PITTSBURGH, PENNSYLVANIA

SOUTH, EAST, AND WEST BUSWAYS

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PITTSBURGH, PENNSYLVANIA (USA)
South, East, and West Busways

SUMMARY

Pittsburgh has 16.1 miles [26 km] of busways in service and another 2.3 miles [4 km] under construction. The busways serve about 20% of Allegheny County's daily transit riders, link south, east and west communities with the city center, and result in substantial savings in passenger travel times. Speeds on the busways average 30 to 40 mph [48 to 65 kph]. A brief description of each of Pittsburgh's busways follows:

- The 4.3-mile [7-km] South Busway was placed in service in 1977. Some 16 routes on the eight-station facility carry 13,000 weekday riders. Peak-period time savings range from 6 to 11 minutes. Construction costs were $27 million.
- The 6.8-mile [11-km] East Busway was opened in 1983. Some 36 routes on the six-station facility carry 28,000 riders each weekday. Peak-period time savings typically range from 21 to 24 minutes. The busway, which shares its right-of-way with a relocated rail right-of-way, had construction costs of $113 million. New developments between 1983 and 1996 exceeded $302 million.
- The 5.6-mile [9-km] West Busway opened in September 2000. Some 14 routes on the six-station facility carry about 7,000 riders per day. Time savings are 25 to 26 minutes on the inbound A.M. peak-hour trip. The busway, which follows an abandoned rail line and uses a rehabilitated rail tunnel, cost $275 million.
- A 2.3-mile [4-km] easterly extension of the East Busway, under construction, is scheduled to open during 2003. The busway will have four stations, about 900 park-and-ride spaces, and a linear park. Ridership is estimated at 13,600 weekday passengers. Construction costs will be approximately $63 million.

Each busway operates "all-stop" and express service. There is also through service between the East and West Busways.

The busways were developed by the Port Authority of Allegheny County in cooperation with the City of Pittsburgh, the State of Pennsylvania, and the Federal Transit Administration.

CITY CONTEXT

The Pittsburgh Urbanized Area has a population of about 1.7 million of which about 400,000 live within the City. The region's population has remained relatively constant for several decades while the City's population has declined substantially.

Pittsburgh's central business district (CBD) – the Golden Triangle – is located at the confluence of the Allegheny, Mongonohela, and Ohio Rivers. This geographically constrained 1/2 –square-mile area has an employment of about 140,000. During each peak hour, about 60,000 people enter (or leave) this area – about 60% by public transport.

The City and many of the surrounding suburbs in Allegheny County are located in hilly terrain that limits both development patterns and transportation corridors. Pittsburgh's unique physical

setting has concentrated travel and has fostered public transportation ridership. The hills, valleys, and rivers have helped create natural corridors for roads, railroads, and transit routes. These same features have limited express highway construction.

The Port Authority of Allegheny County Transit (PAT) was created by state legislation in March 1964. Following passage of this act, PAT consolidated the Pittsburgh Railways Company, 32 independent buses, and inclined plane companies into a single integrated transit system. Its service covers a 750-square-mile area that includes the City of Pittsburgh and all of Allegheny County.

Port Authority Transit (PAT) has a fleet of 920 buses, 55 light rail vehicles (LRVs), and 80 mini-buses. It also operates the Monongahela and Duquesne inclines and sponsors ACCESS, the nation's largest paratransit program. Some 3,100 employees serve approximately 260,000 riders daily and more than 76 million riders annually.

Over the years, PAT has modernized the transit fleet, converted the South Hills trolley lines to light rail operation, and built the South, East, and West Busways. It is extending the East Busway and developing light rail transit (LRT) service to the north side of the City. A large proportion of its transit service operates in exclusive or priority rights-of-way.

A Pennsylvania Public Transportation Assistance Fund, created in 1991, has generated up to $38.2 million per year, but has generated less funding in recent years. PAT's operating costs are financed by fares (38%), commercial sources (7%), subsidy and grants (44%), and a tax levy (11%).

Pittsburgh has a long history of public transportation planning and development dating back to the 1850s. More than 16 transit studies and plans have been prepared since 1906, an average of about 1 every 4 years. As a result of the region's confining topography, virtually all studies have located new transit facilities in common corridors extending south and east from the Golden Triangle. All plans developed before 1968 lacked community support and financing mechanisms necessary for implementation.

PLANNING AND IMPLEMENTATION BACKGROUND

The emphasis on public transport improvements was partially triggered by community reaction to proposed highway improvements. Since the 1950s, there had been growing traffic congestion on the Penn Lincoln Parkway, mostly centered on the Penn Lincoln Tunnel. The Pennsylvania Highways Department made plans to rebuild the parkway, but the costs, disruption, and maintenance of traffic during a 7-year construction period were unacceptable to the community.(1) Major highway improvements in the South Hills area were also seen as difficult and costly.

THE EARLY ACTION PLAN

The PAT Board, following initial operations in March 1964, authorized consultants to look at all previous transit studies to determine a rapid transit plan. From the 1967 plan, PAT's "Early Action Program" evolved, which included construction of two busways (the South and East

Busways), a fixed guideway system to replace the aging South Hills Trolley system, and a modest rehabilitation of the remaining trolley line.[2]

These plans were jointly developed by the Port Authority, the Pittsburgh Department of City Planning, and the Pennsylvania Department of Highways as a first stage, easy-to-implement rapid transit system for Allegheny County. Also included were high-occupancy (HOV) lanes on I-79 to serve northern parts of the area.

The City, County, PAT, and the State jointly proposed the busways as an economical and practical method of improving transit service to downtown Pittsburgh and simultaneously preserving rights-of-way.

The busway routes were perceived as relatively easy to implement, politically viable, and affordable. In August 1968, the three rapid transit facilities were approved as part of a countywide rapid transit system. The busway proposals resulted from two basic factors: (1) although eventually light rail was selected, rail advocates had difficulty agreeing on the technology (heavy rail, sky bus, or light rail transit); and (2) PAT's staff recognized that busways could cost-effectively serve a large portion of County residents because bus service could easily extend beyond the limits of the busway.

The busways were approved by the Urban Mass Transportation Administration (UMTA, now FTA) in June 1970.

South Busway

The South Busway was built to enable passengers to bypass severe traffic congestion at the Liberty Tunnel, which is the major roadway link between the Pittsburgh CBD and the South Hills Area. Buses were experiencing difficulty in operating on local streets because of the hilly terrain in the South Hills Area.

To avoid steep grades, the South Busway was built parallel to the Norfolk and Western railroad tracks on an almost flat grade along a right-of-way previously acquired for the proposed sky bus.

About 2 miles of the 4.3-mile [7-km] South Busway are shared with trolleys, including the 3,500-foot [1,065-m] Mt. Washington Tunnel, which was refurbished for joint use by buses, streetcars, and light rail vehicles. PAT also built a new bus-only roadway between Glenbury Street and adjoining roads.

East Busway

Initial plans for the East Busway were developed to alleviate the growing commuter congestion on the Penn Lincoln Parkway and as a means of providing increased transport capacity without the problems inherent in widening the Parkway. The plans called for building a bus-only road that would be converted to LRT later, if necessary, along the Conrail right-of-way. A shared bus-rail right-of-way was found to be possible if a 5-mile section of the corridor were redesigned. The East Busway was viewed as an interim solution that could provide rapid transit in the eastern corridor.

Construction of the East Busway involved relocating and rebuilding the Conrail tracks and widening the right-of-way at several locations. The construction also included replacing the four tracks by two new tracks and a two-lane busway, building a separation wall between the railroad and the busway, relocating utilities, lowering the track bed, reconstructing vehicle and pedestrian overpasses, building bus ramps, and providing stairs and ramps to enable passengers to reach below-grade busway stations.

The Port Authority of Allegheny County negotiated with Conrail and agreed to build the East Busway in such a way that railroad service could continue during construction. They also agreed to upgrade the train signaling and communication systems. These changes were done before the East Busway was built.

Local residents and community organizations were involved in the planning from the start to ensure that the East Busway met their needs and concerns. The original plan called for an 8-mile [13-km] busway between downtown Pittsburgh and Swissvale; however, Swissvale residents' concerns about noise, pollution, and safety at busway stations that were not visible from streets resulted in reducing the busway length from 8.0 to 6.8 miles [11 km] to avoid the perceived impacts.

Citizen's groups also affected the East Busway design; the East Liberty Station, Oakland off-ramp, and Wilkinsburg Interchange were all configured as a result of citizen concerns. A planned station at Shadyside never got majority support from the public because of expected pollution and high level of noise. In more recent times, residents stalled the East Busway Extension, and the initial completion date was extended to 2002.

West Busway

The West Busway was an outgrowth of the 1988–1989 Parkway West Multimode Corridor Study commissioned by the Southwest Pennsylvania Regional Planning Commission (SPRPC), now Southwestern Pennsylvania Commission (SPC), to identify needed transportation improvements in the Airport-to-downtown-Pittsburgh corridor.[3] This study was followed by the Port Authority–sponsored Airport Busway Transitional Analysis of transit recommendations.

In 1991–92, the Airport Busway/Wabash HOV Alternative Analysis/Draft Environmental Impact Study performed further detailed analysis of the busway proposal. A no-build alternative and a Transportation System Management (TSM) option were also analyzed. The Wabash Tunnel, rebuilt for buses and high-occupancy vehicles, was incorporated into the project. The Phase I Final Environmental Impact Statement Study was completed in April 1994.

The Federal Transit Administration (FTA) issued a Record of Decision for the Phase I Airport Busway/Wabash HOV Project on June 22, 1994. This statement found that the planning process satisfied all federal requirements and authorized the Port Authority to proceed with construction. Ground was broken on the project on October 27, 1994. In November 1996, the U.S. Department of Transportation ranked the West Busway as the second most cost-efficient capital transit project in the country.

Estimated initial costs of $326 million for the Airport Busway grew to $420 million by November 1996 and to over $500 million by May 199. Costs grew, in part, because of the

unforeseen complexity of Berry Street and the Wabash tunnel conversion, the connection to I-279, and the new ridge to the CBD. This required deleting the Mongonohela River Bridge and the West Busway segment on the "Conrail shelf" into downtown Pittsburgh. The opening ceremony was September 2, 2000, and revenue service began later in September.

THE BUSWAY SYSTEM – PROJECT DESCRIPTION

This section describes the features and performance of Pittsburgh's busway system. It overviews the salient characteristics, describes busway design features, and discusses operations, usage, and benefits.

OVERVIEW OF BUSWAYS

The Port Authority Transit's (PAT's) South, East, and West Busways and their relationship to the light rail lines and the I-278 Express HOV lane are shown in Figure 1. Salient features of the three busways are summarized in Table 1.

The three busways in operation include the South Busway, opened in 1977; the Martin Luther King East Busway, opened in 1983; and the West (Airport) Busway, opened in 2000. In addition, an extension of the East Busway is under construction and scheduled to be open by 2003. Collectively, the 16.1 miles of existing busway carry 48,000 people each weekday, about 20% of the total daily transit ridership.

The busways operate both local and express services, with average speeds of 30 to 40 miles per hour.

In addition to the busways, the North Hills Expressway HOV lanes enable express buses traveling between downtown Pittsburgh and the North Hills to bypass congestion. Three free park-and-ride lots are served by express buses. There is also a planned reversible lane for buses and car pools in the Wabash Tunnel under the South Hills. Bus service within and through the Golden Triangle is provided over city streets, often in contra-flow bus lanes.

South Busway

The 4.3-mile South Busway, opened for service in December 1977, was the Port Authority's first busway. Typical views of the South Busway are shown in Figures 2 and 3.

The South Busway is largely located along a previously acquired right-of-way that parallels the Norfolk-Southern tracks. The busway shares the right-of-way with PAT light rail lines through the 3,500-foot Mt. Washington Tunnel and a portion of the Overbrook Trolley Line. Once the Overbrook Trolley Line reconstruction is completed in 2003, the shared right-of-way, other than through the Mt. Washington Tunnel, will be eliminated.

The South Busway provides frequent service between the downtown Pittsburgh station, and many South Hills neighborhoods. Buses avoid the daily traffic tie-ups on Route 51, bringing reliable rapid transit service to the South Hills. Some 16 routes use the South Busway. Eight stops are located along the South Busway at the following places: Station Square, South Hills Junction, Palm Garden, Edgebrook Avenue, Whital Street, Central, Inglewood, Overbrook, and Glenbury. Major stops are handicapped accessible.

Busway construction costs were $27 million. There are 13,000 daily riders and almost 4 million annual riders.

East Busway

The 6.8-mile Martin Luther King Jr. East Busway has been in continuous service since 1983. The East Busway is located in an exclusive right-of-way alongside the Norfolk and Western (formerly Conrail) railroad tracks for its entire length. Figure 4 shows the East Busway extension. Figure 5 shows typical views of the East Busway. Figure 6 shows the East Busway alignment alongside of the railroad tracks.

The East Busway runs from Wilkinsburg to the edge of the City center at the Penn Park station. It serves downtown Pittsburgh, the East End, and the eastern suburbs of Allegheny County. Thirty-six local and express bus routes operate along the East Busway. The East Busway is designed for "walk-on" traffic from neighborhoods surrounding busway stations. Physical arrangements allow convenient transfer from intersecting bus routes; these include pedestrian bridges, stairways, and terminal loops in nearby streets. "Kiss-and-Ride" facilities are provided.

There are six stations and seven bus ramps:

BUS RAMPS	**PASSENGER STATIONS**
Grant Street (downtown)	Penn Park (Street Plan)
26th Street	Herron Avenue
Neville Avenue	Negley Avenue
Penn Mall at Penn Circle (East Liberty)	Penn Mall (East Liberty)
East Liberty Garage Ramp	Homewood Avenue (Homewood)
Wallace Avenue	Penn Avenue (Wilkinsburg)
South Avenue	

The Penn Park station has connections to AMTRAK and the light rail system. The other five stations serve people who live within walking distance. All stations are handicapped accessible. The busway is widened to four lanes at stations to enable express buses to pass around all-stop buses.

Figure 7 shows signage at a busway entrance.

Construction costs totaled $113 million; $60 million of these costs covered relocation of the main line railroad tracks within the corridor right-of-way.

East Busway Extension

A 2.3-mile exclusive right-of-way extension of the East Busway adjacent to the Norfolk and Western Railroad through the Boroughs of Wilkinsburg, Edgewood, and Swissvale is under construction.

The East Busway was initially scheduled for completion in 1998, but opposition from residents caused its completion to be pushed back to 2002. The extension will add four new handicapped-accessible stations with four park-and-ride lots containing more than 900 spaces. (Figure 8)

Costs are estimated at $68.5 million. Daily ridership is forecast at about 13,000 on opening and up to 22,000 by 2005.

A key component of the project is a linear park being built adjacent to the busway in the Boroughs of Wilkinsburg and Swissvale. This park will include a pedestrian path for walking, biking, and skating; landscaping features such as trees, shrubs, and flowers; several benches; two gazebos and a small playground; decorated lighting and fencing; and improved pedestrian access to stations.

West Busway

The 5.0-mile West Busway (the Airport Busway) was placed in service September 2002. It extends from West Carson Street to Carnegie (Figure 9), and services extend to the airport and beyond, some 20 miles from the CBD.

The West Busway is located along an abandoned rail line and through an upgraded rail tunnel. The tunnel, along with grade-separated connections to West Carson Street in the east and the Parkway West, enables buses to bypass Greentree Hill and the congested Fort Pitt Tunnels. An exclusive bus-only roadway provides direct access to the Carnegie, Crafton, East Carnegie, Ingram, Sheraden, and Western Allegheny County communities including the Airport Corridor. Typical views of the West Busway are shown in Figures 10 and 11. Several sections involved extensive cuts and retaining wall construction.

Fourteen routes use the West Busway. It has six stations: Sheraden, Ingram, Crafton, Inglewood, Bell, and Carnegie. Stations are Americans with Disabilities Act (ADA) compliant (handicapped accessible), and there are passing lanes for use by express buses. About 350 park-and-ride spaces are provided at four locations; another 7,400 park-and-ride spaces will be provided in western Pittsburgh locations.

Busway construction required the rehabilitation and enlargement of the 130-year-old Berry Street Railroad Tunnel. The tunnel was widened from 28 to 34 feet using the New Austrian Tunnel Technology. Almost 5,000 linear feet of noise walls were incorporated along the tunnel. Construction costs totaled over $275 million because of the tunnel rehabilitation and mountainous terrain.

Weekday ridership ranges from 6,500 to 7,000 per day – nearly 2,000,000 per year.

The West Busway project also includes the Wabash HOV facility. This 1.1-mile single lane reversible facility includes a tunnel through Mt. Washington and a ramp connecting the tunnel with West Carson Street. Downtown access is provided via the Smithfield Street Bridge.

BUSWAY AND STATION DESIGN

The busways are essentially two-lane, bus-only controlled access roadways. There are virtually no intersections along them except for bus access points. The only exceptions are one grade crossing and one railroad crossing along the West Busway and the shared LRT-trolley-bus access through the Mt. Washington Tunnel and along the Overbrook Trolley Line; however, the joint access along the trolley line will be eliminated as part of the rail line's ongoing conversion to LRT.

Busway Geometry

The geometric design of the busways is adequate for possible future conversion to light-rail transit. Design speeds are 60 mph on the East and West Busways and 50 mph on the South Busway. Bus operating speeds are 55 mph on the West Busway, 50 mph on the East Busway and 40 mph on the South Busway. Speeds on access ramps are limited to 15 to 25 mph. Travel lanes are 12 feet wide except for a 0.1-mile segment west of the East Liberty station and the Mt. Washington Tunnel where they are 11 feet wide. Shoulders are provided wherever possible, ranging from 2 to 10 feet. On the East Busway, for example, shoulders are generally 8 feet for the outbound lane and 2 feet for the inbound lane.

At stations, the busways are widened to four lanes; a fence or median separates opposing directions of flow and channelizes or precludes pedestrian crossings. Each bus access point is designed as a simple intersection with appropriate acceleration and deceleration lanes where practical. Where busways join public streets, signs, pavement markings, and traffic signals provide control movements. Several street intersections were widened to improve bus access.

Stations

The East and West Busways are widened to four lanes at stations to enable express buses to pass around stopped vehicles. Fences or medians separate opposing directions of travel and prevent errant crossings by pedestrians (Figure 12).

Low-platform stations are 120 feet long and accommodate two articulated buses. Several major stations such as East Liberty and Penn Park are 240 feet long and accommodate four articulated buses.

Pedestrian bridges over the busway are provided at key stations such as East Liberty. At other locations, access is provided via stairways or designated crosswalks.

Stations along the busways are simply designed and provide suitable shelters for passengers (Figures 13 and 14). All stations (except the minor "stops" along the South Busway) are ADA compliant/handicapped accessible. The stations along the West Busway feature weather-protective shelters that have an aesthetically pleasing curvilinear design and about 9 acres of landscaped areas. Passenger amenities at stations include newspaper boxes, bike racks,

telephones, customer service and security phone systems, information, and in some cases (as along the West Busway) landscaping.

Stations do not have provisions for fare payment because fares are collected on buses.

Stations along the busways have Kiss-and-Ride facilities. Park-and-ride spaces are provided along the West Busway and are being provided along the East Busway extension.

West Busway Design

Design and construction aspects of the West Busway are as follows:

- Interchanges with the Parkway West in Carnegie provide direct access for buses from the Western suburbs. This interchange allows for future widening of the Parkway West.
- Four new bridges were built, including a 120-foot, radius-curved girder bridge constructed under the existing Parkway West Bridge.
- Eleven bridges were reconstructed, including a new, wider deck on a 70-foot-high former railroad bridge.
- The 130-year-old Berry Street Railroad Tunnel was rehabilitated and was widened from 28 to 34 feet.

OPERATIONS

The opening of each busway brought with it changes in bus routes and service, greater use of articulated buses, and selective marketing efforts.

ELIGIBLE VEHICLES

Three types of vehicles are permitted to use the busways: emergency and police vehicles, Port Authority buses, and neighboring transit agency vehicles. These transit agencies include Beaver County Transit Authority, Westmoreland Transit Authority, and Mid-Mon Transit Authority.

SERVICE PATTERNS AND FREQUENCIES

The busways provide both all-stop (local) and express services. However, they function somewhat differently in the markets they serve and types of services they provide. The South Busway functions primarily as an express operation between outlying neighborhoods (where buses collect and discharge passengers) and downtown Pittsburgh. The East Busway mainly functions like a traditional rapid transit line with high-frequency service operating exclusively on the East Busway, serving all six stations; other buses enter the system, use all or a portion of it and typically run express. There are frequent connections with intersecting bus lines. The East Busway operates like the West Busway in providing frequent all-stop service, but there are fewer connecting bus lines.

1. **South Busway.** Sixteen routes use the busway: 6 operate express; 10 operate local, and there are no connecting routes.

2. **East Busway.** Three different types of service operate on the East Busway between downtown Pittsburgh and Oakland: all-stop service, express service, and through service.

The all-stop service operates mainly on the Busway; however downtown distribution is on city streets, some of which have contra-flow bus lanes. Express buses from outlying areas include neighborhood collection/distribution/and line-haul operation directly on the Busway. Through service operates on the East Busway and the West Busway.

Thirty-six routes operate along the East Busway. Three routes — EBA, EBO, and West Busway — provide frequent all-day service. These are complemented by several rush hour express routes that were started when the East Busway opened (e.g. 73B, 78C, 88A). The remaining 29 express lines were diverted to the East Busway from their previous routes. Another 23 bus routes connect with the East Busway.

Most of the Flyer and express routes stop at only two of the six East Busway stations. (The Flyer routes serve outlying suburban commuters located closer to the terminus of the East Busway).

Service frequencies vary with the type of route. The EBA route (East Busway – All Stops) provides 4- to 5-minute service during the rush hours, 10- to 12-minute midday service, and 18-minute evening service. It operates from about 5 AM to midnight daily. Weekend service operates at 15- to 20-minute intervals. Other services operate at 10- to 60-minute intervals depending upon route and time of day. For example, the EBX (East Busway Express) and the 68EX, Wilkinsburg Express, provide combined rush hour headways of about 12 minutes.

3. **West Busway.** Some 14 routes operate along the West Busway. These include six express routes, and three Flyer routes. The "backbone" service is provided by Route 100 West Busway-All Stops that runs between Carnegie and Oakland. Service operates from about 5AM to midnight daily. Buses operate at about 5- to 7-minute intervals in the morning rush hours and at 10-minute intervals in the evening rush hours. Service frequency is 10 to 15 minutes at midday and 20 minutes during the evening. Weekend service is at 15- to 20-minute intervals.

   Express commuter routes, the second type of service, enter the Busway at various ramps located along the facility and proceed non-stop to downtown Pittsburgh. Beaver County Transit Authority buses use the West Busway for its express airport bus service, which is partially funded by the Airport Corridor Transportation Association.

VEHICLES

Three different types of buses operate on the busways: 35-foot buses (102 inches in width, 119 inches in height), 40-foot buses (96 to 102 inches in width, 118 to134 inches in height), and 60-foot articulated buses (102 inches in width, 130 inches in height). The 35-foot buses have a seating capacity of 33 to 36 seats. The seating capacity of the 40-foot buses is 39 to 53 seats. The articulated buses have 63 seats. All three models have multiple doors on the right side. One hundred sixty of the buses are low floor; the rest of the 1000-vehicle fleet is high floor. The low-floor buses all have next stop announcements. Five of the buses run on compressed natural gas; all the others are diesel with reduced emissions. Side collision avoidance systems are being tested on 100 selected buses using the East Busway.

FARES AND FARE COLLECTION

Fares are established on a zone basis. The basic adult cash fares are $1.00 in the Downtown Zone, $1.60 for a one-zone ride, $2.00 for a two-zone ride, and $2.50 for a three-zone ride. Child and disabled fares are half price. PAT also has prepayment options, including weekly fare permits and monthly passes. The large percentage of riders using passes (50%+) increases the efficiency of fare collection.

Fare collection takes place on board buses. The fare collection policy is consistent across all PAT bus routes. Fares are collected when passengers board on inbound trips and when passengers alight on outbound trips. This method ensures that drivers will only have to deal with a few passengers at a time (because there is no downtown fare collection), which both makes it easier for the driver and prevents delays. After 7 PM, fares are collected upon boarding on both inbound and outbound trips. However, from a busway perspective, there is fare collection in both directions at busway stops; this results in longer dwell times at stops.

MARKETING

Bus schedules are available for each bus route or groups of routes. (Figure 15) The schedule covers clearly indicate routes that use the busway. Marketing efforts were initiated *before* the busways were opened. For example, as segments of the East Busway were completed, tours were provided for the various community groups that had been active in the planning process; brochures advertising the facility were distributed as early as 1981. Figure 16 shows a typical brochure. In addition PAT placed cards describing the East Busway on all East Corridor buses.

The major marketing effort included the free busway service offered the weekend prior to opening. Free EBA service was offered every 30 minutes on Saturday from 9 AM to 6 PM and on Sunday from 10 AM to 5 PM. PAT planned to schedule tour buses for the marketing weekend. The public turnout for the EBA opening was larger than expected. By 9 AM, Saturday, crowds were waiting to board the buses. By 1 PM, 24 additional buses had to be scheduled to meet the demand, and the service was offered for 4 hours longer than planned. In all, 60,000 people rode the EBA that weekend, when the EBA's usual weekend ridership, in 1983, was approximately 8,000.

More recently, the West Busway was marketed through the PAT's brochure, "Connextions – West Busway," published on a monthly basis. The August 2000 issue, "The West Busway Will Open in September," and the September 8, 2000, issue, "Rapid Transit for the West Is Here" describe the features and benefits of the proposed busway.[4] (Figure 17).

PERFORMANCE

TRAVEL TIMES

The three busways have substantially reduced travel times. Each has functioned largely as an elongated *queue bypass* of congested roads and tunnels. Each has improved travel time reliability.

South Busway

The South Busway has saved 6 to 11 minutes of travel time (1.4 to 2.6 minutes per mile) as compared with pre-busway service. More than 160 bus trips per day were removed from congested streets in the South Hills Area.

East Busway

The East Busway has reduced travel times for both busway-only (EBA) service and diverted rates.

The Busway travel time on the EBA route from Wilkinsburg to downtown was about 15 minutes as compared with about 53 minutes for the route operating on local streets. This corresponds to a savings of 38 minutes per trip or 5.6 minutes per mile. Non-stop express routes traverse the length of the busway in about 10 minutes.

The operating speeds for nine routes diverted to the busway increased from 20 to 30 mph before the busway to 30 to 35 mph after. The greatest speed increases were for inbound trips during the morning rush hour.

Total passenger travel times, including access, waiting, in-vehicle and transfer times, were also analyzed.[1] These travel times decreased by an average of 8 minutes in the AM peak and 3.5 minutes in the PM peak for diverted routes.

Total passenger travel times for passengers using the new EBA route were reduced from approximately 51 minutes to 30 minutes in the AM peak hour and midday – a savings of 21 minutes (3.1 minutes per mile). Passenger travel times in the evening peak hour were reduced from 54 to 30 minutes – a savings of 24 minutes or (3.5 minutes per mile). In 1984, the perceived travel time savings by riders on the diverted routes were 4 to 8 minutes (0.6 to 1.2 minutes per mile).

Approximately 38% of East Busway riders who diverted to the East Busway reported that buses stayed on time more often. Changes in both the standard deviations and coefficients of variation of speeds for diverted buses after the East Busway operations began are summarized in Table 2. The decrease in both the absolute and relative variations after buses were diverted to the busway indicates a substantial (often statistically significant) improvement in service reliability.

West Busway

Travel time savings of 25 to 26 minutes (5 minutes per mile) have been reported for the inbound trip during the morning peak hours. Travel time savings during midday and evening peaks are substantially less.

RIDERSHIP

Daily and AM peak-hour ridership on the three busways are shown in Table 3. Daily ridership (2001) on the busways averaged 28,000 on the East Busway, 13,000 on the South Busway, and 7,000 on the West Busway. AM peak-hour, peak-direction ridership averaged 5,400 on the East Busway, 2,000 on the South Busway, and 1,500 on the West Busway. The peak-hour bus flows were 110 on the East Busway, 50 on the South Busway, and 30 on the West Busway.

Ridership Trends

Ridership trends on the South and East Busways are shown in Table 4. Ridership has fluctuated over the years, reflecting the Pittsburgh area's economy, construction activities on roads and bridges, and renovation of the LRT lines. Population in the Pittsburgh Urbanized Area has remained essentially constant in recent decades. Table 4 also shows trends for the "new" and "diverted" routes using the East Busway.

1. **South Busway.** Ridership remained relatively constant at 20,000 from 1980 through 1989. There was a sharp decline to about 8,600 riders during the early 1990's – a period where reconstruction of a bridge into the downtown area restricted bus use. By 1998, ridership grew to 15,000, but has dropped since then to about 13,000.

2. **East Busway.** Weekday ridership on the East Busway increased from about 21,000 riders in 1983 to almost 29,000 in 1986. This growth occurred at the same time that overall system bus ridership declined. Ridership on new routes (other than the EBA) grew about 50%. Since 1986 ridership has remained relatively constant, ranging from 27,000 to 29,000 weekday riders.

   The five *new* routes using the Busway accounted for 13,000 daily riders in 1998 – about 45% of the total. The East Busway All-Stop (EBA) route alone accounted for nearly 11,000 daily riders – about 36% of the total.

Rider Characteristics

On-board surveys conducted in 1984 indicated that the East Busway attracted new riders to both the new and diverted routes. Approximately 11% of the riders surveyed on the new routes and 7% on the diverted routes formerly used an automobile for the trip. It was estimated that approximately 1,900 new daily riders were attracted to bus services because of the East Busway. In response to a second question, two thirds of the former auto drivers indicated that the East Busway was an important factor in their decision to change modes.

A majority of passengers on both the new and the diverted routes reported destinations in downtown Pittsburgh. Some 71% of the EBA and EBO riders traveled to downtown, whereas 87% of the diverted outré riders reported downtown destinations. 23% of the EBA and EBO passengers reported the Oakland area as the destination, 13% of the diverted route riders reported suburban destinations.(1)

The modes of access for the EBA/EBO and the diverted routes were as follows:

	EBO	**Diverted Routes**
Walked to Stops & Stations	63%	64%
Used Feeder Buses	22%	3%
Used Park and Ride	10%	23%
Dropped Off	5%	10%

It is clear that service penetration of neighborhoods contributes substantially to ridership.

COSTS AND BENEFITS

An overview of costs and benefits follows.

Development Costs

Development costs for the various busways are summarized in Table 5. Costs totaled $415 million for the 16.1 miles of completed busway, or $25.8 million per mile. System costs, when the 2.3-mile East Busway extension is added, will total $478 million, or $25.9 million per mile. The high costs per mile of the West Busway resulted from rail tunnel rehabilitation and hilly terrain.

Cost components for the South and East Busways are set forth in Table 6. Construction costs accounted for the largest share of the costs for both busways. Real estate accounted for $15.8 million dollars, almost 14% of the costs for the East Busway.

Busway Maintenance Costs

Maintenance costs were reported at $475,000 per year for the South Busway, about $110,000 per mile. Maintenance costs for the East Busway were reported at $724,000 per year, almost $107,000 per mile.

FUNDING

Funding for PAT's "Early Action Program" was provided through grants. The first Urban Mass Transportation Administration (UMTA) grant funding in June 1970 provided for a 67% federal share and 33% local share. The 33% local share was divided evenly between the County of Allegheny and the Commonwealth of Pennsylvania. By the end of the 1970s, UMTA's formula had changed to 80% federal and 20% local. Of the 20%, the Commonwealth of Pennsylvania maintained their 16.67%, and the County share dropped to 3.5%.

The West Busway and the East Busway extension also had 80% Federal Transit Administration Financing. The remaining 20% in financing was provided by the State and County.

The Port Authority of Allegheny County has no dedicated funding source for busway or LRT development. Its policy has been that planning and construction cannot commence unless needed funds (grants) are in place.[2]

BENEFITS

Pittsburgh's busway system has benefited (1) riders by providing faster and more reliable services, (2) the Port Authority by reducing operating costs, and (3) the surrounding communities by providing amenities that encourage new development.

Travel Time Savings

The busways have saved passengers approximately 6 to 25 minutes in travel time and improved service reliability. For example, a bus rider to downtown Pittsburgh from the East Busway terminus in Wilkinsburg used to require 20 to 60 minutes of travel time, depending on weather

and traffic conditions; this trip now takes 9 to 13 minutes, depending on the number of passenger stops.

Consequently, the busways have improved access to major employment, commercial, entertainment, educational, and retail locations along the busways in Oakland, downtown Pittsburgh, and the Airport Parkway West Corridors.

The travel time savings resulting from busway operations have made it possible to provide additional bus trips in a given time period with the same number of buses. They have also achieved lower operating costs per passenger because of the greater speed.

The Port Authority indicates that the East Busway had an operating and maintenance cost of $0.95 per passenger as compared with $2.55 for the rest of the busway system and $3.22 for the LRT/streetcar service. Operating subsidies were reported as $0.52 per passenger for the East Busway as compared with $1.13 for the rest of the bus system and over $2.00 for the rail transit lines.

Community Benefits

The busways have improved the appearance of the communities that they pass through. Landscaping, lighting, and new stations significantly improved the appearance of the East Busway corridor and helped make the corridor more attractive for development.

The West Busway replaced an abandoned railroad right-of-way, thereby improving the appearance of the corridor. Similarly, the East Busway extension will improve the communities that it passes, rehabilitating a historic train station, building a linear park in Wilkinsburg and Swissvale, replacing the South Avenue Bridge (including improved vertical clearance), and improving street intersections and traffic signal controls in Wilkinsburg and Swissvale.

Development Benefits

A comprehensive analysis was conducted by the Port Authority staff of development along the East Busway between its opening and 1996.[5] Developments in the corridor were strongly influenced by the Pennsylvania Railroad, which had built its line from the east along the corridor more than a century ago. The communities adjacent to the busway are older neighborhoods, many of which have lost population over the past 25 years. Steep slopes and the railroad limit development along most of the East Busway.

Despite the physical constraints and population loss (about 8% from 1980 to 1990), some 59 new developments took place adjacent to or within a 1,500-foot radius of the busway stations – about a 6-minute walk. Forty-four developments (81%) occurred adjacent to or near the stations, and 13 were located beyond 1,500-feet.

The total value of the developments was $302 million; about $225 million (65%) involved new construction. Locations of developments along the East Busway are shown in Table 7. Some $242 million of development (80%) was clustered at stations. The greatest dollar volume of investment, $105 million (35%), occurred downtown; $75 million of this was due to a hotel. The second largest development was in Shadyside, where $77 million of development occurred.

The mix of land uses reflects the diversity of the East Busway corridor. Retail, office, residential, and medical were the most common uses for the developments.

The most important factors regarding locations of development were (1) developments that existed before busway construction and (2) proximity to local markets. Lack of suitable land was the most important constraint on development.

There was public sector financial intervention for some development (e.g., tax abatements, tax credits, tax increment financing, and public investment). However, there are no policies in the Pittsburgh area for encouraging development near fixed-guideway transit.

Given the declining population and lack of a transit-oriented land use policy (as in Ottawa), new development *did* occur along the East Busway.(1)

Response to Emergencies

The busway system provides sufficient flexibility to respond to emergency situations. In the spring of 1987, a major Conrail derailment occurred along the East Busway Corridor. At midnight, more than 100 buses were in the area and helped evacuate approximately 2,000 people. If it had not been for the East Busway, there would have been no access to the derailed tank cars that were laying on the tracks. In fact, the East Busway became so crowded with emergency equipment vehicles (fire trucks, ambulances, and police cars), that monitoring those vehicles became critical.(2)

ASSESSMENT

Pittsburgh's 16.1-mile busway system services about 20% of the daily transit riders. It provides a combination of frequent all-stop (typical rapid transit) and express services. The busways serve as "queue bypasses" in the South, East, and West Corridors, providing time savings of more than 20 minutes per trip during peak periods.

The East Busway has direct access to downtown Pittsburgh. However, buses using the South and West Busway must use Mongonohela River Crossings shared with other vehicles. Unlike Pittsburgh's light rail line, downtown distribution is via city streets, some with contra-flow bus lanes.

There is through routing between the East and West Busways. However, to maximize collection and distribution opportunities in East Pittsburgh, there is limited use of the East Busway.

The Busways themselves are "state-of-the-art" facilities. They are similar to those in Ottawa and Brisbane in their design features and operating practices. Reliable safe speeds of 30 to 40 mph along the busways clearly classify the services on them as "rapid transit."

The Busways were not inexpensive to build. Although costs vary, depending on when a busway was built and ease of construction; overall, they averaged $26 million per mile. Difficult construction along the West Busway, including rail tunnel rehabilitation, contributed to the high costs. Nevertheless, the Busways allow bus service to many areas located well beyond their limits.

The bus rapid transit aspects of the busway service could be enhanced by using distinctive, specially delineated buses with wide doors and low floors for busway all-stop service; by providing off-vehicle fare collection; and by improving passenger amenities at stations.

BUSWAY–LIGHT RAIL COMPARISONS

Pittsburgh's operation of buses and light rail lines as part of an integrated system makes it possible to compare the performance and cost-effectiveness of each. Results of such a comparison for Pittsburgh's South and East Busways and light rail lines in five cities – Buffalo, Pittsburgh, Portland, and San Diego – are given in Table 8. The analyses, prepared by a former Director of Planning and Development indicate that both the capital and operating costs per trip (in 1989 dollars) were less for the busways. (It should be recognized, however, that Buffalo and Pittsburgh's rail lines have subway sections, contributing to increased construction costs.) The author of these analyses concluded "sufficient evidence exists to conclude that busways offer an advantage over light rail for many applications, due to their attractiveness to riders, cost effectiveness, and flexibility."[6] The conclusions were based on Pittsburgh's experience and on ridership and cost data for other modern LRT systems. The conclusions are as follows:

> The recent investments and operating experience of San Diego, Pittsburgh, Portland, Buffalo, and Sacramento provide the transit industry with new information about fixed guideways. In nearly all areas of comparison, busways appear to offer advantages over light rail systems.
>
> Experience of the past few years has shown that busways carry as many riders as light rail systems do. Because busways can be shorter in length and still provide a good level of service, they carry more riders per mile of guideway.
>
> The operating cost advantage is such that busways cost less than half as much per passenger to operate than light rail. On the capital side, the averages presented in this paper show that an $80-million busway carries as many riders as a $310-million light rail system.
>
> The capacity of busways is sufficiently large to carry the expected ridership in the great majority of urban corridors. And, on the basis of their expected level of ridership, busways are as attractive to potential development as light rail.
>
> In addition, busways and bus systems are simpler to operate and maintain, and training requirements are less in comparison to light rail. Finally, busways provide greater operational flexibility than light rail, particularly in the ability to skip stops or to not stop at any stations along the busway if the passenger demand warrants. Express and local services can be better tailored to suit patron requirements. (pp. 96-97)

LESSONS LEARNED

Several lessons emerge from the Pittsburgh case study.

1. Bus rapid transit works well in physically constrained areas where hills, tunnels, and water crossings constrain highway travel and make freeway construction costly, difficult, and impractical.

2. Busways can provide extensive one-seat rides well beyond the limits of the guideway construction. Along Pittsburgh's East Busway, more than half of all riders come from areas beyond the busway limits.

3. Busways are not necessarily a low-cost, early action, public transportation improvement, especially in areas of rugged terrain. Railroad rights-of-way provide relatively flat alignments, but may require costs for track relocation or tunnel reconstruction. In such cases, they may provide the only feasible alignment, even though they may miss major passenger traffic generators.

APPLICATION ELSEWHERE

Three major components of the Pittsburgh busway system have major applications in other U.S. cities. These are busway development, the "overlay routing strategy" in which traditional busway "BRT" service complements express service from outlying areas, and an extensive bus-lane system for downtown distribution.

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2. Hardy, T.C., "Busways In Pittsburgh" in Conference Proceedings, Second National Conference on High-Occupancy Vehicle Lanes and Transitways, Lancaster A., and Lomax, T. eds., Houston, TX, 1987.

3. Connextions-West Busway, Sept. 8, 2000, Port Authority of Allegheny County

4. Pratt, R., et al., Traveler Response To Transportation System Changes, Chapter 4 Draft Busway and Express Bus, Prepared for Transportation Research Board, 2000.

5. Worhill, D.E., "Development Along A Busway – A Case Study of Development Along the Martin Luther King East Busway in Pittsburgh, PA," June, 1996.

6. Biehler, A.D., Exclusive Busways Versus Light Rail Transit: A Comparison of New Fixed-Guideway Systems. In Special Report 221: Light Rail Transit: New System Successes at Affordable Prices, Transportation Research Board, National Research Council, Washington, D.C., 1989, pp. 89–97.

PEOPLE CONTACTED

Al Biehler, former Manager of Planning and Business Development, Port Authority of Allegheny County

Table 1: Pittsburgh Busway Statistics

SUMMARY OF PAT BUSWAYS
(2002)

	South Busway	MLK Jr. East Busway	West Busway (Airport Busway)	East Busway Ext.
Year Opened	1977	1983	2000	2003 (est)
Length	4.3 miles	6.8 miles	5.0 miles	2.3 miles
Capital Cost	$27 million	$113 million	$275 million	$ 62.8 million
Peak Period Travel Time Savings (minutes)	6-11	21-24	25-26 [(1)]	
Bus Access Points	6	7	6	2
Bus Routes	16	36	14	NA
Number of Stations/Stops	8	6	6	4
Weekday Ridership	13,000	28,000	7,000	13,600 (est)
Daily Bus Trips (two way)	500	1,000	250	NA
Park and Ride Spaces	0	0	350	900
Average Speed	40 mph express 30 mph local	40 mph express 30 mph local	40 mph express 30 mph local	

Source: Richard Feder, PAT
3-7-01

[(1)] = A.M. Inbound One Way
NA = Not Available

Table 2: Changes in Speed Variations Resulting from Buses Using the East Busway

Standard Deviations (MPH)	Before	After
A.M. Peak Inbound	4.77	3.37
P.M. Peak Outbound	6.67	3.65
Coefficients of Variation (%)		
A.M. Peak Inbound	18.8	10.2
P.M. Peak Outbound	20.0	11.7

Source: (1) 9 Routes
150 observations before, 175 after

Table 3: Daily and Peak-Hour Riders (2001)

Busway	Daily Riders	AM Peak Hour Peak Direction	
		Passengers	Buses
South	13,000	2,000	50
East	28,000	5,000-5,400	105-110
West	7,000	1,500(1)	30(1)

Source: Daily Riders – Port Authority Transit
Peak Hour Riders – Adapted from Pratt, R., et al
Traveler Response to Transportation System Changes, Chapter 4
Draft Busways and Express (2000), and information received from
Port Authority.

(1) Estimated

Table 4: Ridership Trends on the Pittsburgh Busways

	1980	1983	1986	1989	1993	1995	1996	1998	2001
East Busway									
Average Weekday Boardings	-	21,000	28,820	29,877	28,599	27,400	27,749	29,109	28,000
Average Daily Riders on Selected Routes	-								
EBA Route Passengers	-	11,468	11,856	12,156	N/A	N/A	N/A	10,564	N/A
EBO Route Passengers	-	1,303	1,783	1,655	N/A	N/A	N/A	1,889	N/A
73B	-	222	543	546	N/A	N/A	N/A	279	N/A
78C	-	49	44	70	N/A	N/A	N/A	111	N/A
88A	-	310	646	396	N/A	N/A	N/A	472	N/A
East Busway	-								
Average Weekday Boardings	20,852	18,904	18,051	19,951	8,613	N/A	14,278	14,800	13,000
West Busway	-								
	-	-	-	-	-	-	-	-	7,000

N/A Information not available.
- Information not applicable.

Source: Pratt, R., 1980-1998
Port Authority of Allegheny County, 2000.

Table 5: Busway Development Costs

BUSWAY	MILES	COST (MILLIONS)	COST/MILE (MILLIONS)
South	4.3	$ 27	$ 6.3
East	6.8	$113	$16.6
West	5.0	$275	$55.0
Subtotal	16.1	$415	$25.8
East Ext.	2.3	$ 63	$27.4
Total	18.4	$478	$25.9

Source: Port Authority

Table 6: Components of Development Costs for South and East Busways

	South Busway		East Busway	
Length	6.8 miles		4.3 miles	
Project Started	1970		1970	
Project Completed	1983		1979	
Cost	**Dollars**	**%**	**Dollars**	**%**
Engineering ($ million)	$12.30	10.9	$ 2.70	9.9
Construction/Procurement ($ million)	82.10	72.3	22.80	84.0
Real Estate ($ million)	15.80	13.9	0.95	3.5
Project Administration ($ million)	3.30	2.9	0.70	2.6
TOTAL COST	**$113.50**	**100.00**	**$27.15**	**100**

Source: (2)

Table 7: Development Along MLK Jr. East Busway

(THOUSANDS OF DOLLARS)

	Clustered at Station	Located Elsewhere		Total	%
Community	**Station**	**Amount**			
Wilkinsburg	Wilkinsburg	$7,984		$ 7,984	2.6
Homewood	Homewood	4,530		4,530	1.5
Point Breeze	---		$ 34,150	34,150	11.3
East Liberty	East Liberty	46,026	4,513	50,539	16.7
	Negley	71,098	5,887	76,985	25.5
Laurel Grove	Herron Hill	6,978		6,978	2.3
Strip District	---		16,315	16,315	5.4
Downtown	Penn Park	105,000		105,000	34.7
	Total	241,616	60,865	302,481	100.0
	%	**79.9**	**20.1**	**100**	

Source: (5)

Table 8: Comparisons of Recent Light Rail and Bus Systems

(ALL DOLLAR FIGURES ARE IN 1989 DOLLARS)

System	System Length (miles)	Capital Cost (Millions)	Weekday Ridership	Ridership (per mile)	Capital Costs/Mile (Millions)	Operating Cost (per trip)
Light Rail						
Buffalo	6.4	$565	30,000	4,700	$88	$1.27
Pittsburgh	10.5	$523	18,000	1,700	$50	$1.63
Portland	15.1	$233	19,000	1,300	$15	$1.03
Sacramento	18.1	$184	14,000	800	$10	$1.68
San Diego	20.4	$183	27,000	1,300	$ 9	$0.97
Average	14.1	$338	21,600	1,960	$35	$1.31
Busway						
Pittsburgh East	6.8	$138	29,000	4,300	$20	$0.47
Pittsburgh South	4.0	$ 38	18,000	4,500	$ 9	$0.61
Average	5.4	$ 88	23,500	4,400	$15	$0.54

Source: Allen D. Biehler, Exclusive Busways Versus Light Rail Transit: A Comparison of New Fixed-Guideway Systems. In Special Report 221: Light Rail Transit: New System Successes at Affordable Prices, Transportation Research Board, National Research Council, Washington, D.C., 1989, pp. 89–97. Assumes 300 days per year.

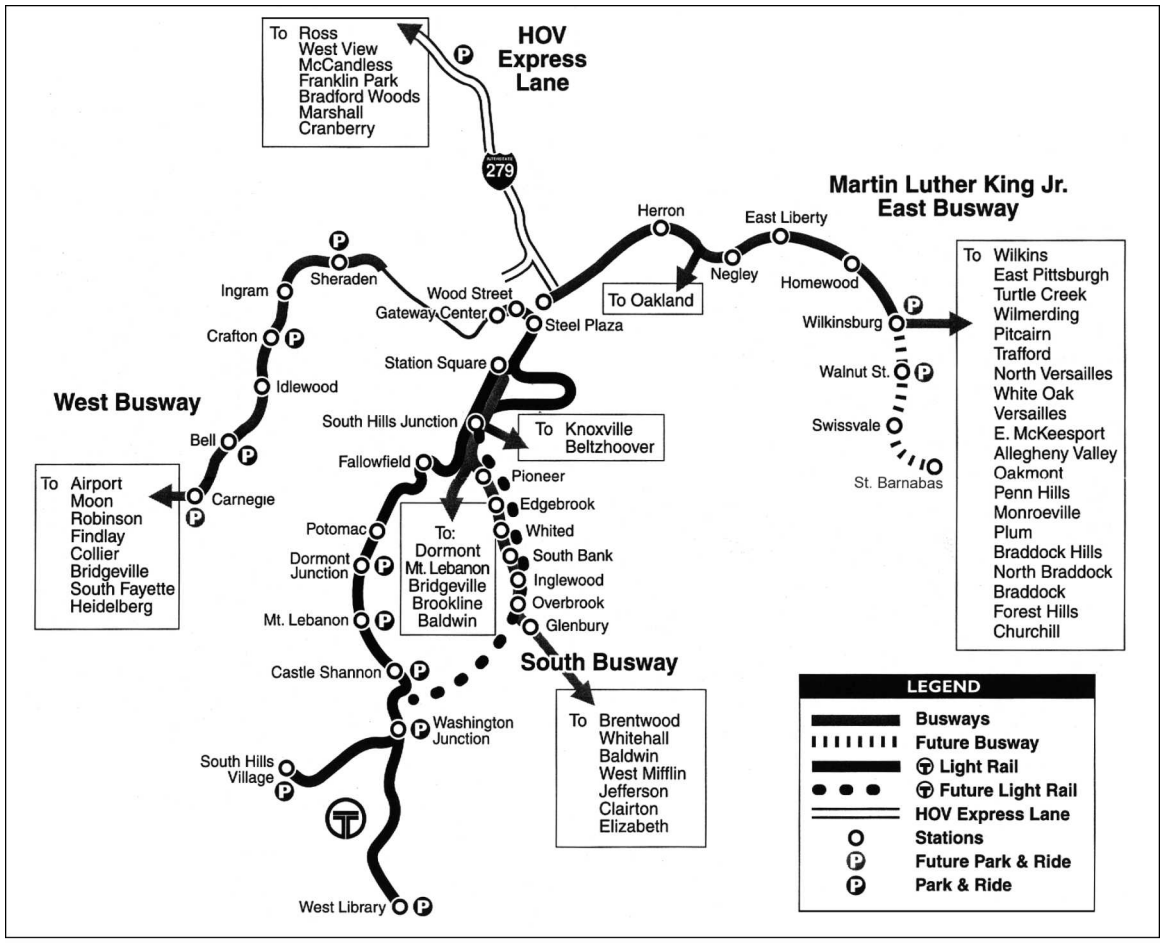

Figure 1: Busway System Map

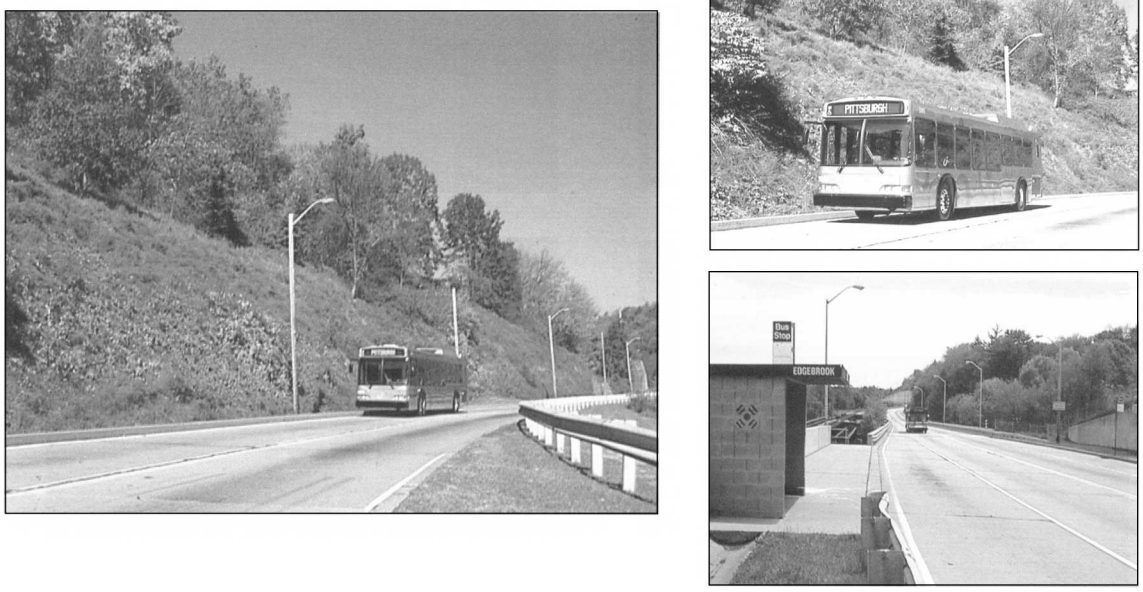

Figure 2: Three Typical Views of the South Busway

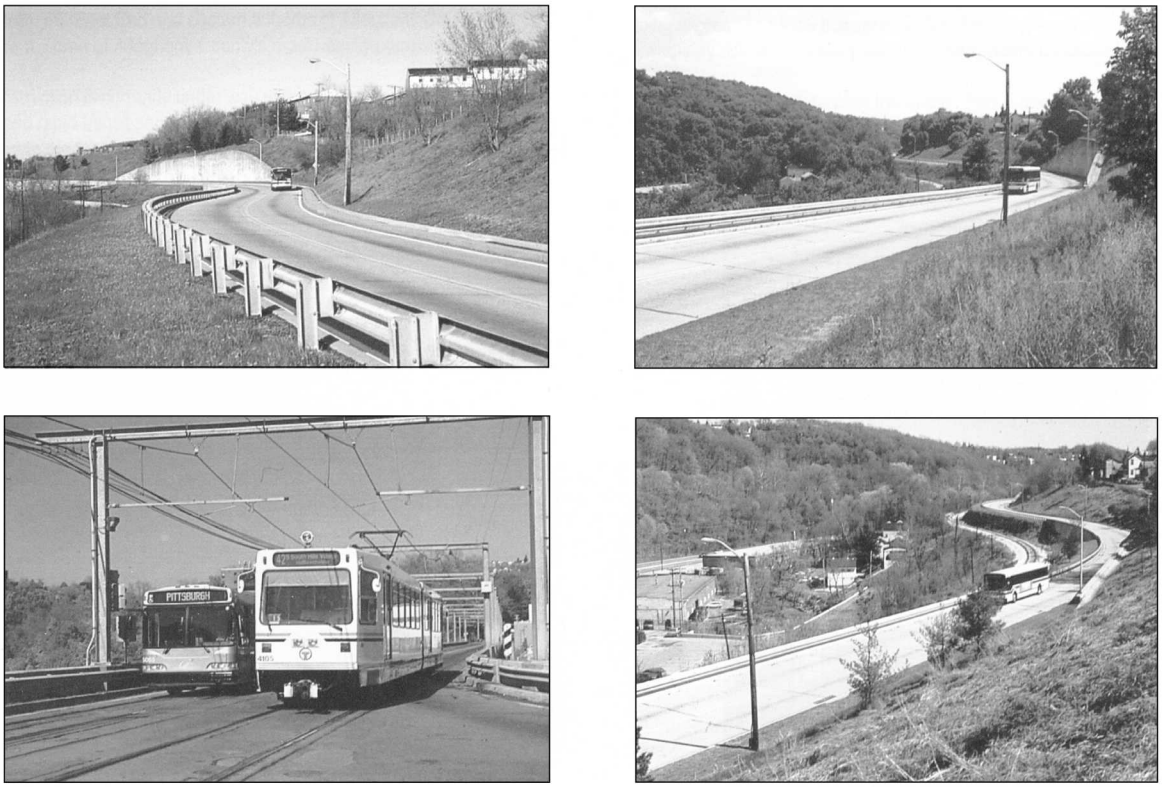

Figure 3: Four Typical Views of the South Busway

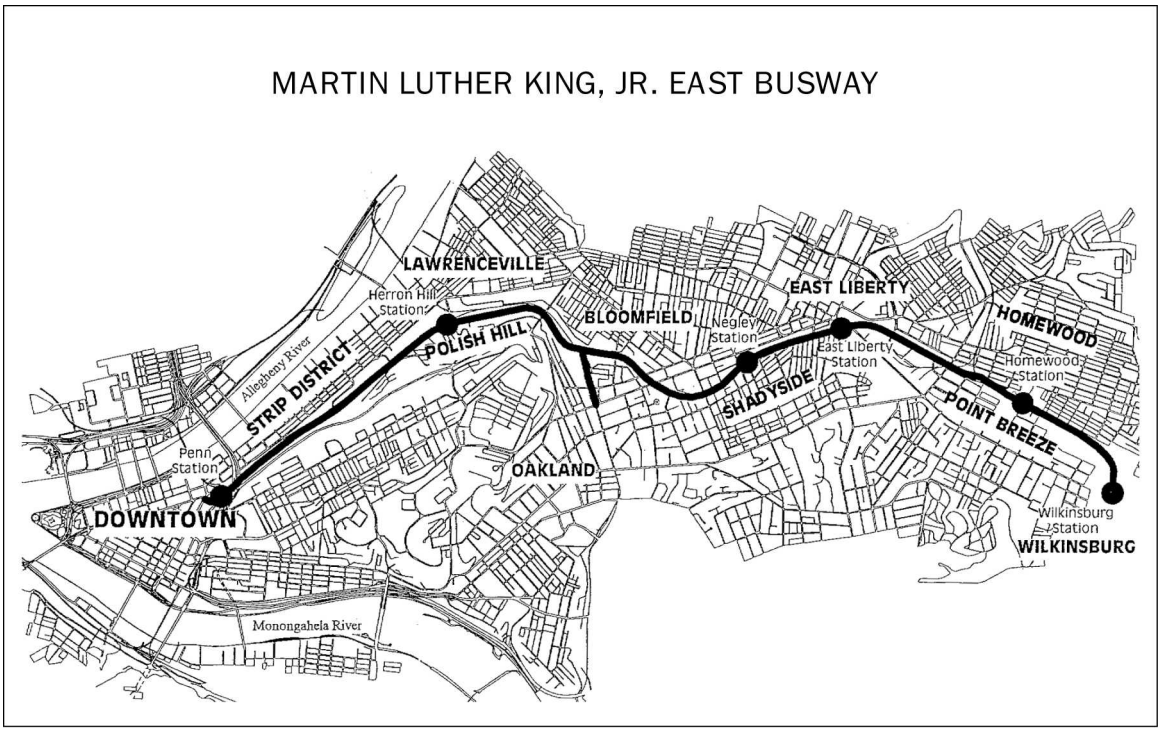

Figure 4: Martin Luther King Jr. East Busway Extension

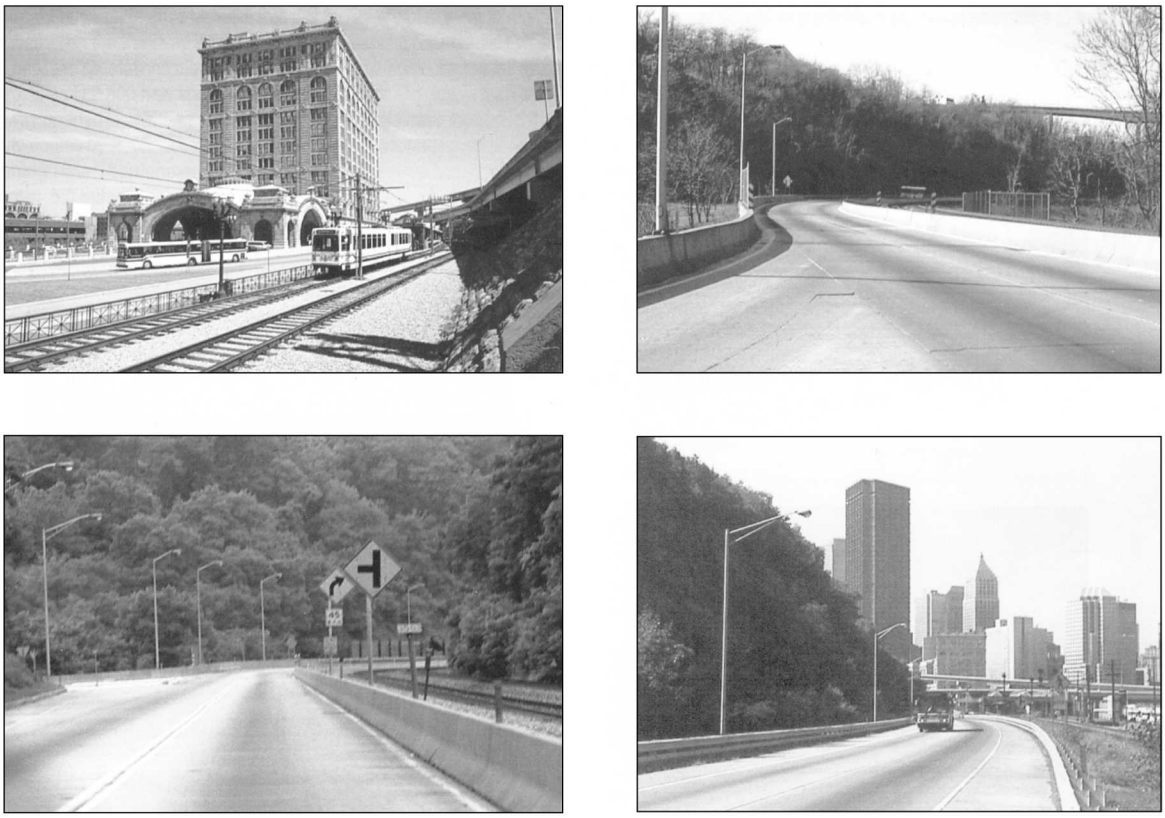

Figure 5: Typical View of the East Busway

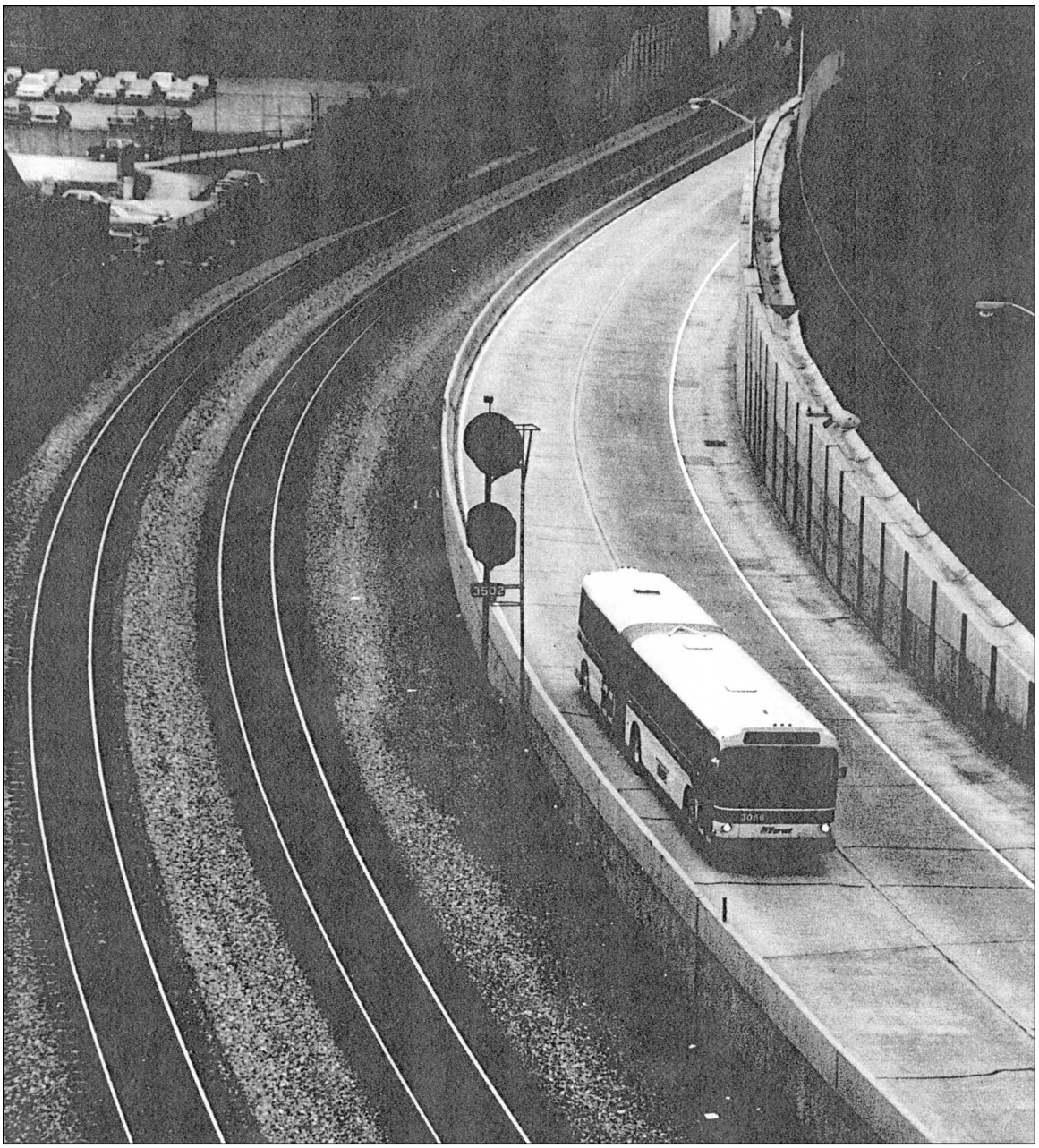

Figure 6: Future East Busway Alignment Along Railroad Tracks

Figure 7: Signage at Busway Entrance

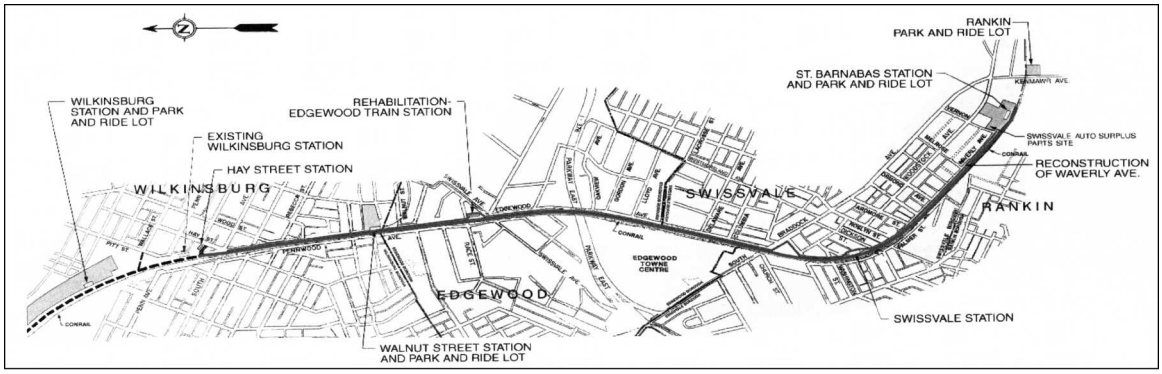

Figure 8: East Busway Extension

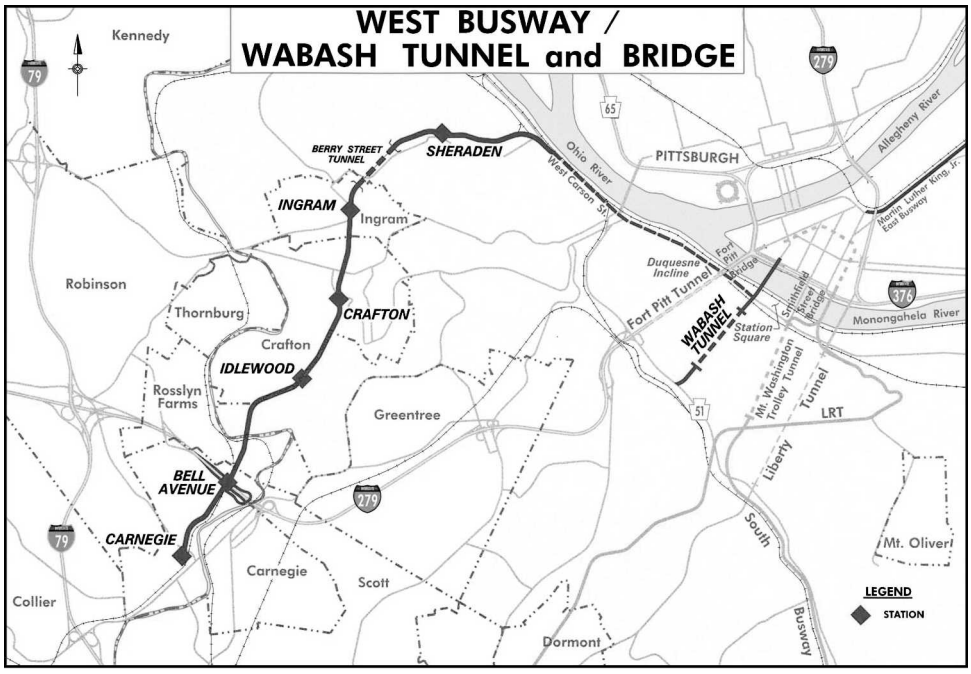

Figure 9: West Busway Map

Figure 10: Four Views of the West Busway

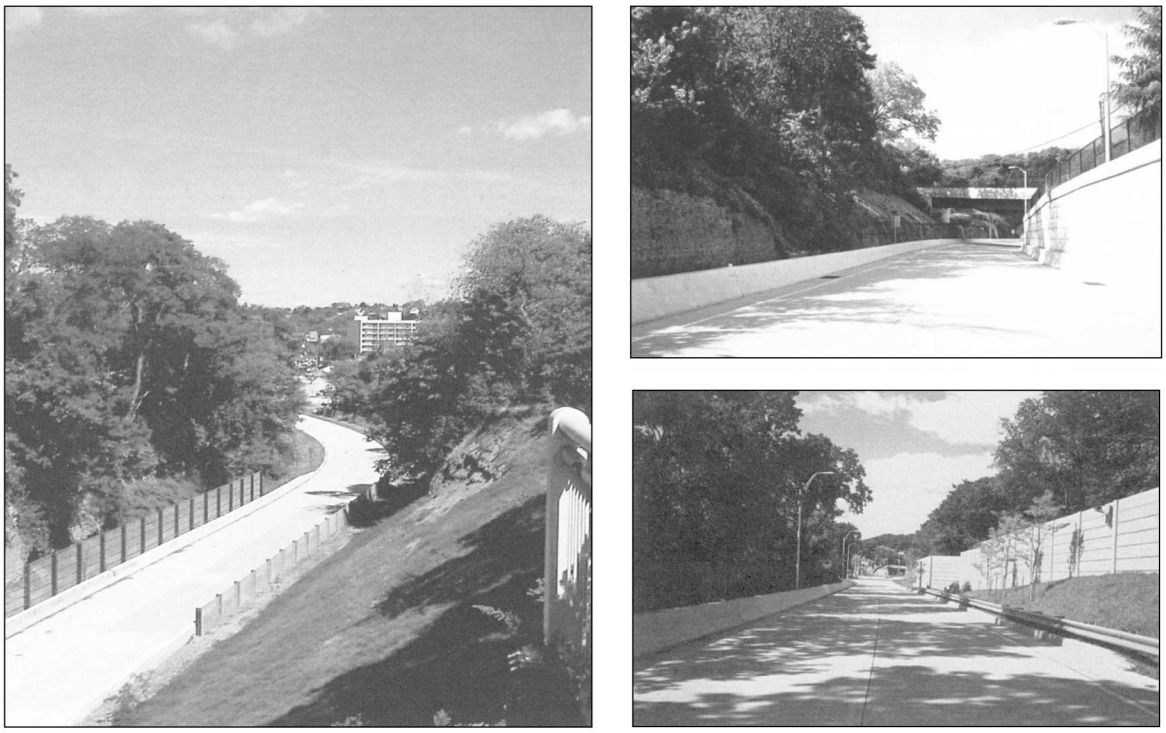

Figure 11: Three Views of the West Busway

Figure 12: West Busway Median at Station

Figure 13: Shelters and Passing Lanes at Stations

Figure 14: West Busway Pedestrian Shelters

Figure 15: Typical Bus Schedules

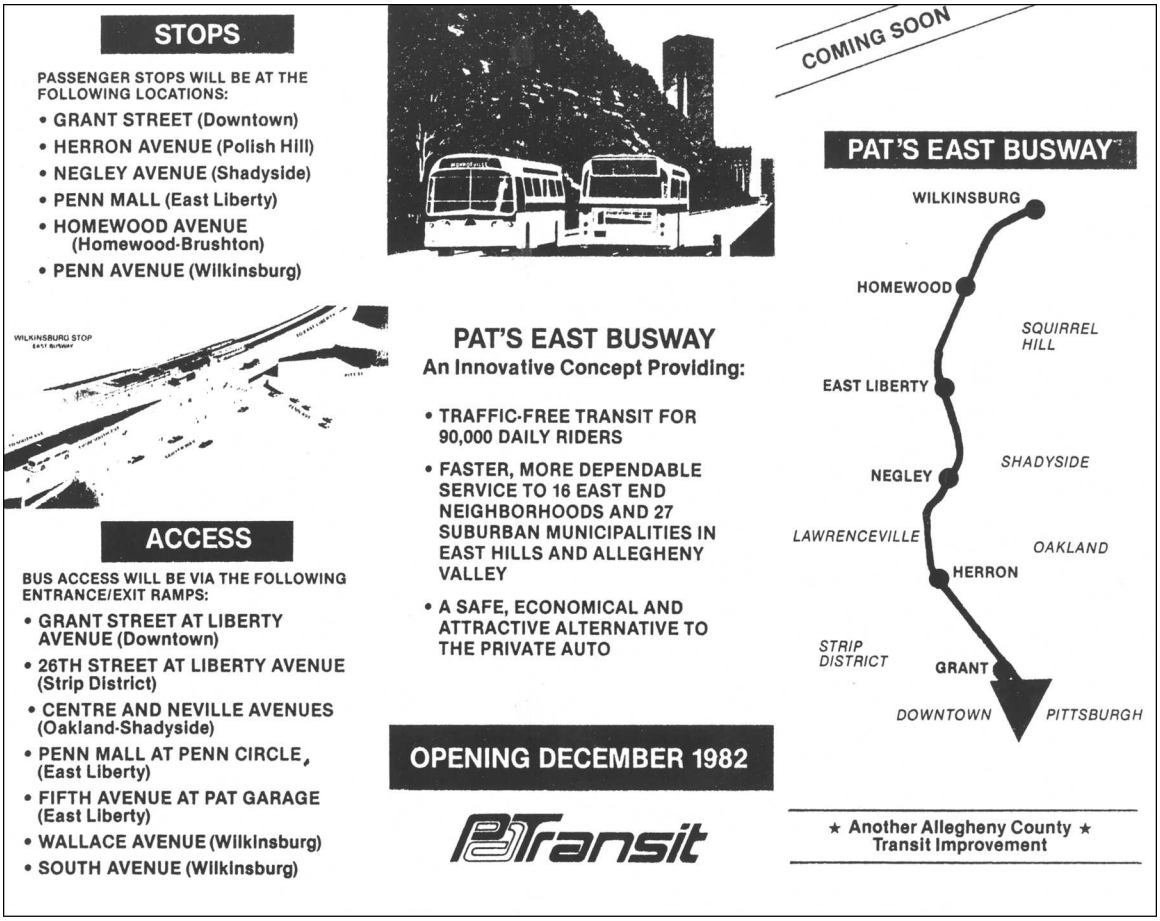

Figure 16: Marketing Brochures

September 8, 2000

CONNEXTIONS west busway

WEST BUSWAY GRAND OPENING
PORT AUTHORITY
COMMEMORATIVE EDITION

Rapid Transit For The West Is Here

A long-awaited addition to the public transit network of services in Allegheny County is coming to fruition today with the grand opening of Port Authority's third bus rapid transit facility, the West Busway.

From planning efforts initiated a decade ago by the Southwestern Pennsylvania Commission, the opening of the West Busway marks a historic milestone for Allegheny County as the newest rapid transit facility debuts to efficiently and reliably carry thousands of Port Authority customers to destinations throughout the Pittsburgh region.

Continued on page 2

This project is 80 percent funded by the Federal Transit Administration

PORT AUTHORITY
Dedicated To A Gold Standard Of Service

Figure 17: Connextions Brochure