6.0 Technical Methodology

6.1 Overview

This chapter summarizes the technical methodology and the assumptions used to estimate transit ridership, capital costs, and operating costs for the alternatives evaluated in the Southwest Transitway Alternatives Analysis (AA).

6.2 Ridership Forecasts

6.2.1 Background and Assumptions

A travel demand model is used to forecast transit ridership and auto traffic volumes, given a set of input assumptions that describe the location of the population, commercial development (in terms of employment), and the roadway and transit system. The model allows the testing of various alternatives, and is a useful tool to forecast the travel-related impacts of new transit improvements. It is also useful in forecasting future demand for other modes, including non-motorized modes such as walk and bike.

The Southwest Transitway AA used the Twin Cities Regional Travel Demand Model to estimate transit ridership. The Twin Cities model is a traditional 4-step travel demand model, which includes trip generation, trip distribution, mode choice, and assignment steps. The model is calibrated, maintained, and updated by the Metropolitan Council.

The regional model was used for the following reasons:

- It covers the entire region and is therefore comprehensive in geography and trip-making.
- It is the model used for long range planning by the Metropolitan Council.
- It is the model used by the Central Corridor and Northstar transit planning studies to forecast demand for Federal and State review.
- It has been reviewed by the Federal Transit Administration (FTA) for compliance with standard planning model practices.
- It is structured to permit full multi-modal demand estimation.

The regional model includes the 7-county area served by the Metropolitan Council. In addition, the model also encompasses the 13-county “ring” surrounding the 7-county area. It was developed based on data collected in 2001 and 2002 from a comprehensive home-interview survey of over 6,000 households, and an extensive survey of travelers entering and leaving the region. Actual ridership data from the Hiawatha LRT line has been used to validate the model. Since its original development, the model has been refined to better reflect observed data. This was done during the FTA review of planning work for the Central Corridor. This review process enhances the credibility of the model results for the Southwest Transitway AA. The FTA’s involvement in this type of model review has become a routine procedure in virtually all transit proposals that will eventually apply for federal funding assistance through the “New Starts” federal program. One important addition allowed by the FTA in the Twin Cities regional travel model is the “mode specific constant”, which allows the model to recognize additional attractiveness (or preference of travelers) to choose to use rail over equally effective bus service during the off-peak period.

The model produces the following results for each of the modeled alternatives:

- Daily transit boardings by route (alternative)

- Daily station boardings and alightings
- Daily transit segment ridership
- Level of service by traffic analysis zone (TAZ)

The latter measure is used to determine "user benefits", which is a measure of the total traveler time and cost savings that result from the alternative compared with the Enhanced Bus alternative. User benefits are one of the inputs used to calculate the cost-effectiveness index, which is an important FTA measure in the overall evaluation of the alternatives for potential federal funding. More information about the cost-effectiveness index is found within *Technical Memorandum No. 6: Travel Demand Forecasting Methodology and Ridership Results.*

6.2.2 Key Assumptions

The two major categories of input data to the model are demand data (who is traveling) and transportation supply data (physical highway and transit routes and capacity). The former consists of:

- Socioeconomic data including population, households, retail and non-retail employment by small areas (called traffic analysis zones or TAZs).
- External travel demand, represented by future year traffic volumes at the periphery of the modeled "ring" (13-county) area.
- Forecasts for enplanements at the Minneapolis-St. Paul International Airport.

Transportation supply data is represented as "highway" (i.e., surface street) networks and transit networks. Highway networks consist of all principal and major arterials and collectors in the 7-county region. The 2030 network also includes the planned and programmed improvements included in the Metropolitan Council's long range transportation plan, the *2030Transportation Policy Plan 2030.* It is the same network used for the current Central Corridor and Northstar Commuter Rail planning studies. There are no differences in the highway network between the transit alternatives in the Southwest Transitway AA.

The model's transit networks are also based on the Metropolitan Council's long range transit plan, the *2030 Transit Plan*. The transit networks include (for year 2030) the Northstar, Rush Line and Red Rock Commuter Rail lines, the Central Corridor and Hiawatha Light Rail Transit (LRT) lines and the three bus rapid transit (BRT) systems: I-35W, Cedar and Bottineau. Transit networks vary among alternatives, reflecting the No Build, Enhanced Bus and variations of the LRT and BRT alternatives. In addition to the LRT or BRT guideways and stations themselves, the alternatives are also defined by the system of feeder bus and compatible local bus services provided within each alternative, as well as the availability of park-and-ride spaces at certain stations.

The assumptions for hours of service and frequency of service are consistent with the operating plans discussed in Chapter 5, Definition of Alternatives.

6.2.3 Methodology

To assure a fair comparison between alternatives, the model used the same highway network for each alternative. The model also used the same transit network outside the Southwest Transitway study area for each alternative. Changes in the transit network inside the Southwest Transitway study area were limited to those identified in the definition of alternatives and operating plans.

The model also assumed a common travel demand for each alternative. This helped ensure that changes in ridership ensued from the different transit services specific to each alternative, and not from unrelated factors. To maintain a common travel demand, the model alternatives used a

common set of person-trip tables, which define the overall demand for travel, regardless of mode. These tables were established from the Enhanced Bus alternative model run.

The Southwest Transitway AA modeled 8 of the 11 alternatives studied. Ridership for the remaining alternatives was estimated using the differences between the modeled alternatives as "pivot points". For instance, the BRT 2 alternative was interpolated outside the model by comparing the difference between the LRT 1 and LRT 3 alignment demand, then adding that difference to the BRT 1 modeled data. In another example, the relative difference between LRT 1A and LRT 1C was applied to LRT 2C to initially estimate the ridership for LRT 2A.

The modeled alternatives were also used to estimate ridership for potential alignment options. For example, ridership estimates for the Hennepin Avenue alignment options were developed "off-line", based on changes in travel time and market accessibility.

More details about the methodology and assumptions used in the ridership estimates can be found in *Technical Memorandum No. 6: Travel Demand Forecasting Methodology and Ridership Results.*

6.3 Capital Costs

6.3.1 Background and Assumptions

Capital costs include the one-time expenditures to design and build the transitway. This includes right-of-way acquisition, bus guideways or rail trackwork, vehicles, structures, maintenance facilities, and signal, communication, and electrical systems.

The Southwest Transitway capital cost estimates are based on a conceptual level of design and reflect a number of assumptions about the scope of each alternative, design standards, unit costs, implementation schedule and inflation rates. The level of detail of the capital cost estimates corresponds with the current level of Southwest Transitway alternative definition, engineering, and environmental screening. The level of estimating detail typically increases as a project progresses from the AA to Preliminary Engineering and Final Design. As the level of design detail increases, more specificity in the cost estimates are realized which leads to the use lower contingencies in the cost estimate.

While the cost estimates include an allowance for contingencies that is intended to recognize the level of engineering available at this early stage, future project decisions may cause the cost estimates to increase or decrease. At this stage of analysis, the capital cost estimates are intended to be used primarily for making relative comparisons among the alternatives.

At the AA stage, the capital cost estimates are developed on a per unit basis. As additional studies are conducted, the capital cost estimates will be refined to reflect additional information.

6.3.2 Key Assumptions

The per unit capital costs were calculated for year 2006 and escalated to year 2015 by applying a compounded 2.7% annual escalation inflation rate, which is consistent with the escalation rate used for the Central Corridor in the *Central Corridor Draft Environmental Impact Statement, 2006.*

A large proportion of the potential right-of-way needed for several of the Southwest Transitway alternatives is already owned by the Hennepin County Regional Railroad Authority (HCRRA). This includes former railroad rights-of-way currently known as the Southwest Corridor, the Kenilworth Corridor, the Cedar Lake Corridor, and the Midtown Corridor. The Authority also owns land at

several potential station sites along these Southwest Transitway alignments. The transfer costs for acquiring any needed rights-of-way already owned by the HCRRA are not included in these capital cost estimates.

Throughout this study there has been an emphasis on building upon previous work by the HCRRA and others related to the Southwest Transitway, and consistency with the Central Corridor planning work. With respect to the capital cost estimates, that was accomplished by reviewing and validating previous estimates for the Southwest Transitway and Central Corridor, and maintaining consistent assumptions wherever reasonably possible.

6.3.3 Methodology

Capital cost estimates were prepared using the format and procedures currently recommended by the FTA. The FTA methodology includes the use of standard cost categories (SCC) and groupings for organization of the data, as well as linked spreadsheets for development of forecast year estimates and annualized capital costs. The FTA SCC organization for capital cost estimates was developed for application on project phases ranging from AA to final design and construction. The FTA SCC format is documented in Table 6.1.

The Southwest Transitway AA capital cost estimates were developed using a segmented and tiered approach. Each of the BRT and LRT alternatives were divided into geographic segments, many of which are common to multiple alternatives. Within each geographic segment the estimates have been separated into the individual SCC categories. Finally, each of those SCC categories consists of multiple line-items with corresponding quantities and unit prices.

The methodology differs for corridor-wide cost elements such as vehicles and support facilities, and for “soft costs” such as professional services and unallocated contingencies. Cost for those elements were identified and added after the individual corridor segment estimates had been combined into the full alternative estimates.

Table 6.1 FTA SCC Capital Cost Estimate Organization

10: Guideway Guideway grading and drainage; retaining walls, bridges and tunnels; LRT trackwork; BRT roadway construction; estimating contingency
20: Stations Construction of station platforms, enclosures, canopies and fixtures; elevators, escalators and stairs; multi-story auto parking structures; estimating contingency
30: Support Facilities Light-duty vehicle maintenance and storage facilities; LRT yard and yard trackwork; estimating contingency
40: Sitework and Special Conditions Demolition, clearing, and earthwork; utilities and utility relocation; hazardous soil and water remediation; environmental mitigation; reconstruction of roadways, intersection, and non-guideway structures; construction of surface parking at stations; pedestrian and bicycle accommodations, sidewalks and trails; landscaping, fencing and lighting; estimating contingency
50: Systems LRT train control signals and signal houses; LRT roadway crossing protection; LRT traction power substations; LRT overhead catenary system; communication systems; central control hardware and software; fare collection systems; roadway traffic signals; estimating contingency
60: Right-of-way Acquisition of right-of-way or easements for guideway, stations; relocation of existing households and businesses; estimating contingency
70: Vehicles Light rail vehicles, buses, non-revenue vehicles, spare parts; estimating contingency
80: Professional Services Preliminary engineering; final design; project management for design and construction; construction administration and management; insurance; legal, permits review fees; surveys, testing, investigation, inspection; agency force account work
90: Unallocated Contingency Overall project contingency and reserves
100: Finance Changes Estimated expenses for local financing of project activities prior to Federal funding commitment

Source: Federal Transit Administration, 2006

Further information about the methodology and assumptions used to calculate the capital costs can be found in *Technical Memorandum No. 7 Capital Cost Estimate*.

The capital cost estimates include two types of contingencies: allocated contingencies and unallocated contingencies. Allocated contingencies are contingencies that are associated with individual cost estimate categories. These contingencies are intended to compensate for unforeseen items of work, quantity fluctuations, and variances in unit costs that develop as the project progresses through the various stages of development. The level of contingency applied to each cost category reflects the relative potential variability of those costs. Table 6.2 lists the allocated contingencies by SCC category.

Table 6.2 Allocated Contingencies

SCC Category	Allocated Contingency
10: Guideway and Track Elements	20%
20: Stations	20%
30: Support Facilities	20%
40: Sitework and Special Conditions	20%
50: Systems	20%
60: Right-of-Way	100%
70: Vehicles	5%

Unallocated contingencies (SCC Category 90) are applied to the overall total capital cost estimate for each alternative. The estimates prepared for the Southwest Transitway AA include an unallocated contingency of 20%.

6.4 Operating Costs

6.4.1 Background and Assumptions

Annual operating and maintenance (O&M) costs consist of the ongoing costs of operating, maintaining, and managing the transit system. These costs typically include labor costs (wages, fringe benefits, and other costs) for bus and rail operators; fuel and electricity; parts, fluids and other materials for maintaining the vehicles; the non-labor operating costs of utilities and materials for cleaning and maintaining facilities; administrative costs; and insurance.

6.4.2 Key Assumptions

The annual operating and maintenance costs estimates for the Southwest Transitway alternatives assume all service identified in the Metropolitan Council's *2030 Transit Plan* is operational. The *2030 Transit Plan* includes an assumption that transit ridership will double through a combination of improved bus service and the implementation of numerous transitways. By 2030, the Metropolitan Council assumes the Hiawatha LRT line, the Northstar Commuter Rail line, the Central LRT line, the Cedar Avenue, I-35W and Bottineau Boulevard BRT lines, the Red Rock Commuter Rail, and the Rush Line Commuter Rail lines are implemented.

Operating and maintenance costs were estimated in 2005 dollars and then escalated to 2015 dollars at a compounded annual escalation rate of 2.7%, which is consistent with the escalation rate used for the *Central Corridor Draft Environmental Impact Statement (DEIS), 2006*.

6.4.3 Methodology

The methodology used to develop the annual operating and maintenance costs for each alternative is consistent with the requirements of the FTA's New Starts process. The annual operating and maintenance cost estimates include all transit service changes for the entire regional transit system. This ensures that the annual costs of operating all transit service, bus and rail, is included.

Annual operating and maintenance costs for the alternatives were estimated using a method called a multi-factor cost model. The cost model uses actual operating and maintenance costs that Metro Transit reports to the FTA's National Transit Database (NTD), a database maintained by the FTA to monitor and report the performance of mass transit agencies in the United States.

The cost model disaggregates these reported costs into categories that can be reasonably assumed to vary with quantities of service provided. For example, some categories of operating costs tend to vary by miles of service (such as fuel costs), while others vary by hours of service (such as driver labor and fringe benefits), or the number of required peak vehicles (such as vehicle cleaning).

The cost model then applies these cost categories to operating statistics that express the different quantities of service for each alternative. These operating statistics act as cost drivers for each alternative's operating and maintenance costs; cost categories for each alternative increase or decrease according to changes in operating statistics.

The Southwest Transitway AA cost model used four operating cost statistics:

- Vehicle revenue hours of service
- Vehicle revenue miles of service
- Number of vehicles required in maximum service
- Number of fixed guideway miles

The model used both outputs from the Twin Cities Regional Model and assumptions provided by Metro Transit staff to determine the operating statistics for each alternative.

Administrative costs are assumed to increase proportionally in response to changes in the volume of service based on their current proportion in the cost of operating the transit system. The model allows some cost items to remain "fixed" and invariable regardless of the volume of service operated.

A full breakdown of the O&M cost items and their assignment by cost categories is provided in *Technical Memorandum No. 8, Operating Cost Estimates*.