Legacy Parkway Supplemental Environmental Impact Statement

Draft Technical Memorandum on Integration of Highways and Transit In the North Corridor

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LIST OF EXHIBITS

ABBREVIATIONS AND ACRONYMS

BRT .... Bus Rapid Transit
CBD .... Central Business District
CPIC .... Community Planning Information Committee
FEIS .... Final Environmental Impact Statement
FHWA .... Federal Highway Administration
FTA .... Federal Transit Administration
HOT .... High Occupancy Toll Lanes
HOV .... High Occupancy Vehicle Lanes
ITS .... Intelligent Transportation Systems
LRP .... Long Range Plan
LRT .... Light Rail Transit
NEPA .... National Environmental Policy Act
ROW .... Right-of-Way
SEIS .... Supplemental Environmental Impact Statement
TDM .... Travel Demand Management
TOD .... Transit Oriented Development
TRAX .... Salt Lake City Light Rail System
TSM .... Transportation System Management
UBET .... Utahans for Better Transportation
UDOT .... Utah Department of Transportation
USACE .... U.S. Army Corps of Engineers
UTA .... Utah Transit Authority
U of U .... University of Utah
WFRC .... Wasatch Front Regional Council

LIST OF PREPARERS

The following list describes the qualifications of the Legacy Parkway Integration Technical Memorandum authors.

Gerard Walters, Fehr & Peers. Mr. Walters holds a B.S. degree in Engineering Science and an M.S. degree in Transportation Engineering. He has 29 years experience in smart growth planning studies, integrated land use and transportation studies, travel demand modeling and forecasting, and transit and station area planning.

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1.0 Introduction

The United States Court of Appeals, 10th Circuit remanded the *Legacy Parkway Final Environmental Impact Statement (FEIS) and Section 4(f), 6(f) Evaluation* for additional information concerning:

1. The Denver & Rio Grande (D&RG) alignment as an alternative.
2. Alternative sequencing of the shared solution.
3. Integration of the Legacy Parkway and mass transit.
4. Impacts on wildlife.
5. Practicability of a narrower right-of-way (ROW).

This technical memorandum has been prepared to present detailed information to the U.S. Army Corps of Engineers (USACE), Federal Highway Administration (FHWA), and Utah Department of Transportation (UDOT) related to the third item above, integration of the Legacy Parkway and mass transit. Specifically, this memorandum identifies how the roads and transit system could be built together, how they could function with one another, and how the usage of both systems could be optimized. Separate technical memoranda have been developed regarding the other above issues raised by the Court.

1.1 Organization of the Technical Memorandum

This document is organized into ten sections.

- Section 1.0, “Introduction,” summarizes the Court’s findings to provide context for the information presented herein on integration of mass transit and the Legacy Parkway.

- Section 2.0, “Integration Assessment Process,” provides an overview of the analysis approach.

- Section 3.0, “Potential Transit Enhancements,” describes how the potential transit enhancements were identified and screened.

- Section 4.0, “Establishing Accuracy of Analysis Methods,” describes the tests used to ensure the analysis meets or exceeds professional standards of accuracy.
- Section 5.0, “Evaluation of Individual Enhancements,” identifies a short list of viable enhancements to be used in defining integrated transit enhancement packages.
- Section 6.0, “Defining Transit-Supportive Land Use,” describes how the transit-supportive land use plan was developed.
- Section 7.0, “Integrated Transit Enhancement Packages,” describes the components of two reasonable maximum transit packages.
- Section 8.0, “Integration Analysis,” describes the performance of each maximum transit package with the Legacy Parkway.
- Section 9.0, “Physical Integration,” describes the physical elements required to ensure transit can be accommodated within the Legacy Parkway right-of-way and describes how the roads and transit elements of the north corridor shared solution work together.
- Section 10, “Conclusions,” provides conclusions from the integration analysis.

1.2 Summary of Circuit Court Findings

The Court ruled that the FEIS failed to consider integrating the construction of the Legacy Parkway with the expansion of public transit.

Although the Court ruled that the FEIS was inadequate because “…integration [was omitted] as a reasonable alternative…”, the Court did not provide the federal lead agencies with guidance on how “integration” should be defined. To ensure that the concept of integration was adequately addressed in the Supplemental EIS (SEIS), the federal lead agencies used the SEIS scoping process to determine the public concerns and desires relative to an Integration Alternative.

Based on input received during the scoping meetings, the following factors were considered in the *Integration* analysis:

- Assume that all components are built,
- Optimize road and transit systems, and supporting sub-systems, and
- Describe how the roads and transit function with one another.

This integration analysis addresses how different transportation improvements could be coordinated, by identifying and evaluating alternative ways of integrating the transportation network.

2.0 Integration Assessment Process

2.1 Objectives and Approach

The lead Federal agencies, guided by the Court decision on integration and the National Environmental Policy Act (NEPA), and exercising their discretion and best professional judgments, and assisted by their own experts and a public scoping process conducted an integration analysis with the following objectives.

§ Objectively evaluate reasonable future transportation networks that blend roads, rail, buses, high-occupancy vehicle (HOV), and park-and-ride facilities.

§ Consider transportation and land use scenarios that are feasible, reasonably foreseeable, and practicable (taking into consideration cost, existing technology, and logistics in light of overall project purpose). Include only scenarios that are feasible without basic changes in statutes or policies of responsible agencies.

§ Evaluate transit-supportive land use and travel demand management (TDM) to the extent supportable by existing local plans and policies

§ Use the most reliable and objective methods available, including the latest peer-reviewed and validated version of the WFRC regional travel forecasting models and credible empirical data from other sources.

To meet these objectives, a technical team was formed to monitor progress, review technical analysis, and provide input/guidance at key points in the overall process. This team comprised representatives from the lead agencies, Federal Highway Administration and U.S. Army Corps or Engineers, as well as the Utah Department of Transportation (UDOT), the Utah Transit Authority (UTA), and Wasatch Front Regional Council (WFRC). In addition, the Community Planning Information Committee (CPIC) was consulted to help ensure the objectives were met. CPIC consists of both local government officials from the north corridor and non-governmental organizations such as the Future Moves Coalition, Utahns for Better Transportation (UBET), and the Sierra Club.

To develop the optimal integration of roads and transit, the study team refined and enhanced the definition of transit and transit/ highway interfaces in the North Corridor. The team also updated the analysis methods used to measure the effectiveness of the integrated transportation modes. The process involved the following steps.

§ Step 1: Identify full list of potential transit enhancements, including transit-supportive land use and TDM.

§ Step 2: Establish credibility of analysis methods, including testing and upgrading mode-choice model sensitivity or using off-model methods.

§ Step 3: Determine maximum feasible range of change in each transit-supportive element.

§ Step 4: Determine likely effectiveness of each enhancement.

§ Step 5: Screen enhancements based on practicability.

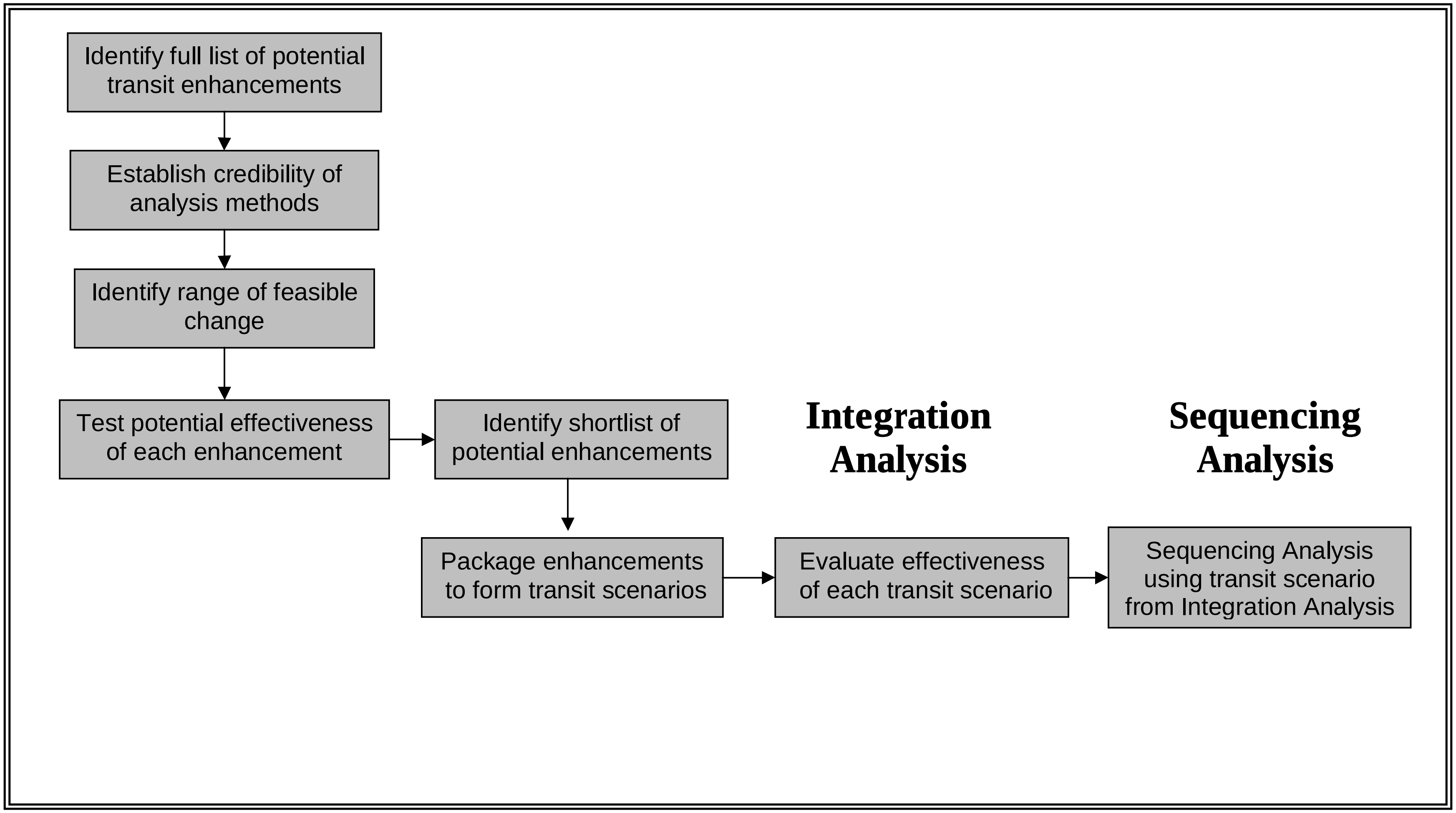
§ Step 6: Prioritize and package effective measures into maximum transit scenarios.

§ Step 7: Perform integration analysis to determine effectiveness of maximum transit packages.

§ Step 8: Advance most effective integration packages as new descriptions of the transit element of the ultimate shared solution, and conduct sequencing analysis to examine implementation staging of the elements of the refined shared solution.

At strategic milestones in the analysis process, meetings were held with CPIC members to discuss approach, report interim findings and obtain input. In addition, a subcommittee of CPIC met in early October 2003 to develop land use assumptions for the assessment of potential transit oriented development (TOD). Exhibit 1 illustrates the assessment process.

Exhibit 1. Integration and Sequencing Assessment Process



2.2 Analysis Framework

The analysis procedures and measures-of-effectiveness were specified to be consistent with those employed in the FEIS, unless information had been superseded or methods made more accurate in the interim. Consistent with the FEIS, the integration analysis focuses on 2020 p.m. peak-hour, peak-direction travel demand volume at the Woods Cross "screenline," expressed as passenger-car equivalents. A *screenline* is an imaginary line used to measure typical traffic patterns flowing through a corridor (i.e., counting the number of vehicles on all roads and transit lines crossing and east/west oriented screenline at Woods Cross measures all north/south travel flowing through that section of South Davis County). The Woods Cross screenline, shown in Exhibit 2, was used in the FEIS to measure travel along the northern transportation corridor.

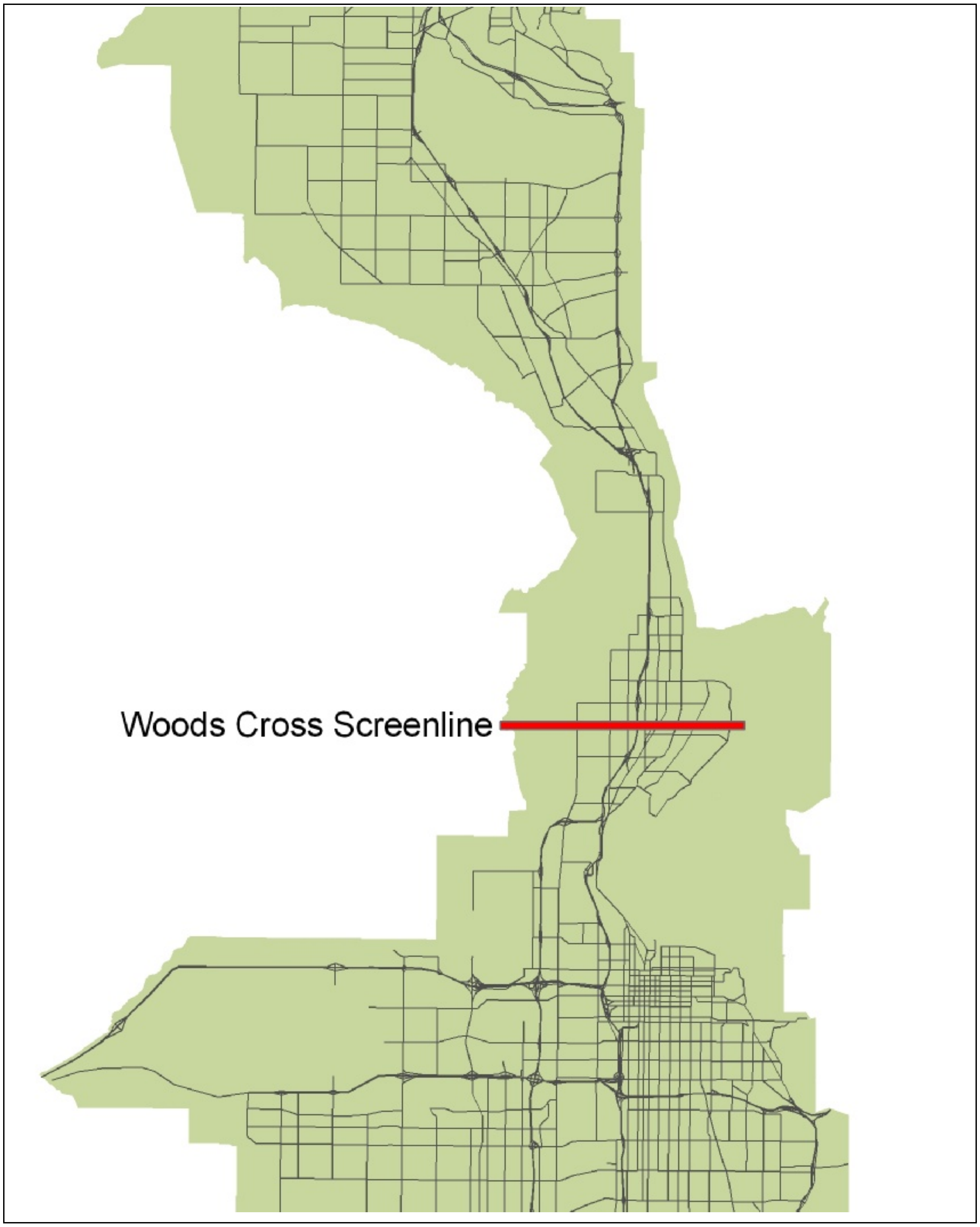
For consistency with the FEIS, this integration analysis addresses a 2020 planning horizon. The feasible set of highway improvements for 2020, based on funding realities and staged construction of multiple highway and transit improvements in the North Corridor, includes Legacy Parkway proposed project and the set of enhanced transit improvements defined by the above process, I-15 in the Preferred Alternative configuration described in the I-15 North Corridor Downtown Salt Lake City to Kaysville DEIS (ten-lane cross-section), but does not include the extension of Legacy Parkway north of Farmington in the northwest Davis County.

The Integration analysis considers a multi-modal approach to solving the 2020 transportation needs in the north corridor. The Integration scenario defines an enhanced set of transportation improvements and interfaces in the corridor, including:

- Transportation system management (TSM) and intelligent transportation system (ITS) measures to fully utilize the capacities of the current and improved arterials, highways, and transit systems.

- TDM to encourage less use of single-occupancy vehicles and less peak-hour use.

Exhibit 2. North Corridor Travel Screenline



- An expansion of the public transit system to the maximum reasonable level.
- Construction of a four-lane Legacy Parkway.

- Consideration of physical integration of enhanced bus and rail transit, park-and-ride and HOV facilities, with planned highway improvements.

The Integration analysis uses the latest WFRC socio-economic projections (superseding the forecasts used in the FEIS), and WFRC travel forecasting models version 3.2, updated and recalibrated in February 2004. Relative to the FEIS, principal changes in the analysis assumptions and methodology are:

1. Updates to the officially adopted land use forecasts for the north corridor and for the region. Changes include a roughly 20% reduction in North Corridor population and employment and an improved balance between corridor jobs and housing. As indicated below, both of these changes lead to a reduction in projected 2020 travel demand (person trips) in the corridor.
2. Improvements to the WFRC travel forecasting model. The model has undergone continuous update and refinement in recent years and represents a "state of the practice" model. Improvements since the model version used in the FEIS analysis include: a) implementation of "feedback", through which the model responds to the effects of highway congestion on travelers' propensity to travel to certain destinations (trip distribution), b) state-of-practice "nested logit" mode choice model validated against UTA transit on-board survey data, c) ability to directly estimate travel in the peak-period time frame rather than only on a daily basis. By reflecting travel congestion in the trip distribution and mode choice decisions, the current model is more sensitive to latent demand in the corridor.
3. Updates to the future regional transportation network to reflect the region's latest adopted transportation Long Range Plan (LRP). The Integration analysis reported in this memorandum also considers a set of "extraordinary" transit improvements and demand management policies that could conceivably be implemented in the north corridor but which are not included within the December 2003 fiscally constrained plan.
4. Recently developed methods to capture the travel effects of transit-oriented land use patterns. The Integration analysis uses off-model adjustments to overcome minor insensitivities within the model when compared with empirical data on traveler responses to changes in land use and transit oriented development. These adjustments are described below.

The enhanced WFRC travel forecasting model accounts for the primary elements of travel demand management (TDM), reducing the extent of separate manual adjustments to the demand forecasts of the type performed in the FEIS unnecessary. The current model directly reflects users' travel costs and times by respective modes, including: transit fares, transit transfer ease, parking costs, congestion delays, opportunities to travel at non-peak times, availability of HOV lanes and park-and-ride lots, minimizing the need for off-model adjustments. Therefore, in the current analysis, off-model adjustments are limited to situations in which the model is demonstrated to be under-responsive to TDM effects as described below.

The current analysis also takes more explicit steps to account for the capacity benefits of Intelligent Transportation Systems (ITS). The FEIS method involved adjusting traffic demand to account for the capacity benefits of ITS. The current analysis more directly accounts for the traffic capacity and highway operations benefits of ITS, rather than compensating through an adjustment to non-automobile travel demand.

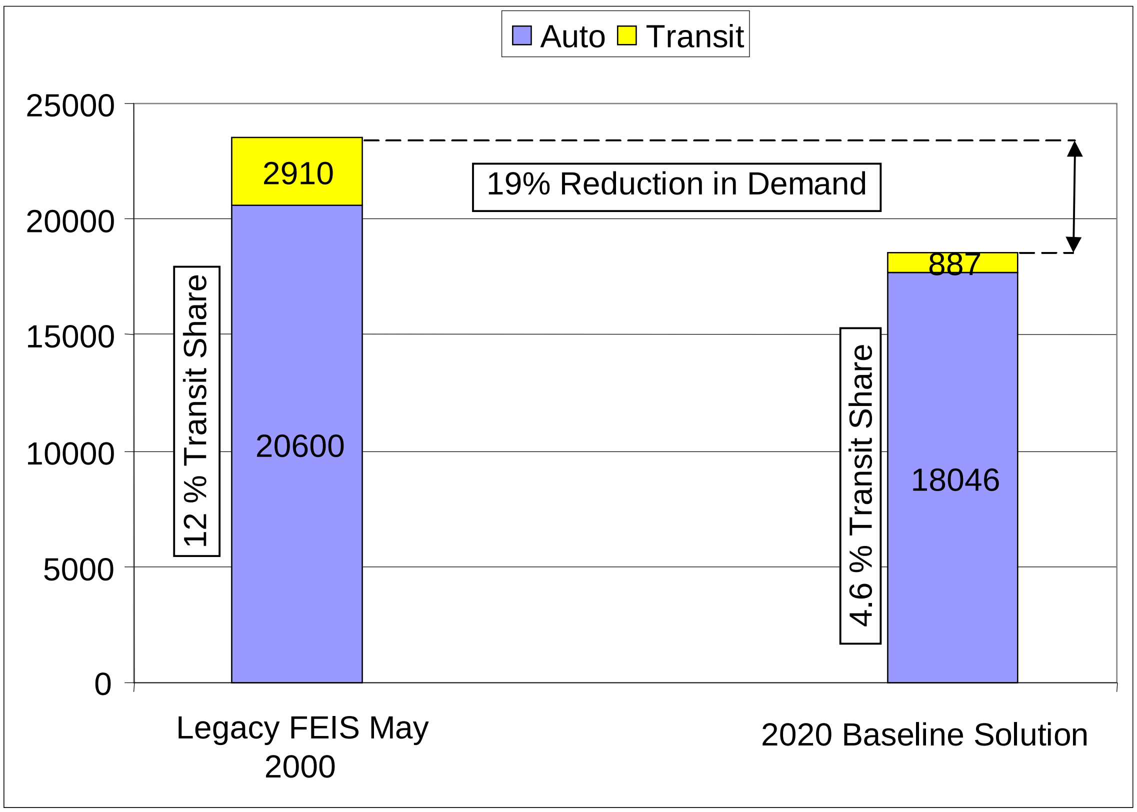
2.3 Analysis Results

Exhibit 3 compares the results for the shared solution from the 2000 FEIS with the results of the 2004 re-analysis. In both results, trips that opt to use transit due to TDM measures are included in the transit trip segment of the bar. Legacy Parkway is assumed to be in place by 2020 in both analysis cases. I-15, was assumed to be widened to 10 lanes by 2020 in the 2000 FEIS and in the 2004 analysis. Each case uses the set of 2020 transit elements reflected in the most up-to-date 2020 LRP available at the time the analysis was performed. Beyond the stated differences in transit systems, the primary differences in the two sets of 2020 forecasts stem from the updated travel model and socio-economic forecasts. The new forecasts of total corridor travel demand at the Woods Cross screenline are about 19% lower than those presented in the FEIS. The changes result from more accurate modeling methods (better representing trip lengths and extra-regional long distance travel) that were not available when the FEIS was prepared.

Exhibit 3. 2020 Travel Forecasts with LRP Transit

- PM Peak-Hour Peak-Direction Passenger Car Equivalents (PCE's) at Woods Cross Screenline

- Forecast contained in 2000 FEIS, which was based on 2000 LRP transit, with Legacy Parkway and 10-lane I-15, compared to 2004 WFRC model forecasts, which use updated 2004 socio-economic projections and models, December 2003 LRP transit, Legacy Parkway and a 10-lane I-15.



Based on the latest forecasts, transit would carry about 5% of total peak-hour, peak-direction travelers in the corridor, with transit service expansion defined in the December 2003 LRP (see Appendix A of this Tech Memo), but without further multi-modal transit enhancement and coordination considered in this Integration analysis. The updated 2020 transit forecast reflects a more-than-doubling of existing corridor transit ridership. The estimated 887 directional peak-hour transit passenger-car-equivalents translate to approximately 1150 transit riders in 2020. This compares with a current count of about 500 to 550 peak-hour peak-direction transit riders at the same location based on the 2002 UTA on-board ridership survey. The FEIS reported about 990 peak period transit riders in the corridor in year 2000. This figure accounts for all of the passenger boardings and alightings on corridor transit lines and is not limited to passenger travel crossing the screenline. It includes about 400 to 450 trips that were intra-corridor local trips, for example trips beginning and ending entirely within Farmington, as well as about 500 to 550 longer distance trips that actually cross the study screenline. By direct comparison, then, the projected 1150 corridor screenline transit riders in 2020 would represent more than twice the year 2000 ridership.

3.0 Potential Transit Enhancements

3.1 Transit Enhancement Options

The integration analysis process included a public scoping session in June and September 2003 to solicit comments from local governments and the public on potential measures to enhance alternate mode performance and multi-modal integration in the corridor. Oral and written comments received during the scoping period requested consideration of the following potential transit and modal integration enhancements in the corridor.

- Commuter rail (CRT).
- Light rail transit (LRT).
- Bus rapid transit (BRT).
- Express bus.
- Feeder bus.
- Local bus.
- Route deviation bus service.
- Seamless transfers.
- Service frequencies.
- Fare structure.
- Service coverage.
- Transit funding.
- Parking pricing.
- High-occupancy vehicle (HOV) lanes.
- High-occupancy toll (HOT) lanes.

- Land use intensification.
  - Rail stations
  - Central business district (CBD)
  - Transit corridors
- Urban design – land use density and diversity.
- Urban design – public spaces.
- Park-and-ride capacity.
- Transit access.
- Intelligent transportation systems/transportation systems management (ITS/TSM).
- Travel demand management (TDM), such as guaranteed ride home.

This represents the full list of transit enhancements that were considered in this integration analysis, as called for in the first step of the integration analysis process (Exhibit 1).

3.2 Initial Screening of Options

Review of the full list of enhancement options revealed that several were already included in the regional transportation long range plan (LRP) and, therefore, already included in the transportation analysis models. Consequently, the following were included in the integration scenarios without being subjected to further individual effectiveness testing or screening: park-and-ride lots at all major transit centers and HOV interfaces with unconstrained capacity and land use intensification in downtown Salt Lake City.

Several suggested options were screened out based on practicability. Following several discussions with CPIC members and a review of cost implications and the status of current planning and decision-making in the corridor, TRAX-type light rail transit extensions were eliminated from consideration for 2020 implementation in the corridor. The following are the primary reasons for not including LRT as a reasonably foreseeable facility in the 2020 integration scenarios.

§ Capital funding for an LRT extension is not available, nor reasonably foreseeable, even under the aggressive funding scenario in the recent LRP update. (Source: WFRC, 2004-2030 Long Range Plan, adopted December 18, 2003).

§ Davis County mayoral support currently favors BRT over LRT, at least as a solution for the next 20 years. (Source: WFRC 2003).

§ UTA supports BRT over LRT because sensitivity modeling of potential LRT effectiveness in the corridor found that LRT would not generate significantly more ridership than BRT and the LRT cost would be much higher. (Source: UTA 2003).

§ Certain CPIC representatives requested that higher priority be placed on strengthening east/west feeder system to other corridor mainline transit (commuter rail and BRT) than on investing in a third mainline mode. (Discussions between UBET representatives and their experts and responsible agencies and their consultants at November 5, 2003 CPIC subcommittee meeting).

Commuter rail (at service levels above those currently proposed) and new BRT service are both included in the group of potential enhancements to transit considered for the corridor.

After preliminary review of the corridor transportation market demand, the following options were also removed from further consideration: HOV and HOT lanes on Legacy Parkway. Overall corridor travel demand is comprised of about 50% through traffic (including abut 65% through on I-15) and less than 10% traffic bound for the Salt Lake CBD. Of the facilities in the corridor, arterials and I-15 handle most of the local and downtown traffic and Legacy Parkway is mainly oriented toward through traffic. Consequently, projected travel market demand indicates that 85 percent of travel served by Legacy Parkway would be long-distance through traffic compared to 2 percent being commuter travel to the Salt Lake CBD. Long-distance through traffic is less likely to use HOV lanes than commuter traffic. The magnitude of potential HOV demand for Legacy Parkway would not justify reserving two of its four lanes for HOV use, and the magnitude of peak-hour congestion projected for Legacy is lower than congestion projected on I-15, ruling out designating a pair of HOT lanes on Legacy.

Alternatives that include major physical changes to other elements of the shared solution were not considered. This integration analysis, therefore, does not address such capacity-limiting alternatives as reducing I-15 to a single, reversible HOV lane, or eliminating Legacy Parkway as a means of increasing traffic congestion and discouraging automobile use.

4.0 Establishing Accuracy of Analysis Methods

The WFRC travel forecasting model has undergone a series of upgrades and refinements since 2001, and the regional mode choice model now used by WFRC is state of the practice. Trip generation categories, trip lengths for internal/external travel, and trip distribution for major generators have all been recalibrated based on local data from the updated WFRC model. In a peer-review process, a set of recommended improvements were incorporated into the mode choice model, including introduction of a sophisticated “nested logit” choice model, incorporation of mode choice for all trip purposes, and calibration to local transit ridership data. The mode choice model has been reviewed by the Federal Transit Administration (FTA) as part of the New Starts application for major transit investments in the region.

The model used for the Integration analysis does not include the UrbanSim land use allocation model currently under review by WFRC. Instead, the Integration analysis process received direct input from corridor city and county planning experts and elected officials on likely land use policies and future development patterns within their respective jurisdictions.

To further ensure that the technical methods used in this integration analysis meet or exceed professional standards of accuracy, the consultant team performed a series of methodological tests. These included tests to determine the sensitivity of the travel forecasting models to change in transit and land use variables and tests to compare the results of this analysis to results of empirical studies of similar situations. The testing process involved the following steps.

1. For each potential transit enhancement, define range of maximum variability (e.g., maximum frequency of bus or rail service, maximum land use density).

2. Conduct literature review of national experience on travel response to transportation system change.

3. Use latest WFRC model to test ridership sensitivity to range of variation in each transit enhancement

4. Compare the model's sensitivity changes in transit service (percentage change in transit ridership resulting from a percentage change in transit service) to empirical findings. Empirical findings on ridership sensitivity were drawn from the latest updated information in the Transportation Research Board's compendium of national experience "Traveler Response to Transportation System Change"[1].

5. Identify the most dependable method of estimating travel change: model-based or off-model empirically based.

These steps were performed in direct consultation with WFRC modelers and UTA travel forecasters, and the results were reviewed with CPIC in September 2003.

The analysis determined that the model performed reliably with respect to measuring ridership changes associated with changes in rail and bus service, mode interfaces, fares, and parking costs. In several respects not ordinarily addressed in conventional travel models, the model review found that additional off-model adjustments would be needed to improve the forecasts. The integration analysis, therefore, supplemented the WFRC model with empirically based adjustments (published by the Transportation Research Board) to forecast the effects of changes deemed reasonable and foreseeable by the responsible local jurisdictions and regional agencies to the design of TOD and land use characteristics within immediate proximity of transit stations, and with respect to incentive-based TDM policies other than parking costs and transit fares.

[1] Transportation Research Board, Traveler Response to Transportation System Changes, Handbook (DOT-FH-11-9579), TCRP Project B-12, 1999-2003.

5.0 Evaluation of Individual Enhancements

The robust transit scenarios for this integration analysis considered the following four complementary strategies.

1. Improve the quality and efficiency of transit service for transit travel along and through the corridor.

2. Improve means available to access mainline service through more distributed and comprehensive feeder service and/or land use patterns designed to take advantage of both mainline and feeder transit services (as described in the Technical Appendix).

3. Create synergies between land use and transit by emphasizing more intensive, transit-oriented and pedestrian-oriented development at transit hubs and opportunity sites.

4. Implement economic and policy incentives to use transit and discourage automobile use, without reducing traffic Level of Service standards.

The full list of transit-related enhancements can be categorized as follows according to these strategies.

- Quality and quantity of transit service.
  - Commuter rail, express bus, BRT and transit ITS.
  - Feeder bus and local bus.
  - Seamless transfers and service frequencies.
- Proximity and access to transit.
  - Land use intensification along corridors.
  - Expanded bus service coverage.
  - Transit access efficiency.
  - Route deviation bus service.
- Transit-oriented development (TOD).
  - Land use intensification at rail stations.
  - Urban design: density, diversity, and public spaces.

- Travel demand management (TDM).
  - Parking pricing.
  - Transit fare structure.
  - Employer incentives and guaranteed ride.

The effectiveness testing process considered each of these categories generally, and also evaluated most of the individual elements, or proxies, from each category. The analysis did not specifically address the cost or funding sources for implementing these strategies. It focused on predicting their effectiveness. For testing purposes, the level of change introduced for each element tended toward the highest level that might reasonably be considered relative to the planned LRP level. This was done in order to test the range of model sensitivity and to provide the study team an understanding of the maximum transit potential effect of each element. It was not intended that a robust transit strategy would necessarily include maximum emphasis on all potential program elements. The testing was performed terms of daily transit ridership change in order to provide a basis for comparison against the empirical data reported in the literature.

Exhibit 4 summarizes the analysis findings for transit ridership increases resulting from category-level and individual transit/land use enhancements. The exhibit also indicates where the standard WFRC model did not demonstrate a reasonable level of sensitivity based on empirical evidence of the effectiveness of individual measures. The analysis also revealed that the following elements had the most significant effect on corridor mode-split percentages: commuter rail service increase, transit-supportive land use and TOD, express bus, seamless transit transfers, and parking cost increases.

Upon reviewing and discussing the results, city and county representatives of CPIC expressed support for a robust transit scenario, including commuter rail, BRT and transit-supportive land use.

Exhibit 4. Comparison of Model Estimates to Empirical Evidence of Transit Ridership Increases for Individual Transit/Land Use Enhancements

Transit Enhancement	Range of Variability Tested[1]	Model Response[2]	Empirical Evidence[3]
Commuter Rail	Double train frequency (from 30 to 15 minutes)	Ridership up 47%	NA
Bus Rapid Transit (BRT)	Five BRT routes added on US-89 (increased total BRT routes from zero to five)	Ridership up 40%	Ridership up 20–50%
Express Bus	Increase frequency 50–100% (from 15 or 20 minutes to 10 minutes)	Ridership up 84%	Ridership up 28%
Local Bus	Double frequency (from 30 to 15 minutes, or from 20 to 10 minutes)	Ridership up 4%	Ridership up 33%
Seamless Transfer	Reduce from 15 to 5 minutes	Ridership up 29%	Ridership up 33%
Transit Access	90% of all people within walking distance (0.25 mi) of any type of transit service	Area transit share up 2%	Area Transit Share up <5%
Transit-Oriented Design (TOD)	Double walkability, connectivity (placing transit-oriented development within 0.25 mile of stations)	*Negligible*	*Auto Trip Gen down 3%*
Proximity to Transit Stations	Double 0.5 mile density (varied by station)	*Ridership up 7%*	*Ridership up 20–25%*
Transit Fares	Reduce current fare by 50%	Transit share up 10%	Transit share up 10% –20%
Parking Costs	Increase current parking costs in the Salt Lake City central business district 50%	Central business district transit share up 2%	Central business district Auto Trips Down 15%
Travel Demand Management (TDM)	Available to 15% to 20% of employees (up from zero)	*NA*	*Screenline Share up 5%*

Notes:

1 Range of variability tested was the highest level that could reasonably be considered possible relative to the current long range plan; i.e. if long range plan stated that commuter rail would run every 30 minutes, analysis doubled it to run every 15 minutes. The range of variability is not the level used in the maximum future transit packages; instead, it is a level used to provide the study team with the maximum potential effectiveness of each element to serve as a starting point for the development of robust transit packages.

2 In several respects not ordinarily addressed in conventional travel models, the model review found that additional off-model adjustments would be needed to improve the forecasts. Italicized text indicates that the WFRC model is not sufficiently sensitive to changes to the land use/transit enhancement being tested, and therefore the analysis includes off-model adjustments based on empirical findings.

3 Empirical findings used were published by the Transportation Research Board, *Traveler Response to Transportation System Chang*, TCRP Project B12, Third Edition, USDOT, 1999–2003.

4 Italicized text indicates off-model adjustments will be used to incorporate this empirical evidence into forecasting.

NA = Not applicable.

6.0 Defining Transit-Supportive Land Use

To define the maximum level of transit-supportive land use achievable in the corridor, a CPIC land use subcommittee was convened. Representatives of local jurisdictions identified TOD potential around prospective transit nodes for a robust transit system as part of the shared solution. Other CPIC members discussed TOD opportunities with individual jurisdiction representatives during the planning process and follow-up presentations during the meeting.

The subcommittee meeting was attended by almost 40 CPIC members and other interested parties. Attendees included representatives of each jurisdiction with transit opportunity sites in the corridor: the Cities of Woods Cross, Centerville, Farmington, Bountiful, and West Bountiful, as well as Davis County. Representatives of UBET and the Sierra Club also participated. Federal, state, and regional agency representatives and consultants also attended, including FHWA, UDOT and WFRC.

Through a planning session that included individual break-out sessions and full group discussions, CPIC local jurisdiction representatives identified the highest level of transit-oriented land use that the jurisdiction, community members, property owners, and future real-estate market could support within areas surrounding commuter rail stations and prospective BRT stops. The planning exercise was based on the following two ground-rules.

§ Participants were asked to base their recommendations on current or reasonably anticipated plans and policies and to avoid pure speculation.

§ Participants were asked to maintain city-wide growth totals. (It was assumed that allocations of additional growth to TOD areas beyond the levels allocated by WFRC through the regional process would not increase total jobs or housing in the corridor or any individual city. Therefore, increased growth allocation to TOD areas within a city would reduce future development levels in other parts of the city.)

City and county representatives identified a number of parcel-specific land use changes and decisions that were underway within the influence areas of their transit station. City representatives presented their recommendations to the full group and responded to questions and comments. Exhibit 5 illustrates the depth of the evaluation and related discussion.

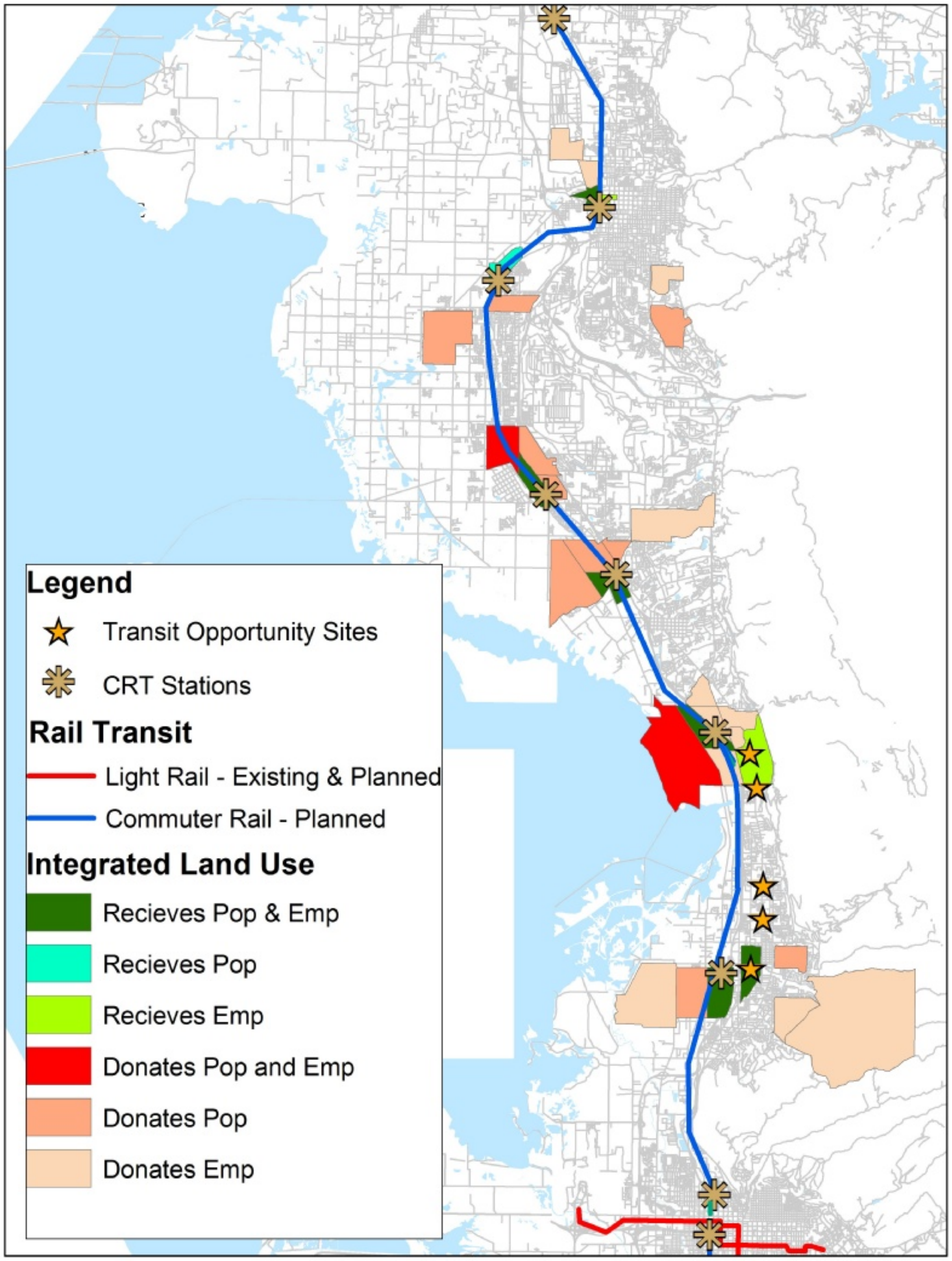
In addition, city and county representatives filled out survey forms quantifying the amounts of shifted land use in terms of numbers of residents (population) and employment opportunities (jobs) each station-area would contain above the level allocated to the area in the WFRC forecast. Exhibit 6 shows the locations and general magnitudes of the shifts in the WFRC land use forecast recommended by the city and county representatives on the subcommittee. Within the corridor, the subcommittee representatives recommended shifting population and employment totaling about 5,250 people to locations within 0.5 mile of transit stations. The integration analysis consultants also conducted interviews with representatives of cities with transit station sites located north of the CPIC area. In these cities, including Pleasant View, Ogden, Roy, Clearfield and Layton, population and employment totaling about 3,360 people were shifted from the WFRC allocation zones to areas within 0.5 mile of planned transit stations.

Exhibit 7 indicates the changes in land use on a site-by-site basis in South Davis County between the WFRC adopted allocation in the transportation LRP and the CPIC subcommittee recommendations for the integration analysis. On a percentage basis, the largest recommended changes were at the Farmington, 500 South, and Woods Cross stations. The Bountiful 500 South station shows the greatest absolute increase, adding about 1000 population and about 750 jobs. Exhibit 8 summarizes the total TOD land use change by sub-corridor.

The potential land use changes defined in this section represent the professional judgment of senior staff at the involved jurisdictions. In some cases, the ordinances needed to achieve these changes are not in place and achievement of these land use intensifications will depend on the actions of elected officials to make the levels of transit orientation feasible and the reaction of

Exhibit 5. CPIC Land Use Subcommittee Meeting

Exhibit 6. Land Use Shifts Considered Achievable by CPIC Sub-Committee



- Changes in land use density between WFRC forecast and transit-oriented development scenarios.
- Increase in population and employment within 0.5 mile TOD radius:
    - S Davis =5,250 people
    - N Davis & Weber = 3,360 people

Exhibit 7. Changes in Land Use within 0.5 mile of Premium Transit
South Davis TOD Sites

- Changes by station area in South Davis County between the WFRC adopted allocation in the transportation Long Range Plan (LRP) and the CPIC subcommittee recommendations for the Integration assessment

- Major increases: Farmington >400%, 500 South 28%, Woods Cross 39%

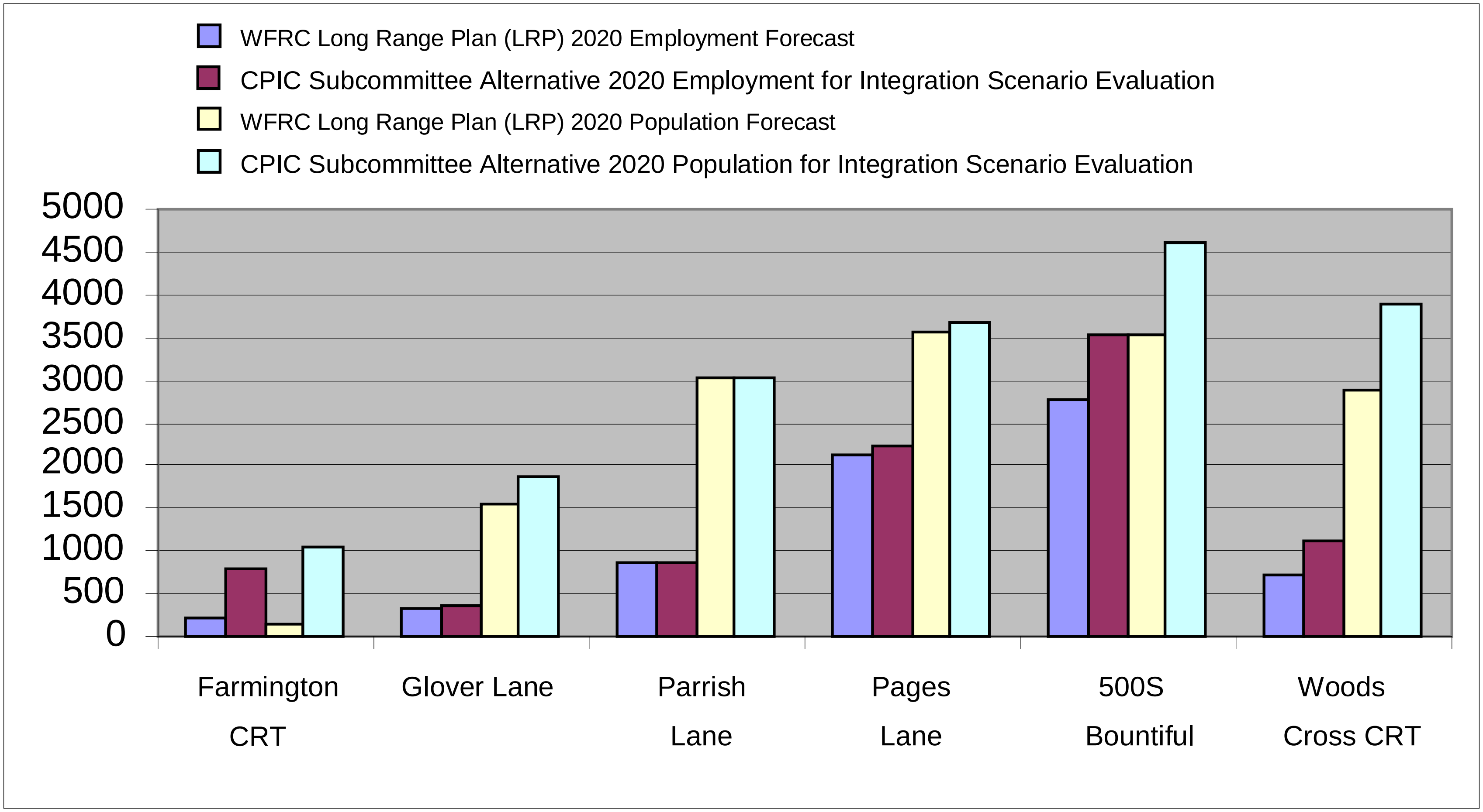
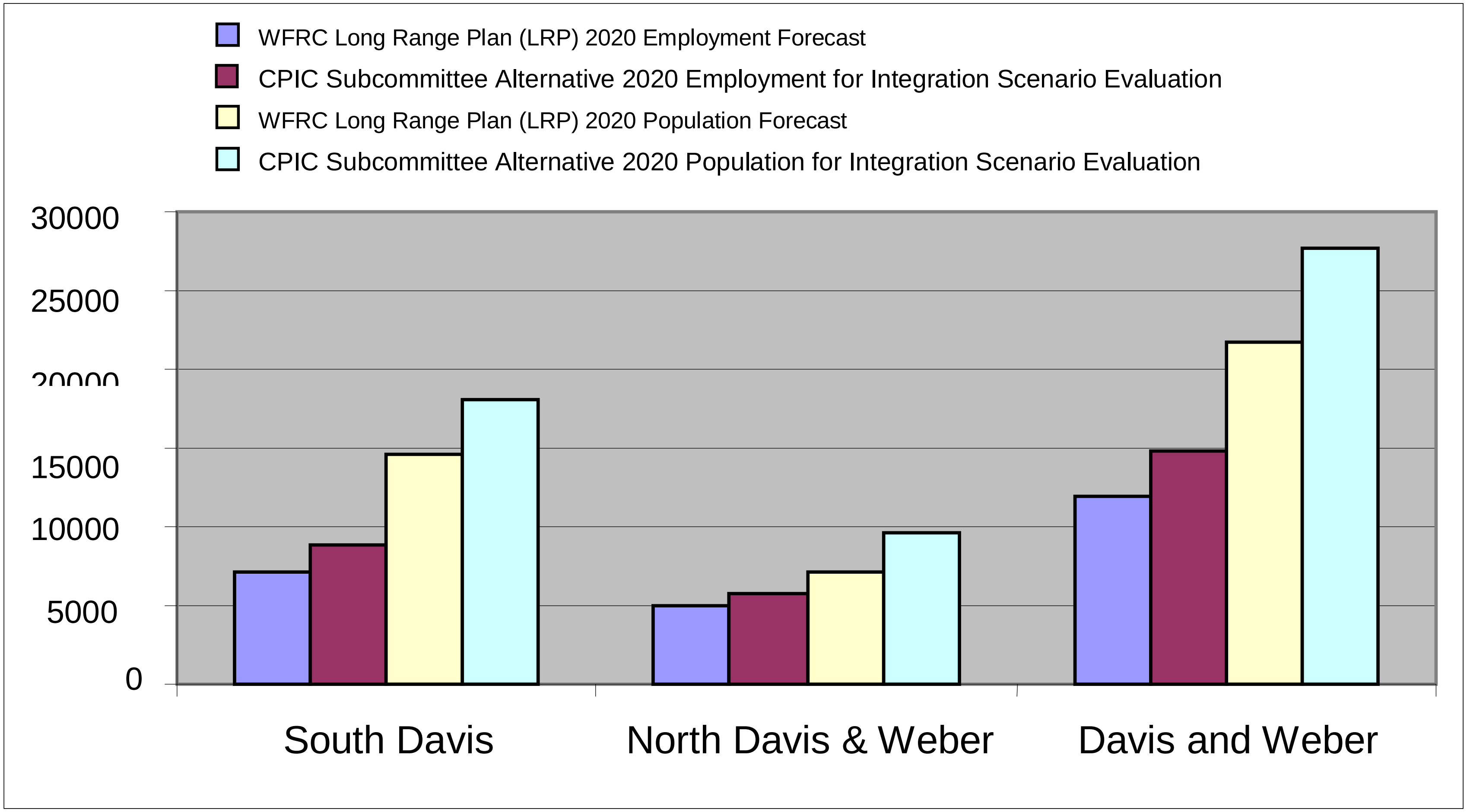


Exhibit 8. Changes in Land Use within 0.5 mile of Premium Transit
County Totals

- Changes by sub-corridor between the WFRC adopted allocation in the transportation Long Range Plan (LRP) and the CPIC subcommittee recommendations for the Integration assessment



the real estate market to make them achievable. Given the associated uncertainties, the integration analysis considered two potential scenarios for the level of future transit-supportive land use: a) land use projections as defined in the existing WFRC model based on current policies and land use economic forecasts, and, b) alternate levels considered achievable by planning staff at the affected local jurisdictions but without full policy, ordinance or market support.

7.0 Integrated Transit Enhancement Packages

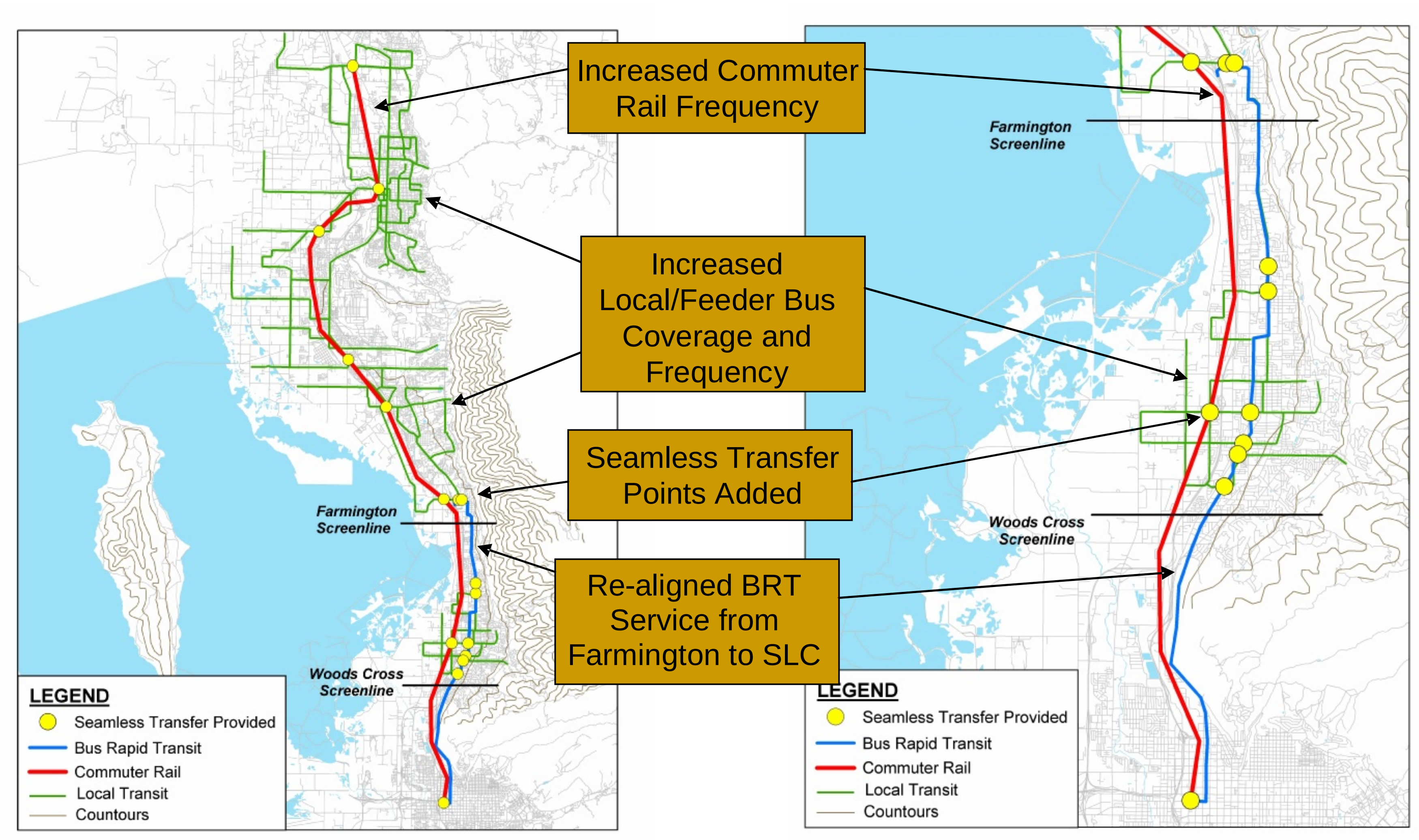
As described above, the following criteria were used for selecting and packaging transit and land use enhancements in the integration analysis robust transit packages.

- Effectiveness.
- Recommendations from CPIC.
- Capital and operating costs.
- Reasonably foreseeable funding availability (based on December 2003 regional transportation LRP aggressive funding program, which assumes $100 million per year in state general fund revenues for highway projects and additional local tax revenue for transit projects equivalent to a ¼ cent sales tax increase and a 30 percent contribution from joint development and community participation.
- Land use policies and flexibility (as recommended by CPIC land use subcommittee).

Exhibit 9 indicates the primary transit enhancements identified as reasonable elements of enhanced, or “maximum’, transit in the corridor. These enhancements are upgrades from the levels included in the current WFRC LRP. The elements were combined to create two maximum transit packages, differing from one another primarily with respect to emphasis on land use and other policy changes that depend on uncertain aspects of the future real estate economy in the corridor and central Salt Lake City.

The integration analysis considers each transit package in the context of the highway components of the Shared Solution. The multi-modal transportation network evaluated in each maximum transit analysis includes all of the highway components of the LRP and Shared Solution with the exception of the Legacy Parkway extension north of Farmington. Consistent with the LRP and Shared Solution, the transit packages include the planned express bus service designed to take advantage of the planned I-15 HOV lanes.

Exhibit 9. Additional Integrated Transit System Enhancements to the Current Long Range Plan



7.1 Package A–Maximum Transit with Moderate TDM Policy Change

Maximum Transit Package A includes transit investment above the LRP levels to allow increased commuter rail service, several BRT lines and improved local bus service, transit access systems, transfer synchronization, as well as reduced transit fares. This transit package also assumes a 50% increase in downtown parking costs in addition to inflation adjustments. This represents a reasonably aggressive assumption given the recent downtown employment decline and proposals to reduce parking prices or increase supply, but is consistent with WFRC and the City of Salt Lake projected increase in downtown development densities by 2020. The primary elements of Package A are listed below and illustrated in Exhibit 10.

§ Commuter rail: 15-minute headways.

§ BRT: premium service.

§ East/west bus lines with seamless transfers.

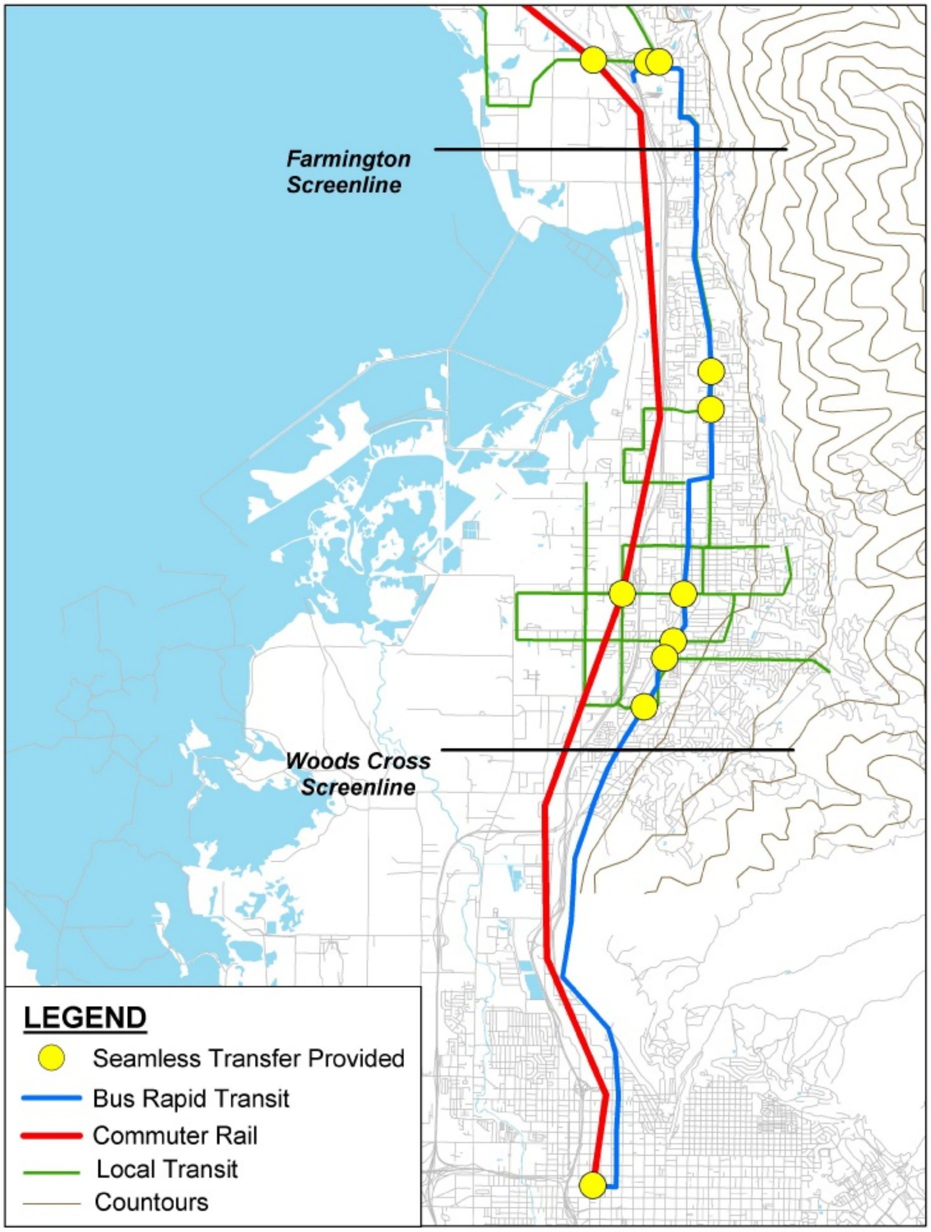
§ Local bus service distributed widely enough so that 95% population and employment is located within 0.25 mile of transit.

§ Premium transit fares reduced 50%.

§ Downtown Salt Lake City and University of Utah parking costs increased 50%.

Appendix A to this Tech Memo compares the LRP transit service characteristics with those of the Maximum Transit scenarios.

Exhibit 10. Package A–Maximum Transit with Moderate TDM Policy Change



- Commuter rail: 15-minute headways
- BRT: premium service
- E/W bus lines with seamless transfers
- 95% land use density within 0.25 mile of transit
- Premium transit fares reduced 50%
- Downtown parking costs increased 50%

7.2 Package B–Maximum Transit and Aggressive TOD/TDM Policies

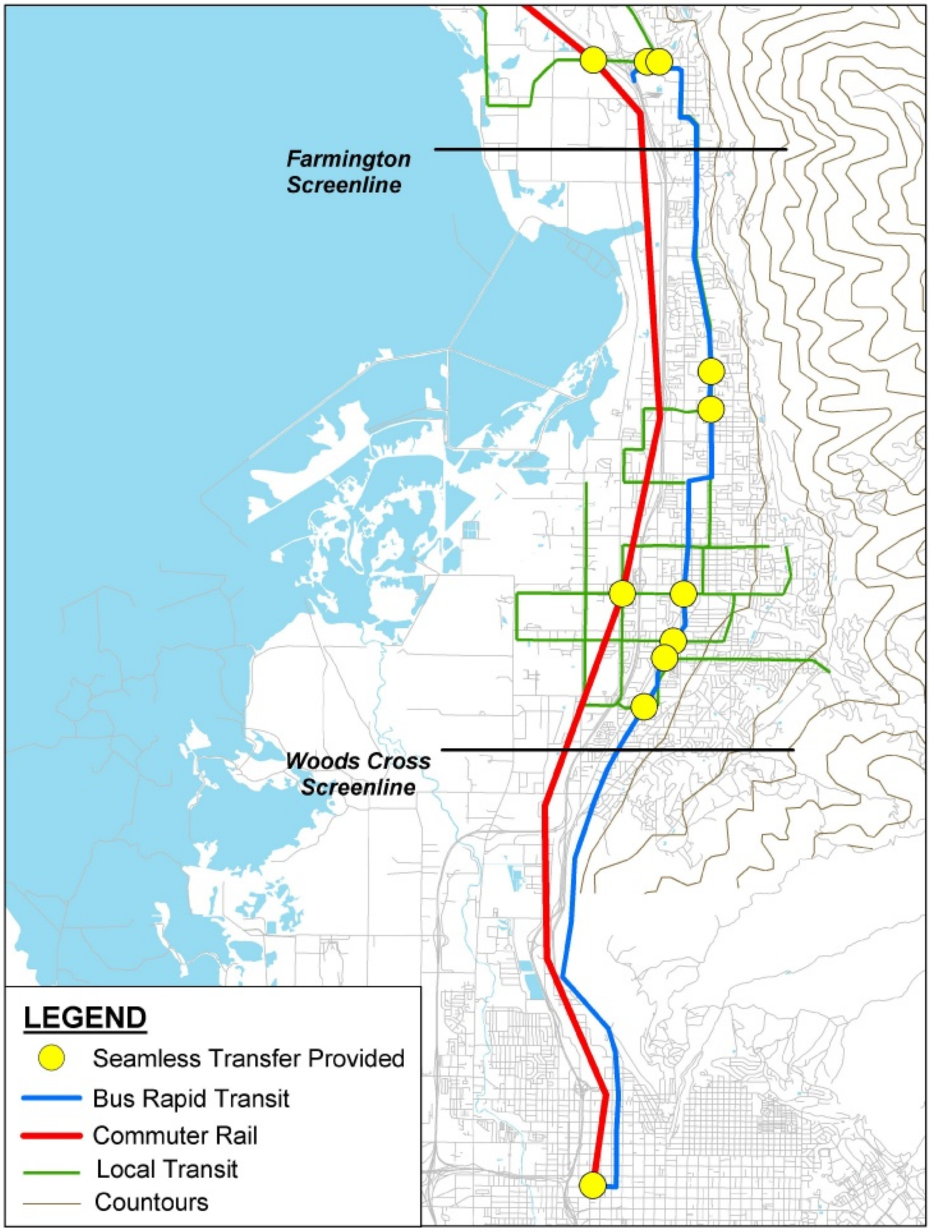
Maximum Transit Package B includes all of the transit and elements in Package A, and further strengthens the transit-supportive policy or "software" aspects of the shared solution. It adds TOD and further increases downtown Salt Lake City and University of Utah parking prices to increase incentives related to using transit. Package B includes all of the elements of Package A, as shown in Exhibit 11, plus the following elements.

- Maximum encouragement of TOD at transit station sites, as defined by the CPIC land use subcommittee
- Increased land use density within 0.25 mile of premium transit by 24% in South Davis County.
- Increased downtown parking costs 100%.

The land use and parking-pricing strategies included in Package B are aggressive and represent the upper end of the reasonably foreseeable range.

The transit system enhancements and land use adjustments described above represent two maximum transit scenarios that could be included as part of the shared solution for the north corridor. Exhibit 12 presents a comparison of the packages to one another and to the future baseline condition, the set of transit improvements included in the current regional transportation LRP.

Exhibit 11. Package B–Maximum Transit and Aggressive TOD/TDM Policies



- Commuter Rail: 15-minute headways
- BRT: premium service
- E/W bus lines with seamless transfers
- Premium transit fares reduced 50%
- Maximum TOD as defined by the CPIC land use subcommittee
- Land use density within 0.25 mile of premium transit increased 24% within South Davis County
- Downtown parking costs increased 100%

Exhibit 12. Comparison of Evaluated Maximum Transit Scenario Packages to the Baseline

	Integration Scenarios	
Baseline	**A – Maximum Transit with Moderate TDM Policy Change**	**B – Maximum Transit with Transit Supportive land Use and Aggressive TDM Policies**
Land Use Per Long Range Plan (LRP)*	Long Range Plan Land Use	Transit Supportive Land Use
Highway Improvements per LRP **	Highway Improvements per LRP**	Highway Improvements per LRP**
Commuter Rail operating per 2020 LRP	Increase Commuter Rail Frequency	Increase Commuter Rail Frequency
Express Bus, I-15 and US-89	Express Bus, I-15 and US-89	Express Bus, I-15 and US-89
Local Bus – LRP Plans	Increased local bus service – designed to feed Line-Haul transit	Increased local bus service – designed to feed Line-Haul transit
Bus Rapid Transit – Farmington to Salt Lake	BRT – re-aligned through all TOD opportunity sites	BRT – re-aligned through all TOD opportunity sites
Transfers – 15 to 20 minutes	Seamless Transfer at BRT and CRT Stations	Seamless Transfer at BRT and CRT Stations
Parking Costs – LRP Plan	Parking costs further increased by 50%	Parking costs doubled
Transit Access - Baseline	Improved transit access	Improved transit access
Transit Fares -- Premium	Reduced Fares for Premium Transit	Reduced Fares for Premium Transit

* All references to Long Range Plan (LRP) in this table refer to December 2003 WFRC Transportation Long Range Plan.

** Includes Legacy Parkway and ten-lane I-15. Does not include Legacy Parkway extension north of Farmington.

8.0 Integration Analysis Results

8.1 Performance of Transit-Enhanced Shared Solution

Exhibit 13 presents the results of the integration analysis of the two transit-enhanced shared solution scenarios for the north corridor. All of the analysis cases presented Exhibit 13 assume that Legacy Parkway is completed by 2020 and that I-15 is ten lanes. The forecasts were produced through a combination of model-based and off-model analyses, as indicated in Exhibit 12.

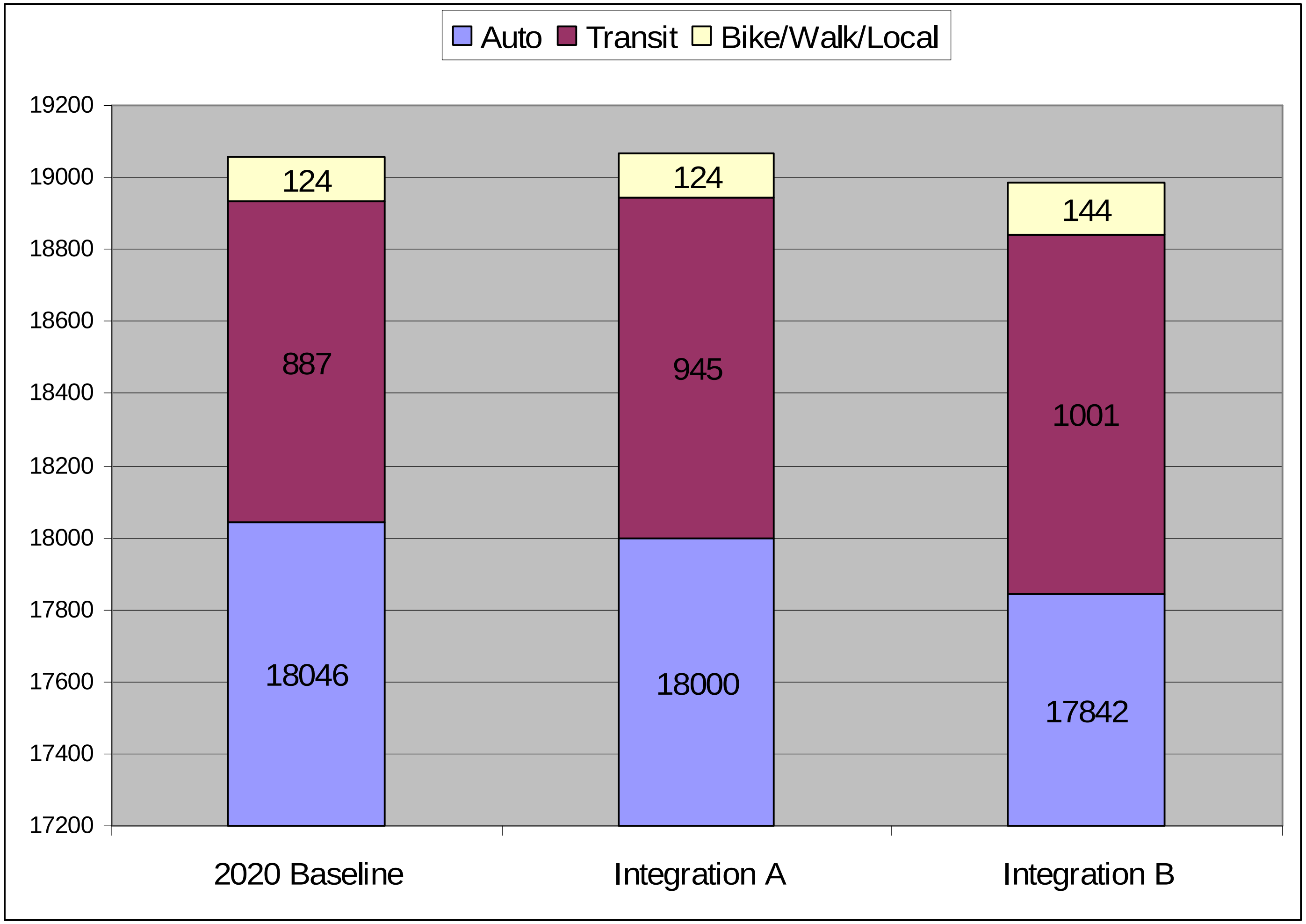
For each Integration transit scenario, two types of comparisons are useful:

§ relative to a consistent modeling base (the 2004 model with 2020 transit as defined in the December 2003 LRP), the degree by which integrated maximum transit would increase transit ridership in the North Corridor (measured in terms of transit riders, and translated into passenger car equivalents)

§ the resulting 2020 p.m. peak-hour peak-direction automobile pce's based on the 2004 modeling analysis with integrated maximum transit, compared with the 2020 p.m. peak-hour peak-direction automobile pce's reported in the 2000 FEIS.

Integration Package A enhances the current (December 2003) LRP transit system to include an optimal integration of roads and transit and transit/ highway interfaces in the North Corridor. Compared with the December 2003 LRP, Integration Package A increases 2020 p.m. peak-hour northbound transit ridership by 58 passenger-car equivalents (about 75 passengers). This increase in transit ridership increases corridor mode share from about 4.6% to about 5.0%.

Exhibit 13. Comparison of Peak Hour, Peak Direction Trips* By Mode– 2020 Baseline, and Integration Packages



*** Trips reported in Passenger Car Equivalents (PCE's)**

Integration Package B enhances the December 2003 LRP transit system to include an optimal integration of roads and transit and transit/ highway interfaces in the North Corridor, as well as the highest achievable levels of transit/land use integration in the opinion of senior staff of the affected jurisdictions. Package B increases peak-hour, peak-direction transit ridership by about 113 passenger-car equivalents (about 147 passengers) over the LRP transit system. This takes the corridor mode share from about 4.6% to about 5.3%. As a result of its more compact land use, Package B is also able to reduce trip lengths and increase non-motorized travel. Therefore, the total number of person trips, vehicle trips and PCE's crossing the screenline in Package B are all lower for Package B than for the LRP and for Package A. Taking this vehicle trip reduction into consideration along with the reduction due to increased transit use, Package B reduces corridor vehicle demand by about 1% relative to the current LRP.

8.2 Reasonableness of Results

The 4% to 5% transit shares predicted for the corridor in 2020 appear reasonable given the multiple functions of the north corridor when compared with other corridors that perform similar functions. The 4% to 5% mode shares are similar to the current actual mode spits in the TRAX/I-15 corridor south of downtown Salt Lake City (at about 4000 South). They are also similar to mode splits in such rail transit corridors as the Denver southwest corridor (I-25/Santa Fe Drive). The composite 4% to 5% mode shares projected for the North Corridor are considerably higher than the 1% to 2% mode splits on bypass or through-trip corridors such as San Diego's I-15 and Seattle's I-405.

The results also appear reasonable given the multiple functions of the north corridor. The corridor serves interstate and inter-regional through travel, dispersed travel within the Salt Lake region, and a small percentage commute travel to downtown Salt Lake City (8% to 9% predicted by WFRC model). Considering only the sub-set of corridor travelers who are commuting to downtown Salt Lake, the projected transit mode share is 13% for all trip purposes combined, and about 25% to 30% for home-based-work commuters. This compares with 20% to 35% transit shares for the downtown commute sub-market in regions such as Denver, Portland, San Francisco and Washington D.C.

The robust transit packages described above represent a reasonable best effort on the part of the CPIC, interested members of the public, regional and federal agencies including UTA, and consulting transportation planners to integrate transit with the corridor highway projects. The integration scenarios transit improvements, interfaces, and service coordination include park-and-ride opportunities , competitive pricing, and responsive land use The more aggressive robust transit scenario (package B) could increase the transit share in the corridor from about 4% to about 5% and reduce vehicle use in the corridor by about 200 peak-hour peak-direction PCE's relative to the currently planned transit system. However, following careful state-of-the practice analysis, we conclude that the amount of transit use achievable in the corridor is lower than the very aggressive assumptions used in the Legacy Parkway FEIS.

9.0 Physical Integration

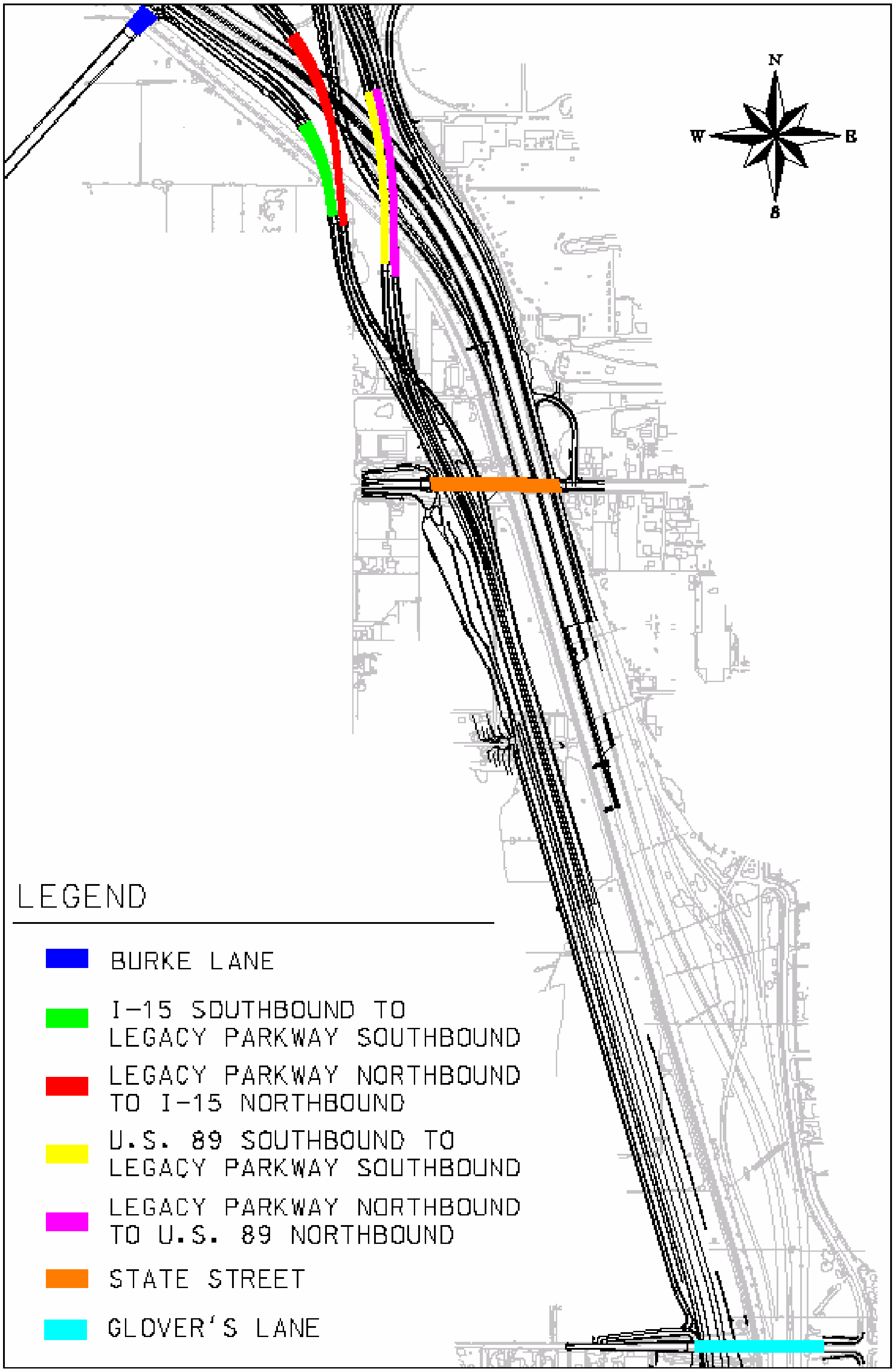
The previous sections focused on accounting for the interactive effects of pursuing strategies in combination. This section highlights the physical elements of Legacy Parkway that provide for efficient interfaces and service coordination of highway and transit travel. It also describes the Legacy Parkway related design elements required to ensure transit can be accommodated within the Legacy Parkway right-of-way.

The north corridor Commuter Rail project plans two rail stations in Davis County, one in Farmington near the interchange of I-15/US 89/Legacy Parkway, and one in Woods Cross at 500 South near I-15. Legacy Parkway plans interchanges at both locations, providing convenient park-and-ride and feeder-bus access to commuter rail stations.

As a part of the design for the Legacy Parkway, structures were lengthened to accommodate the physical integration of the commuter rail component of mass transit with the Legacy Parkway and I-15. UDOT has paid an additional $6,800,000 in design and construction cost to allow the physical integration of commuter rail in the following structures (refer to Exhhibit 14):

- Burke Lane (construction completed)
- I-15 southbound to Legacy Parkway southbound
- Legacy Parkway northbound to I-15 northbound
- US 89 southbound to Legacy Parkway southbound
- Legacy Parkway northbound to US 89 northbound
- State Street
- Glovers Lane.

Exhibit 14. Bridges Designed to Accommodate Commuter Rail



In addition to the above structures, UDOT provided the local transit authority, the Utah Transit Authority, with $10,000,000 to aid in the purchase of commuter rail right-of-way, which right-of-way passes directly beneath the proposed Legacy Parkway and adjacent to I-15.

10.0 Conclusions

10.1 Conclusions Related to Enhancement and Integration of Transit Service

The I-15 north corridor serves a broad variety of travel needs, including very long distance inter-state and international travel, inter-urban travel within Utah, and travel throughout the Salt Lake City region. Unlike urban areas with beltways, the Salt Lake region's freeway system is linear. Although I-15 passes near downtown, it does not carry a high concentration of downtown-oriented travel. According to the WFRC model, ten percent or less of the traffic generated within or traveling through the corridor is bound to or from downtown Salt Lake City. The remaining 90 percent is roughly evenly split, with about 40 to 45 percent of all corridor travel oriented toward eastern Salt Lake County and eastern regional gateways, and about 45 to 50 percent oriented toward to western Salt Lake County and western or southern gateways. This usage pattern limits the ability of even the best downtown-focused transit system to attract a high percentage of corridor travel. Long distance beltway demand is much less susceptible to capture by urban transit or alternative modes.

Of the future elements of the shared solution, Legacy Parkway is expected to serve as a bypass, carrying primarily through traffic from points north of South Davis County to points south and/or west of downtown Salt Lake City. Other transportation facilities in the north corridor, such as US 89, I-15 and commuter rail, would be better suited to integrate travelers between buses and rail because they are more downtown-oriented and have more interchanges with local arterials. For Legacy Parkway, integration strategies are limited to services for a dispersed set of long-distance destinations served most effectively by express buses, carpools, and other high-occupancy highway-based vehicles.

This integration analysis considered the following maximum alternative mode and transit enhancements.

- Improved quality and efficiency of commuter rail, express bus, and BRT mainline transit through the corridor.
- Improved access to mainline service through distributed and comprehensive feeder service and land use patterns designed to take advantage of both mainline and feeder transit services.
- Transit-oriented land use emphasizing more intensive, pedestrian-oriented development at transit hubs and opportunity sites.
- Economic and policy incentives to encourage transit use and discourage automobile use.

These combinations were evaluated with significantly updated and peer reviewed travel models and a series of off-model adjustments to improve sensitivity to TOD land uses and increase transit ridership. The forecasting models incorporate the latest adopted regional and jurisdiction-level growth forecasts and also incorporate transit-oriented land use intensification to the extent supportable by local plans and visions. The result for the full maximum transit concept (Package B) is an estimated 5.3% peak hour transit mode share and an increase in the number of people who, as a result of more clustered land uses, would travel shorter distances primarily via bike and walk modes.

These results are similar to the model-based forecasts prepared for the 2000 FEIS. The FEIS projected transit ridership, including commuter rail use, was equivalent to about 1,200 peak-hour vehicles, or about 5% of the total 24,110 vehicle demand estimated at that time. The current results are lower than the results of three other estimates prepared for the 2000 FEIS. A very aggressive financial constraint planning method was also used in the FEIS to set an upper bound of 12% transit share. Two other independent methods of analysis were also considered (Sketch Planning and Maximum Reasonable Future). The results from the Maximum Reasonable Future method are comparable to the Mode Choice Model Method and the Sketch Planning results were halfway between the Mode Choice Method and the Financial Constraint Method.

The integration analysis findings are consistent with transit mode splits found in corridors elsewhere in the Salt Lake region and in other similar regions, and the approximately 5% transit share appears reasonable considering that less than 10% of the travel in the corridor is oriented to downtown Salt Lake City.

10.2 Conclusions Concerning Physical Integration

Roads and transit will work together in the North Corridor through a combination of transit service integration and physical integration of the travel modes. Transit and roadways will each serve important shares of 2020 travel demand in the corridor. Based on the latest plans and analysis methods, enhanced and integrated transit can achieve a share of up to 5% of 2020 corridor-wide p.m. peak-hour peak-direction travel. Rail station locations in the corridor have been defined in response to physical constraints and ridership generation goals, and Legacy Parkway interchanges are planned at locations that will provide convenient access to the Farmington commuter rail station. Design of Legacy Parkway bridge structures and interchanges includes lengthening to accommodate the physical integration of the commuter rail and provides assistance in right-of-way acquisition. The Legacy interchanges also provide parking lot locations to facilitate carpooling and express-bus park-and-ride.

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12.0 Technical Appendix

A. Overview

This memorandum summarizes the methodologies used to perform the technical analyses for the Legacy Parkway SEIS Integration Analysis. The analyses were performed in five stages, namely:

1. Verification of suitability of the model for the analyses performed.

2. Travel Demand Model coding of two Integration scenarios, and a 2020 Baseline. The two integration scenarios and the 2020 Baseline are defined by the changes made to the adopted Long Range Plan model set (version 3.2, February 9, 2004).

3. Post-processing of Travel Demand Model Data. This was performed to convert raw travel model data into formats useful for scenario comparison in the Integration Analyses. This primarily involved deriving peak hour trip data crossing the Woods Cross screenline.

4. Off-Model Adjustments were made to raw model data to account for travel behavior that is not otherwise reflected within the travel model itself.

5. Formulation of results for comparison to the FEIS.

The five stages of analysis are described below.

B. Applicability of the Travel Demand Model

<u>Use of PM Peak Period Travel model assignment</u>

The travel demand model's calibration year is 2001, it is calibrated to the daily level for both auto and transit modes. The 2001 PM peak period travel model results could not be validated against 2001 peak period traffic counts for all the roadway segments in the north corridor since the data were not available. Regional trends however could be applied to the model's daily data in order to derive a PM peak period data set.

The travel demand model allocates 24 percent of all daily trips to occur during the PM peak 3-hour period. Year 2004 data obtained from the UDOT ITS system shows that currently 24 percent of daily traffic is observed during the PM 3-hour period on I-15 between 2300 North and Beck Street in Salt Lake City.

The 2001 calibration run shows a 62 percent northbound directional split during the PM 3 hour peak period on I-15 at the Woods Cross screenline, and on I-15 between 2300 North and Beck Street in Salt Lake City. Year 2004 data from I-15 between 2300 North and Beck Street showed that 62 percent of PM 3-hour peak period traffic is northbound.

These comparisons of model output and existing traffic used the best data available, and found that the PM Peak Period model performed acceptably.

<u>Conversion of Peak Period Traffic Volumes to Peak Hour, Peak Direction PCEs</u>

Year 2002 data obtained from the UDOT permanent count station on I-15 at 650 North in Salt Lake City were used to determine an appropriate factor to convert the 3-hour traffic forecasts to a 1 hour traffic forecast. That factor was 0.36.

Application of this factor was verified as being reasonable for future scenarios by comparing peak period volume to capacity (V/C) ratios for the 2001 calibration and 2020 Baseline travel model runs. The I-15 PM v/c ratio did not increase between the base year and forecast year. Stable V/C ratios imply that the degree of peak spreading remains consistent over time.

Historic daily truck percentages are published by UDOT. For I-15 through the north corridor, the daily percentage has in recent years been stable at 7 to 8 percent. The historic daily truck percentages were significantly higher than the observed peak hour peak direction 1 to 2 percent (year 2002 peak period traffic video) as would be expected given the nature of the facility. This section of I-15 is part of the CANAMEX corridor which is used for long-haul trucking. Interstate trucking typically avoids urbanized areas during peak commute hours so daily truck percentages on this section of I-15 were expected to be higher than peak hour truck percentages. Video of year 2002 peak period traffic on I-15 between Beck Street and I-215 were used to determine the truck percentage of peak hour peak direction traffic. The observed truck percentage was used to derive a heavy vehicle factor using HCM 2000 methodologies. The resulting heavy vehicle factor was 0.99.

A peak hour factor was not applied as the analysis is based upon the peak hour, as opposed to the peak 15 minutes within the peak hour.

Summary:

Peak Period Peak Direction Travel model traffic volume * 0.36
=peak hour peak direction (PHPD) traffic volume

PHPD traffic/ Heavy Vehicle Factor

= Peak hour peak direction traffic volume / 0.99
= Peak hour peak direction passenger Car Equivalents

C. Travel Model Coding – Integration Packages

Two integration packages were presented to the CPIC during 2003. Integration Package A included increased transit service provision, moderate policy change, but no land use intensification. Integration Package B included the same transit system as Package A, but policy changes were stronger and land use was intensified around TOD opportunity sites. Packages A and B both assume that Legacy Parkway is completed by 2020 and that I-15 is ten lanes, including one HOV lane. The two integration scenarios are described below by the ways in which they differ from the year 2020 scenario included in the WFRC Travel Demand Model, version 3.2 which includes:

- Existing highway network of collectors, arterials and freeways.
- Existing fixed route transit system.
- Highway improvements planned for completion by 2020, which include:
    - Legacy Parkway (I-215 to US-89)
    - I-15 widening between I-215 and 500 S (Bountiful)
    - Redwood Road widening between 500 South (Bountiful) to 1000 North (Salt Lake City)
    - Extension of Legacy Parkway north of Farmington (this was removed from the scenarios analyzed for the SEIS)
- Transit improvements planned for completion by 2020 which include:
    - Commuter Rail from Salt Lake City to Pleasant View operating at 20 minute peak headways
    - Bus Rapid Transit from Salt Lake City to Farmington, and from Farmington to Ogden operating at 15 minute headways
    - Added local bus coverage on Redwood Road, 1100 West, 800 West, 500 West and 200 West operating at 15 to 30 minute peak headways

Model coding for Integration Package A and B as described in Table 1 are therefore based on the December 2003 Long Range Plan and are designed to operate within travel model version 3.2. Table 2 shows the adjustments made to land use inputs to generate the transit supportive land use scenario included in Integration Package B. Population and Employment totals for each city were maintained, though land uses in TOD opportunity sites were intensified.

TABLE 1 INTEGRATION SCENARIO CONFIGURATIONS		
Base Model	**Edits Made**	**Scenario Model**
WFRC Version 3.2, obtained 2/16/04	• Code I-15 in 2020 to reflect the Preferred Alternative from the I-15 North Corridor DEIS (ten lane I-15, of which 2 lanes are HOV) • Remove the extension of Legacy Parkway north of Farmington. • Add the following script files to the model stream to allow for automated post-processing: Ms\9Assign_Tran_pers_mtx2net.s, Ms\9Assign_NM_pers_mtx2net.s, Ms\Add_Flag_2_LoadedNet.s, Ms\NM_Add_Flag_2_LoadedNet.s As\Add_Flag_2_LoadedNet.s	2020 Baseline
2020 Baseline	• Provide 100% walk access to transit to all South Davis TAZ's if the default value is >10% (PCTWACC20 column in the 9ZonalStaticData.dbf) • Increase parking cost by 50% in TAZ's 141,305,306,383,425,438,449,455-459,465-468,484-488,495-498,707,1143,1213 in Salt Lake CBD, the college campuses and the Salt Lake International Airport. (PRKCSTPERM and PRKCSTTEMP columns in 9ZonalStaticData.dbf) • Reflect a reasonable provision for seamless transfer at CRT and BRT stations and at bus transef locations within South Davis County. If not already capped at 4 mins, set maximum transfer wait time to 5 mins -Nodes 12631,12633, 12637, 12652, 12661, 12707, 3417, 3436, 3436, 3439, 3436, 3440, 3482, 5189, 5199, 3404, 3415, 3548, 3739, 5506, 5516 (trnb_seamless_xfer.block) • Apply regular transit fares to premium transit service (1ControlCenter.txt) • Ogden to Salt Lake Commuter Rail – decrease peak headway from 20 mins to 15 mins • Realign BRT_DAV to follow the alignment determined by the CPIC subcommittee (10/7/03) between Parrish Lane in Centerville to State Street in Farmington. Adjust operating speed through the realignment section to reflect in-street exclusive ROW premium transit service. • Extend S60BOUNT bus route to Main Street TOD Opportunity site (Node 5198) • CRT/BRT Feeder Buses – decrease peak headway from 30 mins to 15 mins on routes O626, O627, O628, ONSLAYTON, and from 20 mins to 15 mins on routes S60EW, S62BOUNT	Integration Package A

Integration Package A	• Increase parking cost by to double the costs in the 2020 Baseline dataset for TAZ's 141,305,306,383,425,438,449,455-459,465-468,484-488,495-498,707,1143,1213 in Salt Lake CBD, the college campuses and the Salt Lake International Airport. (PRKCSTPERM and PRKCSTTEMP columns in 9ZonalStaticData.dbf) • Reflect TOD land use determined by CPIC sub committee 10/7/03 (run reallocated zonal land use through 3_go.bat, create a new HHDistrib_Joint_IncLoHi_2020.dat, repath 1ControlCenter.txt 'HHDistribLoHi' path to read the new file)	Integration Package B

TABLE 2 SOCIO-ECONOMIC DATA – 2020 BASELINE AND TRANSIT SUPPORTIVE LAND USE				
Location	**Baseline & Integration Package A**		**Integration Package B**	
	Population	Employment	Population	Employment
Ogden TAZ 41	0	5,736	0	5,586
Ogden TAZ 54	244	4,646	244	4,496
Ogden TAZ 65	167	776	667	926
Ogden TAZ 70	102	2,266	102	2,416
Ogden TAZ 75	5	219	5	419
Ogden TAZ 141	1,081	3,556	1,081	3,356
Ogden TAZ 164	4,380	390	3,880	390
Roy TAZ 110	1,329	181	1,329	1,091
Roy TAZ 132	4,122	536	4,122	326
Roy TAZ 153	10,412	964	10,412	264
Clearfield TAZ 219	5,247	3,707	4,997	3,507
Clearfield TAZ 220	3,949	635	3,849	635
Clearfield TAZ 227	1,977	2,092	2,377	2,292
Clearfield TAZ 231	1,552	1,344	1,502	1,344
Layton TAZ 244	10,219	1,034	10,219	884
Layton TAZ 247	5,382	533	5,282	533
Layton TAZ 248	1,872	5,415	1,822	5,415
Layton TAZ 249	2,034	267	1,984	267
Layton TAZ 254	3,714	864	3,914	1,014
Farmington TAZ 267	347	744	1,847	1,699
Farmington TAZ 268	1,704	187	1,704	58
Farmington TAZ 301	2,299	307	799	64
Farmington TAZ 302	1,407	736	1,407	495
Farmington TAZ 303	937	318	937	137
Farmington TAZ 304	1,794	124	1,794	60
Farmington TAZ 305	11	1,426	11	1,115
Farmington TAZ 306	5,206	2,636	5,206	2,850
Bountiful TAZ 324	2,116	1,644	2,166	1,994
Bountiful TAZ 326	3,542	952	3,442	952
Bountiful TAZ 331	2,174	2,431	2,224	2,731
Bountiful TAZ 334	2,664	280	2,664	130
Bountiful TAZ 337	5,807	704	5,807	204
Woods Cross TAZ 327	62	1,875	62	1,475
Woods Cross TAZ 328	3,650	1,811	2,650	1,811
Woods Cross TAZ 329	4,598	1,477	5,598	1,877
Total	**96,106**	**52,813**	**96,106**	**52,813**

Note: Table lists data only for zones whose land use assumptions change between Baseline and Integration A. Therefore table totals do not represent countywide nor corridor-wide totals. Because of changes in WFRC model TAZ boundaries in model versions used since 2000, above data from current WFRC model should not be compared with 2000 FEIS data on a TAZ-by-TAZ basis.

D. Travel Demand Model Data Post-processing

For comparison to the FEIS, Integration Analyses Results were to be reported in Passenger Car Equivalents (PCE's) traveling northbound across the Woods Cross screenline during the 2020 PM peak hour.

Standard travel model results are reported as follows:

1. AUTO - PM 3-hour peak period vehicles on each segment of a roadway, in each direction

2. TRANSIT - Daily boardings for each transit route in the system

3. WALK/BIKE/LOCAL – daily person trips between each origin and destination zone

The auto trip conversion involved factoring:

- from 3 hours to 1 hour – using an 0.36 factor
- and vehicles to PCE's – using a 0.99 heavy vehicle factor.

<u>EXAMPLE</u>

- A highway link in the final model loaded highway network has 1000 northbound vehicles during the PM 3-hour period.
- 1000*0.36 =360 northbound vehicles per hour
- 360/0.99 =364 northbound passenger cars per hour

This link would contribute 364 northbound PCE's to the screenline total. This calculation was performed for all highway and arterial segments that cross the Woods Cross screenline. The sum equals the screenline auto PCE demand.

The derivation of screenline transit trips involved post-processing transit data produced in an intermediate step of the standard travel demand model process. The typical model process derives a total number of motorized (i.e. non-walk/bike) person trips that will be made during a day. That daily motorized trip total is then split into daily trips in autos and daily trips on transit by the mode choice model. The daily auto trips are then divided into four periods during the day, AM, PM, Mid-day and Evening in the highway assignment model. Peak period transit trips are not typically calculated. Since auto trips are assigned to four periods during the day after mode choice has occurred, peak period transit share does not depend on the transit capture of a portion of all peak period trips, rather it is calculated by comparison of auto and transit peak period trips, both of which are derived as a portion of their daily trips independently from one another. Peak period auto trips are fixed as they are a direct output of the model. A method for deriving peak period transit trips was developed specifically for these analyses.

During the mode choice step various zone-to-zone transit trip matrices are produced. These describe the number of daily transit trips that will be made between each origin and destination within the model. If the origin of a transit trip is north of the Woods Cross screenline and its destination is south of the screenline, it is a transit trip that crosses the screenline. At this stage, the specific transit route that the trip will use has not been determined. Northbound daily transit person trips crossing the screenline were determined by assigning a transit origin-destination trip matrix to a network and summing all trips that cross the Woods Cross screenline.

Daily transit person trips across the screenline were factored to give northbound PM peak period transit trips based on data from the 2001 UTA On Board Survey. This survey showed that 56 percent of northbound daily transit trips crossing the Salt Lake County/Davis County line (3.5 miles south of the Woods Cross screenline) occurred during the PM peak period. It was assumed that year 2020 northbound peak period transit trips across the Woods Cross screenline would also be 56 percent of daily trips.

Once PM peak period transit person trips were calculated an average vehicle occupancy factor of 1.3 was used to convert person trips to auto trips. The average vehicle occupancy factor was taken from comparing auto person trips to vehicles trips in the north corridor. The same method as applied to auto trips was then applied to the transit trips to derive peak hour peak direction transit PCE's.

<u>EXAMPLE</u>

- The 2020 Baseline run shows that 5,654 transit trips cross the Woods Cross Screenline northbound daily.
- Converting this to peak period trips gives: 5,603*0.56=3,166 transit person trips northbound during the 3-hour PM peak period.
- Converting these trips to the peak hour gives: 3,166*0.36=1,140 transit person trips during the PM peak hour.
- Assigning these person trips to vehicles at a 1.3 person per vehicle occupancy rate gives: 1,140/1.3=877 auto trips.
- Converting these auto trips to Passenger Car Equivalents using the heavy vehicle factor gives: 877/0.99=887 transit PCE's in the peak hour peak direction across the Woods Cross Screenline.

Walk and bike screenline trips were derived by assigning the daily person non-motorized trip table to a network and applying the same peak period factors used for auto trips (24 percent of daily trips occur during the PM peak period) to calculate northbound peak period, then peak hour peak direction PCE's.

EXAMPLE

- § The 2020 Baseline run shows that 445 walk and bike trips cross the Woods Cross Screenline northbound during the PM 3-hour peak period.
- § Converting these trips to peak hour trips gives: 445*0.36=160 walk and bike person trips during the peak hour
- § Assigning these person trips to vehicle trips using a 1.3 Average Vehicle Occupancy rate gives
- § 160/1.3=123 auto trips.
- § Converting these auto trips to Passenger Car Equivalents using the heavy vehicle factor gives: 123/0.99=124 walk/bike PCE's in the peak hour peak direction across the Woods Cross Screenline.

E. Off-model Adjustments

Integration Scenario B included a transit supportive land use element. Off-model adjustments were made only to Integration Scenario B to reflect changes in travel characteristics resulting from the change in land use that the travel demand model was unable to capture. The travel demand model was able to capture changes in trip making resulting from increased land use densities and improved balance of jobs and housing. Adjustments were made to account for changes in trip making characteristics as a result of increased population and employment within ½ mile radii of BRT transit stops or Commuter Rail stations, and transit oriented development (TOD) design elements within a ½ mile radius of commuter rail stations. The off-model adjustment methodology is described below:

Population and Employment Proximate to Commuter Rail/BRT Stations

Comparison of the transit supportive land use scenario to the 2020 Baseline land use scenario recognizes the degree to which residence and job proximity to transit stations affect transit ridership. Based on research at established commuter rail stations in northern California, each new job or resident within a half mile radius of a commuter rail station would generate about 0.018 new peak direction rail riders in the 3-hour peak period, or about 0.006 new northbound peak hour transit riders in the peak hour. The same ridership generation factor was used for jobs and residences within a half-mile of a primary bus station on a quality service BRT lines. All of the added commuter rail and BRT trips are assumed to cross the Woods Cross screenline. Riders are attracted to transit from the automobile. An example adjustment would be:

- 300 new jobs and 350 more residents are located within ½ mile of a commuter rail station. That station therefore has: 300+350=650 new jobs/residents
- 650*0.006=4 new peak hour peak direction commuter rail riders crossing the Woods Cross screenline.
- Converting these riders to PCE's (using the 1.3 average vehicle occupancy rate) results in
- 4/1.3=3 additional transit PCE's, which are subtracted from the auto PCEs.

<u>TOD Design Elements</u>

National research on the effects of urban design on trip generation (Transportation Research Board, *Traveler Response to Transportation System Change,* 2002) indicates an elasticity of -0.05 between neighborhood design and vehicle trips per capita. Using this elasticity, and taking into consideration the degree to which the WFRC model already contains sensitivities to local design elements, the total number of auto trips generated within the ½ mile radius of the Commuter Rail or BRT stations are reduced by 2.7% to account for TOD design. The change in number of trips is multiplied by the percent of trips made from the TOD that cross the Woods Cross Screenline. This number of trips is subtracted from auto trips. Half the trips are assigned to transit, half become walk, bike or local trips. For example:

- 1,500 peak hour auto trips are generated within ½ mile of a BRT station. Half of these cross the Woods Cross screenline northbound.
- TOD design elements result in a reduction of: 1,500*0.027=41 vehicle trips generated within the ½ mile radius.
- Since only half the trips generated by the TOD cross the screenline northbound, the reduction in auto trips from the screenline is 41*0.5=20
- Of which 10 are assigned to transit, 10 are assigned to walk/bike/local

F. Formulation of Results

The models were run and results were derived as described in sections C and D. The formulation of results simply involved compiling the results from the three model runs. The results of the Integration Analysis; 2020 Baseline, Integration Package A, and Integration Package B are summarized below.

The 2020 Baseline run showed:

- 18,046 PCE's in Autos;
- 887 PCE's in Transit; and,
- 124 PCE's walking/biking across the Woods Cross screenline during the 2020 PM peak hour.

The Integration Package A showed:

- 18,000 PCE's in Autos;
- 945 PCE's in Transit; and,
- 124 PCE's walking/biking across the Woods Cross screenline during the 2020 PM peak hour.

Integration Package B before off-model adjustments were made, showed:

- 17,905 PCE's in Autos;
- 959 PCE's in Transit; and,
- 123 PCE's walking/biking across the Woods Cross screenline during the 2020 PM peak hour.

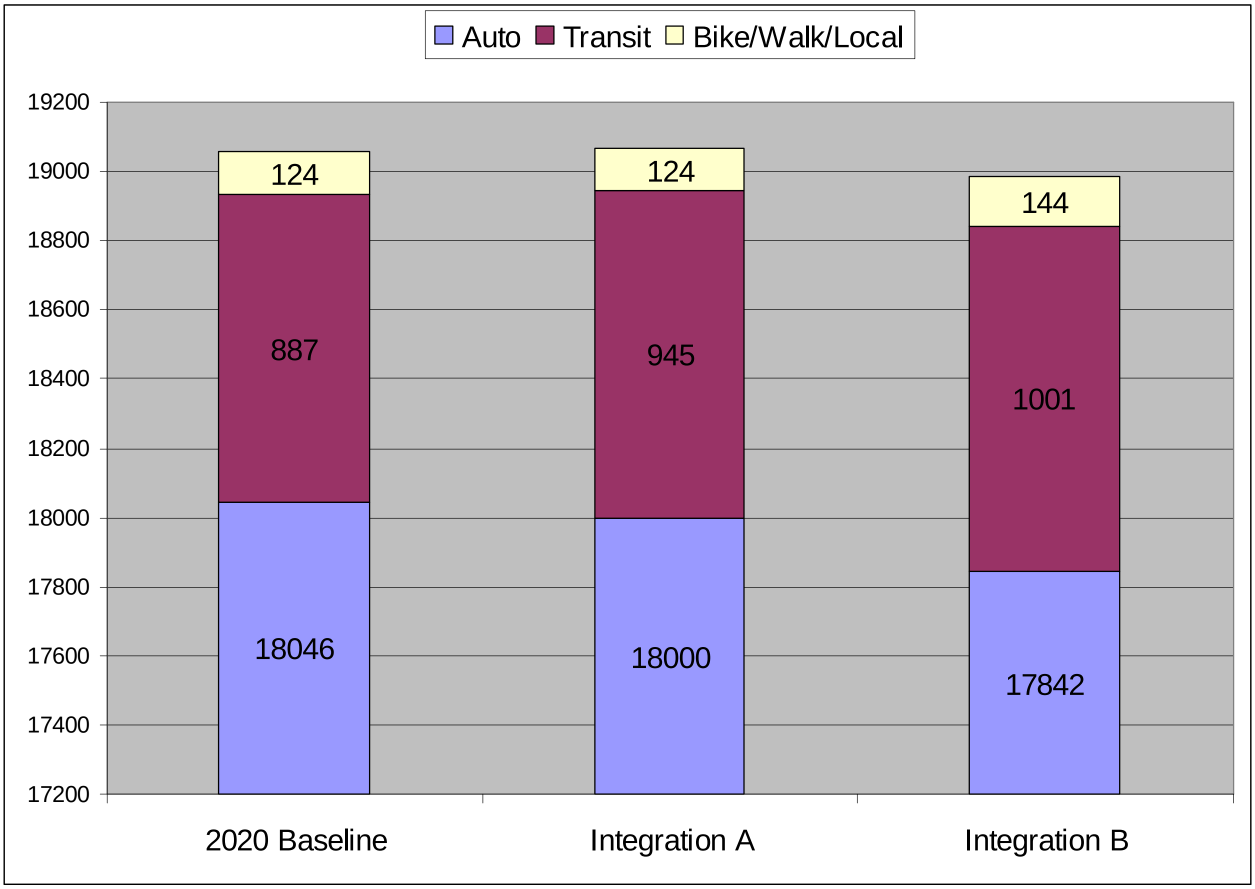
Those results were modified with the following off-model adjustments. The proximity to BRT and CRT station adjustment moved 21 PCE's from Auto to transit, and the TOD design element adjustment moved 42 PCEs from Auto, 21 of which switched to transit, and 21 switched to walk/bike. Combining these adjustments, auto PCE's are reduced by 63, transit PCE's are increased by 42, walk/bike/local PCE"s increased by 21 PCE's.

After off-model adjustments were made, Integration Package B showed:

- 17,842 PCE's in Autos;
- 1,001 PCE's in Transit; and
- 144 PCE's walking/biking across the Woods Cross screenline during the 2020 PM peak hour.

Figure 1 presents this data.

Figure 1. 2020 PM Peak Hour Northbound PCE Demand – Woods Cross Screenline



Trips reported in Passenger Car Equivalents (PCE's)