# RAIL-ORIENTED DEVELOPMENT:
## STRATEGIES AND TOOLS TO SUPPORT PASSENGER RAIL


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The Rail-Oriented Development: Strategies and Tools to Support Passenger Rail Handbook (the Handbook) is the final work product associated with the Land Use and Transportation System Components to Support Passenger Rail Study (the Study), sponsored by the Colorado Department of Transportation in 2001. This nine-month Study was initiated in an effort to research and define the land uses, land development patterns and transportation system characteristics that would support a statewide passenger rail system in Colorado. The findings of the Study are presented in this Handbook, which has been designed to provide practical answers to questions regarding how to plan for passenger rail. The Handbook is based on extensive research into the land use/rail transit relationship, and on an evaluation of existing North American rail transit systems and their urban environments. The Handbook is not meant to advocate rail transit, per se, but rather to describe the recommended land uses and development patterns that would support rail transit in Colorado, as well as those that are likely to emerge as a result of passenger rail.

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# EXECUTIVE SUMMARY



## ▶ Introduction

The Rail-Oriented Development: Strategies and Tools to Support Passenger Rail Handbook (the Handbook) is the final work product associated with the Land Use and Transportation System Components to Support Passenger Rail Study (the Study), sponsored by the Colorado Department of Transportation in 2001.
This nine-month Study was initiated in an effort to research and define the land uses, land development patterns and transportation system characteristics that are supportive of passenger rail. The findings of the Study are presented in this Handbook, which has been designed to provide practical answers to questions regarding how to plan for passenger rail. This Handbook lists factors to be considered by local decision makers when developing a community's policies regarding land use decisions that support rail. The Colorado Department of Transportation does not endorse these factors or present them as recommended policies.

This Handbook is based on extensive research into the land use/rail transit relationship, and on an evaluation of existing North American rail transit systems and their urban environments. The Handbook is not meant to advocate rail transit, per se, but rather to describe the recommended land uses and development patterns that would support rail transit in Colorado, as well as those that are likely to emerge as a result of passenger rail.

In addition, it is worth noting that the land uses, development patterns and transportation system characteristics described in this Handbook have value outside of the application of rail transit in Colorado. Communities across the state and country will find that these strategies and tools also achieve a variety of other common community goals, including:

- A mix of land uses and design treatments, which can help to create lively activity centers and contribute to a sense of place;
- creation of a balanced transportation system;
- a land use pattern that can easily be served by any type of transit; and,
- preservation of open space by encouraging infill development.

## ▶ Literature Review: Select Findings

Interest in rail transit has undergone a resurgence in the United States over the past couple of decades. This has given rise to an extensive body of new research and analysis into the relationships between rail transit systems and urban form.

◇ **Light Rail Ridership Increases with the Overall Size of a Central Business District (CBD)**

Light rail can serve CBDs with between 25,000 and 250,000 jobs. Above this, capacity may become an issue.

◇ **Commuter Rail Ridership Increases with the Density of a Central Business District (CBD)**

CBD density plays a more important role in commuter rail ridership than residential density because commuter rail often has only one station at its downtown terminus. Commuter rail operates well when it serves a CBD of at least 100,000 jobs, but becomes even more effective with 250,000 to 400,000 jobs.

◇ **Widespread Urban Densities are Not Required for Successful Passenger Rail**

Station catchment area for passenger rail is the land within two miles around a passenger rail station. Station catchment area for local bus routes is the land within one-quarter mile of a bus corridor.

◇ **Minimum Residential Densities Apply Only to Station Catchment Areas and Vary by Level of Transit Service**

For example, commuter rail is much less dependent on residential density for success than is light rail, rapid rail or frequent bus service.

| Transit Service Level | Minimum Residential Density (Dwelling Units/Acre) |
|---|---|
| Minimum Bus Service | 4 |
| Intermediate Bus Service | 7 |
| Frequent Bus Service | 15 |
| Light Rail | 9 |
| Rapid Rail | 12 |
| Commuter Rail | 2 |

◇ **Creating a Mix of Land Uses can Contribute to the Success of the Rail System**

Introducing retail and service-based commercial uses into employment centers can reduce automobile use; as can the introduction of neighborhood-oriented commercial uses into new residential areas.

◇ **The Design of Station Areas and Activity Centers Plays an Important Role in the Success of Rail Transit**

Station areas and other key destinations must be designed for the pedestrian, so that trips can be completed effectively and efficiently on-foot. Necessary elements include sidewalks, crosswalks, street frontage and clear signage.

◇ **Travel Sheds, or the Area from which a Rail Passenger Will Travel to Access the Rail System, Vary by Mode-of-Access**

| Mode-of-Access | Travel Shed |
|---|---|
| Pedestrians | ½-mile around rail station |
| Bicycles | 3-miles around rail station |
| Buses | ¼-3 miles around each bus stop on the route serving the rail station, depending on mode of travel to the bus stop |
| Automobiles | Depends on overall commute time |

◇ **Rail Transit Impacts Land Use, Urban Form and Local Economics**

- It increases the value of commercial property near transit stations.
- It increases the value of residential property near transit stations.
- It supports increased intensity of development near transit stations.
- It influences the regional land development structure.

## ▶ Peer Systems Study: Key Findings

To maximize relevance to this Study, peer rail systems were targeted for application to three prototypical rail corridor types in Colorado, including:

- *The Front Range*: connects a series of major activity centers.
- *The I-70 Corridor*: connects the primary CBD with both rural and mountain communities.
- *Rural Valleys and Mountain Resort Areas*: supports tourism and some demand for daily commuting.

In an effort to learn more about the existing relationship between land use, supporting transportation and rail, the following four peer rail systems were studied:

- Caltrain (San Francisco)
- Metra Rail (Chicago)
- BC Rail (Vancouver)
- VIA Rail (Victoria)

The following is a summary of key findings from the peer systems study. The full report is included in Appendix B of the Handbook.

◇ **Surrounding Land Uses**

- Stations with a low level of rail service induce minimal land use response nearby.
- Stations with a high level of rail service induce moderate to high land use response nearby.
- Multiple entities must collaborate on station area improvements, development and redevelopment.
- Stations near CBDs experience more development and redevelopment than remote stations.

◇ **Interconnecting Transportation Systems**

- The location and quantity of parking for rail systems impacts regional and local travel patterns.
- Stations (within the same system) that are multimodal transportation centers experience boardings comparable to or greater than stations with large parking reservoirs.
- Sidewalk networks play a critical role in moving commuters from parking areas, transit riders from nearby routes and residents from surrounding neighborhoods.
- Seamless coordination of transit bus services with rail operations are required to support commuting patterns on the regional and local level.

## ▶ Putting It All Together

◇ **Strategies and Station Types**

The following two tables summarize passenger rail support strategies and implementation tools. The first table, ***Strategies and Station Types***, lists the strategies described in the Handbook, as they apply to the four station types established for the purposes of this Study.

- *CBD*: stations serving the largest employment areas in the state.
- *Downtown*: stations serving the downtowns of smaller cities.
- *Community/Suburban*: stations located outside of a downtown area but within a developed community.
- *Rural*: stations with little or no adjacent development.

The table uses a system to rate the importance of each strategy in supporting a particular station type. Some of the strategies, such as those associated with regional land use and development patterns, are meant for application on a broader level, rather than for individual stations. Thus, the rating for these strategies is "important" across the board as they provide a solid foundation for planning all elements of rail transit.

◇ **Implementation Tools and Entity Roles**

The second table, ***Implementation Tools and Entity Roles***, shows the tools available to entities seeking to implement passenger rail support strategies.

# Strategies and Station Types

| Rail Transit Support Strategies | CBD Station | Downtown Station | Comm/Suburb Station | Rural Station |
|---|---|---|---|---|
| ***Regional Land Use & Development*** | | | | |
| Develop a Regional Structure Supportive of Passenger Rail | ◖ | ◖ | ◖ | ◖ |
| Locate and Develop Activity Centers at/along Potential Rail Stations and Rail Corridors | ◖ | ◖ | ◖ | ◖ |
| Develop a Hierarchy of Activity Centers | ◖ | ◖ | ◖ | ◖ |
| ***Community Land Use & Development*** | | | | |
| Create Employment Density in Existing and Planned Activity Centers | ● | ● | ● | ○ |
| Create Minimum Residential Densities for Areas Within Two Miles of Potential Rail Corridors | ● | ● | ◖ | ○ |
| Incorporate Retail and Service-Based Commercial Uses in Employment Centers | ● | ● | ◖ | ○ |
| Incorporate Neighborhood-Oriented Commercial Uses in New Residential Areas | ◖ | ◖ | ● | ○ |
| Take Advantage of Shared-Parking Opportunities in Mixed-Use Areas | ● | ● | ● | ○ |
| ***Station Area Land Use & Development*** | | | | |
| Determine Station Type and Define Station Area | ● | ● | ◖ | ○ |
| Develop Station Area with the Highest Commercial and Residential Densities | ● | ● | ◖ | ○ |
| Orient Commercial and Service Uses Towards Transit Users | ● | ● | ◖ | ○ |
| Locate Transit, Bicycle and Park-and-Ride Facilities to Facilitate Pedestrian Transfer | ● | ● | ● | ◖ |
| Orient Buildings to the Street | ● | ● | ◖ | ○ |
| Create a Fine-grained Grid Network for Streets and Sidewalks | ● | ● | ● | ○ |
| Prioritize Pedestrian Access and Circulation Through Urban Design | ● | ● | ● | ○ |

**Legend:**

● **Very Important**
◖ **Important**
○ **Somewhat Important**

# Strategies and Station Types (cont)

| Rail Transit Support Strategies | CBD Station | Downtown Station | Comm/Suburb Station | Rural Station |
|---|---|---|---|---|
| ***Supporting Transportation System Strategies*** | | | | |
| Use the Station Type to Prioritize the Most Effective Supporting Transportation Modes | ● | ● | ● | ○ |
| Develop Improved Pedestrian Facilities In Station Areas | ● | ● | ◖ | ○ |
| Provide for Bicycle Access and Circulation in Station Areas and Within Bicycle Travelsheds | ● | ● | ◖ | ○ |
| Develop Connecting Transit Systems | ● | ● | ● | ○ |
| Locate Transit Stops for Convenient Transfer Between Modes | ● | ● | ● | ○ |
| Use Park-and-Ride Facilities to Expand Catchment Areas for Rail Passengers | ○ | ◖ | ● | ● |
| Design Parking Facilities that are Reflective of Local Context and Increasing Demand | ◖ | ◖ | ◖ | ○ |
| Use Cost and Availability of Parking to Influence Preferred Modes-of-Access | ◖ | ● | ● | ○ |
| Make Pedestrian, Bicycle, Transit and Parking Facilities Safe, Convenient and Comfortable | ● | ● | ● | ● |
| ***Transit System Development Strategies*** | | | | |
| Build Transit Ridership on Buses in Anticipation of Rail Transit | ● | ● | ● | ● |
| Build Supporting Transportation Facilities (access streets, sidewalk networks, park-and-rides) | ● | ● | ● | ○ |
| Limit Expansion of Parallel Arterial Roadways | ◖ | ◖ | ● | ● |
| Coordinate Transit Systems with Different Transit Operators | ● | ● | ◖ | ◖ |
| Market Transit Systems | ◖ | ◖ | ◖ | ◖ |
| Grow Transit Systems Over Time with Incremental Service Improvements | ◖ | ◖ | ◖ | ◖ |
| ***Other Strategies to Increase Transit Ridership*** | | | | |
| Develop and Improve Transit System Management Programs | ● | ● | ◖ | ◖ |
| Implement Transportation System Management Programs | ◖ | ◖ | ◖ | ○ |
| Develop and Implement a Transportation Demand Management (TDM) Program | ● | ● | ◖ | ◖ |
| Develop Paid Parking Systems | ● | ● | ◖ | ○ |
| ***Transitional Strategies*** | | | | |
| Shape Local and Regional Land Development Patterns Proactively | ● | ● | ◖ | ○ |
| Build Transit Patronage to Levels that Support Rail Transit | ● | ● | ◖ | ○ |
| Develop a Multimodal Transportation Network | ● | ● | ● | ○ |

**Legend:**

- ● **Very Important**
- ◖ **Important**
- ○ **Somewhat Important**

# Implementation Tools and Entity Roles

| Strategy Implementation Tools | Entities | | | |
|---|---|---|---|---|
| | **State** | **Regional** | **Local** | **Private Sector** |
| ***Planning*** | | | | |
| Regional Plans | ○ | ● | ● | |
| Comprehensive Plans | | ○ | ● | |
| Area Plans | | | ● | ○ |
| Site Master Plans | | | ● | ● |
| Urban Renewal Plans | | | ● | ○ |
| Multimodal Transportation Plans | ● | ● | ● | |
| Rail System and Corridor Plans | ● | ● | ● | |
| Pedestrian Master Plans | | | ● | |
| Bikeway Plans | | ○ | ● | |
| Highway Improvements & Facilities Plans | ● | ● | ● | |
| ***Education*** | | | | |
| Public Information and Transit Marketing | ○ | ● | ● | ○ |
| ***Incentives*** | | | | |
| Density Bonuses | | | ● | |
| Expedited Review Procedures | | | ● | |
| Transferable Development Rights | | | ● | |
| Reduced Fees | | | ● | |

**Legend:**

● **Primary Responsibility**

○ **Secondary / Supportive Role**

## Implementation Tools and Entity Roles (cont)

| Strategy Implementation Tools | Entities | | | |
|---|---|---|---|---|
| | **State** | **Regional** | **Local** | **Private Sector** |
| ***Regulatory Tools*** | | | | |
| Urban Growth Boundaries | | ● | ● | |
| Zoning Ordinances | | | ● | |
| Development Standards | | | ● | |
| Street Connectivity and Street Design Standards | ○ | ○ | ● | |
| Transportation Level-of-Service Standards | | ○ | ● | |
| ***Organizational / Administrative Tools*** | | | | |
| Regional Planning Commissions | | ● | ● | |
| Intergovernmental Agreements | ○ | ● | ● | |
| Joint Development Agreements | ○ | | ● | ● |
| ***Targeted Public Investment Tools*** | | | | |
| Land Acquisition | ● | ○ | ● | ● |
| Land Assemblage and Banking | | ○ | ● | ● |
| Purchase of Development Rights | | ○ | ● | ● |
| Options and Rights of First Refusal | | ○ | ● | ● |
| Condemnation | | ○ | ● | |
| Investing in Public Facilities | ● | ● | ● | |
| Highway Interchange Improvements | ● | ○ | ○ | |
| ***Financing Tools*** | | | | |
| Public Funding | ○ | ○ | ● | |
| Capital Improvement Program | | ○ | ● | |
| Rural Transportation Authority and Districts | | ● | ● | |
| Improvement Districts | | | ● | ● |

**Legend:**

● **Primary Responsibility**

○ **Secondary / Supportive Role**

# 1. INTRODUCTION AND PURPOSE



## 1.1 Recent Developments in Rail Transit

### ▶ Rail Transit in North America

Over the past fifteen years, there has been a resurgence of interest in rail transit in North America. The nation's older cities have long relied on subways (New York City, Buffalo), metros (Philadelphia, Chicago) and trolleys (Pittsburgh, New Orleans). However, urban exodus and declining public transit ridership during the last half of the 20th century placed these older systems at risk and discouraged implementation of new systems. A few metro rail systems were implemented after 1950 (Washington, D.C., San Francisco, Atlanta, Miami), but for the most part, our younger and smaller cities developed as auto-oriented places with little or no rail transit.

Beginning with the MAX light rail transit line in Portland, Oregon in the mid-1980s, cities throughout the country once again began turning to rail transit systems for mobility solutions. Northeastern cities (Buffalo, Pittsburgh), southern cities (Dallas, Jacksonville), West Coast cities (San Diego, Los Angeles, San Jose, Sacramento, Portland) and even a Midwestern city (St. Louis) have built light rail transit or elevated guideway systems.

### ▶ Rail Transit in Colorado

Denver joined this list in the 1990s with its first light rail line, and Denver area governments continue to make progress toward implementation of a rail passenger network to meet the challenges of growth in the six-county metro region. Other Front Range cities, such as Fort Collins and Pueblo, are also considering the potential for rail transit solutions as part of their long range planning.

The towns and counties in Colorado's mountains also are interested in the potential that rail transit might offer as they wrestle with unprecedented growth and tourism. Local governments in the Roaring Fork Valley have been working for over a decade on a "Valley Rail" system from Glenwood Springs to Aspen, as well as on an "Entrance to Aspen" light rail line. Local governments in the Yampa River valley have considered the potential for rail transit service parallel to U.S. 40 between Craig, Hayden and Steamboat Springs. Other rail concepts have been proposed in other rural corridors (e.g., Leadville – Vail). Finally, rail transit is actively under consideration as part of long range planning for the I-70 corridor in Colorado from Denver west to Grand Junction.

One of the principal challenges facing those who favor rail transit as a strategy for meeting mobility needs in Colorado is the fact that Colorado's cities, towns and counties have not "grown up" around public transit service, and generally do not have the type of land development pattern that would ensure the success of rail transit services. Our auto-oriented Colorado places have small downtowns, low-density residential areas and sprawling suburban growth in poorly connected "pods" of development with little or no bus transit service. Clearly, if rail transit were to be part of Colorado's future outside of the Denver metro area, the pattern of urban growth and development we have experienced over the past two decades would have to change.

But change how? What, specifically, is required for rail transit to succeed? High-density development everywhere? Concentration of all commercial development in a few existing downtowns? What is it that local governments, working alone or in regional partnerships, can do to set the stage for successful rail transit systems? And, while exploring these issues, it is appropriate to ask, what is meant by "a successful" rail transit system?

Passenger rail service in Colorado today includes the emerging light rail network in the Denver metro area, AMTRAK services through Denver, Glenwood Springs and Grand Junction, and a Ski Train from Denver to Winter Park.

As part of its multimodal mission, the Colorado Department of Transportation will continue to assess the potential feasibility of rail services in particular corridors. Local governments, acting alone or in regional partnerships will also continue to evaluate and pursue possible rail transit systems.

This Handbook does not attempt to directly address the wide range of public issues associated with the potential for passenger rail services in Colorado, nor does it specify or prioritize potential future rail corridors. The Handbook does identify types of passenger rail corridors that are likely to be under active consideration in Colorado. These include:

- A passenger rail system connecting Front Range cities;
- a rail transit system, potentially based on high-speed technologies, in the I-70 Corridor; and,
- rail transit lines servicing Colorado’s rural resort areas and mountain valleys.

In most cases, these corridors exist at a conceptual level and are not associated with a particular alignment. Therefore, individual cities and towns today cannot be immediately sure whether they might be served directly by a future rail line or if they would need to connect to a rail line in a neighboring town. This Handbook addresses the development patterns associated with these varying scenarios.

## 1.2 Introduction to this Handbook

### ▶ Purpose

This Handbook is designed to provide practical answers to questions regarding how to best plan for passenger rail in Colorado. It is based on extensive research into the land use/rail transit relationship, and on an evaluation of existing rail transit systems and their urban environments in North America. The Handbook is not meant to advocate rail transit, per se, but rather to describe the land development patterns that would be required to support rail transit in Colorado. This Handbook lists factors to be considered by local decision makers when developing a community's policies regarding land use decisions that support rail. The Colorado Department of Transportation does not endorse these factors or present them as recommended policies. This Handbook identifies factors that can assist local decision makers in developing a community's policies regarding land use decisions when a desire for passenger rail has been identified as part of the transportation planning process.

### ▶ Who Should Use this Handbook?

Users of this Handbook are likely to include representatives of state, regional and local governments, including planners, engineers, elected officials, appointed representatives and others. In addition, transportation and transit agency representatives, real estate developers, and local citizens will find the information in this Handbook informative and useful in understanding the type of development pattern and transportation network that would be needed in their communities to support rail transit services.

This Handbook describes land use relationships, development patterns and supporting transportation system characteristics that are necessary for various types of rail transit (e.g., commuter rail, light rail, etc.) It examines the relationships between rail transit and other modes of transportation – walking, bicycling, bus transit and motor vehicle circulation. In addition, the Handbook identifies the roles of mixed-use development and active, vital downtowns or activity centers in helping to create statewide, regional and local land use patterns that would, in the future, be supportive of rail transit, bus transit and other alternative modes.

The principles, strategies and tools set forth in this Handbook are relevant far beyond the application of supporting passenger rail service. The land uses, development patterns and transportation-system characteristics described in this Handbook could be used to promote the development of livable communities with a high quality of life throughout the State with or without rail transit, and are therefore relevant to every region, county, city and town in Colorado, regardless of proximity to a current or future passenger rail corridor.

## 1.3 Candidate Rail Corridors in Colorado

### ▶ The Colorado Transportation Commission's Rail Corridor Preservation Policy

In June 2000, the Colorado Department of Transportation adopted a policy, which details the conditions under which "CDOT will consider participating in rail transportation" (CDOT Policy Directive, No. 1607.0 June 30, 2000.) Detailed in this policy directive are criteria, which define rail corridors of state interest and descriptions of the type of activities related to rail, in which CDOT may participate.

In the effort to advance statewide transportation interests, CDOT will engage in planning for rail transportation for the following reasons:

- Preserving rail corridors for future use may save money;
- rail transportation may be needed in certain corridors to supplement the highway system and to provide adequate mobility and travel capacity;
- rail transportation can be a cost-effective and environmentally preferable mode of transportation in certain situations;
- preserving existing freight rail service by preventing a railroad from being abandoned can reduce the maintenance costs on state highways; and,
- freight rail service can serve as an economic lifeline to the economic health of a community when there are no other modes that adequately and economically serve the needs of the community (CDOT Policy Directive).

"Rail Corridors of State Significance" describes corridors, which CDOT believes, play a role in advancing statewide transportation interests. The criteria used to determine "State Significant Rail Corridors" are:

- Existing or potential future demand for passenger/freight rail services; and,
- local and regional public and/or private support for preservation of the corridor.

In State Significant Rail Corridors, "CDOT shall, where feasible and prudent, design and construct roads and roadway related structures to preserve an envelope sufficient to accommodate future rail service or other transportation purposes planned in the corridor." CDOT participation in these corridors may involve:

- Corridor preservation;
- rail right-of-way/track ownership;
- coordination with railroad companies; and,
- cost sharing of reserving right-of-way.

In corridors that have not been found to be of "state significance," CDOT may engage in cost sharing and the incorporation of future rail into highway design and construction.

Funding of these CDOT activities will be prioritized according to the following criteria:

- Magnitude of negative impacts upon adjacent highways;
- immediacy of possible abandonment of existing rail line;
- immediacy of possible jeopardy of an existing or future rail line;
- estimated cost of acquiring and/or preserving a corridor for rail; and,

- the opportunity to participate in a public-private partnership.

Finally, all funding of rail transportation is subject to rail corridors being included in the Statewide Transportation Plan.

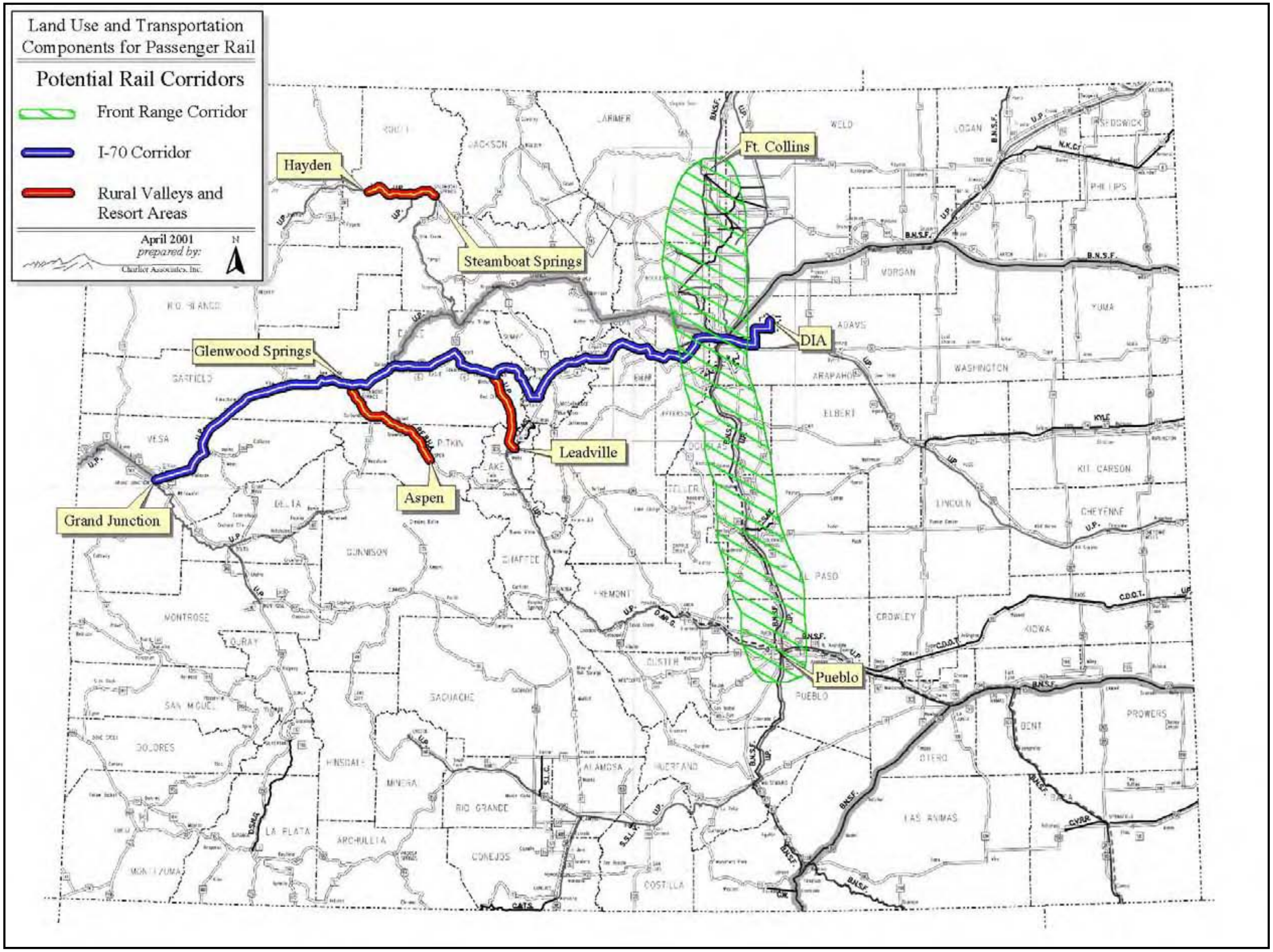
### ▶ Candidate Passenger Rail Corridors

The current project reviewed the Colorado Passenger Rail Study's recommended core system, planning activities that have occurred since the completion of the aforementioned passenger rail study, and land use and supporting transportation system considerations, and developed a map of potential passenger rail corridors to guide the subject project (see Figure 1a.). This map of potential rail corridors generally consists of the high-priority network recommended as part of the 1996 Colorado Passenger Rail Study, which identifies each corridor in one of the three locational classifications:

- Front Range;
- I-70 corridor; or,
- rural valleys and resort areas.

This locational classification system is important as land use and supporting transportation system strategies and tools described in this document often vary in their use and application. This classification system is used to provide guidance to the reader on what strategies and tools are appropriate for each of these unique Colorado areas, and how the strategies and tools should be applied in each area, particularly in terms of potential rail station types, which are described at the beginning of Chapter 3.

**Figure 1a. Potential Rail Corridors**



# 2. OVERVIEW AND BACKGROUND RESEARCH



## 2.1 Introduction

This chapter provides an overview of the research conducted during the initial phases. As such, it includes important background information regarding rail transit. This research provided the basis for or reaffirmed the strategies and tools presented in chapters 3 and 4. The organization of this chapter is as follows:

- **Literature Review: Selected Findings**

Prior to the development of this Handbook, project representatives conducted an extensive review of current research regarding land use/passenger rail relationships and supporting transportation systems. Selected findings from the literature review are summarized in this section. The complete literature review, entitled "State of the Practice," is included in Appendix A of this Handbook.

- **Peer Systems Study: Key Findings**

In tandem with the literature review was a review of peer rail systems. The following commuter rail systems were examined:

- Caltrain (San Francisco)
- Metra Rail (Chicago)
- BC Rail (Vancouver)
- VIA Rail (Victoria)

This section describes key findings regarding existing relationships between land use, supporting transportation and passenger rail. The full research report, entitled "Peer Systems Study," is included in Appendix B of this Handbook.

- **The Colorado Transportation Environment**

This section describes the current state of planning and implementation for various modes of transportation in Colorado. This information is intended to help readers understand the context within which they are planning for passenger rail.

- **Effects on Transit Ridership**

Understanding transit ridership requires some knowledge of how people access the transit system. Travel sheds, or the areas from which people travel to access a transit system, are explained in this chapter, by mode. This information can help planners, developers and other stakeholders to anticipate the "influence areas" for transit service and plan land uses, development patterns and supporting transportation systems appropriately.

- **Economic Relationships in Rail Transit**

This section highlights key economic effects of rail transit on property *and* of property on rail transit. Included in this section are planning strategies that will help guide appropriate development to station areas and help communities to capture the value of property surrounding these areas.

## 2.2 Literature Review: Selected Findings

This section summarizes selected findings from the literature review. More specifically, this section points out findings related to three primary relationships.

- The impact of urban form and land development patterns on rail transit.
- The impact of rail transit on urban form and land development patterns.
- The impact of the interconnecting transportation system on rail transit.

### ▶ The Impact of Urban Form and Land Development Patterns on Rail Transit

Research suggests that the success of rail transit depends on several interdependent factors.

- Size and Density of the CBD
- Length of Rail Line and Distance from CBD
- Residential Population Density
- Land Use Mix and Urban Design
- Mode-of-Access

#### ◇ Size & Density of the CBD

The size, measured by employment, and density of a regional CBD plays a critical role in a number of factors related to rail transit. The size of a CBD is most important in determining the best application of rail technology while densities associated with both commercial and residential uses will impact ridership, depending on various factors.

#### ◇ Length of Rail Line & Distance from CBD

The length of a rail line and the distance of service areas from the CBD will not only factor into the selection of a specific rail transit mode, but will also shape the regional structure for land use and development patterns. The relationship between ridership and the distance of a community from the CBD depends on mode, density and other factors.

#### ◇ Residential Population Density

Similarly, the impact of residential population density varies in importance depending on factors such as rail transit mode, station catchment area, station area design and the nature of the interconnecting transportation system. For example, residential density plays a more important role in light rail ridership than it does in commuter rail ridership.

#### ◇ Land Use Mix & Urban Design

Appropriate land use mix and urban design are necessary for rail transit to succeed. Particularly in employment centers, commercial and residential uses can help reduce dependency on the automobile and promote pedestrian trips. Increased use of transit is related to reduced dependence on the automobile for the purposes of commuting and other mid-day, work-based trips. Residential areas can also benefit from the inclusion of commercial uses, such as small grocery stores and daycare services, which facilitate the use of transit by eliminating the need to travel to a third location, between home and place of employment, to complete daily errands.

◇ **Mode-of-Access**

The sensitivity of rail transit to access mode varies somewhat by rail transit mode. Commuter rail systems draw ridership from fairly large areas around stations, and over fairly long corridors. As a result, commuter rail services tend to rely heavily on interconnecting bus service and on automobile park-and-ride. Thus, commuter rail stations generally require fairly large supplies of auto parking and well-timed, well-planned feeder bus routes.

Light rail transit typically draws ridership from smaller travel sheds. The average light rail corridor is also shorter than the average commuter rail corridor. As a result, while light rail systems may collect passengers from interconnecting bus routes and from automobile access, they tend also to rely on pedestrian access (and, to a lesser degree, bicycle access). Thus, a light rail system will normally benefit from a well-planned pedestrian grid and a strong mixed-use development pattern in its station catchment areas. Light rail stations may or may not include significant auto parking, depending on their location and type of service.

▶ **The Impact of Rail Transit on Urban Form and Land Development Patterns**

◇ **Increase in Value of Commercial Property**

Commercial property values tend to rise at a faster than average rate when they are located in close proximity to rail stations. This increase has also been noted in anticipation of a planned rail system. This impact is limited, however, to the station catchment area.

◇ **Increase in Value of Residential Property**

Similarly, residential property values tend to increase, particularly where rail transit is competitive, in terms of cost and time, with the private automobile. Again, this impact is limited to the station catchment area.

◇ **Increase in Intensity of Development Near Transit Stations**

Areas surrounding rail stations tend to see an increase in the intensity and density of development. Commercial and office development, in particular, tends to surge in rail station areas, which could be the result of not only local planning policies but also of the market interest in such locations.

◇ **Influence on Regional Urban Form and Land Development Patterns**

Finally, rail transit plays a role in shaping a region's structure by encouraging the construction of infrastructure and the development of private property in close proximity to stations along the rail line. While urban form takes shape over the course of decades, the land development patterns that evolve around passenger rail stations are often evident within a decade or even sooner.

▶ **Impact of the Interconnecting Transportation System on Rail Transit**

Rail transit systems thrive only where they are integrated into regional multimodal transportation networks. Access to transit stations via interconnecting bus, private auto, walking and bicycling is important and should be part of planning for rail transit.

Because of the importance of auto and feeder bus access, rail transit stations should be integrated into the local and regional street network. Station locations should be easy to find, easy to drive to, and easy to navigate. For rail corridors running parallel to freeways, the location of interchanges relative to the location of transit stations is an important consideration.

The perception that rail systems thrive where road systems are inadequate or congested is an oversimplification of a complex relationship. Research confirms that rail systems compete with freeways and major arterials (with travel time being a major competitive consideration). Further, foregoing investment in such trunk highway facilities may help make rail transit a more attractive alternative. However, good vehicular access to each rail transit station will be needed if people are to patronize the rail service.

Rail transit stations must be well located and well connected within the local and regional roadway network. This is especially important for commuter rail systems, which rely on interconnecting bus and auto parking as sources of passengers. Certain urban light rail stations are intended to serve their immediate catchment areas and do not have significant parking. In these cases, the rail system relies on pedestrian access from a dense, mixed-use area and is less sensitive to the need for good street connections.

## 2.3 Peer Systems Study: Key Findings

Existing North American rail systems can offer insight into land use and transportation planning for passenger rail in Colorado. Four peer rail systems were studied, with specific attention to regional, community-wide and station area land uses, development patterns and transportation systems. These rail systems included: Caltrain, which serves the San Francisco area; Metra Rail in Chicago; BC Rail in Vancouver; and, VIA Rail in Victoria. The Study involved research, site visits and analysis to learn more about the relationship of land use, supporting transportation and rail, from those with experience. For the detailed report on the peer systems and research findings (see Appendix B).

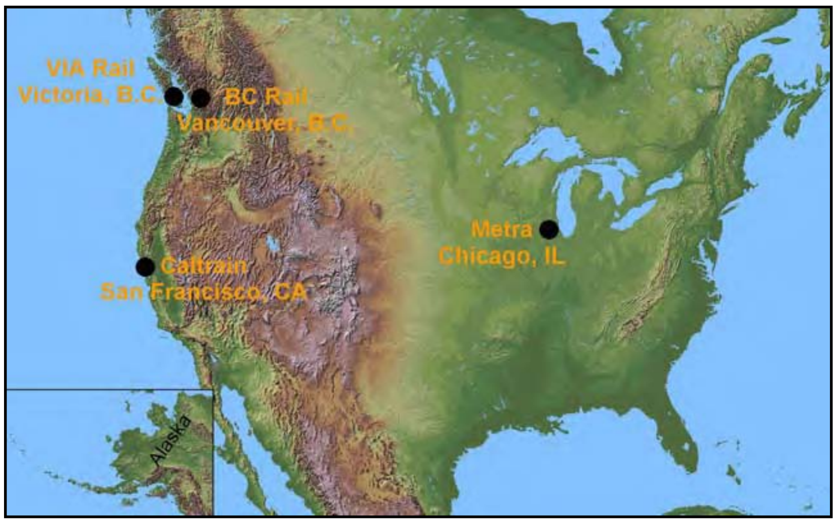



**Figure 2a. Location of the Four Peer Systems**

In order to maximize the relevance of the analysis, peer rail systems were targeted for application to the three prototypical rail corridor types for Colorado: the Front Range, which connects a series of major activity centers; the I-70 corridor, which connects a major CBD with rural and mountain communities; and, rural valleys and mountain resort areas, which are geared towards tourism and tourism industry commuting.

The Caltrain and Metra systems have relevance to the Front Range corridor. The BC and VIA rail systems served as peers for the more rural areas, with varying degrees of relevance to both the I-70 and rural and mountain resort corridor prototypes.

While the application of specific stations and rail systems in the Peer Study vary in relevance to Colorado's situation, the analysis offered the following insights.

### ▶ Surrounding Land Uses

The relationship between land use and rail varied from very strong to weak, with factors such as level of rail service, economic climate, and governmental involvement appearing as primary determinants, as follows:

- Stations with a low level of rail service have a minimal land use response nearby;
- stations with a high level of rail service have a moderate to high land use response (i.e. development and redevelopment activity) nearby;
- multiple agencies and entities are collaborating on station area improvements, development and redevelopment; and,
- stations near CBDs are experiencing development and redevelopment; remote stations experience little land use response, which may be a result of local policy.

### ▶ Interconnecting Transportation Systems

The Peer Study included a wide variety of primary modes-of-access. Rail stations and interconnecting transportation systems in some communities were carefully designed to encourage the use of feeder transit; others made convenient and affordable parking a priority. In addition, the following observations were made:

- The location and quantity of parking for rail systems affect regional and local travel patterns;
- stations (within the same system) that have multimodal transportation centers experience boardings comparable to or greater than stations with large parking reservoirs;
- sidewalk networks play a critical role in moving commuters from parking areas, transit riders from nearby routes and residents from surrounding neighborhoods; and,
- seamless coordination of interconnecting transit services with rail operations can significantly impact commuting patterns on the region and local level.

**Figure 2b. The Area Around the Arlington Heights Station on Metra's Northwest Line is the Site of Significant Development and Redevelopment as a Result of Public-Private Partnerships**

**Figure 2c. Interconnecting Transportation Systems, such as the Light Rail, Connect Caltrain's Riders with Local and Regional Destinations**

## 2.4 The Rail Transit Travel Shed

Three closely related concepts are used in this Study to describe characteristics of travel sheds:

- "Travel Shed" – This is the geographic area from which a rail system draws its passengers – at both the origin and destination ends of rail trips. Within the travel shed, passengers may travel to a rail station via interconnecting bus routes (if provided) or automobile (if there is parking at the rail station). The pedestrian and bicycle access areas within the travel shed are much smaller than the interconnecting bus and auto access areas. The size and shape of the travel shed is influenced by many factors, including the spacing of stations, the level of rail transit service, the competitive travel time via the rail system, and the condition of the local road and street network.

- "Catchment Area" – This refers to that portion of the travel shed for a rail corridor that immediately surrounds the rail station. Within the catchment area, pedestrians are able to walk to the rail station and development patterns are directly influenced by the presence of the rail system.

- "Station Influence Area" – This is the geographic area within which a rail transit station has a direct, observable influence on land development patterns. For many rail stations, including most light rail stations, the station influence area will be essentially coterminous with the station catchment

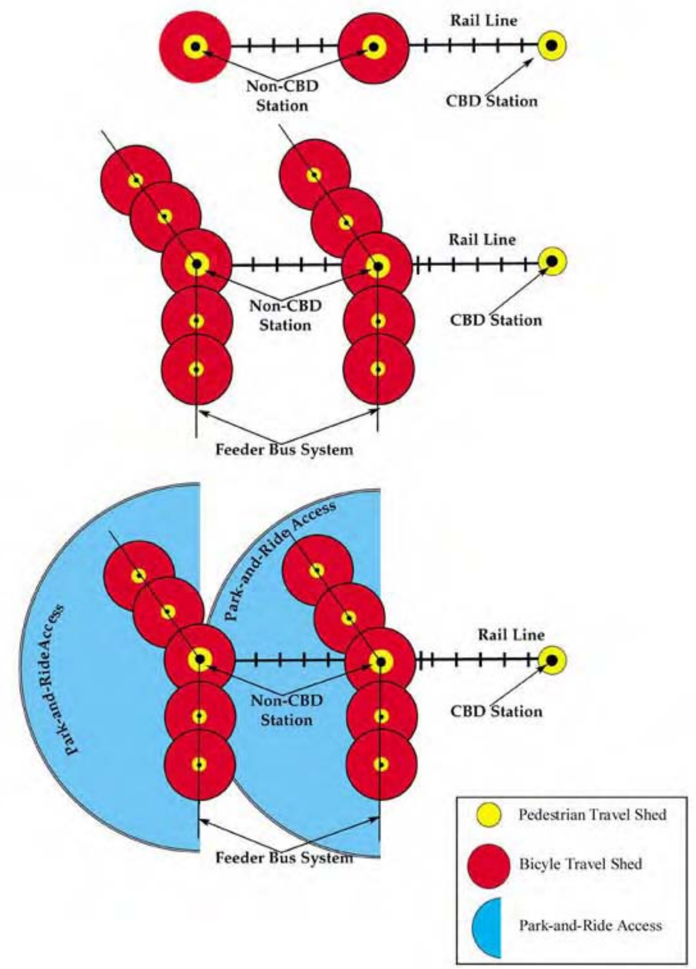



**Figure 2d. Travel Shed and Effects on Ridership**

area (defined above). For major commuter rail or metro rail stations with high levels of service and high levels of ridership, the station influence area may extend beyond the catchment area or pedestrian access zone.

Pedestrian access to rail stations occurs primarily within a catchment area described by a quarter mile radius around the station. Under some conditions – a mixed-use setting, a great walk environment, a high level of rail transit service – the radius of the pedestrian catchment area may be extended to as much as two miles. On the other hand, unfavorable topography or climate can limit the size of the pedestrian catchment area.

Bicycle access to rail stations normally occurs within a radius of about three miles, although with good bicycling facilities and attractive rail service this can be extended out to a radius of five miles or more. (See Figure 2d.) Bike access can be limited by barriers (e.g., freeways or rivers), by unfavorable topography (hills), and by climatic factors (rain, cold, etc.)

Interconnecting bus routes that access rail stations with good service and coordinated schedules can extend the rail travel shed considerably, thereby contributing positively to rail ridership. The influence of feeder buses on ridership has been higher for light rail than for commuter rail. Providing bus service to a light rail station can increase ridership by as much as 130 percent compared to a station without bus service. Feeder bus service for commuter rail systems adds about 50 percent more riders (TCRP Report 16, Vol. 1, p.14).

Details of the feeder bus route structure influence the shape and size of the rail transit travel shed. Pedestrian access to

| **Mode** | **Travel shed** |
|---|---|
| Pedestrians | ½ mile to 2 miles depending on pedestrian environment. |
| Bicycles | 3-miles to 10 miles depending on availability to bike routes, climate and topography. |
| Buses | Equal to the length of the bus route plus the walk access zone around bus stops. |
| Automobiles | Depends on length of rail line and relative travel time advantage of rail over auto; examples exist of auto travel sheds in excess of 20 miles for long commuter rail lines. |

interconnecting bus service (and, hence, indirectly to the rail service) will occur primarily within a quarter mile radius of each bus stop. If the bus system is equipped with bicycle parking and accommodation for bikes on the buses, the rail transit travel shed can be extended out further. Again, topography and climate may affect the shape and size of pedestrian and bicycle travel sheds. The attractiveness of walking or bicycling directly to a rail station is greater than that of walking or bicycling to a bus route that, through a mode change, provides access to a rail line. Thus, the size of the pedestrian and bike access zones around interconnecting bus route stops will almost always be smaller than the pedestrian and bike access zones directly surrounding the rail station itself.

Like feeder bus systems, park-and-ride facilities can expand the travel shed for passenger rail systems. Many commuter rail stations outside CBDs gather a significant percentage of their passengers from parked cars. Holding other factors equal, a light rail station with parking will normally have about 50 percent more boardings than another station on the same line without parking. Providing (adequate) parking at commuter rail stations can increase boardings by more than 100 percent (TCRP Report 16, Vol. 1, p.14).

The degree to which park-and-ride facilities are appropriate will depend on the rail station type and the area in which it is located. Often, suburban communities and urban neighborhoods may chafe at the large parking lots or parking garages associated with auto access to rail transit. In the intensely urban areas (downtowns, major activity centers) at the "downtown" end of rail lines, auto parking may be unnecessary or even counterproductive.

In suburban and rural areas park-and-ride availability is essential to attracting transit ridership. Park-and-ride facilities enable a rail system to serve low-density settlements over a relatively large travel shed. The size of travel sheds for automobile access to a rail station will depend on the travel time for the total trip, including both the auto and rail portions of the trip. The travel shed will generally be limited to the area within which the total portal-to-portal travel time for auto/rail travel is competitive with the auto-only travel time. However, other factors such as high parking costs (or lack of parking) at the destination end, high levels of congestion on competing highway corridors, and transit pass programs can affect the rail travel shed.

Finally, rail transit travel sheds tend to be larger on the side of the transit station away from the major destination on the rail line. In other words, people are not inclined to drive or ride a bus in the opposite direction from their ultimate intended direction of travel. For suburban stations connected by rail to large downtowns, the travel shed will be larger on the side away from downtown. People starting their trips closer to downtown than a given transit station normally will be inclined to travel to the next transit station or to drive the entire trip. However, for station-to-station travel in suburban areas, or in areas where there is no principal direction of travel this effect is less pronounced.

## 2.5 Economic Relationships in Rail Transit

Economic relationships in rail transit have two dimensions.

- Rail transit affects the value of real property; and,
- the economics of real property in station areas affects the success of passenger rail. Consideration of both dimensions should be a part of the planning for passenger rail in Colorado.

### ▶ Transit Stations May Increase the Value of Nearby Residential Property

The original "streetcar suburbs" around North American cities up to about 1920 demonstrated the connection between suburban property values and rail transit. Some of these systems were funded by developers in anticipation of the tremendous appreciation in property values associated with suburban living within a five minute walk of rail service to the core city.

In certain well-known instances (e.g., Pasadena), highly successful satellite cities with their own bustling downtowns were connected to suburbs and to the core city by interurban rail transit lines. The influence of rail transit declined rapidly after 1920 as automobiles became affordable and as a long process of disinvestment in rail transit began – a process that would continue into the 1980s.

A number of studies over the years have shown a clear relationship in modern times between rail transit and residential property values. Research conducted in Philadelphia in the early 1970s and replicated in 1986 found that residential properties within station influence areas had increased in value by about seven percent more than average residential values. This effect was most pronounced in areas relatively far from the downtown. Similar research in Boston in 1994 documented a seven percent increase in residential property values in areas where commuter rail service was available. Today, apartments close to Portland MAX stations command an 11 percent rent premium over other similar apartments (these examples are summarized in TCRP 16, Volume I, Chapter 3). In Portland area newspapers, "apartment available" ads for station area apartments prominently announce proximity to MAX in much the manner that such ads in Florida newspapers might mention proximity to the beach.

The impact of rail transit on residential land values is greatest where the rail transit system provides significant mobility benefits. In other words, the rail transit service must be fast, frequent and reliable. If door-to-door transit travel times are competitive with auto travel times, then the transit system will confer value to residential property. However, such benefits are felt only within the transit station catchment area. In cases where transit travel times are not competitive, or the rail transit service suffers from other deficiencies, no increment in property value occurs. Residential areas along the light rail lines serving San Jose and Sacramento have experienced no boost in value from their proximity to these lines.

### ▶ Transit Stations Also May Increase the Value of Nearby Commercial Property

In recent decades (post 1970), rail transit systems have conferred significant impacts on nearby commercial real estate. This process begins even before the rail transit line is built and continues into the future as long as the rail service operates. Dramatic increases in commercial land values have been documented within the station influence areas of the Washington, D.C. Metro lines. Price differentials of 100 percent to 400 percent were measured in the 1980s. A more complex relationship emerged in studies of land development trends around BART stations (San Francisco Bay area) in the mid-1990s. While commercial land values near stations were higher than in other areas, this also correlated with higher quality development. In other words, part of the reason land values were higher was the fact that developers had built high quality office, retail and industrial properties in anticipation of market support for this at those locations.

Office developments near Atlanta (MARTA) stations command a rent premium of $3 to $5 per square foot over similar buildings in other areas. This relationship is also correlated with lower parking requirements and much higher transit commute mode shares (see Bernick and Cervero, 1997).

The impact of rail transit on retail centers can also be pronounced – under the right circumstances. Bernick and Cervero conclude that, while there is a significant increase in transit mode shares at rail transit area retail centers, this effect is most evident where parking supplies are limited. In cases where large supplies of free parking are available, transit mode shares, or the percentage of travelers using transit, are not as high, although they are still above average.

However, there does appear to be a positive impact on retail property values. For example, the Urban Land Institute recently reported that the Dallas Area Rapid Transit (DART) light rail line has increased retail business in downtown neighborhoods by 30 percent. (Urban Land, Volume 60, No. 5, p. 89). This effect is translating into a reversal of the long-standing downward trend in downtown Dallas land prices – affecting office, retail and hotel land values.

Finally, there is strong evidence that, under the right circumstances, rail transit will encourage private sector commercial development in and around station areas. The Portland MAX experience has been well documented. Similar effects have been reported in San Diego and San Jose (at least in downtown). In Dallas, about $1 billion in private investment has been made in private sector development within the DART "transit village" influence areas.

**Figure 2e. Increased Development Activity at Transit Stops has been Observed Along Portland's Max Line**

### ▶ Transit Station Areas Cannot Compete With Greenfield Sites

Greenfield sites are undeveloped parcels typically located at the periphery of developed areas. Greenfield sites may be less expensive to buy than developed parcels as well as less expensive to develop, due to minimal infrastructure costs. When greenfield sites are available for development in areas away from rail stations, little or no development will occur in the areas adjacent to rail stations. Many factors discourage development or redevelopment in rail station areas. Some of the more important of these are listed below.

- Land is generally much more expensive in infill/station areas. Outlying fringe lands – often farm or ranch lands – can be purchased in large parcels at relatively low cost.
- The land in station areas may be subdivided into parcels that are too small to support feasible development projects. The process of assembly is slow, the costs of assembly are high, and the risks are high.
- Local ordinances and standards may prevent development patterns that would enable a developer to maximize return on the project. Excessive setback requirements, landscaping set-asides, and parking supply requirements are just a few examples. While these same requirements might be imposed in suburban or rural areas, they are of less concern there because the underlying land is inexpensive and there is space for a low-density development pattern. Impact fees, exactions and other fees and levies are often more expensive to the developer at infill sites around rail stations than in fringe areas, especially if suburban and rural sites are available outside incorporated limits.
- Infrastructure costs associated with urban projects may be higher than for rural projects, especially if local jurisdictions have infrastructure systems that effectively subsidize low-density development patterns.

Urban development and redevelopment sites are able to compete with “greenfield” sites only if local and regional governments act to level the playing field. After the Atlanta (MARTA) and Miami (METRO) rail systems were built, little development occurred around their rail stations for many years because so much inexpensive land was available for development in outlying suburban and rural areas. Now that these outlying areas are less attractive due to excessive roadway congestion and commute times, the transit station areas in both cities have seen major amounts of development and redevelopment activity, belatedly fulfilling their builders’ original vision.

By contrast, Portland’s (MAX) and Toronto’s (TTC Subway) rail transit systems immediately attracted tremendous private sector development and investment, in large part because local and regional policies prevented development in suburban and rural fringe areas. Portland, with tight regional limits on the dispersion of urban growth, saw well over a billion dollars in private investment in development and redevelopment projects at the MAX line stations within a few years of the initiation of service.

Rail transit does not, in itself, attract private investment unless local and regional policies are designed to cause this to occur. Low density, sprawling communities do not support rail transit well, and cannot expect much private sector interest in development opportunities around rail stations.

It is also important to keep in mind that rail transit area development is subject to the same general economic forces as all other types of development. In a "down" market – a recession or real estate slowdown – rail stations will have little leverage on adjacent land development. The proposed Florida High Speed Rail system floundered in the late 1980s because a real estate downturn took away the primary financial engine of the system – appreciation in property values around stations. If commercial development in general has taken a hiatus, this will affect the pace of both greenfield and transit station development. In this case, all of the right policies might be in place, but an additional component might be needed: patience.

## 2.6 The Colorado Transportation Environment

Currently, private motor vehicles carry most of the person miles of travel in Colorado. An extensive network of freeways, arterials and local roads constitutes the backbone of the state's transportation system. For most Coloradoans, automobiles are the primary source of mobility. In many parts of the state, driving is the only practical means of transportation.

At the same time, public transit is steadily growing in importance in Colorado. The Denver metro area currently has more rail corridor development activity underway than virtually any other city in the nation. The Denver light rail network, including the 5.3-mile Central line (Figure 2f.) and the 8.7-mile Southwest Corridor, has become a key component in the daily travels of thousands of area residents and commuters. This emerging light rail system is overlaid on a large and mature Regional Transportation District (RTD) bus network, including express, regional, and local routes. Particularly high levels of bus service are available into and out of Downtown Denver and within Boulder. Other parts of the Denver region, including the major highway corridors in Lakewood and Aurora receive high levels of RTD transit service and, as a result, have high levels of ridership.

A number of other significant transit systems operate outside the Denver region in Colorado. Fort Collins, Pueblo, Grand Junction and Colorado Springs all are working to improve their urban bus transit systems. Many of the mountain communities have developed bus services that play a major role in local and regional circulation. The Roaring Fork Transit Agency (RFTA) provides regional services in the rural corridor from Glenwood Springs to Aspen, as well as local service in Aspen. Local bus transit systems also operate in Vail, Avon, Eagle County, Steamboat Springs, Crested Butte, Summit County and Breckenridge, and Winter Park, to name just a few.

**Figure 2f. Denver LRT**

Most Colorado communities have placed significant emphasis on improving walking and bicycling. The resort communities have done this in part to compete with their rivals in Colorado and in other states. Cities like Boulder and Fort Collins have made significant investments in walking and bicycling facilities. These investments, coupled with large student populations, have resulted in high pedestrian and bicycle mode shares, especially in the core areas of these cities. However, many parts of urban and suburban Colorado have little or no accommodation for walking or bicycling, and little or no transit service. Rail transit stations in such places would have to rely primarily on private auto access and associated large parking areas.

Roadway congestion has worsened in many areas of the state over the past couple of decades. While the actual intensity and duration of local congestion varies, most residents feel growing traffic is a major concern. In Colorado, daily vehicular travel has been increasing at about three times the rate of population growth. On average, people are driving more each day, and average trip lengths have increased. This is, in part, a manifestation of development patterns, which have favored low densities and segregated land uses. The trend is most pronounced in the Denver Region, now among the nation's most congested urban areas in terms of the amount of time people spend in traffic. (See Figure 2g.)

The potential for rail transit in Colorado is different in different parts of the state. Clearly, the Denver Region will continue to pursue completion of an extensive network of rail transit lines, with many if not all of these being light rail transit. The Southeast I-25 corridor is under construction now. The West Corridor to Lakewood, the I-225 corridor, the North Metro corridor, a connection to the Denver International Airport (DIA), and service to northwest metro area communities in the U. S. 36 corridor are all in some stage of planning.

Ultimately, rail connections among the communities of the Front Range may be developed. The I-25 corridor north from Denver to Fort Collins is one such candidate currently under study. Over the long range, connections between Denver and Colorado Springs and Pueblo may also be considered.

The heavily traveled I-70 corridor, from Lakewood west through the mountains to Glenwood Springs, is currently under study, with consideration of a range of possible modes. The potential for high-speed, technologically advanced rail service in the I-70

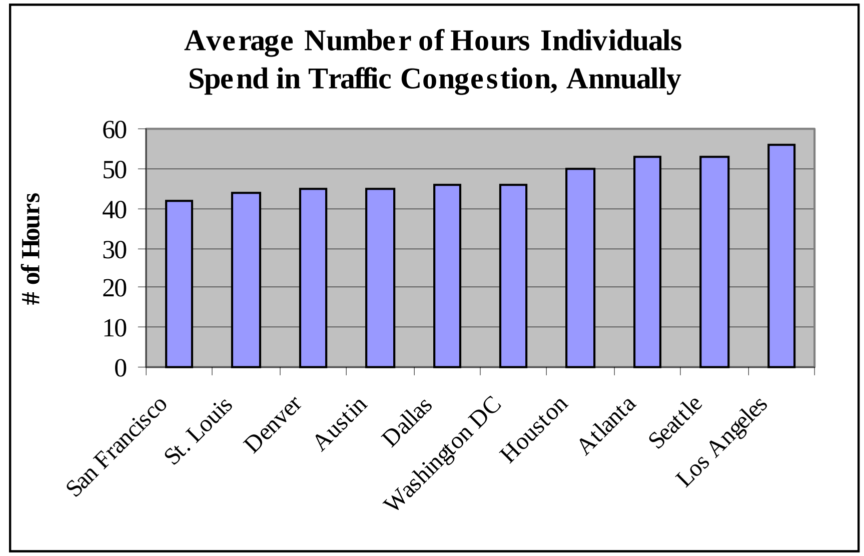



**Figure 2g. A Recent Study Published in the Texas Transportation Institute's 2001 Urban Mobility Report Ranks Denver Among the Top Ten Cities, in Terms of Number of Hours Spent in Traffic**

mountain corridor is a subject of active debate. If rail service is established in this corridor – regardless of technology – it will face the unusual condition that there are no cities of more than a few thousand residents between the Denver metro area and Grand Junction, over 200 miles to the west. If there is to be significant ridership on such a system, a robust level of interconnecting transit service as well as large auto parking areas will be needed.

Other potential rail corridors in Colorado have been studied or proposed. The Roaring Fork Valley governments have purchased an abandoned rail corridor connecting Glenwood Springs to Aspen, through Carbondale and Basalt. A "Valley Rail" system, perhaps using diesel mobile unit (DMU) technology has been proposed in this corridor. The Entrance to Aspen Environmental Impact Statement resulted in a locally preferred alternative that would include a light rail transit connection from near the Aspen airport into downtown Aspen, interconnecting with the Roaring Fork Valley Rail line.

Interest has been expressed over the years in the potential for rail passenger service into and out of Steamboat Springs from the west, perhaps to Hayden and the regional airport. A potential rail service from Leadville over Tennessee Pass and down to the I-70 corridor west of Vail has been discussed. Other potential rail transit corridors may occasionally be the subjects of local interest around Colorado.

All of these rural and mountain resort areas are characterized by populations that are small, with no large central business districts or other major commercial activity centers. Many of the mountain communities are experiencing heavy traffic associated with commuting and tourism, and as noted above, many have implemented good bus transit systems. However, making the step to rail transit in these places will require approaches and solutions that are specifically tailored to rural, small town areas. The urban rail transit systems of North America – Portland, Sacramento, San Jose, Dallas, St. Louis, Buffalo, or Denver – may offer useful lessons, but cannot be models for these rural mountain environments.

To ensure the usefulness of this Study, the potential rail transit operating environments present in Colorado have been summarized in three categories:

- The Front Range urban areas from Fort Collins south to Pueblo, including the Denver region;
- The I-70 corridor through the mountains west of the Denver region; and,
- The rural, mountain valleys and resort areas.

A map of the state showing the areas described above is provided in Section 1.3 Candidate Rail Corridors in Colorado.

# 3. PLANNING STRATEGIES



## 3.1 Introduction

This chapter describes strategies related to land use, development patterns and transportation that would improve the prospects for success of passenger rail in Colorado.

To make the application of the strategies as effective as possible, four types of rail stations are identified for the purposes of planning both land uses and supporting transportation systems.

- *CBD*, which describes stations serving the largest employment areas in the state;
- *Downtown*, which describes stations serving the downtowns of smaller cities;
- *Community/Suburban*, which describes stations located outside of downtown areas but within a developed community; and,
- *Rural*, which describes stations with little or no adjacent development.

The strategies vary in importance depending on the station type. The relationship between the strategies and the station types is summarized at the end of this chapter.

### ▶ Passenger Rail Transit Station Characteristics

Stations are important to the success of rail transit systems. The rail lines themselves are of only secondary importance. The location of stations relative to other elements of the transportation network, and the relationships between stations and their surrounding land uses are key considerations.

Rail transit systems are more likely to succeed where their stations become integral parts of local pedestrian-oriented transit “villages” or districts. They also are more likely to succeed where they are well integrated with feeder bus routes and local streets.

The following sections describe the character of the different types of stations and their characteristics, including:

- Where they are located in the community;
- The opportunities that each represents; and,
- The nature of the supporting transportation system.

### ▶ CBD Transit Stations

CBD transit stations are the most intensively developed transit centers, located in the Central Business District or downtown area of Colorado’s largest cities. They are located in high-density urban centers. To qualify for rail transit planning purposes, CBDs should have employment of 100,000 jobs or more.


**Figure 3a. CBD Transit Station**

Such places typically already have land use characteristics supportive of cost-effective regional rail transit service. These characteristics include a mix of land uses, large employment base, a walkable street grid, and major retail and entertainment destinations. Pedestrian activity accounts for much of the circulation within these centers. Parking supply is constrained and parking prices are high.

CBD transit stations feature high levels of connecting bus service, often with the potential for multimodal transit interconnections. These station areas offer opportunities for transit-oriented development and redevelopment.

For the purposes of planning for passenger rail, only the most dense regional business districts qualify as a CBD. Colorado examples of potential CBD transit stations include:

| | |
|---|---|
| FRONT RANGE | **Denver Union Station** |
| I-70 MOUNTAIN CORRIDOR | **None** |
| RURAL VALLEYS AND RESORT COMMUNITIES | **None** |

- **Downtown Transit Stations**

Downtown transit stations have characteristics similar to CBD transit stations but are smaller. They are located in the commercial core districts of Colorado cities and towns. Whereas regional CBDs have employment bases of 100,000 jobs or more, transit stations in this category are located in downtowns with 25,000 or fewer jobs. They draw commuters from surrounding rural areas and neighboring towns, but are too small to qualify as CBDs for rail transit planning purposes.

The intensity of development around downtown stations will vary by town, often with both commercial and residential uses nearby. The extent of supporting transportation systems will vary among Colorado downtowns. One can generally expect at least some connecting bus service, as well as reasonably good pedestrian facilities. Parking supply may be limited and paid parking will predominate, at least on weekdays.

For traditional North American rail planning purposes, most of Colorado's downtowns (other than downtown Denver) would be regarded as too small to qualify as rail transit destinations. However, in Canada. Europe, and many other parts of the world, smaller downtowns are successfully served by rail transit. Modest downtowns may also succeed as transit destinations if they are part of a larger transit network with multiple nodes of similar size. Examples of Colorado places with downtowns in this category include:

| | |
|---|---|
| FRONT RANGE | **Pueblo, Boulder, Colorado Springs, Fort Collins** |
| I-70 MOUNTAIN CORRIDOR | **Vail, Avon, Glenwood Springs** |
| RURAL VALLEYS AND RESORT COMMUNITIES | **Steamboat Springs, Aspen** |

**Figure 3b. Transit Station in Aspen, Colorado**

- **Community/Suburban Transit Stations**

Community/suburban stations would typically be located along major highways and transportation routes, in locations that have some degree of development, but are outside of a community's central business district. Land use patterns at these locations would vary, depending on the amount, type, and intensity of development activity in the station environs.

In most cases, these stations would be located in areas that contain major concentrations of employment and other land uses, but typically would be located away from the centers of the communities in which they are located. Examples of these types of areas include the U.S. 36 corridor near Broomfield and Superior; Eagle and Dillon in the I-70 corridor; and, Castle Rock in the south I-25 corridor.

Community/suburban transit stations will have feeder bus service, though the level of service will vary. Ideally, these stations would be served by connecting bus service including service to neighboring communities. Opportunities for transit-oriented development will vary by community, depending on station location and community-wide land use patterns. If development located near stations is planned in anticipation of the transit system, then transit-oriented development can be expected to occur. Community/suburban stations would include high levels of pedestrian and bicycle access.

Parking is likely to exist in significant quantities at these stations as driving will be one of the primary modes of access to the rail system. Design considerations should include convenient pedestrian connections to, from, through and along parking facilities.

Examples of potential Colorado stations include:

| | |
|---|---|
| FRONT RANGE | **Westminster at U.S. 36; Loveland at U.S. 34 and I-25** |
| I-70 MOUNTAIN CORRIDOR | **Eagle or Dillon at I-70** |
| RURAL VALLEYS AND RESORT COMMUNITIES | **Basalt** |

- **Rural Transit Stations**

Rural transit stations would be located some distance away from populated or developed areas. They would primarily serve as regional park-and-ride facilities with little, if any, connecting bus service, and little pedestrian and bicycle access. They would be located in areas with direct vehicular access and the space to accommodate surface parking areas. Because of their location away from developed areas, little or no transit-oriented development opportunities would exist at these stations, other than limited amenities such as commuter services. Over time, development activity may occur in the vicinity of these stations and they may evolve into community/suburban transit stations. For the near term, they would be expected to serve as park-and-ride facilities.

Examples of potential rural rail transit stations include:

| | |
|---|---|
| FRONT RANGE | **Johnstown (State Highway 60 at I-25)** |
| I-70 MOUNTAIN CORRIDOR | **Evergreen; Morrison** |
| RURAL VALLEYS AND RESORT COMMUNITIES | **Carbondale** |

## 3.2 Regional Land Use and Development

Strategic regional land use and development patterns help to create an environment that is supportive of rail systems by creating a structure for development and focusing appropriate land uses close to rail corridors. Although land use and development patterns vary among successful rail networks, key characteristics relate to regional structure, density, land use and urban design.

► **Develop a Regional Structure Supportive of Passenger Rail**

A key determinant of the regional land use pattern that will support passenger rail is the size of the regional CBD, in terms of employment. Metropolitan areas with large regional CBDs tend to develop a hub-and-spoke rail network, while those areas without large CBDs tend to develop rail networks that connect a series of nodes to the CBD. Both patterns are supportive of passenger rail. For the purposes of planning for passenger rail, a strong regional CBD is defined as having 100,000 or more jobs. This structure will inform the location of development and redevelopment within a region.

► **Locate and Develop Activity Centers at Potential Rail Station Locations and/or Along Potential Rail Corridors**

A region's structure should be understood in terms of their business or employment and residential centers, or activity centers, for the purposes of planning for passenger rail and other transportation modes. These nodes of activity, or activity centers, indicate key origins and destinations, for the purposes of transit planning. Activity centers should be located adjacent to an

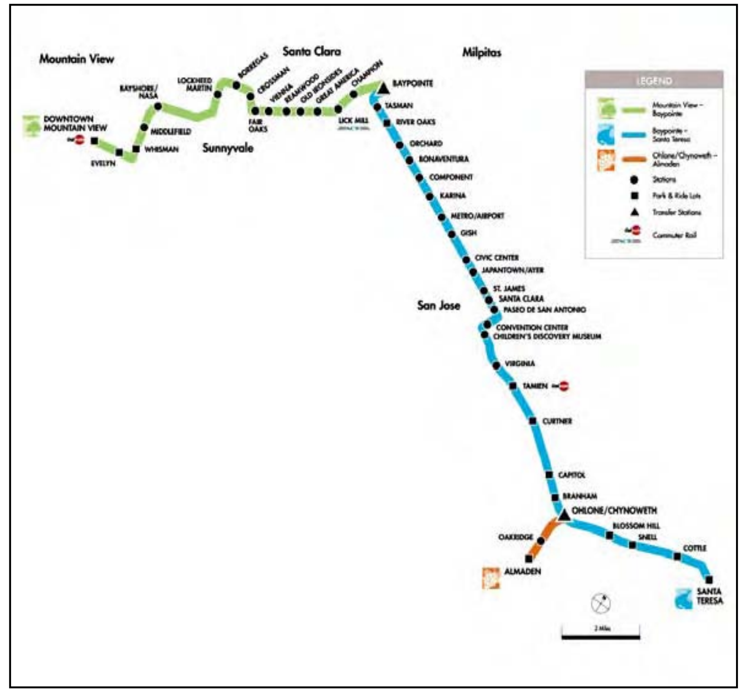



**Figure 3c. The Valley Transportation Authority (VTA) Light Rail System in San Jose is Linear, Connecting Multiple Activity Centers to One Another**

anticipated rail corridor whenever possible to maximize access to the rail system.

The spacing between activity centers will vary; as will rail station spacing, depending on the type of technology used. Commuter rail stations are typically spaced 2.3 miles apart. Light rail stations are typically spaced 0.6 miles apart. While not every activity center located along a rail line is guaranteed to include a future rail station, the activity center structure is easily served by both rail and supporting transit.

New commercial and residential development should be focused in existing or planned activity centers. This will support alternative modes of transportation, including rail by creating nodes of activity that can be easily connected to the rail system. While it is desirable to develop activity centers adjacent to an anticipated rail corridor, it is possible to link satellite activity centers to the rail line (e.g., through the use of shuttles).

- **Develop a Hierarchy of Activity Centers**

An activity center is a location, which supports a concentration of commercial and/or civic uses, and serves as a primary destination on a local or regional level. Activity centers may be first identified as existing and/or planned centers for employment or retail but should evolve to include a mix of land uses. The size of an activity center will vary widely in application, from the downtown area of a major city, which attracts employees on a regional level, to the central business district of a mid-size town, which serves as an employment hub for neighboring towns.

Consistent with the concept of a regional structure, nodes of activity and development should be categorized or developed within a hierarchical framework. The size and nature of activity centers will vary, depending on their location, context and the type of rail service implemented. The downtowns of Denver, Glenwood Springs and Evergreen, Colorado are all examples of activity centers. By establishing a framework for activity centers, development can be targeted appropriately, with the largest concentration of employment and commercial uses happening in the dominant activity centers, which typically have strong supporting transportation systems.

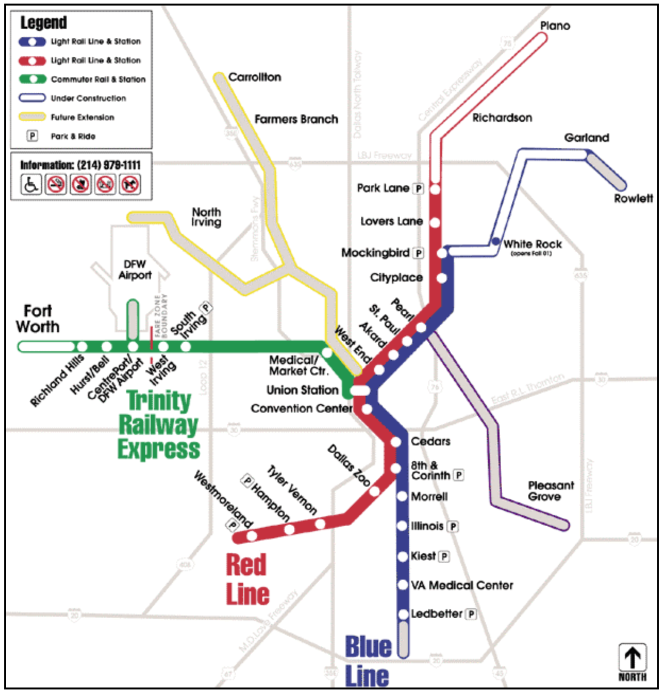



**Figure 3d. The Dallas Area Rapid Transit (DART) Light-Rail has a Hub-and-Spoke Network, Connecting a Dominant CBD to Peripheral Areas**

**Regional Land Use & Development Strategies**

✓ **Develop a Regional Structure Supportive of Passenger Rail**

✓ **Locate and Develop Activity Centers at Potential Rail Station Locations and/or Along Potential Rail Corridors**

✓ **Develop a Hierarchy of Activity Centers**

## 3.3 Community Land Use and Development

The patterns and land uses described below are appropriate for community-wide planning. Because the development of passenger rail, including the corridors, alignments and station locations may not be known during the planning process, it will be necessary for communities to think broadly about their relationship with future passenger rail service. Strategies described here will support passenger rail by creating nodes of activity and density, which will facilitate *direct* or *connecting* linkages to a future rail system.

▶ **Create Employment Density in Existing and Planned Activity Centers**

All transit networks benefit from a healthy regional and local activity center. An activity center describes a node of development, which should include retail, office and residential uses. Activity centers, which include a significant concentration of employment, support the transit system by creating primary destinations for both commuters and patrons.

Clearly, the degree of density in an activity center will vary by community and by the type of activity center. In regional activity centers, also referred to as CBDs, employment density could be upwards of 50,000 employees per square mile. In smaller cities, 10,000 employees per square mile may be a more appropriate employment density, and in rural areas, employment density may be represented simply by those employed in the local business district, which could be 100 employees. The goal is to concentrate new employment or guide the relocation of existing employment in activity centers to promote the use of rail or supporting transit for the purposes of commuting and other trip-making purposes.

▶ **Create Minimum Residential Densities for Areas Within Two Miles of Potential Rail Corridors**

Residential density supports passenger rail systems by increasing the number of potential passengers accessing the rail system. The following table provides residential density thresholds to support various modes of alternative transportation. Although minimum residential densities associated with commuter rail service are relatively low, it should be noted that supporting bus transit would require higher densities for service to be effective. Mode-of-access to the rail system must be considered in planning for residential density. Residential density is measured as gross residential density and applies to the area two miles on either side of the rail corridor.

| Service Level | Minimum Residential Density[1] (Dwelling Units/Acre) |
|---|---|
| Minimum Bus Service | 4 |
| Intermediate Bus Service | 7 |
| Frequent Bus Service | 15 |
| Light Rail | 9 |
| Rapid Rail | 12 |
| Commuter Rail | 2 |

[1] Pushkarev and Zupan.

**Figure 3e. This Table Establishes Minimum Residential Density Thresholds for a Variety of Transit Service Types**

**Measuring Residential Density**

This Handbook recommends using "gross density" when measuring residential density.

- ✓ **Gross Density** measures the total number of dwelling units per acre across a large area, such as a region or town. This is the preferred unit of measure for the purpose of land use and transportation planning because it reveals information about public infrastructure such as the width of streets.

- ✓ **Density of Development** measures the total number of dwelling units per acre within a particular development project or subdivision. This includes information about non-residential uses, but only within a given subdivision.

- ✓ **Net Residential Density** measures the number of dwelling units per acres of residential land. This measure does not include any information about other uses or infrastructure. It is less useful for the purposes of this discussion.

Regardless of the measure being used, it is most important to be clear about the implications of each measure and to ensure that comparisons between densities are appropriate.

The residential density threshold associated with light rail is much higher than that associated with commuter rail for reasons relating to income demographics and modes-of-access. Residential density for the purposes of supporting rail tends to decline in importance with increasing distance from the rail station and the regional Central Business District, which creates nodes of density around rail stations, particularly those closer to the CBD.

- **Incorporate Retail and Service-Based Commercial Uses in Employment Centers**

Both quantitative and qualitative research shows that mixed-use zoning can help in the creation of vital activity centers and support alternative modes, including rail. There are certain strategies that will help communities benefit most from mixed-use zoning.

In the creation and development of activity centers, a mix of retail and employment can help communities to decrease reliance on the use of automobiles by allowing mid-day trips by local employees to be made on-foot. This land use pattern supports transit by eliminating the need for a car to make trips while at work.

- **Incorporate Neighborhood-Oriented Commercial Uses in New Residential Areas**

Although residential areas are not necessarily activity centers as described in this Handbook, they can evolve as smaller-scale activity centers, which support neighborhood needs. New residential areas, which incorporate neighborhood-serving retail uses, such as a small grocery or local restaurant can encourage the use and effectiveness of transit by allowing trips to be made on either end of the commute and providing a local hub for transit service. The introduction of mixed-use development into established communities may be difficult, as some believe the associated impacts to be negative.

- **Take Advantage of Shared-Parking Opportunities in Mixed-Use Areas**

Mixed-use areas also present an opportunity for shared parking for facilities such as office space and movie theaters, which have different times of peak use. This in turn, may reduce the total amount of parking required within an activity center, thus opening up more land for development and creating a more pedestrian-friendly environment.

**Figure 3g. Neighborhood Commercial Uses on South Gaylord in Denver, Colorado**

**Figure 3f. Example of a Mixed-Use Area in Boulder, Colorado**

| Community Land Use & Development Strategies |
| --- |
| ✓ **Create Employment Density in Existing and Planned Activity Centers** |
| ✓ **Create Minimum Residential Densities for Areas Within Two Miles of Potential Rail Corridors** |
| ✓ **Incorporate Retail and Service-Based Commercial Uses in Employment Centers** |
| ✓ **Incorporate Neighborhood-Oriented Commercial Uses in New Residential Areas** |
| ✓ **Take Advantage of Shared-Parking Opportunities in Mixed-Use Areas** |

## 3.4 Station Area Land Use and Development

The land use and development pattern adjacent to a rail station can play a major role in facilitating access to a rail system and linking other modes of transportation to the rail system. Station areas can serve as vital commercial hubs for those who live or work in the area. Stations should be located within downtowns or activity centers whenever possible, to include characteristics that will support rail, such as density, mixed-use zoning and an advanced urban design component. However, some train stations will be located in suburban or rural areas and may not have much adjacent development, particularly when first planned. The extent to which these station areas include the following land uses and development patterns should be determined on a case-by-case basis (see Section 3.9, "Putting it All Together" for guidance on the application of these strategies).

### ▶ Determine Station Type and Define Station Area

The land considered to be part of the "station area" will vary, depending on the size, location and nature of the urban area in which it is located. A station area is not necessarily synonymous with a catchment area, which describes the area in which a majority of the trips to the station originate. The size of catchment areas is influenced by factors such as the nature of the interconnecting transportation system and station spacing. Many of the patterns described in this section would further support rail systems if applied to entire catchment areas, such as residential density. However, for the purposes of this discussion, station areas will refer to the land immediately surrounding a station, encompassing 0.5 to 2.0 miles in radius. Station areas are not likely to be perfect circles but will reflect local characteristics, such as adjacent land use and topography.

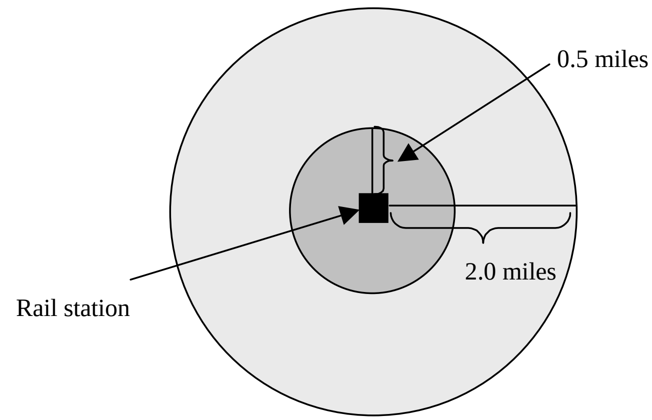



**Figure 3h. "Station Areas" Include the Area with 0.5 to 2.0 Miles of Station, Depending on the Nature of the Surrounding Area and the Characteristics of the Supporting Transportation System**

The role of the pedestrian should not be underestimated in the area surrounding a rail station. All passengers of the rail system are pedestrians both before and after their trip, whether traveling from an origin, to a destination or between modes of transportation, including the automobile. Land adjacent to a station should be used as efficiently as possible and pedestrian-scale urban design elements should be included. Access by all modes should be carefully planned and controlled so that everyone, approaching by foot, bicycle, bus or car, can safely and conveniently use the rail system. Not only will this support the success of the rail system but it can help create a vital community center, as well.

- **Develop Station Area with the Highest Commercial and Residential Densities**

Station areas located within activity centers should include the highest densities relative to the area, associated with both commercial and residential uses. This concentration of population and employment will contribute to the development of the station area as a hub and facilitate access to the rail system.

- **Orient Commercial and Service Uses Towards Transit Users**

There are particular commercial uses that serve rail passengers, such as food services, travel information services and various retail shops. These are encouraged at station areas to support rail passengers as they begin or end their travel.

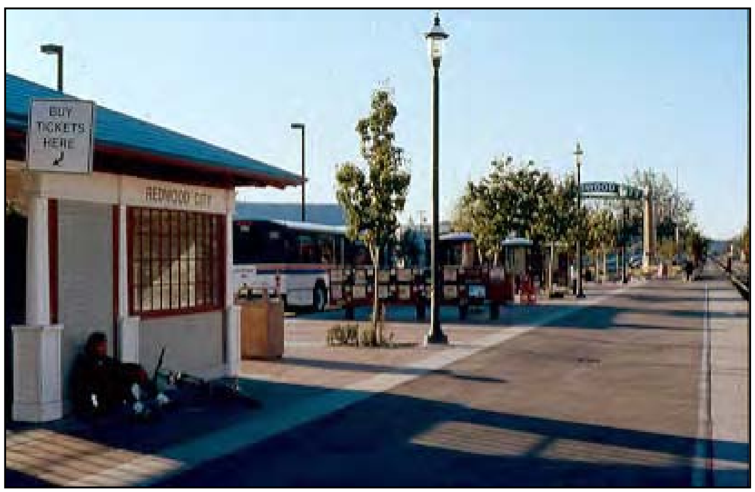



**Figure 3i. Transit Facilities at the Station Area**

- **Locate Transit, Bicycle and Park-and-Ride Facilities to Facilitate Convenient Pedestrian Transfer**

Facilities associated with the supporting transportation system, if not included with a station itself, should be incorporated in close proximity to a station. Land should be set aside for transit stops with passenger facilities, bicycle parking and related facilities as well as parking areas.

At both the project and building level, aspects such as building orientation, street layout and the location of parking can help to create the kind of environment, particularly near rail stations, to support alternative modes of transportation.

- **Orient Buildings to the Street**

Locating a building and its primary entrance close to the street and sidewalk of an activity center increases accessibility and helps to create a street frontage, creating interest and comfort for pedestrians. Parking lots are best located at the rear of a building site so that they make a minimal impact on the pedestrian environment.

- **Create a Fine-Grained Grid Network for Streets and Sidewalks**

A street network based on a grid promotes access and efficiency for many alternative modes, including bus transit and pedestrians, by minimizing circuitous routes and better distributing traffic over a range of streets. A *fine-grained* grid network would include shorter blocks, ranging in size from 150-350 feet on the long side.


**Figure 3j. Parking Facility at Station Area**

**Figure 3k. Buildings Oriented to the Street**

### ▸ Prioritize Pedestrian Access and Circulation through Urban Design

An important aspect of regional land development patterns is the inclusion of an urban design component into existing and planned developments. Urban design is of particular importance in close proximity to rail stations, where it can help to create a cohesive, pedestrian-oriented environment in which the transportation network – and community can thrive.

Pedestrian-oriented design creates an environment in which walking is a more attractive and effective mode of transportation. A pedestrian-friendly area, particularly adjacent to a rail station, can have the effect of reducing auto use by encouraging trips typically made in automobiles to be made on-foot, by extending the length of typical pedestrian trips and facilitating access to transit.

**Figure 3l. Parking Lot Located at the Front of a Store**

**Figure 3m. Pedestrian-Friendly Design**

◇ **What makes a place pedestrian-friendly?**

- A pedestrian grid with fine-grained intersections, preferably every 200 feet or less.
- Direct sidewalk connections to key destinations at safe, convenient points.
- Visual cues such as signage, sight lines, view planes and orienting landmarks to support way finding.
- Sidewalk widths adequate for social use (e.g., 6 to 20 feet depending on type and location).
- Pedestrian plazas provided to create "places" and tie buildings and uses together.
- Direct, continuous, buffered sidewalks across any large parking areas.
- Walkways and sidewalks that are protected from obstructions, such as parked vehicles.
- Complete provision for the needs of disabled and physically challenged travelers.
- Sidewalks that are buffered from streets with a landscaping strip or on-street parking.
- Crosswalks at driveways and adjacent streets.
- Curb cuts and ramps cut at 90º to the roadway with adequate width and landings.
- Canopies, awnings and arcades used to provide shelter from sun and rain.
- Appropriate furniture and lighting on major walkways.

**Station Area Land Use & Development Strategies**

- ✓ **Determine Station Type and Define Station Area**
- ✓ **Develop Station Area with the Highest Commercial and Residential Densities**
- ✓ **Orient Commercial and Service Uses Towards Transit Users**
- ✓ **Locate Transit, Bicycle & Park-and-Ride Facilities to Facilitate Convenient Pedestrian Transfer**
- ✓ **Orient Buildings to the Street**
- ✓ **Create a Fine-grained Grid Network for Streets and Sidewalks**
- ✓ **Prioritize Pedestrian Access & Circulation Through Urban Design**

## 3.5 Supporting Transportation Systems

▶ **Use the Station Type to Prioritize the Most Effective Supporting Transportation Modes**

Rail system ridership is dependent on the ability of people to travel to and access the rail system. Good access should be provided for all transportation modes, including pedestrians, bicyclists, transit, and the automobile. The extent that access is supported for one transportation mode over another is a function of the location of station (e.g., within a CBD, in a downtown, activity center or rural area), the availability of transportation options, and community preferences. For example, a station in a downtown, or CBD location with good supporting bus transportation, has less need for expansive park-and-ride facilities; versus a station located in a rural area with no supporting bus transportation.

▶ **Develop Improved Pedestrian Facilities in Station Areas**

All rail transit patrons are pedestrians during some part of their transit trip. Some persons will access rail stations by walking directly from their residence or work place. Others will transfer from connecting buses or other transit systems by walking. Still others will access rail stations by driving to a park-and-ride facility and walking from their vehicle to the station.

The distances people are willing to walk varies, but is in the range of 500 feet from vehicles parked at park-and-ride facilities, to 0.5 miles for persons walking directly from their home to a rail station, to up to 1.5 miles from rail stations to places of employment.

**Figure 3n. Pedestrian-Friendly Environment**

Creating pleasant places to walk can lengthen typical walking distances. Pedestrian pathways that are convenient, attractive, efficient, safe and enjoyable will encourage persons to walk to and from passenger rail stations. Figure 3n. illustrates a street with wide sidewalks, landscaping, and lighting improvements that provide an attractive, safe and enjoyable place to walk. Street connectivity, sidewalk connectivity, and safe arterial street crossings increase the likelihood of walking to/from rail stations.

Pedestrian considerations for park-and-ride facilities include clear direction on how persons should travel to the rail station, the

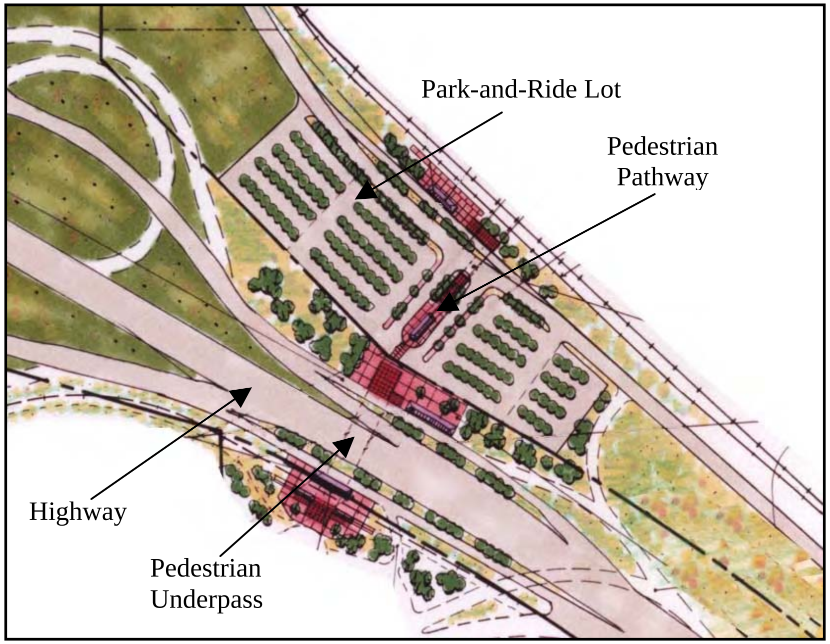



**Figure 3o. Pedestrian Pathway Through a Park-and-Ride (Source: Broomfield Park-and-Ride Relocation Plan -City of Broomfield/RTD)**

buffering of the walkway with landscaping, and the provision of walkway shelter for inclement weather. Figure 3o. depicts well-defined pedestrian pathways through a park-and-ride facility.

- **Provide for Bicycle Access and Circulation in Station Areas and within Bicycle Travel Sheds**

The provision of bicycle facilities and amenities can result in a larger number of persons using bicycles as their means of transportation to a rail station.

Reasonable bicycle distances are generally considered to be one to three miles, with more "hardcore" riders bicycling considerable greater distances. Bicycle routes, bicycle lanes and separated pathways are alternatives for bicycle travel facilities, with the appropriate type dependent on the demand for bicycle travel; the design, speed, and volume of traffic on adjacent roadways; the surrounding environment; land constraints; and costs. Bicycle facilities should allow bicyclists to reach their destination quickly, safely and efficiently. Bicycle facilities should not have gaps, but should be continuous through intersections and activity centers, with safe crossings of arterial streets provided. Figure 3p. illustrates a separated mixed-use pathway that provides for bicycles and other non-motorized means of transportation.

**Figure 3p. Example of a Separated Mixed-Use Pathway**

Bicyclists need safe locations to store their bicycles during the day. Bicycle storage could include racks, lockers, or manned bicycle stations at rail stations. Figure 3q. depicts alternative designs of bicycle racks and lockers.

Providing bicycle racks on buses that connect to rail transit systems can further increase the bicycle travel shed influence area. Figure 3r. illustrates a bus with a typical front-mounted bicycle racks used in many United States cities. Some rail passengers may require their bicycles at their destination. Provisions for allowing bicyclists to take bicycles on board could increase ridership.

**Figure 3q. Alternative Designs of Bicycle Racks and Lockers**

- **Develop Connecting Transit Systems**

Providing good, supporting bus (or other type of transit) transportation for a rail system will increase rail ridership and reduce the demand for park-and-ride lots. Rail stations located in areas that are already developed or experiencing high development pressures may be better served by providing a well-connected transit network, versus dedicating large expanses to surface parking. Also, dedicating large tracts of land to surface parking will reduce the number of persons who walk or bicycle to a rail station as the large parking lots detracts from the walk or bicycling experience.

- **Locate Transit Stops for Convenient Transfer Between Modes**

Bus stops that serve rail stations should be as close as possible to the station doorway, with maximum distances of approximately 200 feet. Even more convenient transfers could be provided with cross-platform transfers. Figure 3s. illustrates

**Figure 3r. Typical Design of a Bus Bike Rack**

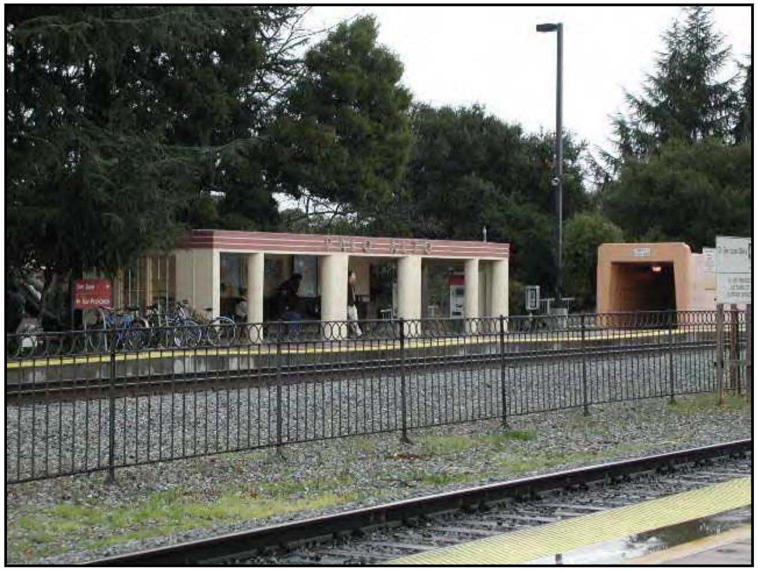


**Figure 3s. Bus Stop Located Outside of Palo Alto Caltrain Station**

a bus stop located immediately outside the front door of the Palo Alto rail station in California. Transit systems require rail patrons to transfer between modes, which discourage transit patronage due to wait times and travel uncertainty. Actions that reduce the burden of transfers between systems encourage ridership.

- **Use Park-and-Ride Facilities to Expand Catchment Areas for Rail Passengers**

Particularly for stations located outside of a downtown area, park-and-rides provide are an appropriate means of increasing access to the rail system. Like feeder bus systems, they expand the catchment area for passenger rail systems. Many commuter rail systems experience 70 percent of rail patrons accessing rail stations outside CBD areas by car. A light rail station with parking has, on average, about 50 percent more boardings than a station without parking, and commuter rail stations with parking increased boardings by more than 100 percent. In suburban and rural locations, beyond an access distance of one mile, park-and-ride provisions are essential toward capturing transit riders. Park-and-ride facilities serve low-density settlements over a relatively large catchment area and are less appropriate in the CBD and Downtown Transit Stations.

- **Design Parking Facilities that are Reflective of Local Context and Increasing Demand**

While providing parking at suburban and rural stations is important, expansive parking lots around stations can preclude transit-oriented development and diminish the quality of the walk environment as mentioned above. Compact development within a quarter-mile-radius of suburban stations is essential toward attracting walk-on riders. A solution may be the use of large surface parking initially, with structured parking offered as the area develops with higher intensities. Strategically, locating parking lots to serve the rail station may also reduce the impact of the parking on pedestrian and bicycle access. Figure 3t. illustrates a structured parking facility that fits in well with adjacent development, with minimal detractions for pedestrians walking on the sidewalk adjacent to the facility.

- **Use Cost and Availability of Parking to Influence Preferred Modes-of-Access**

The availability of free or low-cost parking increases the likelihood of single occupancy vehicle (SOV) use. Similarly, free or low-cost parking discourages transit use. Reductions in the amount of free parking, particularly at stations located in downtown areas, would increase the incentive for transit patrons to use feeder bus service, which would most likely be more readily available as the area intensifies.

- **Make Pedestrian, Bicycle, Transit and Parking Facilities Safe, Convenient and Comfortable**

Amenities at transit stops, park-and-ride facilities and throughout the pedestrian and bicycle environment can encourage use of alternative modes and transit-friendly access, thereby increasing rail transit patronage. Appropriate facilities, in order of importance, include:

- Security;
- lighting;
- bike racks;
- transit and carpool information;
- pay telephones;
- sheltered waiting areas;
- bicycle rack and lockers;
- seating;
- trash receptacles;
- landscaping;
- vending machines;
- day-care facility (park-and-ride facilities); and,
- public art.

Kiss-and-ride facilities allow rail patrons to be conveniently dropped-off by family members and friends. Facilities required for good kiss-and-ride access include a convenient and easy-to-use drop-off location close to the rail station, and convenient connections to the adjacent road system.

**Figure 3t. Example of a Structured Parking Facility that Fits in with its Adjacent Downtown Environment**

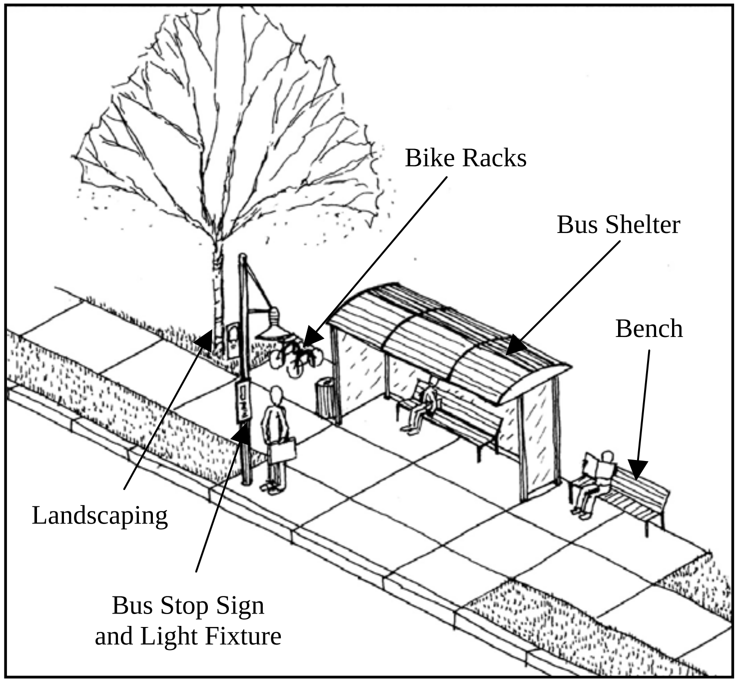



**Figure 3u. Example of a Well-Designed Bus Stop with Passenger Facilities (Source: Fort Collins Transit Design Standards and Customer Amenities Manual)**

## Supporting Transportation System Strategies

- ✓ **Use the Station Type to Prioritize the Most Effective Supporting Transportation Modes**
- ✓ **Develop Improved Pedestrian Facilities in Station Areas**
- ✓ **Provide for Bicycle Access and Circulation in Station Areas and Within Bicycle Travelsheds**
- ✓ **Develop Connecting Transit Systems**
- ✓ **Locate Transit Stops for Convenient Transfer Between Modes**
- ✓ **Use Park-and-Ride Facilities to Expand Catchment Areas for Rail Passengers**
- ✓ **Design Parking Facilities that are Reflective of Local Context and Increasing Demand**
- ✓ **Use Cost and Availability of Parking to Influence Preferred Modes-of-Access**
- ✓ **Make Pedestrian, Bicycle, Transit and Parking Facilities Safe, Convenient and Comfortable**

## 3.6 Transit System Development

The implementation of passenger rail service and the ridership base to support the rail system does not develop overnight. A transportation system must be strategically planned and implemented over time. Strategies that should be followed to ensure a well-developed and integrated transportation network to support future passenger rail service, and a transit ridership base to support the passenger rail system, are described below.

### ▶ Build Transit Ridership

Transit ridership needs to be built-up in anticipation of rail service. Passenger rail systems, regardless of technology, require higher levels of transit ridership than most bus systems. This ridership base must be built over time. Bus riders will transfer to rail systems if the rail system offered is convenient and provides faster service than alternative bus service. In addition, bus riders have already made the mode shift away from single occupancy vehicle (SOV) travel.

### ▶ Build Supporting Transportation Facilities

Transportation networks to support the passenger rail service must be built. Constructing and completing these facilities over time and as opportunities arise will reduce the cost of these systems. The transportation network that supports passenger rail systems includes pedestrian systems, bicycle networks, feeder bus services, park-and-ride facilities, kiss-and-ride drop-off areas and vehicle access to and from passenger rail stations. Early planning actions should include land preservation for rail stations and park-and-ride facilities. Commuter rail systems, particularly in outlying areas, are primarily dependent on park-and-ride for the majority of rail patrons; light rail transit systems depend most heavily on feeder bus access.

Transportation facilities that could be constructed to support future passenger rail service include:

- Bus turnouts;
- bus entry and exit drives from developments;
- bus layover and staging areas;
- pedestrian networks;
- bicycle networks;
- bicycle racks, lockers and/or bicycle stations;
- park-and-ride facilities (including contracting private lots from organizations such as churches);
- lighting and other security measures along pedestrian ways, bicycle facilities, and transit stops and park-and-rides; and,
- amenities at transit stops and park-and-ride facilities.

In the interim, the above facilities will support transit service, including transit operating in corridors planned for future rail service.

### ▶ Limited Expansion of Parallel Roadways

A key factor in the success of transit is its ability to compete with the automobile, with respect to travel time. Congested roadway facilities encourage the use of alternative transportation; expansion of roadway systems can have the opposite effect. Planners should strategically decide whether expansion of roadway facilities parallel to rail corridors would affect rail ridership negatively and consider alternatives.

### ▸ Coordinate Transit Systems

Transit systems have to be well coordinated to best serve transit patrons. Coordinated transit systems reduce the wait times of transfers, and the inconvenience of needing separate fares or transit passes. If transit systems are well-coordinated, transit patrons experience added comfort and convenience knowing they will not be stranded mid trip, need additional monies for transfers, or other inconveniences often associated with traveling separate systems. Options for improving transit system coordination are listed in Mode Choice and Travel Behavior Considerations above.

### ▸ Market Transit Systems

Transit systems need to be marketed to the public to increase ridership. Future rail patrons will need to change behavior and travel differently than they do today. Easy-to-understand information on transportation options needs to be easily available to help people make travel choices. Also, transit is not stagnant, new destinations are served, frequency of service improved, and hours of operation extended. Non-transit patrons need to be aware of these changes as some of these changes may be what is needed to induce a mode shift. The marketing of transit systems could include marketing campaigns such as transportation fairs, special seasonal promotions, tokens for free rides and other options; as well as more routine marketing and educational efforts.

### ▸ Grow Transit Systems Over Time

Passenger rail systems and supporting transit systems must be allowed to evolve over time. Ridership on the first day of operation will not be the same ridership expected after ten years of operation. Rail system growth will occur both in the frequency of service offered, and the length of the rail system.

| Transit System Development Strategies |
|---|
| ✓ **Build Transit Ridership** |
| ✓ **Build Supporting Transportation Facilities** |
| ✓ **Limited Expansion of Parallel Roadways** |
| ✓ **Coordinate Transit Systems** |
| ✓ **Market Transit Systems** |
| ✓ **Grow Transit Systems Over Time** |

## 3.7 Other Strategies to Increase Transit Ridership

The success of passenger rail systems will depend on ridership. To achieve the ridership levels required for cost-effective passenger rail systems, many people will need to change their mode choice for some trips. Travel times and convenience are the primary criteria among those who are considering a mode switch to transit (Ekistic Mobility Consultants, p.52-56). A variety of techniques are available to improve transit travel times and convenience, including transit management techniques, transportation system management (TSM) techniques and travel demand management (TDM) techniques.

### ▶ Develop and Improve Transit Management Programs

Transit management techniques are strategies that transit agencies can implement to improve transit ridership. Transit management techniques that can be implemented to increase transit demand include:

| Transit Management Techniques |
| --- |
| ♦ **Increase service levels;**<br>♦ **extend hours of service;**<br>♦ **improve accessibility;**<br>♦ **reduce travel times;**<br>♦ **time-transfers between transit systems;**<br>♦ **expand service areas; and,**<br>♦ **improve vehicle comfort and capacity**. |

### ▶ Implement Transportation System Management Programs

TSM strategies are techniques that affect the flow of transit on or across roadways. These techniques often need the buy-in of traffic engineers of affected jurisdictions. TSM techniques that can be implemented to reduce transit travel times include:

| TSM Strategies |
| --- |
| ♦ **High occupancy vehicle (HOV) facilities;**<br>♦ **bus-only facilities; and,**<br>♦ **transit priority treatments.** |

HOV and bus-only facilities could include HOV or bus-only lanes, queue jumps at intersections, or HOV or bus-only freeway on-ramps or off-ramps. Transit priority measures included such measures as green extension or red truncation to favor transit movements.

### ▶ Develop and Implement a Transportation Demand Management (TDM) Program

TDM strategies are strategies aimed at achieving a mode shift from single occupancy automobile travel. TDM programs include programs that improve the convenience of using transit. The less restrictive or difficult transit is to use, the easier it is for people to use transit to make a trip. TDM measures that would increase transit ridership by improving the convenience and ease of using transit include:

| TDM Strategies |
|---|
| ♦ **Alternative work schedules;**<br>♦ **flextime;**<br>♦ **guaranteed ride home programs;**<br>♦ **transit pass programs (including subsidized transit passes or "ecopass" programs);**<br>♦ **integrated fare systems; and,**<br>♦ **smart cards for fare payment.** |

Alternative work schedules and flextime gives employees some choice in setting their own starting and quitting times, and the number of days one works in a week. Alternative work schedules and flextime may result in some persons finding it easier to travel by rail as they can set their work schedule according to the arrival and departure times of trains at the station nearest their work place. Guaranteed ride home programs reduce the fear of having traveled by transit, and being unable to get back home due to a work or personal emergency. Transit passes, integrated fare systems, and smart cards increase the convenience of paying for transit, and reduce the need to carry multiple transit passes or understand various transit fare systems. Subsidized transit passes reduce the cost of the transit trip.

### ▶ Develop Paid Parking Systems

In addition to incentives, there are disincentives that can discourage making a trip by automobile. The primary policy disincentive is paid parking, which can be implemented by both the public and private sector, on property within employment centers. Parking pricing strategies create a monetary disincentive to driving alone and encourage HOV use, including transit and rail patronage. Paid parking near rail stations can also encourage the use of alternative modes (walking, biking or transit) to access a rail system, versus driving and parking at the rail station.

Many of the management strategies, program incentives and policy disincentives listed above should be implemented to encourage transit ridership in anticipation of future passenger rail service. Bus transit patrons will form the ridership base for the passenger rail system when implementation occurs.

| Other Strategies to Increase Transit Ridership |
|---|
| ✓ **Develop and Improve Transit System Management Programs** |
| ✓ **Implement Transportation System Management Programs** |
| ✓ **Develop and Implement a Transportation Demand Management (TDM) Program** |
| ✓ **Develop Paid Parking Systems** |

## 3.8 Transitional Strategies

Rail transit systems require years of planning and preparation before they are fully implemented. Even the final stages of project planning, design and construction for specific rail projects often consume a decade or more before service can be initiated. Communities just beginning to plan for rail transit should understand they are embarking on an endeavor that will take many years to bring to fruition.

However, these should not be idle years; there is much to be done in the intervening "transitional" time. Most importantly, communities should begin work:

- Shaping local and regional land development patterns proactively;
- building transit patronage; and,
- developing a multimodal transportation network.

### ▶ Shape Local and Regional Land Development Patterns Proactively

There are a number of strategies and tools available to the public and private sectors that will help make the transition from existing land uses and development patterns to those that are supportive of rail transit. In many cases, the effects of these strategies require many years to take full effect, so starting now is important, even though prospects for rail service seem distant.

Many communities have existing zoning ordinances, as well as design and development standards, that prohibit or discourage the type of development described in this Handbook. Amending these policies and documents is an important first step in planning for future passenger rail service.

**Figure 3v. One of the Stations of San Diego's Light Rail System was Incorporated into a Building, which Involved a Creative Approach to Maintaining the Public Right-of-Way**

#### ◇ Planning for Future Station Areas

Communities planning for rail transit should identify possible stations areas at the earliest possible stage. Rail stations may be existing depots, either in-use or abandoned, which are located along existing rail lines. It may also be the case that a community has had no previous rail service, and therefore, no precedent for rail station location. Regardless of the particular situation, by identifying future rail station locations, communities can begin to shape land development patterns strategically in support of future rail transit service.

- Adopt a land use map identifying current and future activity centers where there will be higher densities and mixed use development.
- Identify future rail transit station locations within these activity centers.
- Establish a mixed-use zoning code, which can be applied to station areas.
- Establish parking standards, which allow for reduced parking requirements in mixed-use areas, and for shared parking among compatible uses.
- Establish design standards that create a pedestrian-friendly environment; apply them to planned station areas – the future "transit villages."

### ◇ Land Banking and Right-of-Way Preservation

One of the most difficult and expensive steps in developing urban rail transit service is the establishment of corridors serving the right areas of the city and region. It can be very difficult, if not impossible, to introduce a rail corridor in a built-up urban area.

- Identify and map any existing (active or abandoned) rail corridors, and take steps to preserve them. Many rail transit projects around the U.S. have utilized active (San Diego, SE Florida Tri-Rail) freight railroad corridors. Others have taken advantage of rail corridors no longer in active use (Portland MAX, St. Louis).
- Identify and map other corridors, existing or planned, that will be needed for rail service. File maps of reservation or other legal documents notifying landowners and protecting these corridors from encroachment.

**Figure 3w. A Portion of the Portland Light Rail System Runs on Freight Tracks, a Preserved Right-of-Way**

### ▶ Build Transit Patronage

It is rare for rail transit to be successfully introduced in a corridor that is not already a highly patronized bus corridor. Virtually every significant rail transit project – whether light rail or commuter rail or other technology – has replaced one or more bus routes operating at high levels of service and carrying large numbers of daily riders. Communities wishing to have rail transit systems in the future should first begin the process of developing bus transit systems with high levels of service and high ridership.

◇ **Designate and Invest in Primary Bus Routes**

Communities often err by providing low levels of bus service over large areas. To set the stage for rail transit, service should be concentrated in those corridors where ridership response will be greatest. A few well-patronized trunk or spine routes can provide the heart of a successful transit system that can then grow with additional feeder and circulator routes. The trunk route corridors eventually become candidates for rail transit service.

◇ **Develop Pass Programs**

One of the most effective strategies for boosting transit ridership – once good routes have been established with good levels of service – is to design and implement a bus pass program. Communities should start with an employee pass program similar to Denver RTD's "Eco Pass" or Seattle Metro's "U-Pass" that encourages employers to buy passes for their employees. This can later be expanded to include student passes, neighborhood passes and so forth. Research shows that people holding a personal transit ID pass are seven times more likely to ride transit than those without a pass.

◇ **Implement Transportation Demand Management Programs**

No expensive service or product should ever be implemented without an aggressive marketing and information program to "sell" it. The best transit marketing and information programs are part of larger "transportation demand management" (TDM) programs that work with employers, schools, universities and neighborhoods to increase awareness of mobility options and opportunities – including public transit services.

▶ **Develop a Multimodal Transportation Network**

Successful rail transit systems require successful streets, successful pedestrian environments, successful bicycling networks, and successful bus transit systems. Rail transit is not a substitute for well-integrated multimodal transportation. Successful rail transit systems sit at the top of a hierarchy of well-planned and well-integrated transportation networks and facilities. In the absence of a strong multimodal transportation system, rail transit will be expensive and poorly patronized, and will not survive.

Again, one key ingredient in developing a multimodal transportation network is time. This cannot be done overnight but rather requires many years of concerted effort and investment. Major components of a multimodal transportation network are listed below.

◇ **Prioritize Pedestrian Improvements**

Develop a comprehensive system of pedestrian facilities as well as areas of the city that are designated and planned as pedestrian districts. Walkable neighborhoods and business districts are absolute prerequisites for successful transit, including rail transit.

◇ **Create a Gridded Street Network**

A well-connected street grid with a mature hierarchy of roadways and streets planned around a logical functional classification system (freeway, arterial, collector, connector, local, etc.) will help to create an environment that is friendly to all modes. Contrary to conventional "street wisdom," poorly connected, circuitous street systems with over reliance on a few very congested primary routes and an incomplete network of collector and local streets do not encourage transit utilization. Rather they make it difficult and expensive to develop workable transit systems and also discourage the kind of dense, mixed-use development that is needed in and around station areas.

◇ **Develop a Bus Transit System**

A robust bus transit system with trunk routes connecting important local and regional destinations, specialized circulators in and around activity centers, and local routes serving neighborhoods will help build transit ridership and encourage transit-friendly development.

◇ **Create a Complete Bicycle Network**

A key component of a multimodal transportation system is a complete bicycling network including both primary and secondary routes, with attention to grade separations at difficult crossings of highways and major streets.

◇ **Plan Connections Between Modes**

Develop well-planned connections between modes, including motor vehicle parking facilities at appropriate locations, bus transfer stations at bus route intersections, and (in larger cities) intermodal transit centers – all with good pedestrian and bicycle access and circulation.

The three community development strategies outlined above – shaping local and regional land development patterns proactively, building transit patronage, and developing a multimodal transportation network – may seem daunting, especially for the smaller communities in Colorado. However, some comfort may be taken from the realization that these are not just good strategies for developing rail transit, but are also the basic elements of developing livable communities.

Communities that pursue these policies will be rewarded not only with high levels of access, circulation and mobility, but with attractive, economically vital neighborhoods and commercial areas. If and when rail transit is introduced in such a community, it will represent a ratification of the wisdom of years of sound public decision-making and public investment.

| Transitional Strategies |
|---|
| ✓ **Shape Local and Regional Land Development Patterns Proactively** |
| ✓ **Build Transit Patronage** |
| ✓ **Develop a Multimodal Transportation Network** |

## 3.9 Putting it All Together: Strategies and Station Types

| Rail Transit Support Strategies | CBD Station | Downtown Station | Comm/Suburb Station | Rural Station |
|---|---|---|---|---|
| *Regional Land Use & Development* | | | | |
| Develop a Regional Structure Supportive of Passenger Rail | ◖ | ◖ | ◖ | ◖ |
| Locate and Develop Activity Centers at/along Potential Rail Stations and Rail Corridors | ◖ | ◖ | ◖ | ◖ |
| Develop a Hierarchy of Activity Centers | ◖ | ◖ | ◖ | ◖ |
| *Community Land Use & Development* | | | | |
| Create Employment Density in Existing and Planned Activity Centers | ● | ● | ● | ○ |
| Create Minimum Residential Densities for Areas Within Two Miles of Potential Rail Corridors | ● | ● | ◖ | ○ |
| Incorporate Retail and Service-Based Commercial Uses in Employment Centers | ● | ● | ◖ | ○ |
| Incorporate Neighborhood-Oriented Commercial Uses in New Residential Areas | ◖ | ◖ | ● | ○ |
| Take Advantage of Shared-Parking Opportunities in Mixed-Use Areas | ● | ● | ● | ○ |
| *Station Area Land Use & Development* | | | | |
| Determine Station Type and Define Station Area | ● | ● | ◖ | ○ |
| Develop Station Area with the Highest Commercial and Residential Densities | ● | ● | ◖ | ○ |
| Orient Commercial and Service Uses Towards Transit Users | ● | ● | ◖ | ○ |
| Locate Transit, Bicycle and Park-and-Ride Facilities to Facilitate Pedestrian Transfer | ● | ● | ● | ◖ |
| Orient Buildings to the Street | ● | ● | ◖ | ○ |
| Create a Fine-grained Grid Network for Streets and Sidewalks | ● | ● | ● | ○ |
| Prioritize Pedestrian Access and Circulation Through Urban Design | ● | ● | ● | ○ |

**Figure 3x. Strategies and Station Types**

**Legend:**

● **Very Important**
◖ **Important**
○ **Somewhat Important**

## 3.9 Putting it All Together: Strategies and Station Types

| Rail Transit Support Strategies | CBD Station | Downtown Station | Comm/Suburb Station | Rural Station |
|---|---|---|---|---|
| *Supporting Transportation System Strategies* | | | | |
| Use the Station Type to Prioritize the Most Effective Supporting Transportation Modes | ● | ● | ● | ○ |
| Develop Improved Pedestrian Facilities In Station Areas | ● | ● | ◖ | ○ |
| Provide for Bicycle Access and Circulation in Station Areas and Within Bicycle Travelsheds | ● | ● | ◖ | ○ |
| Develop Connecting Transit Systems | ● | ● | ● | ○ |
| Locate Transit Stops for Convenient Transfer Between Modes | ● | ● | ● | ○ |
| Use Park-and-Ride Facilities to Expand Catchment Areas for Rail Passengers | ○ | ◖ | ● | ● |
| Design Parking Facilities that are Reflective of Local Context and Increasing Demand | ◖ | ◖ | ◖ | ○ |
| Use Cost and Availability of Parking to Influence Preferred Modes-of-Access | ◖ | ● | ● | ○ |
| Make Pedestrian, Bicycle, Transit and Parking Facilities Safe, Convenient and Comfortable | ● | ● | ● | ● |
| *Transit System Development Strategies* | | | | |
| Build Transit Ridership | ● | ● | ● | ● |
| Build Supporting Transportation Facilities | ● | ● | ● | ○ |
| Limit Expansion of Parallel Roadways | ◖ | ◖ | ● | ● |
| Coordinate Transit Systems | ● | ● | ◖ | ◖ |
| Market Transit Systems | ◖ | ◖ | ◖ | ◖ |
| Grow Transit Systems Over Time | ◖ | ◖ | ◖ | ◖ |
| *Other Strategies to Increase Transit Ridership* | | | | |
| Develop and Improve Transit System Management Programs | ● | ● | ◖ | ◖ |
| Implement Transportation System Management Programs | ◖ | ◖ | ◖ | ○ |
| Develop and Implement a Transportation Demand Management (TDM) Program | ● | ● | ◖ | ◖ |
| Develop Paid Parking Systems | ● | ● | ◖ | ○ |
| *Transitional Strategies* | | | | |
| Shape Local and Regional Land Development Patterns Proactively | ● | ● | ◖ | ○ |
| Build Transit Patronage | ● | ● | ◖ | ○ |
| Develop a Multimodal Transportation Network | ● | ● | ● | ○ |

**Legend:**
- ● **Very Important**
- ◖ **Important**
- ○ **Somewhat Important**

**Figure 3x. (Continued) Strategies and Station Types**

# 4. IMPLEMENTATION TOOLS



## 4.1 Introduction

The previous chapter of this Handbook outlined strategies at the regional, community, and station-area level that best support development of cost-effective regional rail transit service. This chapter builds upon the previous discussions by identifying tools that government officials, planners and the private sector can use to foster transit-supportive land use and development patterns. This chapter also identifies the potential roles and responsibilities of state, regional and local governments and developers in achieving these desired patterns.

### ▶ Organization of this Chapter

The first section of this chapter contains a description of potential tools available to help implement transit-supportive growth and development in Colorado. The tools are organized into seven categories: (1) Planning, (2) Education, (3) Development Incentives, (4) Regulatory Tools, (5) Administrative and Organizational Tools, (6) Targeted Public Investments, and (7) Financing Tools.

The final section discusses the roles and responsibilities of state, regional and local government officials and the private sector in implementing transit-supportive development. In order for the reader of this document to easily determine which tools may be appropriate to use for a particular agency or organization, a matrix showing the relationship of organizations to tools is located at the end of this chapter.

### ▶ How to Use this Chapter

The reader should keep in mind the following principles when considering use of the various tools.

### ▶ Determine Objectives

A community or region must first determine what it wants to achieve before it can decide which tools to use. For example, if a city would like to ensure that their community's development pattern is pedestrian-oriented and supportive of rail transit, a transportation/pedestrian plan would probably be the first step, and zoning and subdivision/design standards and pedestrian level of service standards might be the tools to use. If a property owner would like to develop a mixed-use transit-oriented development in a potential station area, a different combination of tools will probably be appropriate, including possibly a site master plan, zoning ordinance revisions, and public/private partnerships for financing.

### ▶ Consider Using a Combination of Tools

No single approach will work by itself to accomplish transit-supportive development objectives – be it plans, regulations, acquisitions, or incentives. Plans are not implemented without regulations, incentives or financing strategies to follow. Regulations can be effective in controlling land use and density in a community or around a station area, but they often cannot be as effective as incentives for inducing desired patterns of development. Acquisition can be useful when assembling land to plan for future development, but it can be futile if a community's regulations permit development that is contrary to the desired pattern, making transit-supportive development difficult to accomplish. Financing is an important aspect to all implementation approaches. In sum, a well thought-out blend of tools and financing mechanisms are needed to achieve development patterns that are supportive of passenger rail transit. It is likely that communities and regions that are most successful at achieving land use patterns that support passenger rail transit will utilize a combination of many different tools, tailored to fit the particular needs and conditions that are unique to their location.

### ▶ Account for Regional Differences

The regions, towns and cities of Colorado and the potential rail corridors are diverse – geographically, economically and politically. Regions and communities should use the tools that fit their unique circumstances and political nature. In some places this may mean use of regulations. If so, it is important that regulations be tailored to fit the particular characteristics of the region and community, not just copied from other areas. In other instances, the community may not support regulations, and local officials may wish to pursue development incentives as an alternative.

### ▶ Cooperation is Essential at All Levels

By nature, rail transit systems are regional, and thus require cooperation at all levels from the station area to the entire region for implementation. The development patterns surrounding transit systems involve multiple jurisdictions and many private landowners. To achieve land use and development objectives, cooperation is essential. Several tools presented below advance the aim of cooperation, including regional planning, intergovernmental agreements, and joint development agreements.

### ▶ Overview of the Tools

This section lists the tools for carrying out transit-supportive development. The tools are organized into seven categories:

(1) **Planning.** Plans at the regional, community and local levels provide the vision and objectives for transit-supportive land use and design.
(2) **Education and Advocacy.** Government agencies and private organizations can provide education and outreach programs about transit-supportive land use and the advantages of transit.
(3) **Incentives.** Incentives may help to entice the private sector to work with the community to promote transit-supportive development.
(4) **Regulatory Tools.** Regulations require developers to adhere to transit-supportive standards set forth by local ordinances.
(5) **Organizational and Administrative Tools.** These tools are the mechanism by which organizations can coordinate and share responsibilities for transit-supportive planning and development.
(6) **Targeted Public Investments.** Public investments are ways in which a public agency can take the lead in the development of transit-supportive land use and projects.
(7) **Financing Tools.** Creative funding mechanisms can help achieve desired development patterns.

## 4.2 Planning Tools

### ▶ Planning for Transit-Supportive Development

Planning is a process of identifying a common vision for a community, as well as the policies and actions that it will take to realize that vision. If a community is to achieve a transit-supportive development pattern, it should align its vision and goals to meet that objective, whether at the regional scale via a regional plan, at the community-wide level, or at the more detailed local station area level.

Creating plans that are supported by community groups entails meaningful public input where all stakeholders are involved. Public

Figure 4a. Public Participation, an Essential Part of Planning

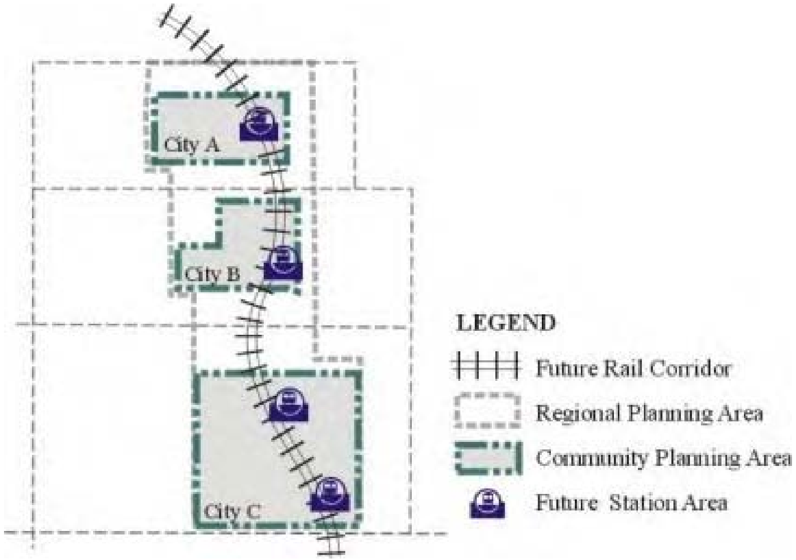
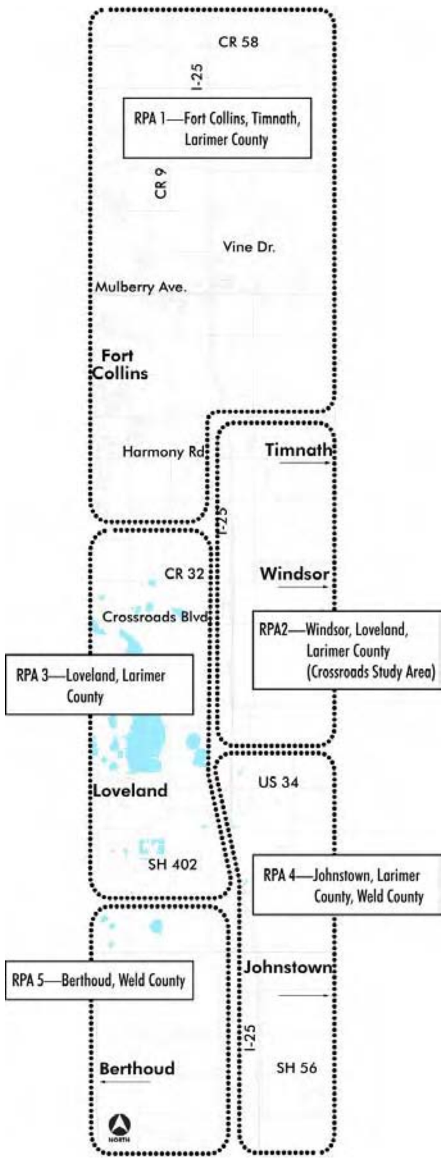



Figure 4b. Types of Planning Areas

participation cannot be overemphasized as an important aspect of planning and implementation to gain acceptance of new transit-supportive development plans or redevelopment plans. The planning process can also be educational and build understanding and a constituency for transit-supportive development plans and patterns.

### ▶ Types of Plans to Support Rail Transit

Plans vary widely in scale and scope from broad regional strategies to detailed, site-specific physical plans. The section below describes the purposes of and differences between regional plans, community plans, area plans and site master plans.



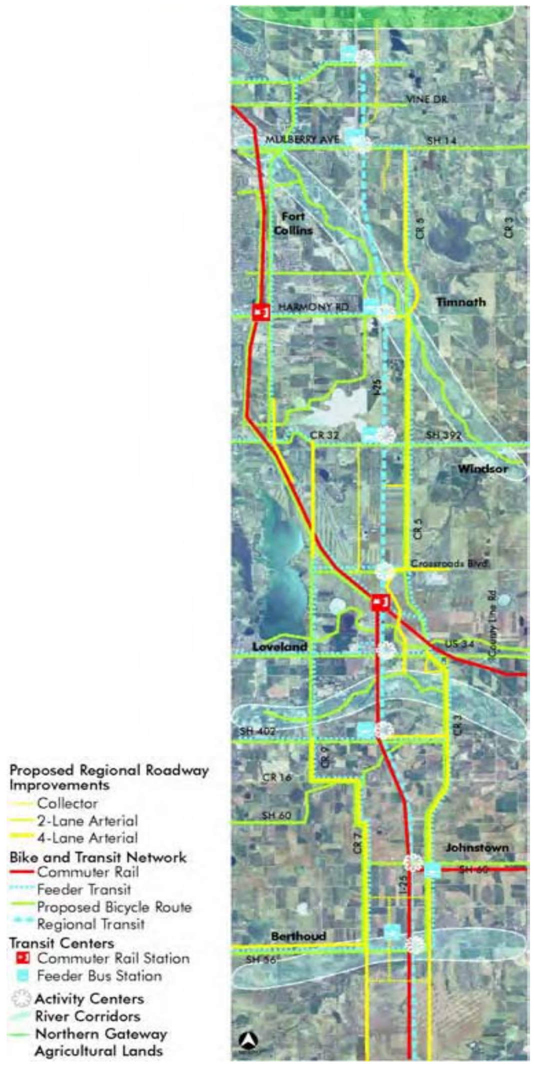




**Figure 4c. The I-25 Corridor Plan Identifies Activity Centers Along a Planned Transit Corridor**

### ▶ Regional Plans

Regional plans are multi-jurisdictional efforts that address growth patterns, land use, transportation and other topics that run across jurisdictional boundaries. Regional plans should be comprehensive and far-reaching in scope. Typically, a regional plan encompasses several communities, counties or an entire region or transit corridor. Such plans might involve voluntary cooperation among local governments or may be coordinated by a regional agency, such as a Metropolitan Planning Organization (MPO). MPOs are responsible for planning within the metropolitan area and developing a plan and program for that area. The regional planning role of the MPO in developing regional transportation plans and Transportation Improvement Plans (TIP) is critical for obtaining federal funds for transportation projects. For this reason, the MPO's role, along with that of the state in project selection for various federal funding categories, is a significant incentive for communities to participate in a regional planning effort.

In Colorado, regional planning efforts can be a challenge to organize and administer because they are typically undertaken on a voluntary basis. They often involve agreements between jurisdictions that require extensive negotiations that can be dissolved if the political climate changes. Regional options for guiding land use and development in Colorado are also somewhat limited because regional agencies have limited or no authority over land use. However, regional planning efforts can create cooperative relationships between local agencies and make allocation of planning resources more efficient.

Regional plans have an important role in promoting the success of rail transit, often long before the transit system is in place. To be transit-supportive, plans should focus on regional growth and development patterns, such as promoting concentrated urban growth areas, or a linear pattern focused around transit systems. Limiting the extent of or shaping the location of the urban area (e.g., establishing urban growth boundaries) can help to encourage more intense development near transit corridors.

| Regional Plans Should Incorporate the Following Transit-Supportive Strategies: |
|---|
| ✓ **Focus on regional growth and development patterns that emphasize a regional structure that supports transit, such as identifying corridors and a hierarchy of activity centers** |

### ▸ Comprehensive Plans

Comprehensive Plans, or community plans, are plans developed for towns, cities and counties that contain policies and physical plans to guide growth and land use development. They establish a vision and basic framework upon which to make land use decisions and to build an implementation program. These plans typically address land use, transportation and circulation, economic development, infrastructure development, open space, environmental quality and conservation. They may also call for more detailed area plans (see Area Plans, below). A Transportation Plan may be completed separately (see Transportation Plans, **page 57**) or included as an element of the community plan.

In Colorado, Comprehensive Plans are advisory only. Therefore, plans must be coordinated with implementation mechanisms if they are to result in real actions. Communities seeking to promote development patterns that are supportive of passenger rail service can develop comprehensive plans that include specific transit-supportive policies and programs, as summarized below.

| Comprehensive Plans Should Incorporate the Following Transit-Supportive Strategies: |
|---|
| ✓ **Identify enhanced transportation corridors and activity centers** |
| ✓ **Establish minimum densities in activity centers for employment and residential uses** |
| ✓ **Promote a mixed-use development pattern** |
| ✓ **Include policies to support walkable, livable neighborhoods** |
| ✓ **Establish limitations on auto-oriented development in activity centers and promote shared parking** |

### ▸ Area Plans

Area Plans provide policies and illustrate recommendations at a more detailed level than a community plan. Whereas a site master plan, described below, may involve just one landowner, an Area Plan would usually involve multiple landowners.

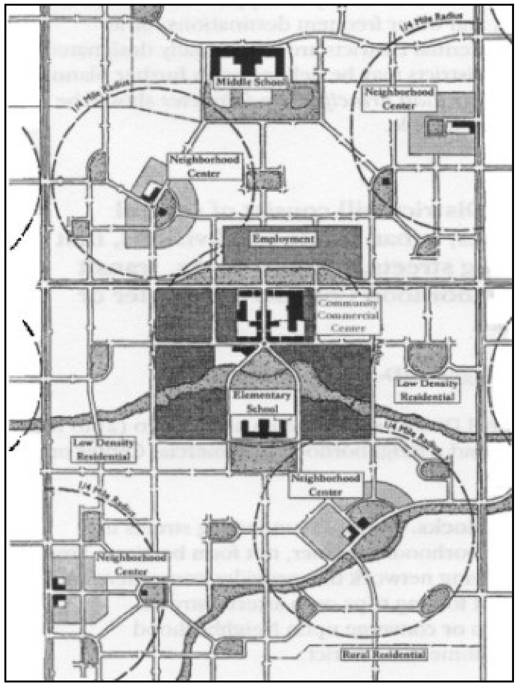



**Figure 4d. Mixed Use Neighborhood Concept (Source: Ft. Collins, Colorado, Comprehensive Plan, City Plan)**

Area Plans are perhaps most useful in promoting transit-supportive design once rail corridor alignments and station locations are determined, or where a rail transit system is already in place. Communities may, however, want to develop Area Plans containing transit-supportive policies for neighborhoods within the community simply because such plans and policies create more livable neighborhoods. To develop a transit-supportive Area Plan, a local government should delineate an area adjacent to or near a potential transit station, and establish detailed policies and physical plans for that location.

One example of area planning is the Light Rail Station Development Program, which the City and County of Denver initiated in 1995 to, "promote growth around the stations that have the potential to maximize transit ridership and enhance neighborhood livability." (City and County of Denver, 1996). The program identifies opportunities and constraints for station area development around light rail stations and provides development strategies and implementation tools.

| Area Plans Should Incorporate the Following Transit-Supportive Strategies: |
|---|
| ✓ **Designate site specific land uses with a mixed-use development pattern** |
| ✓ **Establish design standards for building orientation, pedestrian facilities and parking** |
| ✓ **Provide detailed public facilities planning, including multi-modal transportation systems** |
| ✓ **Establish review criteria for development to ensure that site plans comply with plan objectives** |

### ▶ Site Master Plans

A Site Master Plan is a detailed plan illustrating circulation, parking, land use and proposed development of land uses and structures on a specific piece of property. The property may range in size from several acres to several thousand acres. A small number of property owners responsible for creating the plan are typically involved.

Site Master Plans are relevant to promote transit-supportive design principles in communities where locations for rail transit corridors and stations have been determined. Site Master Plans can be used to demonstrate how land immediately adjacent to a proposed transit station or corridor would be developed, by incorporating transit-supportive design features.

**Site Plans Should Incorporate the Following Transit-Supportive Strategies:**

- ✓ **Include a core commercial area with the highest densities near the station**
- ✓ **Locate transit, bicycle and park-and-ride facilities to facilitate pedestrian access**
- ✓ **Design buildings as a part of a public space and orient them to a sidewalk**
- ✓ **Create a grid-like network for streets and sidewalks**

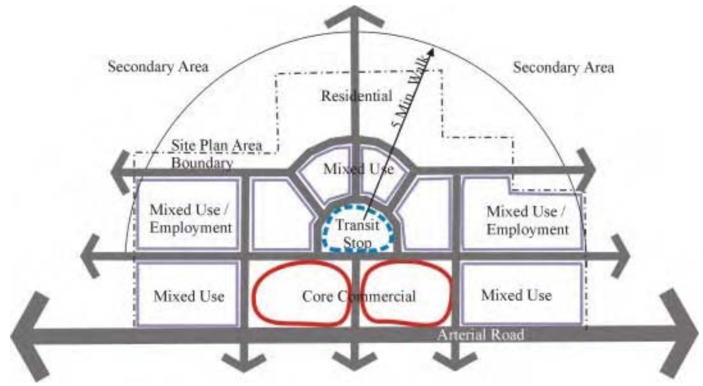



**Figure 4e. Conceptual Transit Oriented Development-Land Uses for a Station Area (Source: Modified from RTD, "Creating Livable Communities: A Transit Friendly Approach")**

### ▶ Urban Renewal Plans / Redevelopment Plans

In Colorado, Urban Renewal Authorities, established by local governing bodies, are responsible for carrying out Urban Renewal or Redevelopment Plans. In Colorado, a community must first determine that an area qualifies as "blighted" before it can establish an Urban Renewal Plan or Redevelopment Plan (C.R.S., Article 25). Redevelopment Plans can stimulate new businesses and encourage infill and mixed use housing projects. Urban Renewal plans have reemerged in recent years as a useful tool for accomplishing redevelopment. If undertaken in a sensitive and thoughtful manner, redevelopment can occur in ways that protect local character while stimulating infill development that is compatible with neighborhood features. Urban renewal can be utilized along planned transit corridors as a means of inducing transit-supportive development.

### ▶ Transportation Plans

A Transportation Plan is usually an element of a community plan (either contained within it, or as a stand-alone document) that shows locations and types of facilities for all modes of transportation, including bus and rail transit, bicycle and pedestrian connections and roadway facilities. The Transportation Plan establishes standards for road improvements and other transportation facilities, as well as requirements for land reservation for roads and transit facilities. At the regional scale, a transportation corridor plan may address rail system and transit coordination and planning. A Transportation Plan can be important in supporting a transit supportive roadway system and facilities for the transit system. Transportation Plans can be comprehensive, addressing all aspects of a community's mobility needs – roadways, transit, bicycles and pedestrians – or they may consist of distinct elements, each addressing a specialized area, as described below.

CDOT has recently adopted Corridor Optimization Guidelines intended to provide an assessment of how to best meet future travel demands in transportation corridors. The Corridor Optimization Process is intended to address fundamental questions regarding modal mix, capacity, access, land use mix and density, cost, and potential funding options. The Corridor Optimization Process is designed to support and provide input to the overall regional and statewide transportation planning process (Corridor Optimization Guidelines, HNTB March 2001).

- **Rail System and Corridor Plans**

Rail Corridor Plans address the feasibility and alternative locations for rail corridors at the regional level. A rail system or corridor plan might also address the performance requirements for different rail technology, strategies for financing and implementation of rail transit, as well as potential land use implications of different alignments. For example, the Roaring Fork Valley Rail Project involved initial feasibility studies and planning for a proposed rail / trail transit project from Glenwood Springs to Aspen.

- **Pedestrian Master Plans**

Many communities have developed Pedestrian Master Plans in recent years to specifically address improving pedestrian access and safety throughout the urban area. It has long been recognized that one of the most important factors in achieving development patterns that are transit-supportive is to have a community that is walkable. The City of Fort Collins Pedestrian Plan is an excellent example for a Colorado community. It presents pedestrian issues and proposed solutions to existing and future problems confronting pedestrians, and identifies five action items to successfully create a walkable city.

**Pedestrian Plans Should Incorporate the Following Transit-Supportive Strategies:**

- ✓ **Establish Pedestrian Level-of-Service Standard**
- ✓ **Adopt a pedestrian right-of-way ordinance**
- ✓ **Evaluate impacts on pedestrians from development applications**
- ✓ **Adopt revised sidewalk and corner ramp standards**
- ✓ **Establish a "walkable city" funding and implementation strategy**

- **Bikeway Plans**

Bicycle access is also an important element of a transit-supportive community development pattern. Like a pedestrian plan, a Bikeway Plan addresses connectivity, safety and aesthetic and functional improvements to bikeways in a community or region. It might also include recommendations for grade-separated crossings and bike lanes that are on and off-roads. Moreover, to be transit-supportive, the Bikeway Plan can address bicycle amenities and improvements at activity centers and around transit stations and give recommendations for bicycle parking (at transit stations and elsewhere).

- **Highway Improvement and Facilities Plans**

As part of their general powers authorized by state statute, communities in Colorado have the authority to plan for and regulate the location, width, and improvements of streets in their municipalities. Typically, this is done through the adoption of a

**Figure 4f. Ft. Collins Mason Street Transportation Corridor Master Plan**

**Highway Plans Should Incorporate the Following Transit-Supportive Strategies:**

- ✓ **Reserve sufficient right-of-way for transit facilities**
- ✓ **Incorporate detached sidewalks on all roadways**
- ✓ **Plan for a roadway system that provides a high level of connectivity**

Master Street Plan and a Capital Improvements Plan. This process provides a significant opportunity for communities to revise their road standards and facilities planning to ensure that road and facility design is completed in a manner that is aligned with transit-supportive development objectives. Highway planning is mostly preformed at the state level, however local communities may seek to work closely with the Colorado Department of Transportation to develop highway improvements that are transit-supportive. For example, plans for state highway facilities could reserve a portion of the right-of-way for future rail corridors and to accommodate stations.

## 4.3 Education

Typically communities face public resistance to transit-supportive development such as increased density, infill development or mix of uses. Therefore, to change public opinion, a certain amount of education and advocacy will likely be necessary at all levels of planning. Government and private organizations can play an important role in increasing public support and advocacy for transit-supportive land use and development. For example, the Regional Transportation District (RTD) held community meetings to educate the public about the benefits of transit oriented design to creating livable communities. In the same vein, RTD produced the handbook, "Creating Livable Communities: A Transit Friendly Approach," to guide the Denver metro area jurisdictions in creating livable communities through transit oriented design.

| Education is a Transit-Supportive Tool that: |
|---|
| ✓ **Helps make public opinion more favorable about higher densities and mix of land uses** |
| ✓ **Educates decision makers about the benefits of transit-supportive land use and development** |

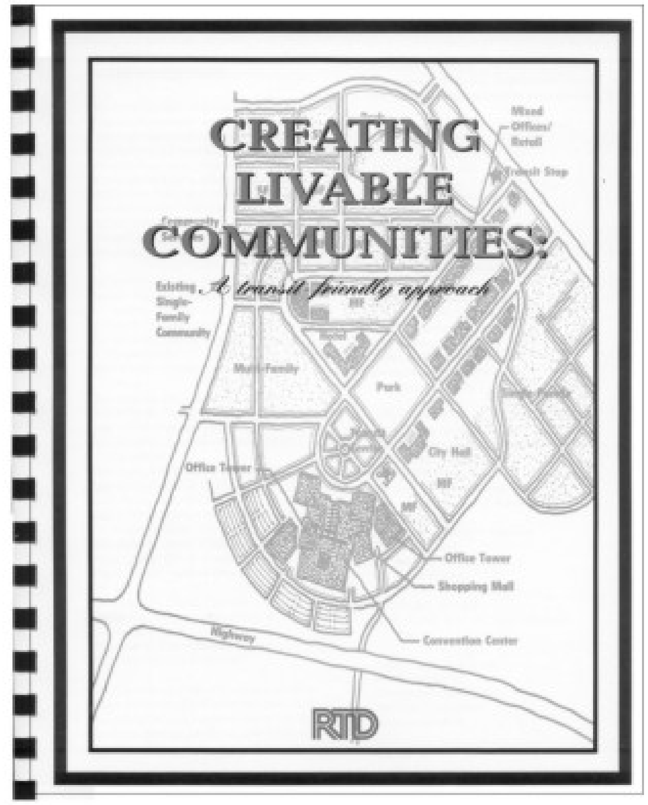



**Figure 4g. RTD Educational Materials**

## 4.4 Incentives

Incentives refer to the granting of an inducement to encourage a desired set of outcomes. Incentives can be used in a number of ways to encourage development patterns that are supportive of passenger rail transit. Examples include additional density or "bonus" residential units, fast-track reviews for development applications or financial benefits. These incentives are already in use in various communities throughout Colorado to achieve other objectives, such as affordable housing, protection of natural resources or other similar goals. The following is a summary of various incentive-based tools that can be used to encourage transit-supportive development.

### ▶ Density Bonuses

Density bonuses can be rewarded to developers if their project meets design objectives that are transit-supportive. Density bonuses might allow developers to build extra units in locations where the increased density would be beneficial in supporting rail transit (e.g., within a quarter mile of a station area), in addition to the number of units permitted under zoning regulations. Bonuses must be substantial enough to invite participation, but cities should be careful that developments designed to qualify for bonuses do not ignore other important planning objectives.

**Density Bonuses are a Transit-Supportive Tool that:**

- ✓ **Can reward developers with extra housing units in areas near transit stations where increased density is beneficial for projects that meet transit-supportive guidelines**

### ▶ Expedited Review Procedures

Most community development review procedures are oriented towards typical suburban development, making it easier to receive approvals for standard single-family automobile-oriented projects than for mixed-use transit-supportive development. Developers who hope to implement transit-supportive development projects may find that local review procedures and regulations are not oriented towards this type of development. Variances and other exceptions may be required to achieve project approvals, which can lengthen the review process and increase costs.

**Expedited Review Procedures are a Transit-Supportive Tool that:**

- ✓ **Enable local agencies to grant a permit "by right" to a development project that meets transit-supportive criteria**
- ✓ **Make provisions for granting of approvals without a public hearing for projects that meet transit-supportive criteria, thereby saving time for developers and facilitating desired development patterns**

Local review agencies can use several methods to expedite review procedures for transit-supportive projects. Communities can zone areas around transit stations as "by right". This would enable a local agency to grant a permit to a development project that meets specific zoning regulations or criteria that are oriented towards transit-supportive development patterns. In addition, this would entail the granting of approvals administratively, without a public hearing, whereas a hearing would be required for projects that do not meet transit-supportive criteria. The benefit to the developer would be the certainty and increased speed of the review process.

**18.320.080 Incentives for Mixed Use District Development**
**(from Clark County, WA Zoning Ordinance)**

1. An increase in maximum densities for office/commercial floor area ratios may be granted when an area equivalent to at least ten percent (10%) of the total area of the structure's first floor is devoted to amenities such as a plaza courtyard, playground, galleria or arcade or underground parking facilities. Floor area ratio may increase to no more than four (4) square feet per square foot of site area.
2. A ten percent (10%) increase in commercial floor area may be granted if a corner entrance is provided which is oriented to one or more transit streets.
3. Traffic Impact Fee (TIF) Reduction. A reduction of the TIF may be granted pursuant to this section with the implementation and maintenance of the corresponding action in Table 8 upon approval of the director. (Sec. 26 (Att. L) of Ord. 1994-12-53)

| Action | TIF Reduction |
| --- | --- |
| Construction of direct walkway connection to the nearest arterial | 1% |
| Installation of on-site sheltered bus-stop (with current or planned service) or bus stop within 1/4 mile of site with adequate walkways if approved by C-TRAN | 1% |
| Installation of bike lockers | 1% |
| Connection to existing or future regional bike trail | 1% |
| Direct walk/bikeway connection to destination activity (such as a commercial/retail facility, park, school, etc.) if residential development, or to origin activity (such as a residential area) if commercial/retail facility | 1% if existing<br>2% if constructed |
| Installation of parking spaces which will become paid parking (by resident or employee)[1] | 3% |
| Installation of preferential carpool/vanpool parking facilities[1] | 1% |
| Total if all strategies were implemented | 10% |

[1] Automatic reduction for developing within the mixed use district.

**Figure 4h. Example of Incentives for Transit-Supportive Development**

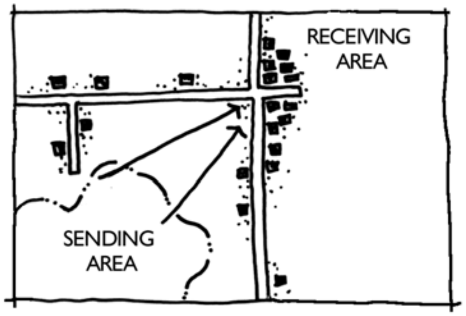



**Figure 4i. Transfer of Development Rights**

### ▶ Transferable Development Rights (TDR)

Transferable Development Rights (TDR) are defined as the removal of the right to develop or build from one property (the sending area) and transfer of the right to a more suitable property (the receiving area). Communities typically use TDR programs to preserve open space, agriculture and/or natural resources on the sending property by transferring the density to a receiving area. Typically, one of the challenges of establishing a successful TDR program is identifying suitable locations for receiving areas, where additional density is desirable and appropriate. One possible application of TDRs may be to transfer density away from "sending areas" in a community, such as river corridors or agricultural lands that are desired to be protected, to a "receiving area" that is in a location planned for transit-supportive development, where higher densities are desired.

**Transferable Development Rights can be a Transit-Supportive Tool that:**

- ✓ **Allow a community to establish station areas as "receiving areas" where higher density development might take place**

### ▶ Reduced Fees

Many local governments require developers to pay impact fees or provide land for facilities to meet the needs or mitigate the impacts generated by a project. If the community is trying to promote infill development or transit-supportive development, the community may consider reducing fees to attract transit-supportive development near station areas. In doing so, communities would need to clearly establish the basis for the reduced fees to avoid a potential challenge to a differential fee structure. However, many communities have successfully adopted a differential rate structure, particularly in areas where the ultimate public costs for transportation or other services may be lower than for development in outlying areas.

**Reduced Fees are a Transit-Supportive Tool that:**

- ✓ **Help promote infill development or attract development to station areas by establishing lower fees for development that is less dependent on roadway infrastructure**

## 4.5 Regulatory Tools

Regulations are perhaps the most common and effective means by which a community can shape development to achieve patterns that are supportive of passenger rail transit. From a broadest scale of shaping a region's growth pattern by establishing urban growth areas, to the finer grain of developing standards for buildings, streets, and facilities that are applied at the site-specific scale, a community's regulations can ensure that development is designed in a manner that is fully supportive of transit. The following is a description of the major types of regulations that can be used to help accomplish transit-supportive development.

### ▶ Urban Growth Boundaries

Urban Growth Boundaries are policies and regulations that designate appropriate areas for urban development and annexations. They are intended to reduce infrastructure extension costs for local governments and encourage a more compact development pattern in the urban areas. This leads to an ideal land use pattern that supports transit. The City of Portland is a commonly cited example of a community that adopted Urban Growth Boundaries in 1979. A primary transit network operates within the growth boundary, including light rail and bus. Station area planning, zoning, design guidelines and transportation planning reinforce the urban growth boundary and the focus of Portland's downtown (TCSP, Report 16, 15). Many communities in Colorado have established Urban Growth Boundaries as a means of managing the location and urban character of development in their communities; for example, Fort Collins and Boulder have established boundaries. Arapahoe County recently adopted a comprehensive plan that includes an Urban Service Area boundary.

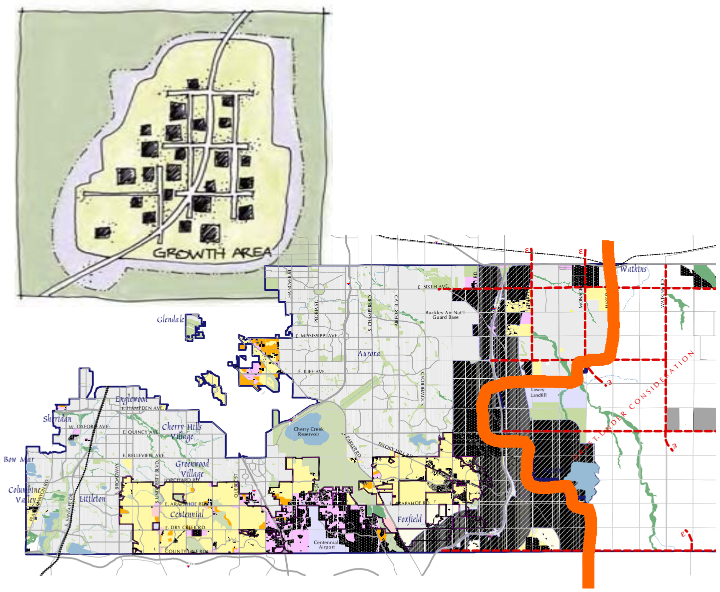



**Figure 4j. Urban Service Area (Source: Arapahoe County Comprehensive Plan, June, 2001)**

| Urban Growth Boundaries are a Transit-Supportive Tool that: |
|---|
| ✓ **Designate appropriate areas for urban development** |
| ✓ **Limits sprawling low density development in rural areas that is not transit-supportive** |

### ▶ Zoning Ordinances

Zoning is the dividing of a municipality or county into districts and the establishment of regulations governing the use, placement, spacing, and size of land and buildings. A zoning ordinance gives a local community power to review development applications and ensure that they meet adopted standards.

Conventional zoning, established at the turn of the century to separate incompatible "smokestack" industries from residential neighborhoods, segregates land uses to keep conflicting activities apart, and limits densities. Moreover, the low cost and ease of automobile transportation in the last half of the 20th century has tended to create zoning that encourages low-density development. However, contemporary zoning ordinances can require mixed uses and higher density development that is more transit-supportive. Through zoning, communities could realize development at higher densities that are more conducive to rail transit near a station area, or a mix of land uses such as retail, offices and residential. A community should review existing zoning ordinances to ensure that they do not prohibit transit-supportive development.

**Zoning is a Transit-Supportive Tool that can be used to:**

- ✓ **Promote mixed-use development in appropriate districts**
- ✓ **Preclude auto-oriented uses from occurring in transit corridors**
- ✓ **Allow higher density housing in activity centers and along transit corridors**

### ▶ Development Standards

Many communities in Colorado are adopting development design standards to address the quality and appearance of development. Design standards are regulations adopted as part of a zoning ordinance to ensure a high quality of development and site design. Such standards can be used to achieve many objectives, such as to preserve trees, preserve historic districts, conserve river corridors and encourage more efficient use of land.

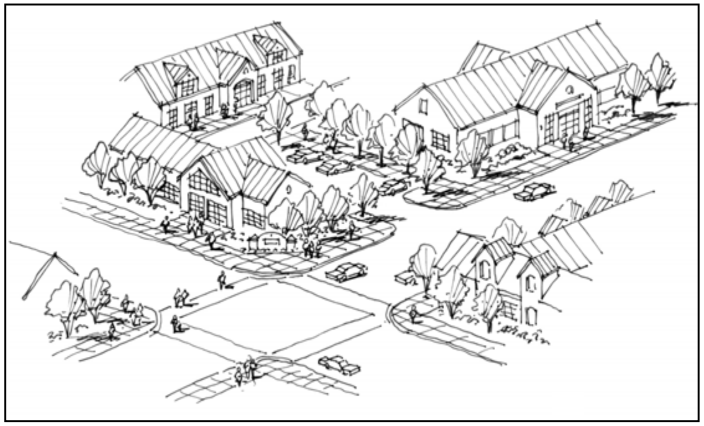


**Figure 4k. Pedestrian Friendly Transit Node Standards (Source: Development Design Standards for the I-25 Corridor)**

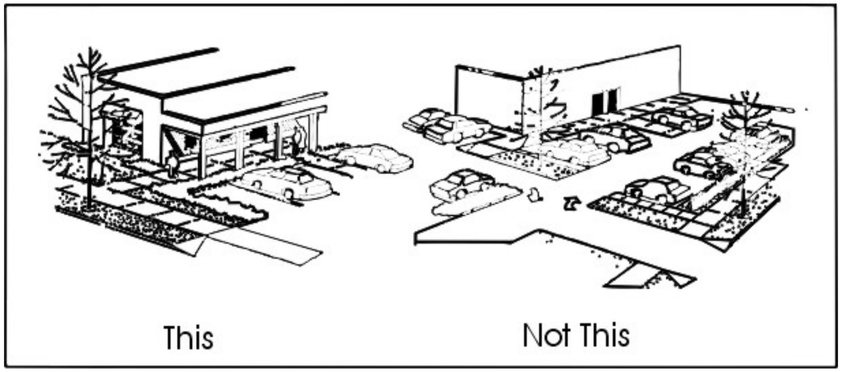



**Figure 4l. Building Orientation and Parking Relationship (Source: Modified from Ft. Collins Land Use Code)**

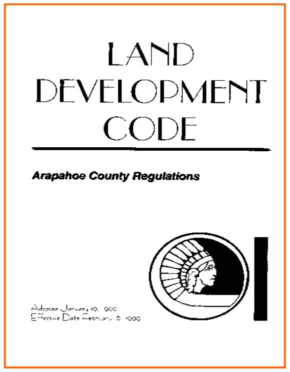



**Figure 4m. Arapahoe County Land Development Code**

Conventional design standards tend to be automobile-oriented and may unintentionally discourage pedestrian and bicycle-oriented design. For example, suburban communities that have minimum parking requirements and minimal parking lot design standards may unintentionally encourage low-density development with buildings that are too dispersed for pedestrians. By contrast, some community standards set maximums on the number of parking spaces to balance motor vehicle needs with transit and other modes of travel. Other examples of design standards that can be utilized to encourage transit-supportive design include requirements for pedestrian connections and amenities, traffic calming devices, building access, building orientation and other features.

- **Street Connectivity and Street Design Standards**

Conventional street standards guide the design of street patterns by establishing requirements for street widths, lane requirements, sidewalk width and location, block lengths, and cul-de-sac diameters. Conventional street standards do not typically address other considerations that are important elements of achieving development patterns that are transit-supportive, such as designing the street network with multiple connections and relatively direct routes; spacing through streets no more than a half mile apart; and providing networks for pedestrians and bicyclists that are as good as the network for motorists.

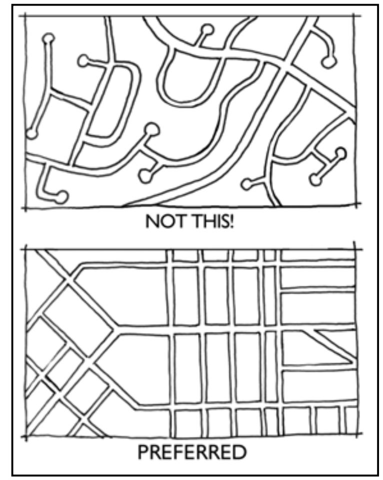



**Figure 4n. Street Design**

Many communities in Colorado have incorporated standards that address street patterns and connectivity requirements. Typically, these include requirements that local street systems be designed to accommodate all modes of travel, and provide for multiple, direct connections to and between local destinations such as parks, schools, and shopping. Local streets should also be designed to provide for both intra and inter-neighborhood connections to unite neighborhoods, rather than forming barriers between them.

**Street Connectivity Standards are a Transit-Supportive Tool that can be used to:**

- ✓ **Establish maximum parking requirements in mixed-use development areas**
- ✓ **Require multiple connections and maximum intersection spacing to ensure better connectivity within and between neighborhoods**

### ▸ Transportation Level of Service Standards

Typically, Transportation Level of Service Standards are used to establish a minimum level of service or capacity desired for roadways and street intersections. Local governments often use level of service (LOS) standards to prevent new development projects from overburdening roads with new traffic, and typically developers are required to provide new roads or upgrade existing roadways to meet adopted LOS standards. However, typical LOS standards for roads may have adverse impacts on transit-supportive development, since it is usually easier and less costly for developers to meet standards and build new roads outside of more intensely developed areas than to upgrade existing road networks in more urbanized areas.

Level of service standards can be adjusted so that they reinforce transit-supportive development patterns. For example, some local governments are adopting lowered LOS standards for roads in areas where they want to encourage higher density development and infill. Essentially, this means that they are accepting more congested roadway conditions in urban areas or areas that are to be served by transit. Local governments might give Trip Reduction Credits for projects that are transit-supportive. Other communities are adopting level of service standards for transit, pedestrian, and bicycle facilities to provide a more balanced approach to mobility in their community.

**Fort Collins Pedestrian Level of Service Standards**
**Service Criteria**

| | |
|---|---|
| *Directness* | Excellent and direct connectivity. |
| *Continuity* | Pedestrian sidewalk appears as a single entity within major activity area. |
| *Signalized Crossing* | 3 or fewer lanes to cross, signal has clear vehicular and pedestrian indications. |
| *Unsignalized Crossing* | Well-marked crosswalks, good lighting levels, and curb ramps. |
| *Visual Interest/Amenity* | Visually appealing and compatible with local architecture. Generous sidewalk width, active building frontages, pedestrian lighting, street trees. |
| *Security* | Sense of security enhanced by presence of other people; good lighting and clear sight lines. |

**Figure 4o. Transportation Level of Service Standards (Source: Fort Collins Land Development Code)**

## 4.6 Organizational and Administrative Tools

Organizational and administrative tools are used to establish the coordination and shared responsibilities involved in creating transit-supportive development and land use patterns. Following are descriptions of several tools that can be used to accomplish these goals.

### ▶ Regional Planning Commissions

In Colorado, cities and counties may create Regional Planning Commissions (RPC) and Regional Service Authorities (RSA). However, regional plans of the RPC and the development guides of the RSA are not necessarily binding on constituent governments nor need they be consistent with the planning and zoning decisions of local governments. The applicable statutes give Regional Planning Commissions many of the powers and duties of county planning commissions, including the duty to make and adopt regional plans "for the physical development of the territory within the boundaries of the region." C.R.S. ' 30-28-106(2)(a) (West Supp. 1994).

At least fifteen Regional Planning Commissions have been established in Colorado. However, none appear to possess any significant land use planning or regulatory authority, except in a few limited areas such as transportation planning where federal legislation gives them special standing, and none combine counties with municipalities.

### ▶ Intergovernmental Agreements

Intergovernmental Agreements provide an alternative to state-authorized regional planning commissions where two or more jurisdictions create their own planning frameworks rather than relying upon the frameworks provided in the regional planning commission statutes. Under Colorado statutes, "local governments are authorized and encouraged to cooperate or contract with other units of government. . . for the purposes of planning or regulating the development of land including, but not limited to, the joint exercise of planning, zoning, subdivision, building and related regulations." C.R.S. ' 29-29-105(1) (West Supp. 1994). The broad powers available to local governments in Colorado to execute Intergovernmental Agreements include joint land use planning.

There are many examples in Colorado of two or more government agencies working together to focus on common regional-scale issues. The most common mechanism for doing so is an Intergovernmental Agreement (IGA), which can be a useful tool for communities in a region that seek to work together to implement a development pattern that will be supportive of passenger rail transit. Agreements designed to achieve these objectives might focus on location of urban development, transit corridor alignments, density, land use mix, design standards, joint development of transportation facilities, and revenue sharing.

**Intergovernmental Agreements can:**

- ✓ **Foster cooperation between communities in a region who seek to implement a transit-supportive development pattern**

### ▶ Joint Development Agreements

A Joint Development Agreement is a formal partnership between a private and public organization or between one or more public agencies to carry out a development program. This type of agreement might be used to address a number of issues, including revenue sharing, land acquisitions, project financing, cost sharing arrangements and provision of infrastructure.

Local governments may choose to work with private developers who elect to undertake transit-supportive development projects. Partnering with a public agency may be considered an incentive to the developer if the agency agrees to help fund part of the project or to share infrastructure costs. For example, a city may provide certain infrastructure improvements or assist with land assemblage for a transit-supportive development.

## 4.7 Targeted Public Investment Tools

If a government agency wants be a leader in development of housing and employment to support transit, putting capital funds into public facilities is a way to initiate greater private investments and to effect changes in land use patterns. Land acquisition, described below, is one form of public investment whereby a community purchases land, sometimes over a long term, to be used for development projects. Investing in public facilities and transportation improvements are other forms of public investment that can instigate greater private involvement.

### ▸ Land Acquisition

The ownership of property or property interests provides the most direct form of control over prospective land uses. Land acquisition strategies can be used effectively as a supplement to regulations, especially where such control is necessary to achieve goals of ensuring that areas are reserved for transit purposes, or that development occurs in a manner that meets specific objectives of a governmental agency. Outright purchase of the land gives the agency the right to control the amount and type of development that takes place. Government entities may use the purchase and subsequent resale of property to direct land development patterns.

Alternatively, government may purchase the property and then lease it, subject to conditions and restrictions as provided in the lease. These arrangements, known as "purchase and sellback" and "purchase and leaseback" arrangements, enable the government to recover its acquisition costs while exercising direct control over the sort of development activity that occurs on the purchased property.

Land may be purchased in fee-simple, or acquired either through eminent domain or condemnation (described below).

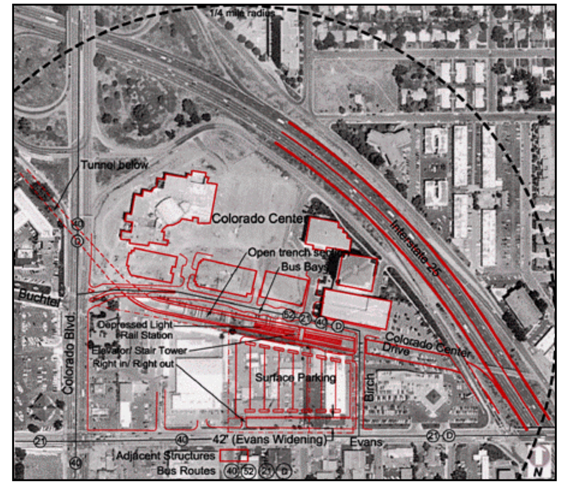


**Figure 4p. Proposed Colorado Boulevard Station Southeast Corridor (Source: Carter Burgess)**

### ▸ Land Assemblage and Banking

Land banking is the purchase and reservation of land for future use. This ensures that public agencies can control the development of the land in accordance with the objectives set out in plans. Land banking also dampens land speculation, because private investors with alternative goals may purchase land and “sit on it” until it is profitable to develop. The disadvantage of land banking is that it requires time and is costly. Moreover, government control and management of large tracts of land can be politically controversial. The advantage of land banking is that it may provide a high level of control over the type and quality of development that occurs to support rail transit.

Land purchase and banking is often correlated with joint development projects. In Canada, for example, Vancouver’s BC Transit works with local government entities to reserve transit corridors for long-term development and purchase land for station area development. Private developers actually develop the land, not the government agency (TCRP Report 16, 19).

### ▸ Purchase of Development Rights

Rather than outright fee simple interest, a public agency may choose to purchase just the development rights or an easement. This is a lower cost alternative than full purchase, but it can require a complex effort to estimate the market value. In this case, the landowner retains the title to the property, but the agency controls the development that occurs on the property.

### ▸ Options and Rights of First Refusal

Purchase options provide a means for a potential purchaser to "tie up" a property. By purchasing an option on property, a potential purchaser reserves the exclusive right to purchase the property within a specified time period. A related concept involves the use of "right of first refusal" agreements, under which the government entity pays for a first right to purchase a property if the property is to be sold. This sort of agreement ensures that the local government shall have an option to purchase that expires only upon the triggering event, which is typically the prospect of transfer and subsequent conversion.

### ▸ Condemnation

A public agency may purchase land through eminent domain, a process by which property needed for a public purpose is condemned and paid for at a fair market price as determined by a certified appraiser. Condemnation of land is usually a last resort if an agreement cannot be made with a willing seller, because it tends to be potentially controversial, unless it is for clear health and safety reasons.

### ▸ Investing in Public Facilities

Public facilities and infrastructure can be a useful tool for attracting new private investment; directing investment to specific locations; and creating incentives for development that achieves certain objectives, such as housing and job creation. By targeting specific locations (and targeting public funding to these locations) a public agency can create a catalyst for new development that is transit-supportive. For example, a city may choose to invest in infrastructure, such as water and sewer service, or undertake the construction of other public facilities such as a parking structure, civic center, or a park in locations where private development is desired to support transit.

The City of Englewood decided to invest in the City Center project, a transit-oriented redevelopment of a site previously occupied by Cinderella City Shopping Mall. The Englewood Civic Center is located at this location along with a variety of retail, open space and residential uses.

**Investing in Public Facilities can:**

✓ **Help "seed" private investment by ensuring that needed infrastructure is in place for transit-supportive development**

### ▸ Highway Interchange Construction and Improvements

Highway interchanges and improvements to interstate highways are constructed in Colorado by the state, under the authority of the Federal Highway Administration. Some of the passenger rail systems that are under consideration in Colorado may utilize highway rights-of-way. It is important that new highway facilities and improvements to facilities be designed to accommodate multiple objectives, including rail transit systems and facilities. This includes the reservation of right of way for future transit requirements and the design and construction of overpasses and interchanges to accommodate transit system needs. New facilities should also be designed to allow pedestrian and bicycle circulation and coordinated with the local roadway network. The Transportation Expansion Project on I-25 through the Denver area, also known as T-REX, is a large construction project that is designed to update the current highway system into an integrated network of highway and light rail options. Transit supportive development features include multimodal enhancements and clustered development at the thirteen light rail stations that are planned (see www.trexproject.com).

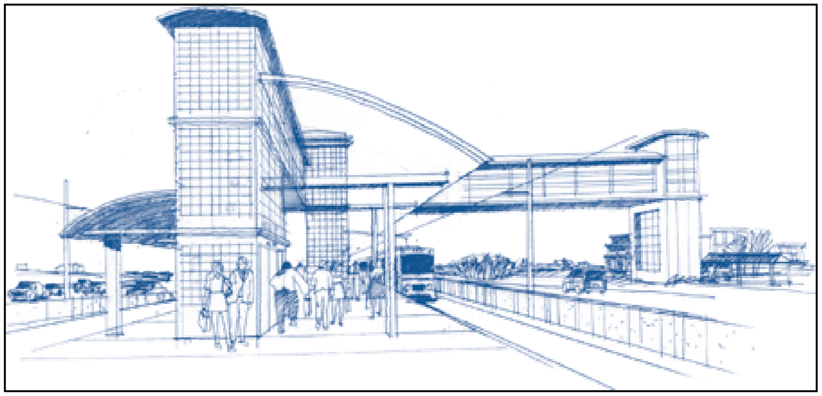


**Figure 4q. Artist's Sketch for Dayton Street Station, in the Median of I-25, Southeast Corridor Plan (Source: Carter Burgess)**

## 4.8 Financing Tools

The ability to finance plans and projects will, to a degree, determine which implementation tools an organization might choose to promote transit-supportive development. For local government agencies, local public funds alone are usually not adequate. Some supplemental public funds are available to offset the costs associated with transit-supportive development infrastructure, especially where it involves infill. A combination of public and private financing can also be effective, where the public agencies and developers share the risk, in promoting transit-supportive land use. The section below describes some of the public funding tools as well as the possible parameters of private/public partnerships.

- **Public Funding: Grants and Loans**

A limited number of state and federal funds are available for purposes related to community transit-supportive development to help leverage local public and private funds. Typically, an MPO administers grants for transportation planning funding for urbanized areas. Projects that use federal funding must comply with all regulatory requirements, including the National Environmental Policy Act (NEPA), Americans with Disabilities Act (ADA), the Clean Air Act and other federal requirements. The following grant and loan programs may assist communities with infill and development projects related to transit.

**Sources for Public Funding**

**Websites:**
Main Street Program: www.nationaltrust.org
TEA-21: www.fhwa.dot.gov/tea21
HUD: www.hud.gov

- **Main Street Program – National Trust for Historic Preservation**

The National Trust for Historic Preservation administers the Main Street Program. This program offers funds to revitalize downtowns of small cities through redesign, pedestrian improvements and other measures.

- **Transportation Equity Act for the 21st-Century (TEA-21)**

The Transportation Equity Act for the 21st Century (TEA-21) was signed into law (PL 105-178) in 1998. TEA-21 authorizes funding for highway, highway safety, transit and other surface transportation programs through 2003. TEA-21 appropriations offer some flexibility in funding based on locally determined goals and objectives for mobility and environmental quality, and can be used for non-motorized transportation enhancements such as bicycle and pedestrian walkways. They can also be used for transit-related enhancements and transit programs and systems.

- **Housing and Community Development Funds**

State and federal housing assistance programs can be used to enhance housing near transit corridors and around potential stations. The state administers federal grants and loans from the U.S. Department of Housing and Urban Development (HUD) for economic development, redevelopment and building infrastructure and community facilities. HUD also administers Community Development Block Grants (CDBG) to local communities that submit a Consolidated Plan (addressing housing and community issues).

### ▶ Tax Increment Financing

Tax Increment Financing, or TIF, is a tool that can be used to help local governments fund improvements needed to support targeted development. TIF also helps to overcome the extraordinary costs that often prevent development and private investment from occurring on environmentally contaminated and other properties. As a result, the TIF area itself improves and property values go up.

A tax increment is the difference between the amount of property tax revenue generated before TIF district designation and the amount of property tax revenue generated after TIF designation. Establishment of a TIF does not reduce property tax revenues available to the overlapping taxing bodies. Property taxes collected on properties included in the TIF at the time of its designation continue to be distributed to the school districts, county, community college and all other taxing districts in the same manner as if the TIF did not exist. Only property taxes generated by the incremental increase in the value of these properties after that time are available for use by the TIF.

Tax Increment Financing may be used to build infrastructure and facilities within a district, such as sidewalks, sewer and streets. It may also be used for development enhancements for projects that are designed to be transit-supportive.

### ▶ Capital Improvement Program

A local Capital Improvement Program is funded through a local agency General Fund and leveraged with outside funds, such as grants. By channeling capital improvements to a station area or to urban growth areas, local agencies can in effect support rail transit systems.

### ▶ Rural Transportation Authority (RTA) / Rural Transportation Districts

The State Rural Transportation Authority (RTA) legislation (C.R.S. ' 43-4-605) creates rural transportation districts as a means for providing transportation services in rural parts of the State to facilitate the flow of goods and services. The idea is that a single governmental entity authorized to levy taxes, can typically serve a region better than individual jurisdictions. Once established, an RTA could align its investment policies and priorities to support land use and development patterns that are transit-supportive.

The Roaring Fork Transit Agency (RFTA), for example, developed an action plan to identify funding sources. Currently 55 percent of funding comes from sales tax revenues (mostly in Aspen and Snowmass) and local government discretionary contributions. The RFTA predicts that the vehicle registration fee could add approximately $1.4 million annually to potential funding (RFTA, Economic White Paper, 14).

### ▶ Special Improvement Districts / Local Improvement Districts

Special Improvement Districts (SID) are a financial mechanism authorized by the Colorado legislature to finance local infrastructure construction, operation and maintenance in cities. Local Improvement Districts (LID) are county's version of SID. An improvement district is an area designated (usually by ordinance) in which a special property assessment is imposed for the purpose of promoting improvements in the district, typically street, sidewalk, sewer and utility construction. A SID may collect money for improvements by an assessment on property located within the district that is "specially benefited" by the particular improvement provided by the district. A SID is not authorized to fund ongoing operational activities of any public improvement it has financed.

## 4.9 Roles & Responsibilities

This section discusses the organizations at various levels in Colorado (state, regional, local, and private) and their responsibilities and types of tools that may be applicable for them to use to implement transit-supportive growth and development.

### ▶ State

At the State level, the Colorado Department of Transportation (CDOT) is responsible for the planning, design and construction of the state highway system (which includes the interstate system). CDOT is also responsible for developing the long range multi-modal statewide transportation plan and integrating regional transportation plans developed by the Metropolitan Planning Organization (MPO) and the regional planning commissions in rural areas into the statewide plan. CDOT also serves as a technical resource for local jurisdictions on transportation issues, and can purchase and manage land for transportation rights of way.

**State Agency Role**

*Examples of State Organizations: CDOT*

Planning
Corridors, roads and transportation facilities
Coordinate and plan rail systems
Statewide transportation planning
Cooperative land acquisition

Education
Publications to guide local jurisdictions

Organizational or Administrative
Administering financing
Allocate resources

Targeted Investments
Develop highway/motor vehicle facilities
Interchange improvements
Parking facilities

### ▶ Regional Agencies

Regional organizations can play a significant role in shaping land use and transportation policies and activities that support transit. They prepare regional plans and help coordinate cross-jurisdictional decision-making, sometimes in the form of intergovernmental agreements. Colorado contains a diverse range of regional organizations. Some are formally chartered and have a specific planning purpose and mission, for example the Denver Regional Council of Governments (DRCOG) and other Metropolitan Planning Organizations. Regional and rural transportation agencies, such as Regional Transportation District (RTD) in the six county metropolitan Denver area, and the Roaring Fork Rural Transit Agency (RFRTA) on the western slope, have more specific missions of operating transit systems on a regional basis. These agencies also consider and plan for the relationship of transportation and land use. Rural transportation planning regions are responsible for developing regional transportation plans to be submitted to CDOT for integration into the statewide transportation plan.

Other regions in Colorado are undertaking regional initiatives on a more informal basis, either through intergovernmental agreements or on an ad-hoc basis. One example of the latter is the recent joint effort of six communities and two counties in northern Colorado to complete an I-25 Corridor Plan, addressing design standards, a conceptual transportation plan, and open lands and natural areas policies for a 30 mile stretch of Interstate 25 between Fort Collins and Berthoud.

The following is a description of the roles and responsibilities that regional entities in Colorado have regarding implementation of transit-supportive land use and development patterns.

| **Regional Government Role** |
|---|
| *Examples of Regional Organizations:*<br>Denver Regional Council of Governments (DRCOG), Regional Transportation District (RTD), North Front Range Transportation & Air Quality Planning Council (NFRT & AQPC), Roaring Fork Transit Agency (RFTA), Northwest Colorado Council of Governments (NWCOG) and Pikes Peak Area Council of Governments |
| <u>Planning</u><br>Prepare regional land use and transportation plans<br>Coordinate cross-jurisdictional decision-making<br>Manage and operate transit systems |
| <u>Education</u><br>Distribute publications and educational materials<br>Host workshops |
| <u>Organizational and Administrative</u><br>Administer grants and loans<br>Coordinate Intergovernmental Agreements |
| <u>Targeted Investments</u><br>Plan for and develop regional transit facilities |
| <u>Financing</u><br>Secure financing through Rural Transportation Authorities |

- **Local Government**

Perhaps the most effective platform for implementing transit-supportive land use and development in Colorado occurs at the local government level, including towns, cities and counties and local transit agencies. Usually, thee responsible departments within local agencies are land use and transportation planning departments and urban renewal agencies. Local government agencies promote economic development that will improve the tax revenues for a community and provide employment opportunities. They have the authority to plan and regulate land use within their jurisdictions, establish policies to support transit and work with private developers to accomplish projects. Local governments are heavily involved in developing community plans, area plans, urban renewal plans, transportation plans and planning for road facilities.

The following table describes the roles and responsibilities of local governments in implementing transit-supportive development.

## Local Government Role

*Example of Local Government Agencies:*
Cities, Towns, Counties and Local Transit Agencies

<u>Planning</u>
Develop comprehensive plans
Prepare area plans and station area plans
Develop urban renewal plans
Develop transportation plans (including roads, pedestrian, bikeways and transit)

<u>Education</u>
Educate decision makers and community organizations about benefits of transit supportive development

<u>Development Incentives</u>
Expedite development review procedures
Provide opportunities for density bonuses
Reduce fees for development projects that meet transit-supportive criteria

<u>Regulatory</u>
Zoning ordinances
Urban growth boundaries
Design standards (for streets, development, urban design, street-connectivity, and transportation level of service)

<u>Targeted Investments</u>
Land assemblage
Property acquisition
Land area/right-of-way reservation
Public/private partnerships & co-development
Redevelopment

<u>Financing</u>
Tax Increment Financing
Special districts and enterprise zones

- **Development Sector**

The development community, including private property owners and non-profit development agencies, play a key role in creating transit-supportive development. By working with local and regional governments, they can maximize their investment and meet community goals. The following is a description of the roles and responsibilities of the private sector in implementing transit-supportive development.

## Private Sector Role

*Examples:*
Property developers; development agencies and organizations

<u>Planning</u>
Site master plans

<u>Education</u>
Advocate transit-supportive development projects

<u>Development Incentives</u>
Participate in programs

<u>Organizational and Administrative</u>
Participate in joint development agreements

<u>Targeted Investments</u>
Land assemblage and reservation
Development agreements
Site development

<u>Financing</u>
Public/private partnerships & co-development
Private financing

## 4.10 Putting it All Together: Tools and Roles

| Strategy Implementation Tools | Entities | | | |
|---|---|---|---|---|
| | State | Regional | Local | Private Sector |
| ***Planning*** | | | | |
| Regional Plans | ○ | ● | ● | |
| Comprehensive Plans | | ○ | ● | |
| Area Plans | | | ● | ○ |
| Site Master Plans | | | ● | ● |
| Urban Renewal Plans | | | ● | ○ |
| Transportation Plans | ● | ● | ● | |
| Rail System and Corridor Plans | ● | ● | ● | |
| Pedestrian Master Plans | | | ● | |
| Bikeway Plans | | ○ | ● | |
| Highway Improvements & Facilities Plans | ● | ● | ● | |
| ***Education*** | | | | |
| Public Information and Transit Marketing | ○ | ● | ● | ○ |
| ***Incentives*** | | | | |
| Density Bonuses | | | ● | |
| Expedited Review Procedures | | | ● | |
| Transferable Development Rights | | | ● | |
| Reduced Fees | | | ● | |

**Legend:**
- ● **Primary Responsibility**
- ○ **Secondary / Supportive Role**

**Figure 4r. Implementation Tools and Entity Roles**

| Strategy Implementation Tools | Entities | | | |
|---|---|---|---|---|
| | State | Regional | Local | Private Sector |
| ***Regulatory Tools*** | | | | |
| Urban Growth Boundaries | | ● | ● | |
| Zoning Ordinances | | | ● | |
| Development Standards | | | ● | |
| Street Connectivity and Street Design Standards | ○ | | ● | |
| Transportation Level-of-Service Standards | | | ● | |
| ***Organizational / Administrative Tools*** | | | | |
| Regional Planning Commissions | | ● | ● | |
| Intergovernmental Agreements | ○ | ● | ● | |
| Joint Development Agreements | ○ | | ● | ● |
| ***Targeted Public Investment Tools*** | | | | |
| Land Acquisition | ● | ○ | ● | ● |
| Land Assemblage and Banking | | ○ | ● | ● |
| Purchase of Development Rights | | ○ | ● | ● |
| Options and Rights of First Refusal | | ○ | ● | ● |
| Condemnation | | ○ | ● | |
| Investing in Public Facilities | ● | ● | ● | |
| Highway Interchange Improvements | ● | ○ | ○ | |
| ***Financing Tools*** | | | | |
| Public Funding | ○ | ○ | ● | |
| Capital Improvement Program | | ○ | ● | |
| Rural Transportation Authority and Districts | | ● | ● | |
| Improvement Districts | | | ● | ● |

**Legend:**

● **Primary Responsibility**

○ **Secondary / Supportive Role**

**Figure 4r. (Continued) Implementation Tools and Entity Roles**

# GLOSSARY OF TERMS



# Glossary of Terms

### ACCESSIBILITY
The measure of ability or ease of all people to travel among various origins and destinations.

### ACTIVITY CENTER
A concentrated area of development often containing a mix of different land uses either within the same building or site, or within a localized area.

### ADA
Americans with Disabilities Act; federal civil rights law which assures people with disabilities equal opportunity to fully participate in society, the ability to live independently, and the ability to be economically sufficient.

### ALIGHT
To get off or out of a transportation vehicle.

### BID
Business Improvement District.

### BICYCLE LOCKER
A lockable, closed container used for storing a bicycle. Typically provided at major transit stops and stations and rented on a monthly basis.

### BICYCLE RACK
1. A fixed post or framework to which bicycles can be attached and locked. 2. A device mounted on the front of a transit vehicle that allows bicycles to be transported outside the passenger compartment.

### BUS TURNOUT
Also called a Bus Pullout, this is a paved area adjacent to a travel lane that allows a transit vehicle to exit moving traffic to facilitate boarding and alighting of the vehicle.

### CATCHMENT AREA
That portion of the travel shed for a rail corridor that immediately surrounds the rail station. Within the catchment area, pedestrians are able to walk to the rail station and development patterns are directly influenced by the presence of the rail system.

### CBD
Central Business District. The downtown commercial core area of a city. Virtually all rail-served CBDs are large enough to provide employment for at least 25,000 people. Large CBDs with rail transit networks generally employ over 100,000 people. CBDs of major multimodal transit cities may have 250,000 to 400,000 workers.

### CDBG
Community Development Block Grant.

## CDOT
Colorado Department of Transportation.

## CENTRAL BUSINESS DISTRICT (CDB)
The downtown retail trade and commercial of a city or an area of very high land valuation, traffic flow and concentration of business offices, theaters, hotels and services. For the purposes of planning for passenger rail service, a CBD generally refers to the dominant CBD in a region or state, with an employment base of at least 100,000.

## COMMERCIAL DEVELOPMENT
The use of a property or structure for a purchase, sale, or transaction involving the disposition of any article, substance (including food), commodity or service; the maintenance or conduct of offices, professions, or recreational or amusement enterprises conducted for profit and also including renting of rooms, business offices, and sales display rooms and premises.

## COMMUTER RAIL TRANSIT
The portion of passenger railroad operations that carries passengers within urban areas, or between urban areas and their suburbs, but differs from rail rapid transit in that the average trip. lengths and headways are usually longer and the operations are carried out over railroad tracks. Commuter rail is often referred to as a type of heavy rail because ridership capacities are much higher than for light rail. ***See also Heavy Rail***.

## DENSITY
The average number of development units per acre of land on a development site.

## DENSITY BONUS
An increase in the ability to develop units in a location where the increased density is beneficial.

## DEVELOPMENT
The process of converting land from one use to another, including, but not limited to, buildings or other structures, filling, grading, or paving.

## DEVELOPMENT STANDARDS
Regulations to ensure a high quality of development and site design.

## DRCOG
Denver Regional Council of Governments. A voluntary association of 49 county and municipal governments in the greater Denver area, which work together to address issues of regional concern.

## FEEDER BUS SERVICE
Refers to bus service that connects smaller areas with few transit options into a large area with more transit.

## HUD
United States Department of Housing and Urban Development.

## HEAVY RAIL
A type of rail transit system characterized by exclusive rights-of-way, multi-car trains, sophisticated signaling and high-platform loading; with the capacity to carry a “heavy volume” of traffic. ***See also Commuter Rail***.

## HIGH SPEED RAIL
Refers to a variety of technologies of rail transit, which operate at speeds above those of traditional rail. These speeds may range between 100 to 350 mph.

## IGA
Intergovernmental Agreement. A written agreement between two or more governmental jurisdictions.

## INCENTIVE (FOR DEVELOPMENT)
An inducement to encourage transit-supportive development.

## INFILL DEVELOPMENT
Development on a vacant or substantially vacant tract of land surrounding by existing development.

## INFRASTRUCTURE
1. In transit systems, all the fixed components of the transit system, such as rights-of-way, tracks, signal equipment, stations, park-and-ride lots, bus stops and maintenance facilities. 2. In transportation planning, all the relevant fixed, constructed elements of the environment in which a transportation system operates.

## INTERMODAL
A transportation service making use of different modes of transportation.

## KISS AND RIDE
An access mode to transit whereby passengers (usually commuters) are driven to a transit stop and left to board a transit unit and then met after their return trip. Transit stations, usually rail, often provide a designated area for dropping off and picking up such passengers.

## LAND USE
The way that a parcel of land is developed and how the buildings are used.

## LAND USE DEVELOPMENT CODES
Regulatory documents that determine how a parcel of land may be developed, usually determined by zoning ordinances or the master plan of the city.

## LID
Local Improvement District.

## LIGHT RAIL TRANSIT
Refers to a rail technology characterized by electrically-powered vehicles on tracks, which may be located within exclusive rights-of-way or mixed with traffic. The "light" in light rail refers to the capacity of the system to carry traffic, relative to traditional, or "heavy" rail.

## LOS
Level of Service. A set of characteristics that indicate the quality and quantity of transportation service provided, including characteristics that are quantifiable *(system performance*, e.g., frequency, travel time, travel cost, number of transfers, safety) and those that are difficult to quantify *(service quality*, e.g., availability, comfort, convenience, modal image).

## MAXIMUM RIDERSHIP LIMIT
The highest number of riders that a system can sustain.

### MINIMUM RIDERSHIP THRESHOLD
The lowest number of riders that a system can sustain and still justify the existence of that system.

### MIXED USE
Development of a tract of land, building or structure with two or more different uses, including but not limited to residential, offices, public facilities or commercial.

### MODE
A particular form of travel  For example, walking, traveling by automobile, traveling by bus, traveling by train.

### MPO
Metropolitan Planning Organization, which serves as a regional planning agency for an urbanized area.

### MULTIMODAL
Relating to or characterized by several different modes of transportation.

### MULTIMODAL TRANSPORTATION CENTER
A transportation center that caters to many modes of transportation (e.g., transit, pedestrian, bicyclist and vehicular).

### NEPA
National Environmental Policy Act;  a comprehensive federal law requiring an analysis of the environmental impacts of federal actions, such as the approval of grants, and the preparation of an environmental impact statement for every major federal action that significantly affects the quality of the human environment.

### NETWORK
A system of links and nodes that describes a transportation system.

### NFRTPAQC
North Front Range Transportation Planning and Air Quality Council.

### PARK AND RIDE
A transit station with a parking lot provided for motorists who wish to use transit, but must drive to the station because of the distance to the station and lack of buses.

### PEAK HOUR
The time when the demand for transportation is the heaviest.

### RAIL PASSENGER TRANSIT
A mode of transportation that can carry large numbers of people and runs on rail tracks.  Trains, light rail and monorail systems are all examples of rail passenger transit.

### RFTA
Roaring Fork Transit Agency.

### RPC
Regional Planning Commission.

### RSA
Regional Service Authority.

## RTA
Rural Transportation Authority.

## RTD
Regional Transportation District.

### SEPARATED PATHWAYS/SIDEWALKS
Are pathways and sidewalks that are separated from the street by buffers, landscaping or decorative paving blocks.

## SID
Special Improvement Districts.

### SITE LINE
The viewshed that pedestrians see directly in front of them as they are walking.

### STATION INFLUENCE AREA
The geographic area within which a rail transit station has a direct, observable influence on land development patterns. For many rail stations, including most light rail stations, the station influence area will be essentially coterminous with the station catchment area (defined above). For major commuter rail or metro rail stations with high levels of service and high levels of ridership, the station influence area may extend beyond the catchment area or pedestrian access zone.

## TEA-21
Transportation Equity Act for the 21st Century; 1998 Transportation Efficiency Act for the 21st Century, provides authorizations for highways, highway safety and mass transit for six years and is the basis of federal surface transportation programs, replaces ISTEA.

## TIF
Tax Increment Financing. A tool used by local governments to finance public projects where a district is designated. The difference between the amount of property tax revenue before the district designation and the amount generated after.

### TDR
Transfer of Development Rights. The ability to transfer the right to develop a certain number of units from one property to another more suitable one.

### TRANSIT ORIENTED DEVELOPMENT (ALSO TRANSIT SUPPORTIVE DEVELOPMENT)
A development plan that provides access routes for pedestrians, bicyclists and transit riders over motorists.

### TRAVEL SHED
Travel Shed – The geographic area from which a rail system draws its passengers – at both the origin and destination ends of rail trips. Within the travel shed, passengers may travel to a rail station via interconnecting bus routes (if provided) or automobile (if there is parking at the rail station). The

pedestrian and bicycle access areas within the travel shed are much smaller than the interconnecting bus and auto access areas. The size and shape of the travel shed is influenced by many factors, including the spacing of stations, the level of rail transit service, the competitive travel time via the rail system, and the condition of the local road and street network.

### URBAN AREA
A generic term that refers to both urbanized areas and urban clusters. An urban area has a census population of at least 2,500.

### URBAN FORM
The structure of an urban area, and the density and type of building and business within the area.

### URBANIZED AREA
A densely settled area that has a census population of at least 50,000.

### ZONING ORDINANCES
Zoning maps, which delineate the boundaries of districts and the regulations governing land uses. The ordinance gives a local community power to review development applications.

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# APPENDIX A
## "STATE OF THE PRACTICE" LITERATURE REVIEW



# Literature Review

## Introduction

Interest in rail passenger transit has undergone resurgence in the United States over the past couple of decades. This has given rise to an extensive body of new research and analysis into the relationships between rail transit systems and urban form.

Over the past ten years, the federal government has funded a Transit Cooperative Research Program, which has provided valuable data on relationships between land development patterns and rail transit patronage and cost. At the same time, the Federal Transit Administration has responded to an influx of rail transit capital funding requests by developing more detailed methodologies for evaluating the potential success of these projects.

Metropolitan area governments have weighed in with guidelines and documents addressing the details of transit-supportive development patterns. Finally, researchers have contributed significant technical research to these issues.

As a result, a large and growing body of literature is available on the subject of land use and rail transit. The purpose of this section is to summarize the salient elements of this work in order to provide an up-to-date foundation for a "Best Practices Handbook" for use by Colorado governments.

## Dimensions of the Relationship

Three primary dimensions in the relationship between land use and rail transit, shown in Figure A1. are relevant.

- The impact of urban form and land development patterns on rail transit, including ridership, cost, and overall feasibility.
- The impact of rail transit on urban form and land development patterns, including property values, intensity of development, community structure, and timing of development.
- The impact of the type and condition of the interconnecting transportation system on rail transit and on urban form and land development patterns.

Many other factors also impinge on rail transit ridership, cost and feasibility, including climate, condition of regional highways, fare structure and topography. While important, these are not the subject of this section and will not be addressed here.

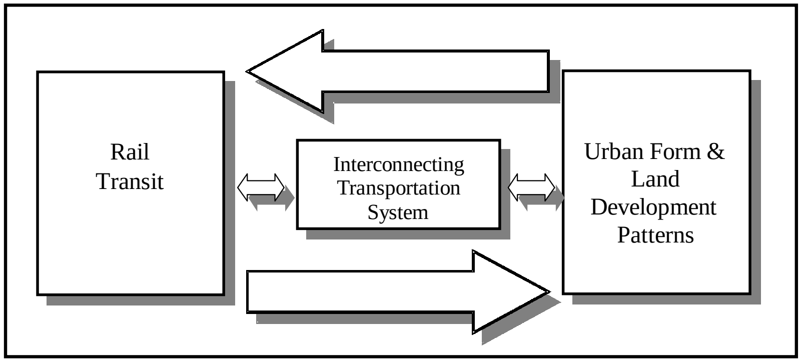



**Figure A1. Land Use and Rail Transit Dimensions**

### ▶ Influence of Urban Form and Land Development Patterns on Rail Transit

Locally specific patterns of urban form and land development have a significant impact on the ridership, cost, and overall feasibility of rail transit systems.

Clearly, low-density rural environments will not support rail transit, while high-density urban environments will. But, where are the lines between feasible and not feasible, and what are the real variables implied by the catchall term – "density?"

### ▶ Overview of Research

A pioneering work by Pushkarev and Zupan in 1977 studied transit systems in the United States to develop a quantitative means of estimating transit system performance. The authors arrived at a system that measures:

- *Density of demand.* This was defined as trip origins per square mile per day and can be estimated based on population and employment densities.
- *Density of supply.* This was defined as vehicle hours of daily transit service per square mile. This measure is neutral with respect to transit mode, and can be applied to bus or rail systems.

Dividing density of supply by density of demand gives *passenger boardings per vehicle hour*, a measure that allows analysis of cost effectiveness and productivity.

Pushkarev and Zupan derived rules of thumb, which, continue to be quoted today.

- At about seven dwelling units per acre, half-hour bus service becomes feasible in residential areas.
- A downtown cluster size of at least 20 million square feet is required to support an express bus system tied to park-and-ride facilities.
- Light rail is feasible in cities with downtowns in the 35 to 50 million square foot range, although in some cases, light rail may be feasible in cities with downtowns as small as 20 million square feet with the right kind of feeder bus service.

In the late 1980s and early 1990s, a number of regional governments around the country undertook studies designed to provide more accurate and detailed look at the metrics of the land use transportation relationship with a specific emphasis on development of rail networks. Notable examples include the Portland area's LUTRAQ (Land Use, Transportation and Air Quality) study and the Puget Sound regional Vision 2020 project.

More recently, the Transit Cooperative Research Program completed a major project to summarize what is known about "transit and urban form" and to develop new research into these relationships. The resulting TCRP Report 16 provides useful data and perspective for light rail and commuter rail systems.

### ▶ Rail Transit Modes

A variety of rail transit modes are in service in North America and others are occasionally considered, including metro, automated guideway transit and funicular systems.

This section focuses on the two modes that have the most potential for implementation in Colorado over the next couple of decades:

light rail transit (LRT) (already in service in Denver) and commuter rail transit. A third mode – high-speed rail – may not receive much attention because little information is available in the literature. Occasional reference will also be made to bus transit where it seems relevant to the discussion.

There are important differences between light rail and commuter rail transit systems, which will affect many of the elements in the land use relationship.

| Parameter | Light Rail | Commuter Rail |
|---|---|---|
| Average Station Spacing (miles) | 0.6 | 2.3 |
| Average Train Frequency (Peak) | 8 | 3 |
| Principal Mode of Access | 1. Feeder Bus<br>2. Ped/Bike<br>3. Parking | 1. Parking<br>2. Feeder Bus<br>3. Ped/Bike |
| Daily Boardings/Station | 470 | 910 |
| Average Line Length | 8.3 | 27.0 |

**Figure A2. Rail Transit Modal Characteristics**

In particular, it will be seen that CBD size is more important to commuter rail, while residential density is more important to light rail. Other important distinctions will be seen in the mode-of-access and in the importance of station area development patterns.

### ▶ State of the Practice

As more North American cities have implemented rail transit systems, a substantial body of data has been generated, which has improved the general understanding of the influence of urban form and land development patterns on rail transit.

Current literature and modeling practice emphasizes these variables as determinants of rail transit ridership and cost.

1. Central business district (CBD) size and density.
2. Length of rail line and distance from CBD.
3. Residential population density.
4. Land use mix and urban design.
5. Income and auto ownership.
6. Mode-of-access.

Income and auto ownership are important explanatory variables, but are not factors to be influenced by land use policy. Mode-of-access is the subject of a later section in this section. The other four will be addressed below.

A number of elements enter any analysis of rail feasibility. These include the capacity of the system, the speed of operations, the travel time for various trip linkages based on station spacing, and other factors. These elements give rise to minimum thresholds of boardings required to justify the use of rail, and maximum capacity limits.

For rail transit to be feasible it should operate at a higher level of service than a comparable bus route would be able to achieve, and should serve ridership demand that "fills" vehicles moving in the peak direction during the peak direction. The thresholds shown in Figure A3. are based on the TCRP Report 16.

About 2,700 boardings per hour in the peak direction are needed to fill single light rail vehicles operating at a 7.5-minute frequency. (TCRP Report 16.) This provides a minimum threshold for an LRT system to be justified on a capacity and time-advantage basis. For commuter rail, three trains of three cars each moving in the peak

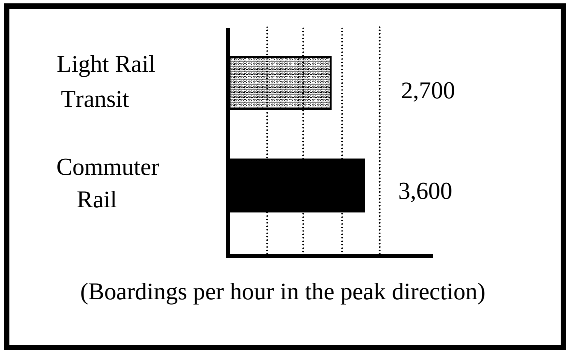



**Figure A3. Minimum Ridership Thresholds**

direction during the peak hour would require about 3,600 riders to fill the cars.

There are also limits to how many riders a transit system can carry. This is important primarily in distinguishing situations where commuter rail may be a better choice than light rail. General rules of thumb for maximum capacity are shown in Figure A4.

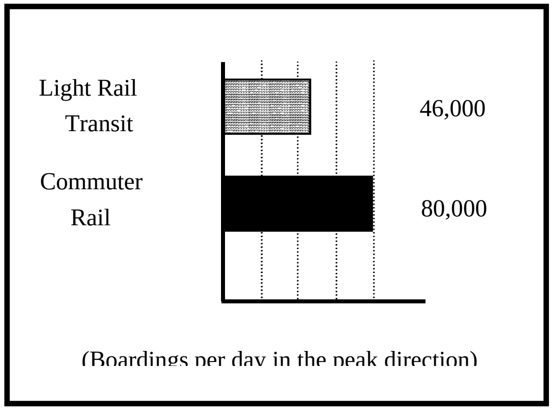



**Figure A4. Maximum Ridership Limits**

### ▶ Central Business District (CBD) –Size and Density

Most rail transit cities in North America (and throughout the world) are characterized by large, dense CBDs. The rail lines radiate out into residential areas from the CBD, often connecting peripheral activity centers and satellite city centers. (See Figure A5.) Studies have shown that CBD size and density are important variables affecting rail transit feasibility.

Ridership on both light rail and commuter rail transit systems is significantly affected by the size of the downtown (usually measured either in total square footage of commercial space or in employment).

Ridership on LRT systems is particularly sensitive to CBD size, with forecast boardings rising steeply as a function of CBD size from about 25,000 to 250,000 jobs. Above 250,000 jobs, LRT may not have adequate capacity. On the low end, LRT systems may meet the minimum ridership thresholds with downtowns as small as 25,000 jobs.

Commuter rail systems are most effective serving CBDs of at least 100,000 jobs and come into a more effective range with downtowns of 250,000 to 400,000 jobs.

CBD density also impacts rail feasibility, but the effect is more pronounced with commuter rail transit. Most commuter rail systems terminate in a downtown terminal – often multimodal – that serves as a focal point for the regional transit system. Thus the density of employment around that central terminal can influence potential ridership. Light rail systems, by contrast, often serve

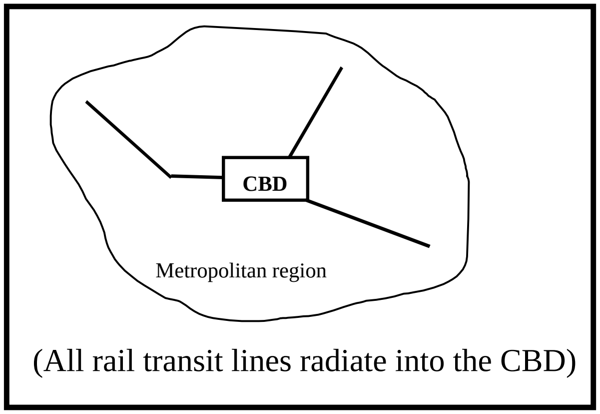



**Figure A5. Radial System**

downtowns through a series of downtown stops, functioning somewhat like bus systems. As a result, LRTs can reach minimum ridership thresholds in somewhat lower density downtowns.

Many of the LRT systems built in North America serve downtowns of less than 100,000 jobs (e.g., Portland, Buffalo, San Diego, Sacramento). These systems rely on ridership that is oriented to other activity centers in addition to the CBD (see Figure A6.).

This kind of rail transit system is not well served by commuter rail unless the downtown is quite large. However, where a large CBD is linked to satellite activity centers along a long line (e.g., Caltrain) a commuter rail system can perform with high effectiveness and low cost per rider.

▸ **Length of Line and Distance from CBD**

In general, commuter rail systems are characterized by longer route lines than LRTs. While light rail lines can function effectively (meeting minimum ridership thresholds at reasonable cost) at lengths of as little as four or five miles, commuter rail systems generally require much longer lines to succeed, especially in the absence of a very large CBD.

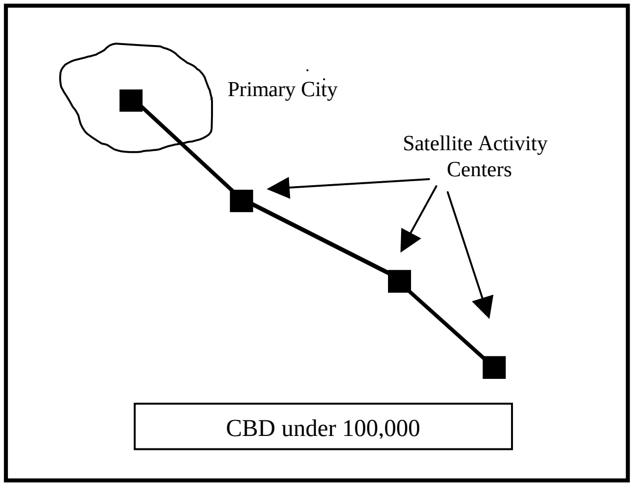



**Figure A6. LRT with Multiple Nodes**

| City | # Of Lines | Average Length (miles) |
|---|---|---|
| Cleveland | 3 | 3.6 |
| Boston | 4 | 4.3 |
| Buffalo | 1 | 4.6 |
| Sacramento | 2 | 5.4 |
| Philadelphia | 2 | 5.9 |
| Baltimore | 2 | 7.8 |
| St. Louis | 1 | 8.6 |
| Pittsburgh | 2 | 10.0 |
| Portland | 1 | 13.6 |
| San Diego | 2 | 13.7 |
| Denver | 1 | 14.0 |
| Los Angeles | 1 | 19.0 |

**Figure A7. Light Rail Line Lengths**

| City | # Of Lines | Average Length (miles) |
|---|---|---|
| Philadelphia | 13 | 13.8 |
| Boston | 11 | 19.9 |
| Chicago | 14 | 24.5 |
| Washington | 3 | 55.0 |
| Los Angeles | 5 | 57.2 |
| San Francisco | 1 | 76.8 |

**Figure A8. Commuter Rail Line Lengths**

For both types of systems, ridership increases as a function of line length. However, for LRT systems, the amount of added daily boardings drops almost linearly with line length – each doubling of line length reduces average ridership per station by about a third. For commuter rail systems, ridership per route mile increases up to about 35 miles and then begins to drop.

Another closely related function of distance is station spacing. For both commuter and light rail systems, stations closer than two miles apart outside the downtown compete for some riders, reducing the average boardings per station. Within dense employment areas, light rail stations appear to compete for riders at station spacing of less than one half mile. Outside of cities, commuter rail system station spacing increases as a function of distance from the CBD and most access is via parked automobiles

### ▶ Residential Population Density

Residential density is the variable most often associated with transit ridership and feasibility. This dates from the work of Pushkarev and Zupan published in 1977, which highlighted the significance of residential density as an independent variable influencing transit mode share.

Pushkarev and Zupan began by defining the relationship between density and transit service levels and in the process creating much of the lexicon of transit planning still in use today. They categorized different levels of bus and rail transit service as follows:

- "Minimum bus" – 1 hour frequency, routes spaced ½ mile apart, total service of about 20 buses per day;
- "Intermediate bus" – half hour frequency, routes spaced ½ mile apart, total service of about 40 buses per day;
- "Frequent bus" – ten minute frequency, routes spaced ½ mile apart, total service of about 120 buses per day;
- "Light rail" – 5 minute peak headways;
- "Rapid rail" – 5 minute peak headways; and,
- "Commuter rail" – 20 trains per day.

Based on actual data from North American transit systems (many of which were in the Northeast at the time), the authors related residential density to minimum thresholds of ridership for system feasibility. Some of their results are shown in Figure A9.

| Service Level | Minimum Residential Density (dwelling units/acre) | Other Key Variables |
|---|---|---|
| Minimum Bus | 4 | NA |
| Intermediate Bus | 7 | NA |
| Frequent Bus | 15 | NA |
| Light Rail | 9 | 25 – 100 sq mi corridor |
| Rapid Rail | 12 | 100 – 150 sq mi corridor |
| Commuter Rail | 2 | NA |

**Figure A9. Residential Density (Pushkarov & Zupan)**

Later research has built on this foundation, with the result that the relationships between residential density and transit service is better understood today than it was in the 1970s. A couple of fundamental concepts are required to work with residential density.

First, it is important to clearly define how density is being measured. Generally, "gross density" is an easier variable to work with, especially at level of a city or region. Gross density is calculated by dividing the number of dwelling units by the land area in acres. As such, it reflects not only the density of residential sites, but also the effect of roads, parks and undeveloped lands.

Some analysts use "net residential density." This usually measures the site density of the actual residential parcels. Often in local government, the "density of development" is used, which includes all of the land within a specific subdivision. This approach takes into account the roads and parks within the subdivision, but not the other land uses around the subdivision.

Gross density is by far the easiest variable to measure in evaluating potential transit system performance, and is the measure used in this section. However, local zoning ordinances and land development codes must use some sort of net density standard, so care should be taken to keep clear what is being measured. Most suburban areas have gross densities equal to about one half the net residential density of their subdivisions, due to undeveloped lands, open space and parks, commercial space, and major highway facilities.

Second, it is important to be specific about the area for which residential density is being measured. The density of lands far from transit stations is not very relevant to transit system performance.

Research has indicated that most walk/bike and feeder bus access to light rail and commuter rail systems is drawn from distances of a half-mile to two miles depending on station spacing. However, this catchment area is not a constant radius circle around the transit station, but rather an oblong area shaped by the direction of travel, as shown in Figure A10.

Of course, this is variable. The actual shape of a given station's catchment area is affected by landscape, development patterns, station spacing, the level of feeder bus service, and the extent to which the station area is pedestrian-friendly.

Commuter rail, and to a lesser extent, light rail, systems also rely on auto/parking access. However, the propensity to ride transit by those who drive to the stations and park is not strongly correlated

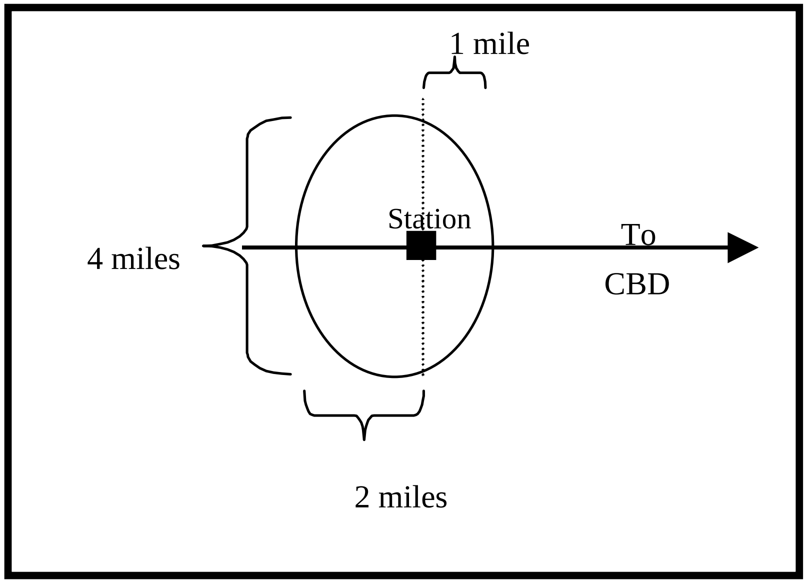



**Figure A10. Station Catchment Area**

with any measure of residential density. The station catchment area for auto/parking access is also highly variable. Its shape is determined by station spacing, details of the highway network in the station area, amount of parking at the station, and other factors. Thus, residential density as an indicator of rail transit feasibility should be measured generally in a corridor that is roughly two miles either side of the rail line.

Residential densities associated with existing light rail corridors are much higher than for commuter rail corridors. 90 percent of all North American LRT stations have population densities of at least 4.5 people per acre – about 1.8 gross DUs/acre. The average for LRT stations is 12 people per acre – about five gross DUs per acre.

By contrast, North American commuter rail systems average 8.2 people per acre in the station catchment area (about 3.4 gross DUs/acre), with ninety percent of commuter rail station catchment areas having at least 1.8 people per acre (about 0.8 gross DUs/acre). (TCRP Report 16).

Light rail systems are sensitive to residential density, with significant increases in ridership as densities increase. Commuter rail systems exhibit a more complex relationships. Commuter rail tends to be more of a premium service with higher fare cost. As such commuter rail services appeal to a population that owns more automobiles, has a higher average income, and has chosen to live farther from the city center. Because much of commuter rail access is via auto/parking, the density of nearby residential land uses is less important.

In general, a doubling of residential density will increase light rail ridership about 50 percent, but will increase commuter rail ridership about 20 percent – other variables being equal.

Another factor affecting the relationship between residential density and LRT ridership is the distance from the CBD. In general, cities exhibit higher densities in their core areas than they do in the suburbs. It is appropriate to look for different densities at different points along an LRT line. Figure A11. draws data from TCRP 16 to show this relationship.

Generally, it is only in the medium- to high-density ranges indicated in this table that LRT systems meet reasonable ridership objectives.

| Distance from CBD | Low Density | Medium Density | High Density |
|---|---|---|---|
| Within 1 Mile | 15 | 18 | 23 |
| Within 10 Miles | 3 | 5 | 9 |
| Within 20 Miles | 2 | 3 | 4 |
| Effect on Ridership | N | N x 1.2 | N x 1.5 |

**Figure A11. Impact of Density on LRT Ridership (DU's per acre)**

### ▶ Land Use Mix and Urban Design

The subject of mixed-use land development patterns and urban design as ingredients of transit-oriented urban form has received extensive attention over the past decade. A number of cities and regions have published guideline documents encouraging or requiring mixed-use and transit-oriented design in commercial projects and in rail transit station area developments.

The Federal Transit Administration has identified a list of "transit-supportive land use" characteristics, and rates New Starts projects in part based on the extent to which these conditions are met:

### ▶ Existing Transit-Supportive Conditions

- Corridor economic conditions
- Existing zoning
- Existing station area development

### ◇ Policies and Actions To Promote Transit-Oriented Development (TOD)

- Station area planning
- Regional growth management
- Urban design guidelines
- Promotion and outreach
- Parking policies
- Zoning changes
- TOD market studies
- Joint development planning

Many of these "transit-supportive characteristics" include significant elements of mixed-use and urban design. (FTA, 1998)

However, there is little empirical data to establish the impacts of mixed land use and urban design on rail transit ridership or cost effectiveness. Some studies have shown quantitative relationships, and others have shed light on the qualitative nature of these relationships. To the extent that relationships have been identified, they fall in the following categories:

- Introduction of mixed land uses in employment centers;
- introduction of mixed land uses in residential areas; and,
- effects of pedestrian-oriented design.

These results of recent studies of each of these topics are summarized below.

### ▶ Land Use Mix In Employment Centers

Research has shown that the introduction of retail, services and housing into large employment areas reduces auto use. Much of this effect is attributable to increases in walking for mid-day trips. Some reduction in driving is also associated with increased transit use, which may in turn be influenced by the reduced requirement to drive for errands such as shopping and to obtain personal services.

A study performed for the U. S. Department of Transportation and Environmental Protection Agency found significant relationships between certain characteristics of employment centers and transit mode shares. These results are summarized in Figure A12.

| Land Use Characteristic | Transit Mode Share If Missing | Transit Mode Share If Present |
|---|---|---|
| Mix of Land Use | 2.9% | 6.4% |
| Accessibility to Services | 3.4% | 6.3% |
| Preponderance of Convenient Services | 3.4% | 7.1% |
| Perception of Safety | 3.6% | 5.4% |
| Aesthetic Urban Setting | 4.2% | 8.3% |

Source: Cambridge Systematics, 1994

**Figure A12. Effect of Urban Design on Transit Mode Share at Employment Centers**

Experience with introducing housing in employment areas has been less conclusive. Certain large metropolitan areas (e.g., Stockholm and Toronto) have pursued conscious jobs/housing balance strategies over many decades. These strategies appear to have supported the growth of extensive rail transit networks in those cities, and to have reduced per capita driving.

On a smaller scale, and for shorter periods of time, the beneficial impacts of jobs/housing balance appear to be slight and are often obscured by other factors such as variations in urban density.

Nevertheless, it seems clear that it makes sense to encourage large employment centers that are to be served by rail transit to introduce a richer mix of land uses as a way to improve the potential performance of a future rail system.

### ▸ Land Use Mix In Residential Areas

The leading investigation into this subject has been the Portland LUTRAQ (Land Use, Transportation, and Air Quality) project lead by the 1000 Friends of Oregon with federal, state and local funding. LUTRAQ established that, in Portland, there is a significant positive relationship between non-auto travel (including transit) and land use mix in the neighborhoods around transit stations. The most significant variable in this relationship was found to be the amount of retail land use in the neighborhood (measured as the number of retail jobs within a specified distance).

Other studies have confirmed this relationship, although it tends to be closely interrelated with – and difficult to separate from – density. Most studies have in fact shown a weaker impact on transit ridership from land use mix than from residential density.

As a policy, land use mix in residential areas can be difficult in application for existing neighborhoods because of resident's concerns about negative impacts of commercial development.
As a condition or requirement for new residential development, land use mix is a reasonable strategy to increase walking and transit mode share.

### ▸ Pedestrian-Oriented Design

Finally, there is a rich body of research into urban design characteristics and travel behavior. In general, studies have found positive relationships between "pedestrian-friendly" design characteristics and transit mode share. This stands to reason, since all transit passengers are to some extent pedestrians.

The LUTRAQ project cited above identified four primary pedestrian variables:

- Street connectivity;
- sidewalk connectivity;
- crosswalks for principal arterials; and,
- absence of topographic constraints.

A significant increase in these factors was found to reduce per household vehicle miles of travel by 10 percent.

The benefits of pedestrian-oriented design appear in both commercial and residential areas. However, the overall impact is greatest in mixed-use commercial areas. A significant body of evidence suggests that a mixed-use, pedestrian-oriented development pattern around rail transit stations is a reasonable requirement that will pay off in increased transit mode share and ridership.

Other studies have refined our understanding of pedestrian-oriented design, to the extent that a fairly detailed list of pedestrian planning and design principles can be articulated.

1. Direct, convenient on-site walkway grid connecting all portals on the site.
2. On-site pedestrian grid has a grain (connection spacing) of 200' or less.
3. Direct sidewalk connections to the external sidewalk grid at safe, convenient points.
4. Sight lines, view planes and orienting landmarks provided to support visual wayfinding.
5. On-site sidewalk widths are adequate for social use (6' to 20' depending on type).
6. Internal pedestrian plazas provided to create "places" and tie buildings and uses together.
7. Direct, continuous, buffered sidewalks across any large parking areas.
8. No parking barriers to major cross-site walkways or sidewalks.
9. Needs of disabled and physically challenged travelers are fully addressed.
10. External sidewalks are buffered from streets with a landscaping strip or on-street parking.
11. On-site driveways and adjacent streets provided with modern crosswalks.
12. Curb cuts and ramps cut at 90º to the roadway with adequate width and landings.
13. Canopies, awnings and arcades used to provide shelter from sun and rain.
14. Wayfinding information provided at key pedestrian intersections.
15. Appropriate furniture and lighting on major walkways.

Finally, it is clear that pedestrian-oriented design is of significance primarily within the station catchment areas of urban and suburban light rail lines. It is also important, although somewhat less so, in the catchment areas of commuter rail stations. However, pedestrian-oriented design is of little importance in suburban and rural park-and-ride facilities that are isolated from other land uses.

### ▶ Summary: Influence of Urban Form and Land Development Patterns On Rail Transit

Figure A13. below summarizes the research into the impacts of variations in urban form and land development patterns on both light rail and commuter rail transit systems.

| Independent Variable | Light Rail Transit | Commuter Rail Transit |
|---|---|---|
| Size of CBD | ++ | ++ |
| Density of CBD | + | ++ |
| Residential Density Within Station Catchment Areas | ++ | NS |
| Length of Rail Line and Distance to CBD | + | ++ |
| Mixed Land Use in Station Catchment Area | + | + |
| Pedestrian-Oriented Design in Station Catchment Area | ++ | + |
| Feeder Bus Service to Transit Stations | ++ | ++ |
| Parking Availability at Transit Stations | + | ++ |

Key to table:
++ Highly significant
+ Significant
NS Not significant

**Figure A13. Impact of Land Use on Rail Transit**

### ▶ Effect of Rail Transit Systems on Urban Form and Land Development Patterns

While the primary purpose of this study is to identify principles that will ensure the success of future rail transit systems in Colorado, there is another side to the relationship. The introduction of rail transit service brings about changes in station area land development patterns and in regional urban form. To the extent these are understood they play a role in helping policy makers appreciate and anticipate the potential impacts of rail transit system development.

The experience of North America's rail transit cities provides a basis for identifying the following relationships. Rail transit:

- increases the value of commercial property near transit stations;
- increases the value of residential property near transit stations;
- increases the intensity of station area development; and,
- affects regional urban structure.

A brief summary of each relationship follows.

### ▶ Impact of Rail Transit on Commercial Property Values

Commercial property values near planned rail lines frequently begin to rise (faster than other similar properties not near rail corridors) in anticipation of rail system development. This effect was observed and measured both along Metro lines in Los Angeles during the 1980s, and near planned BART (Bay Area Rapid Transit) stations in the 1960s and 1970s.

Commercial real estate values near Metro rail stations in Washington, DC, doubled and redoubled in the years after rail service went into effect, easily outstripping average property value appreciation in the region.

The effect is felt most strongly in areas immediately adjacent to the rail station. Rents for commercial real estate next to an Atlanta rail station quickly rose higher than those at similar properties a block away.

Researchers have also found that private investment in property increases in the areas around rail transit stations, perhaps in response to higher land values, and perhaps leading to higher land values.

- **Impact of Rail Transit on Residential Property Values**

Studies in the old rail cities of Philadelphia and Boston have revealed higher average residential real estate values in areas close to rail stations than in other similar areas. This differential is found in both multifamily and single family housing types.

These impacts appear to be most pronounced where rail transit provides a clear time advantage to commuters. Single-family homes near BART in the San Francisco area and San Diego light rail lines are worth more than otherwise similar homes distant from the rail stations.

However, these effects are less pronounced where rail service is relatively slow and offers less time advantage compared to auto travel, such as in the Sacramento and San Jose metropolitan regions.

- **Impact of Rail Transit on Intensity of Station Area Development**

While there have been different responses in various cities, rail transit generally increases the rate and intensity of development in the areas near transit stations. In many regions (San Francisco Bay area, Greater Toronto, Atlanta, Portland, Miami and Washington, D.C.), rail stations have gradually become the principal nodes for office development.

Portland has documented an impressive surge in commercial development in the station areas of the MAX light rail line. The Portland region has also seen significant increases in the density of residential development near rail stations. These increases have been in part the result of zoning ordinances and land development codes, but have also been caused by market interest in rail-proximate investment.

In general, the impacts of rail systems have been greatest on commercial development patterns, and less pronounced on residential development. It also appears that metro-style rapid rail systems have shown more impact than light rail or commuter rail systems.

Finally, it is clear that these effects can take time to manifest themselves. Rail stations in Miami and Atlanta were in service for a couple of decades before significant commercial development began to appear in the adjacent areas. On the other hand, commercial projects in San Diego and Portland were quick to respond to the advent of rail service, in part due to focused local policies encouragement.

### ▶ Effect of Rail Transit on Urban Structure

A number of North American cities can clearly demonstrate that rail transit will, over the years, shape regional development patterns. The central business districts of San Francisco, Philadelphia, Washington, D. C., Toronto and Boston have benefited significantly from rail transit. Not only the size and density of these downtowns, but their economic vitality and ability to withstand suburban competition, are directly and unequivocally related to high levels of transit service.

Satellite photography and remote imaging of urban metropolises around North America and the world clearly document the role of rail transit in shaping urban form, as aerial images reveal lobes of development following the major rail lines radiating out of the city core. These effects require decades to be fully realized. They are also more profound with metro-style rapid rail systems than with either light rail or commuter rail systems.

### ▶ Summary

Development of rail transit systems shapes cities. Property values and private investment patterns begin to respond during the planning stages, before the rail system is built, and then continue once the rail line is in operation. The continued viability of urban downtowns and regional economic vitality of metropolitan regions owe much to the regional rail systems that serve them.

### ▶ The Impact of the Interconnecting Transportation System

One measure of success of passenger rail systems is ridership, which is dependent on the transportation access to the passenger rail system. Besides land use influences, pedestrian and bicycle facilities, the availability of feeder bus service, and the availability of park-and-ride lots influence ridership. Access to passenger rail systems is important for all modes of transportation. "Regardless of mode, a sustained commitment to high-quality, dependable, integrated transit service is necessary to ensure continued support for a transit-based strategy over the long term" (TCRP Report 16, Vol.2, p. 15+). The travel sheds for the various supporting transportation modes determine the travel shed for the passenger rail system.

In addition to transportation infrastructure and systems, transportation policies effect passenger rail patronage. These policies include incentive policies such as travel demand management (TDM) programs that support rail patrons; and disincentive policies, such as the decision to improve transportation travel on parallel roadway facilities. "The likelihood of the travelers between any points using transit is a function of the service provided by transit and by the alternative – the automobile. The availability of access to the station or line, measured by the availability of connecting transit service and the support of adequate parking, adds to the likelihood that people living in an area will use transit" (TCRP Report 16, Vol.1, Part II, p. 6).

### ▶ Travel Shed Influence Area for Passenger Rail Systems

The travel shed influence area for passenger rail systems is dependent on the supporting transportation system and varies by mode. Pedestrian travel sheds could be represented by rings around station areas of 0.25 to 1.5 miles.

Bicycle travel sheds could be represented by rings around stations of approximately 3.0 miles. The structure of the feeder bus system would determine the travel shed contributable to this supporting transportation mode. Park-and-ride facilities would expand the travel shed further, particularly in outlying areas of commuter rail systems.

- **Pedestrian Access to Transit**

All rail transit patrons are pedestrians during some part of their transit trip. Some persons will access rail stations by walking directly from their residence or work place. Others will transfer from connecting buses or other transit systems by walking. Still others will access rail stations by walking from vehicles parked at park-and-ride facilities.

The distances persons are willing to walk varies, but is generally in the range of 500 feet from vehicles parked at park-and-ride facilities, to 0.5 miles for persons walking directly from their home to a rail station, to up to 1.5 miles from rail stations to their work place. Reasonable walk distances for bus patrons have generally been considered to be a quarter mile (1,320 feet). Research by Untermann (1984) concluded that most people are willing to walk 500 feet, with 40 percent willing to walk 1,000 feet, and only 10 percent willing to walk half a mile (TCRP Report 16, Vol.1, p. 9). The Snohomish County Transportation Authority indicated in their report titled, "A Guide to Land Use and Public Transportation for Snohomish County, Washington", that people could be expected to walk no more than 1,000 feet to a bus stop or a park-and-ride parking space. This same report, however, indicated that people would walk slightly further (1/4 to 1/3 mile) to access rail stations (The Snohomish County Transportation Authority, p.3-4). Research by Pushkarev and Zupan resulted in 0.5 miles being considered the walking travel shed for rail stations (Holtzclaw, p._). Walking is the predominate mode of transportation access within 0.5 and 0.75 miles for BART (San Francisco), Metra (Chicago) and CTA (Chicago) for the home end of rail trips. Metra (Chicago), reports walking as the predominate mode of travel for up to 1.5 miles at the work trip end, with few persons traveling beyond this distance by any transportation mode (TCRP Report 16, Vol.2, p. 23).

Walking distances can be stretched by creating pleasant places to walk. Pedestrian pathways that are convenient, attractive, efficient, safe and enjoyable will encourage persons to walk to passenger rail stations. "Studies indicate that a good environment for access to public transit—pleasant walking conditions, wide sidewalks, safe street crossings, good lighting, informative signs, new bus shelters, benches and landscaping—can result in a four percent to six percent increase in ridership (WalkBoston et. al, p.41-42).

Pedestrian systems include pedestrian pathways in residential areas and through activity centers, and walkways through park-and-ride lots adjacent to rail stations. Added considerations for pedestrian pathways as part of park-and-ride facilities include clear direction on how persons should travel to the rail station, buffering the walkway with landscaping, and providing a walkway shelter for inclement weather.

The ability to walk from Point A to Point B is critical if persons are to access transit by walking. 1000 Friends of Oregon found that street connectivity, sidewalk connectivity, street crossings on arterials and the absence of topographic constraints on pedestrian activity increased the likelihood of persons walking to access transit (TCRP Synthesis 20, p.10).

Walking distances are also influenced by:

- The quantity, location and price of parking near transit;
- the characteristics of the transit service; and,
- the characteristics and locations of land uses near transit corridors and stations.
  (TCRP Report 16, Vol.1, p. 9)

The literature indicates that commuters are willing to walk further on their transit-to-work end of their trip than their home-to-transit end of their trip. This is particularly true for commuter rail riders (because there are normally very few CBD stations), but less true for bus and light rail transit patrons (TCRP Report 16, Vol.2, p. 124).

### ▶ Bicycle Considerations

The provision of bicycle facilities and amenities can result in bicycling as the access mode choice for rail transit patrons. Reasonable bicycle distances are generally considered to be one to three miles, with more "hardcore" riders biking considerable greater distances. Providing bicycle racks on buses that connect to rail transit systems can further increase the bicycle travel shed influence area.

Bicycle routes, bicycle lanes and separated pathways are alternatives for bicycle travel facilities, depending on the travel environment. The bicycle facilities should allow bicyclists to reach their destination quickly, safely and efficiently, with travelways provided through activity centers. Bicycle facilities should also connect surrounding neighborhoods with transit centers. Similar to pedestrian access considerations as mentioned above (1000 Friends of Oregon) street connectivity, bicycle facility connectivity, street crossings on arterials, and the absence of topographic constraints will likely increase the likelihood of persons bicycling to access transit.

Bicyclists need safe locations to store their bicycles during the day. Bicycle storage could include racks, lockers, or manned bicycle stations at rail stations.

Some rail passengers may require their bicycles at their destination. Provisions for allowing bicyclists to take bicycles on board may also increase ridership.

### ▶ Supporting Transit Systems

Feeder buses (with stops within 200-feet of a rail station) complement rail services and thus should contribute positively to rail ridership (TCRP Report 16, Vol.1, Part II, p. A-8). "Feeder buses extend the rail catchment area, thereby increasing patronage" (TCRP Report 16, Vol.2, p. 22). This is true at both the home-end and destination-end of rail trips, and particularly for work trip ends in suburban locations. In non-CBD areas 25-50 percent of people ride buses from the rail station to their destinations (TCRP Report 16, Vol.1, p. 1).

The influence of feeder buses on ridership is higher for light rail systems versus commuter rail. A light rail station with feeder bus service has about 130 percent more riders than a station without bus service. Feeder bus service for commuter rail systems adds about 50 percent more riders (TCRP Report 16, Vol.1, p. 14).

For commuter rail, CBD size and density are far more important than residential density, and parking availability is more important than feeder bus access (TCRP Report 16, Vol.2, p. 32). A model developed to ascertain what factors influenced the effectiveness (passenger miles/line miles) of light rail and commuter rail systems resulted in the relationships shown in Figure A14.

In addition to feeder buses, shuttle bus systems are important. Shuttle buses can compress the distance between activity center destinations, and provide important connections between activity centers and region-serving rapid transit stations.

Feeder bus systems, shuttle buses, or other transit options require rail patrons to transfer, which discourage transit patronage. "Transit users hate transferring from one bus to another. The transfer itself, not including any wait time, has as much 'disutility' as 30 minutes of ride time (Ewing, p.48). Actions should be taken to reduce the burden of any required transfers. These actions could include timed transfers between systems, buses oriented to the rail station, transit passes good for travel on both rail and bus systems, and the location of passenger drop-offs close to major entrances of rail stations. At the Dallas Union Station, for example, passengers are provided cross-platform transfers between light rail and the Trinity Railway Express commuter rail system (Mass Transit, p.38).

| Factor | Effectiveness (passenger miles/line miles) | |
|---|---|---|
| | **Light Rail** | **Commuter Rail** |
| Feeder Bus | +++ | ++ |
| Parking Availability | ++ | +++ |
| Line Length | + | Varies<br>best at 50-mile length |

Legend: +++ highly positive
++ moderately positive
+ slightly positive
Source: TCRP Report 16, Vol.1, Part II, p. E-7

**Figure A14. Factors to Effectiveness of Rail Systems**

Feeder bus systems can encourage transit ridership for both the bus and rail systems by providing amenities at bus stops such as:

- Shelters;
- benches;
- route information;
- bicycle racks and lockers;
- trash receptacles;
- lighting;
- community displays;
- attractive wait areas; and,
- parking.

Prior to the implementation of rail systems, or before rail system expansions, bus routes can generate patrons that will later use rail transit and help support the rail system. When the rail system is implemented (or expanded), the affected bus routes will be oriented to the transit station to avoid duplication of service. New rail systems often start small and grow. There are numerous examples of expanding systems in the U.S. In Vermont, service began in

December 2001 between Burlington and Charlotte, a distance of 12.5 miles with two trains in each direction per day. Ten round trips are planned beginning in April 2001 (Mass Transit, p.38-39). Dallas expanded their system in 2000, with more expansions planned for 2001. Pierce Transit in Seattle began limited service between Tacoma and Seattle in 2000, with an expanded commuter rail system expected.

- **Automobile Access (Park-and-Ride Facilities)**

Like feeder bus systems, park-and-ride facilities expand the catchment area for passenger rail systems. In a survey by the Urban Transportation Monitor, of ten commuter rail systems in North America reporting, eight reported that over 70 percent of persons accessed stations outside the CBD by car, the remaining two experienced lower car access (Caltrain – 56 percent, SEPTA – 27 percent) (UTM, 11/10/2000, p.12 & 14). Analysis of the eleven light rail and six commuter rail cities showed that a light rail station with parking has on average about 50 percent more boardings than a station without parking, and commuter rail stations with parking increased boardings by more than 100 percent (TCRP Report 16, Vol.1, p. 14). METRO in Houston offers two types of bus service—local and commuter. Local buses serve Houston neighborhoods and surrounding neighborhoods throughout the day and evening. Commuter service operates like a commuter rail system, providing peak period service between park-and-ride lots and downtown Houston. With the service offered, and the supporting infrastructure provided, most local bus riders walk short distances to bus stops (93 percent), while most of the commuter bus riders drive to park-and-ride lots (92 percent) (TCRP Report 16, Vol.2, p. 19).

In suburban locations beyond an access distance of one mile, park-and-ride provisions are essential toward capturing transit riders. At the same time, compact development within a quarter mile radius of suburban stations is essential toward attracting walk-on riders. This poses a policy dilemma. Park-and-ride facilities serve low-density settlements over a relatively large catchment area, while at the same time, expansive parking lots around stations can preclude transit-oriented development and diminish the quality of the walk environment. Yet in suburban settings, limiting park-and-ride spaces would most likely result in more commuters turning away from transit and choosing to drive (TCRP Report 16, Vol.1, p. 11). A solution in the literature appears to be the use of large surface parking initially, with structured parking offered as the area develops with higher intensities. Reductions in the amount of free parking would increase the incentive for transit patrons to use feeder bus service, which would most likely be more readily available as the area intensifies. The availability of free or low-cost parking increases the likelihood of SOV use. Similarly, free or low-cost parking discourages transit use.

Amenities at park-and-ride facilities can encourage their use, thereby increasing rail transit patronage (see Figure A15.).

| Ranking | Factor |
|---|---|
| 1 | Security |
| 2 | Lighting |
| 3 | Bus Service |
| 4 | Pay Telephones |
| 5 | Sheltered Waiting Areas |
| 6 | Trash Cans |
| 7 | Bus/Carpool Information |
| 8 | Landscaping |
| 9 | Vending Machines |
| 10 | Bike Racks |
| 11 | Day Care Facility |

Source: W.E. Hurrell, A.A. Sgourakis, and S.B. Colman, "Application of Siting and Demand Estimation Model to Coordinate Park-and-Ride/HOV Facility Planning," ITE 1994 Compendium of Technical Papers, Institute of Transportation Engineers, Washington, D.C., 1994, pp.354-358

**Figure A15. Ranking of Important Park-and-Ride Features (Most to Least Important)**

## ▶ Policies that Influence Rail Transit Ridership

### ◇ Incentive Policies

Rail transit would be more attractive with the implementation of programs to support transit patronage. Travel demand management (TDM) programs that have encouraged bus transit ridership could encourage rail patronage. Program components directly applicable to rail transit systems include:

- subsidized transit passes; and,
- guaranteed ride home programs.

TDM programs have already been applied to rail transit. For example, the Virginia Railway Express currently offers customers guaranteed rides home (Mass Transit, p.45).

### ◇ Disincentive Policies

Limiting roadway expansion in parallel corridors is an important way to increase rail transit patronage. Ridership increases were experienced in Virginia to avoid congestion due to construction on neighboring roadways, and because of the attractiveness of the service offered (Mass Transit, p.45). Limiting roadway expansion also affects development that could occur near rail stations.

> One way to reinforce transit use… is to limit new highway construction in the corridor. By so doing, regions can give the access advantage to developers who locate facilities along the transit lines. The more highways compete with the transit lines, the more development will locate facilities outside the designated transit corridors (TCRP Report 16, Vol.2, p. 17).

# APPENDIX B
# PEER SYSTEMS STUDY



# Introduction

The intent of the peer analysis, conducted as part of the Land Use and Passenger Rail Study, was to provide some insight into development patterns around a variety of existing station types. To better understand the land use and development patterns, this chapter will briefly discuss four of the original six peer-comparison systems and look more closely at selected stations on each line. The four systems visited and studied are: the Caltrain system, from San Francisco to San Jose; the Union Pacific/Metra Northwest Line in Chicago; and, two Canadian systems, BC Rail and VIA Rail.

## Key Findings

This peer analysis offered the following insights:

- Rail systems in the peer analysis offer lessons for the I-70 corridor, rural mountain resort systems and front range corridors; and,

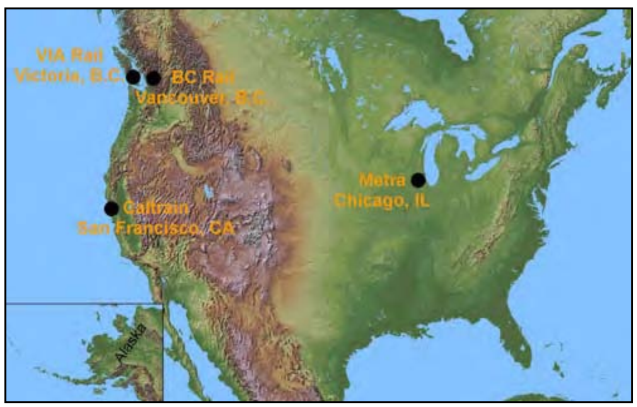



**Figure B1. Location of the Four Peer Systems**

- potential rural mountain resort, I-70 corridor and Front Range systems will require a synthesis of elements from peer examples because:
  - Land use relationships are dissimilar; and,
  - interconnecting transportation system comparisons are relevant only at select locations.

## Surrounding Land Uses

- Stations with a low level of rail service have a minimal land use response nearby.
- Stations with a high level of rail service have a moderate to high land use response nearby.
- Multiple agencies and entities are collaborating on station improvements and (re)development.
- Stations near CBDs are experiencing development and redevelopment; remote stations experience little land use response (local policy?).

## Interconnecting Transportation Systems

- Location and quantity of parking for rail systems affect regional and local travel patterns.
- Stations (within the same system) that have multimodal transportation centers experience boardings comparable to or greater than stations with large parking reservoirs.
- Sidewalk networks play a critical role in moving commuters from parking areas, transit riders from nearby routes, and residents from surrounding neighborhoods.
- Seamless coordination of transit services with rail operations must address commuting patterns on the regional and local level.

### ▶ Caltrain

Caltrain is operated under the Peninsula Corridor Joint Powers Board (PCJPB). The PCJPB is comprised of representatives from San Francisco, San Mateo and San Jose counties. Since 1980 the PCJPB has worked with California Department of Transportation (Caltrans), Amtrak and San Mateo County Transportation (SAMtrans) to provide commuter rail service in the corridor.


**Figure B2. Caltrain Corridor between San Francisco and San Jose**

### ◇ San Francisco to San Jose

Since 1904 passenger rail service has existed between San Francisco and San Jose. The Southern Pacific Railway (SP) operated passenger service in the corridor for nearly three quarters of a century, until changing commuting patterns forced SP to seek public subsidy to keep the railway alive. The SP received that subsidy in the early 1980s from Caltrans and San Francisco, San Mateo and San Jose counties. Shortly after SP agreed to receive public subsidy, the PCJPB was formed to help manage operations. The PCJPB worked with SP on service coordination and right of way issues until 1992, when they purchased the right of way from the SP. The purchase included the right of way from San Francisco Station to San Jose Station with an extension 30 miles south of San Jose to the City of Gilroy. The purchase agreement allowed SP to continue minimal freight operation in the corridor and contract with Amtrak for commuter operations in the corridor.

| At a Glance : Caltrain | |
|---|---|
| Length of Main Line | 77 miles |
| Total # of Track Miles (including Gilroy line) | 107 miles |
| Number of Stations | 35 |
| Average Distance Between Stations | 2.5 miles |
| Range of Distances Between Stations | 2 – 2.5 miles |

Caltrain currently operates from 5:00 A.M. to 12:00 P.M. on weekdays and 7:00 A.M. to 12:00 P.M. on weekends. Weekday peak hour service is every 30 minutes and off-peak service is hourly. Weekend service is offered hourly from 7:00 A.M. to 12:00 P.M.

This section will focus on three stations for more in depth study. The San Francisco station, which acts as the hub for commuters traveling to the City of San Francisco, the San Bruno station, which has remained stagnant to opportunities that other stations are developing, and San Antonio, a station located in the City of Mountain View that is capitalizing on the success of the Caltrain.

***San Francisco Station***

The San Francisco station is located in the south of market area (SOMA) at 4th and King Street. SOMA has been subject to redevelopment focused on increasing residential density and retail/dining opportunities. The Caltrain station is located in the southern portion of this district where most of the redevelopment is occurring.

The station has abundance of passenger amenities such as smart ticketing, real-time arrival and departure information and high-speed Internet access. A portion of the site exists as an active rail yard that continues to operate moderate freight service to remaining commercial and light industrial manufacturing interests.

*Surrounding Land Uses*

Until the prior decade, SOMA existed as a center for commercial activity using the rail yard and surrounding ports as an intermodal center for freight. With the resurgence of business in the area, particularly of the high tech nature, SOMA began conversion of the existing building stock. Recent projects include Pacific Bell Park (new home of the San Francisco Giants), manufacturing buildings to dwelling units, and shifting ports and piers from commercial to entertainment uses.

| At a Glance: San Francisco Station | |
|---|---|
| Population of San Francisco | 801,000 |
| Distance from San Jose | 77 miles |
| Travel Time to San Jose (all stops) | 1 hour 56 min. |
| Service (trains/weekday) | 80 |
| Peak-Hour Frequency | 30 minutes |
| Off-Peak Frequency | 1 hour |
| Average Boardings per Week | 47,600 |
| Commuter Parking Spaces | 75 (private) |

**Figure B3. Renovation of Industrial Buildings to Residential Units at San Francisco Station**

**Figure B4. MUNI Light Rail Trains Across from San Francisco Station Provides Local and Regional Connections**

*Interconnecting Transportation System*

The Caltrain station is situated at the southern end of the San Francisco Municipal Railway Line (MUNI). The MUNI provides high frequency access to major destinations in the city and offers connections to regional Bay Area Rapid Transit routes (BART). Local buses also provide connections to local destinations. Parking for commuters is limited to one off-street lot with 75 spaces. The lot is privately managed and focuses on parking for Pacific Bell Park patrons. Caltrain commuters are charged hourly and Pacific Bell Park patrons are charged daily.

The sidewalk network supports walking to the core area of the SOMA district located 13 blocks away. Lighting is adequate and encourages evening strolls. One local bike route converges on the station and bicycle lockers are provided near the station (bicycles are also allowed on the Caltrain).

***San Bruno Station***

The San Bruno station is located 12 track miles south of San Francisco. The City of San Bruno is characterized by low to medium density residential development, light industrial and enclaves of lower order retail uses. The city was developed as a bedroom community to San Francisco and is adjacent to the San Francisco International Airport. The train platforms offer riders smart ticketing stations, shelters and bicycle storage.

| At a Glance: San Bruno Station | |
|---|---|
| Population of San Bruno | 42,000 |
| Distance from San Jose | 65 miles |
| Distance to San Francisco | 12 miles |
| Travel Time to San Francisco | 20 minutes |
| Service (trains/weekday) | 72 |
| Peak-Hour Frequency | 30 minutes |
| Off-Peak Frequency | 1 hour |
| Average Boardings per Week | 5,908 |
| Commuter Parking Spaces | 45 |

*Surrounding Land Uses*

The San Bruno station is adjacent to a large stock of single-family homes and light industrial uses. The station is four blocks from a retail shopping center that will be redeveloped as part of the extension of the BART system to the airport. Parking at the facility is limited and within walking distance of the station. East of the station, light industrial uses are operating with limited freight service.

The station is located outside the core retail area or "Downtown San Bruno". Downtown San Bruno has a diverse mix of land use and retail uses that act as the center of the community. The land use between the station and the downtown is primarily single family residential.

_Interconnecting Transportation System_

The City of San Bruno currently has SAMtrans bus service. SAMtrans provides San Bruno residents with connections to locations within San Mateo County and the City of San Francisco. The Caltrain station has frequent SAMtrans bus service, although most of the routes have stops at the Airport while on route.

San Bruno will receive BART service by 2004 as construction of the extension from the Airport to the existing northern terminus has begun. The service will offer connections to the Caltrain station and regional connections to the northern Bay Area.

Currently the sidewalk network is not interconnected and the signage is poor. Pedestrians have no indication to the location of downtown, or where transit routes depart. Bicycle parking is provided on the platform, although there are no designated bicycle routes that converge at the station.

***Mountain View Station***

Mountain View is located in the high tech employment center of Silicon Valley, 46 track miles south of San Francisco and 31 track

**Figure B5. Modest Passenger Amenities at San Bruno Station**

miles north of San Jose. The community has a diverse mix of housing with a large stock of single-family homes. Outside the core retail cente, commercial office space has expanded to be the second largest use of land in the community, next to multi-density residential.

Two Caltrain stations serve the City of Mountain View. One station is located in the core area of Mountain View and the other is located in an adjacent retail center. Mountain View Station, located in the core area, has been in existence since passenger rail service has been provided in the corridor. The station is one block from a transportation center with retail and commercial office spaces near the station.

| At a Glance: Mountain View Station | |
|---|---|
| Population of Mountain View | 75,000 |
| Distance from San Jose | 48 miles |
| Distance to San Francisco | 28 miles |
| Travel Time to San Francisco | 50 minutes |
| Service (trains/weekday) | 80 |
| Peak-Hour Frequency | 30 minutes |
| Off-Peak Frequency | 1 hour |
| Average Boardings per Week | 15,400 |
| Commuter Parking Spaces | 338 |

| At a Glance: San Antonio Station | |
|---|---|
| Population of Mountain View | 75,000 |
| Distance from San Jose | 46 miles |
| Distance to San Francisco | 31 miles |
| Travel Time to San Francisco | 56 minutes |
| Service (trains/weekday) | 80 |
| Peak-Hour Frequency | 30 minutes |
| Off-Peak Frequency | 1 hour |
| Average Boardings per Week | 5,887 |
| Commuter Parking Spaces | 75 |

San Antonio, the other Mountain View station, is a recent addition to the Caltrain system. The area surrounding the station evolved as a center for activity that complemented uses in core area. The area developed in part for residents living on the southern portion of town. The following information will only relate to conditions near the San Antonio station, due to interest in recent development patterns and concentration by local authorities.

**Figure B6. Residential Land Uses Adjacent to San Bruno Station**

*Surrounding Land Uses*

The San Antonio station is located in one of the major retail areas of Mountain View. A diverse mix of medium density retail characterizes the development near the station. The retail and entertainment near the station is supported by the medium to low-density residential development within a quarter mile of the station.

Within the last year an aggressive infill project has reached completion adjacent to the station. The project, titled the "Crossing", provides a variety of housing options and market rates. The project developed nearly 350 housing units within a quarter mile of the station. The project includes an affordable housing component and various civic amenities. The goal of the project was to capitalize on the proximity of the development from the Caltrain while not deterring the character of the area.


**Figure B7. San Antonio Corridor Residential Development Across from Caltrain Station Near Retail Center**

*Interconnecting Transportation System*

The San Antonio station has a transit center that provides transfers to SAMtrans buses. Most of the routes at the center provide connections to local destinations and connections to the valley wide light rail (VTA).

Parking at the station is limited to 75 spaces that are provided in two surface parking lots 500 feelt apart from each other. The parking is provided for Caltrain commuters for $3.00 per day.

The sidewalk system in the area is complete and provides strong connections between residential units and the retail center. The San Antonio Center is deemed a walkable community that provides direct connections to housing units and the Caltrain station.

Bicycle racks and lockers are provided for bicycle commuters at the station, but local routes do not converge at the station.

***Key Findings - Caltrain***

*Surrounding Land Uses*

- ◇ The success of the Caltrain is causing development and redevelopment adjacent to the rail corridor.
- ◇ The rail corridor has established retail centers that are within walking distance from stations.
- ◇ Within a half mile of most stations a diverse housing stock exists.
- ◇ Most stations have a modest amount of parking.

*Interconnecting Transportation Network*

- Caltrain system relies on connecting transit, not parking, for ridership.
- Most Caltrain stations are intermodal facilities that provide seamless connections to other transit services.
- Stations generally provide modern facilities that accommodate travel by a variety of modes.

Monthly Caltrain passes offer connections to other transportation systems, providing a highly competitive alternative to the "true" cost of driving an automobile.

**Figure B8. San Antonio Station Transit Center and Surface Parking Lot Adjacent to Retail Center**

### ▶ Metra Rail

Metra is a public agency that operates 12 commuter rail lines in the Chicago Metropolitan Area. Metra is overseen by the Regional Transportation Authority (RTA), which also oversees the Chicago Transit Authority (CTA) and the Pace Suburban Bus System.

**Northwest Line**

Since 1984, Metra has operated the Northwest Line in cooperation with Union Pacific, who owns the track, corridor and employs the agents and conductors on the line. This line extends 63.1 miles from the downtown Chicago station, recently renamed the Ogilvie Transportation Center (OTC). The Northwest Line runs parallel to Route 14, the "Old Northwest Highway," which connects the same towns along the rail line to Chicago. In some cases, such as Cary, Fox River Grove, Arlington Park and Arlington Heights, Route 14 is immediately adjacent to the rail line.

Three of Metra's 10 busiest stations are on this Union Pacific/Northwest Line: Arlington Heights, Arlington Park and Palatine. Ridership on this line grew 2.9 percent, to 9.44 million in 2000. On weekdays, there are 31 inbound trains (14 on Saturday and seven on Sunday), running between 4:50 a.m. and 1:10 a.m. Outbound trains begin at 5:55 a.m. with the last stop at 2:18 a.m. There are 32 outbound trains each weekday, 13 on Saturday and eight on Sunday.

All inbound trains terminate in Chicago and all outbound trains originate in Chicago. There are a variety of express train options during peak hours. Most peak-hour inbound trains originate in Crystal Lake, though Barrington and Arlington Park also serve as points of origin. The same pattern is true of outbound trains in the

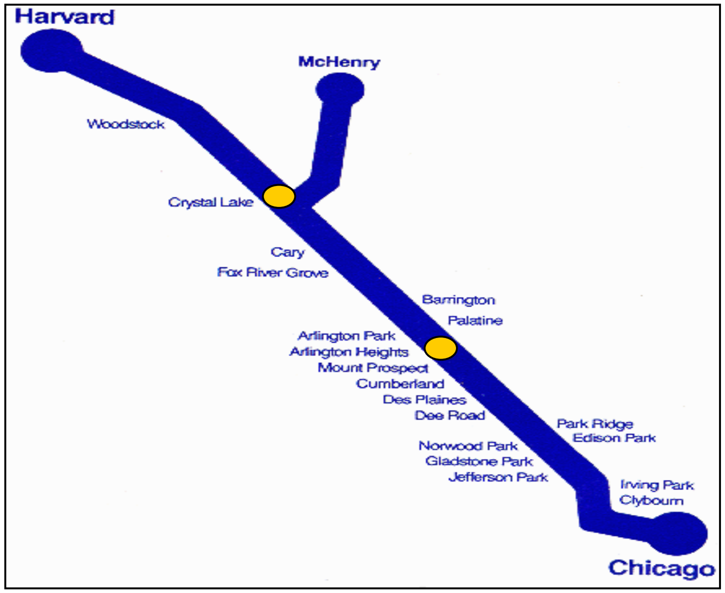



**Figure B9. The Metra/Union Pacific Northwest Line Between Chicago and Harvard/McHenry**

evening peak hour. In addition to the main line that runs between Chicago and Harvard, there is a branch line, which runs from Crystal Lake to the Town of McHenry. Trains originate in Harvard and McHenry throughout the day, though the frequency of service is relatively low.

| At a Glance : Northwest Line | |
|---|---|
| Length of Main Line | 63.1 miles |
| Total # of Track Miles (including branch line) | 70.5 miles |
| Number of Stations | 22 |
| Average Distance Between Stations | 3 miles |
| Range of Distances Between Stations | 1 – 11.5 miles |

Next, the Study will focus on two stations, looking at land use patterns around the stations and the nature of the interconnecting transportation network. The Crystal Lake Station, which serves as the point of convergence for the main and branch lines is one of the two stations to be studied further. The Arlington Heights Station, which is one of the busiest stations within the entire Metra system will also be looked at in more depth.

***Crystal Lake Station***

Crystal Lake lies at what appears to be the very periphery of the urbanized area surrounding Chicago. In fact, Crystal Lake is well within the Metropolitan Statistical Area but the pastoral landscape between Crystal Lake and the communities to the north and west creates a sense that one is just on the edge of suburban Chicago. Crystal Lake serves as the point-of-convergence of the main and branch lines of the Northwest Line. The frequency of service increases significantly here, as compared to Harvard, Woodstock and McHenry. This is due, not only to the merging of the main and branch lines, but service initiates here, as well. As a result, Crystal

Lake appears to draw commuters from a relatively large travelshed. Average boardings per week jump to over 8,000 at Crystal Lake, compared to 1,500 at Harvard and 2,000 at Woodstock. Estimates from local station agents and planners range from one-quarter to one-half of commuters originating in towns further out on the line.

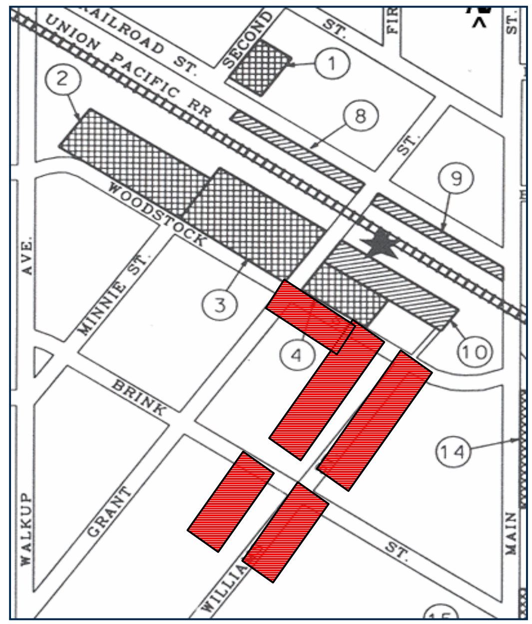
| At a Glance: Crystal Lake Station | |
|---|---|
| Population of Crystal Lake | 35,000 |
| Distance from Chicago (OTC) | 43.2 miles |
| Travel Time to Chicago (OTC) | 1 hour 22 min. |
| Service (trains/weekday) | 22 |
| Peak-Hour Frequency | 4-30 minutes |
| Off-Peak Frequency | 3 hours |
| Average Boardings per Week | 8,332 |
| Average Alightings per Week | 8,315 |
| Commuter Parking Spaces | 944 |

There are plans to build a second station in Crystal Lake, approximately one mile southeast of the existing station. The new station will include 1,500 parking spaces and improved provisions for bicycle access and parking, according to a representative from the Crystal Lake Planning Department.

*Surrounding Land Uses*

*Central Business District*

The Crystal Lake Station is adjacent to the Central Business District. Williams Street, main commercial street, abuts a small park area, which leads to the station. The commercial uses of the CBD wrap the corners, particularly toward the train station. Commercial uses are indicated in red on the figure below.




**The star indicates the location of the depot.**

**Lots 1, 3, 4, 6, 8, 9, 10* and 12 are reserved for holders of monthly parking permits.**

**(* Lot 10 includes both permit and fee parking)**

**The other lots require a daily fee of $1.**

**The area that is red is the central business district.**

**Figure B10. Parking Lots at the Crystal Lake Station**

**Figure B11. The Commuter Parking Lots Separates the Williams Street Train Depot from the Commercial Area**

*Parking*

The increase in frequency of service is one possible explanation for the increase in boardings at Crystal Lake. Another possible factor is the availability of parking. There are 944 parking spaces available to commuters at Crystal Lake, some of which are monthly permit and some of which are daily fee ($1/day). All parking lots are surface lots. The station agent estimated that the permit lots are filled by 7:30 a.m. during the week. The daily-fee lot is usually at least 75 percent full and often fills up.

The configuration of the surface parking lots follows the train tracks in a linear arrangement, with some outlying lots. Those parking in the lots furthest from the station can access the train from any point on the platform. Walking distances may exceed a quarter mile.

*Residential*

At the periphery of the downtown area exist low-density residential units, some of which have been converted into commercial use. In addition, there are a few examples of multifamily units, which appear to be relatively new, as shown in the figure below.

<u>*Interconnecting Transportation Network*</u>

*Transit*

Two bus routes and a call-n-ride system serve the Crystal Lake Station. The scheduled bus routes run at peak hours between nearby towns, also served by this rail line. Service on these routes is fairly limited within town. The call-n-ride system appears to better serve the need for local service within Crystal Lake.

**Figure B12. Multifamily Units Located Across the Parking Lot and Street from the Crystal Lake Depot**

**Figure B13. A Pace Bus Approaches the Crystal Lake Depot**

*Pedestrians*

The proximity of the downtown to the station and the traditional town-planning aspect of Crystal Lake have resulted in pedestrian-friendly access to the station in the form of sidewalks, crosswalks and other connections. However, depending on the direction of approach, the pedestrian may need to cross a large parking lot in order to reach the station, which may discourage pedestrian trips to the station.

*Bicycles*

The Crystal Lake Station is served by a bike route and has some bicycle parking, though the facilities are not elaborate. Plans for a second station in Crystal Lake include a higher level of amenities for bicyclists, including improved bicycle parking facilities and more direct connections to and from nearby bicycle routes.

*Automobile*

A parking map of the Crystal Lake Station reveals that much of the land immediately surrounding the station is devoted to parking, reflecting some degree of priority for private vehicles. The plans for a second station in Crystal Lake are largely related to demand for more parking and the Town's reluctance to expand parking so close to the downtown.

**Figure B14. The Commuter Parking Lot Runs Adjacent to the Railroad Tracks and the Parallel Street System**

***Arlington Heights Station***

Arlington Heights, located approximately 22 miles from Chicago, in Cook County, is a larger, more urban municipality than Crystal Lake. In fact, Arlington Heights is seeing significant redevelopment in its Central Business District, which is located adjacent to the Arlington Heights train station. There are two stations served by UP/Metra trains in Arlington Heights. The second is located at Arlington Park Racetrack, approximately 1.5 miles to the northwest. There are over 1,000 parking spaces provided at this location.

The Arlington Heights Station was recently renovated as part of the Village's "Train Project." The new station includes improved access and circulation for many modes, including trains, pedestrians, bicyclists, buses, taxis and passenger vehicles. The station amenities such as covered bicycle racks; canopies for waiting passenger and in-station vendors were also included.

| **At a Glance: Arlington Heights Station** | |
|---|---|
| Population of Crystal Lake | 75,000 |
| Distance from Chicago (OTC) | 22.8 miles |
| Travel Time to Chicago (OTC) | 49 minutes |
| Service (trains/weekday) | 25 |
| Peak-Hour Frequency | 11-20 minutes |
| Off-Peak Frequency | 1 hour |
| Average Boardings per Week | 13,465 |
| Average Alightings per Week | 13,369 |
| Commuter Parking Spaces | 1,452 |

*Surrounding Land Uses*

*Central Business District*

Approximately 15 years ago, the Village of Arlington Heights adopted the Central Business District Master Plan in an effort to revitalize its downtown. Encompassing a 16-block area, including the train station, the Plan set forth a goal to increase the residential population of the downtown as a first step. In addition to the priority of high-density housing, the Village focused on infrastructure improvements in the downtown, including the addition of parking structures and the renovation of the aging train depot into a multimodal transportation hub. The CBD is receiving a $200 million investment in projects such as a movie theater, an underground parking garage and the Metropolis Performing Arts Center.

*Parking*

Arlington Heights Station provides approximately 1,450 parking spaces for commuters at various locations in the downtown. The lots range from surface lots adjacent to the railroad tracks to top levels of shared parking garages up to two blocks away. Daily fee spaces cost $1.25 and monthly permits cost $25.00.

*Residential*

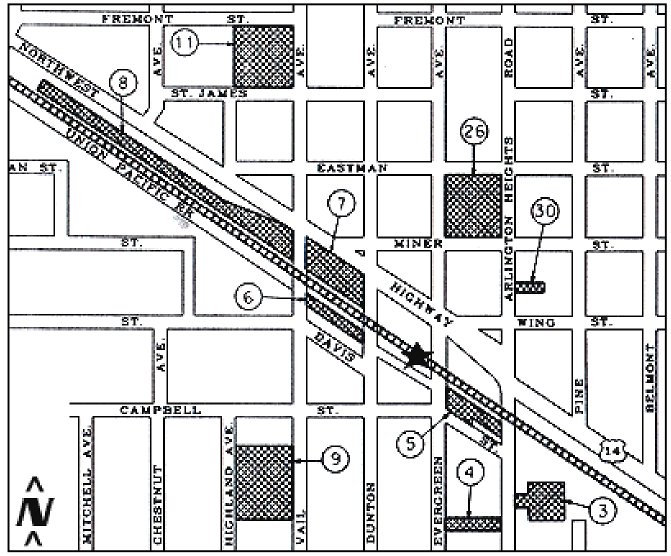
Arlington Heights, as mentioned above, made a concerted effort to increase the residential population of its downtown as part of its Central Business District Master Plan. The number of residents grew from 350 in 1984 to 2,200 today. New higher-density residential development is visible on both sides of the Arlington Heights station. One building, (see Figure B15.) has commercial uses on the first floor, with multifamily units above.

*<u>Interconnecting Transportation Network</u>*

*Transit*

The Arlington Heights station is served by two Pace bus routes. One route offers extended peak-hour service and the other provides all-day service. The renovation of the train station included improved access for transit and pedestrians. The bus stop was relocated so that it is immediately adjacent to the train platform.

**Figure B15. Residential and Commercial Growth South of the Arlington Heights Station**




**The depot is shown as a star.**

**Lots 3, 9 and 26 are shared use parking garages. Lots 6, 7 and 8 are surface parking lots**

**Figure B16. Parking Map for the Arlington Heights Station**

*Pedestrians*

Pedestrian access has also been improved with the renovated train station. Walkways and crossings have been added and improved. In addition, the Village has been successful in promoting higher-densities of commercial and residential development in addition to improved infrastructure and design for pedestrians. According to a Metra study, 80 percent of the passengers living within half mile of the Arlington Heights station walk to the train, suggesting that the Village has been successful in accommodating pedestrian access and circulation in the downtown area.

*Bicycles*

The Arlington Heights train station is located on a number of bike routes. Consistent with the goal to provide improved access for alternative modes, the new station includes covered bicycle racks and improved linkages to bike routes.

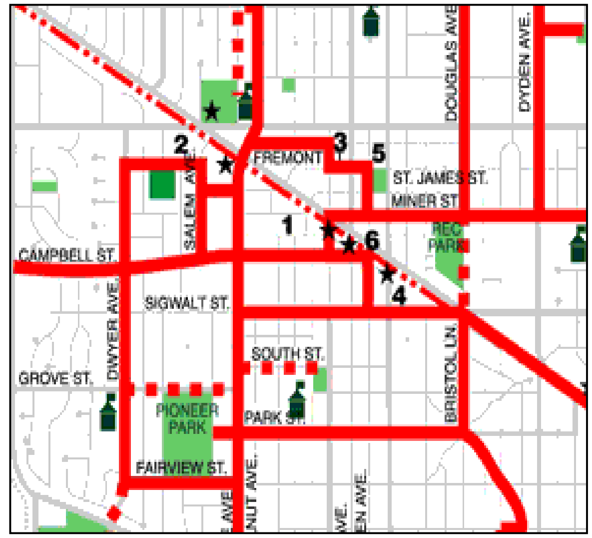
***Key Findings – Metra***

*Surrounding Land Uses*

*Central Business Districts*

Both stations studied, in addition to most of the stations on the line, are located adjacent to Central Business Districts. Metra has been operating this commuter rail line for about 20 years but the tracks have been in place for over 100 years, so the development pattern has a different historical context than exists today. Like many downtowns across the country, the CBD's on this line suffered to varying degrees in the post-war era, due to the proliferation of shopping malls and commercial strips on the outskirts of towns. Many of the towns on this line are in the process of downtown revitalization programs.

**Figure B17. One of the Surface Parking Lots at Arlington Heights Station**




**existing (solid lines)**

**proposed (dotted lines)**

**potential ( dotted and dashed lines) bikeways.**

**The train station is indicated by the number "6" on the map.**

**Figure B18. Village of Arlington Heights Bikeways Map (Source: Department of Planning and Community Development)**

Arlington Heights is an excellent example of a town that saw the value in and potential associated with a commuter rail line tying its population to the regional job center. By increasing residential population in the downtown, creating a multimodal transportation hub train station and improving urban infrastructure, Arlington

Heights took advantage of its position and used it to anchor a downtown revitalization plan.

*Parking*

Parking appears to have been a defining factor for the success of stations located along the Northwest Line. The configuration of parking varies by community, as does the fee system, though Woodstock was the only station on the entire Northwest Line that offered free commuter parking. Arlington Heights has included parking garages as part of its downtown parking plan. There are a few surface parking lots adjacent to the train tracks. In Crystal Lake, however, all 944 spaces are provided on surface lots, resulting in an extensive parking area adjacent to the station.

*Interconnecting Transportation Network*

The two stations studied on the Northwest Metra line are currently served by varying degrees of service with respect to transit, bicycle and pedestrian access.

Arlington Heights appears to have better balanced access for all modes to the station in their redevelopment efforts. Crystal Lake has prioritized access for automobiles, to some degree, resulting in varying convenience for transit, bicycle and pedestrian access.

One reason for the recent and future prioritization of access for other modes is the stations' inability to meet the demand for parking. Arlington Heights has renovated its station into a multimodal transportation hub, with improved amenities for all modes. Crystal Lake has plans to make bicycle access a priority at its second station, which has just recently been approved for development.

**At A Glance: Data for Selected Stations**

| Station | Parking Spaces | Boardings* |
|---|---|---|
| Harvard | 162 | 190 |
| Woodstock | 456 | 318 |
| Crystal Lake | 944 | 1,388 |
| Cary | 758 | 887 |
| Barrington | 907 | 1,533 |
| Palatine | 1,252 | 1,880 |
| Arlington Park | 1,100 (estimate) | 1,668 |
| Arlington Heights | 1,450 | 2,290 |

* Boardings used are a.m. peak plus mid-day based on a Fall 1999 Study conducted by Metra.

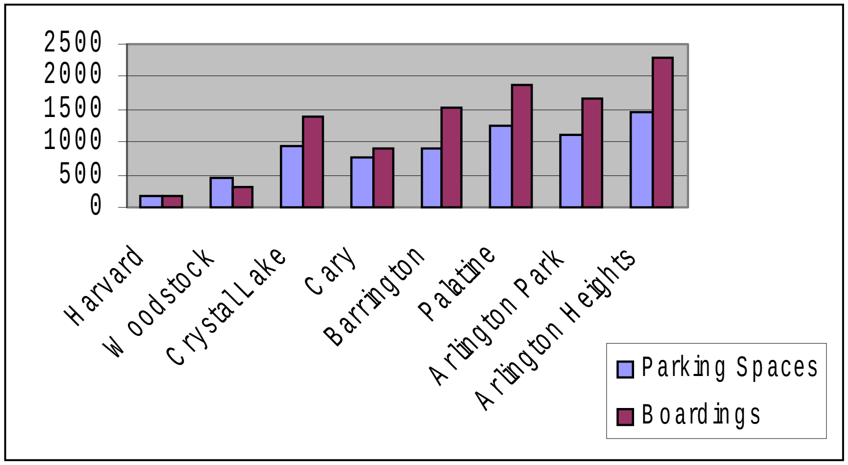



**Figure B19. Graph of the Parking Spaces Versus the Boardings Along the Union Pacific/Northwest Metra Line**

### ▶ VIA Rail

VIA Rail (VIA) operates a variety of passenger rail services within the provinces of Canada. The passenger services are provided for excursion, tourism and commuter purposes.

VIA is a private-public joint venture that was the outcome of the 1986 Canadian National Rail Passenger Transportation Act. The Act allowed VIA, a newly formed private company, the right to operate all of Canadian National (CN) and Canadian Pacific (CP) passenger routes for profit. As part of the act, VIA would also receive a subsidy from the Canadian government for operations. ($171 million in 2000). VIA rail has shown a profit every year they have operated commuter service.

VIA operates excursion rail service on Victoria Island on CN right of way. The service departs from Victoria daily traveling into the Cassidy Mountains to Courtenay. Along the route passengers depart trains for mountain lodges, sightseeing, museums and shopping in historic villages.

| At a Glance : VIA Rail (Victoria to Courtenay) | |
|---|---|
| Length of Main Line | 140 miles |
| Number of Stations | 28 |
| Average Distance Between Stations | 5 miles |
| Range of Distances Between Stations | 2-7 miles |
| Travel Time: Victoria to Nanaimo (80 Miles) | 3 Hours |
| Travel Time: Nanaimo to Courtenay (60 Miles) | 2 Hrs. 30 minutes |

The service is operated with various configurations of "BUD" cars on standard gauge track. The "BUD" cars have direct drive diesel engines that can operate as single units or can be linked together in consists of four vehicles. VIA uses one car for the winter service (off season) and up to four cars for summer service (peak season). Each "BUD" can accommodate 65-seated passengers. Along the route the vehicles travel approximately 35 mph and climb a maximum grade of 3 percent.

Service from Victoria to Courtenay departs at different times during the course of the week given the time of year. A one-way trip takes approximately 5 hours and 30 minutes, making stops for passengers who request specific stations along the route or persons waiting at stations.

This section will focus on stations in urban and rural areas along the route. The major urban areas will include the municipalities of Victoria, Courtenay and Nanaimo. The rural area will include Cliffside, Shawnigan and Malahat.

The major destinations for passengers along the route are Victoria, Courtenay and Nanaimo. The destinations serve as tourist attractions due to their downtowns and recreational activities. Their downtowns have a variety of cultural, entertainment and retail uses compacted into a well defined street grid. The cities are all situated near ports and offer a variety of recreation activities in surrounding wilderness areas.

| Municipality | Population | VIA Station Location |
|---|---|---|
| Victoria | 150,000 | One block from retail and activity center |
| Courtenay | 20,000 | ¼ mile from retail and activity center |
| Nanaimo | 70,000 | ½ mile from retail and activity center |


**Figure B21. VIA Rail from Victoria to Courtenay**

**Figure B20. VIA Rail "BUD" Car at Victoria Station**

***Surrounding Land Uses***

*Victoria*

The land uses surrounding Victoria station are dense and have a variety of uses. One of the major retail and activity centers is located within a block of the station and has a historic building stock that is used for retail-entertainment on the lower levels and commercial on the upper levels. The buildings have zero property line setbacks with on street parking and alleys for delivery access. Twenty five free surface parking spaces are provided adjacent to the station.

**Figure B22. Retail and Activity Center Adjacent to the VIA Station in Victoria**

*Courtenay*

Courtenay station is located outside of the retail and activity center. The land uses surrounding the station are diverse and comprised of low to medium density. Primary land uses include light industrial and residential. A new mixed-use project has just been completed across from the station. The project developed a variety of residential units and modest retail space. Parking at the station is limited to on-street supply that has no time restrictions and is free of charge.

*Nanaimo*

Similar to Courtenay, Nanaimo's station is located outside of the retail and activity center. Land uses surrounding the station consist of low-density light industrial and commercial uses. Adjacent to the station 15 parking spaces are provided for passengers free of charge.

### *Interconnecting Transportation System*

*Victoria*

British Columbia Transportation (BC trans) provides bus and ferry service for the greater Victoria area. BC trans operates buses that serve local and regional attractions and ferries that connect to other islands. BC trans offers two bus routes that stop within blocks of the station. The routes are scheduled to facilitate the 8:10 A.M. departure and the 6:00 P.M. arrival, although trains are not always on time so connections are often broken. The core area has a complete network of sidewalks that provides pedestrian access to attractions and destinations in the core area. Bicycle routes do not converge on the station and amenities are not provided.

**Figure B23. BC Trans Bus Service at VIA Station in Victoria**

*Courtenay*

BC trans offers modest bus service in Courtenay, but it does not provide access to the VIA station. Sidewalks from the stations are well connected to surrounding areas and offer connection to the retail and activity center. Bicycle routes do not converge on the station and amenities are not provided.

*Nanaimo*

Regional District Nanaimo (RDN) operates bus service in the city and the surrounding areas. Routes converge on a transit center in the downtown and offer connections to regional destinations. RDN provides service within a few blocks of the VIA station, although the timing of the route does not meet the arrival of the train. The sidewalk system is complete and provides connections to downtown, but there is limited way-finding for pedestrians. Local bicycle routes pass the station, but racks or storage units are not provided.

**Figure B25. Low Density Development Adjacent to the VIA Station in Nanaimo**

**Figure B24. New Mixed-Use Development Adjacent to the VIA Station in Courtenay**

Passengers who desire access to wilderness areas or small communities along the route can request stops at unscheduled stations along the route. Rural stop locations provide minimal amenities and offer passengers access to dirt roads or hiking trails. Some of the smaller communities have access on paved roads and some have small town centers that cater to tourists. Cliffside, Shawnigan and Malahat represent some of the smaller towns along the route that offer such amenities.

| Municipality | Population | VIA Station Location |
|---|---|---|
| Cliffside | 3,500 | Near access to wilderness area |
| Shawnigan | 3,200 | Provide direct access to lake and resort |
| Malahat | 3,350 | ½ mile from retail and activity center |


**Figure B26. Malahat VIA Station Provides Access to Wilderness Areas**

***Surrounding Land Uses***

Cliffside, Shawnigan and Malahat have a similar development pattern that has evolved to meet the needs of the community. The communities have low density retail centers, adjacent to the stations, which meet the needs of the rural community while developing a marginal source of revenue from tourists. Redevelopment in the retail centers is not present and most of the retail space is leased and thriving. Civic centers are also part of the land use surrounding the stations. The centers provide a gathering place for the community and attract tourists for particular events.

***Interconnecting Transportation System***

The primary means of transportation from the rail station in Cliffside, Shawnigan and Malahat is private transportation. The communities do not have a public transportation or taxi system to move people in the community. With the exception of Malahat, regional bike routes pass near the station but lockers or racks are not provided.

### *Key Findings – VIA Rail*

*Land Uses*

- Development and redevelopment near stations is not being driven by the modest passenger service.
- Mixed-use development and redevelopment is occurring in the core zones of urban areas.
- Rural locations have low-density retail centers that lure passengers from the train for shopping and sight seeing.
- Frequency of service does not warrant large parking reservoirs near stations.

*Interconnecting Transportation System*

- Transit service is not planned around train arrival and departures due to variation in the trains schedule and consistent delays.
- The nature of operation (low frequency excursion service) does not promote mobility from retail centers to stations.
- Most municipalities along the route have a limited number of regional travel patterns (most persons live and work in the same community).
- During winter seasons trains provide the only access to some rural areas.
- Infrastructure in most urban and rural areas does not promote walking or bicycling from the train.

## BC Rail

British Columbia Rail (BC Rail) is a subsidiary of the British Columbia Railway and the British Columbia Railway Properties Corporation. BC Rail is owned by the province of British Columbia and operates 75 percent of the railway for freight operations and the remaining percentage for passenger operations. The passenger operations include five excursions services that offer access to destinations within British Columbia. Many of the services operate in the Canadian Rockies and offer connections to popular destinations such as skiing at Whistler-Blackcomb and mining tours in Squamish.

All of BC Rail's passenger services depart from their North Vancouver rail yard. The main track for passengers services winds through West Vancouver into the foothills of the Canadian Rockies to small mountain communities such as Whistler and

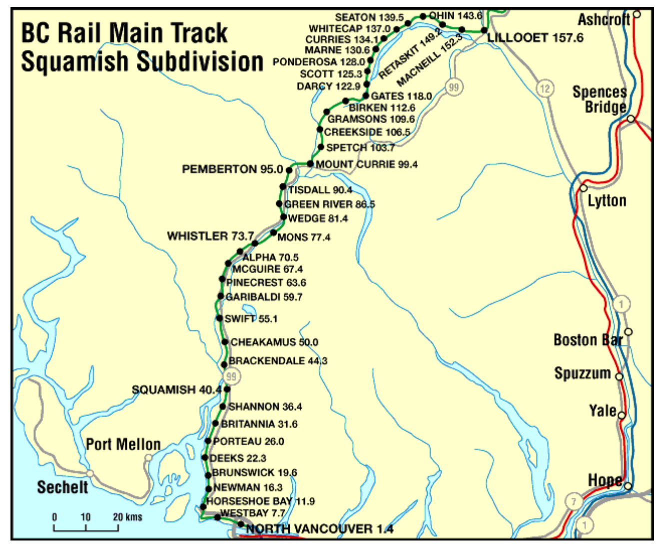



**Figure B27. BC Rail Main Track from North Vancouver to Lillooet**

Lillooet. Similar to the VIA rail system, passengers are requested to inform the conductors of departing stations and trains are required to make stops at stations where passengers are waiting. The service is used to access resort destinations and gain access to wilderness areas.

The service is operated with "BUD" cars that are operated in a variety of configurations depending on the time of year. The route has a maximum grade of 4 percent with a peak elevation of 3,120 feet above sea level.

The following section will focus on a few of the urban and rural areas in the system. For the purpose of this section rural areas that have a retail center that supports a community of at least 3,000 persons will be considered an urban area.

| At a Glance : BC Rail (N. Vancouver to Lillooet) | |
|---|---|
| Length of Main Line | 150 miles |
| Number of Stations | 39 |
| Average Distance Between Stations | 18 miles |
| Range of Distances Between Stations | 4-30 miles |
| Travel Time: N. Vancouver to Whistler (75 Miles) | 2 Hrs 25 minutes |
| Travel Time: Whistler to Lillooet (85 Miles) | 3 Hours |

The urban areas of detail will include North Vancouver, a medium sized community near Vancouver that is the hub for the system; Whistler, a major destination 2 ¾ hours (on train) from North Vancouver that is a major destination for winter and summer activities; and Lillooet, a small town in the Canadian Rockies that is embracing the presence of daily rail service in their community.

The major destinations for passengers along the route are Whistler and Lillooet. The destinations serve as tourist attractions due to their downtowns/villages and recreational activities. Their downtowns have a variety of cultural, entertainment and retail uses in a centralized location, although most are situated away from BC Rail stations.


**Figure B28. BUD Cars in BC Rail Yard Used for Passenger Rail Service from North Vancouver to Lillooet**

| Municipality | Population | BC Rail Station Location |
|---|---|---|
| North Vancouver | 45,000 | Eight block from retail and activity center |
| Whistler | 7,300 | 5 miles from resort |
| Lilloett | 3,000 | 4 mile from retail and activity center |

*Surrounding Land Uses*

*North Vancouver*

The Municipality of North Vancouver is home of the BC Rail yard for freight operations and passenger rail services. The land uses surrounding the rail yard are low-density light and heavy industrial. Most manufactures use BC Rail freight services to deliver their goods and have spurs to accommodate loading. The community's central retail area is located eight blocks from the BC Rail station and has a variety of retail and entertainment uses. Passenger parking is provided at the station (50 surface spaces) at $5.00 per day (U.S. currency).

*Whistler*

The Whistler train station is situated on the outskirts of the Municipality of Whistler in a low-density residential area. The province of British Columbia and the Municipality of Whistler own most of the land adjacent to the station as land preserves. The station is located approximately five miles from Whistler's main village and base area. Land uses between the two areas consist of land preserves and mixed density residential development.

**Figure B29. North Vancouver Rail Yard with Industrial Uses Surrounding Station**

**Figure B30. Whistler Train Depot and Surrounding Public Land Preserves**

*Lilloett*

Lilloett is a small community that has evolved from a mining and industrial past. Historically BC Rail trains delivered natural resources from Lilloett to destinations within British Columbia. The service required spur lines and a large rail yard for loading products. Today the rail yard is used for passenger services as most of the industrial and natural resource businesses have ceased operations. Land uses surrounding the station include land preserves and one small industrial parcel. The central retail area is located a quarter mile from the station with sporadic uses (retail, civic, low-density residential) between the two areas. Free passenger parking is provided in a 25 space surface parking lot in front of the train station.

*<u>Interconnecting Transportation System</u>*

*North Vancouver*

The majority of passengers on BC Rail excursion trains originate from downtown Vancouver. Most of the passengers arrive at the station by cab or public Transportation. BC Trans is one of the public service providers that operate bus, ferry and train service in the greater Vancouver area. During peak summer months, bus service between downtown Vancouver and the train station operates in the morning and evening corresponding to the 7:00 A.M. departure and 9:00 P.M. arrival of the train. In the winter, BC Trans offers bus service from downtown Vancouver to downtown North Vancouver, eight blocks from the station. BC Trans also provides ferry service to and from Vancouver that has a primary dock three blocks from the station. The sidewalk network is complete but has no way-finding for connections to BC Trans or the central retail area of North Vancouver.

**Figure B31. Land Uses Surrounding Lilloett Station**

**Figure B32. BC Rail Station Parking and Drop Off Facilities Near Station**

*Lilloett*

The primary mode of travel in Lilloett is private Transportation. The district has no public Transportation or cab service and has limited facilities for bicycling. Passengers arriving to town by train stroll into downtown on foot via dirt trails and sidewalks. The central retail area has an extensive system of sidewalks, although connections to the station are scattered. Ample free parking is provided at the station with no time restriction. Bicycle routes circulate in the area but facilities are not provided.

*Whistler*

Whistler has an extensive bus system that provides seamless connections between ski portals, lodging and the main village. The system is operated with support from BC Trans and private contributions. The bus system however, does not connect to the BC Rail station. BC Rail contracts with a private service provided to drive passengers from the train station to the village (5 miles). Since the train service is infrequent (one arrival in the morning and one departure in the evening) the charter service prearranges times to pick up and drop off passengers at the station. A local multi-use path offers connections from the station to the village and is maintained for year round use. The station has five parking spaces that serve mostly as loading zones and one informal bus loading zone.

**Figure B33. Private Bus Service to Whistler Village Contracted by BC Rail**


**Figure B34. Pedestrian Improvements in Downtown Lillooet**

Similar to the VIA Rail system, passengers on excursions can request rural stops that provide access to recreation areas and mountain resorts. On the northern portion of the line many small rural towns use the rail as Transportation from one community to the next. This is possible because the northern terminus of the train and the corresponding southern return routes are spaced to facilitate short shopping and altered scheduled school trips. D'arcy, Pemberton and Shalalth represent some of the smaller rural communities along the route that offer access to wilderness areas with limited amenities for passengers at stations.

***Surrounding Land Uses***

D'arcy, Pemberton and Shalalth are small rural communities that survive on local forest and mining industry. The town centers are located 8-12 miles from the rail station and offer very few retail stores and entertainment uses. The retail centers are typically not destinations for tourists and survive on the local market demand. The land uses surrounding the stations are private undeveloped land and public land reserves with wilderness access. The stations have informal dirt parking spaces that are used by private vehicles to meet passengers on arriving/departing trains.

**Figure B35. School Children Using Train Service for Fieldtrips at Northern End of Line**

***Interconnecting Transportation System***

The primary means of Transportation from the rail station in D'arcy, Pemberton and Shalalth is private Transportation. The communities do not have a public Transportation or taxi system to move people in the community. Automobile access to stations is via dirt roads that have minimal winter maintenance.

| Municipality | Population | BC Rail Station Location |
|---|---|---|
| D'arcy | 2,200 | Near local wilderness area |
| Pemberton | 900 | Near local wilderness areas |
| Shalalth | 1,700 | Near local resort |

***Key Findings – BC Rail***

**Land Uses**

- Development and redevelopment near stations in urban areas is occurring on minimal levels.
- Stations near rural centers have large portions of public undeveloped land near stations.
- Retail and entertainment centers are not located near the rail corridor, and it most cases outside of walking distances.
- Parking at stations in rural areas is informal and unmanaged.
- Parking near all stations is providing a limited source of passengers.

**Interconnecting Transportation System**

- Stations in rural areas are relying on private vehicles for Transportation to and from destinations.
- Sidewalks and trail connections are not well defined and wayfinding is nonexistent.
- BC Rail freight trains have priority on the track, causing delays for passenger services.


**Figure B36. Informal Parking and Drop Off Near Shalath**

# APPENDIX C
# RELATED COLORADO PROJECTS



**Related Colorado Rail Projects**

| PASSENGER RAIL LINE | SYSTEM TYPE | ENDPOINTS | LENGTH | STATUS (AS OF AUGUST 2001) |
|---|---|---|---|---|
| **Central Corridor** | Light Rail | 30th Downing to I-25/Broadway | 5.3 Miles | Opened in 1994 |
| **Central Platte Valley Spur** | Light Rail | Central Corridor Line (at Colfax) to 16th Street Mall | 1.8 Miles | Scheduled to Open Summer 2002 |
| **East Corridor** | Commuter Rail | Union Station to DIA | 27 Miles | EIS to Begin in 2001 |
| **I-225 Corridor** | Light Rail | East Corridor Line (at Smith Road) to Parker Road | 10.5 Miles | Pre-EIS |
| **Southeast Corridor** | Light Rail | I-25/Broadway to I-25/Lincoln | 19 Miles | Construction to Begin in 2001; Expected Completion Summer 2008 |
| **Southwest Corridor** | Light Rail | I-25/Broadway to Mineral/Santa Fe | 8.7 Miles | Opened in 2000 |
| **I-70 West/Gold Line** | Light Rail | Union Station to Golden | 11 Miles | Pre-EIS |
| **West Corridor** | Light Rail | Union Station to US 6/Highway 40 | 10.7 Miles | EIS to Begin in Summer 2001 |
| **US 36 Corridor** | Commuter Rail | Union Station to 30th Street/Pearl Street | 28 Miles | Pre-EIS |
| **North Metro Corridor** | Light Rail | Union Station to 120th (and preservation of Brighton corridor) | 13 Miles | Pre-EIS |
| **North Front Range** | Commuter Rail | Downtown Fort Collins to Union Station (and Fort Collins to Greeley) | 88 Miles | Pre-EIS |
| **South Front Range** | No Rail Planned | Denver to Pueblo | -- | -- |
| **I-70 Mountain Corridor** | TBD | C-470 to Glenwood Springs | TBD | EIS Underway; Expected Completion: Spring 2003 |
| **Steamboat/Hayden** | Commuter Rail | Downtown Steamboat to Downtown Hayden (possible spur to Yampa Airport) | 35 Miles | Pre-EIS |
| **Roaring Fork** | Commuter Rail | Downtown Glenwood Springs to Woody Creek | 34 Miles | Pre-EIS; CIS to be Completed: Early 2002 |
| **Leadville/Avon** | Commuter Rail | Leadville to Avon (continuing service to I-70 corridor) | 20 Miles | Alternatives Evaluation Underway w/I-70 EIS |

# APPENDIX D
# PRIMER ON NEW RAIL TECHNOLOGIES



# Primer on Passenger Rail Technologies

▶ **Light Rail (LRT)**

Light rail systems are electrically-powered systems. Overhead catenaries provide 600 to 750-volt DC current (though there is one known example of third-rail power supply.)

Modern light rail vehicles (LRVs) are 50-90 feet long, 8-9 feet wide and roughly 70,000 lbs. in weight. Each vehicle holds a maximum of 200 passengers (including standees). Average operating speeds for light rail systems vary between 15 - 30 mph with top speeds reaching about 60 mph. Light rail systems can operate at minimum headways of two minutes, potentially accommodating over 20,000 passengers per hour per peak direction. Stations are typically spaced between 0.25 and 2.0 miles apart. Light rail trains are able to travel grades ranging from 6 percent to 9 percent depending on vehicle manufacturer and other operational characteristics.

Light rail may be implemented at varying degrees of separation from traffic. It may be built as fully grade-separated (exclusive right of way), reserved (semi-exclusive right of way) or shared (mixed with traffic.) All types of LRT require an on-board operator. Cars can operate singly or be entrained up to four cars long. The term "light" refers to passenger demand, not the weight of the vehicles, nor the technology employed.

▶ **Examples – Light Rail**

- ◇ Denver, Colorado - RTD
- ◇ Dallas, Texas - DART
- ◇ Portland, Oregon - Tri-Met
- ◇ Sacramento, California – Regional Transit District

**Figure D1. Dallas Area Rapid Transit (DART)**

**Figure D2. San Jose Trolley**

### ▸ Commuter Rail

Commuter rail systems are typically propelled in one of four ways: rail diesel cars (RDCs), electricity supplied via 25,000-volt AC overhead catenaries, diesel-electric cars or occasionally, third rails. Some systems apply combinations of the above technologies. Commuter rail systems operate on exclusive rights of way, and may include at-grade crossings and always have an on-board operator. Both the train wheels and the track are made of steel.

Commuter rail vehicles are about 300 feet long, 8-9 feet wide and 10 feet tall. They can weigh up to 182,000 lbs. empty. Each vehicle can accommodate a maximum of about 260 passengers, including standees. Maximum speeds for commuter rail range from 60-75 mph. Most commuter rail systems can handle 20,000 people per hour per peak direction. As many as 10 cars may be entrained, but limitations to platform length and other operational characteristics limit this number. Stations associated with commuter rail may be spaced at a wide variety of distances, depending on the operating environment. Stops spaced between one and 15 miles are common on commuter rail lines in the United States. Commuter rail trains may travel grades approaching three percent.

**Examples – Commuter Rail**

- ◇ Metra, Chicago, Illinois
- ◇ Caltrain, California
- ◇ Metro North, New York
- ◇ Massachusetts Bay Transportation Authority (MBTA), Boston

**Figure D3. MBTA Commuter Rail in Boston**

### ▸ Rapid Rail (Metro Systems)

Rapid rail systems accommodate the highest passenger demand of all rail transit modes. They are typically electrically powered by a 600 to 1000-volt DC-current third rail and are therefore, fully grade-separated. They may be manually controlled or fully automated. The systems use steel wheels on steel rails (though some rubber-tire systems have been implemented.)

The vehicles are typically 75 feet long, 10 feet wide, about 10 feet high and can hold a maximum of 200 passengers, including standees. Up to 10 cars may be entrained in a single train. The stations may be spaced between 0.5 and 3.0 miles apart. The maximum travel grade for rapid rail systems is four percent.

These systems can operate at minimum headways of two minutes, accommodating anywhere between 20,000 to 62,000 people per hour per peak direction. Rapid rail systems can cruise at speeds of 60 mph, with a maximum speed of 75 mph. Average operating speeds are closer to 18-40 mph.

### Examples – Rapid Rail

- Metropolitan Atlanta Rapid Transit Authority (MARTA)
- Chicago Transit Authority, the "El" (Elevated) Train
- Bay Area Rapid Transit (BART)
- The Metro, Washington, D.C.

**Figure D4. The Metro in Washington, D.C.**

### Magnetic Levitation (Maglev) Rail Systems

Maglev train systems are at a different stage of development than any of the other rail technologies discussed here. Though research and testing has been done since the 1970s, no commercial passenger rail service currently uses the maglev technology. There are, however, at least two testing facilities, in Germany and Japan. There are also plans to unveil the world's first passenger maglev train system in Germany in 2002, which will connect Berlin and Hamburg.

Maglev utilizes a specific technology to suspend and propel an object. Using a magnetic field created by an electrical current and a superconducting magnet, a train is suspended or levitated 10-15 millimeters above a guideway and then propelled using a linear induction motor. The direction of the propulsion is reversed for braking. Vehicles are levitated when traveling above about 100 km/hour. Below this speed, the train is lowered onto wheels on the guideway.

Although the electrical current supplied to a guideway makes head-on collisions all but impossible by preventing bi-directional travel on the same guideway, there remain safety concerns, particularly with respect to loss of electrical power.

Maglev train systems are the most expensive among the technologies discussed here. The bulk of the expense is related to infrastructure, although operation of maglev trains requires a great deal of electricity. Guideways are unique to each application and must be engineered within a high degree of precision. In addition, at-grade crossings are prohibited. Otherwise, guideways may be built at or above grade. The frictionless technology may mean less wear and tear on the guideway but the required precision of the guideway may mitigate savings.

Speeds of trains at testing facilities have been upwards of 550 km/hour (approximately 330 miles/hour). The maximum feasible grade for maglev trains is theoretically unlimited, though practical considerations and costs need to be considered. Train lengths are limited only by the length of station platforms; trains usually include a minimum of two cars to facilitate bi-directional travel. Individual cars typically accommodate 60-140 people, depending on the car type and seating layout. Headways for the Berlin – Hamburg train, the "Transrapid," are planned for 10-15 minutes.

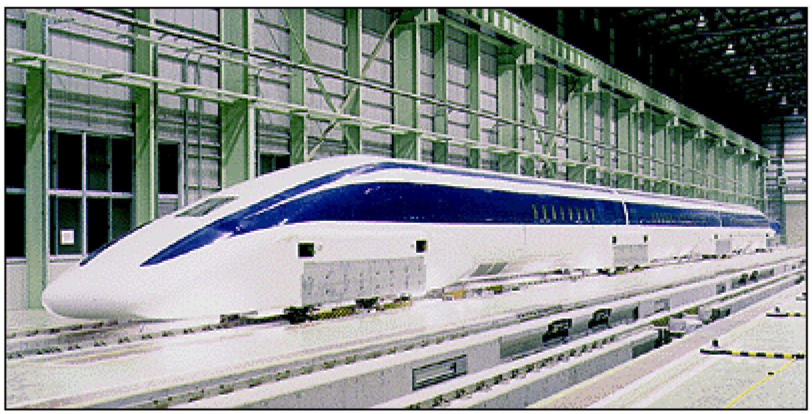


**Figure D5. A Prototype Maglev Train in a Testing Facility**

**Figure D6. Rail Technologies: Comparison**

| Technology | Light Rail | Rapid Rail Systems | Commuter Rail | Maglev Rail |
|---|---|---|---|---|
| **Power Source** | DC electricity | DC electricity | diesel or electric locomotive | electricity via a linear induction motor |
| **Power Distribution** | via overhead cable | third rail | diesel, catenary, third rail or combination | on-board |
| **Spacing Between Stations (miles)** | 0.25-2.0 | 0.5-3.0 | 1.0-15.0 | no defining precedents |
| **Right-of-Way** | grade-separated reserved mixed-traffic | exclusive: fully grade-separated | exclusive to semi-exclusive with at-grade crossings | exclusive; fully grade separated |
| **Degree of Automation** | manual control | manual control or full automation | manual control | manual control |
| **Maximum Operating Speed (mph)** | 40-60 | 55-75 | 60-75 | 330 |
| **Average Operating Speed (mph)** | 12-40 | 18-40 | 20-40 | no defining precedents |
| **Max. Peak-Hour Capacity (people/hour/direction)** | 8,000-15,000 | 20,000-42,000 | 20,000-30,000 | no defining precedents |
| **Minimum Practical Headway (min.)** | 2 | 2 | 3-5 | 10-15 |
| **Maximum Grade** | 9% | 4% | 3% | theoretically unlimited; no defining precedents |
| **Remarks** | able to negotiate tight turns, aesthetics of overhead power can be an issue | major infrastructure investment, highest capacity | only to/from largest business districts if rail line exists | no existing applications; expensive technology; oriented to intercity travel |