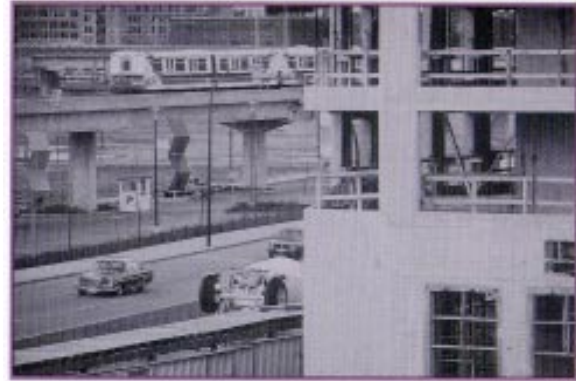
influenced by the proximity of the starting point to transit, the walk distance to the destination, the overall street design, site design, and pedestrian amenities on the sidewalk.

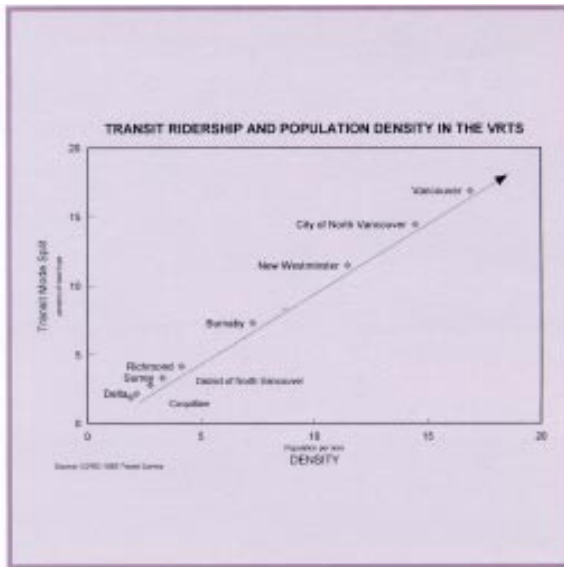
Development Density

The elements of density that are important to transit are its location relative to transit services, and consistent density from origin to destination along a route. The positive relationship between increased density and increased transit ridership is very well documented in literature dealing with the relationship between transportation and settlement patterns⁵. It is further demonstrated by the ridership growth on SkyTrain due to redevelopment in the vicinity. It is also notable on bus routes where a significant development occurs nearby.⁶

The relationship between density and transit ridership is demonstrated in transit systems everywhere. In Ontario, smaller centres of lower density development such as Oshawa support less transit service, whereas larger urban centres with fairly dense populations, such as Hamilton, can support much higher levels of service.

In British Columbia, excluding the Vancouver Regional Transit System, the relationship between density and ridership is illustrated by Nelson, where ridership is high relative to the level of service due to the compact urban area; and Kelowna, which has comparatively low ridership for the amount of service, partially because it is developed at low density. There are similar examples in the Vancouver region as well. Generally, as residential and employment densities increase, the number of passengers per route kilometre increases, and a higher level of service is justified.





Continuous development is the second component of the influence of density on transit. Policies such as the Agricultural Land Reserve or similar “green zone” initiatives make contiguous development impossible for some areas. The municipalities affected may experience higher costs per capita for infrastructure such as roads, sewers, water, and other municipal services that extend around the non-urban areas. Some of these costs are recovered by the municipality through development cost charges; however, costs for new transit service should also be factored into the municipal assessment of new infrastructure required. Extending transit services can be expensive.

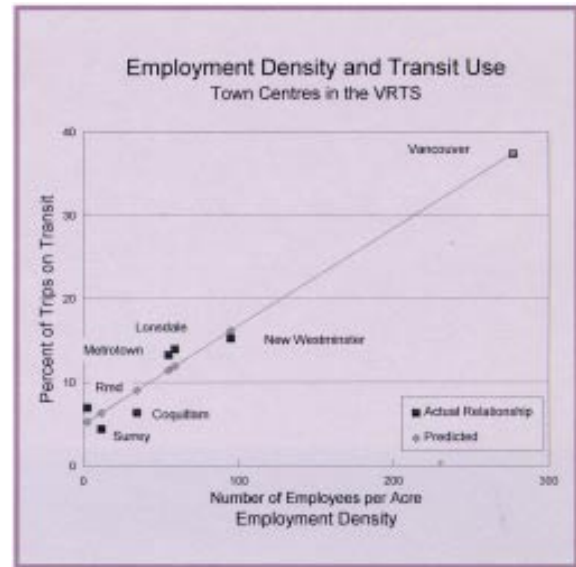
Municipalities are able to costjustify development proposals beyond the existing urban area, but a full accounting of the services required has not been made if the cost of extending the transit system is not being considered.

Location of Employment and Density

The principles of sustainable development promote an employment to labour force balance in each community. However, a land use policy which encourages employment generating activities to be scattered throughout the community can be problematic from a transit perspective. Clustering businesses into a few areas of significant development creates the critical mass that transit requires to serve the area more cost-effectively. A greater number of employment centres over a large area results in a scattered travel pattern, whereas transit is best suited to “many-to-one” travel patterns.



A study of trip making in Seattle found that as the number of employees per acre increased, the transit mode split improved.⁷ It was concluded that transit Eldership increases substantially when employment density reaches a threshold of 50 employees per net acre, where the employment centre has more than 10,000 jobs. Studies of travel patterns in suburban locations find that density, combined with the mix of business types on the site have the strongest influence on overall travel demand.⁸ The transit mode split was found to be most closely associated with the availability of parking on site. It is clear that transit use is heavily influenced by the critical mass of employees, and the availability of free parking. A critical mass of employees represents a viable market for the transit service.



The relationship between employment density and transit mode split is clearly demonstrated in the Vancouver region as illustrated. The proportion of trips made by transit increases directly with increases in employment density. Transit's share of the work trip market is highest in downtown Vancouver where employment density is also highest.⁹ Low employment density in a town centre results in a small mode share for transit. Employment centres are scattered throughout the lower mainland, and although they may have a significant number of employees, some are poorly situated in relation to the transit system. Suburban business parks occupy large land areas, usually provide ample free parking for employees, and are a poor market for transit.

Employment Densities in the Vancouver Region

Location	Employment Density (Jobs/Acre)	Percent of Motorized Trips by Transit
Downtown Vancouver	276.8	37.4%
Other Vancouver	18.3	14.9%
North Vancouver Lonsdale	58.9	13.9%
Other North Vancouver	6.2	8.9%
Richmond Centre	2.5	7.0%
Other Richmond	9.3	3.6%
Surrey City Centre	11.5	4.5%
Other Surrey	3.6	2.7%
Coquitlam Centre	34.4	6.4%
Other Coquitlam	2.9	4.5%
MetroTown	54.8	13.3%
Other Burnaby	10.5	9.4%
New Westminster Centre	94.9	15.2%
Other New Westminster	12.9	10.0%

Further details about the relationship between employment density and transit ridership are shown in Table 1. Downtown Vancouver has almost three times the employment density of the next most dense area in the region, downtown New Westminster.



The amount of employment located downtown compared to elsewhere in the municipality is a good indicator of the type of businesses present. Land use policy and zoning determine the location of employment and has a major influence on traffic patterns. Employment that is not centred results in a scattered web of travel patterns which are impossible for public transit to serve effectively.

Business Parks



The business park is a popular form of office development in suburban areas where land is affordable for business to develop at low density with large parking lots. Businesses with requirements for storage and distribution of goods, and close linkages to commercial transportation also favour the business park. Business parks located outside the main business district help to reduce traffic in the core. While this may be viewed as positive because the traffic is dispersed, it is not conducive to transit. A municipality which is dominated by automobile dependent business will have lower transit and consequently warrant a lower level of transit service.



Office functions have employees who generally do not need to use a car during business hours, and represent a good potential transit market. Two facts discourage transit in office parks: (1) there is little incentive for these employees to consider transit when there is free parking; and, (2) office parks may be located outside the urban core and far from existing transit services. Due to the second factor, transit services are more costly to provide. In addition, office employees tend to justify the use of an automobile to do errands at lunch etc., because there are no convenience services located nearby.



Residential Density and Transit Service

It is generally accepted that in order for transit to be feasible, a minimum threshold population is necessary. Although there is considerable empirical research that supports the notion that density and transit usage are co-dependent, empirical studies of minimum density thresholds for transit are limited. Nevertheless, the desire for straightforward guidelines has led to strong support from decision makers and planners for using measurements of density to determine transit service levels.

Conceptually, this approach has merit, however, BC Transit is finding that the relationship between service levels on a specific route and density is not simple, and has yet to develop a “workable” set of density thresholds. In lieu of clear guidelines, new services begin operation at a level of service which is considered to best meet demand. Providing service levels in response to demand is typical of most transit operations in North America because it is too costly to provide a higher service level in anticipation of demand. As a result, some services are peak period only, others operate only during the day, and some operate late at night.



The Vancouver Regional Transit System provides different types of services in response to the market: local service, intermunicipal connections, as well as regional service generally focussed on downtown Vancouver. In order to ensure a reasonable level of convenience, the Transit Commission (or municipality) sets a minimum frequency policy for times when demand is low. Similar policies are in place for all transit systems in British Columbia. The increased requirement for effective deployment of public resources is encouraging BC Transit to examine how minimum density “standards” could be utilized.





TRANSIT SERVICE RELATED TO DENSITY

SERVICE DESCRIPTION	DENSITY (Dwellings/ha)
Local bus, daytime hourly service	9.88
Local bus, extended hours and 60 minute service, or 30 minute daytime service	17.29
Frequent bus service, some express	22.23
Very frequent service (@5-10 minutes)	37.05

The table summarizes an often quoted study by Pushkarev and Zupan. Common relationships between residential density and level of service were documented from their research of transit properties across North America. The study found that certain densities were associated with different services.¹⁰

Land Use Mix

Neighbourhoods in older cities often contain a mix of residential, retail, commercial, institutional, and recreational uses in close proximity. This dense urban form reflects the dominance of public transit and walking during the period of construction. Today, these areas continue to generate fewer automobile trips overall and higher transit ridership.¹¹

These communities typically feature pedestrian oriented streetscapes, with building entrances directly at the sidewalk within a few steps of transit, and with sidewalks that have amenities such as trees, benches, and some border between the sidewalk and the street. People living in these communities are more inclined to use public transit because their familiarity of the area is not dependent on automobile use. Many places are easily accessible from the sidewalk as opposed to being hidden inside an enclosed space like a mall.

Mixing land uses means combining commercial uses of various types, permitting personal services and restaurants to be located near industry or commerce. Most importantly, residential subdivisions should include convenience services within walking distance. The opportunity to walk to and from bus stops and accomplish errands conveniently is further motivation to use transit rather than drive.





A transit oriented residential subdivision will have a variety of characteristics, including a focal point consisting of non-residential land uses including convenience retail, parks, schools, and other amenities. A mix of land uses in close proximity to each other makes it easy for people to accomplish several trip purposes by walking, a single transit trip, or a single automobile trip, rather than several destinations. The key to reducing single automobile trips with mixed land uses is to incorporate road designs and pathways that allow direct pedestrian access.



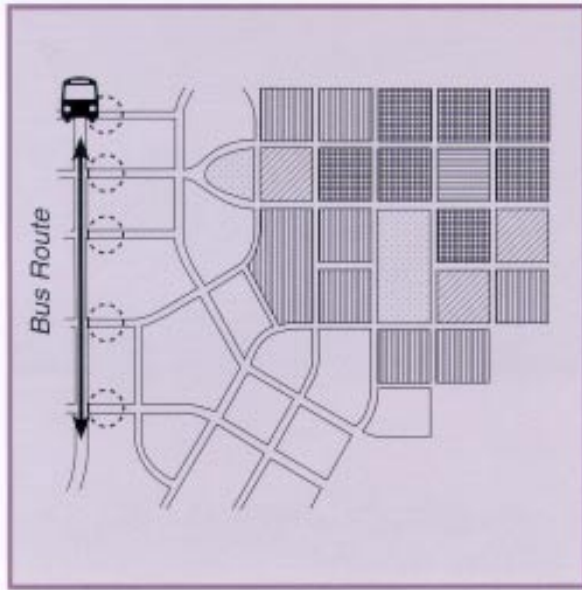
Current zoning often requires strict land use segregation, resulting in large distances between different activities (schools, shopping, post office, recreation centres etc.). Although the goal of curvilinear streets and single block zoning is to encourage quiet homogeneous neighbourhoods and discourage through traffic, the result is a high number of automobile trips within the subdivision.

Road Network Design and Pedestrians

In order to design a road system that is advantageous to both pedestrians and vehicles, engineering for vehicle safety and pedestrian behaviour need to be combined so that the right-of-way has well defined spaces for both users. How the interface between pedestrians and traffic is treated by urban designers and engineers is critical to achieving a “people” place.



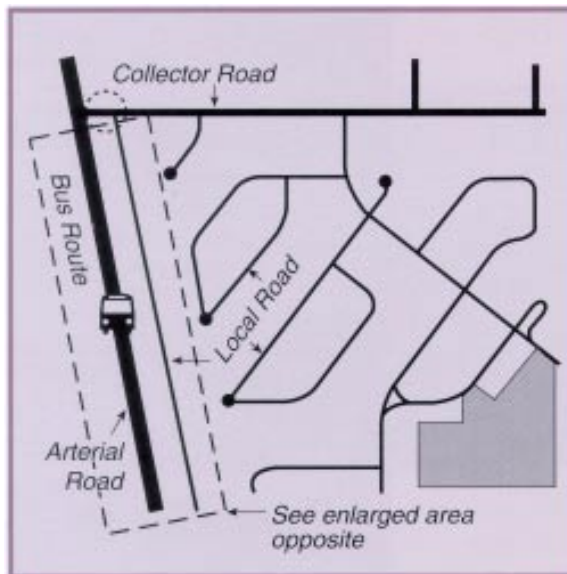
The principles of sustainable development and neo-traditional land use planning concepts offer several suggestions on road design for reduced automobile dependency and higher transit ridership.¹³ To support shorter walk distances between buildings, narrower streets on a grid pattern with smaller blocks and more intersections to slow local traffic down are recommended.



A traditional or modified grid of streets provides direct and convenient pedestrian access to transit service.

The grid network found in older communities was designed for convenient, direct pedestrian access to services, shops and transit that were located on the arterial road. This convenience continues and the result is more pedestrian activity and higher transit ridership.

In most urban developments which have occurred since the 1940s, the road network and complementing land use layout assumed automobile availability. The traditional cul-de-sac and crescent roadway designs common in subdivisions were created to discourage through traffic, but they inadvertently resulted in the increased use of automobiles. Traffic is channelled onto arterial streets, whereupon the road becomes congested, and a harsh environment is created for pedestrians. Transit is less attractive due to poor pedestrian access to arterial roads. The regular geometric pattern of a traditional grid of streets at intervals of 200-300 metres contrasted with the curvilinear sidewalks to the same arterial reveals that curvilinear streets and sidewalks can be made more amenable to pedestrian travel if direct pathways exist for pedestrian access to the main road.



Attempts to reduce traffic intrusion with discontinuous streets, unpaved shoulders and minimal street lights discourage transit customers.

Subdivisions of the 1960's, 70's and 80's tended to focus on the internal structure of the community and designed roadways to reduce travel speeds and discourage through traffic. The objective of quiet neighbourhoods was achieved, but the trade off has been increased reliance on the automobile for running simple errands. Large and small scale subdivisions of the 1990's are continuing to focus on internal traffic control through the use of cul-de-sacs and crescents. The focus on internal structure is further enhanced by walls, berms, gates or other barriers at the perimeter of the community. There is very little attention given to integrating the new development into the existing community. Indeed, the intent is to isolate the new community from its surroundings.



The attitudes that this type of development represent are unlikely to be associated with using the transit system.

Other notable factors that encourage pedestrian activity and have a direct impact on the attractiveness of walking to the bus stop and waiting for the bus include.¹⁴

- barrier free routes, crosswalks, overpasses, ramps
- good lighting, safe environment
- sidewalk, seating, shelter, removed from street traffic
- pleasant views, and other sensory pleasures

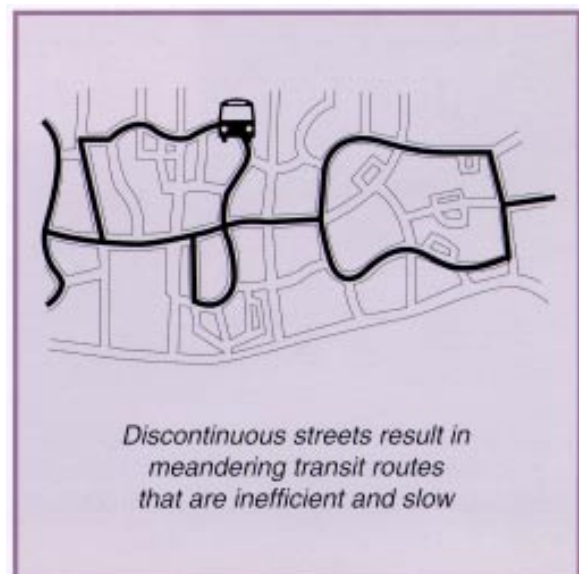
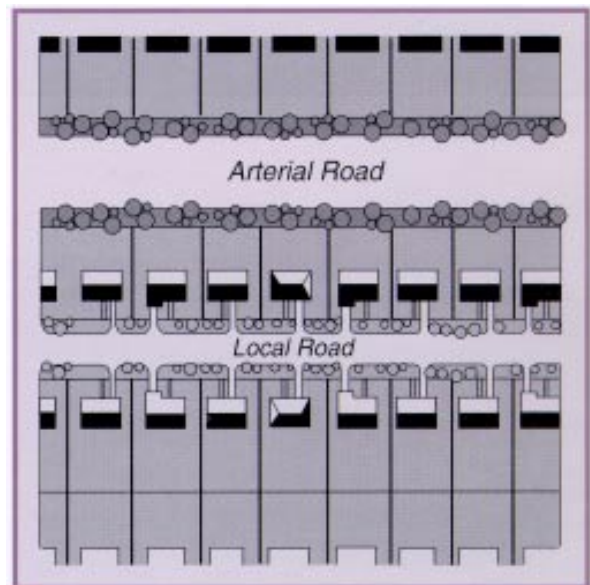


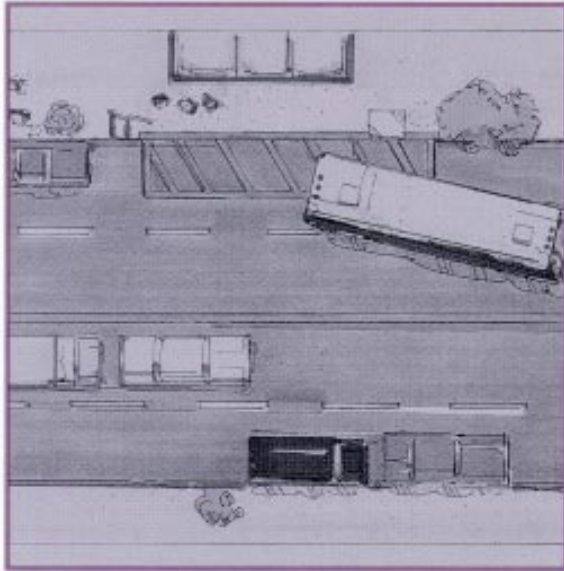
Road Design and Transit Vehicles

Where do the road requirements of public transit fit into this new vision of urban villages? Arterial roads for high traffic volumes and direct travel routes are still necessary, and according to neo-traditional thinking, local grid streets will not be inundated with traffic provided there is a fine grid of relatively narrow streets. For a public transit agency to provide service that is fast and convenient, road design should take into consideration two factors:

- Pedestrian access to the transit route should be safe, comfortable, barrier free, and direct.
- Roadways should be designed to allow transit movements which are competitive with automobile travel time.

While the grid system benefits vehicles and pedestrians by offering alternative routes to the same destination, the arterial has more intersections, and potentially slower travel speeds. This effect





can be mitigated somewhat by introducing traffic control signals that give priority to arterial traffic and particularly buses. Without penalizing the private automobile owner, transit priority measures on arterial roads improve the transit system by:

- improved schedule reliability
- more competitive with private automobile
- potential to increase market share of trips

The subject of transit priority measures is usually addressed by municipal engineering divisions due to the technical requirements.¹⁵ Nevertheless, local traffic conditions may warrant progression from pedestrian friendly design to traffic and parking management and sometimes physical transit priority measures.

Queue bypasses, bus lanes and bus malls are utilized sparingly in municipalities due to the additional resources required. Reprisal from local residents and businesses is also a major deterrent to increased use of transit priority measures. In areas where traffic congestion is an issue with local residents, the benefits of bus lanes should be communicated to residents affected by the through traffic. Road design and traffic management around new developments too often focus on convenient access for vehicles, forgetful of pedestrians and transit passengers.



Although commonly used in traffic management, right hand turn channels are unsafe for pedestrians crossing the intersection, particularly if signal triggers are located on an island in the intersection rather than on the sidewalk. Free flowing right turns in close succession may result in high risk manouevers across lanes to access

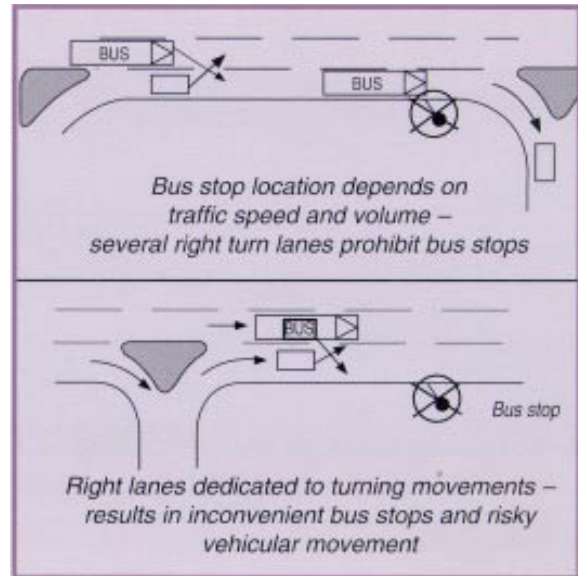


different areas. They make bus movements extremely difficult, and have often resulted in removal of bus stops. Fewer bus stops translate into longer walking distances for customers. Conveniently located bus stops, relative to building entrances, etc., are as important to transit customers as convenient parking stalls are to auto users.

Commercial site Layout

Commercial sites which are transit supportive usually face the street and provide ease of access for patrons who are approaching by foot, not by automobile. A transit supportive streetscape provides the majority of parking behind buildings, rather than having angle parking or large lots in front. Some retail businesses are automobile oriented, resulting in heavy traffic on streets where they are located. Typically, these businesses have parking directly off the street. However, all retail and commercial development does not require this automobile access.

Design features which encourage pedestrian flow include continuous sidewalks, trees, benches and other street furniture that provides a buffer zone between circulating traffic and the sidewalk. Although a lane of parked cars serves as a physical barrier to traffic and increases the comfort level of pedestrians, it interferes with bus movements during peak congestion times. In some areas, curb lane parking restrictions may be the only method of ensuring competitive transit travel times and schedule reliability. Municipal planners and engineers can design wider sidewalks incorporating street furniture and trees to provide a buffer for pedestrians.





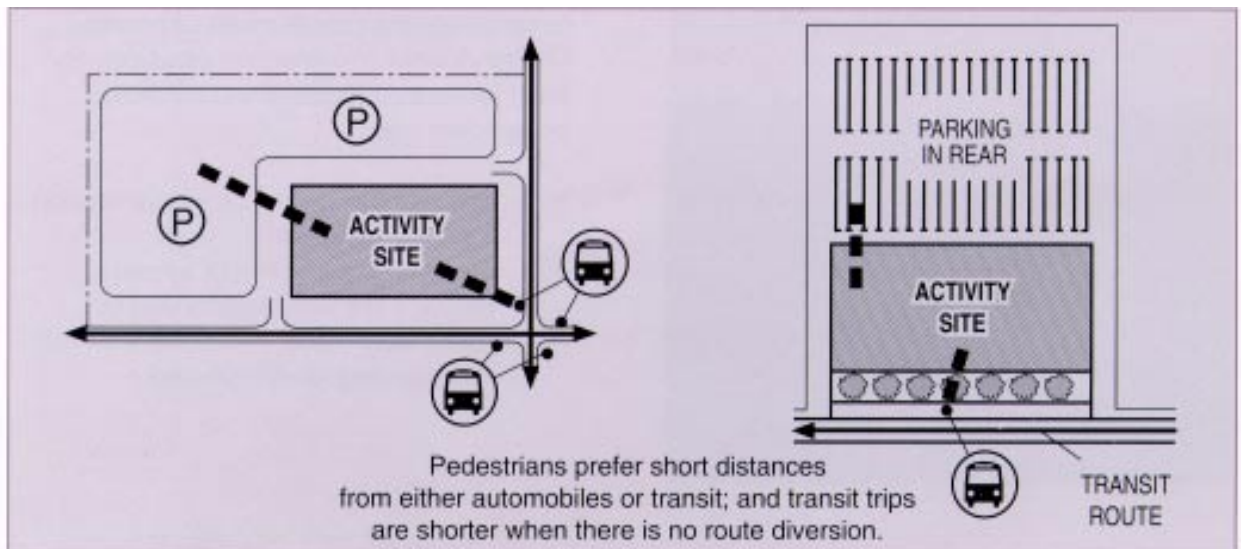
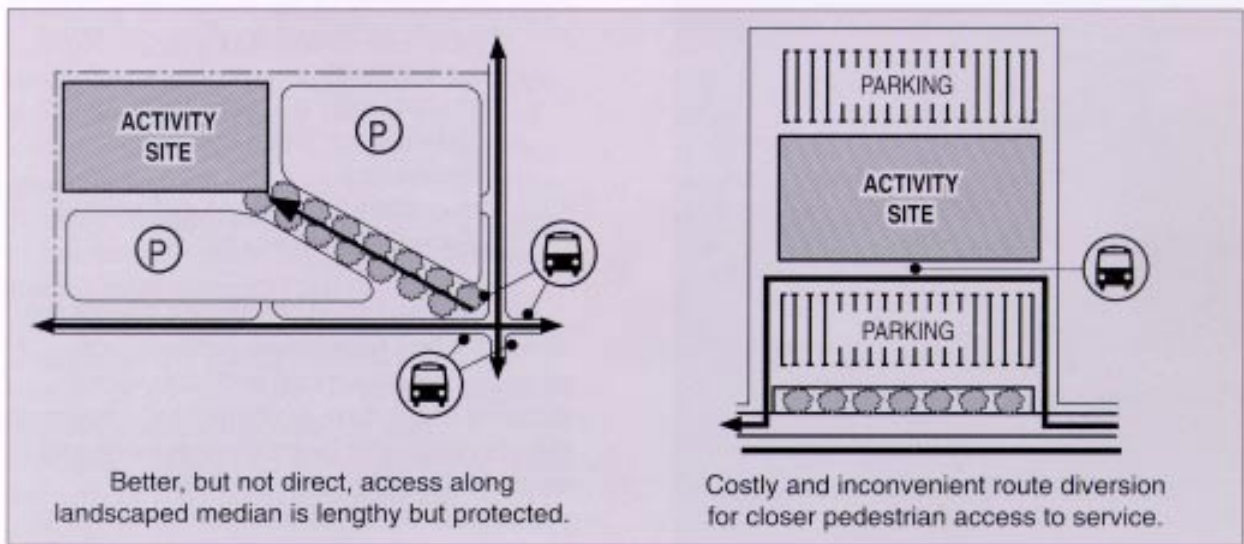
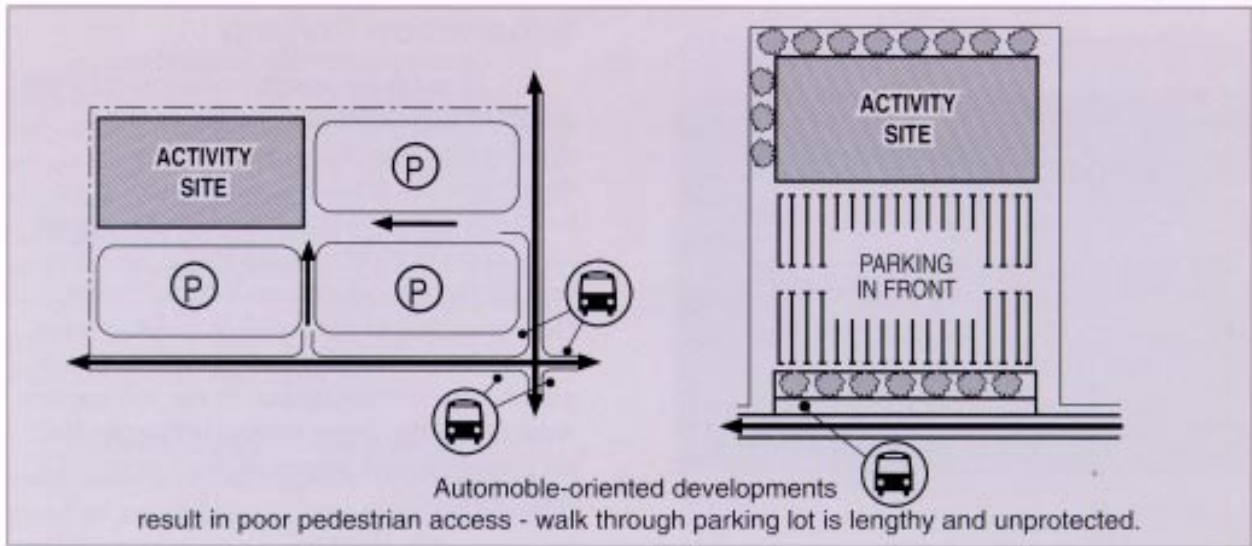
Retail Mall Design



Many town centres have modernized or expanded through the development of shopping malls. These are typically internal structures surrounded by surface parking or a combination of parkade and underground parking, and very little of the structure is oriented toward the street. Without the large neon signs on the exterior of the buildings, the structural form would not be recognized as a retail centre.



While there are many advantages to the shopping mall, most designs could be more pedestrian oriented with respect to other activities outside the mall. As illustrated on the following page, there are mall layouts that provide better access for pedestrians, and more closely resemble traditional retail shopping. The same aspects of retail mall design that are important to transit are important to retail business as well. Customers value the ambience of street oriented shopping, and upgrades of shopping malls now feature the building orientation toward the street.



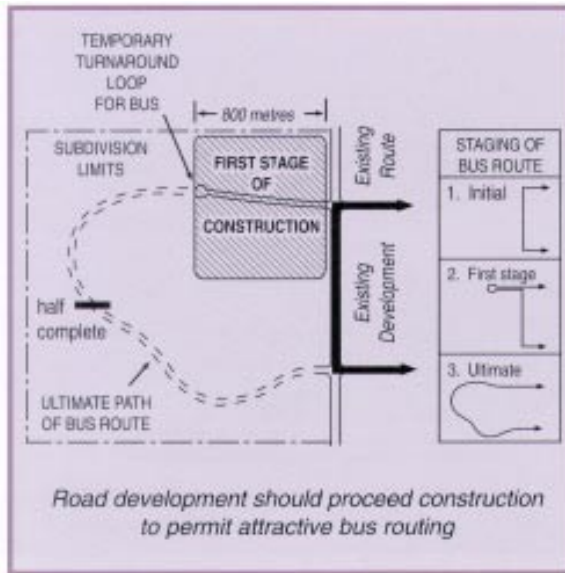


Subdivision Staging

Residential communities in the early stages of development challenge the standards transit agencies follow to determine if a service is warranted. A small but growing population that is new to the area, and developing new travel patterns, represents a good potential transit market. However, due to the small population, the service levels are likely to be minimal and may be inconvenient due to the incomplete road network. Three factors influence the success of transit penetration in new subdivisions:



- the location of the subdivision relative to existing transit services and other development
- the continuity of roads through the subdivision while it is under construction
- the continuity of roads connecting adjacent development



As illustrated, providing a large cul-de-sac for bus turn-around movements provides transit service within walking distance of the new development. However, this diversion can be time consuming and result in degraded service to other passengers. An ideal situation would be to build the road access through the site prior to commencing construction of homes. Under current construction practices, the most important factors from a transit perspective are:

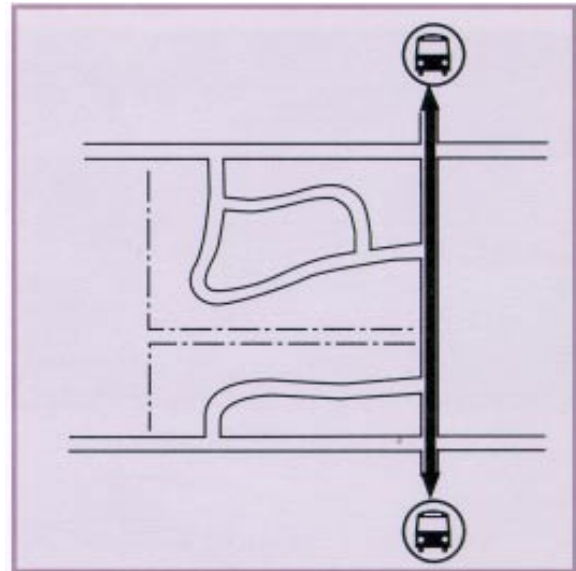


- appropriate geometric configuration for the cul-de-sac
- eventual completion of a road through the subdivision that is reasonably direct and connects with surrounding developments.

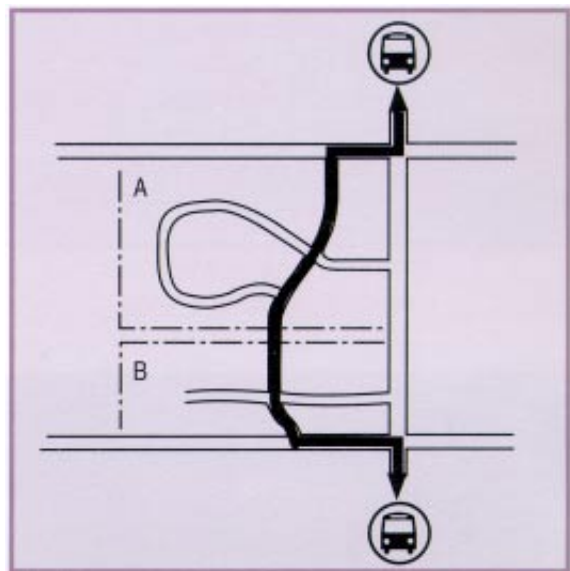


Establishing the route prior to people moving in reduces local resident opposition to the presence of buses on their street. Although not every new subdivision may warrant transit service, it is prudent to consult with BC Transit as large areas become open for development. Developers could then identify the streets where future transit services will operate, thereby informing new residents.

Continuity of roads between subdivisions is also important to maintain good access to transit. Notwithstanding the resistance from local residents to buses operating in the community, transit service is more efficient and saves travel time if routes are direct. The illustrations show that a meandering bus route can be prevented with consideration to connectivity between subdivisions. Since travel time is one of the primary considerations of people choosing to use transit, transit friendly subdivisions should have through roads and connect with through roads of the next subdivision. Otherwise, the transit route is likely to remain on the periphery of the community, beyond walking distance for many residents. This option is less attractive when the arterial road is unimproved; no sidewalks, street lights, etc.



Transit routes located at the edge of a community may result in lower ridership due to inconvenient access and unimproved arterials.



Continuous streets through subdivisions allow transit routes that are convenient for more people to use.



What Municipalities Can Do



Municipal planning and engineering must recognize the link between automobile dominance and low density development patterns. Improvements to public transit alone will not attract a significant number of new patrons. Local land use, urban design and traffic management share the influence over travel behaviour and mode choice.

There are no formal requirements in the Municipal Act to include transit service considerations in the Official Community Plan, or in the provisions for zoning. Similarly, subdivision controls exclude transit considerations. Some municipalities include broad policy statements supporting public transit in their Official Community Plans, however, there is no mechanism in place to follow through with action.

A stronger commitment from municipal decision-makers to support public transit through zoning and development by-law provisions is necessary. At the same time, the privileges currently allotted to private automobiles must be seriously debated and adjusted to reflect the desire for less vehicle traffic and higher transit ridership.

Municipal Initiatives

A recent survey of municipal officers regarding the possibility of a prescriptive approach through changes to the Municipal Act found a low level of supports. It was generally felt that formal authority to consider public transit would do little to address the issue without political support. The preferred approach to consider public transit is to support, encourage, provide technical assistance, and so on. BC Transit wishes to become a participant in planning communities in order to ensure that transit is given appropriate consideration.





CONCLUSION

There is a special blend of urban characteristics that result in higher transit ridership. The presence of singular elements may not achieve the desired results. Attention to detail in all aspects of the development itself, and its relationship with surrounding uses and users is important.

Public transit will not resolve urban traffic congestion problems without a radical shift in societal values related to time and convenience of travel. A concerted effort to integrate transit provisions in urban design is a prerequisite to achieving change.

Automobile users and transit riders have great expectations about convenience. Perhaps the realistic short to mid-term goal is to retrofit areas which have necessitated automobile travel, and not cater the design of new buildings and roads to automobile users. Greater attention to pedestrian amenity and site design characteristics is warranted to make transit a more attractive service. Given the pressures on our road system, it is time to refocus land use design away from emphasis on automobile convenience and toward pedestrian movement and transit.

Often, simple low-cost actions can improve access to public transit. The potential benefits include less automobile traffic, less air pollution and noise, and more satisfied residents. Transit friendly designs usually result in people oriented places, without detrimental results for automobile users.

A transit friendly development will reflect many of the following characteristics:

- Location within the existing urban area; or at the edge of existing development;
- Medium to high intensity use of the site;
- Mixed uses to attract both day and evening pedestrian traffic;
- Located near a transit route;
- Pedestrian access to transit service has few barriers;
- Pedestrian environment on the transit route is conducive to walking and waiting for buses.



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Footnotes

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