EVALUATION OF SYSTEM ALTERNATIVES

In an effort to increase the value of the Regional Transportation Plan, the WFRC is evaluating not only the impacts of individual projects but also the cumulative effect of various transportation systems. With this objective in mind, WFRC staff developed a set of transportation system measures along with three combined transit and highway system alternatives. The nineteen system measures that emerged were used to assess overall transportation functionality and monetary, as well as social, and environmental costs. Both direct measures and relative indicators were used to compare the systems. Relative values were assessed rather than absolute values. No total score was given for each system although some measures were deemed more valuable than others. The nineteen measures are listed and briefly defined in Table 5-1.

SYSTEM EVALUATION MEASURES

Three transportation systems were evaluated using the measures summarized in Table 5-1. These three systems were intended to be multi-modal and to have roughly similar construction cost. The three alternatives are described in length in chapter 4. In brief, the three systems were as follows.

- Vision - a combination of the adopted 2030 Long Range Transportation Plan Update: 2004 - 2030 (LRP) and the results from the Wasatch Choices 2040 visioning exercise
- Freeway – a transportation system emphasizing freeway and freeway based bus rapid transit
- Arterial – a system emphasizing arterials and arterial based streetcar

The Vision Alternative was selected and endorsed by the Regional Growth Committee and the Wasatch Front Regional Council. This became the base system and a framework of corridors to refine into a Draft Regional Transportation Plan.

TABLE 5-1

EVALUATION MEASURES

MEASURES	DEFINITION*
Construction Costs	Estimated 2006 highway construction and major transit capital costs
Transit Passenger Miles	Number of miles traveled by transit passengers each day
Vehicle Miles Traveled	Total daily auto miles traveled
Transit Proportion of Work and College Travel	Proportion of all Home-based Work and Home-based College person trips taken by transit in the afternoon peak period
Traffic Volumes in Constrained Critical Corridors	Sum of all morning peak period auto volumes on all modeled street segments that fall within identified areas that have both severe congestion and a practical inability to widen roads
Person Hours by Auto	Total daily person hours spent in an automobile
Weighted Transit Speeds	Average perceived travel speed of all transit trips assuming that the time waiting for transit is perceived as twice as long as the time spent on the vehicle
Home-based Work Auto Speeds	Average speed of all auto trips between home and work on a daily basis
Auto Delay	Annual number of hours of auto delay caused by traffic congestion during the peak periods.

MEASURES	DEFINITION*
Improvements to Geographic Choke Points	Both the number of projects crossing regional geographical choke points and the peak period auto and transit seat capacity added by these projects
Transit Access to Major Activity and Mixed-use Centers	Sum of all households and jobs within 20 minutes transit travel time during the afternoon peak period of each of the identified major activity centers and mixed-use centers
Auto Access to Major Activity, Mixed-use, and Infill Areas	Sum of all households and jobs within 20 minutes automobile travel time during the afternoon peak period of each of the identified major activity centers, mixed-use centers, and infill areas
Freight Center to Freeway Access	Sum of the individual afternoon peak period travel times, in minutes, between each of the largest freight centers and the nearest freeway
Employment Access for Disadvantaged Populations	Sum of all jobs within 20 minute auto and transit afternoon travel times of all Traffic Analysis Zones with a disproportionately high percentage of low income families, minorities, persons with disabilities, seniors, and households with no autos
Households and Employment Potentially Impacted	Number of households and jobs in each five acre grid cell adjacent to a roadway project
Potential Impacts to Historic Neighborhoods	Project miles bisecting US Census Block Groups which have a proportion of homes built prior to 1950 which is higher than the regional average
Potential Impacts to Disadvantaged Populations	Project miles bisecting a US Census Block Group with a disproportionately high percentage of low income families, minorities, persons with disabilities, seniors, and households with no autos
Air Quality	Tons of Nitrogen Oxide, Carbon Monoxide, and Volatile Organic Compounds emitted daily by transportation sources in winter conditions
Potential Impacts to Environmentally Critical Lands	Acres of steep slope, wildlife habitat, wetlands, streams, and lakeshores within 100 to 300 feet (depending upon facility type) of a project centerline
*All transportation statistics are projected for the year 2030	
*All transportation statistics are for travel within Weber, Davis, and Salt Lake Counties	
*Morning and afternoon peak periods are 6:00 am through 9:00 am and 3:00 pm through 6:00 pm	

5.2 SYSTEM EVALUATION CRITERIA

The system evaluation criteria were selected with input from the WFRC, UDOT, and UTA planning staff. It was also presented to, and approved by the WFRC Regional Growth Committee. This section discusses the significance of each measure, how the measure was developed, and subsequent findings.

1. Construction Costs

Costs are one of the most important transportation system alternative measures given that transportation funding needs are always greater than available revenue. Because of this factor, both transportation systems alternatives costing more than available revenues will be modified to best meet demand within available revenues.

Transit cost estimates were taken directly from Utah Transit Authority studies, where available. Costs for transit lines that had not been carefully analyzed were estimated using a simple formula based on per mile costs by the type of transit technology. Costs per mile were derived from the Utah Transit Authority Capital Development Department and from construction costs found in the Ogden / Weber State Transit Corridor Study. All cost figures were considered drafts for the purpose of equalizing the various alternatives and may be different from the values used to financially constrain the completed Plan. The per-mile costs, in 2007 value dollars, and the general assumptions are as follows.

- Light-rail would cost $52.7 million per mile in 2007, assuming the typical new line to be in a street with rails set on a ballasted bed rather than a paved bed.
- Streetcar would cost $26.1 million per mile in 2007, assuming exclusive lanes and $9.0 million without exclusive lanes, substantial stations, or other non-basic amenities.
- Bus Rapid Transit (BRT II) would cost $6.0 million per mile in 2007, assuming 22 percent exclusive lanes. Enhanced Bus (BRT I) would cost $1.9 million per mile, assuming no significant exclusive lanes.

The costs of alternative highway projects were estimated using construction costs per mile for their respective right-of-way (ROW) widths. The construction costs per mile were derived from the Utah Department of Transportation's (UDOT) concept cost estimation form. Table 5-2, *"2030 RTP Construction Cost Estimation Template,"* provides the construction cost per mile for various ROW widths, types of major facilities, and interchanges. Project costs were estimated for 2006. Rights-of-way acquisition costs for both highways and transit were estimated by using $5 per square foot, where applicable.

Total estimated construction costs for the three highway systems in 2006 uninflated dollars ranged between $8.918 billion for the Vision highway system and $5.713 billion for the Arterial highway system. This is a range of about 56.1 percent. The 2030 RTP highway system, as of January 24, 2007, was estimated to cost $8.360 billion in 2007 dollars. This is 6.3 percent less than the Vision highway system alternative.

Total estimated transit construction and capital costs ranged between $3.287 billion for the "Vision" transit system and $3.566 billion for the Arterial transit system in year 2006, un-inflated dollars. This is a range of about 8.5 percent.

2. Transit Passenger Miles

"Transit passenger miles" are the number of miles traveled by transit passengers each day. It is one of the most important measures of transit use because each mile traveled by a transit passenger has a direct positive impact upon energy used, pollutants emitted and cumulative delay experienced on the roads. Transit passenger miles can be a better measure than transit boardings, a commonly used measure of transit, because it also accounts for the length of the transit trips. Increased transit passenger miles may also alleviate or reduce the need for major road projects and their accompanying social, economic, and environmental impacts.

Each of the combined transit and highway system alternatives were analyzed by using the WFRC Regional Travel Demand Model. The model was used to project the total number of passenger miles to be taken by transit patrons each day in 2030, given the adopted land use projections and transportation alternative. Each of the alternate transportation systems was allocated only minimal background bus service in order to isolate the effect of the plan projects. Projected transit passenger miles for the three transit systems ranged between 2.48 million for the "Vision" system and 2.41 million for the Freeway system. This is a range of about 3.1 percent.

TABLE 5-2

HIGHWAY CONSTRUCTION COST ESTIMATION TEMPLATE

ROW (FT)	CONSTRUCTION COSTS $ / MILE - 2006	DESCRIPTION
60 – 66	$5,500,000	4 lanes, and sidewalks; or 2 lanes, 2 shoulders, and sidewalks
80 – 86	$6,300,000	4 lanes, 1 two way left turn or median, and sidewalks; or 2 lanes, 1 two way left turn or median, 2 shoulders, and sidewalks
100 – 110	$7,300,000	6 lanes, 1 two way left turn or median, and sidewalks; or 4 lanes, 1 two way left turn or median, 2 shoulders, and sidewalks
125 – 150	$8,300,000	6 lanes, 1 two way left turn or median, 2 shoulders, and sidewalks
N. Legacy	$8,800,000	4 Lanes, 2 medians, and 4 shoulders
MVC	$43,400,000	8 Lanes, including ROW and interchanges
US-89 / I-215	$25,000,000	
I-15 I-80	$50,000,000	Including interchanges
SR-201	$30,000,000	
Bridge	$10,000,000	Bridge over Jordan River
Structure	$20,000,000	Highland Drive Structure over Dimple Dell Park, RR bridge at 4500 South, 24th Street Viaduct, 1800 N. RR Structure
Re-stripe	$100,000	
Freeway to Freeway Interchange	$50,000,000	
New Interchange	$35,000,000	
Upgrade Interchange	$15,000,000	
Overpass	$10,000,000	

3. Vehicle Miles Traveled

Vehicle Miles Traveled is the total motorized vehicle miles (excluding transit) traveled each day. Reductions in the rate of growth in vehicle miles traveled are desirable for many reasons, including reduced energy consumption and congestion relief. In addition, vehicle miles traveled is directly associated with the level of fine particulate matter in the atmosphere. Fine particulate matter has been associated with several diseases including lung cancer, decreased lung function in children, chronic bronchitis, aggravated asthma, heart disease, and stroke.

There are several factors that influence auto vehicle miles traveled. Among these factors are the directness of travel and the ease of driving, compared with using transit. Like transit passenger miles, each of the combined transit and highway system alternatives were analyzed by using the WFRC Regional Travel Demand Model. The model was used to project the total number of motorized vehicle miles estimated for all non-transit vehicles each day in 2030, given the adopted land use projections and the transportation alternatives.

Daily vehicle miles traveled in 2030 for the three systems ranged between 49.0 million for the Arterial system and 50.4 million for the Freeway system. This is a range of about 2.8 percent. The "Vision" transportation system alternative, the alternative chosen for further refinement, had 50.1 million vehicle miles traveled, near the middle of the range.

4. Transit Proportion Of Home-Based Work And College Travel

Transit complements roads because service capacity can be increased with relative ease as passenger volumes increase. On the other hand, roadways lose their capacity as congestion increases. Therefore, from among the six standard trip types tracked by the regional transportation model, transit is best targeted at large movements such as peak-period home-based work and home-based college trips. The number of home-based work and home-based college trips is not only large but these trips are also most likely to take place within a narrow time period. Therefore, they can be more economically served by transit.

Each of the combined transit and highway system alternatives were analyzed using the WFRC Regional Travel Demand Model. The model was used to project the proportion of all home-based work and college person trips to be taken by transit between 3:00 pm and 6:00 pm in 2030, given the adopted land use projections and transportation alternative.

The transit proportion of home-based work travel for the three transit systems ranged between 6.7 percent for the Freeway system and 6.9 percent for the Arterial system. The "Vision" system fell in the middle with 6.8 percent of the home-based work travel. The transit proportion of college-based work travel for the three transit systems ranged between 28.5 percent for the freeway system and 28.9 percent for the arterial system. The "Vision" system fell in the middle with 28.6 percent of the home-based college travel.

5. Traffic Volumes In Constrained Critical Corridors

This measure is the sum of all morning peak period auto volumes on all modeled street segments that fall within identified areas that are projected to have both severe congestion and a practical limit to widening roads. One measure of the success of the combined transit and roadway network is its ability to draw traffic away from these areas. As with many other measures, the relative value is much more critical than the absolute value.

Severe congestion was identified by WFRC staff by modeling projected 2030 area demographics on the existing and committed transportation system identified in the 2007 - 2012 Transportation Improvement Program. Road segments of two or more miles in length that have peak period traffic volume far in excess of their theoretical traffic capacity (volume to capacity ratios greater than 1.2) were identified. Each of the roads projected to have severe congestion was evaluated via aerial and field studies to determine the feasibility of expanding its surface. Areas with regionally significant roads with two or more miles of severe congestion without the reasonable prospect of widening were identified as “Constrained Critical Corridors”. Traffic volumes in Constrained Critical Corridors for the three systems ranged between one million for the Arterial system and 920,000 for the Freeway system. This is a range of about 9.6 percent.

6. Person Auto Hours

“Person auto hours” are the total number of person hours spent in an automobile. These values were derived from the regional travel demand model projections for the year 2030. Given that land use was fixed in each of the transportation scenarios, these values do not include person auto hours due to transportation induced sprawl or transit oriented development. However, they do include induced or reduced auto travel due to the ease of travel by auto. Person auto hours for the three systems ranged between 2.26 million for the “Vision” system and 2.27 million for the Freeway and Arterial systems. This is a range of about 0.5 percent.

7. Weighted Transit Speeds

Transit speeds may or may not be important to existing and potential transit riders, depending upon their travel characteristics and their personal preferences. This measure assumes that speed is adequate but that the time waiting for a transfer is perceived to be twice that of the time spent in the transit vehicle. This assumption is consistent with national studies of rider perceptions. Station to destination walking time is only roughly measured by the Travel Demand Model and was not included in this speed calculation.

Generally there are two dominant factors influencing transit speeds. The first is station spacing. As the number of stops along a given line increases the in-vehicle speed decreases. However, the “walk to transit” portion of the trip may become shorter with more stations. In a similar manner, the more direct a route is, the fewer destinations it will service and more transfers may be required. The second factor influencing transit speeds is delay caused by congestion and traffic signals. These factors are treated consistently across system alternatives in terms of cost and time savings. The speeds for TRAX and those estimated for the FrontRunner commuter system have been determined through individual studies. The speeds for all Bus Rapid Transit II and Streetcar lines were based upon congested roadway speeds, except when they dropped below 20 miles per hour in Salt Lake County and 25 miles per hour in Weber and Davis Counties. Where this was projected to occur, the speeds and costs of exclusive transit lanes were attributed to the project. Weighted transit speeds for the three transit systems ranged between 10.89 miles per hour for the "Vision" system and 11.37 mile per hour for the Freeway system. This is a range of about 4.1 percent.

8. Home Based Work Travel Speeds By Auto

Peak period, home-based work travel speeds are the average speed of all daily auto trips between home and work. This measure, although assessing the most difficult trip of the day, may or may not reflect driver frustration levels. Speeds are more likely to be influenced by the road type, and hence, posted speed limits, rather than congestion. Additionally, decreasing average auto speeds may or may not negatively affect vehicle emissions. The emission rate for Carbon Monoxide and Nitrogen-oxides are generally highest at speeds over 50 miles per hour and at speeds under 15 miles per hour.

Peak period, home-based work travel speeds by auto were also generated for the three WFRC counties using WFRC's regional travel demand model projections for the year 2030. The resulting number is the average daily congested speed between 6:00 am and 9:00 am and 3:00 pm and 6:00 pm. Congested speeds take into account congestion and traffic signal delay, but do not account for weather, vehicle breakdowns, or accidents. Peak period, home-based work travel speeds by auto for the three systems ranged between 26.2 miles per hour for the Arterial system and 27.6 miles per hour for the Freeway system. This is a range of about 4.9 percent.

9. Peak Period Auto Delay

Peak period auto delay is the annual number of hours of auto delay caused by traffic congestion during the peak periods. This measure may be one of the most noticeable aspects of the transportation system in that it may reflect, to some degree, the level of driver frustration when the driver expects more free flow conditions. High levels of driver frustration may lead to erratic driving patterns and safety issues.

Peak period auto delay data was generated for the three WFRC counties using WFRC's regional travel demand model projections for the year 2030. Segment delay was measured first on a link-by-link basis by calculating the difference between peak period speeds and posted speed limits in both the peak and off-peak direction. Peak period is defined as 6:00 am through 9:00 am and 3:00 pm through 6:00 each weekday. Congested speeds take into account congestion and traffic signal delay but do not account for weather, vehicle breakdowns, or accidents. "Segment delay" was multiplied by the number of vehicles to determine the total delay for each segment. All segments were then totaled to estimate total auto delay per weekday. "Delay per weekday" was converted to "average daily delay" by assuming that the delay as experienced over Saturday and Sunday is the equivalent to a single weekday. Peak period auto delay for the three systems ranged between 50.0 million hours for the Freeway System Alternative and 57.5 million hours for the Arterial System Alternative. This is a range of about 13.1 percent.

10. Improvements To Geographic Choke Points

The greater Salt Lake Metropolitan area sits primarily on a 95-mile long series of narrow strips of developable land confined on the east by the Wasatch Mountain Range and on the west by the Great Salt Lake, Oquirrh Mountains, and Utah Lake. Joining each of these narrow strips and the east and west passages out of the Metropolitan area are even narrower locations which are geographic choke points for transportation.

These geographic transportation choke points are critical locations from a local, regional, and national perspective. There are generally few alternatives for moving around these locations poor weather conditions can make them even susceptible to emergency incidents. The WFRC staff has identified these geographic choke points and has prioritized projects that add alternatives for bypassing choke points. The geographic choke points identified throughout the Wasatch Front region are illustrated in Map 5-1 on the following page.

The additional “person capacity” through a regional geographic choke point resulting from each project was based on a specific set of transit or highway assumptions. For transit; peak hour, one-direction seats were estimated for this measure. 3,000 peak hour, direction seats are attributed to commuter rail assuming ten, 100 seat cars travel through a choke point every 20 minutes. 1,040 hour, direction seats are attributed to light-rail assuming four, 65 seat cars travel through every 15 minutes. 240 peak hour, direction seats are attributed to BRT II, Streetcar, and Enhanced Bus assuming one, 60 seat vehicle travels through every 15 minutes.

Highway choke point capacity for each system alternative was totaled by adding the additional peak hour passengers per lane capacity through each choke point at maximum flow. Freeway capacity increases ranged between about 2,100 and 2,300 peak hour vehicles per lane per hour. Arterial capacity increases ranged between about 600 and 800 peak hour vehicles per lane per hour. The additional vehicle totals were multiplied by average peak hour vehicle occupancy of 1.2 to reflect the total passenger capacity through the choke point. This method takes into account only free flow capacity rather than congested capacity, although during the peak period service road capacity drops precipitously as traffic volumes increase and speeds decrease.

The additional one-direction, peak hour person capacity added to the identified choke points by the three systems ranged between 27,614 for the Arterial system alternative and 69,207 for the “Vision” system. The additional facilities added at these choke points in each alternative are 16 for the Vision Alternative 1, 14 for the Freeway Alternative 2, and 10 for the Arterial Alternative 3 as shown in Table 5-3.

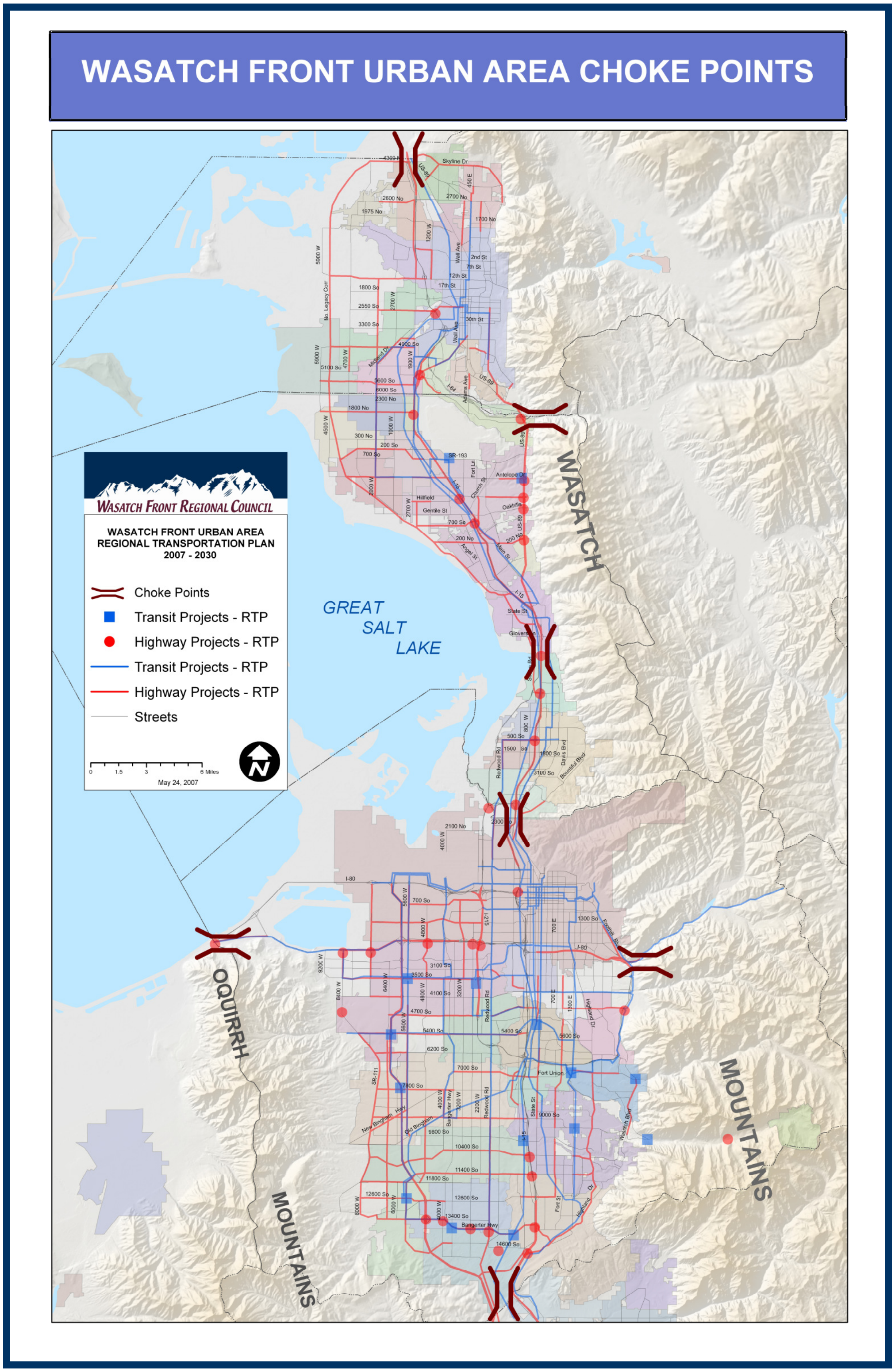
TABLE 5-3

NEW CHOKE POINT CAPABILITIES AND FACILITIES

PEAK HOUR PASSENGER CAPACITY ON NEW LANES (NUMBER OF NEW FACILITIES)			
	“Vision” Alt. 1	**“Freeway” Alt. 2**	**“Arterial” Alt. 3**
Freeway	53,568 (7)	54,835 (5)	11,059 (2)
Arterial	5,119 (3)	5,119 (3)	7,075 (3)
Transit	10,520 (6)	9,720 (6)	9,480 (5)
Total	**69,207 (16)**	**69,674 (14)**	**27,614 (10)**

MAP 5-1

WASATCH FRONT GEOGRAPHIC CHOKE POINTS



11. Transit Access to Major Activity and Mixed-Use Centers

Transit is a critical component of building major business, housing, and sports centers. Transit service reduces the need for expansive parking that reduces the effectiveness of the activity or mixed-use center. Transit also has the ability to penetrate such centers without the impacts associated with large road facilities.

In an effort to integrate local plans for land-use development with the regional transportation system, (as called for in the Wasatch Choices 2040 Growth Principles) transit system alternatives were evaluated by how well they served activity centers and mixed-use centers. The level of service was quantified by summing all the household and jobs within 20 minutes transit travel time of each of the identified centers.

WFRC staff identified the largest 55 activity centers and 14 mixed-use centers in the region, using local knowledge, regional travel model outputs, and aerial photos. Households and jobs within 20 travel minutes of several centers would be counted several times. Households and jobs within 20 minutes of an area that is both a mixed-use center and an activity center would be counted twice. All identified areas were recorded on a map and their traffic analysis zones (TAZs) were listed in a database for future use. Large and intense areas such as downtown Salt Lake City were broken into several districts of one-half mile radius to represent individual walking distances. Activity centers of regional significance were selected based upon their daily trips per acre. Most identified centers were roughly equivalent to or larger than the size of the Salt Lake Community College's Redwood Road Campus. Activity centers with daily activity equal to or greater than the Redwood Road Campus were selected based on the modeled density of weighted trip origins and destinations within each of the WFRC TAZ. Areas that were designated as activity centers are listed in Table 5-4.

TABLE 5-4

REGIONALLY SIGNIFICANT ACTIVITY CENTERS

WFRC REGION		
Business Depot Ogden	Lake Park Corp. Centre	Daybreak
Downtown Ogden (3 districts)	Jordan Landing	Capitol / City Creek
Newgate Mall	Sugarhouse	Salt Lake City Library
Weber State University	Fort Union	St. Mark's Hospital
McKay-Dee Medical Center	East Downtown SLC	S. Jordan Gateway
Riverdale Road	I-80 and I-15	University of Utah
West Hill Air Force Base	Knudsen's Corner	900 South State Street
Freeport Center	International Center	Boyer Gateway
Layton Hills Mall	I-80 Business Park (3100 S. & State Street)	Cottonwood Mall
Farmington Station	Sharon Steel (7800 South Jordan River)	South Towne Mall
Lagoon Amusement Park	Salt Lake International Airport	Sugarhouse
Gateway in West Bountiful	Valley Fair Mall	Family Center Taylorsville
North Salt Lake Gravel Pits	9000 South Jordan River	Westminster College
Downtown Salt Lake City (7 districts)	Salt Lake International Airport East	New Intermountain Health Care Center
Salt Lake Community College Jordan	Salt Lake Community College Redwood	OC Tanner / County Complex
Fashion Place Mall		

The largest mixed-use centers were selected based upon technical knowledge of the area. The mixed-use TAZ were 707 (Fashion Place Mall), 870 (South Towne Mall), 682 (Valley Fair Mall), 704 (Fort Union Area), and multiple TAZs in downtown Salt Lake City and Ogden. Once again, select large and intense areas such as downtown Salt Lake City were divided into several districts of one-half mile radius to represent individual walking distances. The number of households and jobs within 20 minutes transit travel time of identified major activity centers and major mixed-use centers ranged between 18.1 million for the Freeway Alternative and 18.8 million for the Vision Alternative within the three transit systems. This is a range of about 3.6 percent.

12. Auto Access To Major Activity, Mixed-Use, And Infill Areas

Auto access is currently essential to an area's ability to attract and maintain economic development. This is especially true in the Intermountain west. For this reason providing reasonable auto access to major activity centers, mixed-use centers, and infill areas is essential to retarding regional sprawl, irrespective of the amount of transit service available for a given activity or mixed-use center. In the existing development climate, large internal areas are often passed over for more peripheral areas due to access issues. The measure used for this analysis is the sum of all households and jobs within 20-minute afternoon peak period travel time of each of the identified major activity centers, mixed-use centers, and infill areas. A listing of the five-infill areas used can be found in Table 5-5. (Note: The number of household and jobs are counted more than once).

TABLE 5-5

INFILL AREA BY TRAFFIC ANALYSIS ZONE (TAZ)

NAME	TAZ
Clinton City	204
Farmington Station	302
UDOT Property	758
Midvale Slag	808
Sandy City	853

This measure ranged between 55.7 million for the Vision Alternative and 54 million for the Arterial Alternative within the three systems. This is a range of about 3.2 percent.

13. Freight Center To Freeway Access

The ability to move freight is an important factor in the region's ability to maintain and further develop a healthy business climate. Studies by the Federal Highway Administration indicate that currently 84 percent of all freight nationwide is delivered via roads and that the demand for freight transportation services will increase 87 percent by 2020. Congestion has more than tripled since 1982 (Texas Transportation Institute) making the cost of doing business more expensive. The cost of delay to a 5-axle combination truck was calculated to be $34.08 per hour in 2001. Additionally, manufacturing is increasingly dependent upon a "just-in-time" delivery system, which is very susceptible to delay.

"Freight center to freeway access" is defined as the roadway travel time from the closest freeway to major freight terminals, as identified by UDOT's freight planner. The measured values are the sums in minutes of the individual afternoon peak period travel times for each transportation alternative. The major freight terminals are identified in Table 5-6.

TABLE 5-6

REGIONALLY SIGNIFICANT FREIGHT TERMINALS

NAME	TAZ
Smith Food & Drug Center	248
FedEx Ground	339
UPS Freight	343
C.R. England, Inc.	357
UPS Package	359
Nicholas & Company	424
Watkins Motor Lines	424
ABF Freight Systems	452
Intermodal Center (5600 West)	521
Con-Way Freight	523
Roadway Express	523
Swift Transportation Company	523
Link Trucking	524
UFS Reddaway	548
FedEx Freight West	549
Huish Detergents	549
Ryder Logistics	549
Associated Food Stores	551
Estes Express	551
Central Refrigerated Services	594
Pride Transport	594
Yellow Transportation	596
Old Dominion Freight Lines	658
James H. Clark & Sons	710
Frito-Lay	725
LTI, Inc.	727
Swire Coco Cola, USA	936

The cumulative time from the major freight terminals to the nearest freeways for the three systems ranged between 87.4 minutes for the “Vision” system and 99.56 minutes for the Arterial system. This is a range of about 12.3 percent.

14. Employment Access For Disadvantaged Populations

Inadequate access to jobs is one of the most frequently cited obstacles to financial independence for disadvantaged populations. Transportation is the second largest expense for families with limited financial resources. Nationally, twenty percent of households with the lowest incomes spend about 39 percent of their income on transportation. In addition to families with limited incomes, access to dependable transit service is also a critical need for households who do not own automobiles and persons with disabilities.

Access for disadvantaged populations was quantified by determining the number of employment opportunities within 20 minutes transit travel time and within 20 minutes auto travel time of each of the 123 Traffic Analysis Zones that have a disproportionately high percentage of low income families, minorities, seniors, and households without automobiles. (Note: The number of jobs in each area are counted more than once resulting in the large sums.) The number of jobs within 20 minutes transit travel time for the three combined transportation systems ranged between 97,800,000 for the "Vision" system and 93,700,000 for the Freeway system. This is a range of about 4.4 percent.

15. Households And Employment Potentially Impacted

The purpose of this measure is to examine the potential cumulative direct impacts of each of the transportation systems upon the built environment. The measure was derived by summing the 2030 projected number of jobs and households in each five acre grid cell bordered or intersected by a transportation project. Although the extents of the impacts, if any, are unknown; it is assumed to be a relative indicator of future impacts. In the case of collector roads and transit these impacts may be positive. Nonetheless, it is assumed that the fewer the jobs and households potentially impacted the better. Household and employment potentially impacted by the three systems ranged between 420,000 for the Arterial system and 510,000 for the Freeway system. This is a range of about 18.3 percent. The Vision Alternative chosen for further refinement, has potential impacts to 470,000 jobs and households, near the middle of the range.

16. Potential Impacts To Historic Neighborhoods

Historical areas are considered cultural treasures and are irreplaceable. The WFRC Staff rated areas as of historical significance if they had greater than two times the regional average of homes built before 1950. WFRC Staff then used Geographic Information Systems to calculate the miles of highway and transit project potentially impacting these areas. The miles of highway and transit project potentially impacting historic areas for the three systems ranged between 151 miles for the Freeway system and 161 for the "Vision" system. This is a range of about 6.3 percent.

17. Potential Impacts To Disadvantaged Populations

The requirement to assess potential impacts on disadvantaged populations is derived from Executive Order #12898 regarding environmental justice. E.O. 12898 requires any program using federal funding to assess the impacts and benefits to disadvantaged populations. The intent of the Executive Order is to ensure that neighborhoods with large disadvantaged populations are not unfairly impacted by the construction of public facilities and that they receive comparable benefits from transportation projects as other areas.

The WFRC has identified disadvantaged populations for this analysis as members of minority groups, persons with incomes below the poverty level, the elderly, the disabled, and households who do not own vehicles. Areas with high concentration numbers of these populations are defined as areas with greater than two times the regional average for persons in these categories. The "potential impact analysis" was based on the number of miles of projects that would be constructed through these areas.

The miles of highway and transit projects potentially impacting disadvantaged areas in the three systems ranged between 125 miles for the "Vision" system and 133 for the Arterial system. This is a range of about 6.2 percent.

18. Air Quality

To compare the air quality impacts of the various system alternatives considered in developing the 2030 RTP, WFRC staff estimated the daily on-road mobile source emissions of nitrogen oxides (NOx), carbon monoxide (CO), and volatile organic compounds (VOC) for each alternative. These tailpipe emissions contribute to the non-attainment and maintenance designations by EPA for certain areas along the Wasatch Front. The emissions comparison of the alternatives was intended to estimate the relative impact on emissions for each alternative. Winter conditions were used in the model because CO and NOx emissions are more severe in the winter months. Winter VOC emissions are lower in the winter but the relative VOC emissions for each alternative is still captured in this analysis.

By weight, CO is by far the single largest tailpipe emission comprising 95% of tailpipe emissions. Emissions of CO have been substantially reduced in the past decades to levels well below the limits defined in the SIP. Localized or "hot spot" emissions of CO at sensitive receptor locations can be a concern and these impacts are examined in individual project studies.

NOx emissions are perhaps the most critical emission to track because NOx contributes both to ozone (O_3) pollution in the summer months and particulate matter (PM_{10} and $PM_{2.5}$) in the winter months. VOC emissions also contribute to summer O3 conditions.

In reviewing the results of the emissions analysis it may be most helpful to look at the relative difference in each emission type for the various alternatives evaluated rather than focusing on the alternative with the lowest total emissions. As mentioned previously, CO is the dominant emission by weight but the greatest air quality challenges for the Wasatch Front Area is not with CO. Looking at the NOx emissions one finds a 0.31 tons / day difference between the three alternatives, a variation of about + / - 1%. This difference is not significant enough to place one alternative over another based on air quality impacts shown in Table 5-7.

TABLE 5-7

AIR QUALITY IMPACTS*

2030 RTP ALTERNATIVES	CO TONS/DAY	NOx TONS/DAY	VOC TONS/DAY	Total TONS/DAY	PERCENT INCREASE
"Vision"	613.84	16.19	16.10	646.13	1.7%
Freeway	607.48	16.04	15.87	639.40	0.7%
Arterial	603.33	15.88	15.96	635.17	------

* Daily winter exhaust emissions

19. Potential impacts To Environmentally Critical Lands

Wildlife habitat, streams, and wetlands are all lands that are critical to the continued functioning of the region's ecosystem. It is less difficult to preserve these areas than to recreate them. Slopes greater than 20 percent are generally natural areas and have inherent geological instability. Most communities discourage or prohibit development on slopes with grades greater than 20 percent

A geographic information system mapping program was used to estimate the potential impact of the various system alternatives upon critical lands. The set of critical lands were defined as wildlife habitat, lake shores, slopes greater than 20 percent, streams, and wetlands. Digitized map layers for each of these critical lands were obtained through the Coalition for Utah's Future (Envision Utah), These maps were used previously to evaluate the 2040 Wasatch Choices scenarios. The software was used to center buffers of varying widths upon the proposed project centerlines and calculated how much of each of the critical land type was within the buffer. This acreage was used as the evaluated measure. The buffer widths varied by proposed transportation facility type in order to ascertain the level of impact. The buffer widths are as follows:

- 600 feet for Freeways and new highways;
- 200 feet for Arterials, Collectors, Bus Rapid Transit, and Streetcars; and
- 30 feet for Commuter Rail Lines on existing rights-of-way.

Critical lands potentially impacted for the three systems ranged between 902 acres for the Arterial System and 1,428 for the Vision System. This is a range of about 36.9 percent.

PUBLIC INPUT ON SYSTEM ALTERNATIVES

Pursuant to the requirements of SAFETEA-LU, the Wasatch Front Regional Council developed a set of alternatives for the 2030 RTP based on public involvement scoping and a transportation needs evaluation. These draft alternatives were then displayed at open houses in October and November 2006, to the respective county councils of governments, technical advisory committees, the Joint Policy Advisory Committee, the Regional Growth Committee, and Trans Com. In addition, scoping level comments were taken from chambers of commerce, environmental groups, the local transit workers union, disabled rights groups, Native American groups, low income organizations, senior citizens committees, state, federal and local government agencies, and many other interested citizens and groups. No comments were specifically directed towards the systems as a whole; however, many comments were received regarding specific projects. The comments are summarized below by County.

Davis County

- 2000 West should be widened to four lanes
- East / West travel is rapidly becoming a problem
- The North Legacy extension should be in the first phase of the 2030 RTP
- Overpasses for I-15 and US-89 should be built to facilitate east / west travel
- The connection of North Legacy to I-15 needs further study
- A BRT line running north / south through the Kaysville, Layton, and Clinton area would be well used in a growing area and alleviate congestion
- The BRT line through Farmington City should be along the I-15 frontage road as agreed to in the Farmington City Master Plan

Weber County

- Growth will be strong in the northwestern portion of the County
- East / West travel will quickly become a problem as the area west of I-15 is built up
- The Weber County portion of the Legacy Highway should be identified and preserved
- North Legacy should be west of 4700 West through Plain City. Plain City's general plan will call for an alignment along 5200 West when approved
- Traffic on Harrison Blvd. near Weber State University is at "failure"

- A lane of travel should be added to Riverdale Road in each direction
- The freeway interchange at 24^{th} Street needs improvement;
- There is strong support for a streetcar to Weber State University instead of a gondola
- Ogden City should remain the transit hub of Weber County
- Any north / south transit line through Ogden City should extend to 2700 North
- Bicycle lanes should be part of any highway or transit project
- Park and ride lots at the interchange of US-89 and I-84 and at Shepard Lane on US-89 will help alleviate congestion
- Widen Pioneer Road in Weber County from 1200 West to I-15 as in Alternative 2

Salt Lake County

- Bingham Junction Boulevard currently has funding available and needs to stay in the first phase of the Regional Transportation Plan
- East / west travel, especially across Bangerter Highway, is becoming a big problem
- SR-111 needs to remain limited access similar to Bangerter Highway
- Both super arterials and the 6200 South Freeway are needed and might be considered as components of a single alternative
- Expand 7200 West and 5600 West north of I-80. Connect 5600 West and 7200 West with 700 North in the northwest quadrant of Salt Lake City
- Widen State Street from 6200 South to 8800 South
- Add a major transit investment corridor to the northwest quadrant of Salt Lake City
- A 4700 South super arterial will have conflicts with interchanges on I-15, I-215, and possibly the Mountain View Corridor
- The widening of SR-201 west of Bangerter Highway to I-80 is needed
- 14600 South west of I-15 needs the railroad bridge removed and widened to 4 lanes to the Mountain View Corridor
- BRT service on the Mountain View Corridor should extend north to I-80
- TRAX should extend along 3500 South to 9200 West

5.5 SYSTEM EVALUATION RESULTS

The system evaluation results were reviewed by the WFRC staff and presented to the Regional Growth Committee and the Wasatch Front Regional Council. Each of the three system alternatives performed better than the others in some of the evaluation factors. For instance, the Arterial Alternative had the lowest Vehicle Miles Traveled and the highest transit ridership, but resulted in the largest delay per year and did not provide as much access as the others. The Freeway Alternative had the greatest Vehicle Miles Traveled, but also the lowest delay and highest speeds. It also had the lowest transit ridership and provided less access than the Vision Alternative. The Vision Alternative was the middle alternative with regard to Vehicle Miles Traveled, delay, and transit ridership, but it more effectively met the Wasatch Choices 2030 Growth Principle criteria to provide good access to mixed-use areas, to disadvantaged populations, and to freight centers.

The Regional Growth Committee and the Wasatch Front Regional Council endorsed the Vision Alternative as the best starting point for the 2030 RTP project selection and refinement process. However, projects from the Arterial and Freeway System Alternatives having significant benefits were considered as the draft 2030 RTP was developed and refined. Discussions in Section 5.3 lend insight to the system selection by explaining the significance of each measure and how the findings were interpreted. Table 5-8 displays the evaluation results for each of the alternatives.

TABLE 5-8

SYSTEM ALTERNATIVES EVALUATION RESULTS

EVALUATION MEASURES	VISION	FREEWAY	ARTERIAL
Highway			
1. Vehicle Miles Traveled (Million of Miles per Day)	50.08 miles / day	50.41 miles / day	49.02 miles / day
2. Annual Hours of Auto Delay (Millions of Hours Per Year)	51.50 hours / year	50.02 hours / year	57.54 hours / year
3. Home Based Work Auto Speeds (Miles Per Hour)	27.47 mph	27.60 mph	26.24 mph
4. Freight Center to Freeway Access (Travel Time in Minutes)	87.35 minutes	89.55 minutes	99.56 minutes
5. Auto Access to Major Activity, Mixed Use Centers, and Infill Areas (Millions of Households and Jobs	55.66 households and jobs	55.35 households and jobs	53.99 households and jobs
6. Household and Employment Potentially Impacted by New Capacity Projects (Millions of Households and Jobs)	0.47 households and jobs	0.51 households and jobs	0.42 households and jobs
7. Person Hours by Auto (Million of Persons per Auto Hour)	2.26 person / auto hour	2.27 person / auto hour	2.27 person / auto hour
Transit			
8. Transit Proportion of Work and College Travel (Percentage of Total Population)	6.78% work 28.58% college	6.70% work 28.52% college	6.91% work 28.86% college
9. Weighted Transit Speeds (Miles Per Hour)	10.89 mph	11.37 mph	11.11 mph
10. Transit Passenger Miles (Millions of Miles per Day)	2.48 miles / day	2.41 miles / day	2.45 miles / day
11. Transit Access to Activity and Mixed Use Centers (Millions of Households and Jobs Within 20 Minutes)	18.79 households and jobs	18.13 households and jobs	18.70 households and jobs
Both Highway and Transit			
12. Improvements to Choke Points (Number of Alternative and Capacity Added)	16 69,000	14 70,000	10 28,000
13. Air Quality (Ton of Emission per Day)	636 tons	625 tons	636 tons
14. Potential Impacts to Environmental Critical Lands (Number of Acres)	1,428 acres	1,149 acres	902 acres
15. Potential Impacts to Historic Neighborhoods (Project Miles)	161 miles	151 miles	154 miles
16. Potential Impacts to Disadvantaged Populations (Project Miles)	125 miles	126 miles	133 miles
17. Employment Access to Disadvantage Populations (Thousand of Jobs with a 20-minute Commute)	98 jobs	94 jobs	94 jobs
18. Traffic Volume in Constrained Corridors (Millions of Automobiles)	.93 autos	.92 autos	1.01 autos
19. Total Costs (Millions of 2006 Dollars)	$ 12,205	$ 11,826	$ 9,279