ATLANTA BELTLINE/
ATLANTA STREETCAR
SYSTEM PLAN

Technical Memorandum 3

Ridership Modeling Analysis and Results

February 2014

Atlanta BeltLine/Atlanta Streetcar System Plan Technical Memorandums

Technical Memorandum 1: Planning Process and Phasing Methodology and Results

Technical Memorandum 2a: Market Impact of the Connect Atlanta Plan Transit Projects on the Atlanta BeltLine and Central City

Technical Memorandum 2b: Projection of Tax Increment in the Atlanta BeltLine, Eastside, Westside, and Stadium Neighborhoods Tax Allocation Districts

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1 Introduction

The Atlanta BeltLine/Atlanta Streetcar System Plan (SSP[1]) was initiated in February 2011 to develop coordinated approach and action plan for implementing the City of Atlanta's vision for a streetcar network to provide mobility, increase transportation options and support economic development activities as defined by the *Connect Atlanta Plan*, the City's comprehensive transportation plan.

The SSP seeks to accomplish the following objectives:

1) Refine and update the streetcar transit element of the City's comprehensive transportation plan;

2) Evaluate and integrate the implementation of the streetcar projects defined in the *Connect Atlanta Plan*, the *Concept 3 Regional Transit Plan*, and the *Atlanta BeltLine Corridor Environmental Study Tier 1 Final Environmental Impact Statement (Tier 1 FEIS);* and

3) Develop funding and implementation strategies for priority streetcar projects in the City.

The culmination of this effort is the *Atlanta BeltLine/Atlanta Streetcar System Plan Final Report*, which prioritizes streetcar projects into four implementation phases and details the City's strategy for implementing the streetcar system to achieve the goals of increased transportation options, economic development and mobility throughout the City over the next 20 years.

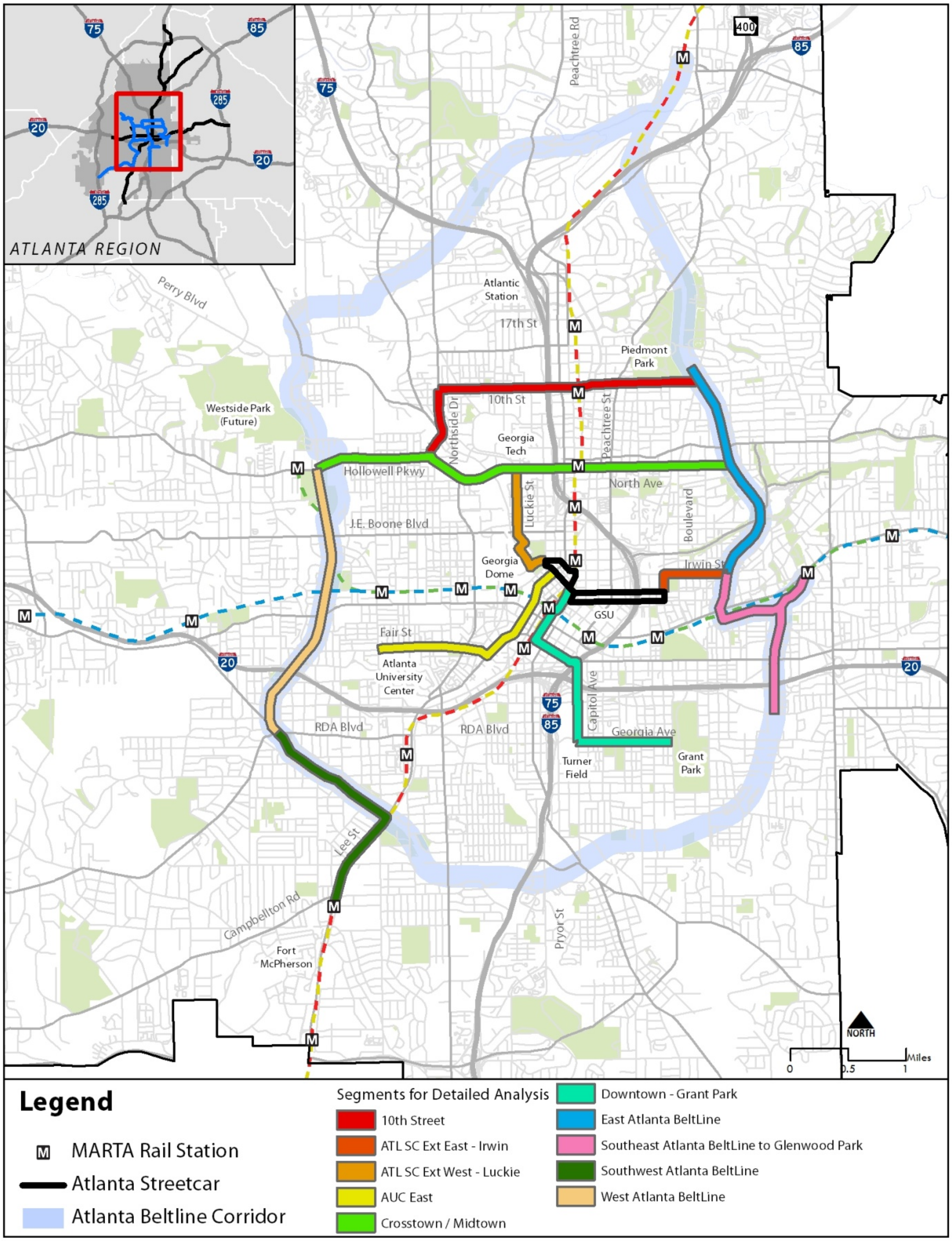
This technical memorandum examines the practicality/ridership and equity guiding principles and documents the ridership modeling task that was conducted as part of the SSP's Detailed Analysis phase. During this phase, nine streetcar segments were evaluated, as identified in Table 1 and displayed in Figure 1.

Table 1: Streetcar Segments for Detailed Analysis

Segments	Termini
Atlanta Streetcar East Extension - Irwin	BeltLine/Irwin - Auburn/Jackson
Atlanta Streetcar West Extension - Luckie	Andrew Young Blvd/C.O.P. Dr - Luckie/North
Crosstown / Midtown	North/BeltLine - Hollowell/BeltLine
East Atlanta BeltLine	10th/Monroe - BeltLine/Irwin
West Atlanta BeltLine	Hollowell/BeltLine - BeltLine/RDA Blvd
Southeast Atlanta BeltLine to Glenwood Park	Kennedy Way/Glenwood Ave - BeltLine/Irwin
Southwest Atlanta BeltLine	BeltLine/RDA Blvd - Oakland City MARTA
AUC East	Spring/Auburn - Fair/Lowery
Downtown / Grant Park	Peachtree/Auburn - Georgia Ave/Cherokee Ave
10th Street	North/BeltLine – 10th St/BeltLine

[1] The name of the project was changed during the planning process when the study was expanded from the Atlanta BeltLine corridor to the entire city streetcar network. The original name of the project was Atlanta BeltLine Transit Implementation Strategy (TIS)

Figure 1: Streetcar Segments for Detailed Analysis



Section 2 of this technical memorandum reviews the modeling assumptions for this task, including a general overview of the four-step travel demand modeling process and the Atlanta Regional Commission (ARC) model used for the SSP analysis, as well as SSP-specific modeling assumptions. Section 3 provides an overview of the ten model runs that were conducted, and Section 4 provides the results of these runs.

2 Modeling Assumptions

2.1 Definition of Terms

The following section provides a definition of the technical terms used throughout this document.

- **Auto trip:** A unique person trip conducted via private motor vehicle.
- **Boarding/Unlinked passenger trip:** Unique person trip conducted via transit. Often used interchangeably with unlinked passenger trips.
- **Build Scenario:** Scenario that assumes some level of transit investment.
- **High Occupancy Vehicle (HOV): Motor** vehicle carrying more than one passenger.
- **Linked passenger trip:** Unique person trip conducted via transit including transfers. Even if a passenger must make several transfers during a one-way journey, the trip is counted as one linked trip.
- **No Build Scenario:** Scenario that does not assume any new transit investment beyond what is included in the region's fiscally constrained plan.
- **Unique Person trip:** Movement of a single person via any mode of transportation. Each person is considered as making one person trip. For example, four persons traveling together in one private motor vehicle are counted as four person trips.
- **Single Occupant Vehicle (SOV):** Motor vehicle carrying one passenger, or one person trip.

2.2 Overview of Modeling Process and ARC 2040 Travel Demand Model

Travel demand was forecast for the year 2040 using computer-based supply and demand models. These models account for future study area population, projected employment, and other major activity centers, socio-economic characteristics of study area residents, travel time and cost characteristics of the competing highway and transit modes of travel. The Atlanta Regional Commission (ARC) 2040 travel demand model was utilized to develop ridership forecasts for each of the SSP scenarios.

The model set simulates travel on the entire highway and transit system in the Atlanta metropolitan region containing all transit services provided by the Metropolitan Atlanta Rapid Transit Authority (MARTA), including its local bus, express bus, and heavy rail service. Other regional providers such as Cobb Community Transit (CCT), Gwinnett County Transit (GCT), and the Georgia Regional Transportation Authority (GRTA) are also included, as well as smaller shuttle-based operators such as Georgia Institute of Technology (Georgia Tech), Georgia State University (Georgia State), and Emory University. The model contains information on service frequency (i.e. how often trains and buses arrive at any given transit stop), routing, intermodal connections, travel time and transit fares for all transit lines. The highway system includes all express highways and principal arterial roadways, as well as minor arterial and local roadways. Outputs of the model set contain detailed information relating to the transportation system. The highway side of the model provides output data on traffic volumes, congested travel speeds, vehicle miles traveled, and average travel times on the roadway links. The transit side provides output information relating to the average weekday ridership on different transit sub modes (rail, local buses, express buses and commuter buses), station boardings, park-and-ride demand, and peak load volumes. The following text describes the modeling methodology in greater detail.

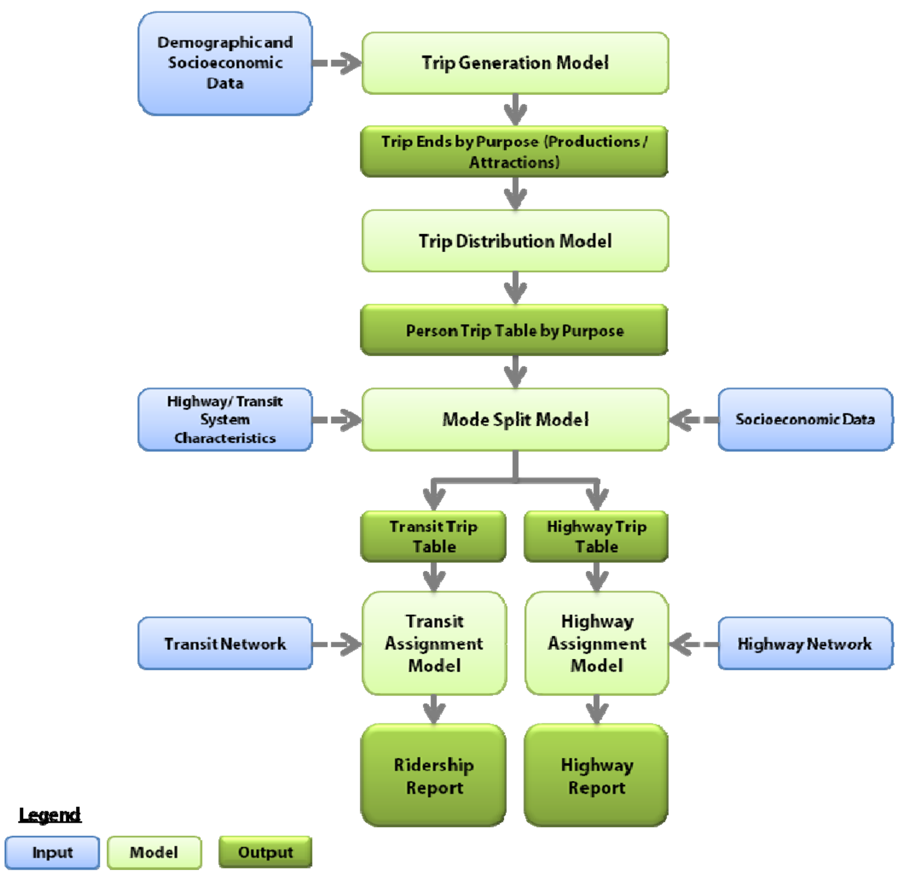
2.2.1 Transit Patronage Modeling

Daily ridership for all the transit alternatives was estimated using ARC's travel demand model set. These models are the same type as those used in most large urban areas in North America. They are based on the traditional **four-step, sequential process** known as:

- Trip generation
- Trip distribution
- Mode choice
- Trip assignment

This process is used to estimate the average daily transit ridership, based on the best available population and employment forecasts, projected highway travel conditions and projected transit service. The geographic area represented in ARC's model, the Atlanta metropolitan area, is divided into smaller areas known as **transportation analysis zones (TAZs)**. All calculations in the travel model are performed at the TAZ level. A brief description of the Four-Step process is given below, and a schematic representation of the process is shown in Figure 2.

Figure 2: Four-Step Travel Demand Modeling Process Flow Chart



Step 1 - Trip Generation: In the first step, the model estimates the number of trips produced in and attracted to each TAZ. To accomplish this, the model uses estimates of projected population, employment and other socioeconomic and household characteristics of each TAZ. Trips are divided in to three major categories, home-based work trips, home-based other trips and non-home based trips. A trip generation model run is executed for each trip purpose. The output of the trip generation model feeds into the rest of the model chain. Therefore, great care is taken to ensure that the demographic and socio-economic data are as error-free as possible to prevent the propagation of errors in the remaining model steps.

Step 2 - Trip Distribution: In this step, the distribution model links the trip ends[2] estimated from trip generation to form zonal trip interchanges[3]. The output of the second step is a trip table, or matrix, containing the number of trips occurring between every origin-destination zone combination. Trip distribution is performed for each trip purpose.

Step 3 - Mode Choice: In this step, the mode choice model allocates the person trips estimated from the trip distribution step to the two primary competing modes; automobile and transit. This allocation estimates the desirability or utility of each choice a traveler faces, based on the attributes of that choice and the characteristics of the individual. The resulting output of the mode choice model is the percentage of trips that use the automobile and transit for each trip interchange. The transit trips are further divided into two modes of access: walk-access transit trips and drive-access transit trips (park-and-ride trips). The auto trips are further divided into single-occupancy and multiple occupancy trips. Inputs to the mode choice model, transit travel times and costs and highway travel times, socio-economic data are supplied by the computerized transit and highway networks.

Step 4 - Trip Assignment: In this final step, the model assigns the transit trips to different transit modes such as local bus, express bus, rail, etc. The model uses all the available transit paths from one zone to another. This path may involve just one transit mode, such as local bus or commuter bus or multiple modes, such as local bus with a transfer to a rail line. Highway trips are assigned to the highway network. Thus, future year traffic volumes on highways and forecasted transit ridership on transit lines can be obtained from the model outputs. Population and employment are key inputs to the demand forecasting process and are developed by ARC. The future year transit fare structure is assumed to be similar to the current year fare structure. The models assume that people, as a rule, wish to minimize transfers, as well as minimize their overall cost of travel in terms of time and money.

Preparing the Model for Application

Before the model is applied to a specific study, it is first run and adjusted several times until it has replicated the existing highway volumes and transit ridership data at an acceptable level of accuracy. This adjustment is called model **calibration.** It is done by adjusting the constant coefficients in the model using an automated procedure. Sometimes additional fine tuning is necessary and that is usually done by modifying how the access[4] to the highway and transit system is represented in the model. Once the highway and transit component of the model are well calibrated to simulate the current

[2] Trip ends represent the point from which the trip is produced or to which it is attracted.
[3] Movements between two zones.
[4] How the passenger gets to the station, either by walking or driving to the park and ride lot.

conditions, it is ready for forecasting. The forecast year inputs are then created and the entire model set is run to simulate future year travel.

2.2.2 Model Preparation and Application for SSP Model Runs

For the SSP model runs, the forecast year (2040) transportation network was developed by including all the future highway and transit projects that were programmed in the ARC's fiscally constrained Regional Transportation Plan. On the transit side, each transit alternative was coded in the computerized network by providing all the necessary information regarding the operational characteristics of the proposed service. This would include access characteristics at each station, peak and off-peak headways, station dwell times, travel times, proposed fares and intermodal connections. For each alternative, appropriate market areas (groups of zones on either side of the proposed alignment) were delineated for each station and proper transit access connections were coded.

Using the updated transit network information and other future year model inputs, the entire model set was run for each transit alternative. The daily transit ridership on the proposed transit service was obtained directly from the model outputs. The model provides daily boardings by line, as well as other important demand statistics such as linked transit trips in the system, vehicle miles and hours travelled by all modes of transportation, and boardings by transit sub-modes.

2.2.3 Major Factors Affecting Ridership

The ridership forecasts estimated by the travel demand models depend heavily on the input assumptions. Among those, the most important are:

- future population growth (based on ARC's 2040 forecasts),
- future employment growth (based on ARC's 2040 forecasts),
- forecasted socio-economic characteristics (based on ARC's 2040 forecasts),
- forecasted highway congestion (estimated by model); and
- proposed level of transit service.

It should also be noted that traditional travel demand models similar to that used for the Atlanta region are generally not well suited for estimating streetcar ridership. This is due to the fact that the ARC model is designed to estimate travel demand on a very large, regional scale, and is thus not well equipped to model ridership activity on a small-area scale. A small-area model would need to be developed in order to more accurately capture travel behavior on a scale appropriate to streetcar, which tends to serve shorter trip lengths. However, for the purpose of this effort, the ARC regional model produces order-of-magnitude results suitable for this level of planning.

Refer to ARC's Travel Forecasting Model Set 2010 Documentation for a more detailed explanation of the modeling process.

2.3 SSP Modeling Assumptions

The following SSP-specific assumptions and modifications were coded into the model for each alternative:

- Utilized ARC's 2040 travel demand model with existing and committed transit network, with the following exceptions:
    - Removed projects:
        - Atlanta Streetcar, currently included in the 2040 model as a single project, removed in all build alternatives due to duplicative operations with modeled scenarios
        - North Avenue Streetcar, currently included in the 2040 model as a single project, removed in all alternatives due to duplicative operations with modeled scenarios
        - BeltLine Transportation Corridor, currently included in the 2040 model as a single project, removed in all alternatives due to duplicative operations with modeled scenarios
    - Added projects:
        - Clifton Corridor High Capacity Rail Service added due to inclusion in Transportation Investment Act Final Constrained Project List
        - Northwest Corridor High Capacity Rail Service added due to inclusion in Transportation Investment Act Final Constrained Project List
- Methodology for bus network modifications
    - No changes were made to the existing local or express bus network. This decision was made in conjunction with MARTA staff with the intention of revisiting operational and feeder bus scenarios as SSP projects are refined.
- Operating assumptions
    - 10 minute peak and 15 minute off-peak headways were assumed for all build alternatives
- Fare assumptions
    - Fare assumptions were kept consistent with the current MARTA fare structure built into the model, which assumes a standard fare of $2.50.

3 Overview of Model Runs

Ten model runs were conducted for the SSP project. These runs represent both individual SSP segments and combinations of segments to aide in determining optimal implementation scenarios.

1. No Build: Existing + committed transit network without streetcar.
2. Run A: Downtown Streetcar Extension West. (Figure 3)
3. Run B: Downtown Streetcar Extension East and East Atlanta BeltLine. (Figure 4)
4. Run C1: Line 1- Downtown Streetcar Extension West, Crosstown/Midtown via North Avenue, and West Atlanta BeltLine. Line 2- Crosstown/Midtown via North/Hollowell and the portion of East Atlanta BeltLine between North Avenue and 10th Street. (Figure 5)
5. Run C2: Line 1- Downtown Streetcar Extension West, Crosstown/Midtown via North Avenue, and West Atlanta BeltLine. Line 2- 10th Street. (Figure 6)
6. Run D: Line 1- Downtown Streetcar East Extension, Southeast Atlanta BeltLine to Glenwood Park. Line 2- Downtown Streetcar Extension East and East Atlanta BeltLine. (Figure 7)
7. Run E: Line 1- Downtown Streetcar Extension West, Crosstown/Midtown via North Avenue, West and Southwest Atlanta BeltLine to Oakland City. Line 2- Crosstown/Midtown via

North/Hollowell and the portion of East Atlanta BeltLine between North Avenue and 10th Street. (Figure 8)

8. Run F: AUC via Fair and Downtown. (Figure 10)
9. Run G: Downtown/Grant Park via Pryor and Downtown. (Figure 11)
10. Run H:
    - Line 1 – One-way counter-clockwise loop comprised of:
        - Downtown Streetcar Extension West, Crosstown/Midtown via North Avenue, West and Southwest Atlanta BeltLine to Oakland City
        - Downtown Streetcar Extension East and East Atlanta BeltLine
    - Line 2 – One-way clockwise loop comprised of:
        - Downtown Streetcar Extension East and East Atlanta BeltLine
        - Eastern half of Crosstown/Midtown via North
        - Downtown Streetcar Extension West (Figure 12)

Figure 3: Model Run A

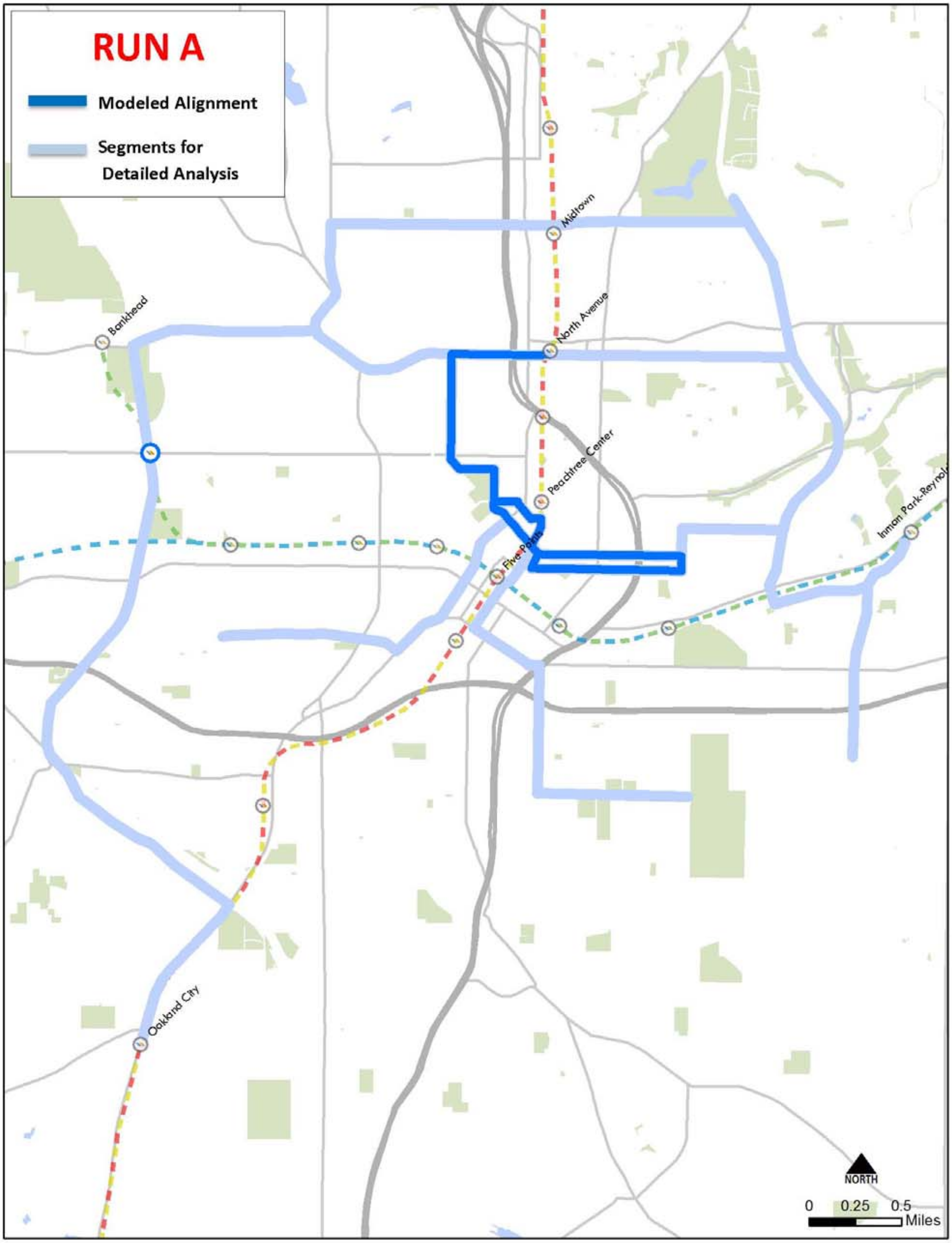


Figure 4: Model Run B

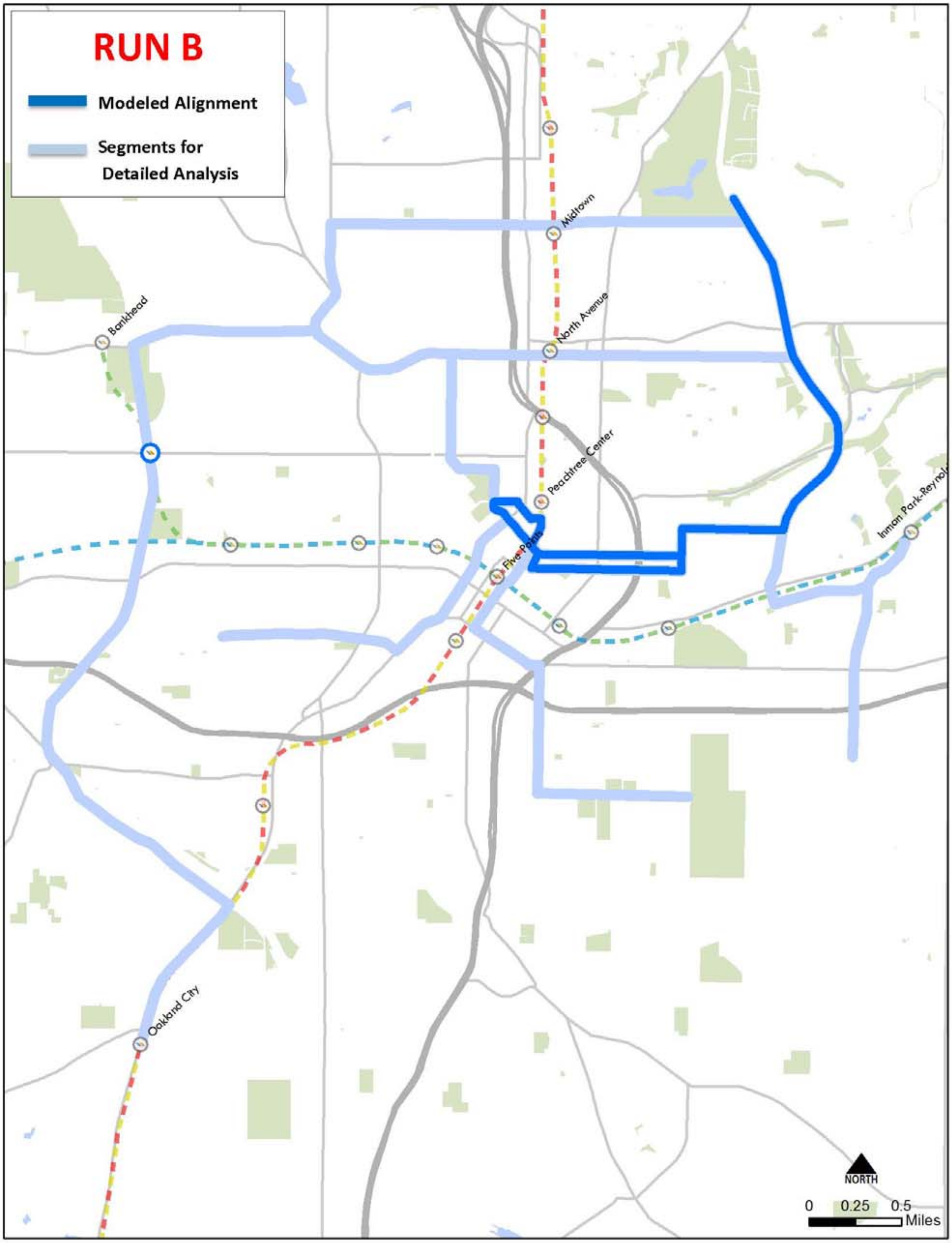


Figure 5: Model Run C-1

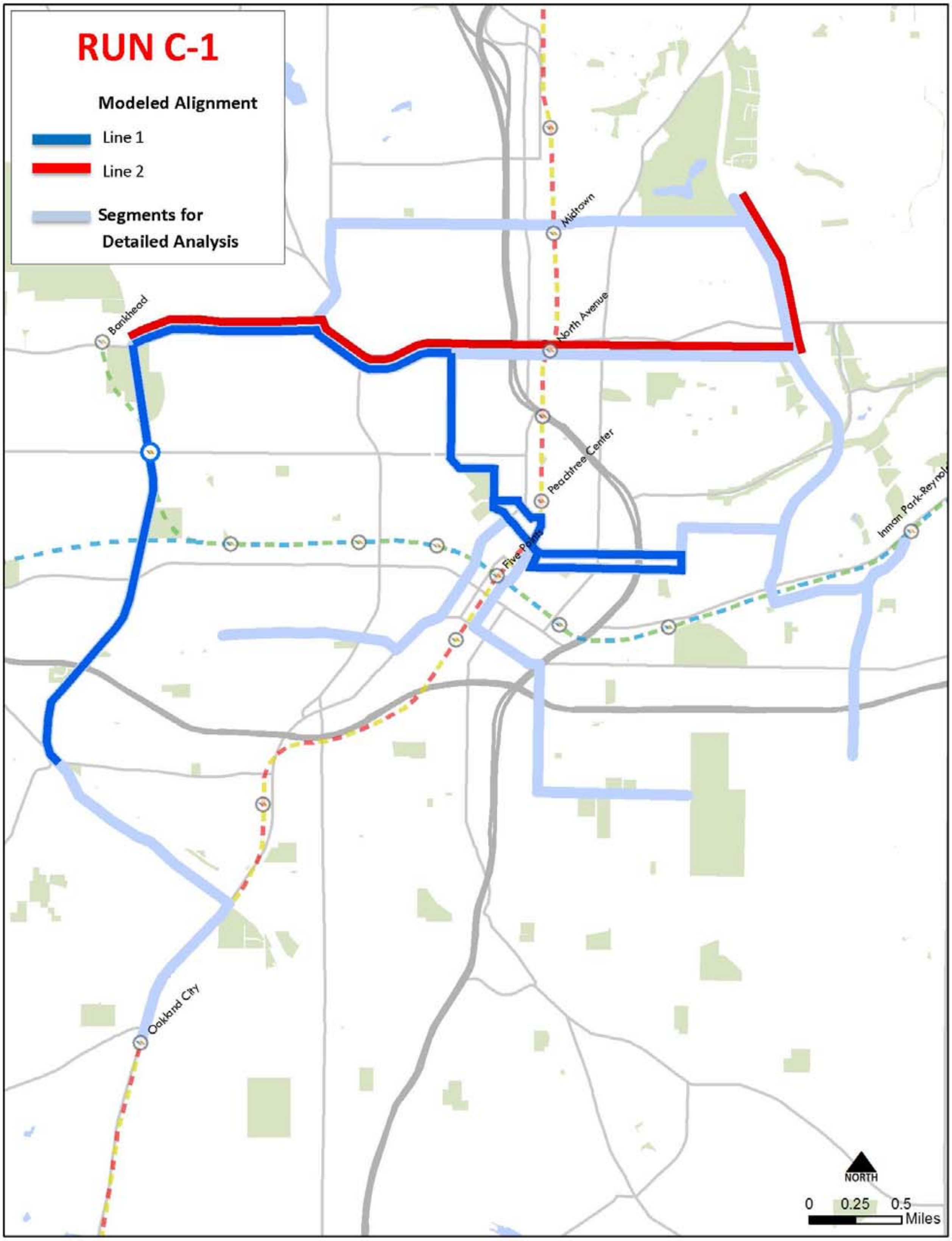


Figure 6: Model Run C-2

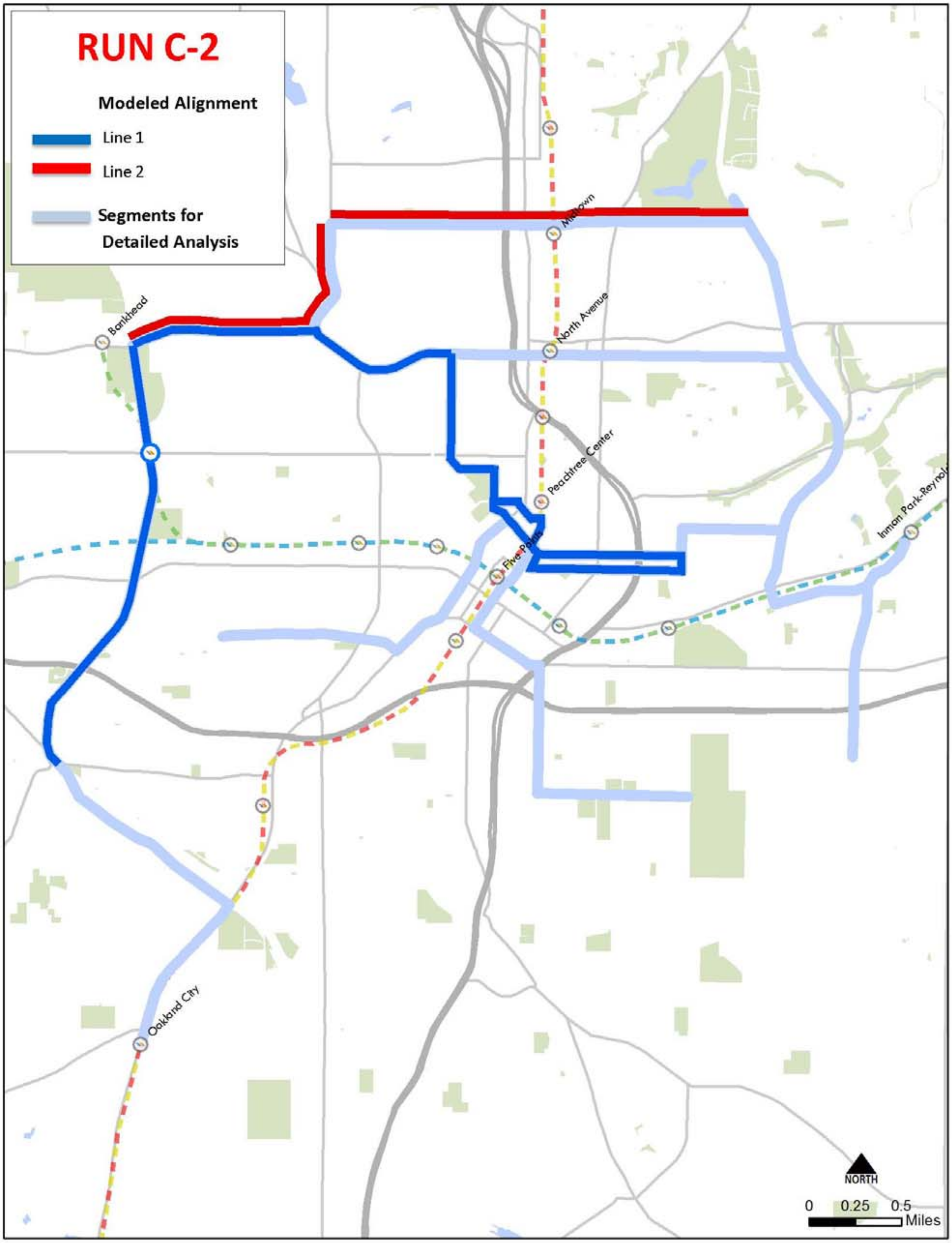


Figure 7: Model Run D

Figure 8: Model Run E

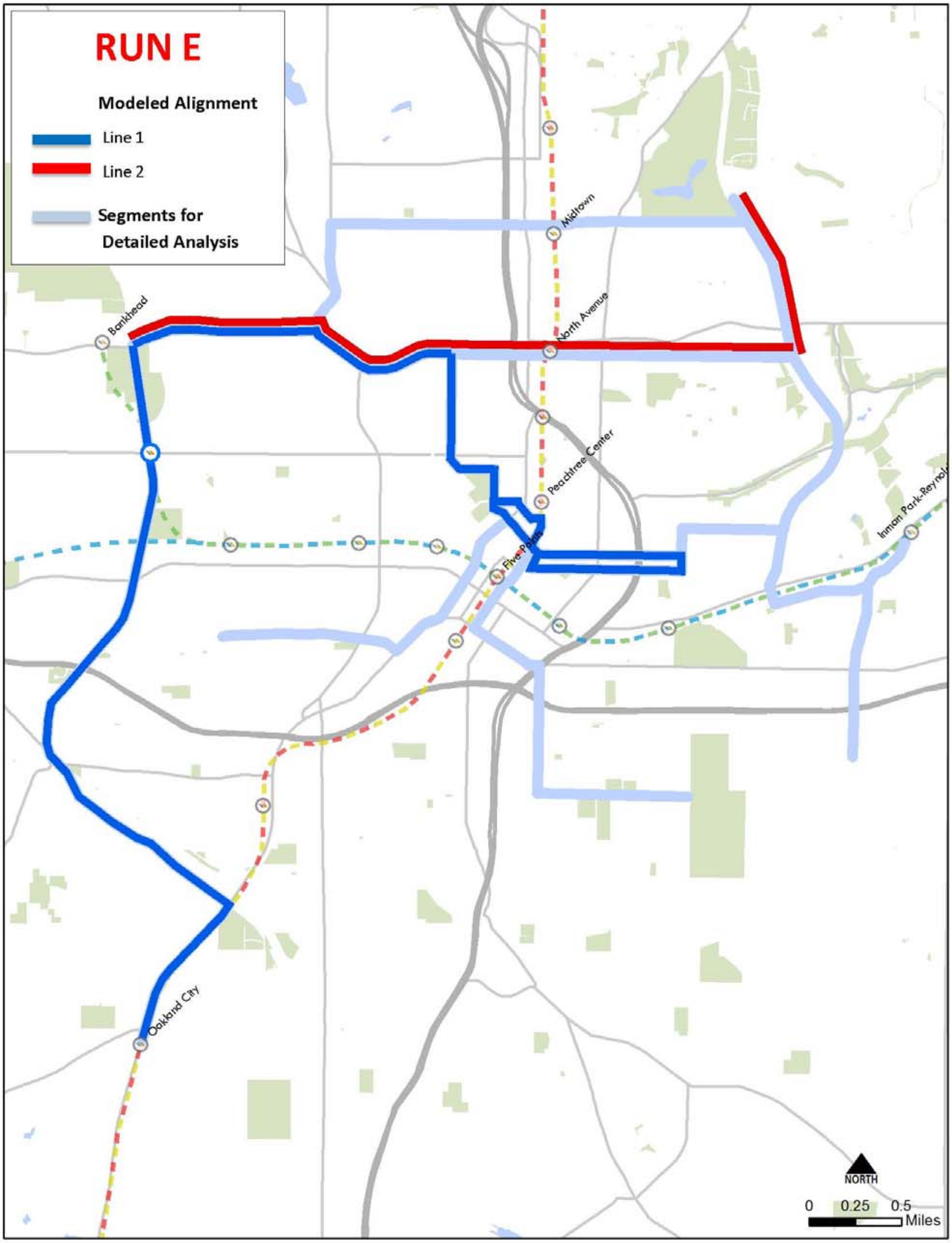


Figure 9: Model Run F

Figure 10: Model Run G

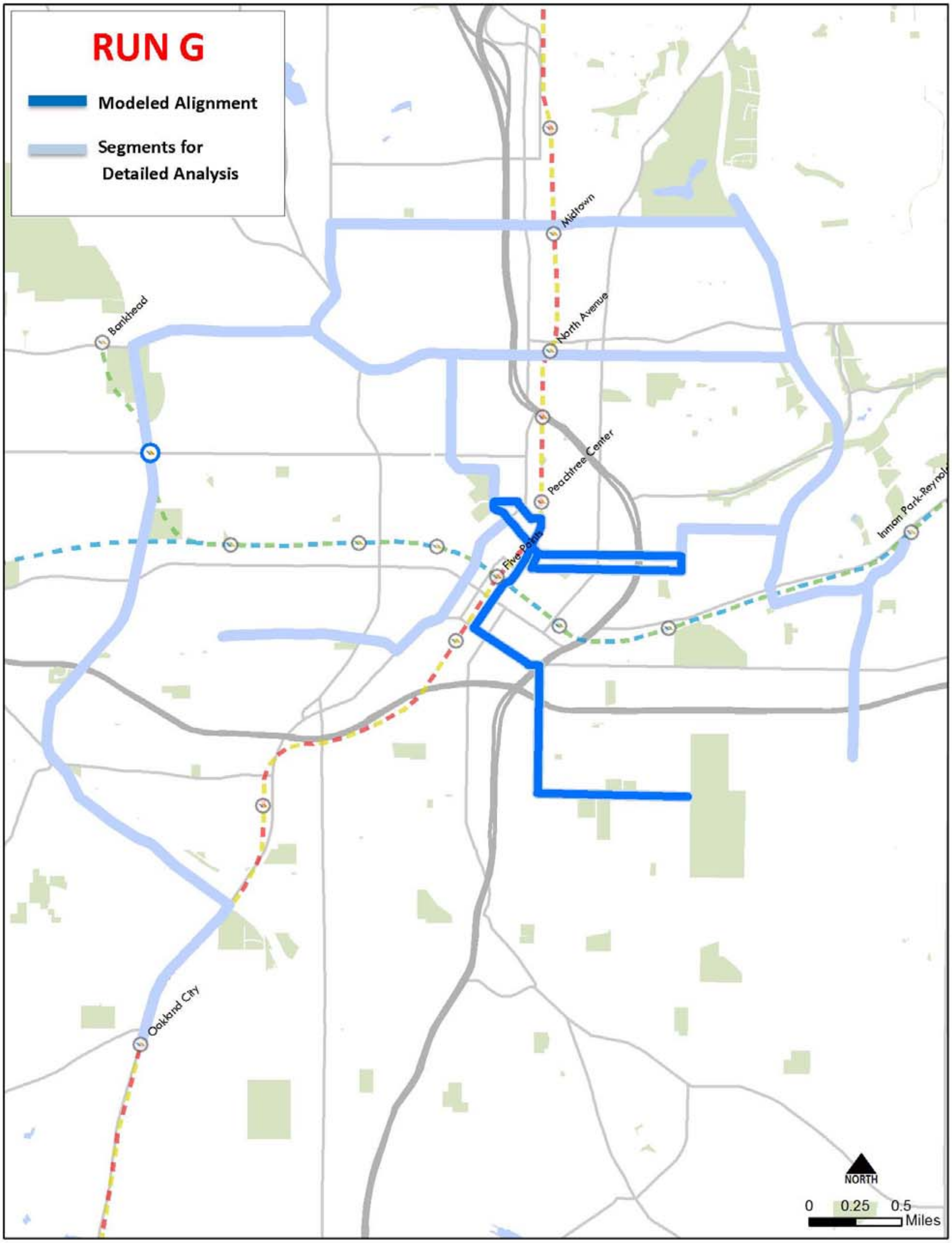
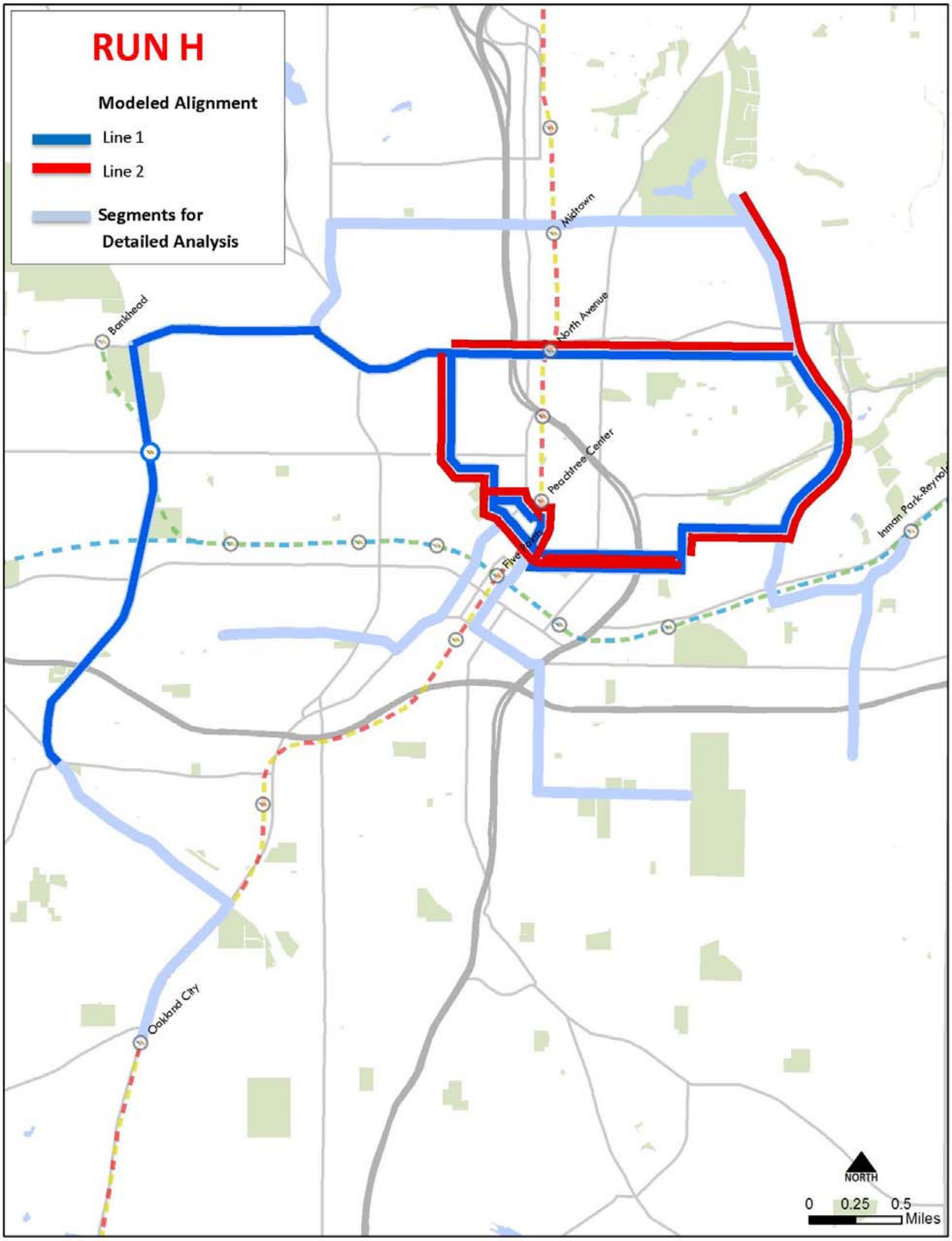


Figure 11: Model Run H



4 Model Run Results

The following sections provide the results of the ridership modeling task. Section 4.1 details the general model outputs, such as daily boardings, new regional boardings, and travel time savings. Section 4.2 details model outputs which deal with impacts to Environmental Justice (EJ) communities, which are communities defined by high incidences of low-income and/or minority populations.

4.1 General Model Outputs

This section provides analyses of total person trip and total passenger boardings across all modes, streetcar ridership by operating line, and travel time savings.

4.1.1 Total Person Trip and Total Passenger Boarding Analysis

Table 2 and Table 3 provide a summary of basic model outputs for each scenario including total person trips, total auto trips, total transit trips, daily transit boardings by operator and mode, and streetcar boardings. Table 4 and Table 5 provide a summary of the differential values for these outputs between the No Build and Build scenarios. Table 7 provides a detailed summary of the ridership modeling results. All figures are based on year 2040 projections.

As shown in the tables, the number of total person trips is relatively constant across all scenarios. However, the number of auto trips decreases in each of the build scenarios. This, combined with an increase in total linked transit trips[5], suggests that the streetcar investments will slightly increase the transit mode share in the region.

Daily transit boardings, reported as unlinked trips[6], fluctuate among scenarios. Some scenarios actually see a net decrease in unlinked boardings, which is likely attributed to an increase in direct trips resulting from enhanced connectivity provided by the streetcar investments rather than commuters opting for other alternatives. This notion was confirmed by the transfer rate for each scenario, as shown in Table 9.

[5] Linked transit trips include those which require a transfer between line or mode

[6] Unlinked transit trips are total passenger boardings, regardless of transfers

Table 2: Summary of Model Outputs, Model Runs No Build – C2 (Year 2040)

Model Output	No Build	Model Run A	Model Run B	Model Run C1	Model Run C2
TOTAL STREETCAR LENGTH (Mi)	2.6	4.1	5.2	12.5	11.9
Daily Total Person Trips	24,754,421	24,754,397	24,754,378	24,754,253	24,754,305
Auto Trips	24,309,259	24,308,571	24,307,808	24,306,525	24,307,418
Transit Trips (linked)	445,162	445,826	446,570	447,728	446,887
Daily Transit Boardings (unlinked)	736,872	736,849	737,613	740,111	736,240
Streetcar	**900**	**2,670**	**5,521**	**12,599**	**9,286**
Line 1	**N/A**	**2,670**	**5,521**	**4,778**	**5,742**
Line 2	**N/A**	**N/A**	**N/A**	**7,821**	**3,544**

Table 3: Summary of Model Outputs, Model Runs D – H (Year 2040)

Model Output	Model Run D	Model Run E	Model Run F	Model Run G	Model Run H
TOTAL STREETCAR LENGTH (Mi)	10.1	14.7	4.5	5.1	15.1
Daily Total Person Trips	24,754,381	24,754,207	24,754,389	24,754,394	24,754,281
Auto Trips	24,306,846	24,306,690	24,308,991	24,308,199	24,306,513
Transit Trips (linked)	447,535	447,517	445,398	446,195	447,768
Daily Transit Boardings (unlinked)	738,436	739,001	735,546	737,521	739,302
Streetcar	**9,396**	**16,381**	**2,080**	**4,903**	**14,420**
Line 1	**4,492**	**9,040**	**2,080**	**4,903**	**9,511**
Line 2	**4,904**	**7,341**	**N/A**	**N/A**	**4,909**

Table 4: Change from No Build Scenario, Model Runs A – C2 (Year 2040)

Model Output	No Build	Model Run A	Model Run B	Model Run C1	Model Run C2
TOTAL STREETCAR LENGTH (Mi)	2.6	4.1	5.2	12.5	11.9
Daily Total Person Trips	24,754,421	-24	-43	-168	-116
Auto Trips	24,309,259	-688	-1,451	-2,734	-1,841
Transit Trips (linked)	445,162	664	1,408	2,566	1,725
Daily Transit Boardings (unlinked)	736,872	-23	741	3,239	-632
Streetcar	**900**	**2,670**	**5,521**	**12,599**	**9,286**
Line 1	**N/A**	**2,670**	**5,521**	**4,778**	**5,742**
Line 2	**N/A**	**N/A**	**N/A**	**7,821**	**3,544**

Table 5: Change from No Build Scenario, Model Runs D – H (Year 2040)

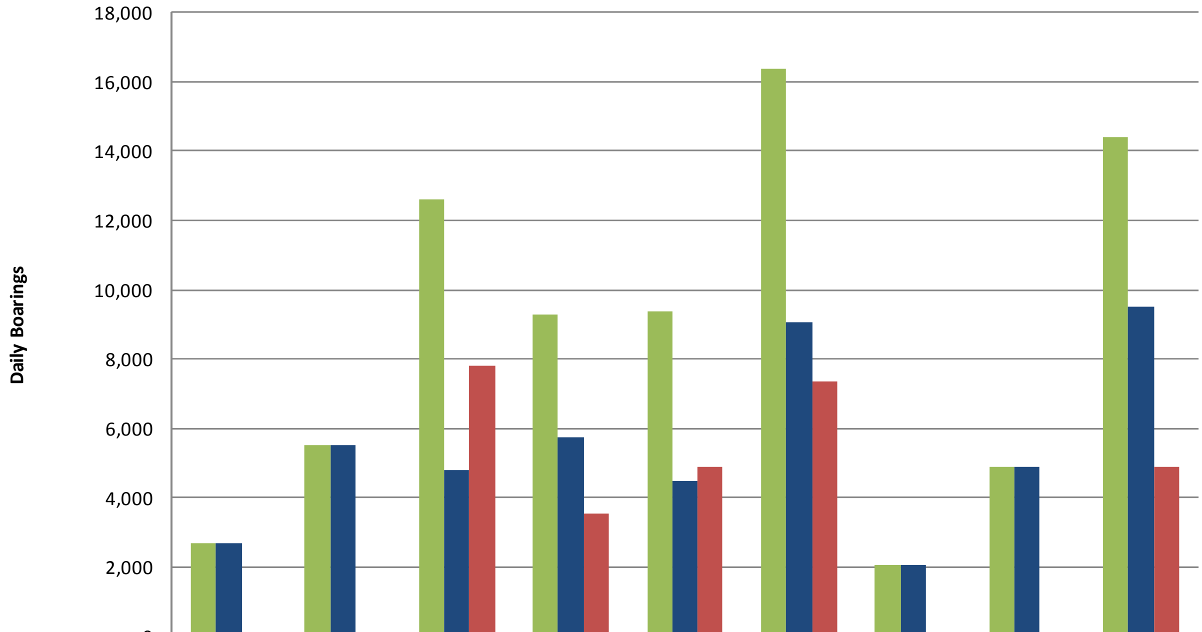
Model Output	No Build	Model Run D	Model Run E	Model Run F	Model Run G	Model Run H
TOTAL STREETCAR LENGTH (Mi)	2.6	10.1	14.7	4.5	5.1	15.1
Daily Total Person Trips	24,754,421	-40	-214	-32	-27	-140
Auto Trips	24,309,259	-2,413	-2,569	-268	-1,060	-2,746
Transit Trips (linked)	445,162	2,373	2,355	236	1,033	2,606
Daily Transit Boardings (unlinked)	736,872	1,564	2,129	-1,326	649	2,430
Streetcar	**900**	**9,396**	**16,381**	**2,030**	**4,903**	**14,420**
Line 1	**N/A**	**4,492**	**9,040**	**2,030**	**4,903**	**9,511**
Line 2	**N/A**	**4,904**	**7,341**	**N/A**	**N/A**	**4,909**

4.1.2 Scenario Ridership Analysis

Figure 12 through Figure 17 depict comparisons of each build alternative in regards to total daily boardings, boardings per mile, new regional boardings, new regional boardings per mile, a comparison of total transit trips added versus total auto trips eliminated, and total transit trips per mile added versus total auto trips eliminated per mile.

As shown in Figure 12, Scenario E has the highest total ridership (Lines 1 and 2 combined), followed by Scenario H, and Scenario C1. The highest operating line is Scenario H Line 1, followed by Scenario E Line 1. Both of these operating lines serve the southwest Atlanta BeltLine and downtown.

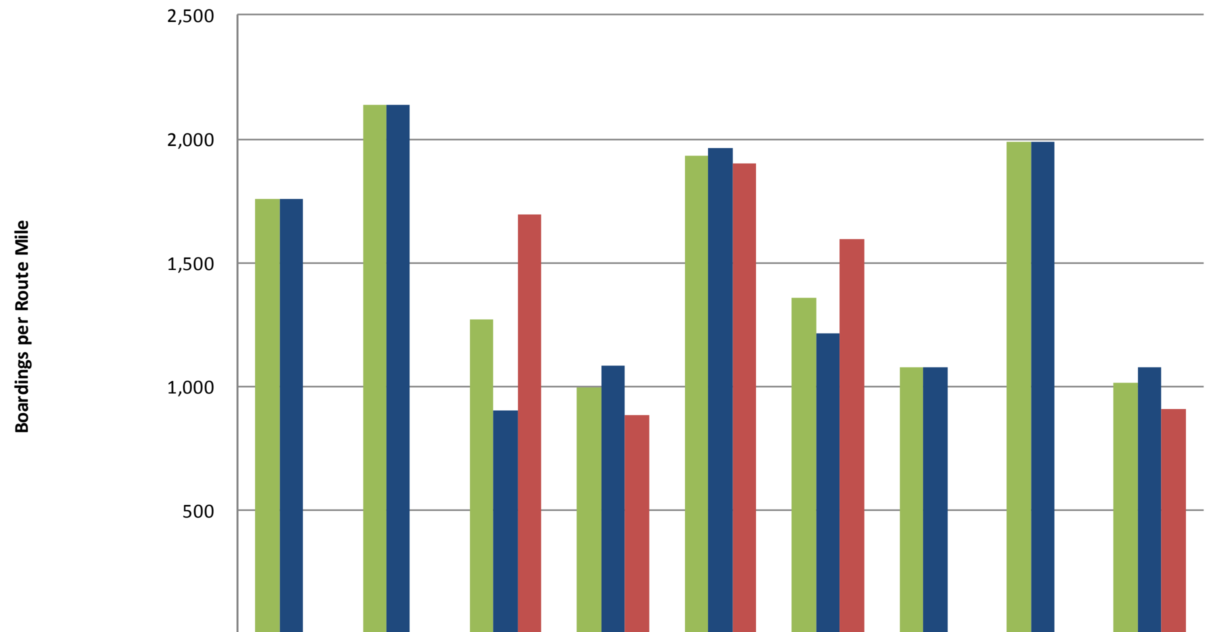
Figure 12: Daily Boardings by Model Run (Year 2040)



	A - Luckie to North Ave	B - Irwin to East BeltLine	C1 - West BeltLine/ North Ave	C2 - West BeltLine/ 10th St	D - SE BeltLine	E - SW BeltLine extension	F - AUC	G - Turner Field / Grant Park	H - TIA Corridors
Total Boardings	2,670	5,521	12,599	9,286	9,396	16,381	2,080	4,903	14,420
Line 1	2,670	5,521	4,778	5,742	4,492	9,040	2,080	4,903	9,511
Line 2	0	0	7,821	3,544	4,904	7,341	0	0	4,909

As shown in Figure 13, when normalized by route miles to provide an equal comparison among scenarios or varying length, Scenario B is the strongest performer, followed by Scenario G and Scenario D. The strongest operating lines are Scenario B Line 1, Scenario G Line 1, and Scenario D Line 1. Each of these operating lines serves downtown.

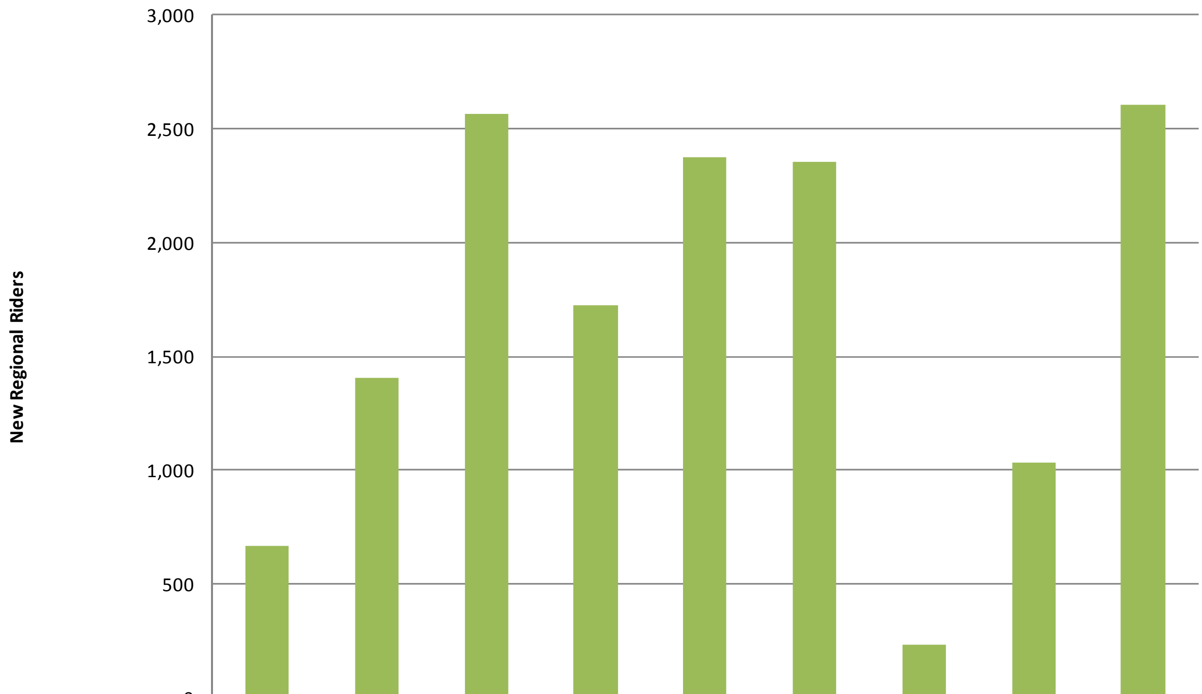
Figure 13: Daily Boardings per Mile by Model Run (Year 2040)



	A - Luckie to North Ave	B - Irwin to East BeltLine	C1 - West BeltLine/ North Ave	C2 - West BeltLine/ 10th St	D - SE BeltLine	E - SW BeltLine extension	F - AUC	G - Turner Field / Grant Park	H - TIA Corridors
Total Boardings / Mile	1,757	2,140	1,271	998	1,929	1,359	1,078	1,985	1,015
Line 1 Boardings / Mile	1,757	2,140	902	1,083	1,962	1,215	1,078	1,985	1,081
Line 2 Boardings / Mile			1,697	886	1,901	1,592			907

Figure 14 illustrates the degree to which each scenario attracts new daily transit boardings, which are new transit riders diverted from auto-based trips. Scenarios C2 and H are the highest performing and attract just over 2,500 new daily transit boardings, while scenarios D and E are close behind with approximately 2,300 new daily boardings.

Figure 14: New Daily Regional Boardings by Model Run (Year 2040)



	A - Luckie to North Ave	B - Irwin to East BeltLine	C1 - West BeltLine/ North Ave	C2 - West BeltLine/ 10th St	D - SE BeltLine	E - SW BeltLine extension	F - AUC	G - Turner Field / Grant Park	H - TIA Corridors
New Regional Riders	664	1,408	2,566	1,725	2,373	2,355	236	1,033	2,606

As shown in Figure 15, when evaluated on a per route mile basis, Scenario B attracts the most new daily regional boardings, followed by Scenario D and G.

Figure 15: New Daily Regional Boardings per Route Mile by Model Run (Year 2040)

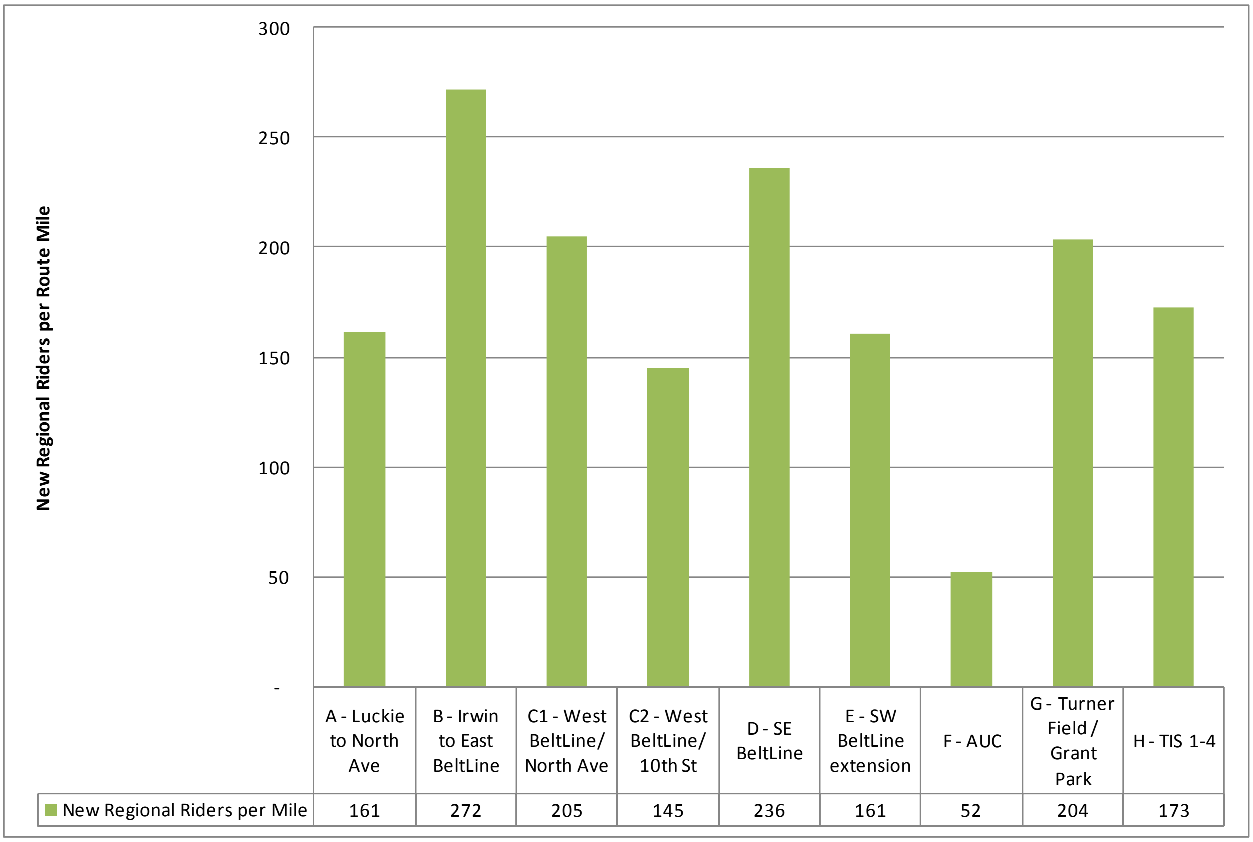
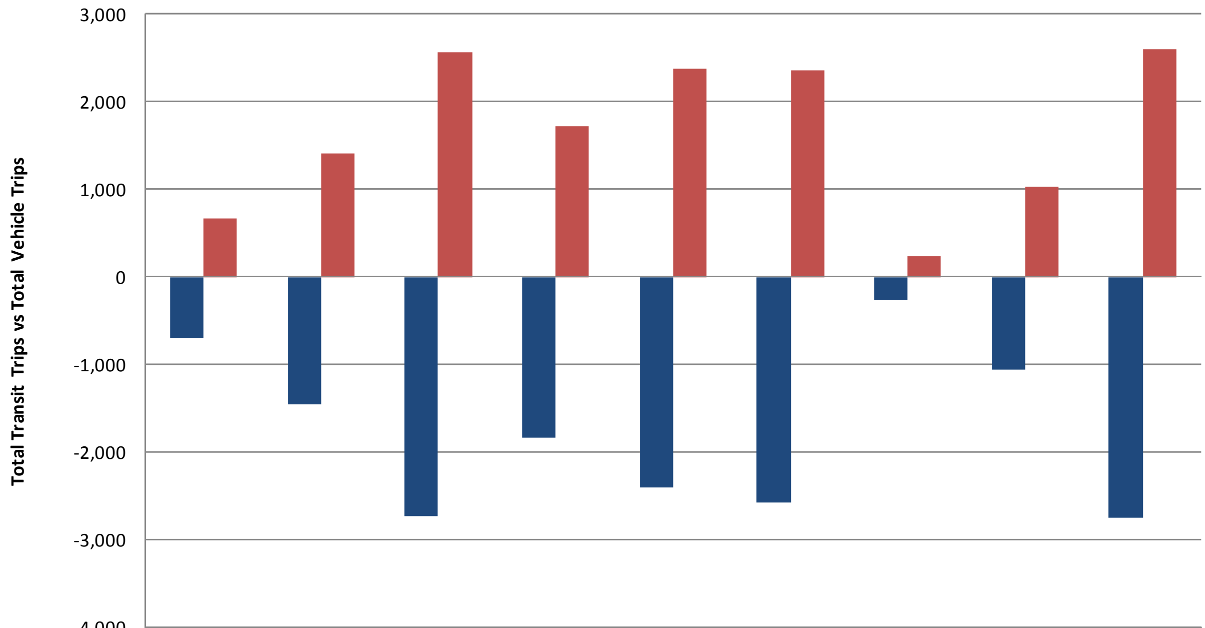


Figure 16 illustrates the differential between regional auto trips eliminated versus regional transit trips added. Scenario H both adds the most transit trips and reduces the most vehicle trips, followed by Scenario C1.

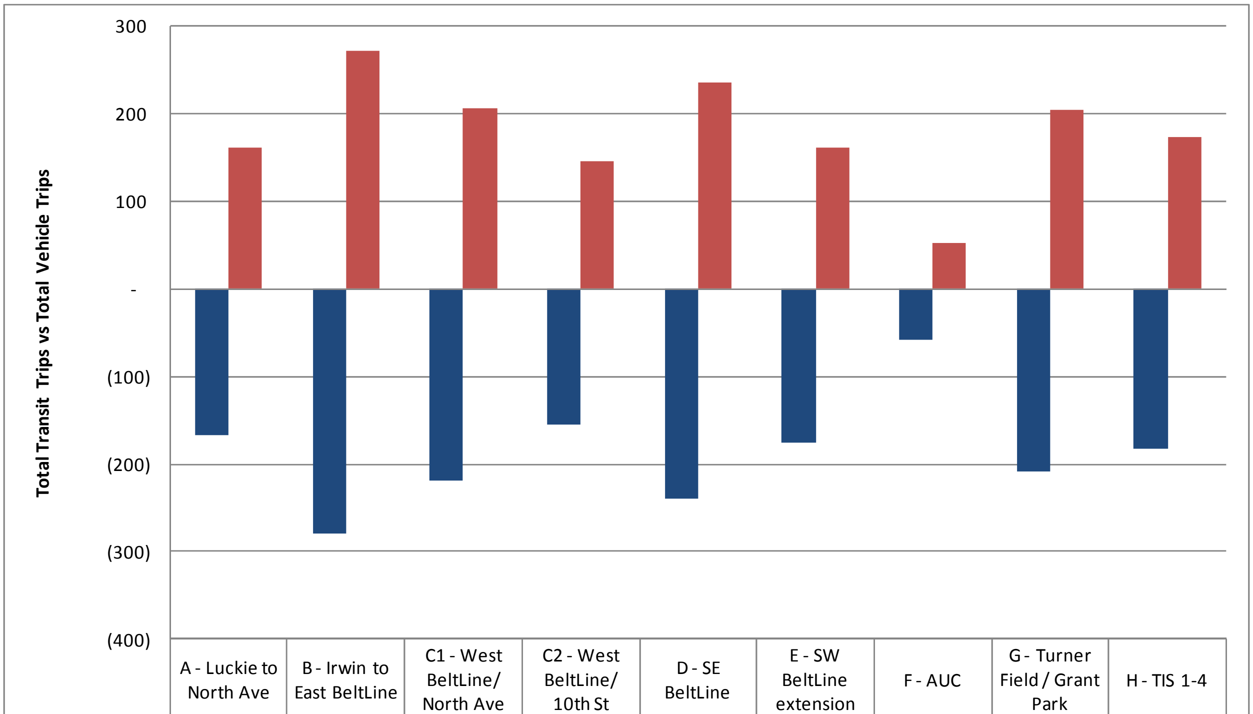
Figure 16: Daily Total Transit Trips Added versus Daily Total Auto Trips Eliminated (Year 2040)



	A - Luckie to North Ave	B - Irwin to East BeltLine	C1 - West BeltLine/ North Ave	C2 - West BeltLine/ 10th St	D - SE BeltLine	E - SW BeltLine extension	F - AUC	G - Turner Field / Grant Park	H - TIS 1-4
Vehicle Trips	-688	-1,451	-2,734	-1,841	-2,413	-2,569	-268	-1,060	-2,746
Transit Trips	664	1,408	2,566	1,725	2,373	2,355	236	1,033	2,606

As shown in Figure 17, when evaluated on a per route mile basis, Scenario B adds the most transit trips and reduces the most auto trips, followed by Scenario D, C1, and G.

Figure 17: Daily Total Transit Trips Added per Mile versus Daily Total Auto Trips Eliminated per Mile (Year 2040)



	A - Luckie to North Ave	B - Irwin to East BeltLine	C1 - West BeltLine/ North Ave	C2 - West BeltLine/ 10th St	D - SE BeltLine	E - SW BeltLine extension	F - AUC	G - Turner Field / Grant Park	H - TIS 1-4
Vehicle Trips	(167)	(280)	(219)	(155)	(240)	(175)	(59)	(209)	(182)
Transit Trips	161	272	205	145	236	161	52	204	173

4.1.3 Transit Travel Time Savings Analysis

A transit travel time savings analysis was performed to determine which scenario provides the greatest benefits to commuters in terms of reduction in transit trip duration to major employment centers. The following employment centers were evaluated:

- Downtown
- Midtown
- Buckhead
- Emory/CDC
- Cumberland
- Airport
- Perimeter

The first step in this analysis was identifying origin and destination TAZ's based on the build scenario corridors and employment centers. As shown in Figure 19, 21 origin TAZ's were selected to cover a broad area adjacent to the SSP corridors. Where there were multiple TAZ's within an employment center, the destination zones were selected based on the most central TAZ. The origin and destination zones were kept consistent for all scenarios to ensure an even comparison.

Next, travel time matrices identifying the transit travel times between the origin TAZ's and destination TAZ's were developed for each scenario. The TAZ pairs which indicated a net travel time reduction compared to the No Build scenario were averaged, and a percent reduction was calculated for each scenario. The results of this analysis are presented in Table 6, below.

In general, most of the scenarios see the greatest travel time benefits to Midtown and Downtown. Scenario C1 generally shows the greatest travel time benefits, including an average 30% reduction to Downtown, 17% reduction to Emory, and 14% reduction to Perimeter. Scenarios C2 and D also show strong overall transit travel time reductions. In particular, Scenario C2 provides a 22% reduction to Downtown and Midtown, and Scenario D provides an 18% reduction to Downtown and a 14% reduction to Midtown.

An example of a trip with travel time savings is from Hollowell Parkway at Lowery Boulevard to Downtown at Peachtree Street and Andrew Young International Boulevard. If the build projects modeled in scenario C1, which include streetcar transit along the west BeltLine, North Avenue/Hollowell Parkway, and Luckie Street, were constructed and operated, the average transit trip time would be 30% less than the current transit trip duration for the same origin-destination pair.

Figure 18: Example of Travel Time Savings Analysis, No Build vs. Build Scenarios

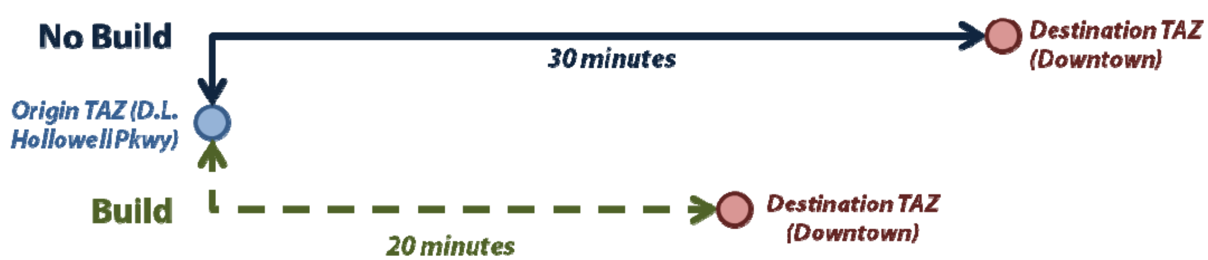


Figure 19: Selected Origins and Destinations for Travel Time Analysis

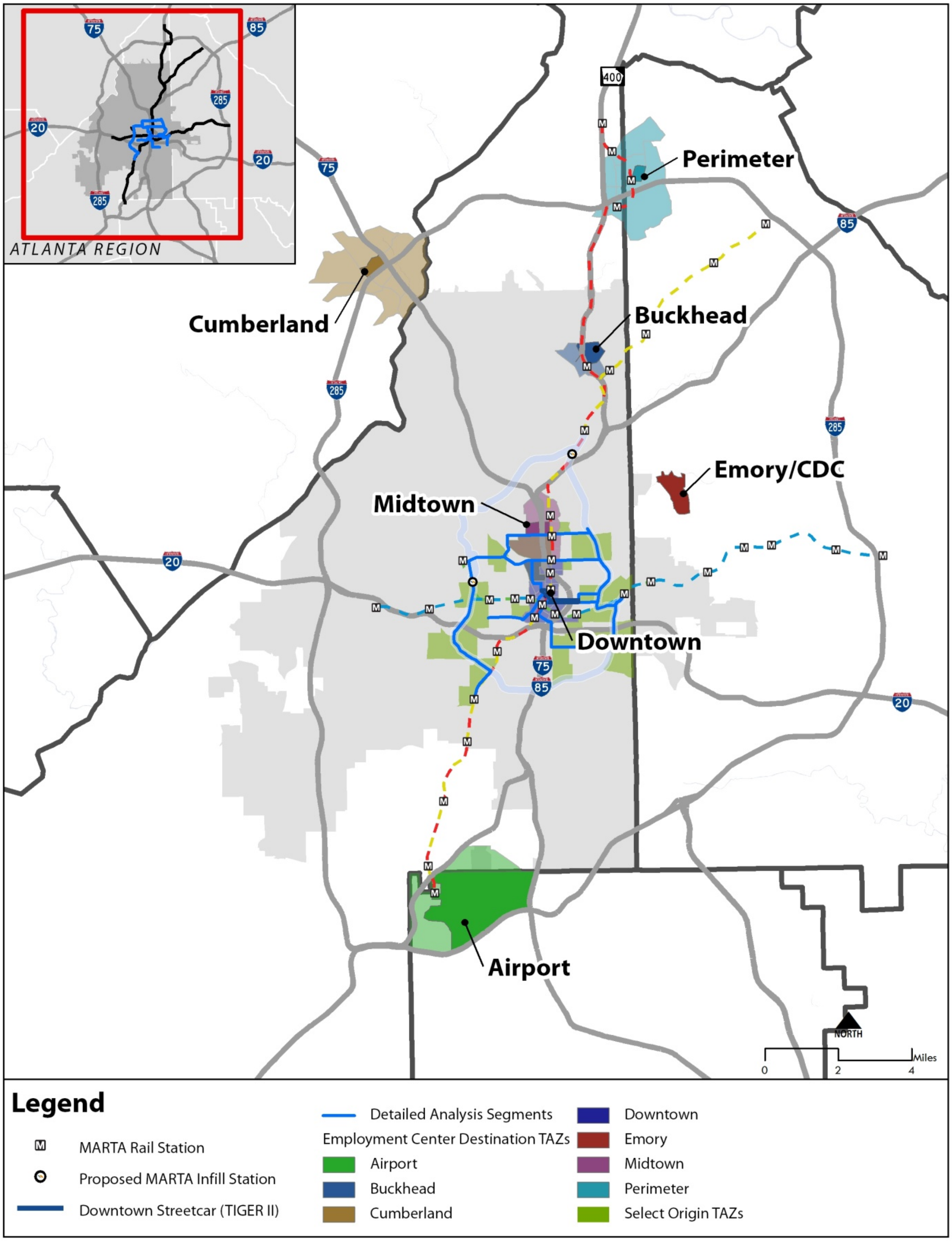


Table 6: Average Percent Transit Travel Time Reduction to Major Employment Centers

Employment Center	Model Run								
	A	B	C	D	E	F	G	I	H
TOTAL STREETCAR LENGTH (Mi)	4.1	5.2	12.5	11.9	10.1	14.7	4.5	5.1	15.1
Downtown	-11%	-13%	-30%	-22%	-18%	-25%	0%	-14%	-17%
Midtown	0%	-8%	-10%	-22%	-14%	-9%	0%	0%	-14%
Buckhead	-1%	-5%	-11%	-7%	-10%	-10%	0%	0%	-8%
Emory	-1%	-6%	-17%	-8%	-11%	-10%	0%	0%	-9%
Cumberland	0%	-4%	-11%	-5%	-7%	-7%	0%	0%	-6%
Airport	0%	-4%	-9%	-8%	-5%	-8%	0%	0%	-7%
Perimeter	-1%	-5%	-14%	-6%	-9%	-8%	0%	0%	-7%
AVERAGE	**-2%**	**-6%**	**-14%**	**-11%**	**-11%**	**-11%**	**0%**	**-2%**	**-10%**

Based on these results, it was observed that lines which did not see substantial travel time savings (including Runs A, F, and G) in the build alternative typically run parallel to existing bus routes, which were not removed from the model for the purpose of this analysis. These lines also do not have the benefit of traveling in exclusive guideway along the Atlanta BeltLine corridor, whereas lines that indicate greater travel time savings have significant portions of alignment within exclusive Atlanta BeltLine right-of-way.

Table 7 and Table 8, on the following page, provide the detailed outputs from the nine model runs. The outputs are as follows:

- **Single-occupancy vehicle trips:** Total daily person trips using single-occupancy vehicles
- **High-occupancy vehicle trips:** Total daily person trips using high-occupancy vehicles (2-plus passengers)
- **Transit (linked) trips:** Total unique daily transit trips, including transfers
  - **Walk to non-premium trips:** Total daily linked local bus transit trips via walk access
  - **Walk to premium trips:** Total daily linked premium transit trips via walk access
  - **Drive to non-premium trips:** Total daily linked local bus transit trips via auto access
  - **Drive to premium trips:** Total daily linked premium transit trips via auto access
- **Total trips:** Total regional daily trips, all modes
  - **Percent single-occupancy vehicle trips:** Percent total regional daily trips made via single-occupancy vehicle
  - **Percent high-occupancy vehicle trips:** Percent total regional daily trips made via high-occupancy vehicle
- **Percent transit trips (mode split):** Percent total regional daily trips made via transit
- **New Line 1 (Streetcar) trips:** Daily transit trips made via streetcar build alternative – Line 1
- **New Line 2 (Streetcar) trips:** Daily transit trips made via streetcar build alternative – Line 2 (multiple line scenarios)
- **New Line (Streetcar) total trips:** Total daily transit trips made via streetcar build alternative – All lines
- **Total daily boardings (unlinked):** Total regional daily transit tips, not including transfers
- **Transfer rate:** Percent of transit trips that make transfer

Table 7: Detailed Model Run Data, Runs A – C2

	Model Run								
	No Build	**A**	Increase from No-Bld	**B**	Increase from No-Bld	**C1**	Increase from No-Bld	**C2**	Increase from No-Bld
	Person Trips								
Single-Occupancy Vehicle Trips	14,717,095	14,716,643	-452	14,716,570	-525	14,715,968	-1,127	14,716,737	-357
High-Occupancy Vehicle Trips	9,592,164	9,591,928	-237	9,591,238	-926	9,590,558	-1,607	9,590,680	-1,484
Transit (linked)	**445,162**	**445,826**	**664**	**446,570**	**1,408**	**447,728**	**2,566**	**446,887**	**1,725**
Walk to Non-Premium	105,100	105,757	657	105,405	305	105,261	161	105,603	503
Walk to Premium	156,153	156,350	196	157,409	1,256	158,285	2,132	157,219	1,066
Drive to Non-Premium	26,793	26,841	48	26,759	-34	26,822	29	26,931	138
Drive to Premium	157,116	156,879	-237	156,997	-119	157,359	243	157,134	18
Total Trips	**24,754,421**	**24,754,397**	**-24**	**24,754,378**	**-43**	**24,754,253**	**-168**	**24,754,305**	**-116**
Percent SOV	59.5%	59.5%	0	59.5%	0	59.4%	0	59.5%	0
Percent HOV	38.7%	38.7%	0	38.7%	0	38.7%	0	38.7%	0
Percent Transit (Mode Split)	1.798%	1.801%	0	1.804%	0	1.809%	0	1.805%	0
New-Line 1 (Streetcar)	N/A	2,670	2,670	5,521	5,521	4,778	4,778	5,742	5,742
New-Line 2 (Streetcar)	N/A	N/A	N/A	N/A	N/A	7,821	7,821	3,544	3,544
New-Line (Streetcar) TOTAL	**0**	**2,670**	**2,670**	**5,521**	**5,521**	**12,599**	**12,599**	**9,286**	**9,286**
Total Daily Boardings (unlinked)	**0**	**2,670**	**2,670**	**5,521**	**5,521**	**12,599**	**12,599**	**9,286**	**9,286**
Transfer Rate	-100.0%	-99.4%		-98.8%		-97.2%		-97.9%	

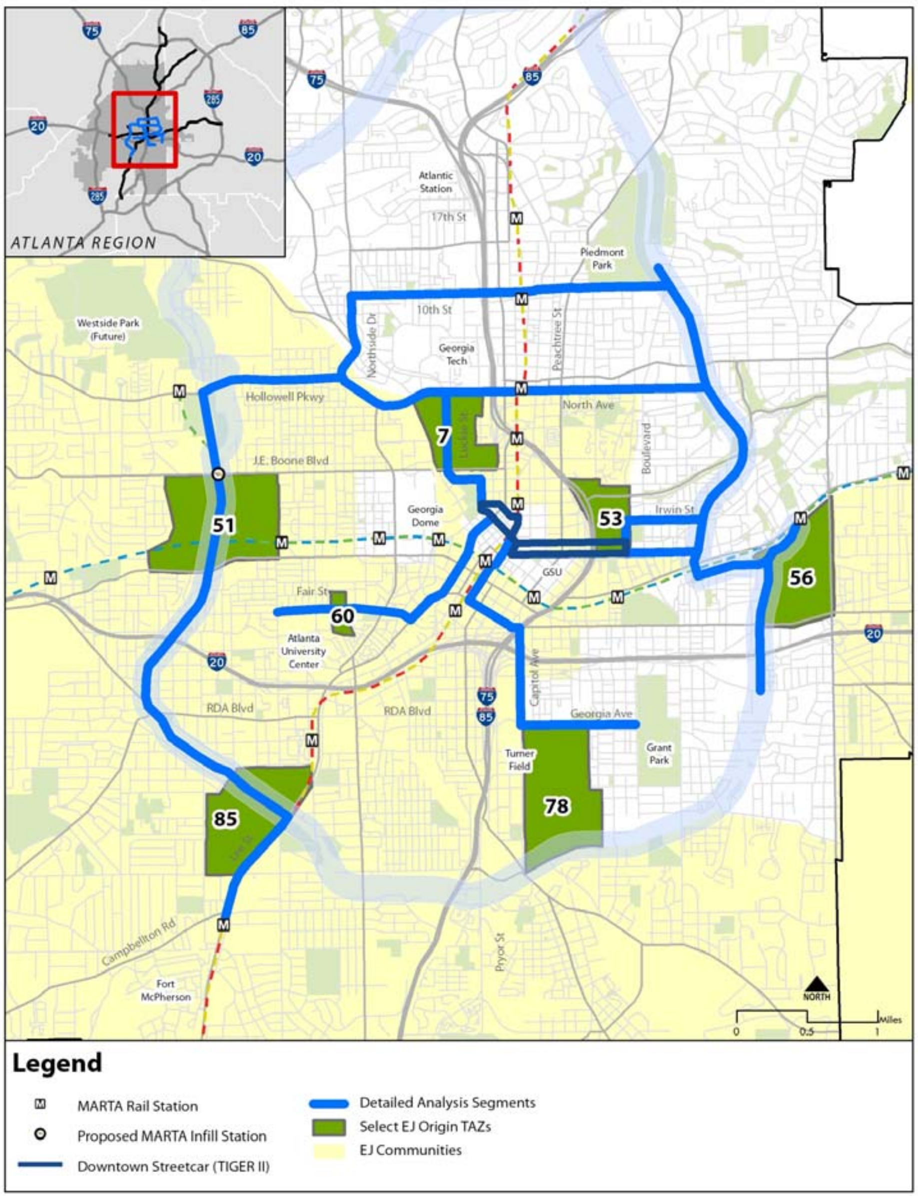
Table 8: Detailed Model Run Data, Runs D - H

	Model Run									
	D	Increase from No-Bld	**E**	Increase from No-Bld	**F**	Increase from No-Bld	**G**	Increase from No-Bld	**H**	Increase from No-Bld
	Person Trips									
Single-Occupancy Vehicle Trips	14,715,179	-1,916	14,715,855	-1,239	14,717,401	307	14,716,727	-368	14,716,100	-995
High-Occupancy Vehicle Trips	9,591,667	-497	9,590,834	-1,330	9,591,590	-575	9,591,472	-692	9,590,413	-1,751
Transit (linked)	**447,535**	**2,373**	**447,517**	**2,355**	**445,398**	**236**	**446,195**	**1,033**	**447,768**	**2,606**
Walk to Non-Premium	105,084	-16	105,017	-83	105,631	531	105,671	571	105,100	0
Walk to Premium	158,340	2,187	158,573	2,419	156,186	33	156,734	581	158,954	2,801
Drive to Non-Premium	26,773	-20	26,872	79	26,790	-3	26,776	-17	26,800	7
Drive to Premium	157,337	222	157,056	-60	156,791	-325	157,014	-102	156,914	-202
Total Trips	**24,754,381**	**-40**	**24,754,207**	**-214**	**24,754,389**	**-32**	**24,754,394**	**-27**	**24,754,281**	**-140**
Percent SOV	59.4%	0	59.4%	0	59.5%	0	59.5%	0	59.4%	0
Percent HOV	38.7%	0	38.7%	0	38.7%	0	38.7%	0	38.7%	0
Percent Transit (Mode Split)	1.808%	0	1.808%	0	1.799%	0	1.802%	0	1.809%	0
New-Line 1 (Streetcar)	4,492	4,492	9,040	9,040	2,080	2,030	4,903	4,903	9,511	9,511
New-Line 2 (Streetcar)	4,904	4,904	7,341	7,341	N/A	N/A	N/A	N/A	4,909	4,909
New-Line (Streetcar) TOTAL	**9,396**	**9,396**	**16,381**	**16,381**	**2,080**	**2,030**	**4,903**	**4,903**	**14,420**	
Total Daily Boardings (unlinked)	**9,396**	**9,396**	**16,381**	**16,381**	**2,080**	**2,080**	**4,903**	**4,903**	**14,420**	**14,420**
Transfer Rate	-97.9%		-96.3%		-99.5%		-98.9%		-96.8%	

4.2 Environmental Justice (EJ) Model Outputs

Several environmental justice (EJ) model outputs were generated to assess the job access and travel time impacts of the build scenarios on disadvantaged communities. Job access and travel time impacts are critical factors when considering the equity implications of transit infrastructure investments, as they measure how the investment expands accessibility to employment opportunities within low-income and minority communities. These analyses were conducted in a similar manner to the travel time analysis documented in Section 4.1.3, however the origin TAZ's were selected based on EJ status as defined by ARC's Equitable Target Area (ETA) analysis. In addition to being designated ETA zones, the origin TAZ's were selected based on their central location along each SSP segment. Figure 20 illustrates the ETA communities and the EJ TAZ's selected for analysis.

Figure 20: Selected EJ Origin Zones



4.2.1 EJ Transit Travel Time Savings Analysis

The EJ transit travel time savings analysis was conducted in the same manner as the general transit travel time savings analysis described in Section 4.1.3, however only EJ origin zones were evaluated. The results of this analysis are presented in Table 9, below. Of the nine model runs, Scenario D provides the greatest overall travel time benefits to the EJ communities along its alignment, with travel time savings provided to all major employment centers. Scenario E also provides strong overall travel time savings, followed by Scenarios B and H.

An example of a trip originating in an EJ zone that realizes travel time savings in the Build scenario is from Reynoldstown in east Atlanta to Downtown. If Scenario D were to be constructed and operated as modeled, which assumes streetcar along the southeast BeltLine to Downtown via Irwin Street, passengers would experience a 28% transit travel time reduction compared to current transit travel times.

Table 9: Average Percent Transit Time Reduction for Selected EJ Areas

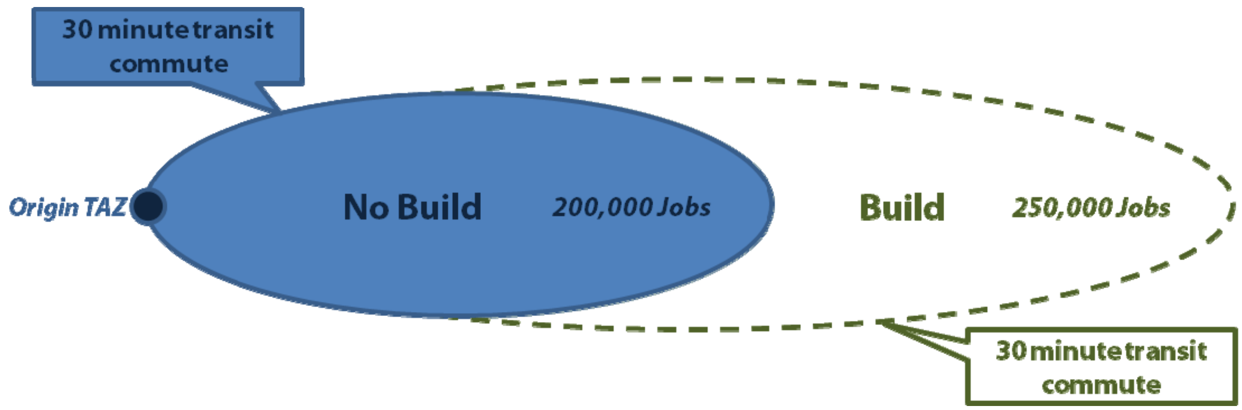
Employment Center	Model Run								
	A	B	C	D	E	F	G	H	I
TOTAL STREETCAR LENGTH (Mi)	4.1	5.2	12.5	11.9	10.1	14.7	4.5	5.1	15.1
Downtown	-8%	-5%	-28%	-8%	-27%	-28%	0%	-14%	-9%
Midtown	0%	-8%	0%	0%	-14%	-7%	0%	0%	-10%
Buckhead	-1%	-5%	0%	0%	-10%	-5%	0%	0%	-7%
Emory	-1%	-6%	0%	0%	-11%	-5%	0%	0%	-8%
Cumberland	0%	-4%	0%	0%	-7%	-3%	0%	0%	-5%
Airport	0%	-4%	0%	0%	-7%	-7%	0%	0%	0%
Perimeter	-1%	-5%	0%	0%	-9%	-4%	0%	0%	-6%
AVERAGE	-2%	-5%	-4%	-1%	-12%	-9%	0%	-2%	-6%

** Negative percent change denotes transit travel time reduction*

4.2.2 EJ Job Access Analysis

In order to quantify job access benefits of the transit alternatives to EJ communities, an analysis of employment within a 30 minute commute of the EJ origin TAZ's was conducted. The objective of this analysis was to determine how the transit investments, or the 'build' scenarios, increase the accessibility of persons living within EJ communities to employment opportunities within the region. Figure 21 illustrates this analysis.

Figure 21: Example of Employment Catchment Analysis, No-Build vs. Build Scenarios



This objective was achieved by calculating difference between the number of jobs within a 30 minute transit commute of the origin TAZ's in the No Build and build scenarios. The origin zones used for this analysis are displayed in Figure 20.

The most substantial increase in job accessibility was along the west Atlanta BeltLine, where Scenarios C1, C2, E and H all increase the 30-minute employment catchment by 17,000 to 22,000 jobs. The build scenarios were also projected to increase job access along North Avenue and Luckie Street, where Scenarios C1, C2, E, and H increase employment catchment by 12,000 to 18,000 jobs. The greatest increase in job access on a percentage basis was found for Scenario G, where the 30-minute employment catchment was increase by 44%. This is likely due to the direct access to the downtown employment center provided by the Downtown - Grant Park line.

Table 10: Employment within 30 Minute Transit Trip of Selected EJ Zones

Model Run	7 - Luckie / North Avenue	51 - West BeltLine	53 - Irwin	56 - Southeast BeltLine	60 - Atlanta University Center	78 - Downtown-Grant Park	85 - Southwest BeltLine	TOTAL
No Build	280,618	175,383	255,390	202,663	200,570	34,814	156,797	
A	286,200		257,933					
Increase from No Build	5,582		2,543					8,125
% Increase	2%		1%					1%
B	282,654		262,521	203,553				
Increase from No Build	2,036		7,131	890				10,057
% Increase	1%		3%	0%				0%
C1	298,996	193,217	260,335					
Increase from No Build	18,378	17,834	4,945					41,157
% Increase	7%	10%	2%					3%
C2	293,248	193,217	260,335					
Increase from No Build	12,630	17,834	4,945					35,409
% Increase	5%	10%	2%					3%
D	282,654		262,521					
Increase from No Build	2,036		7,131	711				9,878
% Increase	1%		3%	0%				1%
E	299,156	197,632	260,335				158,050	
Increase from No Build	18,538	22,249	4,945				1,253	46,985
% Increase	7%	13%	2%				1%	4%
F	281,975	175,596	255,416		203,477			
Increase from No Build	1,357	213	26		2,907			4,503
% Increase	0%	0%	0%		1%			0%
G						50,190		
Increase from No Build						15,376		15,376
% Increase						44%		1%
H	293,611	193,217	266,261	203,553				
Increase from No Build	12,993	17,834	10,871	890				42,588
% Increase	5%	10%	4%	0%				3%

** Positive percent change denotes employment catchment benefit*

*** Blacked out cells denote that this Equity Analysis TAZ was not served by the projects in the model run*