Evaluation of Alternatives

ALTERNATIVES ANALYSIS AND DRAFT ENVIRONMENTAL IMPACT STATEMENT

The Atlanta Regional Commission

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1.0 INTRODUCTION

The purpose of this memorandum is to determine how well the alternatives meet the goals and objectives identified for the I-285 Transit Corridor Alternatives Analysis/Draft Environmental Impact Statement (AA/DEIS) project. The introduction of this memorandum describes the project's goals and objectives, the scoring methodology used in the evaluation and a brief review of the identified alternatives. Section 2 describes the evaluation process, performance measures and results. Section 3 identifies the future tasks for the project. Supplemental data concerning ridership and cost criteria is presented in Appendix 1 and Appendix 2, respectively.

1.1 Goals and Objectives

Goals and objectives developed as part of the Marietta-Lawrenceville Transportation Study (MLTS) and *I-285 Transit Corridor Feasibility Study* were used as a starting point for this project. The Technical Advisory Committee (TAC) and Policy Advisory Committee (PAC) each reviewed these goals and objectives, and offered suggestions that were incorporated. The revised goals and objectives were presented to the public at a series of meetings that took place at various locations along the project corridor during the second and third weeks of April 2003. The goals and objectives are as follows:

Goal: Serve Existing And Future Mobility Demand
Objectives:

- Increase accessibility within the project area;
- Improve travel safety within the corridor;
- Improve travel efficiency within project area; and
- Enhance regional connectivity.

Goal: Provide Cost Effective Transportation Options
Objectives:

- Maximize cost effectiveness; and
- Provide realistic and practical modal options.

Goal: Minimize Adverse Social And Environmental Impacts
Objectives:

- Reduce mobile source emissions;
- Reduce greenhouse gas emissions;
- Decrease energy consumption;
- Minimize impacts on social, cultural and historical resources;

- Maximize environmental justice benefits, while minimizing adverse impacts;
- Minimize adverse impacts to the natural environment; and
- Minimize adverse impacts to built environment.

Goal: Complement Existing And Future Land Uses And Trends
Objectives:

- Support existing and future land uses;
- Support development plans and policies; and
- Complement urban design characteristics.

These goals and objectives were developed specifically for the I-285 Transit Corridor project. However, the project goals and objectives need to consider the regional context that the project will be a part of. The 2030 Regional Transportation Plan (RTP) is the overarching regional plan, and includes the following four goals:

1. Improve accessibility and mobility options for all people and goods;
2. Maintain and improve system performance and preservation;
3. Protect and improve the environment and the quality of life; and
4. Increase the safety and security of the transportation system.

As mentioned previously, these goals and objectives provide a basis for defining and evaluating potential alternatives. The following section will detail the scoring methodology used to assess how well the alternatives satisfy the goals and objectives.

1.2 Evaluation Methodology

The evaluation process was presented in the earlier report: *Evaluation Framework and Definition of Alternatives, November 2003*. In summary, for each of the objectives mentioned above, one or more performance measures have been defined. These measures have been estimated for each of the four build alternatives, and for the baseline alternative if applicable.

A four-step procedure for ranking the four build alternatives is based on the resulting values for each performance measure:

- Step One: For each performance measure the numeric values (in units such as passengers, dollars, acres, etc.) are arrayed and grouped into up to three ranges, corresponding to the rating scale: Most Desirable = 2, Less Desirable = 1, Least Desirable = 0. In many cases, there are natural breaks in the data that established differentiation among the alternatives, and the data are placed in the three ranges. Alternatively, where the variance is very small among the values, one or two

ranges are used as appropriate. The grouping is done in a way that avoids overstating the difference between closely grouped alternatives.

- Step Two: The scores generated for each performance measure are aggregated to create a single score for each Objective. The aggregate scores for each alternative are then rated again using the same three-point scale, based on the stratification of scores for each objective across alternatives.
- Step Three: A composite score for each of the four Goals is computed by adding the scores for each Objective, calculated in Step Two. Each goal is then rated again using the 2, 1, and 0 scale.
- Step Four: The composite scores for each goal are summed into an aggregate rating for each alternative. This rating is the basis for comparing alternatives.

This method removes any bias across objectives, meaning that each objective will affect the composite score for the goals equally. Furthermore, the aggregate rating will be based on the four goals without bias toward a specific goal.

1.3 Description of Project Alternatives

The project alternatives are described in detail in the report: *Detailed Description of Alternatives, Jan. 2004*. This section is a brief summary of the baseline and four build alternatives.

Baseline Alternative

The Baseline Alternative includes improvements in bus service in the study corridor. The intent of the Baseline Alternative is to establish a basis for determining the effects of the build alternatives on the transportation network, relative to a low-cost improvement plan.

Alternative 1: Light Rail Transit

An LRT Alternative is carried forward from the previous study. Proposed LRT stations will serve existing major development centers. Auto and bus access to the stations will be provided via major intersecting arterials. Along the freeway, most of the alignment could be at-grade. However, elevated sections will be necessary to cross freeways and other major highways. Signal pre-emption is preferable at any at-grade intersections. Potential alignments are to either side of the freeway, at-grade or elevated. This alternative will also include two concurrent flow HOV lanes (one in each direction) for the length of the corridor.

Alternative 2: Bus Rapid Transit in Exclusive Busway

This alternative is a two-lane busway facility, which runs the entire length of the corridor. Most of the busway runs at-grade alongside I-285; several elevated sections will be needed to cross freeways and major highways. In the central portion of the corridor, the busway runs along

Hammond Drive in order to locate stations closer to major destinations. All buses will have signal priority at any at-grade crossings. The corridor will serve multiple bus operators. A two lane concurrent flow HOV system along I-285 is also assumed for this alternative.

Alternative 3: Bus Rapid Transit in HOV Lanes

The technology used in Alternative 3 is a hybrid of BRT and HOV. Buses will run concurrently with HOV's in a four-lane barrier separated HOV facility that runs the length of the corridor. Most of the proposed facility would be located along the north side of I-285. As much of the system as possible will be at grade, with elevated sections for crossing freeways and major highways. Access points for both BRT and HOV will be provided along the corridor, consistent with the locations detailed in the GDOT HOV System Implementation Plan. Additionally, BRT stations will be located along the corridor based on input from public involvement, the TAC, and ARC staff.

Alternative 4: Bus Rapid Transit in HOV Lanes and Exclusive Busway

This alternative is a combination of Alternative 2 and Alternative 3. It includes the 4-lane HOV facility along the entire corridor. In the east and west segments, on-line BRT stations would be the same as Alternative 3. In the central segment, a two-lane busway would depart from I-285 to serve Sandy Springs and Perimeter Center; this is similar to the central segment of the busway in Alternative 2.

2.0 EVALUATION OF ALTERNATIVES

This chapter presents the results of the evaluation of the alternatives. The first section is an overall summary of the evaluation results. Subsequent sections present the detailed results for each of the four goals, broken down by objective and then by individual performance measure. The discussion of each performance measure includes a brief description of the methodology as well as the results. Several of the performance measures are required to be reported as part of the FTA New Starts process; these measures are denoted with an asterisk*.

2.1 Evaluation Summary

Table 2-1 is a one-page graphical summary of the evaluation results. As shown, Table 2-1 provides the resulting ratings for each of the sixteen objectives, along with the summary rating for each of the four goals, and the overall rating for each alternative. The specific performance measures addressing each of the sixteen objectives are provided later in this report.

In Table 2-1, the three-point rating scale is converted to colored dots, with green representing most desirable, yellow less desirable, and red least desirable. The results are illustrated in Table 2-1 and summarized as follows:

- Alternative 2 (BRT – Busway) receives the best overall rating. It scores the best of all alternatives in the first two goals – mobility and cost-effectiveness, and it scores well in the land use goal.

- Alternative 1 (LRT) has an overall rating in the intermediate group. It scores best on the impacts and land use goals, but does poorly on mobility and cost-effectiveness.

- Alternative 4 (BRT in HOV & Busway) also has an overall rating in the intermediate group. It scores as well as Alternative 2 in mobility, and nearly as well in cost-effectiveness. But it does poorly in the impacts goal.

- Alternative 3 (BRT – HOV) has the lowest overall rating. It has medium ratings on mobility and cost-effectiveness, and does poorly on land use.

Table 2-1: Summary Evaluation by Objective

Goals	Objectives	Alternative Ratings			
		Alternative 1 - LRT	Alternative 2 - BRT in Busway	Alternative 3 - BRT in HOV Lanes	Alternative 4 - BRT in HOV Lanes & Busway
Serve existing and future mobility demand	Increase accessibility	🟡	🟢	🔴	🟢
	Improve travel safety within the corridor	🔴	🟡	🟡	🟡
	Improve travel efficiency within project area	🔴	🟢	🟢	🟢
	Enhance regional connectivity	🔴	🟢	🟡	🟢
	Overall Goal Rating	🔴	🟢	🟡	🟢
Provide cost effective transportation options	Maximize cost effectiveness	🔴	🟢	🟡	🟡
	Provide realistic and practical modal options	🔴	🟢	🟡	🟢
	Overall Goal Rating	🔴	🟢	🟡	🟢
Minimize adverse social and environmental impacts	Reduce mobile source emissions	🟡	🔴	🟡	🔴
	Reduce greenhouse gas emissions	🟢	🔴	🟡	🔴
	Decrease energy consumption	🟢	🔴	🟡	🔴
	Minimize impacts on social, cultural and historical resources	🟡	🟡	🔴	🔴
	Maximize environmental justice benefits, while minimizing adverse impacts	🟡	🟡	🔴	🟡
	Minimize adverse impacts to the natural environment	🟡	🟡	🟡	🟡
	Minimize adverse impacts to built environment	🟢	🟢	🔴	🔴
	Overall Goal Rating	🟢	🟡	🟡	🔴
Complement existing and future land uses and trends	Support existing and future land uses	🟢	🟢	🔴	🟡
	Support development plans and policies	🟢	🟡	🔴	🟡
	Complement urban design characteristics	🟢	🟢	🔴	🟡
	Overall Goal Rating	🟢	🟢	🔴	🟡
Overall Rating		🟡	🟢	🔴	🟡

Legend

🔴 = Least Desirable

🟡 = Less Desirable

🟢 = Most Desirable

2.2 Goal 1: Serve Existing and Future Mobility Demand

This goal encompasses four objectives, each of which is evaluated by one or more performance measures. Each of the objectives is discussed in more detail below, with the results for each performance measure.

All of the measures under this goal make use of data from the ridership forecasting model. Appendix I contains some background information on the model, and more detailed tables of ridership results, including some values that are not directly used in the evaluation process.

2.2.1 Increase Accessibility

Evaluating accessibility at the corridor level refers to the ease with which individuals can travel within and through the corridor. Increased accessibility is achieved by decreasing transit travel times and providing more transit access.

The accessibility to transit measures indicate which alternatives provide the largest increase in the number of potential riders who are within walking distance of LRT or BRT stations. Also, each alternative is evaluated to determine optimal transit travel times related to the proposed improvements. There are two goals in providing transit improvements: to improve service and to attract more transit riders by diverting users of the highway network. To that end, the evaluation criteria used to measure the increase of accessibility include:

- Average Transit Travel Time to, from and within Zones in the Study Area
- Low Income Households Served
- Employment Near Stations
- Population Near Stations

2.2.1.1 Travel Time To And From Zones Within The Study Area

This measure was calculated by determining the transit trips that had either an origin, destination, or both in the study area from the transit trip table and the total transit travel times for each origin-destination pair. The total transit travel time for each trip consists of the following components: walk times to the initial transit access and to transfer to other transit modes, drive time to a rail or BRT station or park/ride lot, rail, bus and BRT in-vehicle time and wait times for the first transit service as well as any additional transit transfers. The average of all of the selected origin-destination pairs was then calculated. This measure reflects the change in transit travel time and location of additional new transit users to, from, and within the study area. Table 2-2 lists each alternative, average

travel time for transit trips to, from and within the study area (in minutes), and the qualitative assessment for each alternative.

Table 2-2: Travel Efficiency and Congestion Criteria

Alternatives	Average Transit Travel Time (minutes)					
	To Zones in the Study Area	Rating	From Zones in the Study Area	Rating	To and From Zones w/in the Study Area	Rating
Baseline	44.1	-	32.3	-	28.2	-
Alternative 1 - LRT	40.1	0	29.1	0	21.6	0
Alternative 2 – BRT in Busway	39.0	2	27.1	2	19.5	2
Alternative 3 – BRT in HOV Lanes	37.8	2	27.6	2	20.0	2
Alternative 4 – BRT in HOV Lanes and Busway	39.0	2	27.1	2	19.5	2

There is a decrease in transit travel times for all alternatives relative to the Baseline alternative. This stands to reason, as each alternative is providing significantly new transit service with substantial station and park-and-ride locations within the study area. The impact of providing additional transit service in the corridor has the effect of improving travel efficiency to, from, and within the corridor. This measure is also used as a measure of travel efficiency provided later in this report in Section 2.2.3.1.

The LRT alternative, however, shows a smaller decrease in average transit travel time than all of the BRT alternatives. This fact is due to the higher transit travel times associated with an additional transfer and wait time for LRT mode. All of the BRT alternatives show a similar decrease in average travel time. For this reason, the LRT alternative was given a rating of *Least Desirable*, and the BRT alternatives were all given a rating of *Most Desirable*.

2.2.1.2 Low Income Households Served *

This is a New Starts measure, and the methodology is designed to be consistent with *Reporting Instructions for the Section 5309 New Starts Criteria*, issued by FTA. Low income households are defined by the U.S. Census of Population as households with income below the poverty level. In addition to low income households served, FTA also requires households served.

Table 2-3 below shows the number of low-income households that are served by the proposed transit stations. This measure is defined by the number of households that are located within a ½ mile radius of each station.

BRT Alternative 4 shows the largest change in low income households served, with a value of 433. BRT Alternative 3 shows a slight decrease in households served with a value of 390. The station locations for Alternative 4 are in TAZ's with a greater number of low-income households than the other alternates. However, the differences among all of the alternatives are very small, and therefore they are all given a rating of *Less Desirable*.

2.2.1.3 Employment Near Stations *

Table 2-3 below also shows the number of jobs that are located within walking distance of the proposed stations. Like the low income household measure, this measure is determined by calculating the number of jobs within a ½ mile radius to each station. The values for this measure are also dependent on the socio-economic data for the TAZ's which contain the proposed stations.

The LRT Alternative 1 and BRT Alternative 2 both have identical alignments in the corridor, and therefore have the same values for this measure. Both of these alternatives show the greatest increase of employment served near the station, gaining over 85% compared to the Baseline. For this reason, Alternatives 1 and 2 were given a rating of *Most Desirable*. Alternatives 3 and 4 also show a good increase over the Baseline – at about 45% and 49%, respectively. For this reason, these two alternatives were given a rating of *Less Desirable*.

2.2.1.4 Population Near Stations

This value is based on the number of persons that live within a ½ mile radius of the proposed stations.

Table 2-3 shows that the most significant increase in population served near the transit stations is in BRT Alternative 4. This has an increase in almost 230% compared to the Baseline Alternative. For this reason, Alternative 4 is given a rating of *Most Desirable*. Alternatives 1 and 2 show a slightly smaller increase in population served – and for this reason they were assigned a rating of *Less Desirable*. Alternative 3 had the smallest increase in population served, and therefore was assigned a rating of *Least Desirable*.

Table 2-3: Transit Accessibility Criteria

Alternatives	Transit Accessibility					
	Low Income HH Served	Rating	Employment near Stations	Rating	Population near Stations	Rating
Baseline	398	-	23,805	-	4,346	-
Alternative 1 - LRT	419	1	44,082	2	13,810	1
Alternative 2 – BRT in Busway	419	1	44,082	2	13,810	1
Alternative 3 – BRT in HOV Lanes	390	1	34,580	1	12,592	0
Alternative 4 – BRT in HOV Lanes and Busway	433	1	35,582	1	14,298	2

2.2.2 Improve Travel Safety Within the Corridor

Travel safety is an important component of any transportation project. For this objective, a single performance measure is used, which is based on the vehicle miles traveled for each alternative. The number of accidents is based on roadway facility type, freeway versus surface streets and the number of vehicles using that facility. The accidents rates are based on data collected by the Georgia Department of Transportation. The larger the decrease in the number of annual accidents, the greater the benefit.

Table 2-4 shows the results. Alternatives 2, 3, and 4 each show virtually no change in the annual accidents compared to the Baseline Alternative. For this reason, they are all given a rating of *Less Desirable*. Alternative 1 shows a slight increase in estimated accidents, and therefore is given a rating of *Least Desirable*.

Table 2-4: Improve Travel Safety within the Corridor

Alternatives	Safety	
	Est. Annual Accidents per 1,000,000 VMT	Rating
Baseline	8,185	-
Alternative 1 - LRT	8,213	0
Alternative 2 – BRT in Busway	8,188	1
Alternative 3 – BRT in HOV Lanes	8,188	1
Alternative 4 – BRT in HOV Lanes and Busway	8,182	1

2.2.3 Improve Travel Efficiency Within The Project Area

The travel efficiency/congestion measures are evaluated to help determine the overall performance of the transportation system in the study area. These measures will examine both the impact of the transit improvements on the highway network and the travel time for travelers on either highway or transit facilities. Greater travel efficiency is achieved through reduced delay or congestion on the highway network, and less hours of person travel by either highway or transit mode. The following eight performance measures have been established to evaluate travel efficiency within the project area.

2.2.3.1 Total Travel Time To And From Zones Within The Study Area

This measure is an indicator of the change in transit travel time for each alternative for both existing and new transit users. The discussion of this measure was included in Section 2.2.1.1 above. Because it is in indicator of both accessibility and efficiency, the measure was included in both sections. Please refer to Section 2.2.1.1 for the discussion of this measure.

2.2.3.2 Person Hours Of Delay

This measure reflects the change in time spent traveling for all persons with at least one end of their trip in the study area by either the transit or highway system that occurred because of congestion. If all persons were able to make their trip under ideal non-congested free-flow conditions, there would be no person hours of delay. A decrease would represent a benefit to travelers to, from, and within the study area.

Table 2-5 below shows the change in person hours of delay relative to the Baseline Alternative. Alternatives 2 and 3 show the greatest decrease in delay with values of 206,536 and 233,928 hours, respectively. For this reason, both of these BRT alternates were rated as *Most Desirable*. Alternative 4 had a slightly less decrease in person hours of delay, though still a significant change. It was therefore rated as *Less Desirable*. The LRT alternative had a very small decrease in delay relative to the Baseline Alternative. For this reason, Alternative 1 was given a *Least Desirable* rating.

2.2.3.3 Change In Average V/C Ratio

Congestion on highways and surface streets is at a maximum in the A.M. and P.M. peak periods. In order to reduce this peak period congestion, the transit alternatives must provide improved transit access to employment with shorter travel times to make a transit trip at least as attractive as the same highway trip.

This measure reflects the average volume-to-capacity ratio on all the links within the study area. Congested conditions are defined as the condition when volumes on the highway network exceed the capacity of the network. This corresponds to a vehicle to capacity ratio of 1.0, which is consistent with Level-of-Service (LOS) F.

Table 2-5 shows the average V/C ratio for each alternative for the PM Peak Period. Alternatives 1 and 4 have unchanged ratios compared to the Baseline Alternative. As a result, they are rated as *Less Desirable*. Alternative 2 has a higher V/C ratio than the Baseline Alternative and is rated as *Least Desirable*. Alternative 3 shows a V/C ratio decrease of almost 4% relative to the Baseline Alternative and is rated as *Most Desirable*.

2.2.3.4 Total Annual Travel Time Savings *

This measure reflects the effectiveness the transit improvements in the study area have at decreasing travel times for transit passengers. There are two goals in providing transit improvements, improve service and attract more transit riders by diverting users of the highway network. The larger the savings, the greater the benefit to the transportation system.

Table 2-5 shows the annual travel time savings for each alternative. Alternatives 2 and 4 have the highest value of savings, and receive a rating of *Most Desirable*. Alternative 3 has only slightly less savings, and is rated as *Less Desirable*. The LRT Alternative 1 has the least amount of savings, and is thus rated as *Least Desirable*.

Table 2-5: Travel Efficiency and Congestion Criteria

Alternatives	Travel Efficiency					
	Person Hours of Delay (change)	Rating	PM Peak Average V/C Ratio	Rating	Annual Travel Time Savings	Rating
Baseline	-	-	0.76	-	-	-
Alternative 1 - LRT	-9,779	0	0.76	1	5,697,536	0
Alternative 2 – BRT in Busway	-206,536	2	0.77	0	7,864,554	2
Alternative 3 – BRT in HOV Lanes	-233,928	2	0.74	2	7,495,942	1
Alternative 4 – BRT in HOV Lanes and Busway	-132,903	1	0.76	1	7,759,639	2

2.2.3.5 Person Throughput

This measure reflects the effectiveness the transit improvements in the study area have at enhancing person travel throughout the study area. This includes travel on both the transit and highway system. The larger the value, the greater the benefit to the transportation system.

This measure was calculated by establishing screenlines at specific locations in the corridor and counting the highway and transit trips that crossed these locations. Four locations were chosen: just east of I-75 at the Chattahoochee River, just west of GA 400, just east of GA 400, and just west of I-85. The results of the east-west traffic captured at these locations for each alternative are shown in Table 2-6 below.

The largest person throughput found on all screenline locations can be seen in Alternatives 3 and 4. Therefore, these alternatives were given a *Most Desirable* rating. Alternative 1 and 2 had slightly less person throughput, but it is still much higher compared to the Baseline Alternative. Therefore Alternatives 1 and 2 were rated as *Less Desirable*.

Table 2-6: Travel Efficiency and Congestion Criteria (Person Throughput)

Alternatives	Person Throughput				
	Across Chattahoochee River	West of GA 400	East of GA 400	Between PIB and I-85	Rating
Baseline	433,338	448,748	501,374	443,343	-
Alternative 1 - LRT	448,740	461,068	514,105	452,678	1
Alternative 2 – BRT in Busway	450,671	463,112	516,028	461,449	1
Alternative 3 – BRT in HOV Lanes	463,018	475,803	527,612	468,553	2
Alternative 4 – BRT in HOV Lanes and Busway	459,815	472,854	526,587	469,811	2

2.2.3.6 Daily Transit Station Boardings in Corridor

This measure includes the total number of transit boardings in the study area at the proposed transit stations. The results of this measure are a good indicator of the attractiveness of a particular transit alternative, as it directly correlates to the number of passengers using the proposed transit system.

Table 2-7 evaluates the total number of transit boardings within the study area for each alternative. This value is calculated from the output of the transit assignment portion of the travel demand model. It includes all trips that board any of the transit modes within

the study area, as well as trips that transfer from one mode to another. For example, one transit rider boarding a local bus and transferring to rail at Dunwoody station will be counted as two boardings. The BRT Alternatives have a higher number of daily boardings than the LRT Alternative for two reasons. First, the BRT alternatives attract more transit passengers, both new and old. The second reason is due to the operations of the BRT service. The BRT alternatives provide more local and express bus service feeding into the rail system, which results with more transfers. The Alternatives with the highest ridership are BRT Alternatives 2 and 4, at 67,200 and 66,000 boardings, respectively. These two alternatives were given a rating of *Most Desirable*. BRT Alternative 3 had a slightly lower value of boardings and was given a rating of *Less Desirable*. The LRT Alternative 1 had the smallest number of station boardings at 43,500 and was rated as *Least Desirable*.

Table 2-7: Travel Efficiency

Alternatives	Travel Efficiency					
	Daily Transit Station Boardings	Rating	New Transit Riders	Rating	Transp. System User Benefits	Rating
Baseline	-	-	-	-	-	-
Alternative 1 - LRT	43,500	0	15,000	0	24,936	1
Alternative 2 – BRT in Busway	67,200	2	39,962	2	50,296	2
Alternative 3 – BRT in HOV Lanes	63,600	1	39,910	2	54,175	2
Alternative 4 – BRT in HOV Lanes and Busway	66,000	2	41,255	2	52,789	2

Additional tables regarding transit boardings are presented in Appendix I. Table I-1 shows the number of boardings in the region and study area for various transit modes broken down by the four alternatives. Table I–2 shows the station boardings for the stations in the study area for each of the four alternatives.

2.2.3.7 New Transit Riders

This measure describes the number of new transit riders on the entire regional transit system in relation to the Baseline Alternative. The number of new transit trips across the whole region is calculated from the mode choice output of the travel demand model. This value represents new linked trips on the transit system due to the BRT or LRT

improvement alternative. Tables 2-7 above evaluates the number of new transit riders on the regional transit system for each alternative.

All three BRT alternatives show a similar number of new transit riders, ranging from 39,910 to 41,255. The LRT alternative had a significantly lower number of new riders at 15,000. The LRT alternative requires users to transfer from bus/rail to either enter or exit the corridor. The reason for this is because of the additional transfer required for the light-rail mode. For example, a transit passenger from northern Cobb County would have to travel down to Akers Mill Station and transfer to the LRT in Alternative 1 to travel across I-285; whereas in the BRT alternatives, it is possible for that same passenger to continue directly on the BRT to a destination along the I-285 corridor. The additional transfer in Alternative 1 thus discourages a number of potential new transit riders. Alternatives 2, 3, and 4 were given a rating of *Most Desirable*, while Alternative 1 was given a rating of *Least Desirable*.

2.2.3.8 Transportation System User Benefits

This measure reflects the total benefits received by travelers on all modes between the Baseline Alternative and the build alternative. This measure is used to calculate cost-effectiveness as part of FTA's New Starts process; see section 2.3.? below. This measure is determined through software developed by FTA called Summit. The user benefits derived from this measure produce a measure of the traveler utility for all modes on the transportation system.

Table 2-7 shows the transportation system user benefits for each alternative. Each of the three BRT alternatives show a high daily user benefit with values ranging from 50,296 for Alternative 2 to 54,175 for Alternative 3. The three BRT Alternative 1, 2, and 3 were all given a rating of *Most Desirable*. The LRT Alternative showed significantly less user benefits with a value of 24,936. For this reason, Alternative 1 was rated as *Less Desirable*.

2.2.4 Enhance Regional Connectivity

Based on the trip patterns in the I-285 corridor, connectivity with other transit systems in the region is key to the success of the project. Five performance measures were developed to evaluate regional connectivity. A description of these performance measures are presented below.

2.2.4.1 Number Of Activity Centers Connected

Activity centers are generally defined town centers or regional employment centers. They generally include significant employment and retail development, such as large

shopping centers or regional malls. Examples of activity centers within the project area include Cumberland/Galleria, Perimeter Center, Sandy Springs, and Doraville. This measure reflects the ability of the transit alternatives to make connections with some of the region's major areas of population and employment. By connecting transit to these activity centers, an option of travel other than driving is provided and, with comparable travel times to highway trips, promotes the use of transit.

Table 2-8 lists each alternative, the number of activity centers connected, and the qualitative assessment of each alternative. All of the alternatives provided connections to three activity centers and were awarded ratings of *Less Desirable*.

Table 2-8: Enhance Regional Connectivity

Alternatives	Regional Connectivity	
	Number of Activity Centers connected via transit	Rating
Baseline	0	-
Alternative 1 - LRT	3	1
Alternative 2 – BRT in Busway	3	1
Alternative 3 – BRT in HOV Lanes	3	1
Alternative 4 – BRT in HOV Lanes and Busway	3	1

2.2.4.2 Low Income Households within 45 minutes of the Study Area by Transit

This measure tabulates the number of low income households within 45 minutes travel time via transit (assuming walk access) to the study area. Since low income households are more likely to be transit dependent, it is important that transit alternatives be provided to improve access and service to this potential market.

Table 2-9 lists each alternative, the number of low income households within 45 minutes of the study area via walk to transit, and the qualitative assessment of each alternative. All the BRT alternatives showed approximately 84,000 low income households within 45 minutes of the study area via a walk to transit trip and received a rating of *Most Desirable*. The LRT alternative had around 81,000 low income households and received a rating of *Less Desirable*. The BRT alternatives are able to provide more households with transit access due to the shorter transit travel times. Having to transfer to the light rail in Alternative 1 results in a longer travel time, and therefore results in fewer low income households located within 45 minutes of the study area by walk access to transit.

2.2.4.3 Total Households within 45 minutes of the Study Area by Transit

This measure tabulates the number of total households within 45 minutes transit travel time via transit (walk access) to the study area. This measure shows the ability of the transit alternative to provide connectivity to all incomes.

Table 2-9 lists each alternative, the number of total households within 45 minutes of the study area via walk to transit, and the qualitative assessment of each alternative. All the BRT alternatives showed more than 374,000 total households within 45 minutes of the study area via a walk to transit trip and resulted in ratings of *Most Desirable*. The LRT alternative again resulted in the lowest increase when compared to the Baseline alternative and was given a rating of *Less Desirable*. These results parallel the low income households performance measure, and the reason is again the additional transfer required for most users of the light rail alternative.

2.2.4.4 Jobs within 45 minutes of the Study Area by Transit

This measure tabulates the number of jobs within 45 minutes of the study area with walk access to transit. Since congestion is at the highest during the AM and PM peak periods, a transit alternative should provide more connectivity to areas of employment. By providing people with an alternative mode of transportation other than driving in the peak periods, a transit alternative can help alleviate some of the congestion due to highway work trips.

Table 2-9 lists each alternative, the number of jobs within 45 minutes of the study area via walk to transit, and the qualitative assessment for each alternative. Alternatives 2 and 4 provided the largest number of jobs within 45 minutes of the study area with transit walk connectivity with around 1.74 million compared to 1.65 million in the Baseline alternative. As a result, alternatives 2 and 4 both were given *Most Desirable* ratings. BRT alternative 3 had approximately 1.73 million jobs within 45 minutes by transit and resulted in a rating of *Less Desirable*. The LRT alternative had about 1.71 million jobs within 45 minutes by transit and was given a rating of *Least Desirable*.

Table 2-9: Enhance Regional Connectivity

Alternatives	Regional Connectivity					
	Low Income HH's within 45 minutes via walk to transit	Rating	Total HH's within 45 minutes walk to transit	Rating	Jobs within 45 minutes walk to transit	Rating
BASELINE	78,573	-	346,726	-	1,652,736	-
Alternative 1 - LRT	81,464	1	361,275	1	1,712,490	0
Alternative 2 – BRT in Busway	84,181	2	375,697	2	1,741,222	2
Alternative 3 – BRT in HOV Lanes	83,925	2	374,141	2	1,730,745	1
Alternative 4 – BRT in HOV Lanes and Busway	83,828	2	376,029	2	1,744,351	2

2.2.4.5 Summary of Performance Measures for Mobility Goal

The following table presents the overall rating each alternative earned for how well it met the goal of serving existing and future mobility demand. The table lists the four objectives and twenty-two criteria described above and displays the score for how each alternative performed against the criteria. The sum of these scores and the overall goal rating for each alternative are also presented in the table.

Alternatives 2 and 4 performed the best and have overall goal ratings of *Most Desirable*. Alternative 3 has an overall goal rating of *Less Desirable.* Alternative 1 did not perform well and rated *Least Desirable*.

Table 2-10: Review of Mobility Performance Measures

Goals	Objectives	Criteria	Baseline	Alternative 1 - LRT		Alternative 2 - BRT in Busway		Alternative 3 - BRT in HOV Lanes		Alternative 4 - BRT in HOV Lanes	
				Measure	Rating	Measure	Rating	Measure	Rating	Measure	Rating
Serve existing and future mobility demand	Increase accessibility	Total travel time to and from zones within the study area (Weighted transit average)	104.6		0		2		2		2
		To Study Area	44.1	40.1		39.0		37.8		39.0	
		From Study Area	32.3	29.1		27.1		27.6		27.1	
		Within Study Area	28.2	21.6		19.5		20.0		19.5	
		Low income households served	398	419	1	419	1	390	1	433	1
		Employment near stations	23,805	44,082	2	44,082	2	34,580	1	35,582	1
		Population near stations	4,346	13,810	1	13,810	1	12,592	0	14,298	2
		Sum of Criteria Ratings			4		6		4		6
		Overall Objective Rating			1		2		0		2
	Improve travel safety within the corridor	Estimated number of annual accidents per 1,000,000 VMT*	8,185	8,213	0	8,188	1	8,188	1	8,182	1
	Improve travel efficiency within project area	Total travel time to and from zones within the study area (Weighted transit average)			0		2		2		2
		To Study Area	44.1	40.1		39.0		37.8		39.0	
		From Study Area	32.3	29.1		27.1		27.6		27.1	
		Within Study Area	28.2	21.6		19.5		20.0		19.5	
		Person hours of delay (change)	4,271,961	-9,779	0	-206,536	2	-233,928	2	-132,903	1
		PM peak period average v/c ratio	0.76	0.76	1	0.77	0	0.74	2	0.76	1
		Annual travel time savings	N/A	5,697,536	0	7,864,554	2	7,495,942	1	7,759,639	2
		Person throughput (Cutlines)			1		1		2		2
		E-W Across Chattahoochee River	433,338	448,740		450,671		463,018		459,816	
		E-W bet. Roswell Rd & GA 400	448,748	461,068		463,112		475,803		472,854	
		E-W bet. GA400 & Ashford Dunwoody	501,374	514,105		516,028		527,612		526,587	
		E-W bet. P'tree Ind & I-85	443,343	452,678		461,449		468,553		469,811	
		Daily Transit Station Boardings in corridor	N/A	43,500	0	67,200	2	63,600	1	66,000	2
		New Transit Riders		15,000	0	39,962	2	39,910	2	41,255	2
		Transportation System User Benefits from Summit (Daily Hours)	N/A	24,936	1	50,296	2	54,175	2	52,789	2
		Sum of Criteria Ratings			3		13		14		14
		Overall Objective Rating			0		2		2		2
	Enhance regional connectivity	Number of activity centers connected via transit	0	3	1	3	1	3	1	3	1
		Number of Low Income Households within 45 minutes of study area via walk to transit access	78,573	81,464	1	84,181	2	83,925	2	83,828	2
		Number of Total Households within 45 minutes of study area via walk to transit access	346,726	361,275	1	375,697	2	374,141	2	376,029	2
		Number of Jobs within 45 minutes of study area via walk to transit access	1,652,736	1,712,490	0	1,741,222	2	1,730,745	1	1,744,351	2
		Number of transfers occurring in the study area	59,467	67,198	0	80,498	2	76,278	1	80,638	2
		Sum of Criteria Ratings			3		9		7		9
		Overall Objective Rating			0		2		1		2
		Sum of Objective Ratings			1		7		4		7
		Overall Goal Rating			0		2		1		2

2.3 Goal 2: Provide Cost Effective Transportation Options

Goal 2 addresses costs to construct, costs to operate and the relative cost effectiveness of each build alternative. Many of the measures described in this section are required by FTA for an Alternatives Analysis and are calculated according to FTA's technical guidelines. The second objective within this goal compares transit travel times to auto travel times for each alternative as a means of assessing whether an alternative provides a "realistic" travel option. Each measure is described in detail in the following subsections.

2.3.1 Maximize Cost Effectiveness

A key measure of project success, cost effectiveness assesses the cost of a project alignment with respect to ridership and transportation system user benefits. Five performance measures are designed to assess costs and benefits.

2.3.1.1 Capital Cost

The total capital cost of each alternative is an important evaluation measure on its own. In addition, the annualized capital cost is an essential input to three other measures: the incremental cost per rider and per new rider, and the incremental cost per user benefit, which is a New Starts measure.

Table 2-11 lists the total capital cost for each alternative, and the associated ranking. It also shows the annualized capital cost, which is calculated according to FTA's guidelines, which are described in Appendix II. The capital costs include the cost of HOV lanes in the corridor. The Baseline Alternative capital cost of $260 million is for a two-lane HOV facility; this cost is also included in the costs for Alternatives 1 and 2. The cost for Alternatives 3 and 4 includes a four-lane HOV facility in place of the two-lane facility.

Alternative 2 has the lowest total capital cost of $840 million, and is rated *Most Desirable*. Alternative 3 has an estimated cost of $968 million, and is rated *Less Desirable*. Alternatives 1 and 4 have total capital costs of about $1.1 billion, and are rated *Least Desirable*.

Table 2-11: Capital Costs

Alternatives	Total Capital Cost	Rating	Annual Capital Cost	Annual O & M Cost	Rating	Total Annualized Incremental Cost
Baseline	260,000,000	N/A	N/A	N/A	N/A	N/A
Alternative 1 - LRT	1,108,000,000	0	89,180,000	21,000,000	0	89,120,000
Alternative 2 - BRT in Busway	840,000,000	2	67,960,000	11,900,000	1	58,800,000
Alternative 3 - BRT in HOV Lanes	968,000,000	1	76,090,000	10,900,000	1	65,930,000
Alternative 4 - BRT in HOV Lanes and Busway	1,113,000,000	0	87,360,000	11,300,000	1	77,600,000

2.3.1.2 Annual Operating And Maintenance Cost

The annual operating and maintenance (O&M) cost for the baseline and build alternatives is estimated based on the operating plan and feeder bus system for each alternative. The methodology for estimating operating costs is summarized in Appendix 2.

Table 2-11 lists the incremental O&M cost for each build alternative, relative to the Baseline Alternative. The three BRT Alternatives (2, 3, & 4) have incremental O&M costs in the range of $11-12 million annually, and are rated *Less Desirable*. Alternative 1 has a significantly higher O&M cost of about $21 million annually, and is rated *Least Desirable*. The light rail system has various fixed costs that outweigh the inherent advantage of being able to carry more passengers with a single driver.

Table 2-11 also shows the total annualized incremental cost, which is the sum of the annualized capital cost plus the annual O&M cost, both calculated relative to the Baseline Alternative. This measure is used in the subsequent calculations of cost-effectiveness and the methodology for calculating it is summarized in Appendix 2.

2.3.1.3 Total Annual Cost Per Transit Rider

This measure relates the combined capital and O&M costs of each build alternative to the ridership carried by that alternative. The total annual incremental cost, shown in the last column of Table 2-11, is divided by total transit ridership in the study area.

The results are shown in Table 2-12. BRT Alternative 2 has the best (lowest) value of $2.92, and is rated *Most Desirable*. Alternative 3 follows it at $3.46 and Alternative 4 at $3.92, both rated *Less Desirable*. Alternative 1 has a value of $6.83, and is rated *Least Desirable*.

2.3.1.4 Total Annual Cost Per *New* Transit Rider

This is a measure that was formerly used by FTA in evaluating cost-effectiveness (now replaced by user benefits, as discussed below). However, the measure is still of interest, though it is not included in the overall ranking process. It reflects the incremental cost, relative to the Baseline, of attracting one new passenger to transit from automobile travel.

The results, shown in Table 2-12, closely parallel the results for cost per transit rider, described above, and for cost per user benefit, described below. BRT Alternative 2 has the best (lowest) value of $4.90, followed by Alternative 3 at $5.51 and Alternative 4 at $6.27. Alternative 1 does not perform as well, with a value of $19.80.

Table 2-12: Cost Per Transit Rider and User Benefit

Alternatives	Total Annual Cost per Transit Rider	Rating	Total Annual Cost per New Transit Rider	Rating	Change in Operating Cost per Passenger Mile	Rating	Incremental Cost Divided by Transportation System User Benefits	Rating
Alternative 1 - LRT	$6.83	0	$19.80	0	$0.004	0	$12.76	0
Alternative 2 - BRT in Busway	$2.92	2	$4.90	2	-$0.015	2	$4.18	2
Alternative 3 - BRT in HOV Lanes	$3.46	1	$5.51	1	-$0.008	1	$4.35	2
Alternative 4 - BRT in HOV Lanes and Busway	$3.92	1	$6.27	1	-$0.010	1	$5.25	1

2.3.1.5 Change in Operating Cost Per Passenger Mile *

This measure is part of the New Starts submittal. It is intended to gauge the change in operating efficiency of the transit system by comparing the operating cost per passenger mile of each build alternative to the baseline alternative. The measure is calculated based on the total transit O&M cost and the transit passenger-miles for the entire Atlanta region. Therefore the differences among alternatives due to a single transit project are fairly small.

Table 2-12 shows the results. BRT Alternative 2 shows the largest improvement, a decrease of 1.5 cents per passenger-mile, and is rated *Most Desirable*. BRT Alternatives 3 and 4 have a decrease of about 1 cent per passenger-mile, and are rated *Less Desirable*. LRT Alternative 1 shows a very small increase in O&M cost per passenger-mile, and is rated *Least Desirable*.

2.3.1.6 Incremental Cost Divided By Transportation System User Benefits *

This measure is a new method of evaluating cost-effectiveness, and is based on FTA's *Reporting Instructions for the Section 5309 New Starts Criteria*. It is intended to be a broader measure of cost-effectiveness than the previous cost per new rider, by including a measure of travel time savings. It therefore includes benefits that are realized by previous transit riders and by automobile users, rather than just looking at new transit riders.

To calculate this measure of cost-effectiveness, the total annual incremental cost (from the last column of Table 2-10) is divided by transportation system user benefits (discussed above in section 2.2.3.4).

The results are shown in Table 2-12. BRT Alternative 2 has the best (lowest) value of $4.18, followed closely by Alternative 3 at $4.35; both are rated *Most Desirable*. Alternative 4 has a value of $5.25, and is rated *Less Desirable*. Alternative 1 has a value of $12.76, and is rated *Least Desirable*.

2.3.2 Provide Realistic and Practical Modal Options

In order for a transit project to be effective, it must present a realistic alternative to the private automobile in terms of time savings. For this objective, a single performance measure is used to compare travel time savings across alternatives. Alternatives that save more travel time compared to the Baseline Alternative are desirable.

The travel times between major activity centers were calculated for both highway and transit trips using the travel demand model. The highway travel times excluded the use of HOV lanes; they are based on single-occupant vehicle (SOV) users of the system only. Table 2-13 lists each alternative, the results for the travel time savings criterion, and the qualitative assessment for the alternative as a whole for travel time savings. A positive number represents a savings.

Table 2-13: Travel Time Savings

Alternatives	Travel Time Savings as compared to SOV mode			
	Doraville to Cumberland	Gwinnett Place to Perimeter	Marietta to Perimeter	Rating
Baseline	-12.2	-0.6	5.4	-
Alternative 1 - LRT	2.9	4.1	1.2	0
Alternative 2 – BRT in Busway	5.8	4.4	5.9	2
Alternative 3 – BRT in HOV Lanes	2.6	1.5	5.1	1
Alternative 4 – BRT in HOV Lanes and Busway	5.3	4.4	5.9	2

The above table shows that all of the alternatives provide a decrease in transit travel time when compared to the SOV travel times for the same trips. The LRT alternative shows the smallest decrease in travel time savings and is therefore given a rating of *Least Desirable*. Alternative 3 shows a greater travel time savings than the LRT alternative, but not quite as significant as the other two BRT alternatives. As a result, Alternative 3 was given a rating of *Less Desirable*. The remaining BRT alternatives, 2 and 4, both were given a rating of *Most Desirable*.

Alternatives 2 and 4 rated the highest overall score of *Most Desirable* for the goal of providing cost effective transportation options, with Alternative 3 achieving the rating of *Less Desirable.* Alternative 1 was the lowest performer and rated *Least Desirable*. The following table presents the scores each alternative earned for how well they met the two objectives and eleven criteria for this goal.

Table 2-14: Review of Cost Effectiveness Performance Measures

Goal	Objective	Performance Measure	Baseline (includes 2 HOV lanes)	Alternative 1 - LRT (plus 2 HOV lanes)		Alternative 2 - BRT in Busway (plus 2 HOV		Alternative 3 - BRT in 4-lane HOV		Alternative 4 - BRT in 4-lane HOV plus Perimeter	
				Measure	Rating	Measure	Rating	Measure	Rating	Measure	Rating
Provide cost effective transportation options	Maximize cost effectiveness	Total capital cost**	$ 260,000,000	$ 1,108,000,000	0	$ 840,000,000	2	$ 968,000,000	1	$ 1,113,000,000	0
		Annualized total capital cost**	$ 21,060,000	$ 89,180,000		$ 67,960,000		$ 76,090,000		$ 87,360,000	
		Incremental systemwide annual operating and maintenance cost	base	$ 21,000,000	0	$ 11,900,000	1	$ 10,900,000	1	$ 11,300,000	1
		Total annual incremental cost	base	$ 89,120,000		$ 58,800,000		$ 65,930,000		$ 77,600,000	
		Total annual cost per transit rider	base	$ 6.83	0	$ 2.92	2	$ 3.46	1	$ 3.92	1
		Total annual cost per new transit rider	NA	$ 19.80		$ 4.90		$ 5.51		$ 6.27	
		Operating cost per transit passenger mile	$ 0.326	$ 0.330		$ 0.311		$ 0.318		$ 0.316	
		Change in operating cost per passenger mile	NA	$ 0.004	0	$ (0.015)	2	$ (0.008)	1	$ (0.010)	1
		Incremental cost divided by transportation system user benefits	NA	$ 12.764	0	$ 4.175	2	$ 4.346	2	$ 5.250	1
		Sum of Criteria Ratings			0		9		6		4
		Overall Objective Rating			0		2		1		1
	Provide realistic and practical modal options	Travel time savings as compared to SOV mode			0		2		1		2
		Doraville to Cumberland	-12.2	2.9		5.8		2.6		5.3	
		SOV	32.3	32.6		32.4		32.3		32.6	
		Minimum Transit	44.5	29.7		26.6		29.7		27.3	
		Gwinnett Place to Perimeter	-0.6	4.1		4.4		1.5		4.4	
		SOV	40.5	40.2		40.2		39.9		40.7	
		Minimum Transit	41.1	36.1		35.8		38.4		36.3	
		Marietta to Perimeter	5.4	1.2		5.9		5.1		5.9	
		SOV	39.6	39.6		39.3		39.5		39.3	
		Minimum Transit	34.2	22.5		33.4		34.4		33.4	
		Sum of Objective Ratings			0		4		2		3
		Overall Goal Rating			0		2		1		2

2.4 Goal 3: Minimize Adverse Social and Environmental Impacts

Goal 3 addresses the relative impacts (both positive and negative) of each alternative to the natural and built environments. This goal is assessed through seven objectives addressing air quality, energy consumption, impacts to critical resources and potential residential displacements. These are described in detail in the following sections.

2.4.1 Reduce Mobile Source Emissions

Currently, the U.S. Environmental Protection Agency (EPA) has designated Atlanta a non-attainment area for ozone pollution. A reduction in mobile source emissions is an important objective of the I-285 Transit Corridor Project. One performance measure that assesses four mobile source emissions has been developed.

2.4.1.1 Tons of VOC, CO, NOx, PM10

Table 2-15 lists the annual emissions of each pollutant in tons for each alternative, and the qualitative assessment for the alternative as a whole for reducing the emissions.

Alternatives 1 and 3 show some overall reduction in mobile emissions and therefore receive a rating of *Less Desirable*. Alternatives 2 and 4 show minimal reductions in emissions. Therefore, they both receive ratings of *Least* Desirable.

Table 2-15: Change in Mobile Source Emissions

Alternatives	Reduce Mobile Source Emissions (Annual Tons for the Region)				
	VOC	CO	NOx	PM10	Rating
Baseline	-	-	-	-	-
Alternative 1 - LRT	0.1	1.5	0	0	1
Alternative 2 – BRT in Busway	0.3	2.7	0	0	0
Alternative 3 – BRT in HOV Lanes	-0.3	-3.4	-0.1	0	1
Alternative 4 – BRT in HOV Lanes and Busway	0.2	2.2	0	0	0

2.4.2 Reduce Greenhouse Gas Emissions

In addition to the specific emissions analyzed above, it is desirable to reduce the amount of greenhouse gas emissions that can contribute to global warming. A single performance measure is used for this objective. Greenhouse gas emissions are calculated based on the energy consumption estimate that is included in the next section.

Table 2-16 lists the annual change in CO2 consumption (in millions of tons) between the Baseline and each alternative, and the rating for the alternative in reducing the emissions. All four alternatives show an increase in CO2 emissions, likely due to increased overall VMT on the highway network. Because of the lowest increase in CO2 in Alternative 1, this was given a rating of *Most Desirable*. Alternative 3 was rated as *Less Desirable*, while Alternatives 2 and 4 were rated as *Least Desirable*.

Table 2-16: Change in Greenhouse Gas Emissions

Alternatives	Reduce Greenhouse Gas Emissions	
	Change in Annual CO2 Emissions	Rating
Baseline	NA	-
Alternative 1 - LRT	58,667	2
Alternative 2 – BRT in Busway	111,079	0
Alternative 3 – BRT in HOV Lanes	88,733	1
Alternative 4 – BRT in HOV Lanes and Busway	112,110	0

2.4.3 Decrease Energy Consumption

A single performance measure is used to evaluate the achievement of the objective of reducing energy consumption. This measure reflects the net impact on energy savings as a result of changes in automobile travel in the region, offset in part by the energy requirements for operation of the proposed transit investment.

The assumptions for this measure are provided for in the New Starts criteria manual. It is assumed that BTU consumption includes gasoline autos, as well as diesel, CNG, and electric transit vehicles. Although there may be energy savings with a decrease in one type of vehicle fleet, there may be an increase in energy due to another. For example, a reduction in gasoline consumption from reducing highway travel may be offset by a greater increase in fuel consumption by additional transit buses.

Table 2-17 lists the annual change in British Thermal Units (BTUs) between the Baseline and each alternative, and the rating for the alternative. Alternative 1 has the smallest increase in energy consumption and is rated *Most Desirable*. Alternative 3 performs slightly better and receives a rating of *Less Desirable.* Alternatives 2 and 4 perform the worst, thus they are rated *Least Desirable*.

Table 2-17: Decrease Energy Consumption

Alternatives	Decrease Energy Consumption	
	Change in regional energy consumption in the forecast year (million BTU)	Rating
Baseline	NA	-
Alternative 1 - LRT	21,853	2
Alternative 2 – BRT in Busway	27,229	0
Alternative 3 – BRT in HOV Lanes	24,750	1
Alternative 4 – BRT in HOV Lanes and Busway	27,357	0

2.4.4 Minimize Impacts On Social, Cultural, And Historical Resources

Alignments that minimize potential impacts on social, cultural, and historical resources are considered more desirable. These impacts were quantified based on known resources that have been mapped as part of the project's geographic information system. It should be noted that the identified impacts are "potential" – meaning that these may be avoided or mitigated during subsequent preliminary engineering and environmental work.

This analysis identified four potential impacts for each alternatives 3 and 4, and three potential impacts for each alternatives 1 and 2. Based on this evaluation, alternatives 3 and 4 each scored a rating of *Most Desirable*, while alternatives 1 and 2 rated *Less Desirable*.

2.4.5 Maximize E.J. Benefits, While Minimizing Adverse Impacts

Two performance measures have been developed to identify impacts on EJ communities. Both benefits and adverse impacts to the communities will be determined through these performance measures. EJ populations are defined as communities where an above average amount of the population is minority, low-income, or elderly.

2.4.5.1 EJ Population Within Walking Distance To Stations

This performance measure will be calculated using a methodology similar to the one used to determine the low income households near stations performance measure. In order to estimate the population near stations, analysis zones of ½ mile radius around the transit stations on the project alignment must first be defined. GIS software was used to determine these analysis zones. Next, GIS was used to overlay census data at the tract or block group level with the analysis zones. To prevent the double counting of persons, stations less than one mile apart were grouped into a cluster and total data for the cluster was reported. Additionally, total area covered by the cluster was reported. In cases where only part of a tract or block group fell within the analysis zone, the population was factored based on the estimated percentage of the tract or block group within the zone. This measure reports all EJ persons, which include low income, minority, and seniors. Alternatives with higher EJ populations within walking distance to stations are desirable.

This analysis identified EJ populations within walking distance to stations of 5,493 for Alternative 1, 5,493 for Alternative 2, 5,169 for Alternative 3, and 5,723 for Alternative 4. Based on this analysis, Alternatives 1 and 2 received ratings of *Less Desirable*, with Alternative 3 receiving a rating of *Least Desirable* and Alternative 4 receiving a rating of *Most Desirable*.

2.4.5.2 EJ Population Within A 200 Foot Noise, Vibration, And Air Quality Buffer

Using GIS, a 200-foot buffer was drawn around each alignment. Next, GIS was used to overlay census data at the tract or block group level with the buffer. Finally, all EJ persons, including low income, minority, and seniors were reported. Alignments with a lower number of EJ persons within the 200-foot buffer are desirable.

Results of this analysis indicate that 782 EJ persons are within the buffer in Alternatives 1 and 2. EJ persons within the buffer in Alternatives 3 and 4 number 861 and 863, respectively. Alternatives 1 and 2 received ratings of *Less Desirable.* Alternatives 3 and 4 were rated *Least* Desirable.

2.4.6 Minimize Adverse Impacts To The Natural Environment

The project area is largely developed; therefore potential impacts to the natural environment are fairly minimal. This analysis assessed two areas: wetlands and visual impacts. Each is described below.

2.4.6.1 Potential Impacts to Wetlands

The project area in question is largely developed, however there do exist several areas where impacts to wetlands are a consideration. The potential to impact identified wetlands was assessed through a GIS overlay analysis. This analysis identified approximately 7 acres for alternatives 1 and 2, and approximately 6 acres for alternatives 3 and 4. The resulting ratings include *Less Desirable* for alternatives 3 and 4, and *Least Desirable* for alternatives 1 and 2.

2.4.6.2 Visual Impacts

The relative visual impacts of each alternative were assessed qualitatively relative to the other build alternatives. The visual impacts of alternatives 1 and 2 were assessed as *medium*, while alternatives 3 and 4 were assessed as *high* due to their increased dimensions and scale of structures required in elevated sections. Alternatives 1 and 2 were rated *Most Desirable*, while alternatives 3 and 4 were rated *Least Desirable*.

2.4.7 Minimize Adverse Impacts To Built Environment

The built environment in the project corridor may be impacted by the various alternatives directly through displacement, or indirectly through noise or vibration impacts. While the project costs presented earlier include all potential displacements, the displacements quantified here include only those for residential uses.

2.4.7.1 Potential Residential Displacements

Potential residential displacements were estimated from aerial photography and field reconnaissance of each build alternative. (It should be noted that for all alternatives, displacements along Hammond Drive are not included because a roadway widening is already programmed that will purchase and displace those properties.) Alternatives 1 and 2 achieved a *Most Desirable* rating, while alternatives 3 and 4 achieved a rating of *Least Desirable*.

2.4.7.2 Potential Noise and Vibration Impacts

The potential for noise and vibration impacts was assessed qualitatively for each of the build alternatives. Due to the anticipated vehicle volumes and corresponding levels of noise and vibration, alternatives 1 and 2 achieved a *Most Desirable* rating, while alternatives 3 and 4 achieved a rating of *Least Desirable*.

Table 2-18: Review of Social and Environmental Performance Measures

Goal	Objective	Performance Measure	Baseline (includes 2 HOV lanes)	Alternative 1 - LRT (plus 2 HOV lanes)		Alternative 2 - BRT in Busway (plus 2 HOV		Alternative 3 - BRT in 4-lane HOV		Alternative 4 - BRT in 4-lane HOV plus Perimeter	
				Measure	Rating	Measure	Rating	Measure	Rating	Measure	Rating
Minimize adverse social and environmental impacts	Reduce mobile source emissions	Daily Tons of VOC, CO, NOx, PM10 for the Region			1		0		1		0
		VOC	93.9	94.0	0.14%	94.2	0.35%	93.6	-0.36%	94.1	0.26%
		CO	754.1	755.6	0.20%	756.8	0.36%	750.7	-0.45%	756.3	0.30%
		NOx	142.2	142.2	0.02%	142.2	0.06%	142.1	-0.04%	142.2	0.06%
		PM10	5.3	5.3	-0.01%	5.3	-0.01%	5.3	-0.09%	5.3	-0.03%
	Reduce greenhouse gas emissions	Change in criteria pollutant and precursor emissions and greenhouse gas emissions (Million CO2)	NA	58,667	2	111,079	0	88,733	1	112,110	0
			6,491,132,367,082	6,549,798,976,446		6,602,211,041,236		6,579,865,078,024		6,603,242,165,258	
	Decrease energy consumption	Change in regional energy consumption in the forecast year (Million BTU)	NA	21,853	2	27,229	0	24,750	1	27,357	0
			2,493,168,304,718	2,515,021,648,431		2,520,396,977,885		2,517,918,475,721		2,520,525,431,815	
	Minimize impacts on social, cultural and historical resources	Potential impacts to cultural resources and historic properties (number of resources or properties)	0	3	1	3	1	4	0	4	0
	Maximize environmental justice benefits, while minimizing adverse impacts	EJ population within walking distance to stations	2,174	5,493	1	5,493	1	5,169	0	5,723	2
		EJ population within a 200 ft noise, vibration, and air quality buffer	NA	782	1	782	1	861	0	863	0
		Sum of Criteria Ratings			2		2		0		2
		Overall Objective Rating			1		1		0		1
	Minimize adverse impacts to the natural environment	Potential impacts to wetlands (acres)	0	7.2	0	7.2	0	6.1	1	6.2	1
		Visual impacts		medium	1	medium	1	high	0	high	0
		Sum of Criteria Ratings			1		1		1		1
		Overall Objective Rating			1		1		1		1
	Minimize adverse impacts to built environment	Potential Residential Displacements	0	0	2	0	2	12	0	11	0
		Potential noise and vibration impacts		low	2	low	2	high	0	high	0
		Sum of Criteria Ratings			4		4		0		0
		Overall Objective Rating			2		2		0		0
		Sum of Objective Ratings			10		5		4		2
		Overall Goal Rating			2		1		1		0

2.5 Goal 4: Compliment Existing and Future Land Uses and Trends

Goal 4 addresses consistency with existing and future land uses and types of development. Although the ratings are mostly qualitative, they are based on a wealth of data and analysis included in the *Detailed Description of Alternatives Report*. In particular, the transit station area descriptions and concepts in that report demonstrate the issues and opportunities associated with each alternative and transit station area relative to complimenting land uses and development near the project. Goal 4 is evaluated through three objectives relating to land uses, development plans and policies, and urban design characteristics.

2.5.1 Support Existing and Future Land Uses

Compatibility with existing and future land uses along the corridor considers the accessibility of each alternative, the type of trips likely to be best served and the demand for trips associated with the land uses along the corridor. These factors favored alternatives 1 (LRT) and 2 (busway), which can more easily be located in close proximity to trip destinations. Therefore, alternatives 1 and 2 rated *Most Desirable*, while alternative 3 rated *Least Desirable*. Alternative 4, being a hybrid of alternatives 2 and 3, rated a *Less Desirable* rating.

2.5.2 Support Development Plans and Policies

The ability of each alternative to support development plans and policies was assessed through a review of ongoing and planned development activity, as well as a review of recent and pending changes in development policy. Those alternatives that compliment development activity and encourage continued investment in the area scored more highly. Alternative 1 rated *Most Desirable*, while Alternatives 2 and 4 rated *Less Desirable*. Alternative 3 received a *Least Desirable* rating because it is perceived to have less affect in encouraging continued investment in the area.

2.5.3 Compliment Urban Design Characteristics

The extent to which each alternative compliments urban design characteristics considered compatibility with neighborhoods, business districts and community centers. Alternatives 1 and 2 rated *Most Desirable* for their ability to blend in and compliment surrounding areas. Alternative 4 rated *Less Desirable*, and Alternative 3 received a *Least Desirable* rating due to its lack of contribution to enhancing the urban design of the area.

Table 2-19: Summary of Land Use Performance Measures

Goal	Objective	Performance Measure	Baseline (includes 2 HOV lanes)	Alternative 1 - LRT (plus 2 HOV lanes)		Alternative 2 - BRT in Busway (plus 2 HOV		Alternative 3 - BRT in 4-lane HOV		Alternative 4 - BRT in 4-lane HOV plus Perimeter	
				Measure	Rating	Measure	Rating	Measure	Rating	Measure	Rating
Compliment existing and future land uses and trends	Support existing and future land uses	Compatability with existing and future land uses along the corridor		high	2	high	2	low	0	medium	1
		Compatability with regional land use plans		high	2	high	2	medium	1	medium	1
		Sum of Criteria Ratings			4		4		1		2
		Overall Objective Rating			2		2		0		1
	Support development plans and policies	Provides complimentary infrastructure and service to developing or redeveloping areas		high	2	medium	1	low	0	medium	1
		Encourages continued investment		high	2	medium	1	low	0	low	0
		Sum of Criteria Ratings			4		2		0		1
		Overall Objective Rating			2		1		0		1
	Compliment urban design characteristics	Compatability with neighborhoods and communities along corridor		high	2	high	2	low	0	medium	1
		Enhances built environment		high	2	high	2	low	0	medium	1
		Sum of Criteria Ratings			4		4		0		2
		Overall Objective Rating			2		2		0		1
		Sum of Objective Ratings			6		5		0		3
		Overall Goal Rating			2		2		0		1

3.0 NEXT STEPS

This report summarizes the results of the technical evaluation of each project alternative, and concludes a thorough process documented through a series of technical reports. Based on the results of this evaluation, in concert with citizen input received throughout the process, the Atlanta Regional Commission voted unanimously on February 25, 2004 to adopt **Alternative 2 – Bus Rapid Transit in Exclusive Busway** as the Locally Preferred Alternative for the I-285 corridor.

The process, findings and results of this project are documented through a series of technical reports. The project team will prepare a summary flyer for presentation to citizens and planning partners throughout the region. The project team will also finalize all project documentation and make all information available through the Atlanta Regional Commission and on the project's web site.

These actions sets the stage for the Atlanta region to move ahead with the next necessary actions toward implementation of the I-285 Transit Project. Those next actions include:

- ARC will consider including the project in the region's long range transportation plan (Mobility 2030) later this year;
- Project partners will further evaluate coordination of this project with other potential improvements in the corridor;
- Project partners will more specifically define a funding and operational framework for this multi-jurisdictional project, potentially allowing for a New Starts submittal in 2005; and
- The project partners will consider proceeding with environmental and preliminary engineering work after the Mobility 2030 Plan is adopted later this year.

APPENDIX I – RIDERSHIP FORECASTS

The regional travel demand model was used to study the impact of potential transportation improvements on travel demand, mobility, and accessibility on the transportation system for the various alternatives in this study. A travel demand model consists of a set of computerized mathematical models that can simulate existing and forecast future travel patterns. The application of the travel demand model links land use, development and transportation infrastructure improvements with travel patterns and conditions. Models are developed based on collected data that reflects the unique traveling patterns and conditions of the particular urban area. The regional travel demand model developed by the Atlanta Regional Commission (ARC) was used as the base modeling structure for this effort. The traffic analysis zones within the study area were refined which required that input data and procedure files also be refined to conduct this effort. A detailed description of the modifications to the regional model set is discussed in the *Patronage Forecasting Methodology Report*.

The regional travel demand model set consists of an enhanced four-step process: trip generation, trip distribution, mode choice, and network assignment. Trip generation determines the number of trips by purpose that are generated in the region. Trip distribution estimates the linkages between the trip ends, i.e., which trips are traveling to which locations. Mode choice determines the mode of the trip. The available modes range from auto, High Occupancy Vehicle (HOV), local bus, express bus, and train. Traffic assignment estimates the potential route of either the highway or transit trip. This model process includes feedback from the assignments back to trip generation. In addition the model is linked to the forecast of future land use. ARC's model has been designed to represent the state of the practice and to meet the modeling requirements specified in related transportation and air quality federal and state regulations. The model was also designed to support technical and policy decisions that are a part of the multi-modal planning and programming process. The model has been reviewed by both a panel of recognized experts and federal officials who have designated the model as state-of-the-practice.

The model system encompasses 1,760 traffic analysis zones, of which 94 are in the study area. The model system also includes over 35,000 links, which represent the highway network. The network system includes all freeways, arterials, and major collectors in the thirteen county region. A transit network representing all local and express bus routes and rail service is also included in the model system.

Table I-1 presents some of the key results of the ridership forecasts for the Baseline and the four build alternatives. Some of these values are used in the evaluation process, as described in section 2.2 of the main report. The table is divided into a top section which

shows ridership values for the entire region, and the bottom section which gives results for the I-285 study area.

Table I-2 shows a more detailed breakdown of transit boardings, with the daily boardings at each station for each alternative.

Table I-1: Travel Demand Modeling Results

	Baseline	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Regional Transit Trips (linked)	640,594	655,594	680,556	680,504	681,849
New Transit Trips	-	15,000	39,962	39,910	41,255
Regional Transit Boardings	1,032,986	1,066,998	1,104,923	1,102,000	1,106,851
Local Bus	452,114	459,702	457,051	455,766	453,274
BRT	0	0	87,316	81,749	87,617
Heavy Rail	434,639	417,158	423,864	426,024	426,488
Light Rail	6,355	49,534	6,378	6,371	6,347
Express Bus	133,007	133,908	123,474	125,252	126,325
Commuter Rail	6,930	6,755	6,906	6,906	6,867
Regional Mode Share					
HBW	6.4	6.6	6.8	6.8	6.8
Total	3.3	3.4	3.5	3.5	3.6
Study Area Boardings	116,475	155,733	184,770	177,766	183,990
Local Bus	42,633	45,629	43,260	40,452	40,920
BRT	0	0	74,495	69,235	74,898
Heavy Rail	31,427	27,278	31,136	30,904	30,808
Light Rail	0	43,330	0	0	0
Express Bus	42,419	39,497	35,886	37,178	37,372
Commuter Rail	0	0	0	0	0
Study Area Mode Share					
HBW	9.2	9.7	11.8	11.8	11.9
Total	5.5	6.0	7.8	7.7	7.8
Regional VMT	185,557,125	185,537,602	185,532,205	185,387,008	185,490,637
Study Area VMT	13,069,517	13,085,981	13,047,110	13,088,557	13,070,907

Evaluation of Alternatives

Table I-2: Predicted Transit Station Boardings

Station	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Cumberland	3,100	0	2,000	2,500
Akers Mill	8,100	14,600	14,100	13,600
Powers Ferry	1,800	4,700	-	-
New Northside Dr	1,300	2,100	2,300	2,500
Roswell Rd	4,900	6,000	7,200	7,100
Hammond Dr	3,900	7,300	-	7,700
Medical Center N	-	-	4,600	-
Dunwoody Sta	7,200	11,400	14,100	11,600
Perimeter Center East	1,500	1,800	-	1,800
Shallowford Rd	3,000	6,500	6,600	6,700
Doraville Sta	8,700	12,800	12,700	12,500
Total	**43,500**	**67,200**	**63,600**	**66,000**

APPENDIX II- COST EFFECTIVENESS EVALUATION

This appendix gives more details on various aspects of the evaluation of cost-effectiveness, described in section 2.3 of the main report. The cost calculations are provided in the *Detailed Definition of Alternatives Technical Report*.

Capital Costs:

As part of the Regional Transit Action Plan, GRTA produced the *Transit Facility Capital Cost Methodology & Unit Cost Guidelines*, October 31, 2002. Where applicable, this methodology and the unit cost estimates provided have been used to estimate capital costs for the I-285 alternatives. Because the I-285 project is at the Alternatives Analysis level of detail, more refined unit cost estimates supercede the GRTA estimates where detailed knowledge of the corridor and conceptual alignments indicates a different unit cost estimate is more appropriate.

Annualized Capital Costs:

In order to compute various measures of cost-effectiveness, it is necessary to annualize the capital costs. This process follows FTA's assumptions on the useful life of specific cost components and an established discount rate. These assumptions, and the resulting annualization factors are shown in Table II-1 on the next page.

Operating and Maintenance Costs:

Operating and maintenance (O&M) costs are estimated for each transit mode in each alternative.

Bus operating costs are estimated separately for each operating agency. The operating plan involves bus routes operated by MARTA, CCT, and GRTA. MARTA's costs are estimated using a line-item, fully-allocated cost model that has been calibrated to detailed MARTA budget data. Costs for CCT and GRTA are based on an average cost per bus hour. The unit cost for CCT is based on the current rate for contracted service. The rate for GRTA has been extrapolated from the rates for CCT and GCT.

Bus operating statistics were estimated based on the route patterns and headways in the operating plans, and the estimated travel times for each bus route from the ridership model. Statistics have been expanded to weekday and then to annual figures.

Evaluation of Alternatives

Table II-1: Annualization Factors for Capital Costs

Item	Useful Life (Years)	Annualization Factor
Right-of-way	100	0.070
Right-of-way preparation (major grading, etc.)	100	0.070
Structures (#)	30	0.081
Trackwork (meters)	30	0.081
Signals, electrification (meters)	30	0.081
Pavement, parking lots, grade crossings	20	0.094
Rail vehicles (#)	25	0.086
Buses (#)	12	0.126
Contingencies	Add item specific contingency to line items	-
Engineering, construction management	Allocate proportionally	-

Light rail operating costs have been estimated using a variation of the MARTA O&M cost model described above. Pending further resolution of the issue, it is assumed that the light rail line would be operated as a new division within MARTA. MARTA's labor rates are used. Productivity figures for light rail (e.g. mechanic hours per car-mile, etc.) are based on a survey of eight other light rail systems across the U.S.

The O&M cost methodology and results are described in more detail in the *Detailed Definition of Alternatives Technical Report.*

Total Annual Incremental Cost:

The annualized capital cost and the annual O&M cost are added together to give the total annual cost for each alternative. Since the cost-effectiveness indices are based on incremental costs, the total annual cost of the Baseline Alternative is subtracted from the

Evaluation of Alternatives

total annual cost of each Build Alternative to produce the total annual *incremental* cost for each Build Alternative.

Cost per Transit Rider (& per New Transit Rider):

By dividing the total annual incremental cost by ridership, this measure normalizes the total cost of the baseline and build alternatives by ridership.

Incremental Cost Divided By Transportation System User Benefits

Transportation system user benefits (TSUB) are calculated by using FTA's SUMMIT software in conjunction with the regional travel demand model for the baseline and build alternatives.

- The calculation of transportation system user expenditures in hours is produced by the SUMMIT travel demand reporting program using files produced by running the regional travel demand model containing the generalized cost of each trip and associated trip tables for each market sector and mode for the baseline and build alternatives.
- Transportation system user benefits in equivalent hours are calculated by subtracting the transportation system user expenditures in hours in the build alternative from the baseline alternative.
- Weekday user benefits from the software are expanded to annual savings in travel time equivalent units (hours) by applying appropriate annualization factors.

The total annual incremental cost of each alternative is divided by the TSUB value to produce the cost-effectiveness measure that is used in the New Starts process.

Evaluation of Alternatives