Capital District Transportation Committee

Capital District Transportation Authority

NY5 Bus Rapid Transit Conceptual Design Study

Deliverable C-2
Operations Plan

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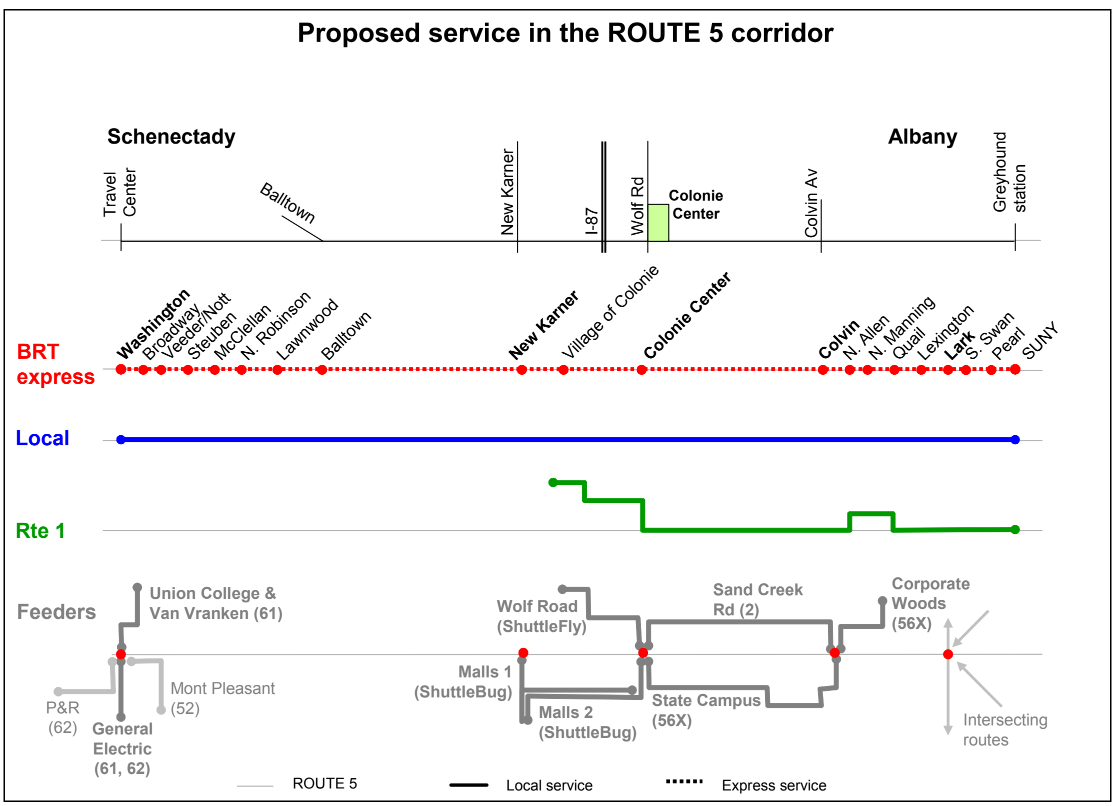
This document constitutes Deliverable C-2 of the NY 5 Bus Rapid Transit Conceptual Design Study. Its purpose is to describe the operations plan for the BRT service on ROUTE 5 and its complementary routes. This document is organized into five sections. The first section describes the proposed service. The second section discusses the stops and stations, including spacing, location, and amenities. The third section provides a specification of the operating plan, including headways, span of service, and fleet size. The fourth section discusses the ridership potential of the proposed services. The last section discusses the Intelligent Transportation Systems requirements for the services.

1 Proposed Service

1.1 Service Concept

Earlier in this study, various service concepts to improve transit operations in the ROUTE 5 corridor were analyzed. Deliverable B and a follow-up memorandum presented four alternative service concepts including an application of a set of evaluation criteria. On March 9, 2004, the second Study Advisory Committee meeting on the NY5 BRT Study was held, and an overall consensus was reached around Alternative 3, which proposed a BRT treatment of the entire corridor with two mainline routes, one express and one local, and a series of feeder routes. Later, during the development of the project, it was decided that only the express route should be marketed as the BRT service. A schematic of the service concept is presented in Figure 1.1.



Notes: 1) BRT express stations shown in bold font are transfer stations.
2) For the feeders, the name or number in parenthesis represents the existing route that is being replaced or renewed

Figure 1.1 Service concept schematic

The basic premise of this operational concept is to treat ROUTE 5 between Albany and Schenectady as a BRT corridor. The corridor will have one main BRT route between downtown Albany and downtown Schenectady. This BRT express service will stop only at key locations that currently have large volumes of passengers boarding and alighting or at strategic locations that are being considered for future large developments or redevelopment. This route is designed to serve long-haul trips with a fast and reliable service and to create an attractive alternative to the private automobile.

Two other mainline routes will complement the BRT express service on ROUTE 5:

- The local service between downtown Albany and downtown Schenectady will stop frequently (i.e. approximately every 1/7 of a mile) to provide greater accessibility in the entire corridor but at a lower average speed.
- A modified version of Route 1, which operates primarily between downtown Albany and Colonie Center and has a few trips going up Wolf Road and Albany Shaker Road to serve the airport and the nursing homes. This route, as the existing Route 1, provides service from Albany to the Transit Center in Colonie Center, responding to the higher demand observed in the eastern part of the corridor. The route deviates from ROUTE 5 between Ontario Street and Everett Road onto 3rd Street to serve the current Route 2 passengers on that segment of the route[1].

These three mainline services on ROUTE 5 will be complemented by feeder routes. The feeder routes operate as cross-town services collecting passengers from neighborhoods adjacent to the corridor and bringing them to transfer stations where they can easily transfer to express or local buses.

The main advantages of this service concept are

- The BRT express route will decrease running time significantly and would become a more competitive alternative to the private automobile
- Both users and non-users will notice the service change, which may spur greater transit usage
- The feeder routes will improve the coverage of the corridor
- ROUTE 5 is more easily perceived as a corridor with permanent rapid transit, which would encourage higher-density developments and pedestrian-friendly environments
- The service concept is easy to understand and the express route can be represented to the public in a very simple graphic way – similar to rail systems.

1.2 Description of Services

The following subsections describe in further detail the three mainline services and eight feeder routes presented above. While these descriptions constitute final recommendations of this conceptual design study, final implementation decisions will be made during preliminary engineering and will take into account the findings of the Transit Development Plan that is being conducted by CDTA.

[1] Route 2 will be converted into a feeder route between Colvin and Colonie stations.

The time periods referred in the following sections are defined as shown in the table below.

Table 1.1 Definition of time periods

Day of the week	Time period	Hours
Weekday	Early AM AM Peak Midday PM Peak Evening Late Evening	before 6 am between 6 am and 9 am between 9 am and 3 pm between 3 pm and 6 pm between 6 pm and 9 pm after 9 pm
Saturday	Morning Midday Evening	before 9 am between 9 am and 5 pm after 5 pm
Sunday	Midday Off Peak	between 9 am and 5 pm before 9 am and after 5 pm

1.2.1 BRT Express

The BRT express service runs between the Travel Center in Schenectady (i.e. State Street and Washington Avenue) and the existing CDTA bus terminal in downtown Albany next to the Greyhound station. Figure 1.2 shows a map of the ROUTE 5 corridor with the BRT express route and stations. For ease of representation, the corridor was broken into two sections, the western segment is shown first and the eastern segment is shown below it.

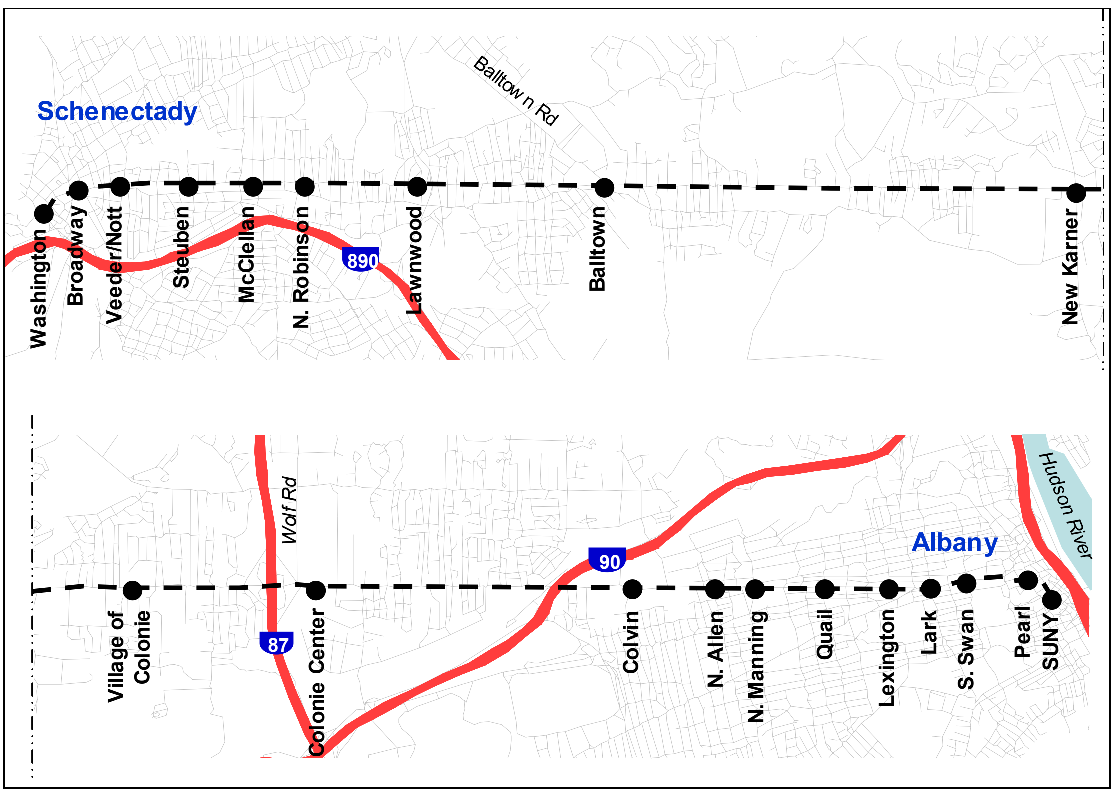


Figure 1.2 BRT express route and stations

The service stops at 20 stations in this 16-mile long alignment, five of which—Washington, New Karner, Colonie Center, Colvin, and Lark—will be designed as transfer stations to ease transfers among BRT, local, feeder, and intersecting routes. The BRT express service runs from 6 am to 9 pm during weekdays and from 9 am to 5 pm during Saturdays; no Sunday service is proposed. During weekdays the service runs with headways of 12 minutes during the AM and PM peak periods, 20 minutes during the midday period, and 30 minutes during the evening. On Saturdays, it runs with a 20-minute headway.

1.2.2 Local

The local service operates very similar to the current Route 55; it runs between downtown Albany and downtown Schenectady in the same alignment as the BRT express. This local service stops frequently (i.e. approximately every 1/7 of a mile) to provide greater accessibility in the entire corridor but at a lower average speed. This route stops at almost all existing Route 55 stops except for some stops that are proposed to be consolidated in the Colvin area and in the eastern part of Schenectady. The consolidation of stops for the local services is presented in further detail in the *Stations* section.

It would run Monday through Sunday, from very early in the morning—around 5:00 am—until approximately 1:00 am. During the week, the headways will be 15 minutes during peak periods, 20 minutes during midday, and 30 minutes the rest of the day.

This local service will be dispatched dovetailed with the BRT express and Route 1 service to provide very frequent service during the peaks and midday, and 15 minute service during the evenings. The coordination of the dispatching is described in further detail in the *Operations* section.

1.2.3 Route 1

Initially, the existing Route 1 was proposed to be eliminated; however, two major issues emerged:

- Service to the Transit Center at Colonie from Central Avenue west of Ontario Street is eliminated (users to the east of Ontario would have the possibility of using Route 2 to reach the Transit Center)
- The analysis of the demand patterns in the corridor showed that the eastern half (Albany) of the corridor has larger demand than the western half (Schenectady). Hence, the elimination of Route 1 would leave the corridor with fewer opportunities to match service and demand, unless some local or BRT trips were short-turned at Colonie.

In order to overcome these two issues without introducing new complexity to the BRT service (i.e. short-turning some vehicles), Route 1 was maintained and Route 2 was converted into a feeder route connecting with the BRT express stations at Colonie Center and Colvin.

The new Route 1 is a revised version of the existing Route 1. The route would continue to run primarily between Albany and Colonie Center and only three trips per day will run up to the Albany County Nursing Home, which will be timed to serve the work shifts at the nursing homes on Shaker Road, but it will deviate between Ontario Street and Everett Road onto 3rd Street. Figure 1.3 shows the routing of the proposed Route 1 on its main segment, primarily along ROUTE 5.

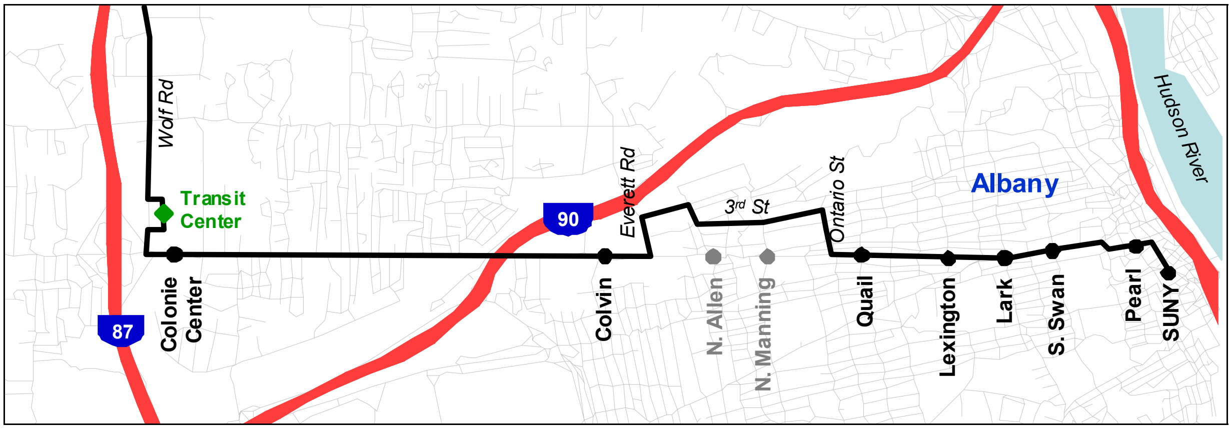


Figure 1.3 Revised Route 1 alignment

With this routing, Route 1 will serve one of the highest ridership segments on Route 2—on 3rd Street between Ontario Street and Everett Road—avoiding a reduction on the service level when Route 2 is turned into a feeder between Colvin and Colonie Center via Sand Creek Road.

The new Route 1 will have slightly expanded hours compared to the current route—to continue to provide current Route 2 passengers with the same span of service: Weekdays between approximately 6:30 am and 8:30 pm, Saturdays between 11 am and 8:30 pm, and three trips on Sunday at 6 am, 3 pm, and 10 pm to serve the shifts at the nursing homes. During weekdays, the headway on peak periods will be 15 minutes, with 20 minutes during midday, and 30 minutes during the evening. Additional weekday trips would serve the airport and nursing homes as they do now.

1.2.4 Wolf Road Feeder

The proposed Wolf Road feeder is a revised version of the existing ShuttleFly. Currently, the ShuttleFly serves as a feeder (i.e. distributor) for the ROUTE 5 corridor. This shuttle service runs along Wolf Road, Albany Shaker Road, and ROUTE 7, serving Colonie Center, the airport, and the Kaiser/CHP Plaza on ROUTE 7. Figure 1.4 shows a schematic of the main route followed by the ShuutleFly.

This service runs every 15-20 minutes during peak hours and every 30 minutes during off-peak hours. Ridership on this route is approximately 9,500 passengers per month. The ShuttleFly does not have designated stops; the vehicles actually may deviate from the main route and stop at specific buildings (i.e. office buildings, retail, health centers, etc) at the request of the passengers. However, they do have specific departure times from both ends of the route.

This route—as well as the ShuttleBug—is an important complement to existing operations and it was concluded that with only minor variations it should be part of the feeder network that would complement the new mainline service on ROUTE 5.

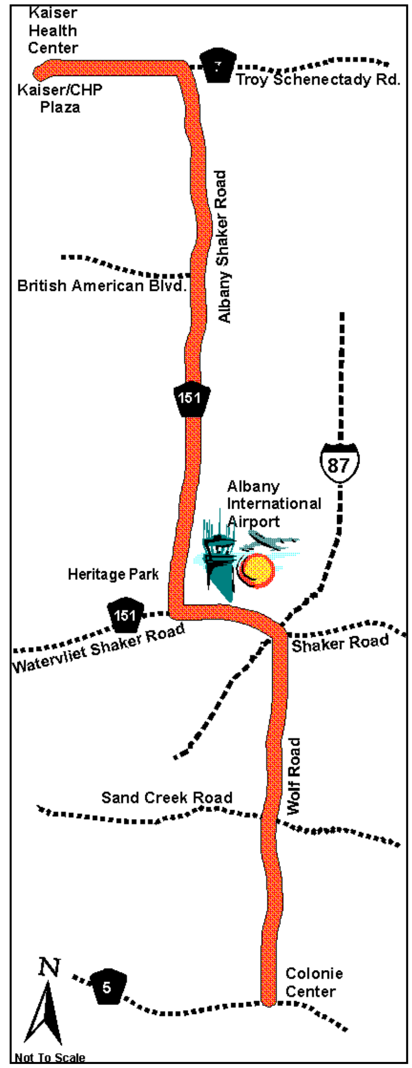


Figure 1.4 ShuttleFly route

The ShuttleFly would be converted into the Wolf Road Feeder, (see Figure 1.7) which would operate very similar to the current service: between 6:00 a.m. and midnight during weekdays, and at 12 and 30-minute headways during peak and off-peak periods, respectively. The peak-hour headway is recommended to change from the current 15 minutes to 12 minutes specifically to match the BRT express service headway to facilitate timed transfers. In the near term, it is *not* recommended to change the midday headway from 30 minutes to 20 minutes (to match the BRT), since the midday demand on the ShuttleFly is much lower than the peak period demand.

1.2.5 Malls Feeders

Similar to the previous feeder, the malls feeders are a revised version of the current ShuttleBug. The ShuttleBug runs primarily on New Karner Road and Washington Avenue serving ROUTE 5 at New Karner Road, the Twenty Mall, Crossgates Commons, and the Crossgates Mall. The main service (i.e. ShuttleBug 1) is provided every 30 minutes during peak hours and every 45 minutes during off-peak hours. Extra service (i.e. ShuttleBug 2) is added between Twenty Mall and Crossgates Mall every 30 min during peak hours. Thus, the resulting combined headway on that segment of the route during peak hours is 15 minutes.

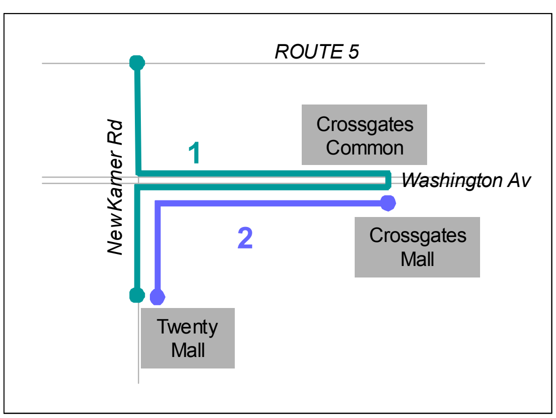


Figure 1.5 ShuttleBug routes

Figure 1.5 is a schematic of the existing ShuttleBug service. As mentioned above, ShuttleBug 2 only operates during peak periods and for 1.5 hours during the midday, to supplement the service provided by the main route.

Total ridership on this route is approximately 14,500 passengers per month. As with the ShuttleFly, the feeder routes analysis concluded that this route is an important complement to ROUTE 5 services and that with only minor changes it should be maintained.

The Malls feeders are composed of the Malls 1 and Malls 2 feeder routes. The Malls 1 runs almost exactly like the existing ShuttleBug 1, from New Karner Road at ROUTE 5 to Twenty Mall and to Crossgates Mall. The Malls 2 would operate similar to the current ShuttleBug 2, but it would be extended to connect Crossgates with Colonie Center. Both feeders would run, during weekdays, at 24 and 40-minute headways to provide a combined 12 and 20-minute headway between Twenty Mall and Crossgates during peak and off-peak periods

A second alternative would be to extend the Malls 2 feeder north of Central Avenue on New Karner Road to Watervliet Shaker and provide a connection to the airport. The final selection of the Malls 2 alternative, as with all other feeders, will occur within the larger system-wide planning effort (Transit Development Plan) that CDTA is conducting. Figure 1.6 shows these two alternative routings.

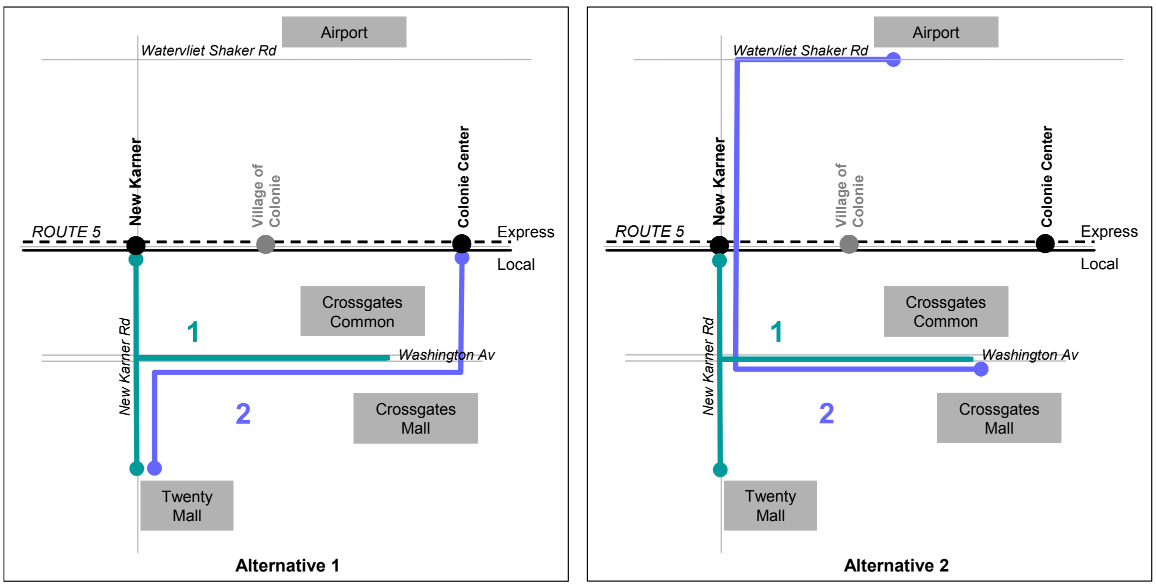


Figure 1.6 Routing alternatives for Malls Feeders

The Malls feeders would run between 6:00 a.m. and midnight during weekdays at 24 and 40-minute headways to provide a combined 12 and 20-minute headway between Twenty Mall/New Karner Rd and Crossgates during peak and off-peak periods respectively.

1.2.6 State Campus Feeder

Currently, Route 56X operates between Schenectady and the State Campus and Corporate Woods complexes. The route operates locally on ROUTE 5 from Washington Avenue in Schenectady to the I-87, where it runs express to the final two destinations mentioned above. This route only has one eastbound trip in the morning and one westbound trip in the afternoon. To improve the level of service while maintaining operational costs at a low level, it is proposed to convert the 56X into two feeder routes: State Campus feeder and Corporate Woods feeder (see Figure 1.7).

The State Campus Feeder would run between Colonie Center station, State Campus, and Colvin station. As opposed to current route 56X, which runs on I-87, it is recommended to route this new feeder service through Fuller Road and Washington Avenue to serve those two markets.

The service level for Route 56X passengers to State Campus would be doubled to two trips per day in the peak direction; the trips would be separated 24 minutes, and scheduled to meet the BRT express at transfer stations. This change in service forces a transfer for passengers, however, this inconvenience is expected to be outweighed by the faster commute—due to use of the BRT express in the ROUTE 5 segment of the trip—and the added trip.

The segment of the route connecting State Campus and Colvin Station is most effective if the service level of this route is further increased, enabling CDTA to eliminate the trips on Routes 12 and 90 that go to the State Campus. Without, this service level increase, it is unlikely to have any trips in the morning between the State Campus area and Colvin Station and vice versa in the afternoon. However, this segment is crucial if passengers from Route 12 are encouraged to take the BRT express to Colvin station and transfer to the State Campus feeder in the morning.

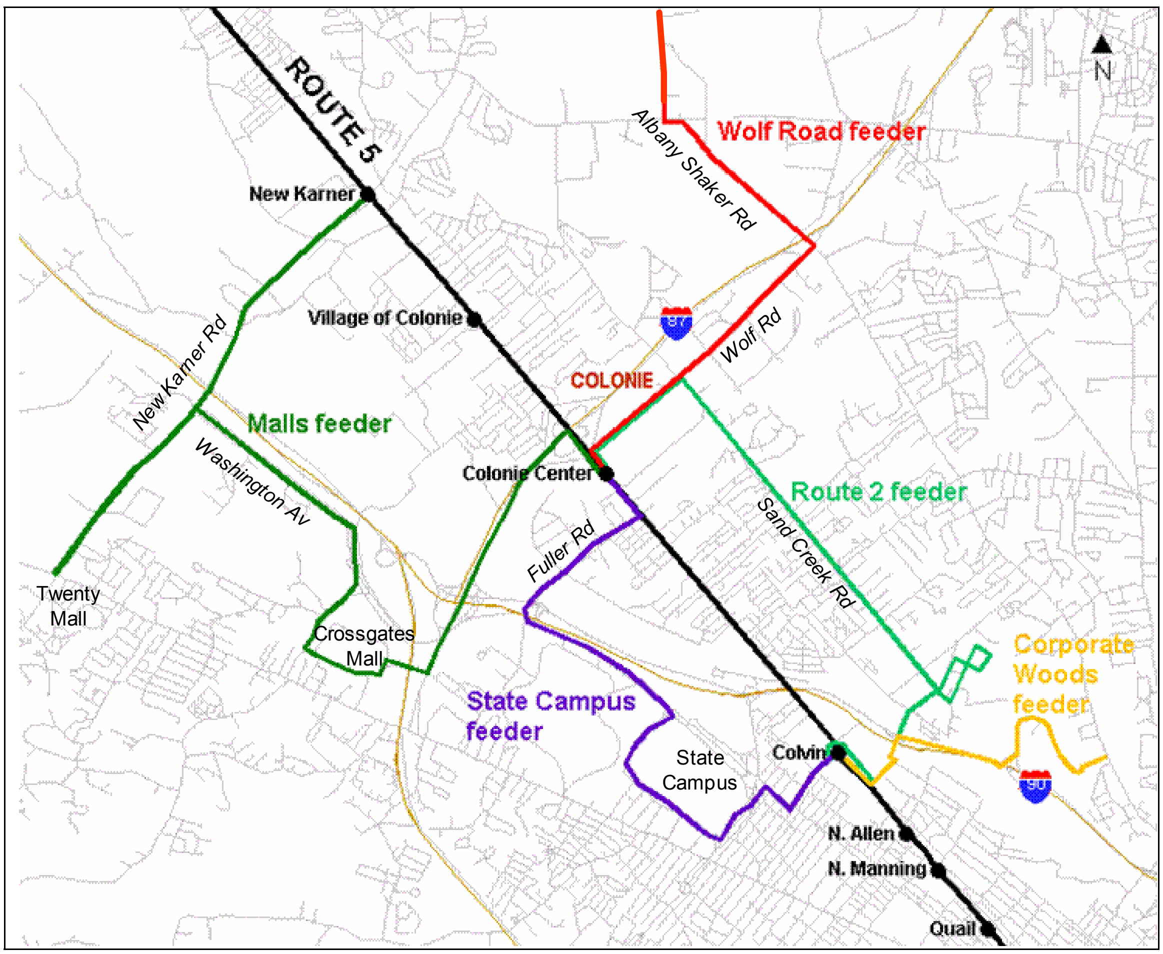


Figure 1.7 Feeder routes in Albany and Colonie

1.2.7 Corporate Woods Feeder

The Corporate Woods feeder also comes from the existing Route 56X. This new feeder route would run between Colvin station and Corporate Woods, using ROUTE 5, Everett Road, Interstate 90, and Corporate Woods Boulevard (see Figure 1.7). As with the State Campus feeder, current passengers will be forced to transfer, but the benefits of this plan are expected to outweigh this inconvenience: travel time will be significantly reduced because passengers will have a more direct trip on ROUTE 5 instead of having to go through the State Campus routing, and the service level would be two trips per day in the peak direction. The trips would be separated 24 minutes, and scheduled to meet the BRT express at Colvin station.

1.2.8 Sand Creek Road Feeder

As mentioned above, Route 2 is proposed to become a shorter feeder route. Currently, Route 2 runs between downtown Albany and Colonie Center via ROUTE 5, Ontario Street, 3rd Street, Watervliet Avenue, Everett Road, Sand Creek Road, and Wolf Road. However, only a small portion of the route's ridership is observed in the large segment of Sand Creek Road and Wolf Road. Thus, it was proposed to

- serve the ROUTE 5 ridership with the BRT express, local and route 1 services,
- deviate the new Route 1 from ROUTE 5 for a short segment to serve the Route 2 passengers between Ontario Street and Everett Road, and
- create a new feeder service between Colvin Station and Colonie Station following the routing of Route 2 between Everett Road and Wolf Road (see Figure 1.7).

These changes to Route 2 seek to maintain the level of service (i.e. one-seat ride) to the great majority of its current riders while providing a more cost-effective service for the portion of the route that currently experiences lower demand. This route would be operated by a minibus.

The new Sand Creek Road would have service hours slightly shorter than those of the current Route 2: Weekdays and Saturdays between approximately 5:30 am and 8:30 pm. (Ridership on the last two trips on Route 2 on the Sand Creek Road portion is fewer than 5 passengers.) Headways will be 24 minutes during peak periods, 40 minutes during the midday, and 60 minutes during the evening to match every other BRT express at the transfer stations during weekdays. This feeder would continue to enter the Palisades Drive and Atrium Drive during the midday on weekdays, as it currently does.

1.2.9 Union College/Van Vranken Avenue Feeder

The feeder routes presented previously are located in Albany and Colonie. In Schenectady, two more feeder routes are proposed for the immediate term: the Union College/VanVranken Avenue feeder and the General Electric feeder. Two additional feeders are proposed for the longer term.

The Union College/Van Vranken feeder replaces current route 61 and it runs very similar to this existing route (see Figure 1.8), from Washington Station to Balltown Road and River Road, passing by Union College and following Van Vranken Avenue for a portion of the route. However, the service level is increased to every 24 minutes during peak periods (currently every

45 minutes) and every 40 minutes during the midday (currently it is 60 minutes) to match every other BRT express service coming into or leaving Washington Station. The two trips that the current Route 61 does to the GE plant in the morning are proposed to be served with the following feeder, eliminating the need for these trip segments from the new Union College/Van Vranken feeder.

1.2.10 General Electric Feeder

The second feeder route in Schenectady is the General Electric Feeder, which would take on the current trips made by routes 61 and 62 to the plant. The feeder would run between Washington or Broadway and the GE plant. The proposed headway is 24 minutes during weekdays peak periods to also match every other BRT express and every Union College/Van Vranken feeder.

1.2.11 Long-term Feeders

Two more feeders are recommended to be implemented in the longer term (perhaps five years after initial implementation). One of these would be the **Mont Pleasant Feeder** operating similar to current route 52 and the other would be the **Park & Ride Feeder** operating similar to the existing route 62, which serves the Rotterdam Mall Park and Ride. Route 52 currently functions more as a stand-alone route than as a feeder and could continue to operate as is and be considered an *important intersecting route*. Route 62 has a small number of transfers to the current Route 55, and is quite long, thus the benefits of converting it to a feeder route of the BRT system may be less than for the others.

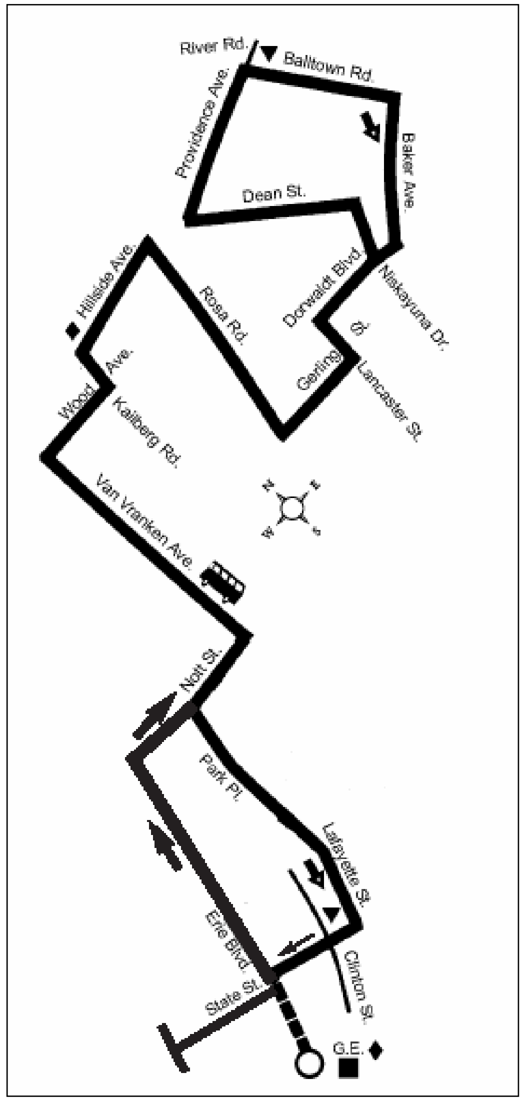


Figure 1.8 Current Route 61

2 Stations

This section discusses the issues and characteristics of the stops and stations for each of the service types: Local service, Express service, and Feeder service.

2.1 BRT Local Stops

2.1.1 Stop-spacing and location

Stop-spacing is a key determinant of walk access time and on-board time. As the distance between stops is reduced, the average access time decreases as well, but the average time that passengers spend on board increases. Thus, the optimal stop-spacing is such that provides good coverage of the corridor while minimizing the combined cost of access time and on-board time.

Acceptable ranges of stop-spacing vary from place to place and depend on several variables such as demand, weather, cultural background, permanence of transit system, and speed of transit service. However, in general in the US, a stop-spacing for local service between 660 feet (1/8 mile) and 880 feet (1/6 mile) is commonly used and recommended.

Currently, the main variant of Route 55—between Washington Avenue and State Street in downtown Schenectady and the Greyhound Bus Station in downtown Albany—has 91 westbound stops and 99 eastbound stops, which results in an average stop-spacing of 900 feet westbound, and 850 feet eastbound. Overall, this is acceptable stop spacing for a local route—around 1/6 of a mile. However, some segments have several consecutive stops with spacing below 1/8 of a mile. Those segments may allow for stop consolidation or elimination depending on their surroundings and demand levels. It is recommended for the new local service on ROUTE 5 to use the same stops currently served by route 55 with some consolidation as described below.

The elimination and consolidation of stops was proposed based on the analysis of three criteria:

- **Stop-spacing**: those stops with current stop-spacing of less than 1/8 mile are considered for consolidation/elimination.
- **Volume**: those stops with current average movements per trip below 1.2 are considered for elimination. Movements per trip are total boardings and alightings divided by the total number of trips serving at each stop during a period of time. Research has shown that stop elimination is most beneficial when the number of movements (ons + offs) per trip at a stop is about 1. When movements per trip are much greater than one, too many people would be affected by the elimination of the stop. When movements per trip are much lower than one, the stop is hardly used and its elimination would not impact travel time significantly. However, if other circumstances are present (i.e. stops are too close, there is no corresponding stop in the opposite direction), low ridership stops are worth considering for elimination.
- **Alignment between eastbound and westbound stops**: those stops without a corresponding stop on the other direction are considered for elimination. In general, it is recommended to provide corresponding stops in both directions. For many parts of ROUTE 5 this is a challenge due to the numerous one-side intersecting streets.

Table 2.1 presents the list of current stops in each direction. Those stops considered for elimination under each criterion according to the thresholds described above are highlighted in pink. Those segments or stops that do not have corresponding stops in both directions are shown in pink in the fourth column. The analysis of this table results in a recommendation to eliminate 11 of the eastbound stops and 2 westbound stops, identified—in Table 2.1—with bold font and a thicker border. After the table, each elimination recommendation is discussed in more detail. As expected, more stations were recommended for elimination in the eastbound side to even out the number of stops in both sides and provide more corresponding stops.

Table 2.1 Stop consolidation for BRT local service

EASTBOUND			
Stop	**Distance to next [ft]**	**Movmnts per trip**	**Corresp. stops**
State St @ Washington Av	579	3.0	
State St @ S Ferry St	578	0.3	
State St @ Erie Blvd	915	0.5	
State St @ Broadway	611	2.4	
State St @ Lafayette	620	2.4	
State St @ Veeder/Nott	685	4.4	
State St @ Close St	811	0.2	
State St @ Hulett St	774	2.6	
State St @ Martin St	420	0.5	
State St @ Steuben St	856	1.4	
State St @ Swan St	652	1.2	
State St @ Waldorf Place	322	0.6	
State St @ Brandywine	**507**	**0.2**	
State St @ McClellan St	450	2.6	
State St @ Kelton Av	817	1.6	
State St @ Elm St	959	1.7	
State St @ Robinson St	460	0.8	
State St @ Charles St	403	0.9	
State St @ Henry St	807	0.3	
State St @ Elbert St	553	1.2	
State St @ Harvard St	**247**	**0.6**	
State St @ Yale St	515	0.3	
State St @ Dartmouth St	**448**	**0.0**	
State St @ Myrtle Av	**539**	**0.0**	
State St @ Lawnwood St	1132	1.2	
State St @ Jackson Av	637	0.9	
State St @ Roosevelt Av	408	0.3	
State St @ Wilson St	**653**	**0.1**	
State St @ Vanzandt St	389	0.5	
State St @ Sanford St	**566**	**0.1**	
State St @ Gebhardt St	**441**	**0.2**	
State St @ Autoport	398	0.3	
State St @ Lorraine	657	0.2	
State St @ Gifford Rd	679	0.5	
State St @ Linda Ln	1466	0.4	
State St @ Balltown Rd	1295	1.1	
State St @ Fairfax	1071	0.3	
Central Av @ Fagan	949	0.1	
Central Av @ Wilber Av	1029	0.2	
Central Av @ Canton St	1468	0.1	
Central Av @ Sunset Trailer Pa	1162	0.3	
Central Av @ No. 2128	1367	0.1	
Central Av @ Lisha Kill Cem.	1332	0.1	
Central Av @ Lishakill Rd	1136	0.1	
Central Av @ Marjorie Rd	980	0.0	
Central Av @ Booth St	987	0.1	
Central Av @ Rutland Av	873	0.5	
Central Av @ Mass Av	719	0.3	
Central Av @ Maryland Av	635	0.1	
Central Av @ Taft Furniture	1005	0.3	
Central Av @ No. 1940	2086	0.5	
Central Av @ St Hwy 155	1478	3.0	
Central Av @ Vly Rd	1410	2.1	

WESTBOUND			
Stop	**Distance to next [ft]**	**Movmnts per trip**	**Corresp. stops**
Dallius St @ Hamilton St	0	0.0	
Greyhound @ Greyhound	303	0.5	
Broadway @ SUNY Plaza	656	0.3	
State St @ James St	633	3.0	
State St @ Lodge St	679	6.3	
State St @ Eagle	774	0.6	
Washington Av @ N Hawk St	728	0.9	
Washington Av @ S Swan St	748	1.6	
Washington Av @ Dove St	705	1.0	
Washington Av @ Lark St	967	6.2	
Central Av @ Henry Johnson Bl	664	2.1	
Central Av @ Lexington Av	884	1.3	
Central Av @ Robin St	789	1.5	
Central Av @ N Lake Av	873	1.7	
Central Av @ Quail St	807	2.7	
Central Av @ Ontario St	737	2.1	
Central Av @ Partridge St	1036	1.6	
Central Av @ N Manning Blvd	1147	2.7	
Central Av @ W Lawrence St	388	1.0	
Central Av @ N Allen St	814	2.4	
Central Av @ King Av	2110	0.4	
Central Av @ No. 855	553	1.9	
Central Av @ Colvin Av	1417	3.7	
Central Av @ No. 979	720	0.8	
Central Av @ Tremont St	1038	0.3	
Central Av @ Yardboro Av	1299	0.2	
Central Av @ Osborne Rd	768	0.4	
Central Av @ Reynolds St	1438	0.3	
Central Av @ Rooney Av	1226	0.5	
Central Av @ Grounds Pl	1185	1.1	
Central Av @ Grounds (Ahl)	1127	0.4	
Central Av @ Fuller Rd	1095	0.8	
Central Av @ Hackett (Cemeter	805	0.0	
Central Av @ Colonie Center	1056	3.9	
Central Av @ Tanglewood	1230	1.1	
Central Av @ Lincoln Av	1462	0.5	
Central Av @ Auto Palace Parts	1158	0.5	
Central Av @ Lapham (Comm (	1670	0.4	
Central Av @ Red Fox Dr	807	0.3	
Central Av @ No. 1741	877	0.3	
Central Av @ Poplar St	686	0.3	
Central Av @ Old Karner	815	0.8	
Central Av @ Vly Rd	1705	1.0	
Central Av @ New Karner	749	0.7	
Central Av @ Dragon Buffet (#1	739	2.2	
Central Av @ Sitar Indian Resta	679	0.5	
Central Av @ Reber	1146	0.4	
Central Av @ No. 1967	875	0.1	
Central Av @ Maywood School	1004	0.3	
Central Av @ Cole Av	634	0.3	
Central Av @ Maywood	1507	0.1	
Central Av @ Marjorie Rd	1149	0.2	
Central Av @ Lisha Kill St	1286	0.2	

Table 2.1 Stop consolidation for BRT local service (continued)

EASTBOUND Stop	Distance to next [ft]	Movmnts per trip	Corresp. stops
Central Av @ Rapple Rd	824	0.2	
Central Av @ No. 1730	748	0.2	
Central Av @ Red Fox Dr	806	0.3	
Central Av @ Lapham Dr	433	0.1	
Central Av @ Ramada Inn	1263	0.8	
Central Av @ No. 1586	906	0.3	
Central Av @ Hawley Av	1071	0.6	
Central Av @ Tanglewood Rd	2866	0.2	
North Way Mall	781	3.7	
Central Av @ Nolan Rd	967	0.1	
Central Av @ Fuller Rd	1226	0.8	
Central Av @ Van Buren Av	1321	0.3	
Central Av @ Interstate Av	1037	0.7	
Central Av @ Arcadia Court	1408	0.4	
Central Av @ Kraft Av	1024	0.3	
Central Av @ Osborne Rd	1120	0.6	
Central Av @ Yardboro Av	816	0.1	
Central Av @ Frost Place	682	0.1	
Central Av @ Austain Av	**432**	**0.3**	
Central Av @ No. 1010	1126	0.4	
Central Av @ Colvin Av	531	1.5	
Central Av @ No. 900	996	4.1	
Central Av @ Everett Rd	1238	0.2	
Central Av @ King Av	453	0.5	
Central Av @ No. 680	**387**	**0.9**	
Central Av @ Allen St	344	1.1	
Central Av @ W Lawrence St	582	0.7	
Central Av @ N Main Av	**498**	**0.6**	
Central Av @ N Manning Blvd	1169	2.3	
Central Av @ Partridge St	633	1.6	
Central Av @ Ontario St	871	2.2	
Central Av @ Quail St	882	2.5	
Central Av @ N Lake Av	810	1.6	
Central Av @ Robin St	887	1.1	
Central Av @ Lexington Av	881	1.7	
Central Av @ Henry Johnson Bl	753	1.6	
Washington Av @ Lark St	741	5.4	
Washington Av @ Dove St	728	0.9	
Washington Av @ S Swan St	735	2.0	
Washington Av @ Hawk St	1115	0.9	
State St @ Eagle St	305	0.7	
State St @ Lodge St	663	1.8	
State St @ Pearl St	715	5.9	
Broadway @ Hudson Av	1952	0.9	
Green St @ Madison Av	545	0.2	
Dallius St @ Hamilton St		0.2	
Number of Stations	99		
Average Stop Spacing [feet]	849		

WESTBOUND Stop	Distance to next [ft]	Movmnts per trip	Corresp. stops
Central Av @ No. 2115	1580	0.1	
Central Av @ Salvation Army	940	0.1	
Central Av @ Sunset M.H.P.	944	0.1	
Central Av @ No. 2197	1365	0.1	
Central Av @ Fullerton Av	1385	0.1	
State St @ Fagan Av	1219	0.1	
State St @ Central Av	504	0.2	
State St @ Balltown Rd	1825	1.3	
State St @ Linda Ln	385	0.4	
State St @ Shirley Dr	729	0.4	
State St @ Chiswell St	740	0.4	
State St @ Marshall Av	**541**	**0.1**	
State St @ Eastholm Rd	869	0.1	
State St @ Corlaer Av	1105	0.7	
State St @ Nassau Av	694	0.2	
State St @ Fenwick St	1189	1.1	
State St @ Laurel Av	1475	1.2	
State St @ Vassar St	670	0.6	
State St @ Fehr Av	712	0.7	
State St @ Western Pky	564	0.8	
State St @ James St	516	0.6	
State St @ Robinson St	807	0.6	
State St @ Elm St	790	0.7	
State St @ Furman St	401	0.8	
State St @ McClellan St	506	3.2	
State St @ Brandywine Av	**483**	**1.0**	
State St @ Waldorf Place	549	0.5	
State St @ Swan St	862	1.1	
State St @ Steuben St	574	1.2	
State St @ Catherine St	702	0.6	
State St @ Mynderse St	792	1.5	
State St @ Close St	745	0.7	
State St @ Nott Terr	917	2.9	
State St @ Clinton	556	3.6	
State St @ Broadway	668	0.7	
State St @ Erie Blvd	447	0.7	
State St @ Ferry St	423	0.4	
State St @ S Church St	648	1.0	
Schenectady Co C.C.		1.3	
Number of Stations	91		
Average Stop Spacing [feet]	902		

Westbound

- **Brandywine Av**: recommended due to short stop-spacing, eliminate in both directions to avoid creating more one-direction only stops
- **Marshall Av**: very close to the Eastholm stop and does not have a corresponding stop in the other direction

Eastbound

- **Brandywine Av**: recommended due to short stop-spacing, eliminate in both directions to avoid creating more one-direction only stops

- **Harvard St, Dartmouth St, Myrtle Av**: these current stops are very close together, and they do not have a corresponding stop in the other direction. With these eliminations, the segment between Harvard St/Vassar St and Lawnwood Av/Laurel Av end up with two corresponding stops spaced approximately 0.2 miles apart, which appears reasonable for the low ridership observed.
- **Wilson St, Sanford St, Gebhardt St**: these are very close stops with no corresponding stops in the other direction. With these eliminations and the elimination of the westbound Marshall St stop the segment between Roosevelt Av and Marshall St ends up with three corresponding stops in each side—approximately 0.15 mile stop spacing.
- **Austain Av**: this stop is very close to the Frost Place stop and does not have a corresponding stop. In addition, it is recommended to move the Frost Pl eastbound stop towards the east (closer to the current Austain Av stop) to Tremont Street to provide better correspondence to the westbound Tremont St stop.
- **No. 680 and North Main Av**: between N. Manning Blvd and King Ave the eastbound side has 6 stops (all less than 1/8 mile apart) and the westbound side has 4 stops, eliminating the No. 680 and N. Main stops, will provide correspondence between stops and will still provide very good coverage with stops less than 1/6 mile apart.

As a result of this consolidation, the local service would stop at 88 eastbound locations and 89 westbound locations, almost all of them with corresponding stops in both directions.

2.1.2 Infrastructure and Amenities

The infrastructure at the local stops (which do not coincide with a BRT express station) will be modest. Some of the stops already have shelters, and there is little consistency in their styles. The existing shelters should be kept and retrofitted to the extent possible to fit the BRT image. New investment at the local stops should be limited to signage and a basic set of amenities. The signs should be designed following the BRT brand to maintain the perception of ROUTE 5 as a BRT corridor, while at the same time differentiating the local stops from the BRT stations (see below). For example, Figure 2.1 shows two types of stops in the LA MetroRapid system. The first picture is a *Bollard Gate* stop and the second one is a *Double Canopy* stop. Although the level of infrastructure and investment of these two stops are different, passengers can easily identify them with the same system.

Figure 2.1 Stop examples from MetroRapid in Los Angeles (Bollard Gate and Double Canopy)

Stops for the local service may resemble the Bollard Gate example, in the sense that only a stop sign and limited amenities may be found such as trash can and static route/system information. Specific elements (i.e. signs, information, materials, and lighting) will be the key to provide the sense of unity and consistency desired among routes in the BRT corridor.

2.2 BRT Express Stations

2.2.1 Station Location

The preliminary selection of the station locations for the BRT express service was based on ridership and stop spacing. An effort was made to select those locations with high numbers of boardings and alighting and at the same time, maintain reasonable spacing between stations. A total of 20 locations are proposed on ROUTE 5 between Washington Street and State Street in downtown Schenectady and Broadway and Hudson Avenue in downtown Albany. Figure 2.2 and Figure 2.3 show the 19 locations on ROUTE 5 along with the current boarding and alighting figures for all stops on the corridor.

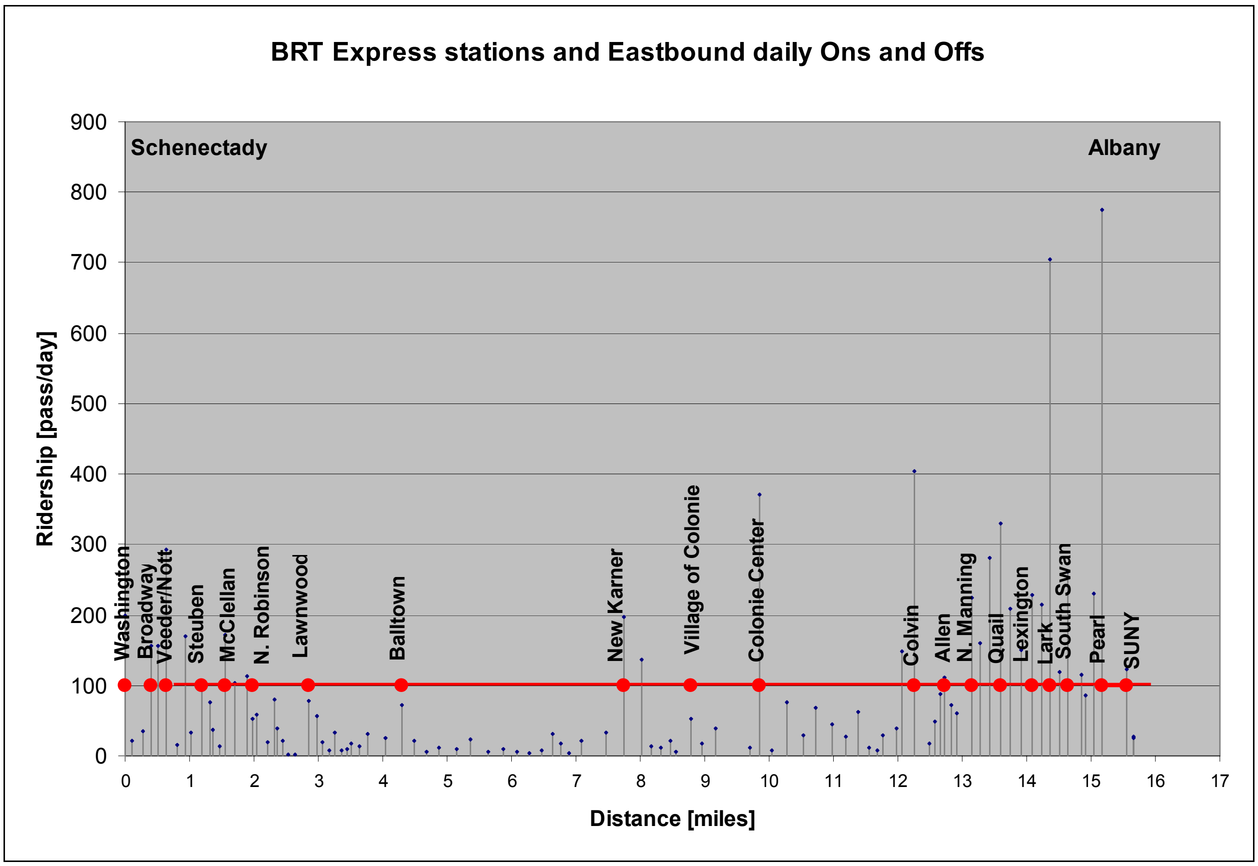


Figure 2.2 BRT stations and eastbound boardings and alightings on ROUTE 5

Most of the BRT stations are located at current high-volume stops. There are some cases of proposed BRT stations at locations with moderate ridership, such as Balltown Road. These locations were recommended because they have higher demand compared to their neighbor stops, and because too large of a gap in urban settings is undesirable. Appendix A shows a list of all stops in each direction ordered by stop volume (boardings and alightings) and indicates which current stops will be BRT stations and those current stops that will be within walking distance to a future BRT stop.

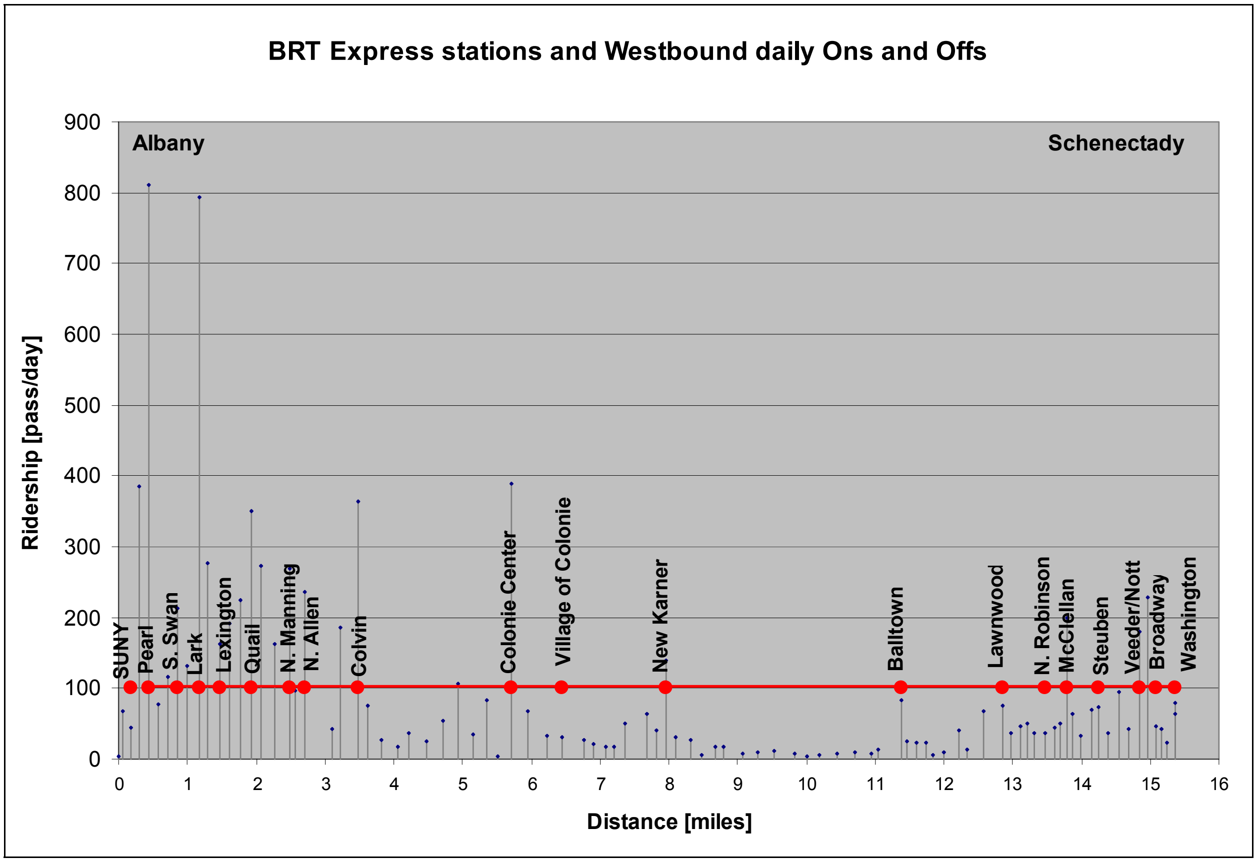


Figure 2.3 BRT stations and westbound boardings and alightings on ROUTE 5

Figure 2.4 shows the approximate locations of the stations along the corridor. These locations result in an approximate stop spacing as follows:

- Downtown Schenectady (Washington Avenue – Lawnwood Street) 0.4 mi
- Middle segment (Lawnwood Street – Colvin Avenue) 2.0 mi
- Albany (Colvin Avenue – Hudson Avenue) 0.4 mi

Some locations, such as the Village of Colonie station near Locust Street, are strategic places where development or redevelopment is planned or will be encouraged. The actual construction of a BRT station there may depend on the development taking place. Three segments appear to have potential to hold this type of stations: 1) Balltown Road to New Karner Road; 2) Village of Colonie (between New Karner and Colonie Center); 3) Between Colonie Center and Colvin Avenue. These future stations would provide the best opportunity to create park-and-ride lots for potential passengers. Opportunities for park-and-ride lots near other stations were studied and the details are presented in Deliverable H/K, which also includes more detail about the stations.

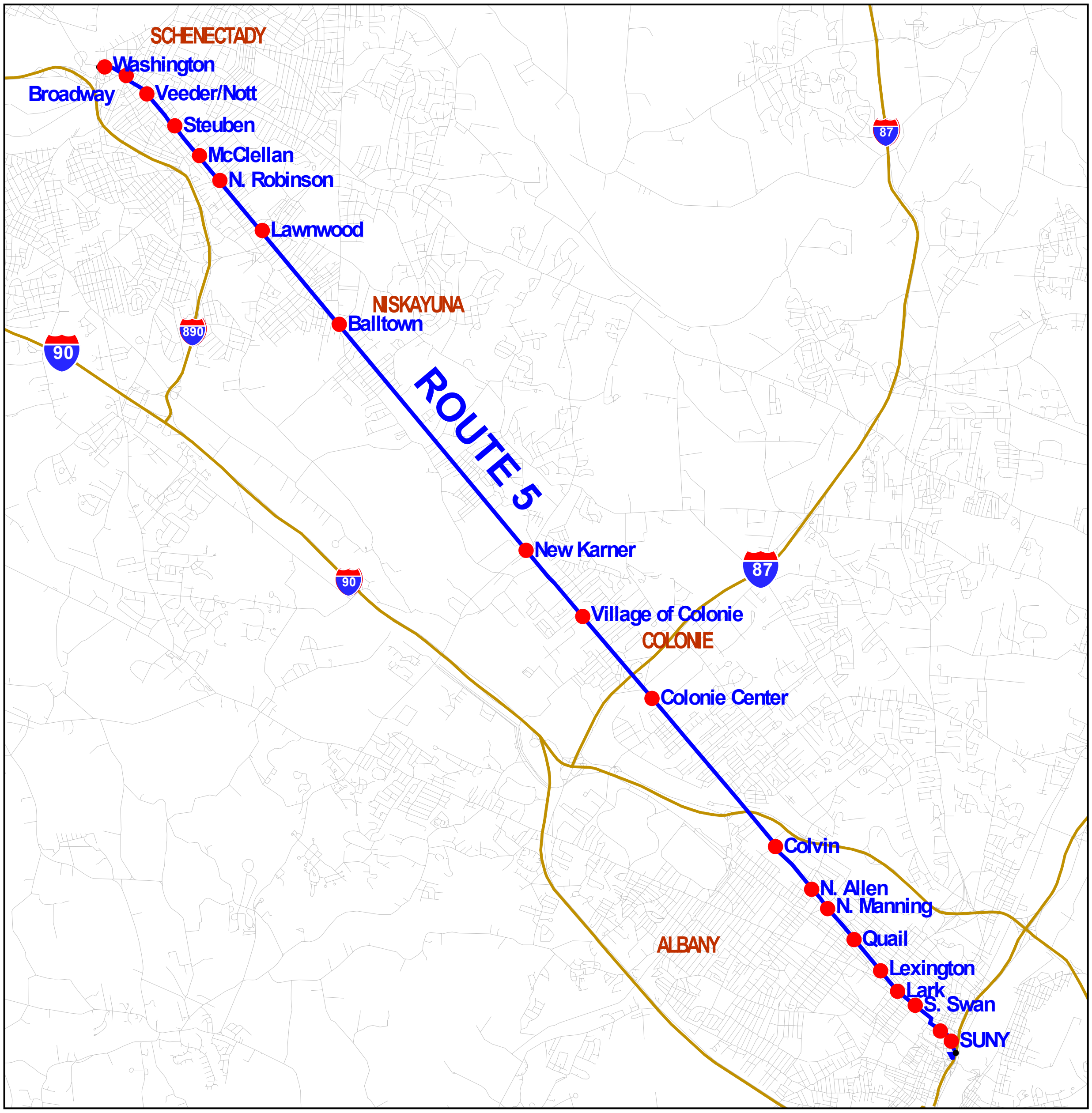


Figure 2.4 Preliminary location of BRT stations

2.2.2 Infrastructure and Amenities

Of the 20 BRT express stations, five would be key transfer stations:

- Lark – transfers to many of the intersecting routes in downtown Albany
- Colvin – transfer to Sand Creek, Corporate Woods, and State Campus feeders
- Colonie Center – transfer to Wolf Road, Malls, Sand Creek, and State Campus feeders
- New Karner – transfer to Malls 1 feeder
- Washington – transfer to Union College/Van Vranken and General Electric feeders

These transfer stations may need heavier infrastructure than that provided at the other locations, especially in Colonie Center, but in general all 20 stations would have similar amenities. A standard set of amenities and an optional set of amenities have been identified and are discussed below. (More detail is provided in Deliverable H/K.) The shelter and all other amenities will be specifically designed for the BRT system aiming for consistency and a unique image that may be provided by using similar materials, color scheme, and design style in all elements.

All BRT stations should be named (as is the case with rail stations) to raise the visibility and permanence of the system. The names of the stations could initially be the crossing streets. However, if there are widely recognized places near the station, naming the station after the place is an alternative. If the place is a commercial organization, a funding opportunity arises. Many transit agencies sell their station names to commercial institutions (e.g., "Colonie Center" station), which obtain advertising benefits in exchange of maintenance or a fixed fee.

2.2.2.1 Standard amenities

The set of standard amenities presented here are recommended for deployment at all BRT express stations. Some amenities play a more important role at particular stations. For example, while off-vehicle fare collection is specifically desirable at locations with high ridership volume, bike racks play a more important role at locations near low density single-family housing areas than in downtown stations[2].

Shelter

The main element of the BRT station will be the shelter, which provides comfort to waiting customers, including weather protected seating and customer information. Two types of shelter prototypes are proposed—urban and suburban—to provide more opportunities to adjust to the architecture and urban setting variation of the corridor.

The urban prototypes are expected to be deployed in downtown Albany and downtown Schenectady. The suburban prototypes would be deployed in the middle segment of the corridor. Two alternatives for each prototype are presented. The stations should be modular to adjust to station demand, and the design such that the shelters may be built with standard construction materials to avoid high initial and maintenance costs. Most BRT express station locations will receive new shelters consistent with BRT image, however some locations may keep their existing shelters. Figure 2.5 and Figure 2.6 show the two urban prototypes and a suburban prototype (Uncle Sam stop in Troy), respectively.

Station sign

Station signs are of great importance to BRT systems: they provide visibility, consistency, and a rail-like image to station areas. Station signs will be particularly important in the ROUTE 5 BRT system because the shelters (the other main BRT infrastructure at station areas) will not be consistent across all stations. Station names should be determined for each BRT express location and displayed on the station sign. Local stops may also have signs with a similar design to the BRT express to provide a consistent image on the corridor.

[2] The discussion of specific amenities at each station is presented in Deliverable H/K.

Figure 2.5 Large Urban Prototype 1 (left) and Medium Urban Prototype 2 (right)

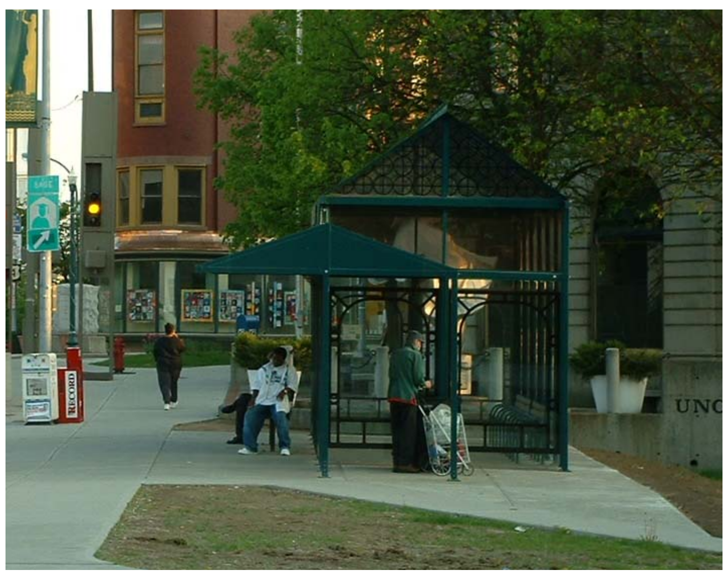


Figure 2.6 Suburban Prototype

Renovated sidewalks

Sidewalks along ROUTE 5 and especially near the stations areas require renovation to provide a safe and attractive environment and to encourage walk access to BRT stations. Pedestrian-friendly sidewalks should include high curbs (to avoid cars), well designated and safe walking areas, and street furniture. The street furniture may be specifically designed for the BRT system to help provide a system image. Below are descriptions of the street furniture elements that will be part of the standard BRT amenities.

Pedestrian lighting
In addition to its main purpose of providing light at night time, pedestrian lighting has the potential to

- play a key role on conveying the system image if it is designed specifically for the BRT system and in accordance with the design of other elements in the system
- delineate the pedestrian area making it safer and more pleasant

Benches
Benches may also play a role in conveying a system image if designed accordingly with other BRT elements, but their main purpose is to transform sidewalks from traveling infrastructures to meeting facilities. Benches allow users to remain at sidewalks and plazas, using them as meeting and leisure areas, which invigorates public space.

Trash cans
Uniform trash cans with a consistent design related to the other elements help to raise the visibility of the stations and maintain the image of the BRT system.

Newspaper dispenser boxes
Newspaper dispensers are a desirable amenity for any transit station. Their design and deployment is usually done by the newspaper provider. However, a standard newspaper dispenser may be designed and enforced by the transit agency to maintain uniformity and consistency in the street furniture of the system.

Customer Information

Static system information
Static information about the BRT system, including routes, stations, schedule, span of service, and fares.

Real-time information
Dynamic information displaying estimated time of arrival of next bus.

Map of area
Map of the area around the station that includes all streets, main buildings, offices, and stores.

Bike racks
A simple bike rack should be provided at all stations. However, some stations may need a more robust bike rack (weather protected) facility to store bikes. These improved facilities should be deployed in stations located in lower density residential neighborhoods to encourage residents from farther distances to ride to the BRT station.

Bulletin board
Bulletin boards are an effective way of providing neighborhood identity to residential areas and communicating with commuters in downtown stations. The station feature holding the bulletin board may be specifically designed for the BRT system and include the public and emergency phones, customer information, etc. Designing one element for many street amenities reduces the

number of independent elements on sidewalk and the element itself may become a sign of the BRT stations.

Emergency and public phone
Installing emergency phones at all BRT express stations may increase public's perception of safety. Emergency phones should be linked to the operations control center and the police. The phones may also serve to alert the control center of service disruptions. Public phones may be deployed as well; their cost should be marginal if emergency phones are being implemented. The phone booth could be designed specifically for the BRT system instead of using standard phone booths to help raise the visibility of the system.

Off-vehicle fare collection
Off-vehicle fare collection could be achieved through

- proof-of-payment – barrier-free, eliminates the need for enclosed stations but introduces higher risk and costs of controlling payment
- barrier-entrance – introduces higher infrastructure and requires more public space to build enclosed stations

More substantial positive impacts are observed at high ridership locations. On the ROUTE 5 BRT, some stations may not require this amenity due to lower ridership. If a proof-of-payment system is adopted, the marginal cost for each additional station is relatively low.

2.2.2.2 Optional Amenities

The optional amenities presented here are recommended for deployment at certain stations according to their characteristics. For example, while vending machines and restrooms may only be provided at the higher volume transfer stations, security cameras may be deployed at stations located in areas with potential safety and security issues.

Vending machines
Vending machines are a great way to provide food and services to users without the risk and costs of facility maintenance. Vending machines are recommended for high volume, key transfer stations, such as Colonie Center, New Karner, and potentially Washington in Schenectady.

Security camera
In addition to their main purpose of monitoring the stations from a safety standpoint, security cameras also provide the operations control center an important tool to monitor the system from a service standpoint and react to unexpected situations. Security cameras also increase the public's perception of safety in the system. Security cameras may be deployed at high ridership stations and at stations located in areas with safety concerns.

Closed Circuit TV
Closed Circuit TV may be implemented in stations with high ridership. The TV system serves to communicate with the passengers. Communications include ongoing information about the system, the city, etc, and unexpected events that may warrant an alert to the customers. Ongoing programming at stations may also help reduce the waiting time penalty perception because users entertain themselves while waiting for the bus.

Restrooms

Restrooms tend to be avoided in most on-street bus stations because of the maintenance burden they impose on the agency and their infrastructure requirements. However, larger transfer facilities usually provide restroom services. In the case of BRT on ROUTE 5, the transfer station at Colonie Center may be the only station that warrants restrooms. If bathrooms are implemented, it is recommended to contract out their operation and maintenance. Poorly maintained bathrooms rapidly deteriorate a facility.

2.2.2.3 Transfer station at Colonie Center

Colonie Center has been recognized in the service design process as a key point for operations and that should be reflected in the type of infrastructure provided. The station will most likely be a transfer point between feeder routes and mainline routes. Three main concepts were evaluated and presented to the Study Advisory Committee:

1. **Bi-directional Transfer Station - north side of ROUTE 5**. An off-road station would be built on the setback behind the existing westbound shelter, using part of the mall's parking lot. Westbound vehicles would remain on ROUTE 5 and approach a curbside station platform while eastbound BRT vehicles would leave their mainline ROUTE 5 alignment to enter the station on the northern side. Feeder routes will operate similar to mainline buses. Figure 2.7 shows a schematic of the operation described above. The challenges for this concept are to design the station access to minimize the approach and dwell time for buses from both sides and traffic inconvenience for private autos, and to create an improved pedestrian connection between the station and the Colonie Center and Northway malls.

2. **Two uni-directional transfer stations – both sides of ROUTE 5**. This would be an enhancement to both existing shelters providing specific infrastructure to transfer to shuttles, which would maneuver inside the malls, as the ShuttleFly currently does. Figure 2.8 shows a schematic of this operation. Although the infrastructure would not be as large as the previous concept, the stations would still include new amenities. This concept eliminates the access and dwell time issues from the previous alternative, however, its challenge is to design a creative pedestrian connection between these two stations that would encourage users to cross the street at protected crosswalks, and walk to the malls. It would be possible to join the two transfer stations with an archway or some structure spanning ROUTE 5. While such a structure would raise the cost of the station, it would have a major impact on visibility, improve pedestrian safety and comfort, and make a statement about the importance of transit at this location.

3. **Station(s) by the mall**. This concept proposes to use a station closer to the malls, to minimize walk time for riders going to Colonie Center or Northway Mall. At Colonie Center, this concept could use the existing Transit Center or propose a new one by the southern side of Sears. This concept minimizes inconvenience for riders going to the malls, but it imposes a significant time penalty for through riders. Another barrier to overcome would be resistance from the malls, specifically from Northway Mall, which does not currently have a transit center.

Alternative 3 has been discarded after discussions with CDTA because the time penalty imposed to through riders is too high to be offset by the benefits of going close to the mall. The specifics of the traffic engineering issues for Alternatives 1 and 2 are presented in Deliverable L/M. Additional amenities for this station would include a larger shelter, heating, enhanced seating, vending machines, and potentially small retail spaces and restrooms.

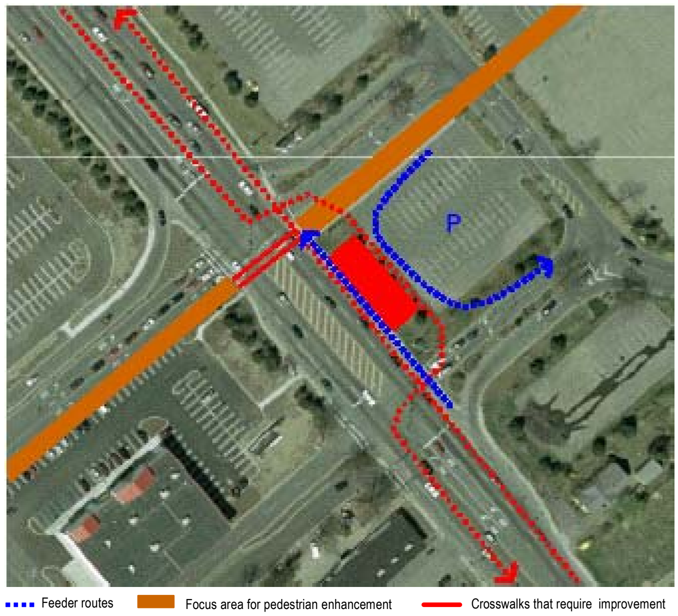


Figure 2.7 Operations schematic for Alternative 1 at Colonie Center station – bi-directional station

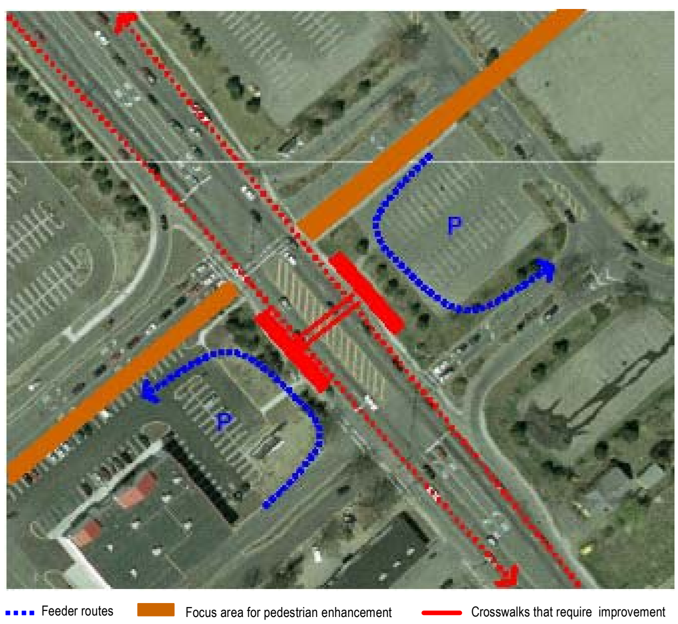


Figure 2.8 Operations schematic for Alternative 2 at Colonie Center station – uni-directional stations

As mentioned earlier, the main challenges with Alternative 1 are to minimize the penalty imposed to through riders and the pedestrian connections. By having a curbside transfer station on the north side, the penalty to westbound riders is minimized. To minimize the penalty to eastbound riders a signal priority or system may be put in place to give priority –to the extent possible—to buses leaving the transfer station over other traffic movements.

In both alternatives, the pedestrian connections with the malls are of great importance to encourage walk access to the station and the most challenging part of this pedestrian environment is crossing ROUTE 5. Three main options exist: a pedestrian bridge, a pedestrian underpass, and a pedestrian crosswalk at-grade.

Pedestrian bridge – pedestrian bridges have been used in some BRT and rail systems to access stations in the median (e.g. BRT in Bogota, Colombia, and Blue Line in CTA rail system) and in general to cross high speed streets in cities. Pedestrian bridges are recommended to cross high speed (> 40 mi/hr) and wide (3 or more lanes per direction) arterials. In streets with slower speeds and/or narrower cross section it is encouraged to study at-grade solutions due to the cost and visual impact of the infrastructure. Pedestrian bridges need to provide ADA access, which may be resolved with access ramps or elevators. The access ramps require a large space to develop and their visual impact is high. The elevators are a good alternative to access ramps but are costly, impose a higher maintenance burden, and provide no redundancy in case of failure. Figure 2.9 shows a pedestrian bridge in the 80th Street corridor of the BRT system in Bogota, Colombia, which has five lanes in each direction.

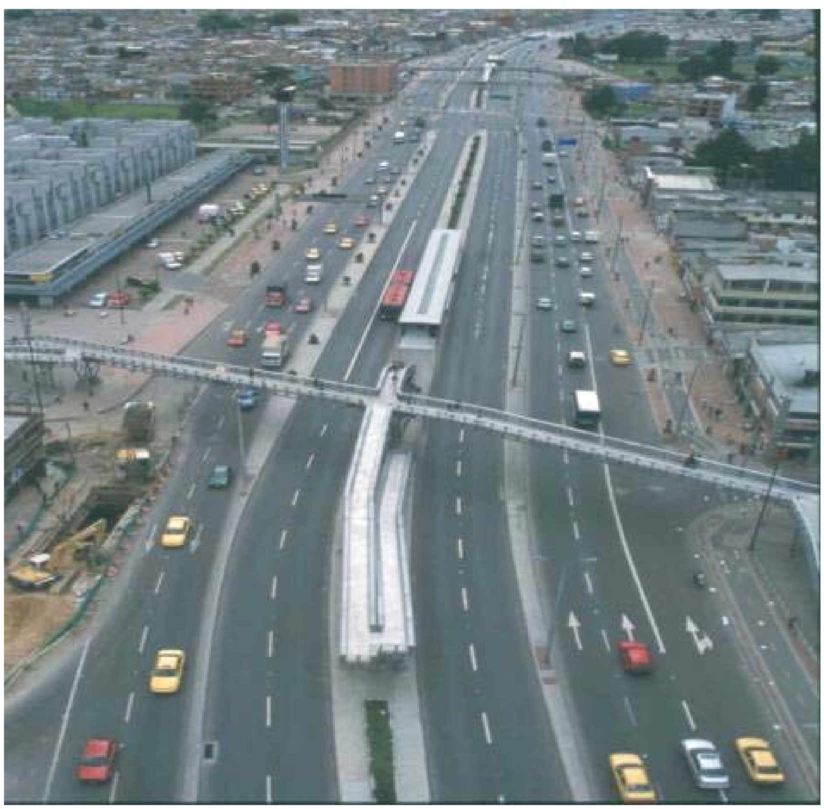


Figure 2.9 Pedestrian bridge in BRT system in Bogotá, Colombia

In the case of ROUTE 5, at-grade alternatives appear to be more feasible and effective than a pedestrian bridge. Given the relatively narrow cross-section of the street, the use of the pedestrian bridge by users other than disabled and elderly is doubtful. Furthermore the usage of the bridge by disabled and elderly often requires the presence of elevators.

Pedestrian underpass – a pedestrian tunnel or underpass has similar issues to a pedestrian bridge, however the space required for ramps is smaller because the clearance distance required for a pedestrian underpass is shorter than that of the road in relation to a pedestrian bridge. Both capital and maintenance costs are expected to be the highest of all alternatives. In addition, usually, there are security concerns associated with underpasses that do not have consistently high foot traffic.

Pedestrian crosswalk – this option appears to be the most effective due to the relatively narrow cross section, the existence of traffic lights nearby, and the availability of a median that can be enhanced to provide a safer pedestrian environment. The design of this crosswalk and the entire pedestrian environment around this station is, as mentioned earlier, of great importance and challenging, deserving a substantial amount of time and resources in the preliminary engineering and design phase of the study.

2.2.2.4 Park and Ride

Providing park-and-ride spaces near the stations improves access to the transit system. People who do not live along the Route 5 corridor but who work along the corridor, particularly in downtown Albany where parking is at a premium, can drive to a station and use the BRT to reach their destination near the corridor.

Park-and-ride spaces are desirable at locations that meet one or more of the following criteria:

- **End-of-the-line stations** – to provide access to those who live beyond the reach of the BRT service. Usually BRT routes, similar to rail lines, operate from residential neighborhoods into downtowns (employment centers). In this case, the service operates between two downtowns; however, Albany is a more significant trip attractor and parking is more difficult, thus park-and-ride spaces at the Schenectady end of the line are more desirable than at the end stations in Albany.

- **Middle-of-the-line stations that naturally collect from residential neighborhoods** – stations such as Balltown, Lawnwood, and Village of Colonie, which are towards the end of clusters of residential areas in the main direction of travel are suitable for park-and-ride spaces because they can naturally funnel commuters from their cars into the BRT service without making them backtrack.

- **Stations with highway access** – to encourage the use of the BRT system for those potential users that live farther out from the corridor and currently use the highway system for their daily commute; for example, McClellan and Colonie Center.

- **Stations in the downtown fringes** – to encourage the use of the BRT service by those occasional users or commuters that wish to get closer to the downtown area using their car but are discouraged to enter downtown due to parking limitations; for example, Colvin and North Allen.

- **Opportunity to include park-and-ride spaces in Transit Oriented Development (TOD)** - while improving access to the BRT service is important, and the park-and-ride spaces must be built in a location convenient to the station, the provision of such spaces should not override the goal of improving land use in the Route 5 corridor, particularly in the immediate vicinity of the stations. Thus, care must be taken in the design phase to ensure that a park-and-ride lot does not preclude a comfortable and lively pedestrian environment at the stations.

For the full-build BRT system, it is recommended to provide 1,250 park-and-ride spaces in the corridor, sufficient to accommodate 10% of the total demand. The stations that would be the primary candidates for early park-and-ride implementation include (in descending order of importance): Balltown, Colonie Center, Washington, North Allen, McClellan, Lawnwood, New Karner, Colvin, and Village of Colonie. Deliverable H/K provides more detail on plans for park-and-ride lots.

2.3 Feeder stops

In principle, the feeder routes will operate similar to the existing shuttles, without predetermined stop locations. The driver would stop at any place along the route where a passenger requests it. However, it may be desirable to deploy BRT feeder signs at key destination sites to raise the visibility of the system. Some people may be unaware of the shuttle services because they do not see a sign on the street referring to this service. These signs should probably be similar in nature to the signs that identify the BRT local stops. Obvious locations to deploy these feeder route signs are the Crossgates Mall, Twenty Mall, Crossgates Commons, Corporate Woods, the airport, the General Electric plant, Union College, and some important office complexes on Wolf Road.

3 Operations

This section describes in further detail the characteristics of the operations of the express, local, and feeder services.

3.1 Routing

The general routing of all services was discussed in Section 1.2. Some specific routing issues at the ends of the BRT express service are discussed below.

The BRT express service would run on ROUTE 5 from Washington Avenue in Schenectady to downtown Albany. At the Schenectady end of the route, the BRT buses would follow the same alignment currently used by route 55 (see Figure 3.1): left on Washington Avenue, followed by a U-turn under the 890 access ramp, right onto State Street to stop in front of the Travel Center. Buses could layover at this location. In the westbound direction, the last BRT express stop would be in front of the Schenectady County Community College. No station or special infrastructure is needed at this point because no one boards at this location. All passengers boarding eastbound buses would do so across the street at the eastbound station in front of the Travel Center.

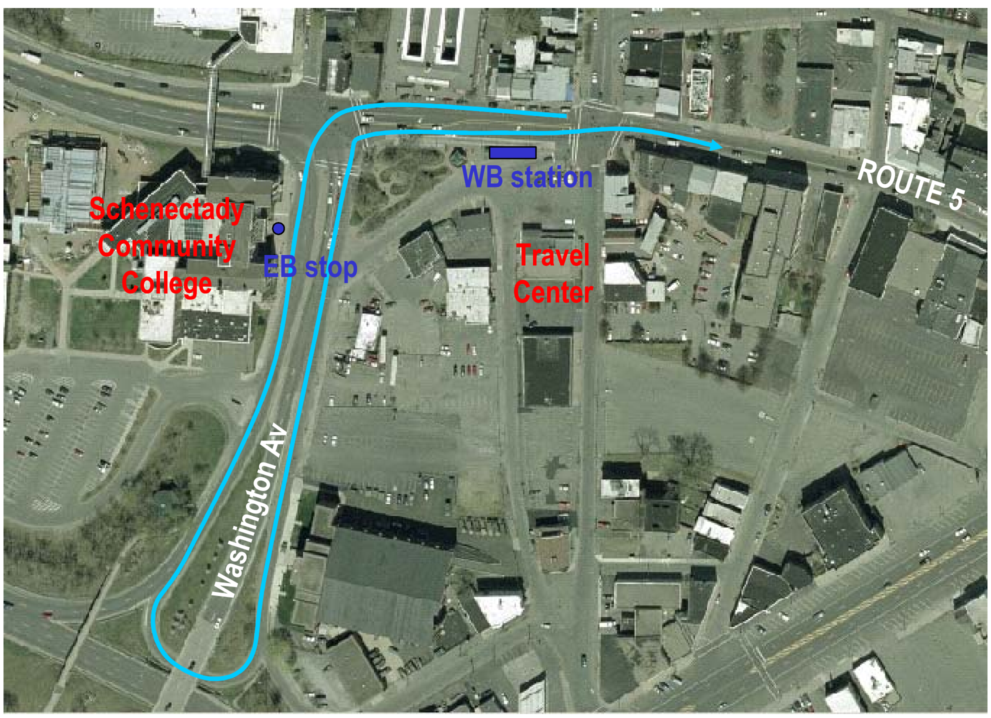


Figure 3.1 Routing of the BRT express and local service at the Schenectady end of the route

For the other end of the BRT express, in downtown Albany, four options were considered for the BRT express routing. Figure 3.2 shows a detail of these routing alternatives.

In **Option 1** eastbound vehicles would follow State Street to Pearl Street, then turn right onto Pearl Street, right on Madison Avenue, right on South Swan and finally turn left on

Washington to head back west. This loop provides service to the Madison Avenue, Empire State Plaza, and South Swan markets that are currently served by route 55X. One stop is proposed in this loop on Madison Avenue in front of the Empire State Plaza (ESP) exit, under the overpass that links the State Museum and the Empire State Plaza. Under this routing option, the Pearl Street and the ESP stations would not have counterparts across the street. In the afternoon, westbound BRT buses and riders around Pearl Street would use the Pearl Street stop on the south side of State Street, separating themselves from the busy bus stops at the other side of the street, where all other routes would be boarding downtown passengers. Under this option, only an eastbound bus exclusive lane on State Street would be considered.

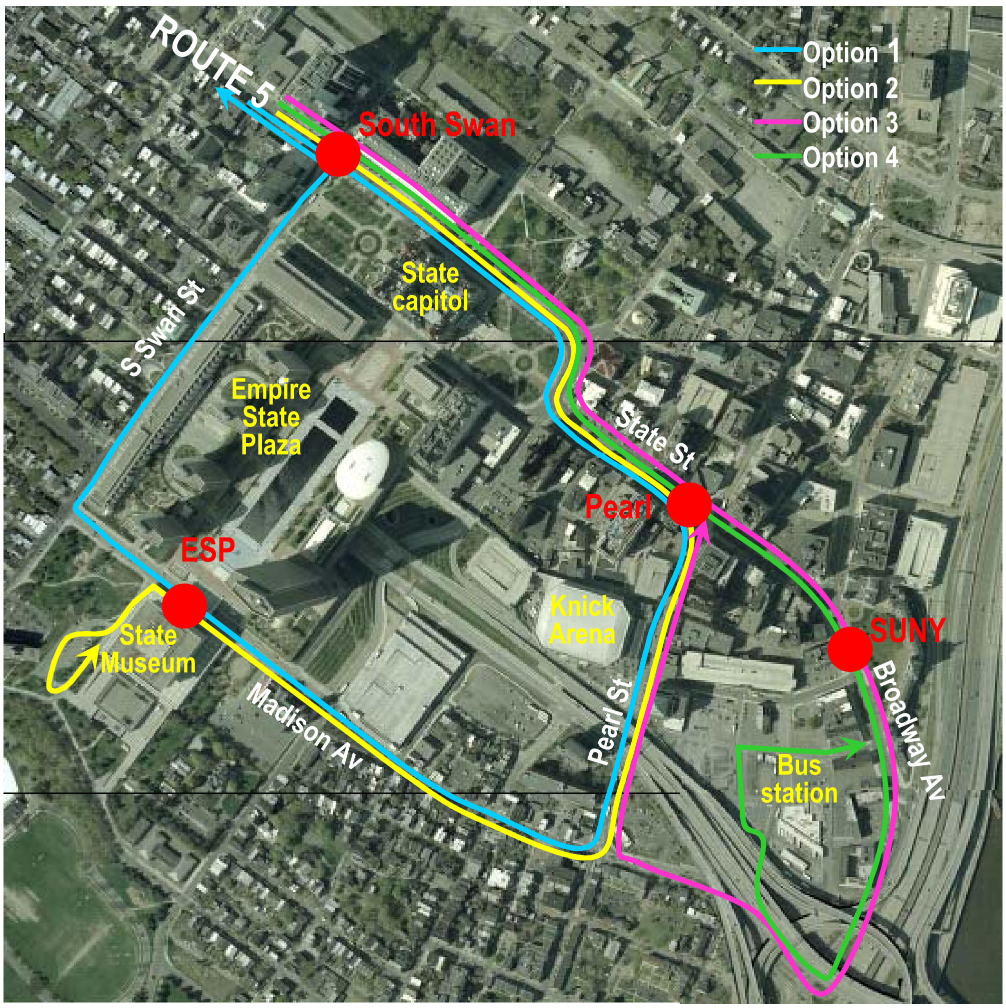


Figure 3.2 Downtown Albany BRT express stations and routing

Option 2 follows the same route as option 1 in the eastbound direction, but after the ESP vehicles would turn around, and layover if necessary, at the parking lot west of the State Museum and follow the exact same route but in the reverse direction. Under this option the Pearl location would have eastbound and westbound stations, and the ESP location would have a station on the westbound direction as the first station of the route and in the eastbound direction only a sign would identify the last stop of the route. An exclusive lane in both directions on State Street would be desirable. The same markets as in option 1 are served. This option assumes that the "no left turn" restriction from South Pearl St to State St would be relaxed for buses.

Option 3 is a loop using Broadway, Madison and Pearl. This loop is more similar to the current 55 operation and provides better access to offices on Broadway such as the SUNY building; however the southernmost part of this loop is around a couple of low density blocks (highway intersection and Greyhound Bus Station) which will not generate much demand. This option would likely introduce a one-way station on Broadway in front of the SUNY Administrative building. As in Option 2, it will require relaxing the "no left turn" from Pearl St to State St. In this case, exclusive bus lanes would be desirable on both sides of State Street, at least west of South Pearl.

Option 4 is very similar to the current routing of route 55, looping around the Greyhound Bus Station using Broadway Avenue, Madison Avenue, Green Street, and Hamilton Street. This option provides better service to offices on Broadway, but unlike Option 3, the service is in both directions. If exclusive lanes are implemented, under this option they should go all along State Street from Eagle Street to Broadway Avenue in both directions.

Ulimately, option 4 is recommended, with a station in front of the SUNY administrative building in the westbound direction. The last stop in the eastbound direction would occur at the current shelter at Broadway Avenue and Hudson Street.

The local service would follow the same route described above for the express service, which is similar to the main variant of the current route 55.

3.2 Proposed Span of Service

This and the following section describe the span of service and headways anticipated for the various services on ROUTE 5. A premise for determining these levels of service was to maintain or improve the existing service levels in the corridor for as many passengers as possible.

Table 3.1 summarizes the proposed span of service for the proposed new routes by direction by day of the week. The proposed span of service for the routes was established to provide at least the same level of service provided by the existing route that they were replacing, if that was the case. Thus, the local service is based on route 55, the revised Route 1 on the existing routes 1 and 2, the Sand Creek feeder on Route 2, the Wolf Road feeder on the ShuttleFly, the Malls feeders on the ShutleBug, the Union College on route 61, and the General Electric feeder on the trips made by routes 55, 61, and 62 to the plant.

As opposed to the current express service, which only provides one-way service during peak hours, the BRT express is proposed to operate in both directions for approximately 15 hours, between 6:00 a.m. and 9:00 p.m.. In this way, service is provided to both its main market target—commuters during the peak hours, and off-peak users that currently do not have an express alternative.

Table 3.1 Proposed span of service

Route	Weekday		Saturday		Sunday	
	Eastbound / Southbound	Westbound / Northbound	Eastbound / Southbound	Westbound / Northbound	Eastbound / Southbound	Westbound / Northbound
MAINLINE SERVICES						
BRT X	6:00a – 9:00p	6:00a – 9:00p	9:00a – 5:00p	9:00a – 5:00p	No service	No service
Local	4:30a – 1:00a	5:30a – 2:00a	5:00a – 12:00a	6:00a – 1:00a	5:30a – 12:00a	7:00a – 1:00a
Route 1	6:30a – 8:30p[a]	7:00a – 9:00p[b]	11:30a – 8:30p[c]	10:30a – 9:00p[b]	6a, 2p, 10p[d]	7a, 3p, 11p[d]
FEEDER ROUTES						
Sand Creek	5:30a – 8:30p	5:30a – 8:30p	5:30a – 8:30p	5:30a – 8:30p	No service	No service
State Campus	2 trips am[e]	2 trips pm[e]	No service	No service	No service	No service
Corp. Woods	2 trips pm[e]	2 trips am[e]	No service	No service	No service	No service
Wolf Rd	6:30a – 12:00a	5:30a – 11:30p	7:30a – 12:00a	7:00a – 11:30p	10:00a – 6:30p	9:30a – 6:00p
Malls 1	6:30a – 11:30p	6:30a – 11:30p	6:30a – 11:30p	6:30a – 11:30p	10:00a – 7:00p	10:00a – 7:00p
Malls 2	6:30a – 9:00a, 1:30p – 6:00p		No service	No service	No service	No service
General Electric	3:00p – 5:30p	5:30a – 8:00a	3:00p – 5:30p	5:30a – 8:00a	No service	No service
Union College	6:00a – 7:00p	6:30a – 7:00p	8:30a – 6:00p	9:00a – 6:30p	No service	No service

a – One extra trip is scheduled around 11pm to serve shift at nursing homes
b – Two extra trips scheduled to serve shift at nursing homes, one at 6am and one at 10pm
c – Two extra trips scheduled to serve shift at nursing homes, one at 7:15am and one at 11pm
d – Only three trips are scheduled to serve the shifts at nursing homes
e – Only two trips scheduled during peak periods in peak direction, times are scheduled to meet the BRT express at transfer stations

3.3 Proposed Headways

Table 3.2 shows the proposed headways for all new routes by time periods of the week. As mentioned above, in addition to demand considerations, the current level of service provided to passengers in the corridor was one of the main concerns when proposing headways for each route to avoid diminishing the current level of service provided.

The BRT express is proposed to operate at a 12-minute headway during peak periods and a 20-minute headway during the midday, while the corridor local service would operate at a 15-minute headway during peak periods and a 20-minute headway during the midday. Route 1 service would operate at the same headway as the local route so that local service for the eastern end of the corridor could be coordinated.

In general, the headways on the feeder routes were set at either 12 or 24 minutes during peak periods to be able to provide timed transfers with either every express bus or every other express bus. In the case of the Wolf Road feeder, which operates similar to the ShuttleFly, service is proposed at 12 and 30-minute headways during peak and off-peak periods, respectively. The peak-hour headway is recommended to change from the current 15 minutes to 12 minutes specifically to match the BRT express service headway to facilitate timed transfers. In the near term, it is *not* recommended to change the midday headway from 30 minutes to 20 minutes (to match the BRT), since the midday demand on the ShuttleFly is much lower than the peak period demand.

Table 3.2 Proposed headways in minutes

Route	Weekday					Saturday			Sunday	
	Early AM	AM Peak	Midday	PM Peak	Evening	Morning	Midday	Evening	Off-Peak	Midday
MAINLINE SERVICES										
BRT X		12	20	12	30		20			
Local	30	15	20	15	30	30	20	30	20 – 60[a]	30
Route 1		15	20	15	60		20	20-60	3 trips[b]	
FEEDER ROUTES										
Sand Creek		24	40	24	60	90	60	90		
State Campus		24[c]		24[d]						
Corp. Woods		24[c]		24[d]						
Wolf Rd		12	30	12	30	30	20	30	30	20
Malls 1		24	40	24	30-60[f]	60	40	60	40	20
Malls 2		24	40[e]	24						
General Electric		24		24		30	20			
Union College		24	40	24	30		40	60		

a – 5:30a – 10:00a (30 min); 10:00a – 6:00p (20 min); 6:00 – 12:00a (60 min)
b – Eastbound at 6:00a, 2:00p, and 10:00p. Westbound at 7:00a, 3:00p, and 11:00p
c – Only two trips eastbound scheduled to meet the BRT express service at transfer point
d – Only two trips westbound scheduled to meet the BRT express service at transfer point
e – Only operates from 1:30p – 3:00p in this time period
f – Every 30 minutes until 9:00p and then every 60 minutes until 11:30p

3.4 Running time

The estimation of the running times for the proposed services was based on the current scheduled running times with some deductions according to the proposed treatment of the route. First, the scheduled running times and the actual running times[3] were compared for routes 1 and 55. This comparison analysis concluded that the actual running times, under regular circumstances, are within an acceptable range of the scheduled running time, meaning that the existing scheduled times accurately represent an average of the expected running times in those routes. With these results, it was concluded that the actual scheduled running times could be used as a base to estimate the running times of the proposed services, accounting for some time savings.

Time savings in a BRT system are generated from a number of sources often including

- a reduced number of stops,
- roadway treatments such as queue jumpers and geometry improvements,
- signal priority treatments,
- exclusive lanes, and
- expedited boarding from off-vehicle fare payment

Initially, the proposed services on ROUTE 5 would benefit from the first three treatments; thus, deductions were made to the scheduled running times of routes 1 and 55

[3] Collected during *Task 1 – Ridership Census* of this study

to account for the various priority treatments in the proposed routes as shown in Table 3.3.

Table 3.3 Running Times Deductions

Proposed Route	Base route	Deductions
BRT express	55	Queue jumpers + Transit Signal Priority + BRT operation (limited stop service)
Local	55	Queue jumpers + Transit Signal Priority
Route 1	1	Transit Signal Priority

Two **queue jumpers** are being proposed in the corridor (Wolf Road westbound, and New Karner westbound). The minimum advantage for a bus using the queue jumper would be when there is no queue at all and the bus could have been in first place in the regular lanes and it only gets a 6-second head start over the vehicles in the other lanes. However, it is unlikely for this situation to occur because both intersections are among the busiest in the corridor. The maximum advantage will occur when the intersection is very congested and the queue is not evacuated in one cycle and cars may be in the intersection for more than 1 complete cycle. The cycle time in both intersections is between 100 and 120 seconds. It is unlikely, however, that under regular everyday operations, the intersections will take 2 or more cycles to evacuate a vehicle. This may occur during the holiday shopping season on Wolf Road or under special conditions (i.e. a downstream accident). Based on these minimum and maximum benefits and the fact that some buses may hit a green light at the intersection, a 60-second travel time savings in average per queue jumper was assumed. Thus, the current scheduled running time for route 55 was reduced by 120 seconds when estimating the running time for the proposed BRT express and local services.

The **Transit Signal Priority** and **limited stop service** deductions were based on the ITC VISSIM Model, from which the consultant team estimated preliminary travel time savings (see Table 9 Deliverable L/M – Traffic Impact Study) as shown in Table 3.4, for the entire corridor. These travel time savings were applied directly to the BRT express and local services, which are entire corridor routes. The TSP impact on Route 1 is expected to be less than what is shown in the table because the route only covers 40% of the corridor length. The impact, however, was assumed to be 50% of the corridor-length impact shown in the table below because Route 1 runs through the most congested part of the corridor (i.e. downtown Albany).

Table 3.4 Travel time savings due to TSP and BRT operation

Condition	Conditional TSP	Unconditional TSP	Conditional TSP + BRT operation	Unconditional TSP + BRT operation
Time savings	2.75 min	7 min	13 min	17 min
Applies to	Local service	Local service	BRT service	BRT service

The travel time savings were calculated under two scenarios: using conditional priority and using unconditional priority (see Deliverable L/M for a full discussion). The final estimates for both scenarios are shown in Table 3.5 and Table 3.6 respectively, including running times for different time periods during weekdays, Saturdays and Sundays.

Table 3.5 Estimated one-way running times with conditional priority

			Running times with Conditional TSP [min]										
			Weekday						Saturday			Sunday	
Route	Dir	Var	Early AM	AM Peak	Midday	PM Peak	Evening	Late Even.	Morning	Midday	Evening	Off-peak	Midday
BRT	EB	Travel Center - Greyhound		55	55	55	55		51	52	44		
	WB	Greyhound - Travel Center		53	53	53	53		49	51	49		
Local	EB	Travel Center - Greyhound	51	65	65	65	65		61	62	55	50	69
	WB	Greyhound - Travel Center		63	63	63	63	48	59	61	60	43	59
01	EB	Transit Center - Greyhound		35	35	35	35			35	34		
		Ann Lee - Greyhound		60		60			50	50		61	61
		Airport - Greyhound					66				62	61	
	WB	Greyhound - Transit Center		32	32	32	32			33			
		Greyhound - Ann Lee		46	59				43	43		43	43
		Greyhound - Airport					50				50	49	

Table 3.6 Estimated one-way running times assuming unconditional priority

			Running times with Unconditional TSP [min]										
			Weekday						Saturday			Sunday	
Route	Dir	Var	Early AM	AM Peak	Midday	PM Peak	Evening	Late Even.	Morning	Midday	Evening	Off-peak	Midday
BRT	EB	Travel Center - Greyhound		51	51	51	51		47	48	40		
	WB	Greyhound - Travel Center		49	49	49	49		45	47	45		
Local	EB	Travel Center - Greyhound	47	61	61	61	61		57	58	52	47	59
	WB	Greyhound - Travel Center		59	59	59	59	44	55	57	57	40	49
01	EB	Transit Center - Greyhound		33	33	33	33			33	32		
		Ann Lee - Greyhound		58		58			48	48		59	59
		Airport - Greyhound					64				60	59	
	WB	Greyhound - Transit Center		30	30	30	30			31			
		Greyhound - Ann Lee		44	57				40	40		40	40
		Greyhound - Airport					48				48	47	

Although the estimation was conducted for both conditional and unconditional priority, the resulting running times with unconditional priority were carried forward because that is the ultimate TSP goal on ROUTE 5. As observed, the weekday running time of the BRT express service would be 51 minutes eastbound and 49 minutes westbound with unconditional priority.

The running times for the feeder routes were also estimated based on the current scheduled times of the corresponding existing routes and adjusting the current times due to route length rather than priority treatments. These estimates are shown in Table 3.7.

Table 3.7 Estimated running times for feeder routes

			Weekday					Saturday			Sunday	
Route	Dir	Var	AM Peak	Midday	PM Peak	Evening	Late Even.	Morning	Midday	Evening	Off-peak	Midday
Sand	EB	Colonie Center - Colvin	17	20	17	15	15	12	15	15		
Creek	WB	Colvin - Colonie Center	17	20	17	15	15	12	15	15		
State	EB	Colonie Center - State Campus	15									
Campus	WB	State Campus - Colonie Center			15							
Corp.	EB	Colvin - Blue Cross bldg	10									
Woods	WB	Blus Cross bldg - Colvin			10							
Wolf	SB	Route 7 - Colonie Center	25	20	40	20	20	20	20	20	20	20
Road	NB	Colonie Center - Route 7	35	20	40	20	20	20	20	20	20	20
Malls 1	EB	New Karner - Twenty Mall	45	45	45	45	45	55	55	45		
	WB	Twenty Mall - New Karner	45	45	45	45	45	55	55	45		
Malls 2	EB	Twenty Mall - Crossgates	20	20	20							
	WB	Crossgate - Twenty Mall	20	20	20							
General	SB	Washington - GE	10					10				
Electric	NB	GE - Washington			10				10			
Union	SB	Balltown & River - Washington	27	27	27	27			30	30		
College	NB	Washington - Balltown & River	25	25	25	25			30	30		

To calculate the cycle time for cost estimation, a 20% recovery time for all services was assumed.

3.5 Scheduling

The demand imbalance on the eastern and western halves of the corridor, as well as the speed difference between express and local services, generate a schedule coordination challenge. In general, the schedules for the Local service and the revised Route 1 have been coordinated to the maximum extent possible. Some coordination has also been made for the Local and the BRT, especially in off-peak periods. In peak periods, since the BRT and Local are proposed to operate at different headways (12 minutes and 15 minutes respectively), and they will travel at different speeds, attempts at coordination would not be very fruitful. Ultimately, these two services will serve different travel markets in the corridor, and thus coordination of their schedules is not of the greatest importance.

For off-peak service, the recommended approach to coordinate service is to generate schedules that aim at even headways at the maximum load point—Central Avenue at Ontario Street. This suggests that westbound buses would be dispatched more evenly from Albany and eastbound buses would leave Schenectady with uneven headways seeking to minimize headway variation at Ontario Street. It may be possible to use the Colonie Center station to help regulate the service and maximize the probability of even headways at Ontario street.

Deliverable D – Running Times and Preliminary Schedules presents a potential preliminary schedule for the three main services in the ROUTE 5 corridor: the BRT Express, the Local, and the modified Route 1. These schedules assume that unconditional TSP has been implemented for the length of the corridor, and thus use the running times shown above in Table 3.6. In addition to schedules for each of the three routes separately, composite weekday and Saturday schedules are also shown in that deliverable in order to represent how the three routes would operate together. To provide a preview of those composite schedules, Table 3.8 shows the composite schedule for the eastbound direction between the early morning and 11 am. The trips are sorted by the time that each bus would serve Colonie Center. Table 3.9 shows the same for the westbound direction and the trips are sorted by the departure from the Greyhound terminal in Albany. To see the rest of the composite schedules or the schedules for each of the three main routes for weekday and Saturday service, please refer to *Deliverable D – Running Times and Preliminary Schedules*.

Note that these reduced running times would only be achieved after all improvements (i.e. expanded TSP, both queue jumpers, and limited stop service on BRT express) have been achieved. Early stages of the implementation that may only have some of these elements implemented will not realize all the time savings described here. The phasing plan (*Deliverable Q*) will determine a timeline to introduce each of the new BRT elements in the corridor.

Table 3.8 Weekday Composite Eastbound

Route	Schenectady Travel Center	McClellan	Balltown	New Karner	Ann Lee/ Airport	Colonie Center	Colvin	Lark	SUNY
Local	4:30	4:36	4:43	4:49		4:57	5:03	5:10	5:17
Local	5:00	5:06	5:13	5:19		5:27	5:33	5:40	5:47
Local	5:30	5:38	5:47	5:55		6:05	6:13	6:22	6:31
Local	5:50	5:58	6:07	6:15		6:25	6:33	6:42	6:51
BRT	6:00	6:07	6:15	6:21		6:30	6:36	6:43	6:51
BRT	6:12	6:19	6:27	6:33		6:42	6:48	6:55	7:03
Route 1						6:35	6:49	6:58	7:08
Local	6:10	6:18	6:27	6:35		6:45	6:53	7:02	7:11
BRT	6:24	6:31	6:39	6:45		6:54	7:00	7:07	7:15
Route 1						6:50	7:04	7:13	7:23
Local	6:22	6:30	6:39	6:47		6:57	7:05	7:14	7:23
BRT	6:36	6:43	6:51	6:57		7:06	7:12	7:19	7:27
Local	6:34	6:42	6:51	6:59		7:09	7:17	7:26	7:35
Route 1						7:05	7:19	7:28	7:38
BRT	6:48	6:55	7:03	7:09		7:18	7:24	7:31	7:39
Local	6:46	6:54	7:03	7:11		7:21	7:29	7:38	7:47
Route 1						7:20	7:34	7:43	7:53
BRT	7:00	7:07	7:15	7:21		7:30	7:36	7:43	7:51
Local	6:58	7:06	7:15	7:23		7:33	7:41	7:50	7:59
BRT	7:12	7:19	7:27	7:33		7:42	7:48	7:55	8:03
Route 1					7:10	7:35	7:49	7:58	8:08
Local	7:10	7:18	7:27	7:35		7:45	7:53	8:02	8:11
BRT	7:24	7:31	7:39	7:45		7:54	8:00	8:07	8:15
Route 1						7:50	8:04	8:13	8:23
Local	7:22	7:30	7:39	7:47		7:57	8:05	8:14	8:23
BRT	7:36	7:43	7:51	7:57		8:06	8:12	8:19	8:27
Local	7:34	7:42	7:51	7:59		8:09	8:17	8:26	8:35
Route 1						8:05	8:19	8:28	8:38
BRT	7:48	7:55	8:03	8:09		8:18	8:24	8:31	8:39
Local	7:46	7:54	8:03	8:11		8:21	8:29	8:38	8:47
Route 1						8:20	8:34	8:43	8:53
BRT	8:00	8:07	8:15	8:21		8:30	8:36	8:43	8:51
Local	7:58	8:06	8:15	8:23		8:33	8:41	8:50	8:59
BRT	8:12	8:19	8:27	8:33		8:42	8:48	8:55	9:03
Route 1						8:35	8:49	8:58	9:08
Local	8:10	8:18	8:27	8:35		8:45	8:53	9:02	9:11
BRT	8:24	8:31	8:39	8:45		8:54	9:00	9:07	9:15
Route 1						8:50	9:04	9:13	9:23
Local	8:22	8:30	8:39	8:47		8:57	9:05	9:14	9:23
BRT	8:36	8:43	8:51	8:57		9:06	9:12	9:19	9:27
Local	8:34	8:42	8:51	8:59		9:09	9:17	9:26	9:35
Route 1						9:05	9:19	9:28	9:38
BRT	8:48	8:55	9:03	9:09		9:18	9:24	9:31	9:39
Local	8:46	8:54	9:03	9:11		9:21	9:29	9:38	9:47
BRT	9:00	9:07	9:15	9:21		9:30	9:36	9:43	9:51
Route 1						9:25	9:39	9:48	9:58
Local	8:58	9:06	9:15	9:23		9:33	9:41	9:50	9:59
BRT	9:20	9:27	9:35	9:41		9:50	9:56	10:03	10:11
Route 1						9:45	9:59	10:08	10:18
Local	9:22	9:30	9:39	9:47		9:57	10:05	10:14	10:23
BRT	9:40	9:47	9:55	10:01		10:10	10:16	10:23	10:31
Route 1						10:05	10:19	10:28	10:38
Local	9:42	9:50	9:59	10:07		10:17	10:25	10:34	10:43
BRT	10:00	10:07	10:15	10:21		10:30	10:36	10:43	10:51
Route 1						10:25	10:39	10:48	10:58
Local	10:02	10:10	10:19	10:27		10:37	10:45	10:54	11:03
BRT	10:20	10:27	10:35	10:41		10:50	10:56	11:03	11:11
Route 1						10:45	10:59	11:08	11:18
Local	10:22	10:30	10:39	10:47		10:57	11:05	11:14	11:23

Table 3.9 Weekday Composite Westbound

Route	Greyhound	Lark	Colvin	Colonie Center	Ann Lee/ Airport	New Karner	Balltown	McClellan	Schenectady Travel Center
Local	5:30	5:35	5:43	5:48		5:56	6:01	6:08	6:14
Local	5:50	5:57	6:08	6:15		6:25	6:32	6:41	6:49
BRT	6:00	6:06	6:15	6:20		6:29	6:35	6:42	6:49
Local	6:04	6:11	6:22	6:29		6:39	6:46	6:55	7:03
BRT	6:12	6:18	6:27	6:32		6:41	6:47	6:54	7:01
Route 1	6:08	6:17	6:28	6:38	6:56				
Local	6:16	6:23	6:34	6:41		6:51	6:58	7:07	7:15
BRT	6:24	6:30	6:39	6:44		6:53	6:59	7:06	7:13
Local	6:28	6:35	6:46	6:53		7:03	7:10	7:19	7:27
BRT	6:36	6:42	6:51	6:56		7:05	7:11	7:18	7:25
Local	6:40	6:47	6:58	7:05		7:15	7:22	7:31	7:39
BRT	6:48	6:54	7:03	7:08		7:17	7:23	7:30	7:37
Local	6:52	6:59	7:10	7:17		7:27	7:34	7:43	7:51
BRT	7:00	7:06	7:15	7:20		7:29	7:35	7:42	7:49
Route 1	7:00	7:09	7:20	7:30					
Local	7:04	7:11	7:22	7:29		7:39	7:46	7:55	8:03
BRT	7:12	7:18	7:27	7:32		7:41	7:47	7:54	8:01
Local	7:16	7:23	7:34	7:41		7:51	7:58	8:07	8:15
Route 1	7:15	7:24	7:35	7:45					
BRT	7:24	7:30	7:39	7:44		7:53	7:59	8:06	8:13
Local	7:28	7:35	7:46	7:53		8:03	8:10	8:19	8:27
Route 1	7:30	7:39	7:50	8:00					
BRT	7:36	7:42	7:51	7:56		8:05	8:11	8:18	8:25
Local	7:40	7:47	7:58	8:05		8:15	8:22	8:31	8:39
BRT	7:48	7:54	8:03	8:08		8:17	8:23	8:30	8:37
Route 1	7:45	7:54	8:05	8:15					
Local	7:52	7:59	8:10	8:17		8:27	8:34	8:43	8:51
BRT	8:00	8:06	8:15	8:20		8:29	8:35	8:42	8:49
Route 1	8:00	8:09	8:20	8:30					
Local	8:04	8:11	8:22	8:29		8:39	8:46	8:55	9:03
BRT	8:12	8:18	8:27	8:32		8:41	8:47	8:54	9:01
Local	8:16	8:23	8:34	8:41		8:51	8:58	9:07	9:15
Route 1	8:15	8:24	8:35	8:45					
BRT	8:24	8:30	8:39	8:44		8:53	8:59	9:06	9:13
Local	8:28	8:35	8:46	8:53		9:03	9:10	9:19	9:27
Route 1	8:30	8:39	8:50	9:00					
BRT	8:36	8:42	8:51	8:56		9:05	9:11	9:18	9:25
Local	8:40	8:47	8:58	9:05		9:15	9:22	9:31	9:39
BRT	8:48	8:54	9:03	9:08		9:17	9:23	9:30	9:37
Route 1	8:45	8:54	9:05	9:15					
Local	8:52	8:59	9:10	9:17		9:27	9:34	9:43	9:51
BRT	9:00	9:06	9:15	9:20		9:29	9:35	9:42	9:49
Route 1	9:00	9:09	9:20	9:30					
Local	9:07	9:14	9:25	9:32		9:42	9:49	9:58	10:06
Route 1	9:15	9:24	9:35	9:45					
BRT	9:20	9:26	9:35	9:40		9:49	9:55	10:02	10:09
Local	9:27	9:34	9:45	9:52		10:02	10:09	10:18	10:26
Route 1	9:35	9:44	9:55	10:05					
BRT	9:40	9:46	9:55	10:00		10:09	10:15	10:22	10:29
Local	9:47	9:54	10:05	10:12		10:22	10:29	10:38	10:46
Route 1	9:55	10:04	10:15	10:25					
BRT	10:00	10:06	10:15	10:20		10:29	10:35	10:42	10:49
Local	10:07	10:14	10:25	10:32		10:42	10:49	10:58	11:06
Route 1	10:15	10:24	10:35	10:45					
BRT	10:20	10:26	10:35	10:40		10:49	10:55	11:02	11:09
Local	10:27	10:34	10:45	10:52		11:02	11:09	11:18	11:26
Route 1	10:35	10:44	10:55	11:05					
BRT	10:40	10:46	10:55	11:00		11:09	11:15	11:22	11:29

3.6 Vehicles

3.6.1 Type of vehicles

Acquiring new vehicles is often considered a key component of any new BRT system, as they increase passenger comfort and help to distinguish the service from other regular bus routes. While it would be possible to operate the BRT express service using the newest buses in CDTA's existing fleet, assuming they were repainted to help establish a distinct BRT brand, the maximum benefit from the BRT would be realized with a new vehicle procurement. In the immediate term, it would not be necessary to purchase new vehicles for the feeder services to the BRT. If it is desired to link these services to the BRT brand, they could be repainted. New vehicles for the feeder could be purchased according to CDTA's normal bus replacement schedule.

3.6.2 Fleet size

The fleet requirements were calculated based on the headway and running time figures, provided in the previous sections. Table 3.10 presents the vehicle requirements to operate the AM peak period, which is considered the most critical time period. These figures do not include spare vehicles.

Table 3.10 Peak vehicle requirement

Route	40-foot buses	Minibuses
BRT express	10	
Local	10	
Route 1	5	
Sand Creek		2
State Campus		1
Corp. Woods		1
Wolf Rd		6
Malls 1		5
Malls 2		2
General Electric		1
Union College		3
Total	**25**	**21**

The vehicles required to operate the BRT express, local and Route 1 services are full length (40-foot) buses and the vehicles recommended for the shuttles are minibuses of no more than 30 feet in length and with a capacity of at most 40 passengers including standees.

4 Ridership

4.1 Estimating ridership change on ROUTE 5

This section summarizes the ridership estimate presented in further detail in *Deliverable G – Ridership Forecast*. The general approach to estimate the future ridership of the proposed routes in the ROUTE 5 corridor was based on seven main steps:

1. Determine current ridership
2. Estimate trip origins and destinations
3. Estimate which current trips are likely to use the BRT express service
4. Estimate the ridership change (increase or decrease) due to headway changes
5. Estimate the ridership change (increase or decrease) due to travel time changes including transfer penalties
6. Estimate the ridership change (increase or decrease) due to other improvements (i.e. image, branding, and amenities)
7. Calculate the final estimated ridership for the new system

To **determine the current ridership**, the census data collected under Task 1 of this was used to establish current weekday, Saturday, and Sunday ridership in routes 55, 1, 2, 55X and 56X by direction. The results for the current ridership by route, by direction, and by time period are presented in Table 4.1. The total weekday ridership for all routes combined is approximately 10,000 passengers. Saturday ridership amounts to approximately 6,000 passengers and Sunday ridership is close to 3,000 passengers.

Table 4.1Current ridership

INBOUND											
	Weekday						**Saturday**				**Sunday**
Route	Early AM	AM Peak	Midday	PM Peak	Evening	**Total**	AM	Midday	Evening	**Total**	
55	49	512	1,205	656	535	2,957	271	1,275	453	1,999	1,430
1		249	431	466	29	1,175	13	498	161	672	70
2		143	159	191	114	607	12	53	75	140	
55X		158				158					
56X		20				20					
Total	*49*	*1,082*	*1,795*	*1,313*	*678*	***4,917***	*296*	*1,826*	*689*	***2,811***	***1,500***

OUTBOUND											
	Weekday						**Saturday**				**Sunday**
Route	Early AM	AM Peak	Midday	PM Peak	Evening	**Total**	AM	Midday	Evening	**Total**	
55		486	1,097	747	568	2,898	299	1,394	532	2,225	1,439
1		264	635	437	140	1,476	37	669	38	744	75
2		117	189	138	65	509	46	62	20	128	
55X				117	12	129					
56X				14		14					
Total	*0*	*867*	*1,921*	*1,453*	*785*	***5,026***	*382*	*2,125*	*590*	***3,097***	***1,514***

BOTH DIRECTIONS			
Route	**Weekday**	**Saturday**	**Sunday**
55	5,860	4,220	2,870
1	2,650	1,420	150
2	1,120	270	
55X	290		
56X	30		
Total	***9,950***	***5,910***	***3,020***

The **estimation of trips origins and destinations** was conducted through synthetic O-D matrices. These matrices were created with a Visual Basic program written specifically for this purpose. The program allocates passengers to O-D pairs considering the following restrictions:

- The total number of boardings at station *i* (i.e. sum of row *i* of the matrix) must equal the boardings for station *i* in the load profile
- The total number of alightings at station *j* (i.e. sum of column *j* of the matrix) must equal the alightings for station *j* in the load profile
- The allocation of trips to a particular O-D pair of stations *i* and *j* is proportional to the total number of boardings at *i* and alightings at *j*
- At any time, the passenger that has been on the bus the longest (i.e. boarded at the earliest station) is more likely to be allocated to the next alighting stop than any other passenger on the bus.

To run the program, load profiles for each route were required. The ridership census collected the number of boardings and alightings at every stop for each route on the corridor. This information provides load profiles by route and they can be further broken down by time period. Based on the load profiles, synthetic O-D matrices were generated for each route by time period (i.e. Early AM, AM Peak, Midday, PM Peak, Evening, Saturday, and Sunday) and by direction (i.e. Inbound and Outbound), and by route (i.e. 55, 1, 2, 55X, 56X).

A total of 30 matrices were produced because some routes do not operate in certain time periods and directions. The matrices are an estimated representation of the origin and destination of every trip collected.

To **estimate which current trips are likely to use the BRT express service**, a probability function was established to determine the likelihood that people traveling between O-D pairs currently served by routes 55, 1, 2, 55X, and 56X would use the BRT express service.

It was assumed that if the current O-D pair is exactly the same (i.e. same stops) as a BRT express O-D pair, the probability of using the BRT express is 1. Furthermore, if the current origin OR current destination stops are beyond walking distance from a future BRT station, the probability of using the BRT express is 0. Walking distance is assumed to be 0.25 miles upstream and 0.15 miles downstream. This accounts for the fact that passengers are more likely to walk longer if they are walking in the direction of travel[4]. Thus, if both, the current origin and destination stops are within walking distance of BRT express stations, the probability of using the BRT express is between 0 and 1 and it was assumed that this probability function is determined by a parabolic function[5]. This methodology was used for all stops except for the Transit Center at Colonie Center for which the distance based formula would not reflect the draw that the BRT station at

[4] Maximum walking distance is usually considered between 0.25 and 0.5 miles, however, in this case we consider that users may have already walked some distance before reaching the main corridor (i.e. they have walked perpendicular to ROUTE 5). Thus, we consider realistic to assume that users would only be willing to walk an additional 0.25 or 0.15 miles along ROUTE 5.

[5] The probability function was also tested as a line, which means the probability is directly proportional to the distance between the current stop and the future BRT station. At the end, the results obtained from a parabolic function seemed more realistic based on the consultant's experience.

Colonie Center would have over the Transit Center customers. For this station, the headway operating on Route 1 was the determinant characteristic to estimate the probability. To obtain the number of trips that are likely to use the new BRT service, the probability for every O-D pair was multiplied by the total number of trips currently made for that O-D pair:

*Trips on BRT express between m and n = Total trips between m and n * P(m,n)*

The result of step 3 was a set of matrices one for each route and time period that contains only the trips that would be made by BRT express. A summary of this information is presented in Table 4.2. During weekdays, 3,750 passengers that currently ride on the ROUTE 5 routes are expected to use the BRT express service. For Saturdays that figure amounts to 2,440 passengers. These figures represent 38% and 41% of current ridership, respectively.

Table 4.2 Estimated BRT express passengers from current ridership

INBOUND											
	Weekday						Saturday				Sunday
Route	Early AM	AM Peak	Midday	PM Peak	Evening	**Total**	AM	Midday	Evening	**Total**	
55		178	534	287	238	1,237	120	574	219	913	
1		106	220	247	7	579	4	242	59	306	
2		24	45	41	22	132	3	13	13	29	
55X		48				48					
56X		12				12					
Total	*0*	*367*	*798*	*575*	*267*	***2,007***	*127*	*829*	*291*	***1,247***	***0***

OUTBOUND											
	Weekday						Saturday				Sunday
Route	Early AM	AM Peak	Midday	PM Peak	Evening	**Total**	AM	Midday	Evening	**Total**	
55		187	421	257	196	1,061	129	576	196	901	
1		101	243	165	56	565	4	261	14	278	
2		13	34	15	10	71	6	13	4	23	
55X				36	2	39					
56X				6		6					
Total	*0*	*301*	*698*	*479*	*264*	***1,742***	*139*	*850*	*214*	***1,202***	***0***

BOTH DIRECTIONS						
	Total ridership			% of current ridership		
Route	Weekday	Saturday	Sunday	Weekday	Saturday	Sunday
55	2,300	1,810		39%	43%	
1	1,140	580		43%	41%	
2	200	50		18%	19%	
55X	90			31%		
56X	20			67%		
Total	***3,750***	***2,440***	***0***	***38%***	***41%***	***0%***

The changes that will be introduced to the transit service in the corridor are expected to increase its current ridership. These changes are primarily in the headway, travel time, and amenities provided to users. The expected new riders may come from another mode or may be induced demand. Mode shifts include those riders that are currently making their trip by another means of transportation and decide to use the new service because the transit service has become more convenient for them. Induced demand refers to those riders that are not currently making a trip but decide to make a new trip because the new transit service has improved the convenience of making the trip versus not traveling at all. These riders could include current transit patrons or people who currently use other modes for other trips.

To **estimate the ridership change due to headway changes**, the difference between current and future headways observed by different O-D pairs and industry wide demand elasticities were used. First, the current headways were obtained from the most recent published schedules by CDTA for routes 55, 1, 2, 55X, and 56X. Table 4.3 presents a summary of the current headways used for the ridership forecast. The proposed headways were shown in Table 3.2. For this estimation, only the routes included in the data collection task (routes 55, 1, 2, 55X, and 56X) were considered. Other feeder services including the renewed ShuttleFly, ShuttleBug, the General Electric feeder, and the Union College feeder are expected to have proportional ridership increases due to headway improvements and better connectivity with the mainline services but this increase is not quantitatively calculated because of lack of current detailed data.

Table 4.3 Current headways

Existing Headways									
	Weekday Time Period					**Saturday**			**Sunday**
	Early AM	AM Peak	Midday	PM Peak	Evening	AM	Midday	Evening	
Route	before 6am	6am-9am	9am-3pm	3pm-6pm	6pm +	before 9am	9am-5pm	5pm +	
55	30	15	20	15	30[b]	30	20[e]	30	20 - 60
1		15	20	15	30[c]		20[f]	20	3 trips
2		25[a]	30	20	60[d]	90	90	90	
55X		10		10					
56X		1 trip		1 trip					

a – Headways shown are average values because the headway is not constant throughout the time period
b – Service until 1 am
c – Inbound: no evening service. Outbound: service every 30 minutes until 7:30 pm and one extra trip at 10 pm
d – Service until 11 pm
e – 20-minute service since 7am inbound and since 8am outbound, and until 7pm outbound
f – Regular service from 10:30 am to 6 pm, one extra trip very early in the morning and one late at night to serve nursing homes

Next, the segments of the corridor with different combined headways were identified. A combined headway is the average headway observed at a specific point of the corridor resulting from multiple routes going by the same point. For example, at Colvin Avenue, the headway observed from route 55 in the AM peak is 15 minutes; however, route 1 also goes by the same point, with a headway of 15 minutes. Thus, for those passengers with destinations also served by those two routes, the combined headway is 7.5 minutes. The main segments with different combined headways are shown in Figure 4.1 below. The current headways for the AM peak are shown for routes 55, 1, and 2 and the combined headways of these three routes in the segments are shown.

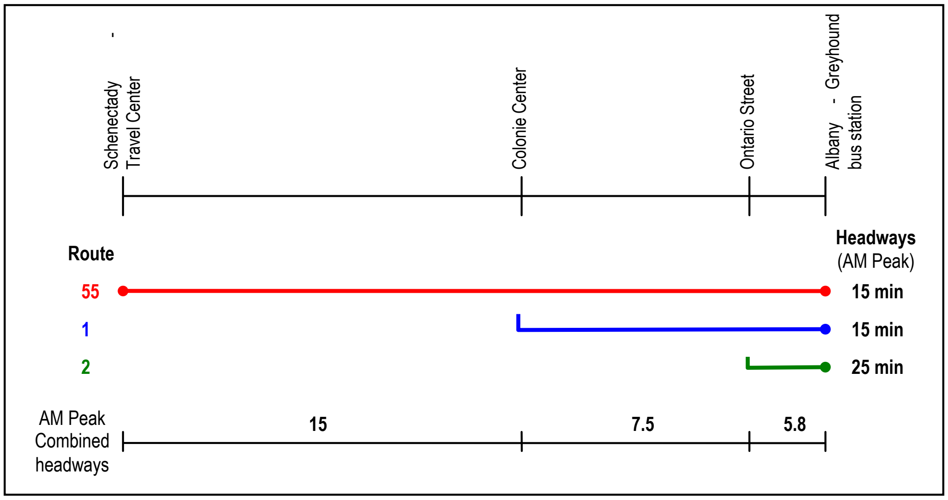


Figure 4.1 Segments with different combined headways

The figure above indicates that any trip made entirely within (i.e. both origin and destination) between the Greyhound station in Albany and Ontario Street currently has an average combined headway of 5.8 minutes. Similarly, trips between Ontario Street and Colonie Center have a 7.5 minute combined headway and trips west of Colonie Center have a 15-minute combined headway. Trips that extend along two or three segments would have the maximum combined headway of the segments it travels. For example, a trip from Schenectady to downtown Albany (between Ontario Street and the Greyhound station) would have a combined headway of 15 minutes.

In addition to the three main segments shown in the figure above, there are other O-D pairs for which their combined headways may change with the proposed service. Those segments or O-D pairs are

- Trips between downtown Albany (the segment from the bus station to Ontario Street) and the Transit Center at Colonie Center
- Trips between outer Albany (the segment between Ontario Street and Colonie Center) and the Transit Center at Colonie Center
- Trips that include any of the stops on Wolf Road or Albany Shaker Road
- Trips that include any of the stops on Sand Creek Road or any other route 2-only stops
- Trips that include any Empire State Plaza stops or any other 55X-only stops
- Trips that include any of the stops in the State Campus, Corporate Woods, or any other 56X-only stops

For each one of the groups of O-D pairs mentioned above, the combined headway was calculated by determining the routes that serve that group and averaging the total number of buses in an hour for the group or segment.

Table 4.4 shows the current average combined headways for all the possible segments or groups of O-D pairs.

Table 4.4 Current combined headways

Current combined headways									
Segments	**Routes in segment**	**Weekday**					**Saturday**		
		Early AM	AM Peak	Midday	PM Peak	Evening	AM	Midday	Evening
Greyhound - Ontario St	55, 1, 2		5.8	7.5	5.5	12	23	9	23
Albany - Colonie Center	55, 1	30	7.5	10	7.5	15	30	10	30
West of Colonie Center/Long-haul trips	55	30	15	20	15	30	30	20	30
East of Ontario St - Transit Center	1, 2		9.4	12	8.6	20	90	16.4	90
Between Ontario St and Watervliet & 3rd	2		25	30	20	60	90	90	90
Ontario St and Colonie Ctr - Transit Center	1		15	20	15	30		20	
Wolf Rd and Albany Shaker Rd stops	1		15	20	15	30		20	
Sand Creek Rd stops	2		25	30	20	60	90	90	90
55X trips	55X		10		10	10			
56X trips	56X		60		60				

Although route 56X has only 1 trip in each direction during the day, a 60 minute headway was assumed for the current situation to be able to make quantitative calculations later on the process. Also note that although the 55X trips could be folded into the West of Colonie Center/Long-haul trips, they are treated separately because the service provided is only in one direction and during a short period of time that does not cover a complete time period.

Similarly, the combined headways for the different groups were calculated for the future with the proposed headways. In the future scenario, however, those groups that are served by the BRT express are broken into two groups: one for the users that can take the express service (it serves their stops) and one for the users that cannot use the express service. For example, consider two passengers waiting at the Colvin station, the first passenger is going to Balltown Road and the second passenger is going to Lisha Kill Road. The first passenger has the option of taking both the express service and the local service, thus his combined headway in the AM Peak would be 6 minutes. Although the second passenger may see the BRT express service go by him and stop at Colvin Avenue, he could not take it for a one-seat ride because the express service does not stop near Lisha Kill Road, thus we assume that his actual combined headway is that of the local service. Table 4.5 shows the combined headways for the different groups under the service levels proposed for future operation.

Table 4.5 Future combined headways

Future combined headways									
Segments	**Weekday Time Period**					**Saturday**			**Routes in segment**
	Early AM	AM Peak	Midday	PM Peak	Evening	AM	Midday	Evening	
Greyhound - Ontario St using X	30	3.9	5.7	3.9	8.6	22.5	6	23	X, loc, 1, 2
Greyhound - Ontario St	30	**5.7**	**8.0**	**5.7**	12	23	8.6	23	loc, 1, 2
Albany - Colonie Center using X	30	4.6	6.7	4.6	10	30	6.7	30	X, loc, 1
Albany - Colonie Center	30	7.5	10	7.5	15	30	10	30	loc, 1
West of Colonie Center/Long-haul trips using X	30	7	10	7	15	30	10	30	X, loc
West of Colonie Center/Long-haul trips	30	15	20	15	30	30	20	30	loc
East of Ontario St - Transit Center		9.2	**20**	**9.2**	20	90	15	90	1
Between Ontario St and Watervliet & 3rd		15	20	15	30		20		1
Between Ontario St and Colonie Ctr - Transit Center		15	20	15	30		20		1
Wolf Rd and Albany Shaker Rd stops		15	20	15	30		20		1
Sand Creek Rd stops		24	**40**	**24**	60	90	60	90	2
55X trips using X		7		7	**15**				X, loc
55X trips		**15**		**15**	**30**				loc
56X trips		24		24					State Camp

The numbers shown in red and bold in the previous table identify those segments and time periods for which the future proposed service level is lower than the current one. For these segments we expect a ridership decrease and for all others a ridership increase or no impact at all.

Industry-standard elasticities were then used to determine the ridership impact due to headway changes. A mid-point arc elasticity formula was used, obtained from the study *Traveler Response to Transportation System Changes* by Barton-Aschman Associates, July 1981. The elasticities used vary depending on the original headway as follows:

Original Service Level (headway)	Elasticity
<10 Min	-0.22
10-50 Min	-0.46
>50 Min	-0.58

These elasticities imply that a headway improvement will generate higher ridership, proportionally to the original ridership, if the improvement is made on an infrequent bus route rather than a frequent route. In other words, a headway improvement is more noticeable to riders on an infrequent bus route than on a frequent bus route.

After applying the elasticity formula to all segments for each time period, the following results are obtained for the ridership change (i.e. increase or decrease) by segment and by time period.

Table 4.6 Ridership impact due to headway change

Ridership increase/decrease								
	Weekday					**Saturday**		
Route	Early AM	AM Peak	Midday	PM Peak	Evening	AM	Midday	Evening
Greyhound - Ontario St using X	0	7	18	12	10	0	18	0
Greyhound - Ontario St	0	0	**-6**	**-3**	0	0	3	0
Albany - Colonie Center using X	0	25	97	41	35	0	150	0
Albany - Colonie Center	0	0	0	0	0	0	0	0
West of Colonie Center/Long-haul trips using X	0	107	208	153	91	0	229	0
West of Colonie Center/Long-haul trips	0	0	0	0	0	0	0	0
East of Ontario St - Transit Center		0	**-34**	**-2**	0	0	6	0
Betw een Ontario St and Watervliet & 3rd		23	17	15	15	0	0	0
Betw een Ontario St and Colonie Ctr - Transit Center		0	0	0	0	0	0	0
Wolf Rd and Albany Shaker Rd stops		0	0	0	0	0	0	0
Sand Creek Rd stops		2	**-13**	**-8**	0	0	11	0
55X trips using X		0		0	**-1**			
55X trips		**-27**		**-20**	**-3**			
56X trips		13		9				
Sub-Total	*0*	*150*	*287*	*197*	*147*	*0*	*417*	*0*
Total			**781**	7.9%			**417**	7.1%

As observed in the table above the net expected impact on ridership due to headway changes is an increase of 781 passengers (approximately 8%) during weekdays and of 417 passengers (approximately 7%) during Saturdays.

This net increase results from a total increase of 889 passengers and a loss of 108 passengers. These 108 passengers are lost mainly due to the lower frequency that will be experienced by current users of the 55X who would not be able to use the BRT express service because it does not serve their stops. The loss is also due to the lower frequency that will be provided to Sand Creek Road passengers on route 2 during Midday and the PM peak when the headway will be increased from 30 to 40 minutes and 20 to 24 minutes, respectively. In addition, passengers east of Ontario that wish to travel to the Transit Center at Colonie Center previously had two alternative routes: Route 1 and Route 1, under the proposed system, these passengers will only have Route 1 as a one-seat ride option. However, the increase of nearly 900 passengers due to better service in other segments outweighs the ridership loss and has an overall positive impact on the corridor.

As expected, the biggest ridership gains will come from users of the express service and especially during segments and time periods that currently have the more infrequent service.

To **estimate the ridership change due to travel time and transfer changes** a similar approach to that due to headway changes was followed. The current and future travel times for each O-D pair were estimated and then industry-standard elasticties were applied to determine the ridership change.

The current travel time for each O-D pair was calculated using the running time data collected during the ridership census. An average travel time was determined for each O-D pair by time period, by direction. The future travel time for each O-D pair was calculated reducing time from the current travel time due to several improvements in the service: queue jumpers, Transit Signal Priority (TSP), and limited stop service—for BRT users only, and adding travel time penalties for induced transfers. The running time reductions were done according to the assumptions and estimates presented in *Deliverable D – Running Times and Schedules*. Faster boarding times were not considered because off-vehicle fare collection does not appear to be feasible in the near future.

Industry-standard elasticities were used to determine the ridership impact due to travel time changes. A mid-point arc elasticity formula was used obtained from the study "Patronage Impacts of Changes in Transit Fares and Services" by Ecosometrics, Inc., Sep 1980. The elasticity used was -0.35. This means that a 1 percent decrease in travel time will generate a 0.35% increase in ridership. The resulting figures of this process explained above are presented in

Table 4.7, where the additional ridership, under the lower and higher scenarios, is presented for weekday and Saturdays. Overall a weekday ridership increase of 360 to 632 passengers is expected. This translates into an added weekday ridership increase of 3.6 to 6.4%. The lower and higher scenarios represent the conditional and unconditional TSP, respectively. With unconditional TSP, the running time savings are higher, thus a higher positive impact on ridership is expected.

The ridership increase due to travel time changes is obtained mainly because of the TSP and BRT operation. The queue jumpers do not provide significant travel time savings but may provide a significant perceived advantage to bus service in the ROUTE 5 corridor.

Table 4.7 Ridership impact due to changes in travel time

	Weekday		Saturday	
	Lower	Higher	Lower	Higher
Current Ridership	9,943		5,908	
Additional Ridership	360	632	236	400
% change	3.6%	6.4%	4.0%	6.8%

To **estimate the ridership change due to other changes including amenities, image, and branding**, a comparison with other systems was conducted. Other systems were studied to determine a range of ridership boost that may be expected due to service enhancements other than frequency and travel time. The systems studied were the Silver Line in Boston, the MetroRapid system in Los Angeles, and the Vancouver B-Line. Using the elasticies mentioned above and the before and after ridership, service levels, and travel time, the expected ridership increase due to headway and travel time improvements was identified. Any remaining ridership gained was allocated to "other" enhancements, which usually include amenities, image, system identity, and branding.

Table 4.8 shows the total weekday ridership increase obtained from different sources and the breakdown of the share due to headway, travel time, and other improvements. This estimate was calculated by the consultant based on the elasticties mentioned above and the ridership increases obtained from the sources indicated in the table.

Table 4.8 Case studies in ridership change

	LA MetroRapid		Vancouver	Boston
	Ventura Blvd	Wilshire / Whittier Blvd	B-Line #98	Silver Line
Weekday ridership increase [riders]	2,850[a]	20,660[a]	4,000[b]	2,290[c]
Weekday ridership increase [%]	26%	33%	29%	30%
Ridership increase due to headway changes	6%	8%	9%	7%
Ridership increase due to travel time changes	10%	12%	6%	2%
Ridership increase due to other changes	10%	13%	14%	21%

a – source: TCRP Report 90 Case studies in Bus Rapid Transit
b – source: APTA Intermodal Operations Planning Workshop August 9 – 11, 2004 – Translink Welcoming Session
c – source: MBTA counts

The ridership increase due to "other" changes, which could be attributed to branding, image, and amenities enhancements, range between 10% and 21% of original ridership.

To estimate the potential ridership increase due to image, amenities, and branding for the ROUTE 5 corridor service, a range was again considered. Based on the results found in other cases, the lower end of the range was assumed to be 10% and the higher end was assumed to be 15% of the original ridership. Part of the relatively high ridership increase observed in Boston may have been due to the deployment of brand new low-floor articulated buses in the corridor, which previously had been operated with old vehicles. Since such distinctive vehicles are not expected to be used in the near term for the ROUTE 5 corridor, a range of 10 to 15% was considered more realistic. In the immediate term, before all amenities are implemented for the full corridor, a smaller ridership impact, on the order of 5% ridership, would be expected. This range of 10 to 15% range was also applied to Saturday ridership.

According to the calculations described in the previous sections, the total ridership expected in the new system is presented in Table 4.9 below. The estimate shows that a ridership increase between 22 and 29% may be expected during weekdays and between 21 and 29% during Saturdays.

Table 4.9 Estimated ridership on ROUTE 5 corridor with proposed service

Total Ridership					
	Weekday		Saturday		Sunday
	Lower	Higher	Lower	Higher	
Current ridership	9,950		5,910		3,020
Ridership increase due to headway	780		417		0
Ridership increase due to travel time	360	620	240	399	0
Ridership increase due to other improvements	1000	1490	590	890	0
Total	**12,090**	**12,840**	**7,157**	**7,616**	**3,020**
Total Increase %	**22%**	**29%**	**21%**	**29%**	**0%**

4.2 Ridership at BRT stations

The ridership increase calculated above due to headway and travel time changes will be shared by the BRT express, and local routes. However, the increase due to other improvements is expected to be observed in the express service mainly. These estimates were also used to determine the ridership at the BRT express stations. Table 4.10 shows the boardings expected at the BRT stations, showing the number of passengers that will use those stations to get on the BRT express service and those who will use them to get on other routes.

Table 4.10 Weekday ridership at BRT express stations

BRT station	Boardings		
	on BRT	Other routes	Total
Washington	110	93	203
Broadway	89	77	166
Veeder/Nott	191	164	355
Steuben	85	22	107
McClellan	150	86	236
N. Robinson	86	4	90
Lawnwood	58	34	91
Balltown	67	32	99
New Karner	97	57	154
Village of Colonie	16	2	18
Colonie Center	272	138	410
Colvin	342	138	480
N. Allen	161	80	241
N. Manning	217	69	285
Quail	325	142	467
Lexington	165	72	237
Lark	459	433	892
S. Swan	167	89	256
Pearl	528	181	709
SUNY	59	21	80
Total	*3,644*	*1,934*	*5,578*

5 Intelligent Transportation Systems

Intelligent Transportation Systems (ITS) encompasses a wide range of applications including Automatic Vehicle Location, Global Positioning System (GPS), mobile data terminals (MDT) in vehicles, signal priority, real-time information, advanced fare collection system, etc. The ROUTE 5 BRT system in the Capital District will include many of these elements.

The following transit-ITS technologies will help improve the BRT's efficiency, reliability, convenience, and safety:

CAD/AVL

An AVL system determines the location of each vehicle that is equipped with appropriate hardware and software. The most popular technology currently used to determine location in an AVL system is the global positioning system (GPS). GPS is a constellation of satellites orbiting the earth. If a GPS receiver has line of sight to at least four satellites to receive their position information, it can determine its location on earth. This location can then be communicated from the receiver (located on a transit vehicle) to central dispatch.

Central dispatch can view equipped BRT vehicle locations on a map, in addition to displaying specific information about each vehicle (e.g., vehicle number 7926 is being driven by Edward Smith and is currently operating Block 411). An AVL system serves as the backbone to many transit ITS applications. For example, deploying an AVL system will facilitate deploying automatic annunciation, vehicle component monitoring, automatic passenger counting (APC), and signal priority systems.

Two additional features of AVL systems that would be applicable to the BRT service are a silent alarm/covert microphone, which the operator can activate in case of emergency, and engine/component monitoring, which can sense (and automatically report to maintenance) when specific components or engine conditions are outside the normal range (e.g., engine temperature goes beyond the acceptable limit for that particular engine type).

AVL systems are usually integrated with a computer-aided dispatch (CAD) system. A CAD system can manage a voice and data communication system by (1) automatically selecting appropriate channels for specific types of communications; (2) allowing operations/dispatch to select a specific vehicle, group of vehicles or all vehicles to receive messages; and (3) facilitating emergency response in the case of an incident.

Mobile Data Terminals (MDTs) – also sometimes referred to as Mobile Data Computers (MDCs) – which can be located in each vehicle near the operator, are an integral part of this aspect of a CAD system since they facilitate data transfer between the vehicle and operations/dispatch. MDTs usually have a small screen that displays text messages, along with a keypad that contains either pre-coded keys (e.g., pick-up/drop-off, request to talk, maintenance incident) or keys that can be flexibly programmed. The use of MDTs for data communication tends to reduce the volume of voice communication since much of the information transmitted between operators and dispatch can be coded.

It is understood that CDTA is in the process of equipping its vehicles with Init AVL system. Since CDTA is acquiring this technology for its other services, it is highly recommended that the same system be deployed on the BRT vehicles.

TSP

A transit signal priority (TSP) system is technology that can extend the green phase of a traffic signal or can turn the signal green earlier than scheduled so that a bus may pass through an intersection more quickly. By giving signal priority to transit buses, transit travel times and delay times are shortened, translating into more convenience to the passengers and cost savings for the agency. It has also been shown that transit signal priority can allow the agency to reduce the number of trips on a route without affecting its level of service.

Furthermore, signal priority can reduce or eliminate “bunching,” a situation in which one or more buses closely follow another on the same route as a result of the first bus running late (especially when headways are short).

There are several TSP technologies available and several methods of initiating a signal priority request. A basic TSP system consists of an emitter on a bus, and a receiver at a particular signalized intersection (in many cases, signal control will need to be upgraded to accommodate priority phasing).

Init, which is providing the AVL system for CDTA fleet, also provides a signal priority system, called LISA. LISA utilizes radio signals to and from log-on/log-off signposts located at designated intersections. The LISA system does not require line of sight between the vehicle and the traffic light. When reaching the log-on and log-off points, an appropriately equipped vehicle uses data radio to transmit a request and/or log-off message to the traffic signal system. LISA receives the data radio messages from vehicles, evaluates them and forwards green light requests to the traffic signal system control unit via a serial interface or via zero-potential contacts.

TSP is in the process of being implemented for 35 intersections in the ROUTE 5 corridor. Deliverable L/M contains a discussion of the potential benefits of expanding TSP to other intersections in the corridor. Generally, the negative impacts on cross-street traffic appear to be minimal based on the traffic analysis, while broad application of TSP to the corridor results in substantial travel time benefits for the BRT and local transit services. The conclusion of this study is that an aggressive pursuit of TSP throughout the corridor is warranted.

Automated Annunciation/Signage System

An automated annunciation/signage system provides useful in-vehicle information to riders concerning their trips and facilitates compliance with the Americans with Disabilities Act (ADA). A key feature of these systems is the use of AVL system data to provide location information to the on-board software, which determines the appropriate announcement/display. Most transit agencies that are implementing these systems are supplying some combination of audio and visual information about next stop, major intersection/point of interest, and transfer points to achieve both objectives. Other in-vehicle information that could be displayed/announced using an annunciation/signage system includes:

Promotional announcements for CDTA or area establishments;
Static transfer/connection information;
Real-time transfer status information; and
News, weather, sports scores, etc.

A recent additional capability of some annunciation/signage systems is the integration of bus destination signs with AVL systems to ensure that the destination information displayed on an external destination sign is legible and audible. By automating the changes, this integration takes away from the vehicle operator the responsibility to manually change the destination sign.

En-Route Traveler Information System

Just as travelers benefit from information before embarking on their trip, information provided en route is no less critical. When transit vehicles run off schedule, travelers may wonder if/when the next bus will arrive and experience anxiety. Providing real-time arrival time at stations and/or stops has been shown to alleviate traveler anxiety.

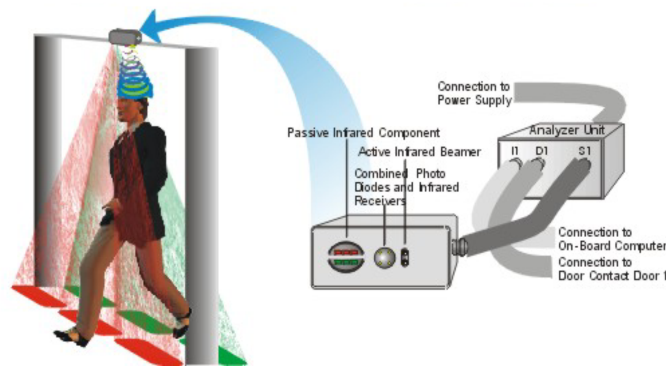
Providing en-route transit information plays a significant role in keeping travelers informed about the status of their vehicle and directing them to the right stops, platforms, and bays. Real-time, or dynamic, information describing current transit operations includes updates on delays, incidents, and service diversions along transit routes, as well as estimated vehicle arrival and departure times for stops along the routes.

The proposed BRT system can benefit greatly from the deployment of a real-time bus information system. With the proposed headways of 12 and 20 minutes during peak periods and midday, respectively, a real-time bus arrival information system will help reduce passengers' anxiety. With a number of feeders being proposed to connect with the BRT system at various stops, a real-time bus arrival information system may also provide information about feeder vehicles.

It is recommended that CDTA provide real-time bus arrival information at least at the five major stops. Ultimately, all of the other stops should be equipped with the same system.

APC

Automatic passenger counters (APCs) automatically count passengers as they board and alight transit vehicles. With the introduction of GPS-based AVL systems, the integration of APC systems with AVL will provide CDTA with bus-stop level ridership data. This differs from using farebox counts, which only provide a count of the number of people entering at a particular location and total passenger counts over some time interval.



An APC system creates an electronic record at each bus stop, typically including the following information: stop location; stop date/time; time of doors opening/closing; number of passenger boardings; and number of passengers alighting. Usually, these records are grouped by trip. APC data can be collected on-board the vehicle and downloaded via floppy disk, PCMCIA card, or infrared transmission in the garage. It can alternatively be transmitted in real-time over the data communication system.

Two basic technologies are used for passenger counting. Treadle mats count passengers by sensing foot pressure as passengers traverse the bus steps while boarding or alighting. Another approach is to use infrared sensors to count people passing a certain point in the doorway. Two types of sensors are commonly used: horizontal and vertical beam tracking. The horizontal beam method requires at least two beams, located at waist-height, projected across the boarding and alighting area at each door. An infra-red beam system counts a boarding or alighting depending on the order of beam interruption. The vertical beam system is mounted above the door and is capable of tracking thermal mass movement.

Although treadle mat APC systems have been used for many years, they have some inherent problems in adverse weather. Sensors imbedded in the treadle mats tend to malfunction due to rain and/or snow. Horizontal infrared beam tracking, while more reliable than treadle-mat technology, has its own problems. Horizontal beam systems require the use of at least two beams at each door, and each beam need to be aligned accurately with their respective receivers. If any of the beams is not aligned properly, the system will fail to count passengers. Moreover, horizontal beam systems are prone to having the sensors inadvertently blocked by objects (e.g., jacket, umbrella). The vertical beam system offers the best solution to counting passengers while at the same time avoiding the issues of the other two technologies. However, the vertical beam system may be a little more expensive.

One important feature of APCs is the ability to accurately "stamp" the data with the exact bus stop location and time of day. We recommend that the CDTA APC system be interfaced with the AVL system – a common approach. Interfacing APC with AVL also helps eliminate the need to rely on operator input on when the route starts/ends. This will increase the accuracy and reliability of the APC data.

APC systems are often implemented to reduce the cost of manual data collection and National Transit Database reporting requirements. The data can also be used for route scheduling (e.g., by identifying the maximum load point, loading profiles, optimizing locations for short-turn patterns). An APC system will help assist CDTA in recognizing if there is a need to add additional vehicles, or vehicles with larger capacity, to handle the overloading.

Transit operators typically deploy APC equipment on about 15% to 20% of their vehicles and then rotate the vehicles on different routes as needed. However, as APC equipment has become less expensive, agencies are beginning to consider comprehensive APC deployment. This avoids the need to ensure the assignment of APC-equipped vehicles to specific routes that need to be surveyed.

Other Technologies

Other potential elements including off-vehicle fare collection, contact-less smart cards, vehicle-component monitoring system, and on-board camera surveillance could be implemented at a later stage, as funding becomes available and depending on the success of the BRT express service on ROUTE 5. These elements are not considered necessary in the initial phases of the BRT system.