

Corridor Two Regional Rail Feasibility Study and Alignment Alternatives

TECHNICAL MEMORANDUM 5.0

Concepts for a Maximum Bus Plan

December 2009

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Introduction

As part of the Corridor Two Preliminary Feasibility Study, several alternatives have been formulated to test the consequences of different levels of investment in transit infrastructure and operations along the corridor. This memorandum presents a description of a bus alternative that differs significantly from the existing bus service in terms of higher operating speeds, more frequent service, longer span of service, and higher levels of both on-board and station stop amenities. Accordingly, this option has been labeled the “Maximum Bus Plan.”

The Maximum Bus Plan calls for application of select features of the Bus Rapid Transit (BRT) concept which has received renewed interest from local transit agencies as well as the federal government. Many transit agencies have implemented BRT while dozens of other agencies are in various stages of planning and implementation. Moreover, considerable research activity has been undertaken to better understand and promote this mode. In addition, the Federal Transit Administration (FTA) has created a “small starts” program to fund BRT projects that are relatively economical in comparison to rail alternatives in terms of initial capital investments.

Evaluation of a Maximum Bus plan is appropriate both as a stand-alone alternative to potentially satisfying the long-term demand for high quality public transit service in the corridor; but also as a potential near term strategy that is part of an incremental approach to ultimately deploying commuter rail service in the corridor. One possible scenario is that through strategic investment in transit capital improvements in support of a frequent, high-capacity BRT-like service in the corridor, near term transit mobility needs can be addressed while also building a stronger transit riding habit in the communities along Corridor Two. The increased acceptance and utilization of transit along with supportive land development patterns, as outlined in the recently-adopted Lebanon County Comprehensive Plan, could converge in a fashion that enhances the prospects for and the ultimate financial performance of a rail system.

Since the Maximum Bus Plan is one key element of a preliminary investigation of alternative modes (i.e., rail and bus), based on the results of the feasibility analysis and comments received, the Maximum Bus Plan could be refined and adjusted through future study efforts.

Existing Bus System

Currently, bus service in the corridor which includes U.S. 422, U.S. 322 and I-83 and parallels the Norfolk Southern rail right-of-way, is provided by three bus operators: County of Lebanon Transit (COLT), Capital Area Transit (CAT) and Capitol Trailways. Each of the services and the routes within the corridor operated by these three carriers is described below.

- **County of Lebanon Transit** - COLT operates about a dozen bus routes which focus on downtown Lebanon and the passenger terminal at 7th and Willow Streets. Many of the routes operate on a timed transfer basis, with buses arriving and departing at approximately the same time to permit transferring between bus routes without lengthy waiting times.

Route 8 operates in the corridor between Lebanon and Hershey, principally along U.S. 422 and Hershey Park Drive, and serves several intermediate communities (e.g., Cleona and Annville). The bus route originates at the 7th and Willow Streets terminal in Lebanon and terminates at the Hershey Outlets. Headways (i.e., the interval between buses in minutes) are not uniform and are relatively long on weekdays. Between 6:15AM and 3:40PM, only six trips are operated in each direction. Typically buses operate about every 90-120 minutes on weekdays.

COLT also operates Twilight service in which certain routes operate during evenings and on Saturday. Route 8 is one of these routes which adds three daily round trips. While running times vary somewhat by time of day between Lebanon and Hershey, typical values are about 40 minutes. COLT also operates the Route 18 Express, which closely follows the alignment of Route 8 with eight round trips provided on weekdays. This route operates from the Capitol Trailways Terminal/COLT park-ride at Schneider Drive and North Lincoln Avenue to the Hershey Medical Center. COLT does not operate any service on Sunday.

- **Capital Area Transit** - CAT provides bus service in the Harrisburg metropolitan area with the Market Square Transfer Center serving as the focal point of the system in downtown Harrisburg. The system is extensive and includes about four dozen bus lines that include both local and express (i.e., park-ride) routes.

Of interest in the current analysis are three routes that operate in or adjacent to the corridor. Route 8: Derry/Rutherford originates at the Transfer Center (i.e., 2nd and Market Streets) and operates principally along Derry Street. The route serves residential communities to the east of downtown Harrisburg with service to major generators such as Harrisburg Mall, Wal-Mart and Swatara Square. Not all bus trips operate the full length of the bus route. The most frequent service is to the

Harrisburg Mall, with only some trips traveling further east. The route is designed to serve residents who work in Harrisburg as well as serve employees and shoppers of the retail establishments.

Buses typically operate about 16 hours from about 6:00AM to 10:00PM on weekdays. Buses operate every 20 to 30 minutes for most of the weekday service period with hourly service in the late evening. Service is also operated on Saturday with a relatively lengthy span of service from about 7:30AM to Midnight. Headways are not uniform and typically are about 30 minutes during much of the day and hourly after 10:00PM. No Sunday service is operated.

Route 322 operates between downtown Harrisburg and the Hershey Outlets utilizing I-83, U.S. 322 and U.S 422. The route serves the Hershey Medical Center and other activity centers in Hershey. The time required to traverse this distance varies by time period and ranges from about 45 minutes to one hour. Service is only operated on weekdays with no weekend service. CAT operates about nine round trips during the service day of about 12 hours (i.e., approximately 6:00AM to 6:00PM).

Reflecting the importance of Hershey Park as a major employer, a seasonal bus line (i.e., Route HP) is operated on Monday through Saturday between Memorial Day and Labor Day. Four round trips are operated during the summer between the uptown area and downtown areas of Harrisburg and the Hershey Park Service Center (i.e., employee entrance).

- **Capitol Trailways** - This carrier operates a route between Reading and Harrisburg. Of interest for purposes of the current analysis is the portion of the Corridor between Lebanon and Harrisburg. The route makes specified stops along the corridor (e.g., Annville and Hershey Medical Center) with flag stops along other portions of the route. It should be noted that while Capitol Trailways is a private carrier, unlike COLT and CAT which are public agencies, it is also a recipient of funding assistance from PennDOT.

The route originates in Lebanon at the Capitol Trailways terminal at Schneider Drive and North Lincoln Avenue. Three round trips are operated daily including weekends. Typical one-way running times are about 60 to 80 minutes. It should be noted that while COLT operates between Lebanon and Hershey and CAT operates between Harrisburg and Hershey, Capital Trailways operates the entire length of the corridor.

The discussion above provides an overview of the three carriers currently operating in the corridor, and a description of the routes operated in terms of alignment, frequency and span of service. For the most part, they provide local bus service in that passengers can board and alight over the entire length. The services are not coordinated among the operators, with service east of Hershey provided by COLT and service west of Hershey operated by CAT. As noted previously, only Capitol Trailways operates the

entire length of the corridor. While not presented here, it should be recognized that demand responsive services are also available. Typically these services are restricted to client groups such as senior citizens, persons with disabilities and low income persons that are part of a human service program.

Maximum Bus Plan

This section describes an ambitious public transportation bus option for the corridor which extends from the City of Lebanon to downtown Harrisburg. It reflects an adaptation of Bus Rapid Transit (BRT) concepts to the corridor and would utilize existing roadways (i.e., U.S. 422, U.S. 322 and I-83) which parallel the rail right-of-way. The plan does not call for buses operating on entirely new and exclusive roadways. Instead, existing roadways will be used with consideration of both physical and operational features at select locations to expedite bus movements through the corridor. This could include additional bus-only lanes for selected segments and traffic control features to expedite bus movements.

Bus Rapid Transit - In view of the current service and the nature of the development patterns in the corridor, a plan embracing Bus Rapid Transit concepts has been suggested. BRT is not a single strategy to improve bus service, but rather a menu of enhancements to make bus service more attractive to new riders. In particular, BRT is designed to attract “choice” riders who have a car and opt to use the bus system. While many current bus riders are “captive” in that they do not have a car and public transportation is their only mobility option, both CAT and COLT reported that a relatively high percentage of choice riders currently use their systems. Survey results for CAT indicated that 58 percent of all riders did have a car available, while the corresponding number for COLT is 47 percent. These results would suggest that both systems have the ability to attract many travelers who have a car available for their. Since most persons in the corridor use a car to make their trips, the choice travelers represents a significant potential market for public transportation. BRT has received considerable attention recently because it is viewed as a cost-effective means to attract new riders that desire premium transit service.

While elements of BRT vary from one location to another, it consists of four primary features which are highlighted below:

- **Higher Speed** - To attract new riders, the transit system must offer speeds that compete effectively with the private automobile. This could include operation of buses on their own right-of-way or on existing streets with preferential treatment. The latter could include traffic signal pre-emption or “queue jumpers” to expedite bus movements. Another feature would be express or limited stop bus service which would afford time savings in comparison to local bus routes that stop every

block or two. Some transit systems have opted for off-line fare collection or new fare technology (e.g., smart cards) to reduce bus dwell times.

PennDOT, in cooperation with Lebanon County, recently completed a traffic analysis of U.S. 422 and is proceeding with implementing improvements to reduce traffic congestion. Signal preemption capability for emergency vehicles is planned to be part of the improvements, and the addition of various aspects of BRT could be integrated with these planned improvements.

- **Reliability** - Travelers associate a time penalty with unreliable transit service. Often buses are delayed because they experience congested conditions. Many of the improvements mentioned above could be used to assure bus service that operates in accordance with the bus schedule. The high level of on-time performance would be an attractive feature of any new service.
- **Passenger Amenities** - This could include bus shelters, passenger kiosks, benches and other features that would afford a more comfortable environment for riders. Other elements could include real-time information on the transit system such as the time of the next arriving bus.
- **Branding** - Another element of BRT is to create a separate identity and image for the new service. This could include new types of buses or more conventional equipment with a unique color scheme. The objective is to distinguish the proposed service from that ordinarily operated by the transit agencies in the corridor. It is anticipated that this new brand, with its superior performance characteristics, amenities, and levels of service will attract new riders who currently drive to make work and other trip purposes.

Service Plan - At the outset, several planning precepts were specified that were included in the Maximum Bus Plan. It should be noted that the plan outlined here is a Maximum Bus Plan that could be approached incrementally. The more capital-intensive improvements could be deferred until ridership grows to a point where the investments are more cost effective. The following principles guided the development of alignment and bus stops and are summarized below:

- **Simple Route Alignment** - The proposed route would extend from the core area of Lebanon to downtown Harrisburg principally along U.S. 422, U.S. 322 and I-83. A single routing would be followed to make it easier for new riders to understand the system. This would not preclude limited “turnback” service (i.e. certain trips only serve a portion of the corridor rather than make the entire trip) or alternate routes to Hershey Park which reflect the seasonal nature of this generator.
- **Limited Stop** - The proposed bus service would only stop in the centers of the more densely developed areas and at major generators. In downtown Harrisburg,

the proposed service would have more closely spaced bus stops to provide convenient access to jobs and other trip attractors.

- High Frequency** – The current service is characterized by relatively long headways. The proposed service would operate at more frequent levels. This could include peak period headways of 10 to 15 minutes and off-peak headways that have buses operating every 30 to 60 minutes. One additional point is that the same headway would not necessarily be operated over the entire length of the service area between Lebanon and Harrisburg. For instance, headways could vary by distance from downtown Harrisburg with more frequent service in the western (more densely developed) portion of the corridor.

As shown in Table 1, the proposed operating plan at this stage of the analysis calls for a significant increase in service. During both the morning and afternoon weekday peak periods, westbound buses destined for Harrisburg would originate every 20 minutes at both Lebanon and Hershey.

Table 1 – Frequency of Service (Headway in Minutes)

Time Period	Hershey to/from Harrisburg	Lebanon to/from Harrisburg
Weekday		
AM Peak	20	20
Midday	--	30
PM Peak	20	20
Early Evening	--	30
Late Evening	--	60
Saturday	--	30
Sunday	--	60

The resulting headways would be 20 minutes on the outlying route segment between Lebanon and Hershey, while the western segment from Hershey to Harrisburg would have a combined headway of ten minutes. At all other times, only a single routing/scheduling would be used and would provide 20 minutes headways throughout the entire length between Lebanon and Harrisburg.

On weekdays, buses would operate every 30 minutes during midday and early evening hours, and hourly service would be provided in the late evening. On weekends, a relatively frequent service of 30 and 60 minutes would be operated throughout the day on Saturday and Sunday, respectively.

- Extended Service Hours** Spans of service would be longer than currently operated, and consistent with an ambitious transit scheme and a high level of service for a more distant horizon period. For example, neither COLT nor CAT currently operates Sunday service which is called for with the Maximum Bus

Plan. As shown in Table 2, the proposed span of service for the BRT is designed to serve a variety of trip purposes.

Table 2 – Span of Service

Day	Begin	End
Weekday	6AM	10PM
Saturday	7AM	8PM
Sunday	9AM	6PM

- Integrate with Other Routes and Services** - The current service operated by COLT and CAT could continue to operate since they only serve portions of the corridor. Further, in many areas their buses would provide local service. Similarly, steps would be taken to integrate the new service with that operated by Capitol Trailways.

Another point is that new shuttle services could be introduced to link areas not within convenient walking distance to the BRT bus stops. For example, Hershey might be a candidate community for a shuttle service since there are a number of major generators that cannot all be served without introducing significant delay for riders destined for points beyond Hershey. Another area that may warrant shuttle connections is in the vicinity the Harrisburg Mall and TecPort complex. This topic is addressed in more detail in the description of station locations.

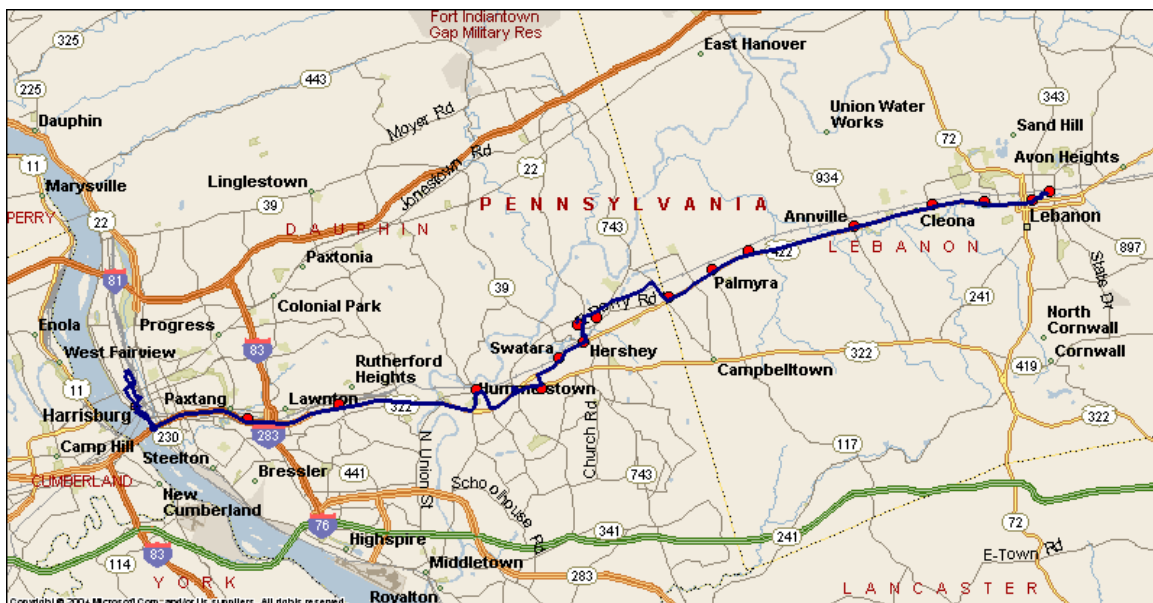
- Flexible** - A key feature of rubber tire transit technology is that it can be revised to respond to growth or special conditions such as seasonal activities. Several examples of how the flexibility of the Maximum Bus Plan could be advantageous in the future include:
 - Provision of special services oriented to either visitors or employees of Hershey Park that could be operated on a seasonal basis in response to shifts in demand
 - Operating buses that collect/distribute passengers in the fast growing residential areas along PA 39 and then join the trunk route in Hershey.
 - Service to a potential development, cited by Lebanon County planners during the course of this study, that could result in a major new mixed use/business park development south of Rt. 422 in the vicinity of Mt. Pleasant Road.

Also, services could be designed with fewer stops to provide an even greater premium express bus service for employees destined for downtown Harrisburg. The concerns with variations are that the service concept is more complicated and not as simple as the initial Maximum Bus Plan. Although this plan does not call for these types of services, the need for such services could be investigated in

more detail as part of the subsequent studies as the BRT concept moves towards implementation.

Route Alignment and Stations - To provide a further description of the BRT concept applied to the corridor, the alignment of the proposed bus service and the suggested stops have been preliminarily specified. It should be recognized that these locations may be revised as this alternative is subject to further analysis during more detailed planning studies. The proposed bus stop locations are intentionally more widely spaced in comparison to the existing bus routes, reflecting the objective of offering a higher-speed, premium service. Access to the stations would be by multiple modes including walking, connecting local bus service, auto (include park-ride and kiss-ride access mode), bicycle, etc. As noted earlier, dedicated shuttles may be warranted to provide convenient connections to/from major generators that are beyond walking distance to the designated stops. Parking facilities could utilize existing parking lots (e.g., shopping centers) or new construction. The alignment of the proposed route and stations are shown in Figure 1, and a description of the proposed station locations follows.

Figure 1 - BRT Alignment and Stops



Along U.S. 422

- Lebanon

- Schneider Drive (existing park-ride and Capitol Trailways terminal) will serve as the eastern terminus
- 7th and Willow Streets (existing COLT terminal)
- Lebanon Valley Mall (potential park-ride)

- Cleona
 - Center Street and Penn Avenue

- Annville
 - Main Street and White Oak Street

- Palmyra
 - Londonderry Square (potential park-ride)
 - North Forge Road and East Main Street

- Palmdale
 - West Main Street and Lingle Avenue

Along North Lingle Avenue and Hershey Park Drive (PA 743) the route diverts from U.S. 422

- Hershey
 - Outlets at Hershey (potential park-ride)
 - Hershey Park Service Entrance (seasonal)

Along U.S. Route 422 the route returns from Park Drive to Chocolate Avenue

- Chocolate Avenue and Linden Road (Intermodal Transportation Center)
- Hockersville Road and West Chocolate Avenue (Swatara)

Along University Drive and then returns to U.S. 322

- Hershey Medical Center

Along U.S. 322 alignment diverts to downtown Hummelstown via split interchange of U.S. 322 with Quarry Road/Waltonville Road and Hanover Street/Middletown Road and returns to U.S. 322. (possibility exists for a park-ride lot at either interchange)

- Hummelstown
 - South Hanover and East Main

- Rutherford Heights
 - Mushroom Hill Road (Weis Market potential park-ride). This location that was the subject of a field examination because of concerns regarding the engineering difficulty and potential costs of a bus stop along U.S. Route 322 at Mushroom Hill Road. Initially, it was thought that the

westbound bus stop would be constructed near the current embankment west of Mushroom Hill Road. The bus stop in the opposite direction would be located on the southwest quadrant of the intersection. Because of the steep grades in the area and the need to assure ADA compliance the concept of constructing eastbound and westbound highway stops was dropped. Instead, the bus would divert from US. Route 322 to an off-line bus stop location in the vicinity of the intersection.

As part of the assessment of options for serving this location, the consultant team was advised that extensive new development is in the early planning stages for a vacant parcel along Rt. 322, immediately west of Mushroom Hill Road. It is recommended that MTP and CAT keep abreast of the development plans and engage both the developer and PennDOT in discussions regarding provision of convenient access/egress to both the new development and to the Swatara Square complex. If appropriate bus flow/stop accommodations can be integrated with the overall development and transportation improvements, the dual benefits of convenient service to the new site and improved service to existing development can be attained.

Freeway Station Along I-83 (possible longer-term strategy)

- Paxtang – Harrisburg Mall - TecPort Area
 - The feasibility of a freeway station, in the vicinity of Friendship Road, was studied as a means to serve Harrisburg Mall and the TecPort complex, without imposing time delays for both eastbound and westbound riders destined for points beyond that location. The concept involved a station along I-83 in the vicinity of Friendship Road. A bus station would be constructed on both shoulders. It would include a deceleration lane, a bus loading/unloading area with shelter, an acceleration lane, and a means to achieve ADA-compliant vertical access between the freeway and Friendship Road. This station would provide access to Harrisburg Mall and the TecPort Complex through the existing CAT route or a shuttle service. Because of the complexity of an aerial freeway bus station, an on-site review was conducted to preliminarily assess the physical and operational feasibility of this concept. The results of this examination suggest that the proposal would be cost prohibitive due to the intensity of the existing transportation infrastructure in the resulting limitations on space to develop the necessary facilities. As a result, this concept was dropped from further consideration.

An alternative approach to serving the Harrisburg Mall and TecPort Complex would have the BRT vehicles exit I-83 and circulate in the area before proceeding downtown. While this would offer a one-seat ride to persons destined for the Harrisburg Mall and TecPort Complex, it would represent a delay to patrons destined for downtown Harrisburg. In the near term, it is anticipated that access to the Harrisburg Mall and TecPort

Complex would be provided by this approach with selected trips routed via these major generators, but with the bulk of service operating non-stop to downtown Harrisburg.

The Harrisburg Area Transportation Study (HATS) group has discussed the need for I-83 capacity expansion through this area. If plans for such a project are advanced, it is recommended that provision for a freeway BRT station/stop as described above, be assessed as part of the overall reconfiguration of the transportation infrastructure in that area.

Downtown Loop

- The objective of the downtown routing would be to provide a one-seat ride for most riders which would mandate a circulation routing with extensive coverage. A few possible options were considered for downtown Harrisburg, which included bus alignments similar to those used by CAT and Rabbit Express (York). With these plans, buses would utilize 2nd Street to enter downtown and depart via Front Street. Another possibility would be to enter and depart downtown via the 13th Street interchange on I-83. Based on discussions with CAT staff, a proposed alignment has been suggested for consideration. Buses would proceed via 2nd Street, Market Street, 5th Street, Commonwealth Street, 6th Street, Reily Street, 7th Street, Forster Street, 3rd Street, Chestnut Street and Front Street. Alternatively, buses could only proceed as far north as Boas Street. The objective would be to serve existing generators (e.g., Pennsylvania Higher Education Assistance Agency) and the developing Midtown area. It is anticipated that existing CAT bus stops in the City would be used by the BRT vehicles. Depending on the extent of development anticipated as a result of HACC's new Midtown Campus and the results of the current sites studies for the new Federal court house, an additional alternative routing would be to continue west along Reily Street (across 6th Street) and then make the left on 3rd Street toward the Capitol and downtown.

Fares – For purposes of the analysis, a fare structure was devised for the premium service that would be offered by the BRT plan. The existing fare structure for CAT and COLT was examined, although neither agency operates the entire length of the corridor. This information was supplemented by the fares charged by Capitol Trailways which operates between Lebanon and Harrisburg. In addition, the fare structure for Rabbit Transit was reviewed since they operate express bus service between York and Harrisburg.

As shown in Table 3, the COLT fare structure distinguishes between trips made within the City and County with longer trips charged more. In addition, COLT also offers a 10-Ride and 31-Day pass program. The former provides no discount while the latter affords a discount of about 15 percent. For example, a person on a City fare who travels every day to work by bus would ride 42 times in a month and pay \$58.80 if they paid \$1.40 each time they boarded the bus. With the 31 Day City Pass, they would only pay \$50.00 or a savings of \$8.80 (i.e., approximately 15 percent).

Table 3 – COLT Fare Structure

Fare Category	City	County
Adult Cash Fare	\$1.40	\$1.80
Day Pass	\$5.00	\$5.00
10 Ride Ticket	\$14.00	\$18.00
31 Day Pass	\$50.00	\$65.00

Another feature of the COLT fare structure is a Day Pass which is accepted for both City and County trips and transfers are free. Senior citizens ride for free with PennDOT reimbursing COLT for these trips.

In a similar manner, the CAT fare structure was reviewed and summarized in Table 4. Fares are generally based on distances traveled which are reflected in the number of zones traversed. Discounts are offered for both multiple ride fare media. For example, a person on a Zone 2 trip, such as Harrisburg to Hershey, who travels every day to work by bus would ride 42 times in a month and pay \$86.10 if they paid \$2.05 each time they boarded the bus. With the Monthly Pass, they would only pay \$58.00 or a savings of \$28.10 (i.e., approximately 33 percent). The individual making this trip would only have to make 15 round trips in a month to make the Monthly Pass more economical than paying the cash fare. A fee of 25 cents is charged for transfers.

Table 4 – CAT Fare Structure

Fare Category	Zone 1	Zone 2	Zone 3
Adult Cash Fare	\$1.65	\$2.05	\$2.45
11 Ride Ticket	\$16.50	\$20.90	\$25.00
25 Ride Ticket	\$33.00	\$43.00	\$53.00
Monthly Pass	\$45.00	\$58.00	\$69.00

The other existing operator in the corridor is Capitol Trailways which charges \$7.95 for trips between Lebanon and Hershey, and offers less costly travel between Hershey and Harrisburg (\$1.85) and between Hershey and Lebanon (\$2.40). No multiple ride tickets or discounts are offered.

RabbitTransit operates express bus service from York to Harrisburg with a one-way cash fare of \$3.00. An 11 Ride Express Hop-n-Go is \$27.00 which results in an average fare of \$2.45 or an 18 percent discount. Greater discounts are provided by the Monthly Express Hop-n-Go which costs \$80.00 and results in an average fare of \$1.90 based on usage on 21 days or a discount of 37 percent. Another feature of the York – Harrisburg service is that the RabbitTransit monthly pass can be used for payment on

Capitol Trailways which operates south of Harrisburg to York and continuing to Baltimore.

Based on the prevailing fare structures, experience in other areas and the concept of a premium service, a fare structure for the Maximum Bus Plan would include three fare payment categories. The fares charged would reflect distance traveled and the provision of discounts for both multiple fare categories. Sample one-way and round trip fares for trips traversing the entire length of the route, and for trips between Hershey and the two end points are presented in Table 5.

Table 5 - Proposed Fare Structure

Fare Category	Hershey to/from Harrisburg	Lebanon to/from Hershey	Lebanon to/from Harrisburg
Adult Cash Fare	2.00	2.50	4.00
10 Ride Ticket	13.50	16.50	27.00
Monthly Pass	55.00	65.00	100.00

Similar to service, fares should be coordinated between the proposed BRT service and both local transit agencies (i.e., COLT and CAT). In addition, a reciprocal fare arrangement with Capitol Trailways would also be a desirable feature of any fare proposal.

Capital Program - The BRT plan would include various physical elements to provide enhanced comfort to patrons. The key elements are highlighted below:

- Vehicles** - An important decision is the vehicle which should provide a comfortable ride, adequate capacity and reflect the branding concept, which would distinguish it from other transit services. Vehicles could include conventional vehicles which are stylized as specialized BRT coaches. The conventional vehicles could be urban transit buses, suburban coaches or inter-city cruisers. Figure 2 presents application of the stylized bus approach to a recently implemented BRT system by NJ Transit in Newark. If demand and operational considerations warrant, the specialized vehicles could include articulated buses which have a streamlined appearance (Figure 3).

Currently, CAT operates a suburban coach that is manufactured by Gillig which offers a low-floor bus in a suburban-style seating configuration. It has a single front door, high-backed upholstered seating, two-plus-two seating plan with relatively wide aisles, reading lights and luggage racks. The vehicles have 35 seats and have a purchase price of approximately \$340,000. With a unique and special paint scheme, this would appear to be a vehicle well suited to the BRT concept in the corridor.

The peak period service levels mentioned previously would require the operation of 13 buses. A reasonable allowance (i.e., about 20 percent) for spare buses to

permit routine maintenance and responding to vehicles out of service, would require three additional buses bringing total fleet requirements to 16 buses. Based on a purchase price of \$350,000 in 2008 dollars, an outlay of \$5.6 million would be required for rolling stock.

- **Passenger Waiting Shelters** - With the exception of downtown Harrisburg, all bus stops would have passenger waiting shelters. They would have a distinctive design and could include benches and lighting. Schedule information and real-time data on the expected arrival of the next bus could be displayed. Consistent with the branding concept that this is a unique transit service, the shelters and amenities would be more elaborate than the current shelter program.

While the design would be subject to refinement in future studies, it is estimated that each of these shelters would require \$100,000 for materials, site preparation, construction and equipment installation. A total of 12 bus stops would have these unique and more elaborate shelters at a total cost of \$1,200,000.

In downtown Harrisburg, an expanded program of shelters and benches would be undertaken with the more heavily used bus stops having a distinctive design to identify them as stops on the premium bus service. It is assumed that existing Capitol Trailways and COLT terminals and six locations in downtown Harrisburg would not require the most costly improvement. At these eight locations, amenities costing approximately \$50,000 each would be required at a total cost of \$400,000.

Figure 2 - Stylized Conventional Bus



Figure 3 – Specialized and Streamlined Bus



- **Bus Stop Signs** - In keeping with the branding concept, all bus stops served by BRT would have a unique bus stop sign. A lump sum amount of \$15,000 has been assumed for bus stop signs at locations along the BRT route that do not have passenger waiting shelters.
- **Information Kiosks** - Schedule information including maps and times would be listed for the BRT route and other transit services. Screens with real-time bus arrival information could be included at select locations and the cost of the displays has been included in the costs of passenger waiting shelters discussed above. A lump sum amount of \$15,000 is estimated for information displays at downtown bus stops. The expense of an Automatic Vehicle Locator system has been included in the cost estimates.
- **Park-Ride Lots** - It is anticipated that many riders would drive to the BRT service, particularly in outlying areas. To the extent possible, existing park lots would be utilized and include: Capitol Trailways lot, Lebanon Valley Mall, Londonderry Square, Outlets at Hershey, Transportation Center, Hershey Medical Center, Swatara Square and Harrisburg Mall. In addition, construction of new parking facilities would be suggested in the vicinity of the Hershey Medical Center and along U.S. 322 near Hummelstown. Total costs of the parking program, which would consist of improving surface lots is estimated at \$250,000. To the extent that existing shopping center lots would not be available, the plan would require new facilities with higher costs.
- **Automatic Vehicle Locator (AVL)** - In keeping with the premium service, the location of all vehicles would be tracked. This would permit operations personnel to monitor service and take appropriate action to assure schedule adherence. In addition, the technology permits real-time information to riders on actual operations. This would include on-board annunciators of stops, next-bus signs at each of the 20 key stops, as well as access via the internet, telephones and Personal Digital Assistants (PDAs). An order of magnitude estimate of the cost of an AVL system would be \$750,000.

An estimate of the necessary capital expenditures, which assumes installation and construction of all features of the BRT plan as discussed above, is shown in Table 6. To the extent, various capital elements were not implemented, capital expenditures would be less. Conversely, if more elaborate physical elements were included in the final plan, the capital costs would increase. It should be recognized that the cost estimates presented here are for comparison purposes with a rail alternative. No amounts have been included for engineering and environmental analysis or for land acquisition or easements.

Table 6 – Estimated Capital Costs

Item	End
Vehicles	\$5,600,000
Passenger Waiting Shelters	\$1,600,000
Bus Stop Signs	\$15,000
Information Kiosks	\$15,000
Park-Ride Lots	\$250,000
AVL System	\$750,000
Total	\$8,230,000

Operating Costs - Based on the proposed service plan (i.e., frequency and span), key operating statistics were determined and used as the basis to estimate annual operating expenses. Initially, preliminary schedules were prepared which indicated revenue hours, revenue miles and peak vehicles for each service day. Since the transit operator and the location of the garage is not known, possible deadhead movements were not computed. Instead, the operating statistics were measured in terms of revenue hours and revenue miles.

As shown in Table 7, the daily results were converted to annual statistics based on the number of days in the year. It was assumed that there were seven weekdays when Sunday service would be operated to reflect a holiday

Table 7 – Annualized Operating Statistics

Period	Number Of Days	Revenue Hours	Revenue Miles	Peak Vehicles
Daily				
Weekday	253	129	2,997	13
Saturday	52	80	1,782	6
Sunday	60	31	693	3
Annual	365	38,570	892,485	--

The next step was to convert the operating statistics to an estimate of operating expenses based on past experience in the service area. For purposes of this analysis, the cost profile of CAT was viewed as representative of the probable costs of providing the premium bus service described in this plan. Further, CAT maintains a detailed set of expense accounts which supports the development of a three-variable cost allocation model.

The basic concept underlying the cost allocation model is that each operating expense is influenced or driven by one or more operating statistics or resource levels. Consideration of the nature of various operating expenses identified three major resource requirements that “drive” each particular expense item. These resources are: (1) revenue hours; (2) revenue miles; and (3) peak vehicles. The “three-variable” model is preferred over a single unit cost factor it provides more accurate results and is sensitive to the speed and vehicle utilization characteristics of the Maximum Bus Plan.

The primary source of data for the cost allocation model was the National Transit Data Base (NTD) submission to the Federal Transit Administration for FY 2006. This represents the most recent one year period approved for accounting purposes. The NTD forms include a description of expenses by function (e.g., vehicle operations) and object (e.g., wages) accounts for fixed route bus service directly operated by CAT. During this period, CAT incurred costs of about 10.4 million dollars, which covers the cost of the entire directly-operated bus system. The cost formula is calibrated by performing the following three tasks:

- Assign each individual expense in the system financial statement to one of the three selected resources that influence costs.
- Sum the costs assigned to each resource to obtain the overall cost allocated to the resource.
- Divide the overall resource cost by the quantity of the resource used by the system. These calculations produce the unit cost of each resource, which are the coefficients of the cost model.

The allocation of each expense item is made on the basis of judgment, although the relationship between the expense item and variable is typically quite evident. For example, operators’ wages are allocated to revenue hours since bus operators are hourly employees. The operating expense of their fringe benefits was also assigned to revenue hours. Some costs, such as mechanics’ compensation, fuel and replacement parts are a direct function of revenue miles operated. In addition, vehicle insurance costs are a function of accident exposure in terms of miles of service.

Many of the expense accounts do not vary as a function of either revenue hours or revenue miles. For example, the cost resulting from providing an operating base and vehicle storage is determined by the number of peak vehicles in service. Also, administrative expenses vary based on the system scale as measured by the number of vehicles required to operate the bus system. The results of this allocation process for the CAT bus system are presented in Table 8.

Table 8 – CAT Cost Allocation Model (FY 2006 dollars)

Basis For Allocation	Amount (Dollars)	Operating Statistic	Unit Cost (Dollars)
Revenue Hours	5,722,200	123,100	46.48
Revenue Miles	3,084,400	1,569,600	1.97
Peak Vehicles	1,619,300	65	24,912
Total	10,425,900	--	--

More than half of all bus system expenses were assigned to revenue hours. This is logical since drivers’ wages and fringe benefits account for a substantial portion of bus system costs. Revenue miles account for about 30 percent of all of the bus system

expenses, with peak vehicles assigned about 16 percent of all costs. The costs attributable to revenue hours result in a cost of \$46.48 per revenue hour. The cost allocated to revenue miles of operation yields a unit cost of \$1.97 per revenue mile, while the costs attributable to each peak vehicle over the course of a year produced a unit cost of \$24,912. The three-variable analysis results in the following cost allocation formula for the CAT bus system:

$$C = 46.48 * H + 1.97 * M + * 24,912 * V$$

where:

C = Cost

H = Revenue Hours

M = Revenue Miles

V = Peak Vehicles

The calibrated three-variable cost formula differs substantially from the traditional transit industry yardstick for measuring cost. This traditional approach is to compute a simple cost per mile or hour statistic. For the fiscal year, systemwide average unit costs for CAT were approximately \$84.69 per revenue hour or \$6.64 per revenue mile. The use of both revenue hours and revenue miles permits the cost allocation model to be sensitive to operating speed and miles operated per vehicle.

Applying the three-variable model to the estimated operating statistics for the Maximum Bus Plan results in annual operating expenses of \$3,868,300 in 2006 dollars. Assuming 12 % total inflation over the past two years, the estimated operating expense in 2008 dollars would be \$4,332,500. The estimated operating expense, revenue, and the resulting deficit are summarized in Table 9.

Farebox Revenue – Utilizing a travel forecasting model developed by the Federal Transit Administration and adjusted for local conditions, estimates were prepared of daily ridership. Documentation of the transit demand estimation process utilized for the commuter rail and maximum bus options is presented in a separate section. Based on the proposed service plan and expected population and employment in 2030, daily weekday ridership is estimated at 2,050 trips. While service would be operated seven days a week, it is reasonable to expect Saturday and Sunday ridership levels to be significantly less than on weekdays. As background, CAT’s Saturday ridership is about one-third of that on weekdays and no Sunday service is offered. Accordingly, an annualization factor of 270 (i.e., annual riders/weekday riders) was assumed.

The proposed fare structure is distance-based and includes passes that offer riders both a convenient fare media and substantial discounts. Based on these features, an average fare (after factoring in the use of discounted fare media) of \$2.00 was assumed with annual revenue estimated to be \$1,107,000 in 2008 dollars. The resulting operating deficit, also in 2008 dollars, would be \$3,225,500.

The estimated operating financial results in 2008 dollars are shown below:

Table 9 - Estimated Financial Results (2008 dollars)

Measure	Amount
Operating Expense	\$4,322,500
Passenger Revenue	\$1,107,000
Deficit	\$3,225,500

Institutional Approach

The current analysis has been directed to assessing the feasibility of a Bus Rapid Transit plan for the corridor and its performance and costs relative to a commuter rail option. Should the Maximum Bus Plan be adopted, various institutional issues regarding the ownership, management, and operation of the service would have to be addressed.

- **Ownership and Management** - Notwithstanding the decision as to who would operate the new service, there would be a need for a public entity that would be responsible for acquiring vehicles and other necessary capital assets, overseeing capital construction projects; and for securing and managing capital and operating grants to finance the improvements and service. Possibilities include one of the existing agencies such as CAT, COLT or the Modern Transit Partnership, or alternatively a new special purpose authority could be created. Regardless of the decision on administration, there would be a need for cooperating agencies/sponsors to enter into an interagency agreement.

The public entity (in consultation with the public sponsors) would also be responsible for all policy and management decisions regarding rates, routes, schedules, and service standards; and would also exercise oversight over the private contractor if one is used. Fare policies that support public transit goals for the area, and are consistent with levels of public funding expected to be available would be established. As noted earlier, the fares charged patrons should be integrated with the current CAT, COLT and Capitol Trailways fare structures. This would include provisions for multiple-ride fare media and reciprocal agreements between carriers. Riders of the proposed BRT service would be allowed to continue their trip on the routes of the existing carriers without an additional charge.

- **Operations** - Because the new service would cover two counties, arrangements would have to be made for the operation of service that covers two counties currently served by three operators. Two basic options would be to either operate the service using (1) in-house agency personnel, or (2) through a contractor. Through an interagency agreement, either CAT or COLT could directly operate the service. If option 2 is preferred and a contractor is selected through a

competitive procurement to operate the service, Capitol Trailways might be interested in providing the service.

Summary

The previous discussion has presented a description of the existing transit system in the corridor in terms of route alignments and coverage, frequency and span of service, and operators. This represents the baseline condition for formulating an ambitious transit proposal for Corridor 2. The alternative suggested for the Maximum Bus Plan calls for adoption of a bus rapid transit scheme which incorporates expanded service levels, higher speed operations and other features of a premium service. The plan also incorporates various amenities and physical improvements that assure a more comfortable environment and trip for potential users. This includes provisions of unique vehicles, shelters and real time bus information.

A suggested service plan has been used to estimate the impacts of the plan in terms of annual hours and miles of service along with peak vehicle requirements. Based on the prevailing cost structure at CAT, estimates of annual operating costs were prepared. Ridership levels for 2030 were forecasted on the basis of the service plan and the expected development patterns in the service area, using a transit demand estimating procedure developed by the Federal Transit Administration. Farebox revenue was estimated using the ridership results and an assumed fare structure.

A capital program was also specified which includes vehicles, park-ride lots and various amenities such as signs, kiosks and shelters. The anticipated capital expenditures along with the expected operating deficit indicate the extent of public subsidy that would be required to support the maximum bus alternative. These financial estimates, combined with the estimated benefits of a significantly expanded transit service along Corridor Two, provide timely input to the planning process to select among the transit options including – maintaining the status quo, the maximum bus plan, commuter rail plan, or a combined bus/rail alternative.
