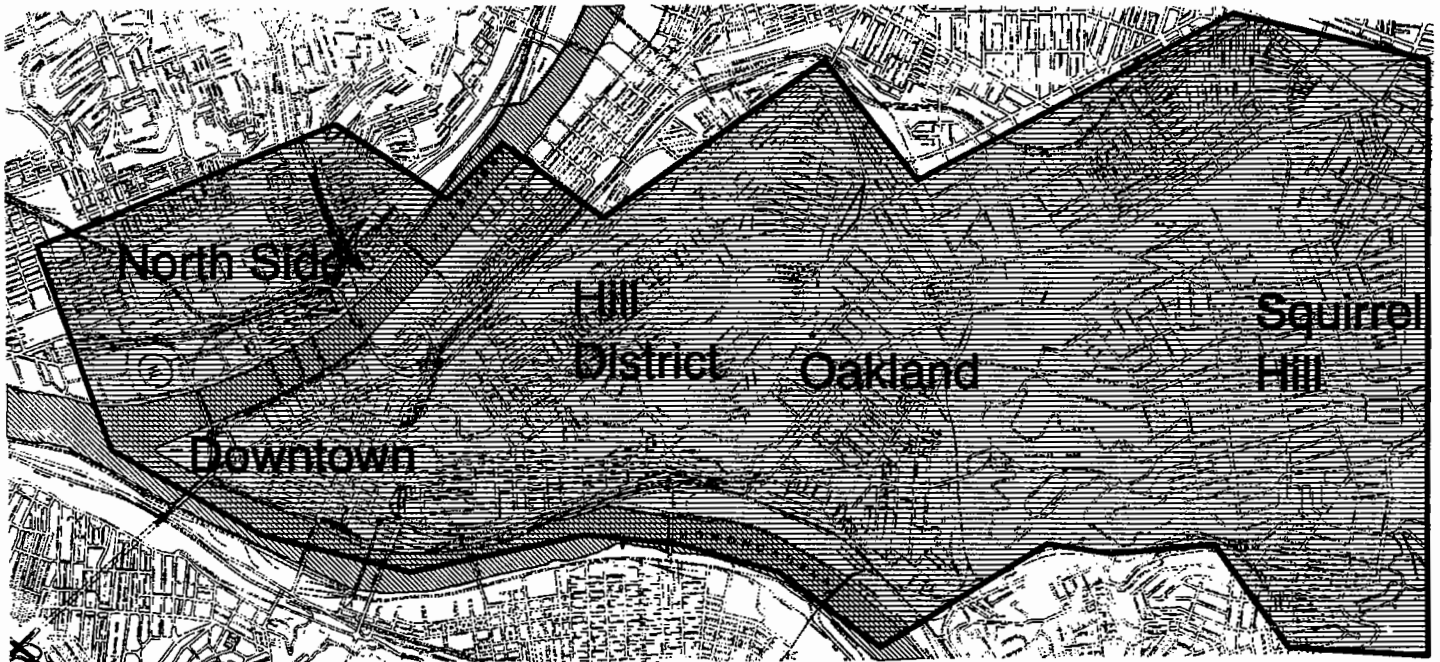


# SPINE LINE CORRIDOR STUDY



**PORT AUTHORITY OF ALLEGHENY COUNTY**

**PITTSBURGH, PENNSYLVANIA**

**U.S. Department of Transportation  
Federal Transit Administration**

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Prepared by ICF Kaiser Engineers

in association with

Maguire Group, Inc.  
Catherine M. Anderson  
Fitzgerald & Halliday, Inc.  
The Goodman Corporation

COMSIS Corporation  
GeoMechanics, Inc.  
LKC Consulting Services

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## **A. STUDY PURPOSE AND BACKGROUND**

Port Authority of Allegheny County (PAT) is evaluating transit improvements in the Spine Line corridor. The eight-mile corridor extends from the North Side to the East End in the City of Pittsburgh. Specifically, it includes the near North Side, Downtown, Hill/Midtown, Oakland and Squirrel Hill communities.

This Executive Summary presents the results of the Spine Line Corridor Study which was completed in 1993. The purpose of the Spine Line Corridor Study was to analyze alternatives for improving transit service in the Spine Line corridor. This document provides a detailed description of the alternatives, how alternatives were selected for further analysis, capital costs, operating and maintenance costs, impacts on the physical environment, community impacts, effect on land use, and projections of ridership and revenues.

Plans for rapid transit improvements in the Spine Line corridor date back to the early 1900's. The existing study began when PAT undertook the Spine Line Corridor Transitional Analysis. This analysis, which was completed in 1985, consisted of an initial engineering feasibility of the Spine Line extensions and a determination as to whether advancing this project was warranted. The extensions were found to be feasible and the analysis determined that the project merited further development.

A project scoping meeting was held in April, 1988 to receive input from the public on the alternatives to be considered. With the approval of the Urban Mass Transportation Administration (now FTA), this Corridor Study began July, 1988. This project was originally scheduled to be completed much earlier, but problems associated with the development of a revised regional ridership forecast model delayed completion of this report until 1993.

## **B. NEED FOR ACTION**

The Spine Line corridor is the most heavily developed and densely populated area of the City of Pittsburgh and Allegheny County. There are 114,000 residents and over 229,000 jobs located in this corridor. PAT's highest volumes of ridership are in this corridor with over 115,000 of the system's 285,000 weekday riders who begin or end their travel within its limits.

The corridor includes downtown Pittsburgh and Oakland, the largest activity centers in Western Pennsylvania. Downtown is the major commercial, retail and office center. Oakland is Western Pennsylvania's civic center with major cultural, educational and medical institutions. Currently, there are 140,000 people working Downtown and 29,000 in Oakland. These numbers are projected to increase to 185,000 and 35,000 respectively by the year 2000. The North Side also contains traffic generators of regional significance such as Three Rivers Stadium, a community college, two hospitals and the Carnegie Science Center.

The arterials and many of the local streets in the corridor are heavily congested. All of the major roadways such as I-376 Parkway East, Fifth Avenue, Forbes Avenue, Liberty Avenue and Murray Avenue are presently operating near or above capacity. Many of the intersections in this corridor also are failing during the AM and PM peaks.

Congestion in the corridor not only occurs during the morning and evening peaks, but during non-peak times as well because of the nature of employment and usage of cultural, educational, entertainment, medical, and sports facilities. As travel to and within the corridor rises due to increased usage of its facilities and greater levels of employment, levels of service on roadways and intersections are predicted to deteriorate further without improvements to the transportation system.

The excessive number of private vehicles results in severe congestion which reduces the productivity of PAT's services and increases its operating costs. Additionally, the slow speeds limit PAT's ability to attract new customers. Conversely, many motorists view the large number of buses in the corridor as a source of traffic congestion. The result is a situation which is mutually disadvantageous to automobile users, transit riders and PAT.

Topographic constraints and intense level of development in the Spine Line corridor make it very difficult to improve existing roadways and virtually preclude addition of new streets and highways. Indeed, the only recent roadway improvements in the Spine Line corridor were the construction of the I-279 ramps on the north end of the Fort Duquesne Bridge, the I-579 Veterans Memorial Bridge and North Side connections and completion of approaches to the north end of the Birmingham Bridge. However, the purpose of these projects was to improve access to and from the corridor rather than movement within the corridor.

Additionally, parking in the corridor is relatively expensive and supply does not meet demand although there are already many parking facilities. There are plans to develop additional parking garages and lots, but their costs and limited land space for additional facilities make this difficult to achieve.

### **C. ALTERNATIVES CONSIDERED**

A range of alternatives was considered for evaluating transit improvements in the Spine Line corridor. These include:

A Null Alternative which maintains the existing transit system plus improvements in service frequency where appropriate;

A Transportation System Management (TSM) Alternative, consisting of additional bus service between Downtown and Oakland and Squirrel Hill via the Martin Luther King, Jr. East Busway; and

Rail alternatives involving extension of PAT's existing Light Rail Transit (LRT) system into Pittsburgh's North Side and East End communities.

Through input from citizens, community organizations and public agencies a "long list" of rail alternatives was screened to a "short list" for further evaluation.

#### **1. The Null Alternative**

The Null, or "No Build" Alternative consists of the existing transit system modified to reflect increased levels of service needed to accommodate increased population and employment in PAT's service area by the year 2005. It serves as a baseline against which the costs, benefits and impacts of the other alternatives can be compared. It also satisfies FTA and National Environmental Policy Act requirements for including a "do nothing" scenario in the study.

#### **2. The TSM Alternative**

The TSM Alternative provides additional express bus service and a new bus transit center in Oakland. The new transit center would be located at Craft and Fifth Avenues. It would facilitate transfers between existing bus lines through Oakland and a new express route between Downtown and Oakland. This new route would begin

at the transit center, travel east through Oakland via the Fifth Avenue bus lane, turn north onto Neville Street and enter the Neville ramp where it would access the Martin Luther King, Jr. East Busway to go Downtown.

In addition to this new route and transit center, service on the W flyer which operates between Downtown, Oakland and Squirrel Hill via the East Busway, would be improved. The W Flyer presently operates once per hour during the peak periods only. Under the TSM alternative, both frequencies and hours of operation would be increased.

PAT already has implemented a full range of TSM measures in the Spine Line corridor. They include frequent bus service between the North Side and Downtown and Downtown and East End communities, use of higher capacity articulated buses, crosstown service between the North Side and Oakland which avoids Downtown congestion, express services which utilize limited-access arterials and the East Busway, and exclusive bus lanes located Downtown, Hill/Midtown and in Oakland.

### **3. The Rail Alternatives**

The rail alternatives involve extensions of the existing Downtown-to-South Hills LRT system also known as the "T". These extensions would tie in with the Downtown subway for Downtown routing.

#### Downtown to North Side

There are two Downtown-to-North Side alternatives connecting with the "T" at a new Gateway Center station which would be relocated to the west beneath Liberty Avenue. The extension would curve north below Commonwealth Street, then east under Fort Duquesne Boulevard where it would emerge through a reconstructed median.

The New Bridge Alternative would cross over the Allegheny River on a new bridge located one block west of the Sixth Street Bridge. After crossing the river it would descend below ground, curve northwest towards the Clark Candy Building and then run north under Arch Street to North Avenue and under North Avenue to Federal Street. In addition to the terminal station at Federal Street and North Avenue, near Allegheny General Hospital, there would be the Stadium/Allegheny station, located along the east face of the Clark Candy Building, with station entrances close to the Stadium and to Allegheny Center.

The Sixth Street Bridge Alternative would use the existing Sixth Street Bridge and a portion of South Federal Street to General Robinson Street. It would turn west onto General Robinson Street and enter into a subway tunnel where it would follow the same alignment as the New Bridge Alternative. Stations would be located at Federal Street at North Avenue, at the Clark Candy building and South Federal Street near General Robinson Street.

#### Downtown to Oakland

Between Downtown and Oakland the alternatives follow three different alignments. The Centre Avenue Alternative would have its junction with the existing "T" at the Manor Building and would be constructed as a subway for its entire length. The line would curve and follow Centre Avenue to Soho Street. It then would turn southeast to enter Oakland at Craft Avenue. Stations would be located at the Civic Arena, Dinwiddie Street, and Soho Street near Kirkpatrick.

The Colwell Alternative would also connect with the "T" at the Manor Building. It could be built either at-grade or in a subway configuration along Colwell Street parallel to Fifth Avenue through the Hill and Midtown

communities. Stations would be located at the Central Medical Center and Hospital near the Civic Arena, at Dinwiddie Street and at Kirkpatrick Street.

The Technology Center Alternative would have its junction with the "T" at the site of the former B & O Railroad Passenger Terminal and be constructed at-grade to the Pittsburgh Technology Center where it would rise up over the Parkway East before entering Oakland. Stations would be located by Duquesne University and at the Pittsburgh Technology Center. This alternative would also serve the proposed First Avenue station, which may be built even without the Spine Line.

All three alternatives would pass through Oakland under either Forbes Avenue or Fifth Avenue. East of Bigelow Boulevard, the line would follow Forbes Avenue to Morewood Avenue across from Carnegie-Mellon University. Stations would be located at Darragh Street/McKee Place, Schenley Plaza and Morewood Avenue.

#### Oakland to Squirrel Hill

The final alternative is the Squirrel Hill extension. It would be built in a subway configuration under Forbes Avenue from Morewood to its terminus east of Dallas Avenue. Stations would be located at Murray Avenue and adjacent to the Homewood Cemetery across Forbes Avenue from Frick Park.

This study assumes that the Downtown subway has the capacity to accommodate both South Hills and Spine Line trains. This would be accomplished by operating two-car South Hills trains and three-car Spine Line trains during rush hours. Should operational reasons preclude reduction of sufficient numbers of trains through increased use of two-car trains on the South Hills lines, the capacity of the existing Downtown subway would be inadequate for both lines' use in rush hours. In this case, a new subway line in Downtown would be required for the Spine Line to operate without degrading service to South Hills.

These alternatives are summarized in Table S.1 and Figure S.1. Their significant characteristics are summarized in Table S.2.

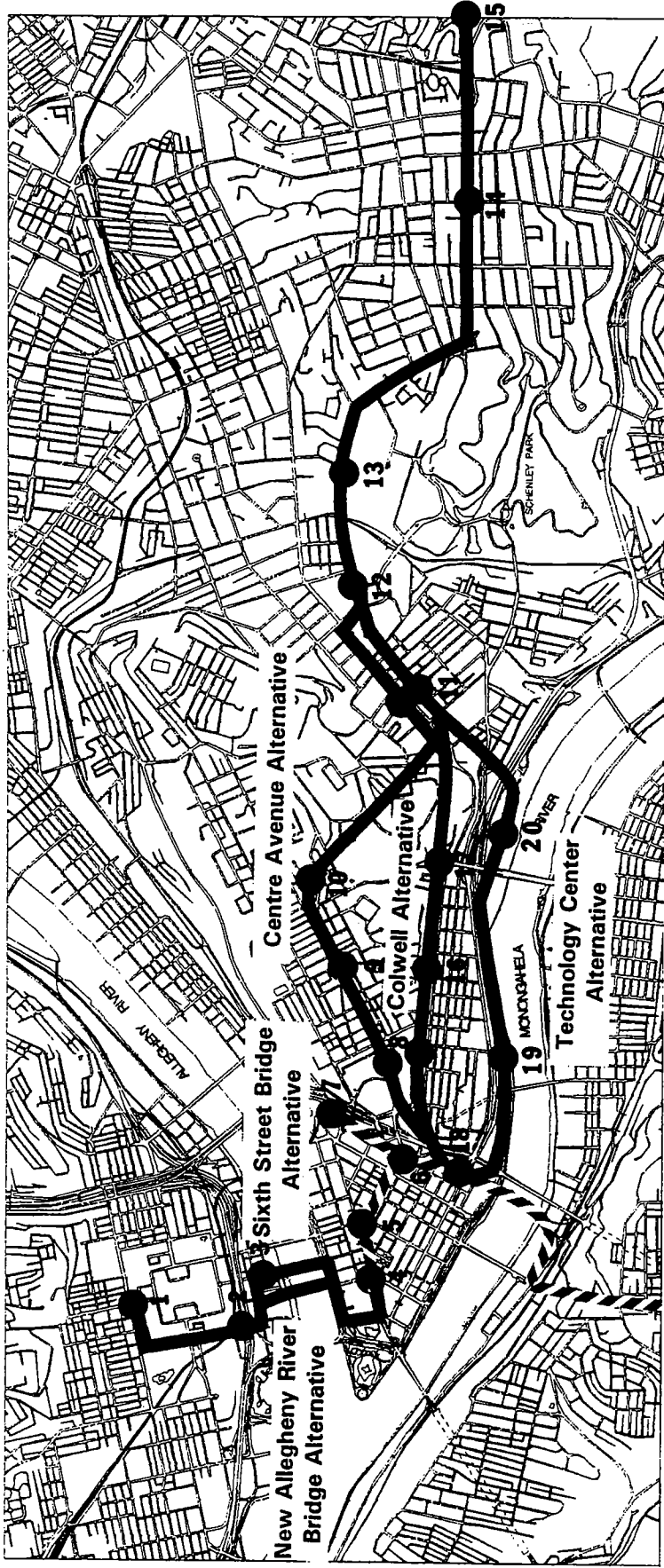
### **D. RIDERSHIP AND SERVICE BENEFITS**

Transit ridership in the greater Pittsburgh area is projected to grow from the current 285,000 weekday trips to 353,000 in the year 2005 for the Null Alternative. All of the other Spine Line alternatives would further increase ridership. These impacts reflect the continuing high level of demand for transit services in the region, particularly for travel to Downtown and Oakland. The effectiveness of the Spine Line alternatives demonstrates the attractiveness of transit service operating on an exclusive guideway in a market with limited roadways and severe congestion.

The TSM Alternative would improve levels of bus service in the Downtown-Oakland-Squirrel Hill market. It would utilize existing exclusive bus lanes and the Martin Luther King, Jr. East Busway. An additional 4,200 weekday riders would be using the transit system. Nearly all of these riders would be traveling to Downtown and Oakland.

The LRT alternatives would improve transit access for residents and workers throughout the entire length of the corridor. The greatest benefits would come to those making the longest trips, as the travel time savings of the LRT alternatives would be greatest for them. Total daily Spine Line ridership on the LRT alternatives would range from 51,700 for the Technology Center Alternative to 59,000 for the Centre Avenue Alternative and 61,000 for the Colwell Alternative.

Figure S.1  
LRT ALTERNATIVES



STATION LOCATIONS

- |                             |                |                     |                       |                         |
|-----------------------------|----------------|---------------------|-----------------------|-------------------------|
| 1. Federal/North            | 5. Wood Street | 9. Dinwiddie/Centre | 13. Morewood/CMU      | 17. Kirkpatrick         |
| 2. Allegheny Center/Stadium | 6. Steel Plaza | 10. Soho            | 14. Murray Avenue     | 18. First Avenue        |
| 3. Federal South            | 7. Penn Park   | 11. McKee           | 15. Frick Park        | 19. Duquesne University |
| 4. Gateway                  | 8. Civic Arena | 12. Schenley Plaza  | 16. Dinwiddie/Colwell | 20. Technology Center   |



Table S.1

SHORT LIST OF ALTERNATIVES

ALTERNATIVE	MODE	DESCRIPTION
NULL	Bus	Existing bus system updated to serve projected Year 2005 demand.
TSM	Bus	Same as Null, plus additional express bus service to Downtown, a new Oakland Transit Center and traffic improvements.
LIGHT RAIL TRANSIT	LRT AND BUS	Extensions to the Downtown LRT subway to North Side and Hill/Midtown, Oakland and Squirrel Hill communities.
<u>NORTH SIDE ALTERNATIVES</u>	LRT AND BUS	Extensions to the Downtown LRT subway to North Side.
NEW ALLEGHENY RIVER BRIDGE	LRT AND BUS	New Gateway Station with extension to North Side via a new bridge west of the Sixth Street Bridge, with stations adjacent to the Clark Candy Building and near Allegheny General Hospital.
SIXTH STREET BRIDGE	LRT AND BUS	New Gateway Station with extension to North Side via existing Sixth Street Bridge, with stations on Federal Street, adjacent to the Clark Candy Building and near Allegheny General Hospital.
<u>EAST CORRIDOR ALTERNATIVES</u>	LRT AND BUS	Extensions of Downtown subway east to Oakland and Squirrel Hill.
TECHNOLOGY CENTER	LRT AND BUS	Junctions with existing subway at Downtown end of the Panhandle Bridge, parallels Monongahela River at grade using the former B&O Railroad right of way and aerial to Forbes Avenue/Boulevard of the Allies, then curves north into Oakland under Forbes or Fifth Avenues, then under Forbes Avenue to Squirrel Hill. Stations at First Avenue (shared by South Hills line), Duquesne University, the Pittsburgh Technology Center, McKee Place/Forbes Avenue, Schenley Plaza, Morewood Avenue/Forbes Avenue, and east of Dallas Avenue at Frick Park along Forbes Avenue.

ALTERNATIVE	MODE	DESCRIPTION
COLWELL SUBWAY	LRT AND BUS	Junctions with existing subway at Manor Building, subway alignment adjacent to and south of Colwell Street to Oakland. In and through Oakland to Squirrel Hill this alternative has the same route and station locations as the Technology Center Alternative. Between Downtown and Oakland it would have stations at Civic Arena, Colwell Street/Dinwiddie Street and Colwell Street/Kirkpatrick Street.
COLWELL AT-GRADE	LRT AND BUS	Same as the Colwell Subway alternative, but at-grade from Washington Place near the Civic Arena to Kirkpatrick Street.
CENTRE AVENUE	LRT AND BUS	Junction at Manor Building, subway alignment under Centre Avenue to Soho near Kirkpatrick then turns southeast to Oakland where it passes under Forbes Avenue to Squirrel Hill. In and through Oakland to Squirrel Hill this alternative has the same route and station locations as the Technology Center Alternative. Between Downtown and Oakland, it would have stations at Civic Arena, Centre Avenue/Dinwiddie Street, and Centre Avenue/Soho Street.

Table S.2

## SUMMARY OF SIGNIFICANT PROJECT CHARACTERISTICS

Alternative	Null	TSM	LRT: Technology Center	LRT: Colwell	LRT: Centre Avenue
1. CAPITAL COST (millions)					
a. 1992 dollars	\$0	\$37	\$864	\$992	\$1,086
b. Construction year dollars	\$0	\$50	\$1,175	\$1,310	\$1,473
2. OPERATING AND MAINTENANCE COST (Millions 1992 dollars)	\$210.6	\$211.4	\$206.9	\$204.6	\$204.6
3. REVENUE (Millions 1992 dollars)	\$106.4	\$108.1	\$113.7	\$115.0	\$113.6
4. RIDERSHIP (year 2005) Weekday Spine Line LRT Riders	N.A.	N.A.	51,700	61,000	59,000
5. TRAVEL TIMES (Minutes)					
Downtown to North Side	7.0	7.0	4.4	4.4	4.4
Downtown to Squirrel Hill	30.0	30.0	16.0	15.0	17.3
Downtown to Oakland	18.0	18.0	9.5	9.3	10.8
6. LAND USE AND ECONOMIC DEVELOPMENT	Continued development in the study area.	No impact relative to the Null Alternative.	Reinforces redevelopment of North Side, supports Oakland and Squirrel Hill development, supports Pittsburgh Technology Center development.	Reinforces re-development of North Side, supports Oakland and Squirrel Hill development, supports re-development of Fifth Avenue corridor between Downtown and Oakland.	Reinforces re-development of North Side, supports Oakland and Squirrel Hill development, supports re-development of Centre Avenue corridor in the Hill District.
7. DISPLACEMENT & RELOCATIONS	None	None	0 residences 2 commercial	52 residences 12 commercial	9 residences 5 commercial
8. NOISE AND VIBRATION	None	No Significant Impacts	No Significant Impacts	No Significant Impacts	No Significant Impacts
9. AIR QUALITY	None	Minor improvement due to auto diversions.	Minor improvement due to auto diversions.	Minor improvement due to auto diversions.	Minor improvement due to auto diversions.
10. VISUAL IMPACTS	None	None	New Allegheny River Bridge and crossing of Parkway East, but no impact identified.	New Allegheny River Bridge, but no impact identified.	New Allegheny River Bridge, but no impact identified.
11. ARCHAEOLOGICAL AND HISTORIC SITE IMPACTS	None	None	Martin Building (potential historic). High probability of archaeological sites near Downtown.	Martin Building (potential historic). Potential historic site and high probability of archaeological sites along Colwell.	Martin Building (potential historic). Probability of archaeological sites near Downtown.

For all three alternatives, the largest volumes of ridership would occur on the segment between Downtown and Oakland. This amount ranges from 34,700 on the Technology Center Alternative to 37,700 and 38,200 on the Centre Avenue and Colwell alternatives, respectively. The Downtown-to-North Side extension carries the second largest volumes with ridership ranging between 19,200 and 20,100. Ridership on the Oakland-to-Squirrel Hill extension would be 16,400 - 16,800 riders.

The Colwell Alternative would add a total of 18,600 new trips to PAT's system ridership. The Centre Avenue Alternative would add 15,100 trips and the Technology Center Alternative would increase PAT's ridership by 14,300. These new trips consist of two components. The first component is trips that would otherwise be taken by automobile, and thus represent a shift from auto to transit. The ridership projections for the Colwell, Centre Avenue and Technology Center alternatives include 5,500, 2,400 and 4,100 weekday trips of this type, respectively.

The other component of these new transit trips represents travel that otherwise would not have been taken at all. These trips would usually occur during the middle of the day rather than during peak periods. They might, for example, include the trip made by a Downtown worker visiting a patient in an Oakland hospital or travel by a Hill district resident to conduct personal business in an Oakland library. Port Authority currently experiences this type of travel among the Downtown "T" stations and between Downtown and Station Square. The Colwell, Centre Avenue and Technology Center alternatives are estimated to produce 13,100, 12,700 and 10,200 such weekday trips, respectively.

As stated above, the three LRT alternatives would attract 14,300 - 18,600 new daily trips to the transit system. Subtracting this information from total ridership yields between 37,500 and 43,800 daily riders who would shift from buses to rail transit if the Spine Line was built.

#### **E. RAIL ALTERNATIVES BENEFIT CONSIDERATIONS**

The three rail alternative alignments between Downtown and Oakland serve different areas. Between Downtown and Oakland there is considerable variation in the amount of residential, institutional and commercial development. Accordingly, different service benefits are associated with the three rail alignments.

The Centre Avenue Alternative serves the greatest number of residents between Downtown and Oakland of the three alternatives. Its primary transportation benefit for those residents would be enhanced access to Oakland. By contrast, there would be less improvement in service to Downtown from the Hill because of the relative speed of bus service. In addition to the direct transportation benefits of implementing this alternative, indirect benefits to the community could accrue in the form of redevelopment at station sites. In conjunction with other public and private sector investments and community initiatives, the Dinwiddie and Soho stations could be the foci of new residential or commercial development which could enhance economic opportunities for Hill District residents and provide needed physical improvements to the community.

The Colwell Alternative would serve residents living within the Fifth Avenue corridor, and institutions such as Duquesne University and Mercy Hospital. It provides the fastest travel times between Downtown and Oakland, with travel times 1.0 minute less than the Technology Center Alternative and 2.3 minutes less than the Colwell Alternative.

The Technology Center Alternative would serve a developing high technology industrial park, the Pittsburgh Technology Center. There are no residents in this area. The primary beneficiaries would be employees and those with business at the Pittsburgh Technology Center as well as users and employees of Duquesne University and Mercy Hospital.

Total travel times between many points in the Hill District and Downtown would actually be greater with the Spine Line than with existing bus service because of the time involved in walking and or taking a bus to the Soho station. On the other hand, trips to Oakland on the Spine Line would take less time than on existing bus lines because of the circuity of their routes.

## **F. ENVIRONMENTAL IMPACTS**

Within the study area a wide range of environmental impacts was assessed, including land use, economic, displacements and relocations, neighborhood character, visual and aesthetic qualities, air quality, noise, ecosystems, wetlands, water resources, utilities, historical and archaeological resources, and parklands.

### **Land Use and Economics**

The TSM Alternative would not change land use or economic patterns in the corridor, as it would only increase the amount of bus service in the Spine Line Corridor. The off-street transfer facility in west Oakland near Craft Avenue would not affect adjacent development due to topographic constraints and the institutional character of the area.

The LRT alternatives are not expected to alter the basic land use and economic patterns of the study area. Site-specific land use changes could occur since each of the LRT alternatives would improve access to Downtown from the North Side and the East End, and to the North Side, Oakland and Squirrel Hill from the balance of the corridor.

The Technology Center Alternative would provide access to Duquesne University and Mercy Hospital as well as the Pittsburgh Technology Center itself. The land use pattern in the vicinity of the Duquesne Station is established and would not be expected to change. Similarly, the Technology Center plans are not expected to change by addition of the LRT station, but the pace and certainty of development of that project could be enhanced.

The Colwell Alternative would traverse the south edge of the Hill District, focusing on the Fifth Avenue corridor, an area of mixed residential, commercial and office uses. This area has experienced some adaptive reuse of its current structures, and addition of the LRT line in this alignment could reinforce this trend.

The Centre Avenue LRT Alternative would serve the Centre Avenue area of the Hill District. This alternative could reinforce current development projects and redevelopment activities proposed for the Hill District.

### **Displacement and Relocation**

No relocations or displacements would be required with the Null and TSM alternatives. The LRT alternatives would each require some displacements and relocation of residences and businesses.

The Technology Center Alternative would require the fewest displacements, with just two businesses affected. The Centre Avenue Alternative would displace 9 residences and 5 commercial uses. The Colwell Alternative would require relocation of 52 residences and 5 commercial structures.

The Sixth Street Bridge alignment for the North Side extension would require relocation of about two dozen businesses in the Martin Building at the corner of Sixth Street and General Robinson Street. The New Allegheny River Bridge alignment would involve no relocations.

For all relocations resulting from construction of the LRT alternatives, there is an adequate supply of replacement housing and commercial buildings or sites.

## **Neighborhoods and Community Resources**

Implementation of the Null or TSM alternatives would not affect the character of neighborhoods or impact community resources in the Spine Line Corridor.

Neighborhood organizations are generally supportive of the LRT alternatives. Citizens at most communities meetings have stated their perception that any changes resulting from implementation of the Spine Line would be positive.

The one exception was Squirrel Hill where there was a mixed reaction to the segment that would extend into that community. Some residents expressed concerns about construction and induced traffic impacts of a subway line in Squirrel Hill and indicated satisfaction with existing bus service.

Of the Downtown-to-Oakland alternatives, the Centre Avenue alignment has received the most support from community residents. In particular, the Hill District community is most vocal and forceful in their support for the Centre Avenue Alternative since it is viewed as being a catalyst for revitalization of that area. The Colwell at-grade Alternative would add a new east-west guideway through the southern part of the Hill District, but it has not been determined how this would impact the community other than the displacements and relocations identified above.

## **Visual and Aesthetic Qualities**

The Null and TSM alternatives would have no visual or aesthetic impacts. Implementation of the LRT alternatives would result in such impacts wherever there are at-grade or aerial alignments.

The Colwell at-grade Alternative would be visible along Colwell Street and in the vicinity of Dinwiddie and Kirkpatrick Streets. The Technology Center Alternative would be visible along the Monongahela River segment, mostly in an existing railroad right-of-way where it would constitute no significant change. As that alignment rises onto aerial structure to cross the Parkway East, the bridge would be visible from that highway and Second Avenue, but would be isolated from sensitive uses and would be but one more of a series of bridges crossing over those roadways.

The New Allegheny River Bridge Alternative would add a new crossing one block west of the Sixth Street Bridge and the adjacent Seventh and Ninth Street Bridges. If this bridge were designed to be visually similar to the other three bridges which are virtually identical in their design, its addition may not be a negative aesthetic impact. Instead, careful attention of its design would result in a structure which would complement the other three bridges rather than compete with them visually.

The Sixth Street Bridge Alternative would result in moderate visual impacts on South Federal Street with installation of catenary and support structures and a small at-grade station.

## **Air Quality**

The TSM and LRT alternatives would result in modest reductions of carbon monoxide, hydrocarbon and nitrogen oxides relative to the Null Alternative, due to traffic volume reductions. Projections of carbon monoxide levels in the vicinity of the five station locations where parking spaces would be provided indicate the maximum projected concentrations would be less than half of the National Ambient Air Quality Standard. Any construction related air pollution could be controlled, and the impact of electric generation of power for the LRT alternatives would produce no significant increase in air emissions. The Spine Line LRT alternatives would contribute to a reduction in vehicle emissions, aiding in achieving the State Implementation Plan's objectives for reduction of hydrocarbon emissions and attainment of the ozone standard.

## **Noise**

The Null and TSM alternatives would not affect current noise levels within the corridor. The LRT alternatives would result in modest peak hour traffic increases near stations slated to provide parking, but average noise levels and peak-hour noise levels are not predicted to change. Because most of the LRT alignments would be in subway, there are few locations where the LRT alternatives would operate at-grade or above grade and where sensitive receptors (including residential uses) also exist. Based on noise projections for those limited number of locations and national noise standards, none would approach, let alone exceed, noise level standards. Construction noise levels, while temporary, would need to be controlled through limitations on the hours of construction activity and provision of noise control measures in sensitive areas.

## **Ecosystems**

The Null and TSM alternatives would not negatively affect ecosystems in the Spine Line Corridor. Since the LRT alternatives would be built in areas which are already heavily developed, there would be little impact on natural ecosystems. In places where vegetation would be affected, replantings would mitigate the impacts. The limited wildlife found in the corridor would not be significantly affected by the removal of some habitat at station sites. No threatened or endangered species are present in the corridor.

## **Water Resources**

No long term effects on surface water quality are expected for any of the alternatives. Similarly, no impacts to aquatic species within the water resources of the corridor are anticipated. The New Allegheny River Bridge would entail construction of two piers in the Allegheny River, requiring measures to control sedimentation and turbidity during construction of the bridge. No wetlands other than waterways were identified.

## **Energy**

The most energy efficient alternative, in terms of operating energy consumed per passenger, would be the Colwell Alternative, followed by the Technology Center and Centre Avenue alternatives. The Null and TSM alternatives consume the most energy per passenger but require the least amount of total energy. Because the LRT alternatives would make greater use of electric as opposed to diesel power, and because there is excess electric generating capacity in the region, the LRT alternatives would be preferable to the TSM or Null alternatives from the standpoint of energy usage to operate.

All of the LRT alternatives would involve expenditure of considerable amount of energy for their construction, with the Centre Avenue Alternative requiring the most energy, followed by the Colwell Alternative at about 20% less energy and Technology Center Alternative at about 25% less energy, largely due to the length of subway construction involved in each alternative.

## **Historic and Archaeological Resources**

The TSM and Null alternatives would not affect any historic or archaeological sites. The LRT alternatives would traverse areas of known historic and potential archaeological significance. Historic structures are located adjacent to the alignments of all of the Downtown-to-Oakland alternatives. The Sixth Street Bridge Alternative would require alteration of a bridge included on the National Register. With the exception of the Martin Building on Federal Street, which may be eligible for the Register, no negative impacts to any historic structures are anticipated. Measures to mitigate impacts to historic and archaeological sites would be incorporated into the construction program, and additional research on any structures or sites affected by the preferred alternative in the next project phase would be undertaken.

## Parklands

The Null and TSM alternatives would not adversely affect any parklands. The LRT alternatives would have temporary impacts on several parks, but no permanent loss of parklands would be required for any of the alternatives. Specific parks which would experience construction impacts include West Park, Point State Park and the Schenley Plaza section of Schenley Park.

## Geotechnical

The Null and TSM alternatives would have no geotechnical impacts. The LRT alternatives all involve significant amounts of tunneling, and would encounter conditions requiring dewatering, would entail some mixed face tunneling and would require normal measures to avoid impacts to adjacent structures during construction. Although there are abandoned mines in the Hill District portion of the corridor, the tunnel profiles would place the LRT tunnels beneath the mined tunnels, avoiding subsidence impacts.

## Hazardous Materials

The Null and TSM alternatives would not be affected by hazardous materials. The LRT alternatives each encounter potential hazardous waste sites when they pass beneath or along railroad rights-of-way, notably on North Side at the Allegheny/Stadium Station and along the Technology Center Alternative alignment along the B&O Railroad. In addition, the LRT alternatives would involve up to five gas station locations, one in the Hill District beneath the Centre Avenue alignment, two in Oakland and two in Squirrel Hill. Experience has shown such sites are prone to soil contamination from underground fuel storage tanks. In each case the contaminated soils would be removed and replaced with clean fill.

## G. FINANCIAL ANALYSIS

### Capital Costs

Capital costs were estimated for the TSM and three rail alternatives. The cost for the TSM Alternative consists of the cost for a bus transfer center in Oakland and 115 buses beyond those required by the LRT alternatives. The total capital costs to implement the alternatives are:

	1992 Dollars (millions)	Construction Year Dollars (millions)
1. Transportation System Management Alternative	\$37	\$50
2. Technology Center Alternative	\$864	\$1,175
3. Colwell At-Grade Alternative	\$965	\$1,310
4. Centre Avenue Alternative	\$1,086	\$1,473

The major source of financing for PAT's transit capital projects has been the FTA which has typically provided funding for 80 percent of the full project cost. The Section 3 Discretionary and Formula program is the primary source of federal transit assistance for capital projects. State (16.67 percent) and county (3.33 percent) sources have provided the non-federal share of funding. Recent Federal policy has been to encourage greater non-federal share of transit



project funding. This not only includes increased shares from state and local general revenue sources but dedicated state and/or local funding raised through special taxes and private contributions as well.

Table S.3 illustrates two funding plans for the alternatives. Plan A shows the funding shares under the traditional financing (80% federal, 16.67% state, and 3.33% county) arrangement. Plan B assumes 50% federal, 16.67% state and 3.33% county, and 30% dedicated, private and other funding. These funding plans are shown only to illustrate the magnitude of funds needed from various sources and do not constitute detailed financial plans. A detailed financial plan will be developed during subsequent phases of this project.

Under Plan A, federal funding would account for between \$940 million and \$1.178 billion for the rail alternatives. However, the Intermodal Surface Transportation and Efficiency Act of 1991 (ISTEA) contains \$12.4 billion in Section 3 funding for the entire nation for a six-year period. Therefore, Pittsburgh's share of total federal capital funds for transit would have to be significant in order to have sufficient federal funding for the Spine Line.

**Table S.3**  
**PRELIMINARY FUNDING PLAN A**  
**(Federal 80%, State 16.67%, County 3.33%)**  
**(In millions)**

Funding Need	TSM	Tech Center	Colwell Street	Centre Avenue
Total Escalated Dollars	\$50	\$1,175	\$1,310	\$1,473
Federal	\$40	\$940	\$1,048	\$1,178
Commonwealth of Pennsylvania	\$8	\$196	\$218	\$246
County	\$2	\$39	\$44	\$49
Total Funding	\$50	\$1,175	\$1,310	\$1,473

**PRELIMINARY FUNDING PLAN B**  
**(Federal 50%; State 16.67%; County 3.33%; Private, Dedicated and Other 30%)**  
**(in millions)**

Funding Need	TSM	Tech Center	Colwell Street	Centre Avenue
Total Escalated Dollars	\$50	\$1,175	\$1,310	\$1,473
Federal	\$25	\$588	\$655	\$737
Commonwealth of Pennsylvania	\$8	\$196	\$218	\$246
County	\$2	\$39	\$44	\$49
Dedicated Funding, Private & Other	\$15	\$353	\$393	\$442
Total Funding	\$50	\$1,175	\$1,310	\$1,473

ISTEA allows recipients of federal aid to use highway funds for transit purposes. Although construction of the Spine Line would not occur until after the expiration of ISTEA in 1997, the funding flexibility provisions may be carried over into the next authorization legislation and could, therefore, be an additional source of federal funding for the Spine Line. However, in relation to the total Spine Line LRT costs, these amounts may not be sufficient, in combination with Section 3 funds, to maintain the 80% federal share. For these reasons, Plan B is presented showing greater levels of funding from non-federal sources which may be necessary to finance a project of this magnitude.

### Operating and Maintenance Costs

One of the most important goals of the Spine Line project is to reduce operating and maintenance costs. Operating expenses include all of the costs of providing PAT service. The largest expense categories are wages and salaries, pension and benefits, materials and supplies, and the ACCESS program.

The annual operating and maintenance costs for the Spine Line Alternatives, in 1992 dollars, are:

1. Transportation Systems Management Alternative	\$211,233,000
2. Technology Center Alternative	\$206,912,000
3. Colwell Alternative	\$204,567,000
4. Centre Avenue Alternative	\$204,589,000

These costs represent the operating and maintenance costs of all Port Authority modes of transit service. The data shown above indicates that implementation of any of the LRT alternatives is projected to result in \$4.3 - \$6.6 million savings in operating and maintenance costs over the TSM Alternative.

### Revenues

Operating revenues include fares, the senior citizen reimbursement from the state lottery, advertising receipts, property rentals, and income from investments. These accounted for 48 percent of Port Authority's operating budget in Fiscal Year 1992. Port Authority is mandated by state law to recover 46 percent of its operating expenses from operating revenues.

Port Authority's systemwide base fare is \$1.25. The peak period cash fare on the "T" is \$1.50 in Zone 1. The four existing Downtown zones are located in the "Free-for-all" zone which is free throughout the day.

The revenue projections in this study assumed that the existing fare structure would remain in effect if the Spine Line is implemented. The First Avenue station would be the only new Downtown station and it may be built even without the Spine Line extensions. The year 2005 annual farebox revenues for the Spine Line alternatives, in 1992 dollars, are:

1. Transportation Systems Management Alternative	\$108,083,000
2. Technology Center Alternative	\$113,662,000
3. Colwell Alternative	\$115,011,000
4. Centre Avenue Alternative	\$113,553,000

In addition to these farebox revenues, the study assumes that operating assistance from Federal, State and local sources would continue to be available. Federal operating assistance is restricted by statute, and the amount has declined in real dollars during the 1980's. This has placed an increased burden on the Commonwealth of Pennsylvania and Allegheny County as well as the rider to cover increased costs.

The TSM Alternative, with the lowest farebox recovery of 51%, still exceeds the 46 percent level that Port Authority is required to maintain. Each of the LRT alternatives have 55 - 56 percent cost recovery ratios. Implementation of the rail alternatives would decrease PAT's subsidy requirements relative to the TSM Alternative.

## H. TRADE-OFF ANALYSIS

Selection of a preferred alternative by local decision makers will involve balancing of advantages and disadvantages associated with each alternative and application of individual priorities and value judgements. While all of the findings presented in this document and public input will be considered, the following factors are of particular importance in making a comparative assessment of the alternatives and selecting a preferred alternative for implementation.

The LRT alternatives all provide improved access to key destinations within the Spine Line Corridor. This is evidenced by the increases in ridership projected to occur for each of the LRT alternatives relative to both the Null and TSM alternatives.

The LRT alternatives would all reduce systemwide operating costs for PAT relative to the Null and TSM alternatives by substituting rail service for bus service in a corridor where congestion is an ever-present operating condition for buses as well as the private auto. The reductions in operating costs combined with greater revenues generated from increased ridership would result in increased farebox recovery ratios for the LRT alternatives.

The cost of construction of the LRT alternatives is a significant obstacle to implementing any of them. Difficult topographic conditions, already inadequate street capacities and the need to achieve operating advantages over the current bus system forced the alternatives to use significant segments in subway configuration, resulting in very large capital costs. The Technology Center Alternative would cost at least \$1.175 billion in year of construction dollars. The Colwell Alternative would cost from \$1.310 to \$1.346 billion depending on whether it would be at-grade along Colwell Avenue or in subway. The Centre Avenue Alternative would cost the most at \$1.473 billion.

In the area between Downtown and Oakland, the LRT alternatives through the Midtown Corridor present distinct tradeoffs. The Centre Avenue Alternative could provide an impetus to redevelopment of Centre Avenue through the Hill District, an area where redevelopment has been planned and which has experienced some residential development. The Colwell Alternative would not provide the same service to the Hill District, but would support the redevelopment underway along Fifth Avenue. The Technology Center Alternative would enhance development at the Pittsburgh Technology Center. Thus, there is a spectrum of trade-offs between serving existing service areas (Hill/Midtown communities) or new ones (Technology Center), and supporting existing development versus new development.

In summary, the Centre Avenue Alternative would reach the most current users in the Midtown segment and may, in conjunction with private sector and other public investments, help to revitalize the Hill community. It would also cost the most and provide somewhat slower service between Downtown and Oakland than the other LRT alternatives. The Technology Center Alternative is its opposite, with the lowest cost and support of the Tech Center development project is already underway, but serves virtually no residents in the Midtown segment. Total ridership on the Centre Avenue is greater than with the Technology Center Alternative. The Colwell Alternative is mid-point in costs and support for redevelopment, but has the highest ridership.

## I. ISSUES RECOMMENDED FOR FURTHER ANALYSIS

The following issues remain unresolved and will need further attention in subsequent phases of this project.

1. If it is determined that the full length Spine Line system will be staged in its implementation, the order and length of the segments to be deferred will need to be established.
2. Selection of a preferred alignment among the Centre Avenue, Colwell and Technology Center alternatives needs to be made.
3. The Downtown subway's capacity to accommodate both South Hills and Spine Line trains is predicated upon exclusive use of two and three car trains during rush hours. Should operational reasons preclude reduction of sufficient numbers of trains through increased use of two car trains on the South Hills lines, the capacity of the existing Downtown subway would be inadequate for both lines' use in rush hours. In this case, a new subway line in Downtown would be required for the Spine Line to operate without degrading service to South Hills.
4. Determination of eligibility and effects to historic and archaeological resources by the State Historic Preservation Officer (SHPO) and the National Advisory Council on Historic Preservation as part of the 4(f) and Section 106 processes, will be necessary to complete a Draft Environmental Impact Statement (DEIS) development process. This is a normal step in the project development process.
5. Several sites such as former or existing gasoline stations adjacent to the LRT alignment may prove to be contaminated, and would require remediation. The testing, remediation procedures and clean-up process will be coordinated with PennDER. If soil samples taken during the next project phase reveal other potential contaminated sites along the corridor, mitigation measures will be developed and coordinated with the appropriate state and/or federal agencies. The known sites of concern are: Centre Avenue at La Place Street, Forbes Avenue at McKee Place, Forbes Avenue near Craig Street, Forbes Avenue at Murray Avenue and Forbes at Shady Avenue.

The Spine Line alignments pass under two active railroad lines which also may be contaminated. The North Side alternatives pass below the Conrail mainline just north of the Stadium/Allegheny station. Between the Schenley Plaza and Morewood Stations, the three LRT alternatives pass beneath a CSX line which runs through Panther Hollow.

6. Completion of a DEIS requires development of a detailed plan for financing the Spine Line's capital costs. Implementation of any of the rail alternatives would be the most costly project undertaken by Port Authority to date. Therefore, the analysis performed for the financial plan will be one of the key tasks in determining the viability of LRT in this corridor.