VI. ISSUE IDENTIFICATION

The potential introduction of regional rail transit improvements in RRCS study corridors raises a variety of issues that must be considered, in addition to mode, location and level of service. These basic service characteristics are defined and evaluated elsewhere in this report in Chapter VIII. The purpose of this chapter is to review related regional efforts, passenger requirements, grade crossing concerns, vehicle/technology options, cost calculation methods, and transit oriented development guidelines. These issues are all important to the overall performance and feasibility of rail service in a corridor. The information presented in the following sections is included to demonstrate examples, guidelines, and possibilities for future rail implementation.

REGIONAL CONTEXT

At the start of the RRCS, there were several key issues related to parallel and/or newly completed work that could have potentially affected the RRCS results. The status of these efforts, as the RRCS study effort began, is summarized in this chapter, including comment on any areas that were of specific relevance to RRCS corridors and analysis.

DFW International Airport Rail Planning Study

The Dallas/Fort Worth International Airport is located in the heart of the Dallas/Fort Worth Metropolitan Area. The long-range mobility plans for the region have contained a variety of passenger rail recommendations that have potential impact on surface transportation access to the Airport. To identify the best approach for serving DFW Airport and capitalizing on the regional access that could also be gained through appropriate connections to and through the Airport, the Dallas/Fort Worth International
Airport Rail Planning and Implementation Study was undertaken in 2001. This effort was reviewed for its relevance to the RRCS along with stakeholder perspectives at the time the RRCS work began.

Background

The DFW International Airport Rail Planning and Implementation Study was initiated by the Dallas/Fort Worth International Airport (DFW), the North Central Texas Council of Governments (NCTCOG), Dallas Area Rapid Transit (DART), and the Fort Worth Transportation Authority (FWTA) in early 2001. After several initial project meetings of the stakeholder agencies (DFW, NCTCOG, DART and FWTA) to agree on the scope and structure of the project, a consultant team was selected to begin work in May 2001.

The study established a decision-making process for determining a Locally Preferred Alternative (LPA) for rail access to DFW International Airport from a variety of areas throughout the region. The study included public and agency involvement efforts for reviewing and determining the preferred alternative and implementation strategies, along with the analysis and consideration of a variety of transportation alternatives against a base case scenario.

Purpose and Need

DFW Airport is one of the most significant activity centers in the North Central Texas region. Past planning efforts identified a variety of rail options to and through the Airport, but recent Airport expansion plans and changes in regional demographics prompted the need to reevaluate. The need to identify alignment and technology options for the immediate, mid-range (2010) and long-term (2025) timeframes was key.
Several issues and conditions contributed to the need to identify improvements to Airport access. Some of these were:

- The Airport Train was over 30 years old and being replaced by an Automated People Mover System (APM) that connects to the secure side of the Airport. (This new APM opened for service in June 2005 and is known as SkyLink.)
- Mobility 2025: The Metropolitan Transportation Plan for North Central Texas, 2004 Update showed planned improvements for all of the roadways surrounding the Airport and for rail corridors accessing the Airport. These improvements required coordination and identification in greater detail.
- The DART Transit System Plan included light rail coming to the north end of the Airport, as recommended in the Northwest Corridor Major Investment Study, and a commuter rail line coming to the south side of the Airport (Trinity Railway Express). These regional travel options required coordination from the perspective of serving airport passengers and employees.
- The DFW International Airport Five-year Capital Development Program called for a multimodal connection at the new APM’s 13th Station. Greater definition of the technology and alignment of this multimodal facility was needed for airport design work to be finalized.
- The State Implementation Plan for Air Quality included requirements for the Dallas-Fort Worth Metropolitan area to reduce mobile source emissions for years 2007, 2015, and 2025. Development of additional rail options in the region would aid in achieving this goal.
Project Goals and Objectives

The study’s Project Steering Committee (PSC) spent several meetings discussing project goals. The formally adopted goal for the effort was as follows:

*To provide a seamless, customer sensitive, affordable, clearly achievable rail interface between the regional rail system and the DFW International Airport Central Terminal Area. This service would provide airport rail access to as many customer markets as feasible. These include airport passengers and employees in both eastern and western portions of the region. The product will be a set of recommendations and an action plan for immediate implementation.*

The PSC also identified objectives for the Study:

- Strive for the most seamless (fewest mode transfers) rail solution possible;
- Provide direct rail access to the Central Terminal Area (CTA) and APM system with as few transfers as possible;
- Provide rail service for key 2012 Olympic sites and transportation distribution nodes from DFW Airport; (Note: this goal became inoperative, when the Metroplex was not selected for the 2012 Olympics)
- Provide equitable rail service from DFW Airport to both the Dallas and Fort Worth Central Business Districts with a total trip time competitive with parallel auto travel time;
- Develop transit options that are compatible with existing and planned regional rail projects;
- Identify options that are capable of being strategically staged for implementation;
- Provide rail options that can be developed using a variety of funding sources;
• Ensure the solution is realistically achievable and that a step by step action plan is included in the recommendation;
• Strive for a solution that enhances the attainment of regional air quality goals;
• Identify solutions independent of transit authority or other jurisdictional boundaries;
• Provide service options for all potential markets – employee, business traveler, vacation traveler, entertainment traveler, and “out-of-town” visitor such as convention visitors;
• Identify solutions that are environmentally sensitive and physically suitable to the areas surrounding their operations.

Project Findings – Locally Preferred Alternative

A wide range of alternatives were considered and screened through several levels of evaluation. The PSC considered the final 22 alternatives and selected the Locally Preferred Alternative from among those. The implementation year for the LPA was 2025 and the recommended plan included both commuter rail service and light rail service. Exhibit VI-1 contains a diagram of the LPA. Commuter rail service is shown along the Cotton Belt rail corridor from the west, entering the Airport on the north side and following International Parkway into the APM system’s 13th Station. The DART Northwest Corridor Major Investment Study included recommendations for light rail along SH 114 to the north side of the Airport. The LPA for the Rail Planning and Implementation Study includes three optional LRT alignments to access the 13th Station on the Airport from various points along the SH 114 alignment, with the understanding that the PE/EIS stage of the Northwest corridor MIS was yet to be completed. Retaining these three options were to provide flexibility for the final analysis of the Northwest Corridor LRT development. The three alignments were:
• To the north of the east airfield runways;
• In a tunnel under the runways; or
• To the south of all the runways.

The LPA includes preservation of a right-of-way corridor for the connection from the south to the Trinity Railway Express. The existing service provided from the TRE to the terminal area by circulator bus was determined to be adequate, but the corridor preservation was included to enable consideration of a rail connection in the post-2025 timeframe. The results of the analysis conducted for the various alternatives also indicated that connecting the NW Corridor LRT to the 13th Station would generate significantly higher ridership than stopping at the north end of the Airport, justifying the added cost.

Some of the reasons the PSC selected the LPA shown in Exhibit VI-1 are as follows:

• It provided equitable service to Fort Worth, downtown Dallas, and the north Dallas area.
• It offered attractive and consistent travel times to all destinations, including downtown Dallas and Fort Worth in less than 50 minutes.
• It attracted ridership that was among the highest of the alternatives (13,200 riders per day in 2025, compared to about 15,000 daily riders for the most expensive, highest ridership alternative).
• It was among the lowest-cost alternatives, with capital costs of about $260 million.
- It was among the most efficient in terms of cost per rider, and had the lowest cost per added rider of all the alternatives (about $64 per added rider).

The lack of a rail connection into the Airport from the Trinity Railway Express corridor was seen as a negative. However, the distance from the TRE to the Airport terminal area is about twice the distance from the Cotton Belt corridor to the terminal area. This resulted in lower ridership and higher costs for the alternatives that included a direct rail connection from the TRE. There were also added right-of-way costs, as property purchases in the Centreport area, outside the property limits of DFW Airport, would be required.
EXHIBIT VI-1

DFW INTERNATIONAL AIRPORT TRANSIT ACCESS PLAN

Source: DFW International Airport Rail Planning Study
Operating and Technology Issues

To further reduce the estimated cost for the Locally Preferred Alternative, the project team reviewed ridership levels and decreased the initial assessment for train length requirements. This adjustment was in the Cotton Belt Corridor commuter rail operation only and resulted in using one-car trains as opposed to two-car trains. Additional investigation into extended headways was also conducted, but the PSC determined that 30-minute headways were the necessary minimum to provide the level of service appropriate for airport-oriented service. The Locally Preferred Alternative includes a variety of technologies:

- Light rail in the DART Northwest Corridor;
- Freight-rail-compatible commuter service on the Cotton Belt Corridor; and
- Bus shuttle systems from the Trinity Railway Express Corridor and for distribution of employees from the 13th Station and the east and west employment centers.

The layout of the 13th Station and the interface with the various rail corridors is such that final selection of the commuter rail technology can be made based on overall corridor requirements and not on Airport geometric requirements. This will allow for sensitivity to changing freight compatibility requirements and the consideration of more fuel-efficient technologies as they become available. To maintain flexibility for potential future “through” airport movements, the technologies employed in the Cotton Belt and TRE corridors should be compatible. Renderings of the 13th Station are shown in Exhibit VI-2 and Exhibit VI-3.
EXHIBIT VI-2
STATION 13 VIEW FROM THE SOUTHEAST

Source: DMJM Aviation, Inc.

EXHIBIT VI-3
STATION 13 VIEW FROM THE NORTHEAST

Source: DMJM Aviation, Inc.

These two exhibits are from the *Dallas/Fort Worth International Airport Rail Planning and Implementation Study: Major Investment Study*; prepared for the North Central Texas Council of Governments, Arlington, Texas; available online at: [http://www.dfwinfo.com/trans/public_trans/dfwrail/index.html](http://www.dfwinfo.com/trans/public_trans/dfwrail/index.html)
Evaluation of Project Status at the Outset of RRCS: Stakeholder Perspectives

- **TxDOT – Dallas District**

  The Locally Preferred Alternative for rail access to DFW International Airport includes preservation of a corridor connecting the Trinity Railway Express Corridor to the 13th Station within the terminal area. This corridor is shown to cross over SH 183 just east of County Line Road and move west and north through Airport property. The Dallas District of the Texas Department of Transportation has been preparing the design for improvements to this freeway, which will include eight main lanes, three high occupancy vehicle lanes, and fully developed frontage roads. The cross-section will be at-grade, thus requiring any eventual commuter rail connection to be elevated over the vehicular lanes of travel. Columns for the rail overpass could be accommodated at points between the frontage roads and the west bound main lanes and again in the concrete barrier area that will separate the HOV lanes and accompanying shoulder from the main lanes in the east bound direction. TxDOT-Dallas has indicated its continued support of this concept, should it become warranted at some future date, and emphasized its willingness to keep the gateway for this crossover clear.

- **TxDOT – Fort Worth District**

  The Fort Worth TxDOT District has been working on the reconfiguration of the SH 121/SH 114 area north of DFW International Airport for several years. The western commuter rail connection along the Cotton Belt Corridor that is shown in the Locally Preferred Alternative for the Dallas/Fort Worth International Airport Rail Planning and Implementation Study crosses the right-of-way for this expanded freeway configuration near Grapevine, to the west of International Parkway. TxDOT has been
consulted several times concerning the introduction of a rail crossover in the freeway/high occupancy vehicle (HOV) corridor and has noted that as long as the rail is elevated over the freeway/HOV corridor and includes a minimum of a 150-foot bridge span, the projects will coexist without negative impacts. The project manager in the Fort Worth District mentioned a potential request from the City of Grapevine for additional access to the reconfigured freeway, but clarified there would be continued protection of the rail crossing area to accommodate the DFW Rail LPA.

- **Dallas Area Rapid Transit**

The Northwest Rail Corridor in the eastern part of the region includes recommendations for light rail to approach DFW International Airport along SH 114 as defined during the Northwest Corridor Major Investment Study. Two options are generally at-grade, while the third is in a tunnel for a substantial part of the right-of-way.

At the outset of the RRCS effort, the DART Board was developing a revised 20-Year Financial Plan and Fiscal Year 2004 budget. These documents were to establish the schedule for future capital improvements, including rail access to the Airport. Given the budget challenges facing DART as a result of declining sales tax revenues, a delay in the light rail program was anticipated. However, DART is continuing to work on the resolution of the Northwest Corridor at the interface with DFW International Airport and the 13th Station.
• **Fort Worth Transportation Authority**

The Fort Worth Transportation Authority continues to support the recommendations contained in the Locally Preferred Alternative for the DFW Rail Planning and Implementation Study. The FWTA Board and the Fort Worth City Council endorsed the recommendations, specifically the development of the Cotton Belt Corridor west of the Airport, as part of the submittal prepared for the reauthorization of TEA 21. The only outstanding issue associated with the support of this stakeholder agency could be the agency’s eventual ability to provide funding for the development of the Cotton Belt Corridor, since the existing right-of-way falls outside the FWTA service area in several sections.

• **Dallas/Fort Worth International Airport**

As the originator of the project, DFW Airport is extremely supportive of the notion of connecting the Airport to the regional rail system. The Airport was continuing to develop Terminal D (opened in July 2005) and Terminal F and the Automated People Mover System (SkyLink, opened in June 2005) in the framework originally outlined during the development of the Locally Preferred Alternative for the rail project. The existing bus connection from the Trinity Railway Express serves the Airport reasonably well, but does not provide direct rail connection to the areas of the region that would be accessible from the rail configuration outlined in the Locally Preferred Alternative. Since DFW serves the larger metropolitan area of North Central Texas, farther-reaching rail connections would be the most beneficial to airport passengers and employees.
The bi-level 13th Station design shown in Exhibit VI-2 and Exhibit VI-3 continues to be viable and would accommodate both commuter rail and light rail options. The potential delay of the introduction of light rail from the east into the 13th Station is not expected to alter the overall design or development of this station.

The DFW International Airport Board submitted the western connection to the 13th Station as part of the program of Airport requests for TEA 21 re-authorization. Although very interested in attaining this multimodal connection, the Airport continues to support a joint funding approach for all sections of the LPA, even those that are entirely within Airport property lines. Federal, state, and local dollars, along with possibly more creative funding sources that might be available due to joint development, are all options the Airport hopes to pursue.

- **North Central Texas Council of Governments**

  Mobility 2025: The Metropolitan Transportation Plan for North Central Texas and subsequent updates contain the Locally Preferred Alternative shown in Exhibit III-2. Thus, the regional planning staff and policy groups support the plan and will continue to keep a placeholder in the Metropolitan Transportation Plan for resolution of DART LRT access to the 13th station.

**Conclusions**

The LPA from the Dallas/Fort Worth International Airport Rail Planning and Implementation Study continues to receive support from stakeholder agencies. The following factors were identified for future monitoring during the Regional Rail Corridor Study:
• The financial situation at DART will cause the LRT connection from the east to be outside the current DART financial planning window. The potential ridership impact of the loss of the direct LRT to Airport connection should be monitored and considered when planning other improvements to the east.

• The requests for funding submitted as part of the transportation reauthorization may provide a potential source of funding for the Cotton Belt Corridor west of the Airport and for development of the commuter rail corridor on the Airport to the 13th Station. This should be monitored for any potential impact on funding strategies for the RRCS.

• Sensitivity to the restrictions of crossing locations and bridge spans that were identified by both TxDOT Districts should be maintained as planning work in the Cotton Belt-West Corridor and the Trinity Railway Express Corridor continue.

• Environmental concerns for clean fuel commuter rail operations are critical.

• Potential funding assistance that may become available through the Regional Transportation Council Partnership Program #2 should be monitored for benefit to the RRCS corridors.

• Creative funding strategies will be key to implementing the entire LPA.

**DART System Plan**

At the outset of the Regional Rail Corridor Study, Dallas Area Rapid Transit was in the midst of developing an update to the DART Transit System Plan for 2030. The rail system provided and planned for by DART is an integral part of the region’s transportation system and an important link for the planned rail improvements resulting from the Regional Rail Corridor Study.
The current DART Transit System Plan was adopted by the DART Board in November 1995. Exhibit VI-4 shows the official current and future rail development contained in this transit system plan. This rail system is contained in the current regional long-range plan and was therefore assumed to be in place in the travel demand forecasts developed for the RRCS planning effort.

The 2030 Transit System Plan Update process continued throughout the RRCS effort. DART staff participated in the regular project team meetings for the RRCS, providing updates and interaction with the System Plan effort as appropriate. The resulting recommendations from the RRCS are part of the continuing 2030 System Plan work, as DART staff and consultants evaluate possible system improvements throughout the DART service area.
EXHIBIT VI-4

DART EXPANSION PLAN

DART’s Transit System Plan for service development includes:
- 93 miles of light rail transit
- 35 miles of commuter rail transit
- 110 miles of high occupancy vehicle (HOV) lanes
- General Mobility Programs
  - Transportation System Management
  - Intelligent Transportation Systems
  - Travel Demand Management/RiderShare
  - Local Assistance Programs
  - Congestion Management

Source: Dallas Area Rapid Transit
Trinity Railway Express Service and Improvement Plans

The Trinity Railway Express (TRE) is a commuter rail service operating between downtown Fort Worth and downtown Dallas. The TRE was developed jointly by Dallas Area Rapid Transit (DART) in Dallas County and the Fort Worth Transportation Authority (The T) in Tarrant County. DART and The T collectively administer the service with DART and The T staff, a TRE Management Committee comprised of the Presidents/Executive Directors of DART and The T, and a TRE Advisory Committee comprised of DART and The T Board members. Service levels and budgets are presented to the TRE Advisory Committee and approved by both DART and The T Boards. Exhibit VI-5 shows the Trinity Railway Express station map.

EXHIBIT VI-5
TRINITY RAILWAY EXPRESS STATION MAP

Source: Trinity Railway Express

VI-18
Service initially started between Dallas and South Irving in December 1996, expanding to eventually reach the two downtown Fort Worth stations in December 2001. Today, TRE operates almost 50 trains each weekday and 22 trains on Saturday. The TRE normally does not offer service on Sunday. Exhibit VI-6 presents the weekday schedule for TRE Rail service.

Because the TRE has operated for over eight years and is actively managed by two of the area’s transit authorities, the TRE corridor was not examined at length by the RRCS. TRE service was reviewed as background for the study and to serve as a baseline for passenger rail service expectations and capital and operating costs. Periodic discussions were held with TRE staff to provide updates on the RRCS progress, assumptions, and conclusions. It is assumed that the TRE Irving Yard, for example, may serve as a vehicle maintenance back shop for heavier work, such as engine overhaul, on regional passenger rail vehicles that would be utilized on the corridors.

Additionally, the TRE capital improvement plan for the upcoming years was reviewed with TRE for any operating impact on the RRCS, as well as to reconcile the RRCS capital cost estimates. Partial funding of the improvements is anticipated to be included in the RTC’s Partnership Program 2.
### Effective MAR 7, 2005

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No Sunday Service - Hay servicio los Domingos. No Service on Memorial Day, July 4th, Labor Day, Thanksgiving, Christmas or New Year's Day. A MODIFIED SCHEDULE (available online or published TRE schedule) will be in effect from Thanksgiving through Christmas Eve and New Year's Eve. Schedules are subject to change. Alternative transportation will be provided for right of way maintenance when required.

The TRE @ 817-215-8600 or DART @ 214-999-1111

Visit on-line at www.thet.com • www.trinityrailwayexpress.com • www.dart.org

TRE is a joint service of the T and DART.
The TRE capital improvement plan was based on six strategic assumptions, each of which had goals to help attain the vision. The strategic assumptions are presented in Exhibit VI-7, and the TRE capital improvement plan projects may be found in the accompanying document on corridors.

### EXHIBIT VI-7

**TRINITY RAILWAY EXPRESS STRATEGIC ASSUMPTIONS FOR CAPITAL IMPROVEMENT PLAN**

<table>
<thead>
<tr>
<th>Strategic Assumptions</th>
<th>Goals</th>
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| Double Track Entire Corridor (Note: Completion allows potential for Amtrak service on Corridor and for Sunday service). | 1. Improve service reliability.  
2. Enhance attractiveness of service - increase ridership.  
3. Provide safe/secure service.  
4. Allows potential for greater throughput of freight service. |
| Maximize Class 4 Track Across Corridor.                                              | 1. Increased track speed (79 MPH) allows for decreased commute time for passengers.  
2. Enhance attractiveness of service - increase ridership.  
3. Increased track speed (59 MPH) allows for decreased corridor transit time for freight customers.  
4. Increased speeds results in decrease in amount of time gate crossings are down assisting local jurisdictions with vehicular traffic flow - cars are at crossing shorter period of time. |
| Provide 30-Minute Headways Weekdays on Corridor.                                      | 1. Enhance attractiveness of service - increase ridership. |
| Provide Four Quadrant Gate Protection Systems at All Grade Crossings on Corridor.     | 1. Provide safe/secure service.  
2. Improve service reliability.  
3. Potential for quiet zones in residential areas adjacent to corridor if adopted by appropriate authority. |
| Improve Customer Service/Satisfaction.                                                | 1. Improve passenger amenities and facilities.  
2. Provide safe/secure system/service.  
3. Enhance attractiveness of service - increase ridership. |
| Asset Management.                                                                    | 1. Expand/maintain existing rolling stock.  
2. Maintain existing asset inventory.  
3. Improve service reliability.  
4. Improve management flexibility. |
DCTA Service Plan

Creation of DCTA

House Bill 3323, which was approved by the 77th Texas Legislature and signed into law by the Governor of Texas in 2001, (now codified as Chapter 460 of the Texas Transportation Code) allows creation of a Coordinated County Transportation Authority in urban “collar” counties adjacent to counties with populations of 1,000,000 or more, which includes Denton County. The legislation requires that a Service Plan, an outline of the services that would be provided by an authority when confirmed by the voters, should be developed by the Transportation Authority. The Denton County Commissioners Court initiated the process to form the Denton County Transportation Authority (DCTA) in October 2001. In 2001, the Denton County Commissioners Court and large municipalities in the County (those with populations above 12,000) made appointments to the DCTA Interim Executive Committee (IEC); the remaining positions were selected by a vote of the governing bodies of municipalities with populations between 500 and 12,000.

Confirmation Election and Sales and Use Tax Election

The DCTA Service Plan was initially approved by the DCTA Interim Executive Committee on June 13, 2002, as required by law prior to the election to confirm the Authority. On November 5, 2002, voters confirmed the creation of the authority with a 73 percent approval rate. Subsequently, the plan was revised to be submitted to the voters again on September 13, 2003, for consideration and approval of a one-half percent sales and use tax. Those plan revisions were approved by the DCTA Board of Directors (then known as the Executive Committee) on July 10, 2003. The Board called for the sales and use tax referendum in the cities of Copper Canyon, Corinth, Denton, Double Oak,
Flower Mound, Highland Village, Lewisville, and Shady Shores. The election was successful in the cities of Denton, Highland Village, and Lewisville. Imposition of the sale and use tax dedicated to the authority began on January 1, 2004.

The DCTA Service Plan

Following the successful initial confirmation election in 2002, the Interim Executive Committee became the Executive Committee. The Executive Committee began re-examining the Service Plan to make any needed enhancements. Primary among the refinements was the need to update the financial elements of the plan to reflect the cities participating in the authority and confirm sales and use tax projections. The Service Plan approved on July 10, 2003, focused on the implementation of a regional rail system that included five of the largest cities in the County. A revised Service Plan was approved prior to a sales and use tax election conducted on September 13, 2003. Upon the favorable vote approving the establishment of a sales and use tax in the three communities (Denton, Lewisville, and Highland Village), the Service Plan was further refined to respond to the vote. Only those municipalities approving the sales and use tax are considered as part of the authority’s initial Service Area. Communities outside the initial Service Area, but in Denton County, may choose to contract with DCTA for services and/or to participate in a future sales and use tax election with a capital recovery component.

Service Plan Recommendations

The Service Plan includes a rail component and three layers of bus service, including Regional Connector Bus Service, Local Routes, and Demand Response Service, as well as a network of Park-and-Rides/Regional Rail and Bus Facilities to serve citizens in
Denton County. The DCTA plan recognizes that Denton County is part of the greater Dallas-Fort Worth region and respects its importance as a component in the regional transportation system. In implementing the plan, DCTA will seek to work closely with DART, FWTA, and NCTCOG to make connections to regional services. In addition, it was always made clear that the recommendations of the Service Plan were subject to a federally sanctioned Alternatives Analysis process and could change as a result of that process.

**Short Term Passenger Rail Service Plan**

Passenger rail is the central element of the Denton County Transportation Authority’s Service Plan. The Service Plan’s concept is to implement initial rail service along a 20-mile corridor in Denton County to connect with DART’s light rail transit (LRT) facilities in north Carrollton. Rail service was initially conceived to operate at 30-minute headways during peak periods and 60-minute headways during off-peak times and weekends. At a minimum, it is DCTA’s intent to work as a partner with DART to develop as seamless a service as possible for DCTA and DART riders. There may also be an opportunity to work with DART, through regional funding support by the metropolitan planning organization (NCTCOG and the RTC) to develop regional rail service to the planned Belt Line Road Intermodal Transportation Center in Carrollton. That would allow not only north-south service between Denton and Dallas County destinations, but also eventual east-west services along the Cotton Belt rail corridor and the possibility of service directly to Dallas-Fort Worth International Airport. The regional rail configuration evaluated for this corridor as part of the RRCS included service to the Belt Line Road Intermodal Center and to Dallas-Fort Worth International Airport.
Exhibit VI-8 shows the recommended passenger rail line from the Service Plan. The DCTA Service Plan called for phasing in passenger services as soon as possible, with service from Lewisville to North Carrollton planned to start within approximately five to six years after initiation of the DCTA sales tax, and the completion of rail service from Denton to Lewisville within approximately seven to eight years after initiation of the sales tax. In any case, the starter line would be designed and constructed to open concurrently with the DART LRT service to North Carrollton.

The Service Plan’s estimated capital cost for the passenger rail service from Carrollton to Lewisville was $132 million, with the extension between Lewisville and Denton estimated at $108 million, for a total capital cost of $240 million (all in 2002 dollars).

Other Service Plan Elements

- *Proposed Longer-Term Regional Rail Expansion Alternatives:* Several corridors are proposed for potential implementation after the Denton to Carrollton regional rail service begins. It is estimated that the agency will have no additional funding capacity to construct additional rail segments until the Denton-Carrollton rail system is completed. As that date approaches, DCTA will be able to evaluate current conditions and prioritize any additional service implementation.

Exhibit VI-9 shows Longer-Term Expansion Alternatives from the Service Plan.
EXHIBIT VI-8
DCTA REGIONAL FIXED GUIDEWAY ELEMENT FROM SERVICE PLAN

Source: DCTA Service Plan
Regional Park-and-Ride/Regional Rail Facilities are recommended along the future regional rail service corridor. Park-and-ride facilities along the future rail corridors can be built to initially serve local and regional buses, but could later serve as Regional Rail Stations. No specific park-and-ride locations have been identified or
recommended at this time. Each community must work with the DCTA and with local landowners to find a location that incorporates the park-and-ride facility into the adjacent area and provides convenient access for potential patrons.

- **Regional Connector Bus Service** would provide a cost-effective interim regional connection between the DCTA Service area, the DART system, and potentially the Dallas Central Business District (CBD) until passenger rail service is implemented. The Regional Connector Bus Service will rely heavily on park-and-ride lots along I-35E, as well as a transit hub in Denton. Headways for the Regional Connector Bus Service are recommended at 30 minutes during peak hours and 60 minutes during off-peak periods. Much of this service would be phased out as passenger rail service is phased in.

- **Local Fixed Route Bus Service** is recommended within the cities of Denton and Lewisville. The local routes would connect with the Regional Connector Bus Service. The City of Denton’s LINK service would continue to operate, with possible additional routes to better serve the University of North Texas (UNT) and Texas Women’s University (TWU). Local bus service is also recommended for Lewisville. The local routes were developed using 30-minute headways, consistent with the current LINK service. Small buses (20-30 passengers) are recommended for the Local Service. This service was the basis for the local and feeder bus system included in the RRCS for Denton County.

- **Demand Response Service** would be funded by DCTA and expanded to better serve the elderly and disabled residents of the DCTA service area.

- **Local Assistance/Corridor Preservation**: The Service Plan recommends that DCTA provides Local Assistance funding to help implement the public transportation system and for corridor preservation within the county. The funding level for the local
assistance program is estimated to be $1 million to $1.5 million annually. The Local Assistance program would allow communities to enhance the public transportation system through:

- Roadway, intersection, and interchange improvements;
- Ramp metering;
- Intelligent Transportation System (ITS) improvements;
- Ridesharing;
- HOV lanes on arterials and freeways in selected areas;
- Vanpools;
- Environmental mitigation; and
- Signalization upgrades.

- **Enhanced Local Assistance Program (ELAP):** Since it will be several years before rail service begins, the Service Plan recommends implementation of an Enhanced Local Assistance Program (ELAP). The ELAP would be used by member cities to facilitate their transportation systems. ELAP funding is available to eligible cities in an amount generally equal to 25 percent of the DCTA sales and use tax collections generated in the respective city for the first four years of the authority’s operation. Eligible cities submit project requests for DCTA approval.

*Short-Term Capital and Operating Costs*

Capital and operating costs have been developed for each of the recommended services in the DCTA Service Plan for the first 10 years of services. Capital and annual transit operating costs are shown in Exhibit VI-10 below.
**EXHIBIT VI-10**

**DCTA SHORT TERM CAPITAL AND OPERATING COST ASSUMPTIONS**

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<th>Proposed Element</th>
<th>Capital Costs (1st 10 years)</th>
<th>Annual Operating and Maintenance Costs</th>
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<td>Regional Rail</td>
<td>$240.0 million</td>
<td>$4.3 million</td>
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<tr>
<td>Park-and-Ride</td>
<td>$7.25 million</td>
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<tr>
<td>Maintenance base/passenger amenities</td>
<td>$10.0 million</td>
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<td>Regional Connector Bus Service</td>
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<td>Local Assistance/Corridor Preservation</td>
<td>$13.5 million</td>
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<td>Enhanced LAP (4 years only)</td>
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<td><strong>Total</strong></td>
<td><strong>$292.3 million</strong></td>
<td><strong>$8.7 million</strong></td>
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* Included in annual operating costs for each transit element

Source: DCTA Service Plan; all costs are in year 2002 dollars

**Alternatives Analysis**

Subsequent to the establishment of the DCTA dedicated sales and use tax in 2003, the agency undertook a federally sanctioned Alternatives Analysis (AA) to further refine the transportation options for the DCTA fixed route project. Results from the Regional Rail Corridor Study evaluation of feasible options for Corridor E-2 were used as a starting point for the AA. The ridership and cost analysis conducted as part of RRCS enabled the DCTA AA to begin with a substantial amount of data already in hand. Results of that Alternatives Analysis are anticipated in the summer of 2005.

**RTC Partnership Program**

As this report was being finalized, the RTC Partnership Program for Fiscal Years 2005 to 2009 was still under discussion. Funds for the programs are available from the Congestion Management and Air Quality (CMAQ) federal grants to non-attainment areas and the federal Surface Transportation Program-Metropolitan Mobility (STP-MM) funds.
STP-MM program funds are distributed to Metropolitan Planning Organizations (MPOs) with populations of more than 200,000. The funds may be used by states and local jurisdictions for projects on any Federal-aid highway, including the National Highway System, bridge projects on any public road, bicycle projects, pedestrian projects, transit capital projects, and public bus terminals and facilities.

Of particular interest as implementation of projects suggested by the RRCS effort is considered is the RTC’s expressed desire to primarily use the Partnership Program #2 for transit projects. Many of the improvements sought by the TRE are considered good candidates for this program.

Project recommendations for funding were scheduled for consideration by the Surface Transportation Technical Committee in August 2005, with RTC action anticipated in September 2005. Projects will then be considered for inclusion in the State Transportation Improvement Program in November 2005 and state and federal approval of the STIP projects in January 2006.

PROTOTYPICAL PASSENGER REQUIREMENTS

Passenger requirements, station locations, and preliminary design concepts identified in this study are general conceptual plans only, which will be delineated in further detail in later phases of planning and implementation. Passenger requirements, station locations, and preliminary design concepts were identified through a highly interactive process that involved the Policy/Technical Committees in determining the following:
• **Where** stations should eventually be located along alternative corridors to provide optimal service and to best provide access to the surrounding community;

• **What functions** each station will serve (commuter park-and-ride, transfer center, neighborhood serving, destination, special generator, etc.); and,

• **What size, shape and appearance** the station and its various elements should be to best serve transit patrons, while fitting into the context of the surrounding environment.

**Station Location Criteria**

Identification and assessment of station location areas included consideration of previous transportation planning efforts, trip-making characteristics of potential transit patrons, site visits, aerial photography, land use development, and community plans. Meetings were held with city planners and community officials to identify and review proposed station areas within their jurisdiction. Input was received from the RRCS Policy and Technical Committees and from the general public during quarterly public meetings.

As a result of this process, three goals for station location planning were developed:

1. Select sites for stations that will provide rail patrons with convenient access to the regional rail system;

2. Provide opportunities for increased ridership without adversely affecting the integrity of communities and neighborhoods; and

3. Select sites that offer opportunity for cost-effective implementation.

Station locations for each corridor are general areas and may include several candidate location alternatives for the actual station sites. The number and spacing of stations
impacts the accessibility and trip time for rail patrons. Development of certain station
locations might be deferred until ridership increases or until joint economic development
opportunities arise.

Alternative station locations were assessed against the following evaluation criteria used
to determine the optimum vicinity locations:

**Site Configuration:**

- **Ridership:** Ensure that station locations serve the existing and future ridership base
  through locations with proper density and activity centers.

- **Station Spacing:** Approximate three- to five-mile station spacing for regional rail
  stations will provide access points to nearby population and activities while
  maintaining efficient station spacing for trip time and commuter train operations.

- **Geometric Requirements:** Ensure that the proposed site will accommodate the
  station layout requirements and design criteria.

- **Spatial Requirements:** Assure that an adequate and efficient site area exists for all
  station facilities, parking, vehicular circulation, and safety/security.

- **Constraints:** Station sites should not require complex and costly design solutions.

**Traffic and multi-modal access:**

- **Parking and Circulation Accommodation:** Ability to provide adequate site access,
  circulation, and parking.

- **Parking Access and Egress:** Ease of access and egress for parking location.

- **Pedestrian Grade Separation Required:** At-grade pedestrian access requires new
  grade separation.
• **Vehicular Grade Separation Required:** At-grade roadway access requires new grade separation.

• **Local Traffic Impacts:** Freeway/Expressway and Arterial access provided by local and regional thoroughfare network.

• **Pedestrian/Bicycle Accessibility:** Selected sites should be conveniently accessible to bicycle and pedestrian routes.

**Environmental:**

• **Neighborhood Compatibility:** Provide for the physical integration of stations into the existing community and activity centers while minimizing negative impacts on adjacent neighborhoods.

• **Relocation of Residences:** Minimize the number of households to be relocated.

• **Displacement of Businesses:** Minimize the number of businesses to be displaced.

• **Environmental Compatibility:** Minimize adverse environmental impacts and avoid sites where impacts would be unacceptable or have high mitigation costs.

**Economic Development/Transit Oriented Development Potential:**

• **Local Plan Compatibility:** Consistency with adopted comprehensive plan for local communities.

• **Existing Zoning – Transit Supportive:** Zoning district regulations provide adequate density and permitted uses.

• **Transit Oriented Development Potential:** Locate stations to take advantage of potential transit oriented development opportunities.
Station Design Concepts

Conceptual station plans and prototypical layouts were developed for the stations and various elements to best serve regional rail patrons, while fitting into the context of the surrounding environment. Station prototypes include conceptual layouts intended for a range of urban and suburban environments.

Prototypical station plans include the following passenger requirements and station amenities:

- Station Platform
- Warning Strips
- Canopies at Door Locations
- Platform Lights
- Windscreens – 2 per canopy
- Seats – 16 per canopy
- Trees and Grates
- Trashcans
- Handicapped Boarding Platforms
- Ticket Vending Machines

Exhibit VI-11 shows a typical urban regional rail station layout, and Exhibit VI-12 shows a typical suburban layout.
EXHIBIT VI-11
TYPICAL URBAN STATION CONCEPT

Source: Carter Burgess

VI-36
EXHIBIT VI-12

TYPICAL SUBURBAN STATION CONCEPT

Source: Carter Burgess
Construction costs for regional rail stations were estimated based on the program for the prototypical concept plan and unit prices for similar facilities. The total estimated construction cost per station is $1,755,000. Real estate costs are not included in this estimate. The estimated construction cost for the prototypical station concept includes the following component costs, exclusive of land costs:

- Platform - $812,000
- Surface Parking - $800,000 for each 200 parking spaces
- Bus Lane - $143,000

**Park-and-Ride Facilities**

Regional rail stations would include park-and-ride facilities for use by carpoolers, vanpoolers, and transit riders. They are meant to encourage people who do not live in the surrounding area to drive to a station, park, and then take regional rail to their destination. Parking facilities at stations would be strictly for use by rail patrons unless posted otherwise. Most park-and-ride facilities would be open 24 hours a day, seven days a week. In cases where park-and-ride facilities are leased from churches, shopping centers, and other privately owned properties, such facilities may have restrictions on the hours and days of use. Parking will be free or at substantially reduced prices compared to parking in the center city.

The station prototype includes a variable amount of parking, depending on the projected ridership at each station location. Further detailed planning in later stages of development would evaluate existing and projected future commuting patterns to determine the number of parking spaces needed at each station location.
Stations can also be located near hike-and-bike trails or other pedestrian or bicycle-friendly facilities so that residents can ride their bikes or walk to stations in their community. Locating these facilities in key spots for tourist attractions in a given area may help to expand ridership for tourism activities, as well. By encouraging shifts to transit, park-and-ride facilities can reduce urban highway traffic congestion and parking demands in the center city and other major employment areas.

GRADE CROSSINGS AND QUIET ZONES

In 2001, the Regional Transportation Council (RTC) initiated the Railroad Crossing Reliability Partnership Program (RCRPP) to improve reliability and safety at the region’s railroad crossings and provide $10 million to local governments for region wide safety improvements. Under this program, RTC selected projects:

- To maximize safety through capital improvements;
- To link operations with nearby traffic controls and other corridor improvements;
- To minimize noise and other environmental impacts near sensitive land uses; and
- To enhance the reliability of antiquated equipment.

Staff worked with railroad partners and local governments throughout the program to develop a scoring process for selecting projects. In August of 2004, the RTC approved funding recommendations for 20 railroad crossings in the Western Sub-region and 24 in the Eastern Sub-region under the Reliability Program, shown in Exhibit VI-13.
A new Federal Railroad Administration (FRA) rule, effective June 24, 2005, requires that locomotive horns be sounded as a warning to highway users at public highway-rail crossings. This rule provides the opportunity for communities to mitigate the effects of train horn noise by establishing “quiet zones”. These are:

- Closure or
- Four Quadrant gates or
- One-way street with a gate across width or
- Channelization with Gates

Examples of crossing gates and channelization are shown in Exhibit VI-14.

**EXHIBIT VI-14**

**EXAMPLES OF CROSSING GATES AND CHANNELIZATION**

**VEHICLE/TECHNOLOGY OPTIONS**

**Description of Available Technology**

Before describing regional rail and light rail technologies, it is important to understand that some trains can be operated in conjunction with freight trains and some cannot.
There are two key federal agencies involved in the regulation of specific areas of the railroad and public transit industries. The Federal Railroad Administration (FRA) is an organization within the U.S. Department of Transportation that is responsible for overseeing public safety in the railroad industry. The Federal Transit Administration (FTA) evaluates project impacts and benefits and administers federal financing for public transit projects. Equipment that is operated concurrently with normal railroad traffic over the national railroad network must meet specific structural and safety standards. Equipment that meets the federal standards is considered to be compliant with the FRA regulations. Equipment that does not meet the FRA standards for operation with freight rail service is considered to be non-compliant. Unless the FRA grants a waiver, equipment that does not meet these standards is restricted from joint operation with railroad equipment. The waiver process is specific, time consuming, and very difficult to obtain. The regulations are contained in 49 CFR Parts 209, 211, and 238.

**Regional Rail**

Regional rail, sometimes known as commuter rail, generally operates between a central city and adjacent suburbs and serves a longer distance market than does electrified light rail systems. Regional rail systems usually range from 20 to 100 miles in length. The number of station stops is also less with an average station spacing of five to ten miles. The fewer stations allow maximum benefit to be gained from the 79 to 90 mph maximum operating speed for regional rail equipment. Platforms at regional rail stations can be either low-level (eight inches above the top of the rail) or high-level (level with the car floor height). While high platforms allow for faster and easier boarding, they are not compatible with the clearance requirements of freight train equipment. If used, high platforms will require a separate track for freight train movements.
Regional rail trains consist of either Locomotive Hauled Consists (LHC) or Diesel Multiple Units (DMU). Both of these technologies normally utilize a diesel engine to power the LHC locomotive or DMU vehicle rather than electricity from an overhead wire (used for light rail) or a third rail (used for heavy rail systems). LHC trains operated in the U.S. are compliant with the federal structural and safety standards. DMU equipment may or may not be compliant with the federal standards. The cars in an LHC train and the vehicles in a DMU train can be either single-level or double level seating depending upon the volume of passengers being accommodated.

LHC consists are generally operated in one of two ways. In the first instance, a locomotive pulls passenger cars in one direction. The train must be turned at the destination end of the line in order that the locomotive will again be pulling the consist on the return trip. For the second method, the locomotive pulls the train in one direction and then pushes the train in the opposite direction. A car known as a cab control car is used at the non-locomotive end of the train when the locomotive is pushing. The train crew operates the train from the cab control car. This method eliminates the need to turn the entire train at its destination. For regional rail operations in the U.S., the push-pull method of operation is the most common. LHC trains can be operated on at-grade and elevated alignments. Usually, LHC trains do not operate on city streets due to their wide turning radius nor in subways due to the diesel engine’s exhaust.

Push-pull operations are in service in many states and cities including the South Florida Regional Transportation Authority’s Tri-Rail, TRE, Chicago METRA, Los Angeles Metrolink, San Francisco-San Jose Caltrain, Altamont Corridor Express (ACE), San
Diego Coaster, Washington State Sounder, Virginia Railway Express (VRE), and Maryland Transportation Authority (MARC). Exhibit VI-15 shows the general characteristics of the LHC technology, and Exhibit VI-16 presents an illustration of the technology.

**EXHIBIT VI-15**

**LOCOMOTIVE HAULED COACH CHARACTERISTICS**

<table>
<thead>
<tr>
<th>General Description</th>
<th>Locomotive pulled or pushed single or bi-level cars or multiple electric units operating on railroad track.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power Source</td>
<td>Diesel-electric or electric with overhead catenary.</td>
</tr>
<tr>
<td>Stations and Typical Spacing</td>
<td>Low or high level platforms with or without shelter or station structure with station spacing of 3 to 5 miles.</td>
</tr>
<tr>
<td>Maximum Operating Speed</td>
<td>79 to 90 mph</td>
</tr>
<tr>
<td>Typical Route Length</td>
<td>20 to 100 miles</td>
</tr>
<tr>
<td>Maximum Grade</td>
<td>3 to 4 percent</td>
</tr>
<tr>
<td>Cars or Units per Train</td>
<td>3 to 12</td>
</tr>
<tr>
<td>Seated Capacity per Unit</td>
<td>80 to 170</td>
</tr>
<tr>
<td>Capital Cost per Mile (Excluding ROW)</td>
<td>$2-20 million</td>
</tr>
<tr>
<td>Capital Cost per Vehicle</td>
<td>$1-3 million</td>
</tr>
<tr>
<td>Vehicle Life Expectancy</td>
<td>25 to 30 years</td>
</tr>
<tr>
<td>Availability</td>
<td>In production</td>
</tr>
</tbody>
</table>

Source: URS Corporation, in collaboration with the RRCS team
Diesel Multiple Unit (DMU) trains can consist of individual vehicles coupled together to form four- or five-car trains or double or triple-articulated vehicles coupled together to form three-vehicle length trains. DMU trains can have a powered vehicle at each end of the train with two or three non-powered vehicles in between. If a vehicle equipped with an operating cab is placed at each end of a train, the train reverses direction at its destination rather than having to be turned. DMU technology is particularly applicable to lower volume passenger lines that are rural or branch line railroad in nature. The operating characteristics of DMU technology are similar to those of regional rail. DMU trains can be operated on city streets, at-grade, and on elevated alignments.

Currently, DMU technology is operated by TRE, Ottawa, and New Jersey (RiverLINE). Other DMU operations, such as San Diego’s North San Diego County Transit District
(NCTD), are planning for DMU operations. Exhibit VI-17 shows the general characteristics of the self-propelled FRA-compliant DMU technology, and Exhibit VI-18 presents an illustration of the technology.

Exhibit VI-19 shows the general characteristics of the self-propelled DMU non-FRA-compliant DMU technology, and Exhibit VI-20 presents an illustration of the technology.

**EXHIBIT VI-17**

**DMU FRA-COMPLIANT CHARACTERISTICS**

<table>
<thead>
<tr>
<th>General Description</th>
<th>Single or articulated multiple unit self-propelled vehicle operating over existing railroad track.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power Source</td>
<td>Diesel-electric or diesel with direct drive.</td>
</tr>
<tr>
<td>Stations and Typical Spacing</td>
<td>Low-level with shelter or structure with station spacing of 2 to 5 miles.</td>
</tr>
<tr>
<td>Maximum Operating Speed</td>
<td>60 to 90 mph</td>
</tr>
<tr>
<td>Typical Route Length</td>
<td>10 to 100 miles</td>
</tr>
<tr>
<td>Maximum Grade</td>
<td>3 to 4 percent</td>
</tr>
<tr>
<td>Cars or Units per Train</td>
<td>1 to 6</td>
</tr>
<tr>
<td>Seated Capacity per Unit</td>
<td>60 to 170</td>
</tr>
<tr>
<td>Capital Cost per Mile (Excluding ROW)</td>
<td>$2-20 million</td>
</tr>
<tr>
<td>Capital Cost per Vehicle</td>
<td>$3-4 million</td>
</tr>
<tr>
<td>Vehicle Life Expectancy</td>
<td>25 to 30 years</td>
</tr>
<tr>
<td>Availability</td>
<td>FRA compliant design currently only available from Colorado Railcar.</td>
</tr>
</tbody>
</table>

Source: URS Corporation, in collaboration with the RRCS team
### EXHIBIT VI-18

**TYPICAL DMU FRA-COMPLIANT TECHNOLOGY**

![Typical DMU FRA-compliant technology](image)

### EXHIBIT VI-19

**DMU NON-FRA-COMPLIANT CHARACTERISTICS**

<table>
<thead>
<tr>
<th>General Description</th>
<th>Single or articulated multiple unit self-propelled vehicle operating over separate tracks or over existing railroad track if separated from freight operations.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power Source</td>
<td>Diesel-electric, diesel with direct drive, or dual powered diesel-electric and overhead electric power.</td>
</tr>
<tr>
<td>Stations and Typical Spacing</td>
<td>Low-level with shelter or structure with station spacing of 1 to 3 miles.</td>
</tr>
<tr>
<td>Maximum Operating Speed</td>
<td>60 to 80 mph</td>
</tr>
<tr>
<td>Typical Route Length</td>
<td>10 to 50 miles</td>
</tr>
<tr>
<td>Maximum Grade</td>
<td>3 to 4 percent</td>
</tr>
<tr>
<td>Cars or Units per Train</td>
<td>1 to 6</td>
</tr>
<tr>
<td>Seated Capacity per Unit</td>
<td>50 to 100</td>
</tr>
<tr>
<td>Capital Cost per Mile (Excluding ROW)</td>
<td>$2-40 million</td>
</tr>
<tr>
<td>Capital Cost per Vehicle</td>
<td>$3-4 million</td>
</tr>
<tr>
<td>Vehicle Life Expectancy</td>
<td>25 to 30 years</td>
</tr>
<tr>
<td>Availability</td>
<td>Non-FRA compliant in production in Europe</td>
</tr>
</tbody>
</table>

Source: URS Corporation, in collaboration with the RRCS team
Light Rail Transit

Light rail transit operates within a city or between a city center and adjacent suburbs. Light rail systems are typically eight to twenty-five miles in length, have an average station spacing of one-half to two miles, have a maximum operating speed of fifty-five to sixty-five mph, and utilize non-compliant equipment. Light rail trains are powered by a 600 to 750-volt dc electric current from an overhead wire. Light rail vehicles are usually double-ended, single articulated vehicles, but double articulated vehicles are also available. Single-articulated vehicles are like the original light rail vehicles used by DART, having two body units with a shared truck (wheels and frame) in the middle. Double-articulated vehicles have three body units with two shared trucks, like the proposed DART “C” cars. The vehicles are equipped with a cab and operating controls at each end to eliminate the need to turn trains at the ends of a line. Light rail trains can be operated on city streets, at-grade, elevated, and subway alignments. Consists of light
rail trains can be up to four cars in length. Station platforms can be of either low-level or
high-level configuration.

Light rail transit systems are in service in many areas in the U.S. including DART, Houston, Portland, Denver, Salt Lake City, Los Angeles, San Jose, San Francisco, Sacramento, St. Louis, New Jersey, Boston, and Baltimore. Exhibit VI-21 shows the
general characteristics of the LRT technology, and Exhibit VI-22 presents an illustration
of the technology.

EXHIBIT VI-21
CONVENTIONAL LIGHT RAIL CHARACTERISTICS

<table>
<thead>
<tr>
<th>General Description</th>
<th>Articulated multiple unit cars operating on city streets, at-grade, elevated, or subway alignments.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power Source</td>
<td>Electric with overhead catenary wire, usually 600 to 750 volts DC.</td>
</tr>
<tr>
<td>Stations and Typical Spacing</td>
<td>Low or high-level platforms with or without shelter or station structure with station spacing of ½ to 2 miles.</td>
</tr>
<tr>
<td>Maximum Operating Speed</td>
<td>55 to 65 mph</td>
</tr>
<tr>
<td>Typical Route Length</td>
<td>8 to 25 miles</td>
</tr>
<tr>
<td>Maximum Grade</td>
<td>7 percent</td>
</tr>
<tr>
<td>Cars or Units per Train</td>
<td>1 to 4</td>
</tr>
<tr>
<td>Seated Capacity per Unit</td>
<td>32 to 90</td>
</tr>
<tr>
<td>Capital Cost per Mile (Excluding ROW)</td>
<td>$20-55 million</td>
</tr>
<tr>
<td>Capital Cost per Vehicle</td>
<td>$2-3 million</td>
</tr>
<tr>
<td>Vehicle Life Expectancy</td>
<td>25 to 30 years</td>
</tr>
<tr>
<td>Availability</td>
<td>In production</td>
</tr>
</tbody>
</table>

Source: URS Corporation, in collaboration with the RRCS team
Bus Rapid Transit

Bus Rapid Transit (BRT) is considered to be a form of rapid transit, serving moderate length trips with frequent service. BRT traditionally operates in separate guideway and serves “stations” in a manner similar to that of light or regional rail. For the RRCS effort, BRT was evaluated in all corridors where there was little to no existing freight service or where there was a parallel roadway corridor available as an alternative. Under either scenario, BRT would be exclusive, with no other vehicles allowed on the running ways.

Within the rail corridor, BRT would be elevated over any main line railroad tracks and industrial track crossings would be equipped with lights, bells, and gates. Major roadway intersections of BRT running ways and streets would be grade-separated. Intersections
with other streets would be coordinated with traffic signals. The BRT would have priority, not pre-emption, at BRT roadway intersections.

The concrete BRT running way would consist of two thirteen-foot wide lanes with four-foot shoulders in order to allow bi-directional operation. At stations, a bus loading/unloading lane would be provided for each direction to allow express buses to pass other buses stopped at the station. The loading/unloading lanes would be one-half mile in length in order to allow for the deceleration and acceleration of buses. The BRT running ways would be fenced to the maximum extent possible to discourage trespassers.

BRT stations can have the following configurations, depending upon site-specific conditions:

- At-grade with side platforms
- At-grade with center platforms
- Elevated with side platforms
- Elevated with center platforms (preferred for elevated stations)

BRT station platforms would be designed to accommodate at least two buses at every platform in each direction. For some BRT operations in the RRCS corridors, the end station occurs in an area (for example, downtown Denton) where a loop bus operation is needed to allow the BRT to turn around and to provide more direct destination service. This is one of the benefits to BRT, in that it can operate outside the fixed guideway.
The vehicles for the BRT operation would be 60-foot articulated buses with a unique look and a seated capacity of approximately 60 passengers. Buses would have a maximum speed of 65 mph. The BRT operation would include ITS elements, such as automatic vehicle location, electronic fare collection, and passenger information and counting.

Generally, the level of service provided would be:

- 10-minute peak period headways and 15-minute off-peak period headways for an average weekday.
- Operating hours of 5 a.m. to 11 p.m. each day.
- Trip time would include an average station dwell time of 40 seconds and a terminal turn back time of 5 minutes on average at each station.

Each RRCS corridor would have specific issues related to the BRT implementation, relating to bridge structure needs, utilization of available right-of-way within the railroad corridor and the definition of appropriate station and platform configurations.

In those corridors where freight traffic is too prevalent within the rail corridor to allow for consideration of BRT in the railroad right-of-way, a parallel roadway facility can be used. Where HOV lanes are proposed in the long-range metropolitan plan, as amended in 2005, it would be appropriate to consider them for BRT implementation. Issues related to stations and direct ramp access would be important to consider. Specific design and interface issues would be clarified and resolved as part of a more detailed alternatives analysis for a corridor. Exhibit VI-23 presents an illustration of the BRT technology.
Evaluation Criteria and Consideration

To compare the various vehicle technologies among each other, a number of evaluation criteria were developed. These criteria measure not only the basic service and cost characteristics for each technology, but also the compatibility factors that are important considering additions within a region with various technologies already in operation. The criteria are:

- Compatibility with local land use and environmental plans;
- Compatibility with existing regional transit system;
- Compatibility with transit oriented development (TOD);
- Compatibility with railroad operations;
- Operations and service levels;
- Expandability and phasing;
- Availability;
- Capital cost; and
• Operating and maintenance costs.

COST DEFINITIONS

Both capital and operating costs were developed for the RRCS project using unit costs. These unit costs were consistent over all of the corridors so as to provide the most accurate planning level costs possible.

Capital and Operating Estimation Methodology

The estimating methodology selected to estimate the capital and operating costs used a combination of two basic procedures, a “bottom up” approach and a “top down” approach. The "bottom up" approach is used for elements for which reasonable assumptions about quantities can be made for the various transit technologies. These elements include the following:

• Fixed guideway trackwork;
• Bridge structures;
• Passenger stations, including fare collection equipment;
• Signaling system;
• Right-of-way acquisitions;
• Utilities;
• Roadway modifications; and
• Special conditions.

The "top down" approach is used to estimate the following elements:
• Vehicles; and
• Maintenance Facility Needs.

The majority of the cost categories comprising the Regional Rail Corridor Study capital cost estimate were developed based on the "bottom up" approach. In this approach, the cost of major work elements is determined by totaling the costs of their component parts. Again, given the conceptual nature of design, engineering and scope at this time, cost estimates will be used primarily for consistent evaluation of alternatives - not for preparation of grant requests or bid documents. Sufficient engineering data is required to reasonably define the scope of work and the quantities. Unit prices are developed and combined with the estimated quantities to determine the costs for each major category of work, such as guideway construction, trackwork, stations, signaling, roadway modifications, and special conditions.

Unit prices used for the development of capital cost estimates for the alternatives considered within each corridor of the Regional Rail Corridor Study were derived from several sources:

• Actual unit costs incurred in 2002 and 2003 for the most recent DART construction of the light rail program and the Trinity Railway Express commuter rail program.
• Actual unit costs incurred in 2002 and 2003 for civil-type construction within each city that a particular RRCS alternative resided within.
• Actual incurred costs for other commuter rail systems across the U.S., such as costs for commuter rail vehicles, maintenance facilities, signaling, and communications.
The approach used in some categories of conceptual estimating is referred to as the "top down" approach. In this method, an order-of-magnitude cost is determined, derived from similar projects, and this cost is used directly or divided by some measure such as track miles and applied as a unit cost. The cost for transit vehicles is generally derived from other projects and therefore is a top down unit cost. The systemwide elements, which are not specifically located, are top down unit costs.

There are four components of a capital cost estimate: the costs associated with civil/structural and special conditions; right-of-way needed for the project; systems and trackwork needed to operate the project (such as automatic train control, communications, etc.); and the vehicles and fare equipment. Within each of the capital cost components, there are additional factors that account for the other individual costs, which will accompany the direct costs of each component. These add-on factors include allowances for:

- Engineering and management;
- Project insurance;
- Conceptual estimate contingency; and
- Construction contingency.

These add-on factors are used in the final estimates as multipliers applied to the baseline construction costs to yield the full direct and indirect capital costs associated with a project. The amount or percentage of the add-on factor applied to the direct costs is based on the actual costs incurred during the engineering design and initial construction of various transit systems.
Operating and Maintenance Costs

Operating and Maintenance (O&M) cost for Regional Rail service were developed using a disaggregate, resource build-up O&M cost model, consistent with the methodology specified by the Federal Transit Administration (FTA) for feasibility and major investment studies. In addition to O&M cost data from TRE, peer system data were used to structure and determine average system O&M costs for a large regional rail system indicative of those resulting from the RRCS effort.

Specific line items were included for each unique labor position (track and way maintainer) and non-labor expense (track materials). Each labor and non-labor expense has been modeled as a separate line item, thus ensuring that the equations are mutually exclusive and cover all operating costs. O&M costs are calculated based on quantity of service supplied and other system characteristics derived from operating plans. Some departments and reporting units are excluded from the model because they are not related to the estimation of operating costs. The departments and reporting units that are excluded from the model are Rail Construction and Bus Operations. Labor costs reflect current DART wages for comparable positions and fuel costs reflect existing DART/TRE fuel rates per gallon.

Input variables determine nearly all costs in the model. Some items are linked to secondary variables such as employment or total cost. The model requires six input variables.

- **Peak Cars** – The maximum number of rail vehicles in scheduled service during peak
Periods.

- **Annual Revenue Car-Miles** – The total vehicle miles operated in revenue service during one year, excluding deadhead mileage.

- **Annual Revenue Train-Hours** – The total train-hours operated in revenue service during one year, excluding report and deadhead time.

- **Passenger Stations** – The number of stations in the system.

- **Directional Route-Miles** – The number of directional route-miles of revenue track, excluding yard and tail track. One route-mile of double track equals two directional route-miles.

- **Maintenance Facilities** – The number of rail maintenance and storage yards (dependent on system size).

- **Inflation Factor** – Cost estimates in the model can be inflated to a user-specified year.

**Corridor Worksheets**

Detailed planning level cost estimates may be found in the accompanying document, *Regional Rail Corridor Study – Corridors*.

**TRANSIT ORIENTED DEVELOPMENT**

Although the RRCS analysis of station areas was not detailed enough to evaluate specific transit-oriented developments, the topic was discussed at many of the Policy and Technical Committee and Public Meetings held for the project. This was done to promote TOD consideration as local governments embraced the concept of regional rail and began to look for ways to support transit in their communities. The following
discussion of TOD is included in this report to continue to encourage TOD consideration in all stages of corridor planning.

According to the American Public Transportation Association (APTA), transit-oriented development (TOD) is defined as compact, mixed-use development near new or existing public transportation infrastructure that serves housing, transportation and neighborhood goals. Its pedestrian-oriented design encourages residents and workers to drive their cars less and ride mass transit more. Some TOD projects can also be significant source of non-farebox revenue for the participating transit agency depending on their involvement with this development.

TOD differs from traditional suburban style development in that it is more compact, more pedestrian oriented, and includes a variety of land uses. There is a greater emphasis on the design of public spaces and streetscaping to make the area more appealing to pedestrians, in contrast to many suburban areas where walking is unsafe or unpleasant. Rather than dead-end streets and cul-de-sacs, TOD incorporates an interconnected street network, often in a grid or modified-grid pattern.

**Typical Features**

- Land uses that encourage transit ridership, typically within a quarter-mile radius of a transit stop.
- Small, human-scale, walkable neighborhoods and streets.
- Structured parking for best use of space.
- Municipal uses and public spaces for pedestrian traffic and community activity.
- Variety of residential options based on local conditions and needs.
• Reduction in driving by including a variety of uses such as banks, child-care, dry cleaners, video rental, athletic clubs, etc. within a walkable distance.

**Benefits**

• Increased transit ridership.
• Increased travel choices for people in the community.
• Easier connections between communities.
• Improved air quality and decreased traffic congestion.
• Increased opportunity for economic development.
• Stronger sense of community from pedestrian-friendly environment.
• Opportunity for "town centers" and unique gathering places.
• Enhanced property values within quarter-mile of station.
• Additional public and open space.

Most Transit Oriented Developments have four common elements. They typically provide a mix of uses, more compact development pattern, greater pedestrian orientation, and are transit supportive. These elements are discussed in further detail below:

• **Mix of uses** – Land use should be mixed both horizontally (different uses on the same site) and vertically (different uses within the same building). Suburban locations primarily focus on residential use with supportive commercial uses such as dry-cleaners and coffee shops. Employment uses may also be supported at activity centers and downtown locations.
- **Compact development** – Development should be constructed at medium to high densities compared to its surrounding area. However, density and the intensity of development are market driven and as a result, higher land values in a market will necessitate higher density development.

- **Pedestrian orientation** – The site layout should have interconnected blocks, streets, and open space that are within walking distance (typically a quarter mile radius from the transit stop). Buildings should be oriented toward the street with a range of streetscape enhancements that create an inviting pedestrian experience.

- **Transit Supportive** – The site plan for TOD’s should include strong pedestrian connections between housing and employment locations and the transit station. Further, the site plan should provide convenient auto access for transit riders using the park-and-ride facilities at stations that provide them.

Exhibit VI-24 shows the layout of a typical Transit Oriented Development where higher density development surrounds a transit station within a five-minute walk.

**EXHIBIT VI-24**

**TYPICAL TRANSIT ORIENTED DEVELOPMENT LAYOUT**

![Diagram of typical Transit Oriented Development layout]
Transit Oriented Development in the Dallas-Fort Worth Region

Light rail in the Dallas area has had an influence on the type and density of development that is possible. Stations located on the edge of the cities will have smaller-scale development to support the local structure. For example, the Illinois Station has single family residential, some retail and office uses, and light to heavy industrial uses surrounding the station. TOD around this station may include one- to two-story apartment buildings, several supportive retail uses, and a park-and-ride. Closer to the city center, development becomes more suburban and the denser the area, the more TOD occurs. For example, the Downtown Plano Station has single family, multi-family residential, retail and office space as well as light industrial. This station was built around a historic downtown with residential uses on the upper floors of the buildings and retail on the ground floor. The TOD in this location has dramatically revitalized downtown Plano (see Exhibit VI-25). Still closer are urban centers, where the Mockingbird Station provides the best example in the region. This station was privately planned and developed with urban lofts, retail and entertainment uses.
EXHIBIT VI-25

DOWNTOWN PLANO TOD EXAMPLE