9. Ridership

This section provides a summary of the methodology used to forecast potential future ridership for each of the Short-List Alternatives, a description of the alternatives' key characteristics pertaining to potential ridership, and the resulting key ridership statistics, including those that are pertinent to specific, key evaluation measures used in the Federal Transit Administration (FTA) project evaluation process.

9.1 Overview

When appropriate to satisfy program requirements for federal funding programs, the FTA encourages project sponsors to employ simplified, data-driven approaches to prepare a proposed project's ridership forecasts. A data-driven methodology was employed to estimate forecasted ridership for the Short-List Alternatives, using the 2010 Nassau Hub On-Board Origin-Destination (O/D) Survey and transit network procedures from the Metropolitan Transportation Authority (MTA) Regional Transit Forecasting Model (RTFM).

The change in transit level-of-service attributes (travel times and costs) was used with the 2010 (i.e., the most current) O/D survey data to estimate results for each alternative relative to specific FTA project-justification measures, including the number of project boardings and project boardings by transit-dependents, changes in automobile person trips and vehicle miles of travel, and the number of net new transit riders.

9.2 Forecasting Methodology

This section summarizes development of the RTFM transit network, processing of the on-board survey, development of the transit trip table and validation of the forecasting process by comparing results generated by the RTFM to the measured (i.e., observed) travel behaviors.

The following aspects of the forecasting methodology are described below:
- Transit network development
- Transit network/travel speed validation
- Refined zone system in Nassau Hub Study Area
- Nassau Hub on-board survey processing
- Preparation of trip tables for survey-based assignments
- Transit path-building/assignment parameters
- Survey assignment validation

9.2.1 Transit Network Development

The existing MTA RTFM 2010 bus networks within the Nassau Hub Study Area were updated for consistency with the 2010 Long Island Bus (LI Bus) schedules. This work included:

- The alignment for each bus route was checked and modified to match the fall 2010 schedules.
- Separate lines were coded to ensure representation of all the branches of a route shown in the schedule.
- The service frequencies were updated to reflect the scheduled headways. Two different service frequencies were coded in the MTA RTFM, for the peak period (6:00 AM – 10:00 AM) and the off-peak period (10:00 AM – 4:00 PM).

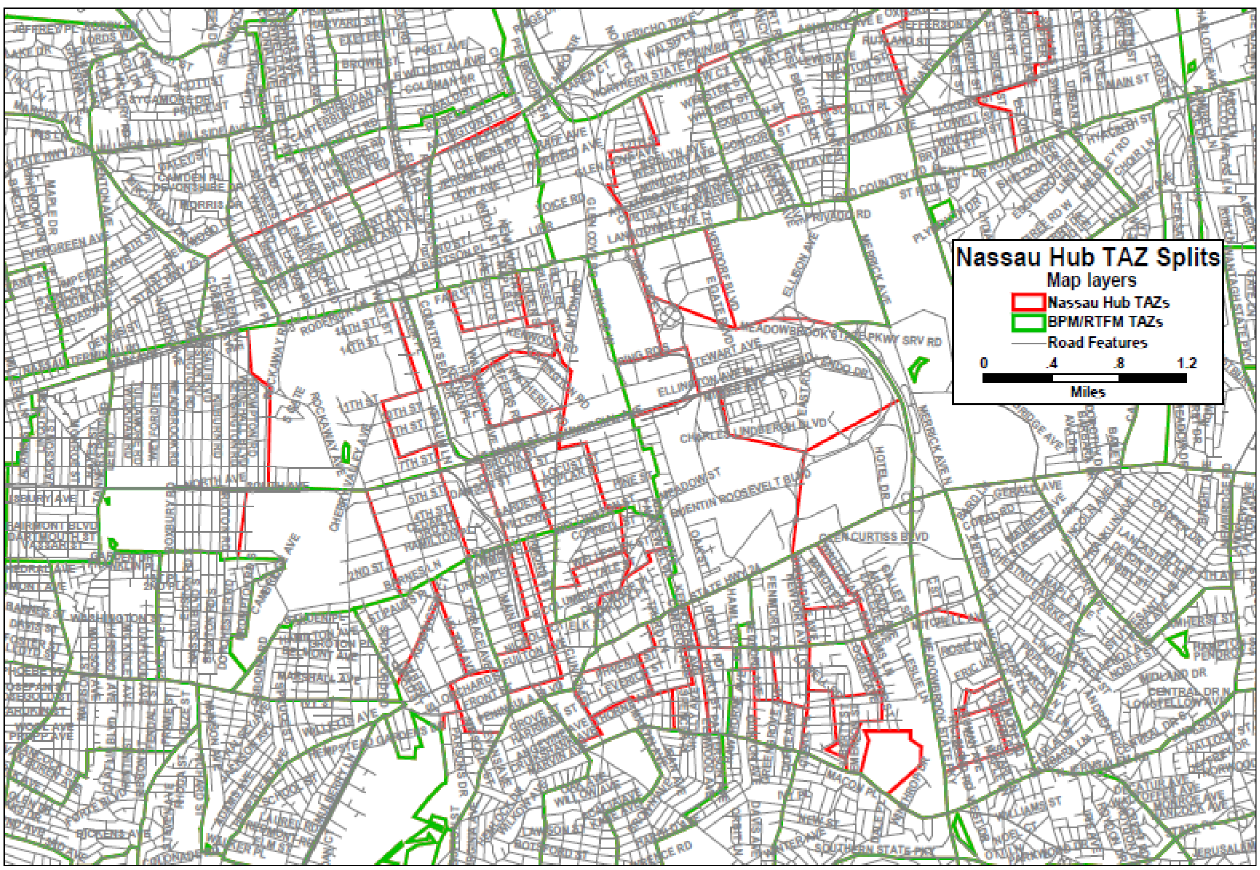
9.2.2 Transit Network/Travel Speed Validation

The MTA RTFM existing year (2010) bus travel times were updated for all routes that operate through the Study Area. The standard MTA RTFM uses generic speed relationships, which relate geographic area to stop-to-stop bus speeds. This approach was further enhanced by using fall 2010 MTA LI Bus schedules to match the time-check to time-check location. Effectively, this ensures that the model properly replicates stop-to-stop bus travel time for each route segment.

9.2.3 Refined Zone System in Nassau Hub Area

A traffic analysis zone (TAZ) is a discrete geographic area used to represent an activity center within the Study Area. For the purpose of providing a greater degree of resolution and geographic specificity for locating activity centers and for the forecasting process, TAZs were split, based on U.S. Census Block Groups and aggregations of Block Groups. The survey-derived trip tables (see Section 9.2.5) were then geo-coded to this revised TAZ system (Figure 9-1).

Figure 9-1: Map Illustrating Nassau Hub Traffic Analysis Zone Splits



Source: AECOM, 2012

Note: BPM refers to the New York Metropolitan Transportation Council (NYMTC) Best Practice Model. The BPM and the RTFM have identical TAZs.

9.2.4 Nassau Hub On-Board Survey Processing

The on-board survey conducted of Nassau County's bus system in fall 2010 was processed to develop a 2010 trip table representing existing demand for bus service. The survey was geo-coded to the enhanced

Study Area TAZs at the origin and destination trip ends using the latitude and longitude information coded in the survey. The resulting trip table was converted to production/attraction formation where the production was located based on the home end of the trip. Based on the availability of information, each record in the survey was tabulated by the following fields:

- Nassau Hub production TAZ
- Nassau Hub attraction TAZ
- Mode of access at production end:
  1. Walk
  2. Auto access (park-and-ride and kiss-and-ride)
- Time of day, selected to match the peak and off-peak period levels of service in order to align service frequency and travel times with customer experience:
  1. Peak period
     a. AM peak (6:00 AM – 10:00 AM)
     b. PM peak (3:00 PM – 7:00 PM)
  2. Off-peak period
     a. Midday (10:00 AM – 3:00 PM)
     b. Evening (7:00 PM – 6:00 AM)
- Linked-trip weight

The small number of survey records that could not be geo-coded was excluded and the survey was re-weighted to match the control totals by bus route. Linked-trip (i.e., number of trips from origin to destination, excluding transfers) weights were calculated by dividing the total unlinked-trip (i.e., boarding-based) weights by the number of transfers involved in the trip. Table 9-1 presents the resulting linked trips by period, purpose and access mode.

Table 9-1: Average Weekday Linked Trips by Time Period, Purpose and Mode of Access

Linked Trips by Time-of-Day and by Mode-of-Access (Linked Trips = Unlinked Trips/(Transfers+1))

Mode of	Peak (6-10am, 3-7pm)				Off-peak (10am-3pm, 7pm-6am)				Total			
Access	HBW	HBO	NHB	Total	HBW	HBO	NHB	Total	HBW	HBO	NHB	Total
Walk	17,362	5,041	6,302	28,705	15,545	10,065	7,586	33,195	32,907	15,106	13,888	61,901
PNR	681	60	277	1,018	686	251	378	1,316	1,367	311	655	2,333
KNR	235	48	52	335	81	320	134	535	316	368	186	870
Total	18,278	5,149	6,630	30,058	16,311	10,636	8,099	35,046	34,590	15,786	14,729	65,104

Source: AECOM, 2012
Notes:
KNR – Kiss-and-Ride/Drop off
PNR – Park-and-Ride
HBW – Home-Based Work
HBO – Home-Based Other
NHB – Non-Home Based

9.2.5 Preparation of Trip Tables for Survey-Based Assignments

The survey linked trips were consolidated into a trip matrix of production-to-attraction flows in TAZ-to-TAZ format with the following tables, stratified by time of day and mode of access:

- Peak period – walk to bus
- Peak period – PNR to bus
- Off-peak period – walk to bus
- Off-peak period – PNR to bus

These survey-based trip tables were then used as input to the assignment process.

9.2.6 Transit Path-Building/Assignment Parameters

A Study Area variant of the MTA RTFM was created for the purpose of representing the local Nassau Hub travel market. This was done by updating the RTFM path-building parameters using the results of the Nassau Hub Stated Preference (SP) survey. A SP survey asks system users and non-users how they would make mode choices given differing levels of travel time and costs. Through statistical analysis of the collected data, relationships among the various components of travel time (e.g., in-vehicle, waiting and walking time; transfers; etc.) and costs can be established.

The SP survey was conducted to ensure that the MTA RTFM model parameters, developed originally to simulate travel behavior to/from New York City, are applicable for travel to and from the Nassau Hub. This survey confirmed that many of the relationships in the existing RTFM are applicable to travelers in the Nassau Hub.

The one material adjustment made to the RTFM, due to findings of the SP survey, was the use of a larger transfer penalty (5 minutes for the first and 10 minutes for the second transfer) for local Nassau Hub transit travel. This is both logical and intuitive, as the transfer penalties in the original RTFM were set based on MTA-New York City Transit transferring activity (i.e., where cross-platform transfers exist). The resulting transfer penalty obtained from the SP research is very consistent with transfer penalties used nationally for suburban bus operators. The transit-network and path-building parameters of the RTFM were adjusted to match the observed ridership patterns. During this process, minor adjustments were made to the MTA RTFM transit path-building and -assignment procedures.

The transit path-building and -assignment routines were calibrated in the RTFM by calibrating the variable weights to best reflect the observed boardings. This process started with the existing RTFM transit weights on variables, implemented the findings from the SP survey (penalty for transfers) and confirmed that the resulting assignments matched observed travel patterns. The path-building parameters and weight factors included in-vehicle travel time, out-of-vehicle time, waiting time and transfer penalties; the weight factors convert the parameters to equivalent minutes of in-vehicle travel time. The following key parameters were applied during the path-building process:

- Walk speed – 3 miles per hour (mph)
- Transfer penalty – 6 minutes per transfer
- In-vehicle-time weight factor – 1.0
- Waiting-time weight factor– 1.5
- Transfer-wait weight factor – 1.5
- Walk-time weight factor – 1.5
- Drive-time weight factor– 2.0

When the transit path-building and -assignment parameters listed above were implemented, the transit trip tables (Section 9.2.5) were found to mimic the observed travel patterns with a fairly high degree of accuracy.

9.2.7 Survey Assignment Validation

An important element of the validation of the transit path-building and -assignment weights is to ensure that selected path-weights mimic the observed travel patterns. Table 9-2 shows a comparison of AM peak-period (6:00-10:00 AM) survey boardings and the survey assignment.

Table 9-2: AM Peak-Period (6-10 AM) Nassau County Bus Boardings by Route (Survey Boardings versus Validated Model Boardings)

Bus Route	Survey AM Peak Period Boardings	Modeled AM Peak Period Boardings
6	2,843	2,833
15	1,552	1,275
16	760	502
22	2,400	3,236
23	714	514
24	1,557	1,088
27	493	631
32/31	1,814	1,555
40/41	2,176	2,042
43	374	925
45	230	449
46/47	161	252
49/48	782	367
50	70	74
51	23	1
54/55	299	442
72/71/70	1,699	2,107
79/78	1,468	840
Total	**19,415**	**19,133**

Source: AECOM 2012

The existing Nassau County bus system in the vicinity of the Nassau Hub Study Area makes it nearly impossible to match route-level assignments within the RTFM because many routes operate in the Study Area in an overlapping fashion, that is, multiple routes and route groups operate within a given corridor. The approach for validating the route-level assignments is important to ensure that the heavily utilized bus routes (i.e., with thousands of AM peak-period boardings) and bus routes with moderate ridership (i.e., several hundred AM peak-period boardings) and the overall number of boardings in the model closely match the survey results.

9.3 Evaluation of Nassau Hub Alternatives

Forecast-year (2035) estimates of ridership were developed for the four Short-List Alternatives. These forecasts were produced during the period between the release of the Notice of Proposed Rule Making (NPRM) (January 2012) and the final rule under the Moving Ahead for Progress in the 21st Century Act (MAP-21) (August 2013). During this period, there were several changes to the project evaluation criteria for New Starts/Small Starts projects. With this transition period in mind, the Short-List Alternatives were evaluated using the following approach:

Step 1 – Grow the 2010 Survey to Represent Year 2035 Conditions

In Step 1, the 2010 on-board survey data were grown to represent opening- and forecast-year conditions. This was done by scaling the base-year (2010) transit on-board survey trip table to represent year 2035 conditions. This was done by applying estimates of forecasted growth in TAZ-level population and employment in the Study Area, as adopted by the New York Metropolitan Transportation Council (NYMTC).

Step 2 – Code Service Plans and Travel Times for Each Alternative

In Step 2, the alternatives' characteristics were coded into the refined RTFM forecasting tool including the service plans and travel times for each of the alternatives, as follows:

- **Year 2035 No-Build Alternative –** This alternative represents transit service within the Study Area without a Nassau Hub transit-improvement investment. It starts with the 2010 base-year representation of the transit network and includes programmed and committed changes (e.g., the Long Island Rail Road's East Side Access project) that would occur between 2010 and the opening and forecast year (2035).
- **Year 2035 Build Alternatives –** These alternatives represent the Nassau Hub build options. In addition to the programmed/committed projects included in the No-Build Alternative, each of these alternatives (i.e., Short-List Alternatives) includes the transit-improvement project elements described in Section 6.1.

The key issue in the development of the ridership estimates was the transit travel times within the Study Area. The FTA will consider travel-time savings for the Nassau Hub investment from two different sources. The first source is the physical improvements with the proposed project (guideway, dedicated running ways and off-board fare collection), which yield *measured improvements* to transit travel times. The second source of travel-time savings, which FTA categorizes as "Alternative Specific Effects" (ASE), assigns travel-time improvements to the *perceived improvements* (enhanced vehicles, station amenities, ride quality, branding and visibility that increase transit utilization). The purpose of ASEs is to capture the equivalent travel-time benefits associated with the perceived improvements. The ASEs were embedded in this analysis consistent with FTA guidance.

Step 3 – Estimate the Transit Impedance for Each Alternative

In Step 3, the resulting measured transit travel times and costs, often referred to as impedances, were derived for each coded alternative by running the enhanced RTFM transit path-building process (described in Section 9.2.6). Following that, a transit-impedance score was developed for all origin-destination TAZ pairs in the region for each of the alternatives. A TransCAD GISDK script was written to write out the transit impedance (consistent with the path-weights described above) using the calibrated impedances:

Transit Impedance =

- 1.0 * Measured Transit In-Vehicle Travel Time (IVTT) (minutes)+
- 1.5 * Measured Transit Waiting Time (minutes) +
- 1.5 * Measured Walking Time (minutes) +
- 2.0 * Measured Drive Time (minutes, if a drive path) +
- 6.0 minutes * Number of Transfers

Step 4 – Estimate the Ridership for the Year 2035 No-Build Alternative

In this step, the "grown" opening- and forecast-year trip tables were assigned to the No-Build networks in the enhanced RTFM Nassau Hub forecasting tool. The resulting boardings by route were summarized and presented as the No-Build volumes.

Step 5 – Estimate Ridership for the Short-List Alternatives

In Step 5, the ridership for the four Short-List Alternatives were estimated. Because these alternatives represent another incremental improvement to transit service within the Study Area, an arc midpoint elasticity of -0.7 on transit impedance was applied to estimate the new riders generated by the given alternative. For the purposes of estimating the alternatives' ridership, the 2035 baseline trip table and the new trips estimated via elasticity were added together to create a 2035 build-alternative trip table. The resulting build-alternative trip table was assigned to the 2035 build-alternative network.

In addition to the "measured" impacts to travel time, non-measured impacts (i.e., ASEs) were represented. These ASEs include the impacts of "non-measured" effects of premium transit service, including:

- Dedicated running lanes/reliability of vehicle arrival
- Improved transit vehicles
- Branding/visibility
- Schedule-free service
- High-quality station stops with dynamic schedule information

FTA generally allows for a two-tiered benefit for trips using premium transit in the build alternative. These benefits include:

- An in-vehicle travel time discount (5 to 20 percent depending on mode) for improved vehicles and associated ride quality
- A constant travel-time benefit, which represents the unmeasured attributes of premium transit service

For the purpose of evaluating the Short-List Alternatives, application of the following ASEs was discussed with FTA in late 2012:

- Modern streetcar alternatives:
  - 10 percent IVTT travel discount
  - 7 minutes of constant effect (i.e., 7 minutes of travel-time savings) for modern streetcar-only trips

- 2 minutes of constant effect (i.e., 2 minutes of travel-time savings) for modern streetcar trips also using local bus

- BRT/premium bus alternatives:
  - 5 percent IVTT travel discount
  - 5 minutes of constant effect (i.e., 5 minutes of travel-time savings) for BRT/premium bus only trips
  - 2 minutes of constant effect (i.e., 2 minutes of travel-time savings) for BRT/premium bus trips also using local bus

9.4 Year 2035 Alternative Definitions

The following alternatives, as described in Section 9.3, were evaluated using the forecasting methodology described above.

Year 2035 No-Build – This alternative includes a representation of transit service within the Study Area without a Nassau Hub investment. It starts with the 2010 base year representation of the transit network and includes committed changes programmed to occur between 2010 and the opening and forecast years. This alternative also includes the service changes that were made as part of the conversion of service from MTA LI Bus to Veolia-operated Nassau Inter County Express (NICE) Bus, effective January 1, 2012. This alternative serves as the basis of comparison to evaluate the performance of the build alternatives.

Year 2035 Build Alternative 2 – This alternative is identical to the 2035 No-Build alternative with the exception that the modern streetcar is constructed and operated between the Mineola Intermodal Center, Carle Place, Roosevelt Field, Source Mall and the Rosa Parks–Hempstead Transit Center. With Alternative 2, the existing local bus service was modified to eliminate duplicative service along the modern streetcar alignment. These changes include:

- N15 – truncated in Village of Mineola
- N16 – truncated in Village of Hempstead
- N22/N22A/N24 – eliminated the section through Roosevelt Field, focused service on Old Country Road
- N23 – truncated in Village of Mineola

The modeled station-to-station travel times are summarized in Table 8-3.

Year 2035 Build Alternative 3 – This alternative is identical to the 2035 No-Build alternative with the exception that the modern streetcar is constructed and operated between the Mineola Intermodal Center, Carle Place, Roosevelt Field, and the Rosa Parks–Hempstead Transit Center. With Alternative 3, the existing local bus service represented in the refined RTFM was modified to eliminate duplicative transit service along the modern streetcar alignment. These changes include:

- N15 – truncated in Village of Mineola
- N16 – truncated in Village of Hempstead
- N22/N22A/N24 – eliminated the section through Roosevelt Field, focused service on Old Country Road
- N23 – truncated in Village of Mineola

The modeled station-to-station travel times are summarized in Table 8-4.

Year 2035 Build Alternative 2A – This alternative is identical to the year 2035 Build Alternative 2 with the exception that the modern streetcar is replaced with a BRT/premium bus service. As with the year 2035 Build Alternative 2, the existing local bus service represented in the refined RTFM was modified to eliminate duplicative transit service along the BRT/premium bus alignment. The station-to-station travel times are summarized in Table 8-8.

Year 2035 Build Alternative 3A – This alternative is identical to the year 2035 Build Alternative 3 with the exception that the modern streetcar is replaced with a BRT/premium bus service. As with the year 2035 Build Alternative 3, the existing local bus service represented in the refined RTFM was modified to eliminate duplicative transit service along the BRT/premium bus alignment. The station-to-station travel times are summarized in Table 8-9.

9.5 Ridership Results

The key ridership statistics are summarized in Table 9-3.

Table 9-3: Year 2035 Summary of Key Ridership Forecasting Statistics by Alternative

	Alternative 2	**Alternative 3**	**Alternative 2A**	**Alternative 3A**
	Modern Streetcar	**Modern Streetcar**	**BRT/Premium Bus**	**BRT/Premium Bus**
	Mineola to Hempstead via Source Mall	**Mineola to Hempstead via South Street**	**Mineola to Hempstead via Source Mall**	**Mineola to Hempstead via South Street**
Annual non-transit dependent trips	1,220,000	1,281,000	793,000	878,400
Annual transit dependent trips	780,000	819,000	507,000	561,600
FTA mobility measure (trips on the Project: + [transit dependent trips * 2]), Annual	2,780,000	2,919,000	1,807,000	2,002,000
Number of trips accessing by walking, bicycling, carpool and other travel demand management methods	2,000,000	2,100,000	1,310,200	1,440,000
Daily project boardings	6,700	7,000	4,400	4,800
Daily diversions in automobile person trips	600	600	400	400
Annual project boardings	2,000,000	2,100,000	1,300,000	1,440,000
Annual passenger miles	4,878,179	5,030,000	3,750,000	3,460,000
Annual revenues (for farebox recovery calc.)	$3,080,000	$3,234,000	$2,002,000	$2,218,000
Annual reduction in vehicle miles traveled (VMT)	442,000	432,000	347,000	289,000

Source: AECOM, 2012

The summary results provided in Table 9-3 reveal that Alternative 3 has the highest predicted number of riders, which is a key factor in the overall alternatives screening evaluation process for selection of the Locally Preferred Alternative (LPA).