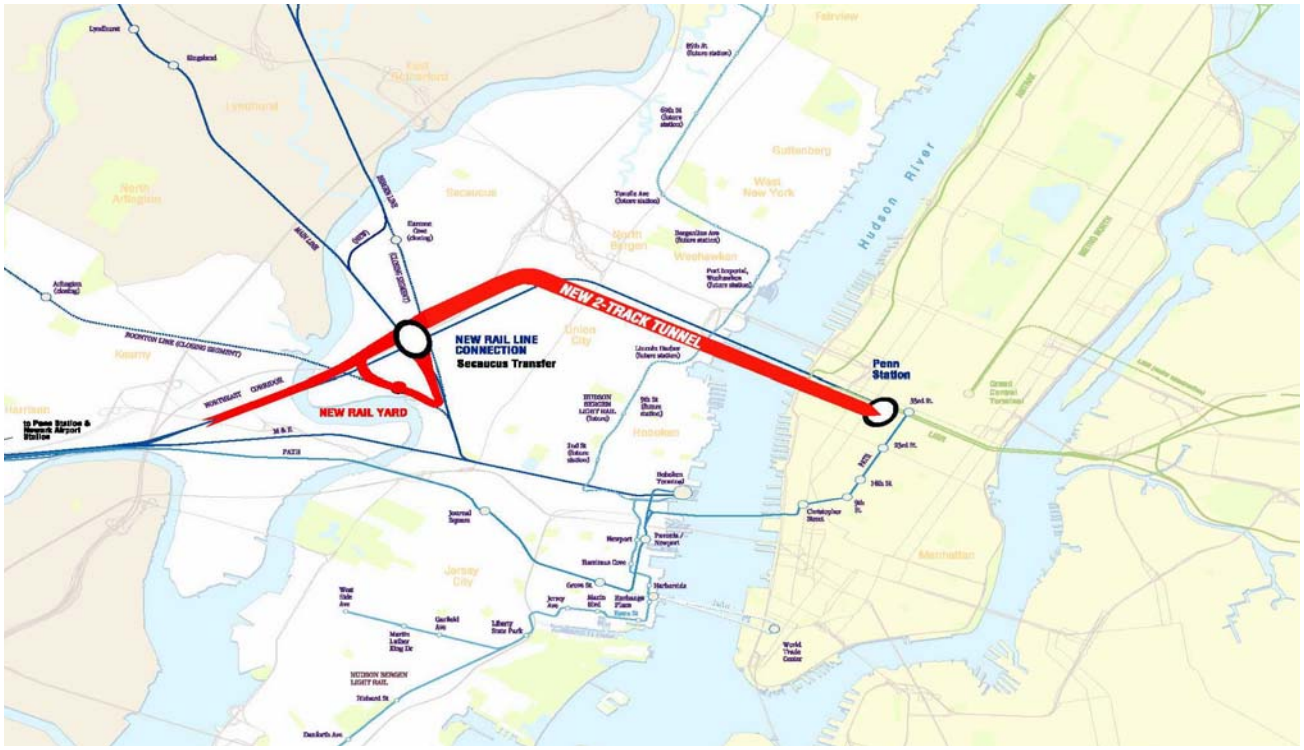
ACCESS TO THE REGION'S CORE

Summary Report 2003



Major Investment Study Sponsored by:

MTA Metropolitan Transportation Authority

NJTRANSIT

THE PORT AUTHORITY OF NY & NJ

ACCESS TO THE REGION'S CORE

MIS SUMMARY REPORT

ABSTRACT

Access to the Region's Core (ARC) is a Major Investment Study (MIS) performed in accordance with Federal Transit Administration (FTA) guidelines, jointly sponsored by the Port Authority of New York and New Jersey (PANYNJ), the Metropolitan Transportation Authority (MTA), and NJ TRANSIT. The ARC MIS began in 1995 with three broad goals:

1. To enhance the economic viability and productivity of the New York-New Jersey region;
2. To improve the quality of life in the region; and
3. To invest and use transportation resources productively, efficiently, and effectively.

ARC Phases 1 and 2 identified and screened 137 alternatives representing a wide range of modal strategies, including bus, light rail, subway, PATH, commuter rail, ferry, new technologies, and auto. This analysis led to the finding that the commuter rail mode serving New York Pennsylvania Station (Penn Station) and Grand Central Terminal offered the best approach to meeting future capacity needs. Alternative AA, which provided a through operation for NJ TRANSIT, Long Island Rail Road (LIRR), and Metro-North Railroad between Penn Station and Grand Central Terminal, was selected as best meeting ARC's goals. Phases 1 and 2 are described in the May 1999 "Milestone Summary Report."

Phase 3 began in July 1999 with a specific mandate to:

- Develop and evaluate near-term improvements that could provide some capacity relief in 5-10 years, while a long-term build alternative was developed;
- Verify constructibility and operability of Alternative AA; and
- Develop and evaluate variants to Alternative AA in case it proved to be infeasible.

In Phase 3, three near-term capacity improvements were conceptualized and recommended:

1. Construction of a linear train storage yard under 31st Street linked to Penn Station Tracks 1-5;
2. Extension of tracks in "C" Yard to create new train storage linked to Penn Station Tracks 19-21; and
3. Construction of a new train storage yard west of Tenth Avenue and south of the existing LIRR West Side Yard, linked to Penn Station Tracks 1-9.

As work on Phase 3 progressed, Alternative AA was modified to create compatibility with changes in the LIRR East Side Access project. In addition, three variants, Alternatives G, P, and S, were selected and analyzed. Common elements of all build alternatives were: construction of a loop track at Secaucus to provide a direct link to Penn Station from Hoboken Division lines and two additional tracks on the Northeast Corridor between Secaucus and Penn Station, including a new trans-Hudson tunnel. Distinctive features of the four Phase 3 build alternatives were as follows:

- **Modified Alternative AA** would create rail links between Penn Station and Grand Central Terminal, serving NJ TRANSIT, LIRR, and Metro-North.

- **Alternative G** would create a rail link between Penn Station and the lower level of Grand Central Terminal shared by NJ TRANSIT and Metro-North.
- **Alternative P** would create new tracks and platforms located beneath existing Penn Station.
- **Alternative S** would create a new rail link to Penn Station, including a new East River tunnel, and train storage facilities at Sunnyside Yard in Queens.

Alternatives P and S and the near-term capacity improvements 1 and 3 are recommended for advancement into a Draft Environmental Impact Statement. These alternatives provide the highest levels of incremental train capacity, accommodate forecasted levels of ridership demand, and provide capacity relief to alternate travel modes. Other alternatives may emerge and be subject to analysis in the Draft Environmental Impact Statement. They also provide opportunities for possible future service to East Midtown. For more information, visit www.accesstotheregionscore.com.

Table of Contents

1.0. INTRODUCTION 1

1.1. THE METROPOLITAN REGION 2

1.1.1. SOCIOECONOMIC TRENDS 2
1.1.2. TRANS-HUDSON COMMUTATION TO MANHATTAN 2
1.1.2.1. Penn Station—Current Conditions 5
1.1.2.2. Penn Station—Evolving Conditions 5
1.1.2.3. Penn Station—Future Capacity Issues 7

1.2. PHASES 1 AND 2 8

1.2.1. PHASE 1—INITIAL SET OF BUILD ALTERNATIVES 8
1.2.2. PHASE 2—ANALYSIS OF SELECTED ALTERNATIVES 9

1.3. NEAR-TERM IMPROVEMENTS 10

1.4. LONG-TERM BUILD ALTERNATIVES 13

1.4.1. MODIFIED ALTERNATIVE AA 13
1.4.2. THREE ADDITIONAL BUILD ALTERNATIVES 14
1.4.2.1. Common Infrastructure 14

1.5. ALTERNATIVE G 15

1.5.1. PENN STATION MODIFICATIONS 15
1.5.2. GRAND CENTRAL TERMINAL MODIFICATIONS 16
1.5.3 MIDDAY TRAIN STORAGE 17
1.5.4. CONSTRUCTION COST ESTIMATE 18
1.5.5. OPERATIONS ANALYSIS 18
1.5.5.1. Fleet Requirements and Acquisition Costs 19
1.5.5.2. Operating and Maintenance Costs 19

1.6. ALTERNATIVE P 20

1.6.1. TAIL TRACKS 20
1.6.2. MIDDAY TRAIN STORAGE 22
1.6.3. CONSTRUCTION COST ESTIMATE 22
1.6.4. OPERATIONS ANALYSIS 22
1.6.4.1. Fleet Requirements and Acquisition Costs 22
1.6.4.2. Operating and Maintenance Costs 23

1.7. ALTERNATIVE S 23

1.7.1. PENN STATION MODIFICATIONS 24
1.7.2. SUNNYSIDE YARD APPROACH 24
1.7.3. MIDDAY TRAIN STORAGE AT SUNNYSIDE YARD 24
1.7.4. CONSTRUCTION COST ESTIMATE 25
1.7.5. OPERATIONS ANALYSIS 25

1.7.5.1. Fleet Requirements and Acquisition Costs *26*
1.7.5.2. Operating and Maintenance Costs *26*

1.8. FREIGHT OPPORTUNITY 26

1.9. TRAVEL DEMAND RIDERSHIP FORECASTS 27

1.9.1. ALTERNATIVE G 28
1.9.2. ALTERNATIVE P 29
1.9.3. ALTERNATIVE S 30

1.10. COMPARATIVE SUMMARY OF RESULTS 31

1.10.1. CAPITAL COSTS 31
1.10.2. OPERATING AND MAINTENANCE COSTS 32
1.10.3. TRANS-HUDSON CAPACITY INCREASE 32
1.10.3.1. Modal Diversions *33*

1.11. CONCLUSIONS AND RECOMMENDED NEXT STEPS 34

1.11.1. ALTERNATIVE G CONCLUSIONS 34
1.11.2. ALTERNATIVE P CONCLUSIONS 35
1.11.3. ALTERNATIVE S CONCLUSIONS 35
1.11.4. BASELINE ALTERNATIVE CONCLUSIONS 36
1.11.5. RECOMMENDATIONS 36

List of Figures

Figure 1.1-1 Regional Rail Network....4
Figure 1.3-1 Near-Term Improvements....12
Figure 1.4-1 Modified Alternative AA....13
Figure 1.4-2 West-of-Hudson Common Infrastructure....14
Figure 1.5-1 Alternative G....15
Figure 1.5-2 Penn Station Key Infrastructure Changes....16
Figure 1.5-3 Grand Central Terminal Breakout....17
Figure 1.5-4 Boonton Yard....18
Figure 1.6-1 Alternative P....21
Figure 1.6-2 Alternative P – Flexed Approach....21
Figure 1.7-1 Alternative S....23
Figure 1.7-2 Sunnyside Yard....25
Figure 1.8-1 Freight Opportunity Alignment....27

List of Tables

Table 1.9-1 Alternative G Ridership Forecast – NJ TRANSIT....28
Table 1.9-2 Alternative G Ridership Forecast - Metro-North Railroad....29
Table 1.9-3 Alternative G Average Weekday Modal Diversions - NJ TRANSIT....29
Table 1.9-4 Alternative P Penn Station Ridership Forecast - NJ TRANSIT....30
Table 1.9-5 Alternative P Average Weekday Modal Diversions - NJ TRANSIT....30
Table 1.9-6 Alternative S Penn Station Ridership Forecast - NJ TRANSIT....31
Table 1.9-7 Alternative S Average Weekday Modal Diversions - NJ TRANSIT....31
Table 1.10-1 Estimated Capital Costs....32
Table 1.10-2 Estimated Annual Incremental Operating and Maintenance Costs....32
Table 1.10-3 Trans-Hudson 2020 Ridership Forecast – AM Peak Hour....33
Table 1.10-4 Average Weekday Modal Diversions - NJ TRANSIT....33

ACCESS TO THE REGION'S CORE

MIS SUMMARY REPORT

1.0. INTRODUCTION

Access to the Region's Core (ARC) is a planning partnership of the Port Authority of New York and New Jersey (the Port Authority), the New York Metropolitan Transportation Authority (MTA), and NJ TRANSIT, the sponsoring agencies. During the late 1980s and early 1990s, these agencies were exploring future travel demands and potential solutions to transportation capacity limitations. The MTA Long Island Rail Road (LIRR) conducted its "Network Strategy Study," with emphasis on new Midtown terminal capacity, which led to the LIRR East Side Access project. NJ TRANSIT completed its "Urban Core" planning work, resulting in Midtown Direct service and the Secaucus Transfer project. The Port Authority completed an "Interstate Network Analysis" examining trans-Hudson linkages and travel in three corridors, especially to the Midtown Manhattan business district.

Recognizing that a joint planning effort would be the most efficient means to examine new rail passenger capacity needs and solutions in relation to Midtown access, the three agencies formed the ARC planning partnership, and commenced this Major Investment Study (MIS) in 1995.

The work and findings of ARC Phases 1 and 2 were documented in the May 1999 "Milestone Summary Report." This Summary Report updates those previous findings and summarizes the third and final phase of the MIS work. It establishes the basis to continue the project into a Draft Environmental Impact Statement phase. All work performed has been in conformance with Federal Transit Administration (FTA) MIS guidelines in effect at the outset of Phase 3, in July 1999.

ARC inextricably links the New York-New Jersey metropolitan area's future economic well being with the need for improved accessibility to the region's largest concentration of employment, Midtown Manhattan. The three broad goals for ARC Phase 3 were to: (1) upgrade accessibility of the region's core; (2) utilize the region's existing transit infrastructure to the maximum extent possible; and (3) maintain and enhance the economic viability of the region. The Phases 1 and 2 Milestone Summary Report documented the need for additional trans-Hudson capacity and summarized a comparison of project concepts pointing toward expanded commuter rail service as the best solution for fulfilling those goals. The Phase 3 study focused primarily on trans-Hudson and New York Pennsylvania Station (Penn Station) capacity issues.

The final year of ARC's planning effort took place in the shadow of the September 11th terrorist attacks. That tragedy resulted not only in significant impacts for the existing regional transit network, especially for trans-Hudson commuters, but also spurred a reassessment of the need to maintain a secure, adequate and resilient transportation system that would minimize the vulnerability of the region's employment and economic base. The past year also presented new challenges for Amtrak, which owns the Penn Station complex and its existing tunnels beneath the Hudson and East rivers. As the federal government considers the policy issues and infrastructure financing requirements of the Amtrak intercity rail system, the region's passenger rail operators have a critical stake in continuing to cooperatively address the need to preserve and enhance this commuter rail facility.

ARC factored these concerns into the findings and recommendation of next steps. In considering the options to be carried forward in the Environmental Impact Statement process, the ARC sponsoring agencies anticipated the need for continued flexibility in the midst of a major program of rebuilding, adapting, and upgrading the regional transportation network.

1.1. THE METROPOLITAN REGION

Census data and forecasts of regional employment and population portray the 31-county tri-state region as a mature metropolitan area, with moderate but steady growth anticipated in population and employment to 2025.

1.1.1. Socioeconomic Trends

The most recent forecast prepared for the New York Metropolitan Transportation Council (NYMTC) for the tri-state region shows population growing from approximately 21.5 million residents in 2000 to 24.0 million by 2025. Total employment for the same region is expected to increase from 11.6 million in 2000 to more than 13.5 million in 2025. Several long-term trends in population, employment, and regional development are expected to continue for the foreseeable future, including population and job growth in both older cities and suburban areas, with somewhat higher population growth in the least developed suburban counties.

These trends also show continuing momentum for employment growth in the Manhattan Central Business District (CBD), extending from 60th Street to the Battery. Manhattan accounted for 2.8 million jobs in 2000, with NYMTC forecasting the addition of nearly 200,000 new jobs by 2025. Midtown Manhattan would continue to serve as the pre-eminent concentration of employment.

Comparison of 1990 and 2000 Census data shows that the region's older urban communities demonstrated strong growth in population, especially in New York City and some urban areas in New Jersey, notably Hudson County. Employment grew in Midtown Manhattan, even as total regional employment continued a long-term trend of greater dispersion throughout the region. The past decade also saw strong performance by the region's public transportation services. NYMTC reported that the number of commuters who drove to work alone fell as transit services gained market share. This is a shift from the earlier trend of declining transit market share that followed the dispersal of jobs and population from the areas best served by public transit. By the late 1990s, many of the region's transit services, especially those serving Midtown Manhattan, were operating at capacity during peak periods.

1.1.2. Trans-Hudson Commutation To Manhattan

These regional trends are especially evident on the system of transit and vehicular connections linking Manhattan with the West-of-Hudson portion of the region. Figures compiled by NJ TRANSIT show that, prior to September 11, 2001, approximately 236,000 inbound commuters crossed the Hudson River to destinations between 60th Street and the Battery from 6-10 AM on weekday mornings, 167,000 using Midtown crossings, and 69,000 entering Lower Manhattan.

For Midtown, the primary transit connection is the Exclusive Bus Lane (XBL) system, providing preferential access for buses to the Lincoln Tunnel, most traveling directly into the Port Authority Bus Terminal. These buses carried more than 60,000 inbound passengers in the AM peak period. Rail service into Penn Station carried more than 33,700 riders, primarily on NJ TRANSIT. Lincoln Tunnel auto, private ferries with cross-town shuttle-bus connections, and PATH uptown service rounded out the Midtown access picture.

For Lower Manhattan, PATH service was the primary trans-Hudson mode, connecting with major NJ TRANSIT rail terminals and carrying more than 39,000 passengers into the World Trade Center terminal during the 4-hour morning peak. The September 11th attacks forced an extended interruption of PATH downtown service, and responses by transit operators and the commuter market they serve vividly illustrate the interrelationships and capacity pressures straining the trans-Hudson network. Midtown-bound ridership surged, dramatically increasing volumes on NJ TRANSIT trains bound for Penn Station in Midtown. This reflected both the loss of downtown PATH service for Lower Manhattan commuters and the primary choice of Midtown for business relocation, at least temporarily, from Lower Manhattan.

Major elements of the region's response to the September 11th disruption included greatly expanded ferry service (especially from Hoboken Terminal), reconfigured PATH service, acceleration of short-term efforts by NJ TRANSIT to improve conditions on rail service to Penn Station, and restrictions on single-occupant-auto entries through the Lincoln and Holland Tunnels during peak hours. Taken together, these measures have accommodated trans-Hudson commuter volumes that have rebounded to within a few percentage points overall of pre-September 11th totals. Many of these service adjustments are temporary. The expected return of PATH service to Lower Manhattan by late 2003 will ease pressure on alternative connections; however, this recovery phase for the trans-Hudson commuter network illustrates the lack of available capacity to absorb ridership growth or readily manage changes in commuter demand. It also demonstrates the interdependence across the West-of-Hudson transit network of the services that carry commuters to Midtown and Lower Manhattan.

In view of these socioeconomic trends, and the projected usage of the entire trans-Hudson transit network, ARC recognized that the commuter rail system, centered on Penn Station, offered the most effective approach to satisfying anticipated trans-Hudson travel demand. The regional rail network, including the Secaucus Transfer Station, is depicted in Figure 1.1-1.

Figure 1.1-1
Regional Rail Network

1.1.2.1. PENN STATION—CURRENT CONDITIONS

The Penn Station facility consists of an integrated network of tracks, tunnel structures, equipment storage yards, interlockings, signaling and communications systems, platforms and passenger circulation facilities, and traction power systems positioned between New Jersey and Queens. This complex is owned by Amtrak and, through operating agreements, is also the only point of direct access to Midtown Manhattan for the LIRR and NJ TRANSIT. As such, it has a critical role in the region's public transportation network.

Penn Station is the most heavily used railroad facility in the country, serving more than 310,000 arriving and departing rail passengers (pre-September 11th) on nearly 800 train trips on an average day. Within the station are convenient links to the New York City subways operating along Eighth Avenue (A, C, E) and Seventh Avenue (1/9, 2, 3). The station is served directly by M4, M10, M16, M20, M34, and Q32 buses. Additional bus, subway, and PATH services are located within one block of the station.

East of Penn Station, four tracks handle LIRR and Amtrak train operations as well as NJ TRANSIT non-revenue trips to Sunnyside Yard in Queens for midday train storage and servicing. During the morning peak hour, 36 westbound LIRR trains (carrying about 40,000 passengers) and one Amtrak train arrive at Penn Station via these tracks. This level of activity is possible because of recent system improvements, including complete reconstruction of the LIRR passenger concourses. Trackage to the west of the station allows LIRR equipment to be moved to the West Side Yard for midday storage.

West of Penn Station, two trans-Hudson tracks accommodate Amtrak and NJ TRANSIT rail service. The eastbound peak-hour capacity is presently fully utilized by 17 NJ TRANSIT and 3 Amtrak trains. Peak-hour NJ TRANSIT and Amtrak commuter (clocker) ridership to Penn Station has grown from about 15,000 passengers in 2000 to nearly 20,000 in December 2001. The majority of this rapid change represents the temporary shift of commuters from PATH as a result of the events of September 11th, though a small portion is attributable to passengers from the Newark Liberty International Airport station (opened in October 2001). Much of this shift will revert back after the restoration of PATH service to Lower Manhattan. In the interim, the demand exceeds NJ TRANSIT's peak-hour seating capacity of about 18,100, resulting in overcrowded conditions on many trains (which were addressed via some train schedule and consist changes). The situation has also put added strain on the passenger circulation facilities at Penn Station.

The Empire Line emanates west from the station as a single track and travels north along the west side of Manhattan. At present, Amtrak operates 13 round trips to/from Albany on weekdays on this line, about half of which continue to/from other points further north or west.

1.1.2.2. PENN STATION—EVOLVING CONDITIONS

A series of ongoing capital improvements will open new markets, attracting additional riders on

trains to Penn Station, adding pressures to capacity and service reliability. Simultaneously, numerous projects are being pursued that will provide various measures of capacity expansion/relief, enabling the Penn Station infrastructure to keep pace with the growing passenger demand. Among the category of projects that will add pressures are:

- ***Montclair Connection***. Introduced in September 2002, this project merged NJ TRANSIT's Boonton Line and Montclair Branch, allowing the introduction of Midtown Direct service to Penn Station on the combined line.
- ***Secaucus Transfer Station***. This major station facility will allow passengers to transfer between trains on the Northeast Corridor and trains on the Main, Bergen County, Pascack Valley, and Port Jervis Lines. The present circuitous route to Midtown Manhattan via Hoboken will be avoided, producing substantial travel time savings and attracting new rail riders. The station is scheduled for opening in 2003. Service will be phased in gradually.
- ***Newark Liberty International Airport Station***. Opened in late 2001, this station now serves about 2,500 daily riders.
- ***JFK AirTrain***. The Port Authority is constructing a light rail link between JFK Airport and the LIRR Jamaica Station that will attract more riders between Penn Station and Jamaica Station.
- ***Amtrak Acela Express Service***. Introduced in 2000, Amtrak's high-speed train on the Northeast Corridor between Boston and Washington has attracted new ridership and increased market share. As demand grows, Amtrak can be expected to increase its peak period service at Penn Station.

Projects that are expected to improve or expand operations, relieving pressures of demand, include:

- ***Amtrak High-Density Signal Improvements***. This project will modify the signal system on the Northeast Corridor High Line between Secaucus and Penn Station, increasing the peak-hour train capacity up to 25 trains per hour. The project is being implemented in conjunction with the Secaucus Transfer and will be completed in 2003, prior to opening of the new station.
- ***NJ TRANSIT Seventh Avenue Concourse***. Opened in September 2002, this new passenger facility in the southeast corner of Penn Station has improved vertical circulation for riders and provided added passenger amenities with the addition of a new passenger ticketing and waiting area. Also included are new stairs and escalators to/from platforms 1-12 and a soon-to-be-constructed new street exit/entry at the corner of Seventh Avenue and 31st Street.
- ***JO Interlocking***. This project will realign the tracks of Lines 1 and 2 east of Penn Station, reducing crossover conflicts in the bi-directional flow of trains and increasing East River tunnel capacity. Combined with fleet upgrades and other changes, this is expected to increase the LIRR morning inbound capacity from 36 to 42 trains per hour.

- ***Farley Post Office Building***. Part of Farley Post Office building on Eighth Avenue to the west of Penn Station is to be converted by the Penn Station Redevelopment Corporation into a rail station concourse and ticketing area for use by Amtrak. While no new platform or track capacity will be added, the project will provide new stairways/escalators to improve vertical circulation at the western end of most platforms.
- ***Equipment Purchases***. NJ TRANSIT has ordered new equipment that will increase average train passenger capacity into Penn Station. This includes 230 Comet V passenger coaches and 29 ALP-46 electric locomotives to augment NJ TRANSIT's existing fleet and replace cars scheduled for retirement. This will allow longer consists on some existing trains operating to Penn Station. Delivery started in 2002 and will be completed in 2003. NJ TRANSIT has completed development of specifications for a bi-level car that would seat in the range of 140 persons (the existing fleet averages about 120 seats per car). A contract for an initial order of 100 cars was approved in December 2002, with options to order over 200 additional cars.
- ***LIRR East Side Access Project***. This capital investment will establish direct LIRR service to a new passenger facility beneath Grand Central Terminal via the 63rd Street Tunnel. This is expected to divert riders from Penn Station to Grand Central Terminal, relieving peak-period capacity constraints for LIRR service to and from Penn Station. The project is currently in design; construction is scheduled for completion in 2011.

1.1.2.3. PENN STATION—FUTURE CAPACITY ISSUES

These programmed capacity improvements will not cumulatively satisfy future growth, particularly in the trans-Hudson market. Increase in demand will occur as a result of continued regional socioeconomic growth. Most of the increased trans-Hudson travel demand will fall on the commuter rail system serving Penn Station. The commuter rail mode will be most attractive due to congested conditions on alternative travel modes such as bus and automobile.

Further pressure on Penn Station will also be generated by public demand for rail system expansion proposals, both to increase one-seat ride opportunities and to serve new markets. A number of potential projects are under consideration by NJ TRANSIT. Also, the MTA/Metro-North Railroad is investigating the feasibility of operating service from some of its existing lines to Penn Station. These proposals would create added train and passenger activity at Penn Station, requiring expanded capacity.

After completion of the high-density signal system, the opening of the Secaucus Transfer Station, and the delivery of bi-level coaches, NJ TRANSIT and Amtrak will use all of the 25 peak-hour trans-Hudson train slots that will be available. NJ TRANSIT's capacity will be expanded to approximately 23,000-24,000 seats; however, ridership forecasts indicate that morning peak-hour passenger demand will begin to exceed that seated capacity at the end of this decade, and the shortfall would reach 4,000 to 5,000 by 2020 (or roughly 20% beyond capacity). This forecast does not include induced demand, i.e., new riders who might change their employment or residence as a result of new services. Nor does it account for displaced Lower Manhattan jobs that relocate permanently to Midtown, or additional development in the

westernmost portion of Midtown if New York City's proposed rezoning concepts are implemented.

It will be difficult to accommodate this excess demand. A small segment of rail trips might be accommodated through shifts in customer travel times to the less congested shoulders of the peak period. Other trips may be accomplished through tolerance of standing and crowding conditions, representing a degradation of service for passengers. Alternate travel modes are now at or near their peak capacities, and will continue to be so despite some short-term relief created by the various programmed commuter rail improvements. The magnitude of the unmet rail demand translates into as many as 105 additional peak-hour buses attempting to utilize the XBL/Lincoln Tunnel, creating a demand 15% over the peak-hour capacity of that facility. Alternately, the unmet demand equates to as much as 4,200 additional autos trying to pass through the trans-Hudson vehicular crossings during the peak hour, a figure requiring the equivalent of two additional highway lanes.

Meeting the region's mobility needs is critical to attaining the economic growth that is forecast and to maintaining Midtown Manhattan as a center of regional, national, and global importance. The potential inability to provide sufficient access to Midtown was recognized as a significant problem, leading to this project's major goal of developing both near-term (5-10 year) and longer-term capacity relief measures for the trans-Hudson transportation system. Ideally, these measures would be capable of increasing trans-Hudson service capacity up to 30 trains per hour (near-term) and substantially higher, up to 60 trains per hour (long-term).

1.2. PHASES 1 AND 2

The initial phases of ARC consisted of analysis of current conditions and expected future needs, followed by exploration of candidate improvements to address those needs.

1.2.1. Phase 1—Initial Set of Build Alternatives

In Phase 1, ARC identified 137 alternatives for initial screening, including commuter railroad, subway, PATH, bus, ferry, light rail, multimodal, new technology, and automobile strategies. Preliminary screenings reduced this to 15 build alternatives. Further quantitative and qualitative evaluation reduced this initial set to four build alternatives (Alternatives A, B, C, and D), which were advanced to Phase 2 for in-depth technical analysis and conceptual planning. These four alternatives were:

- ***Alternative A*** included a new railroad tunnel from the Secaucus Transfer Station, through Penn Station, into Grand Central Terminal's lower level center tracks and then to Sunnyside Yard in Queens via the existing 63rd Street Tunnel beneath the East River. This permitted NJ TRANSIT to reach Grand Central Terminal and Metro-North to reach Penn Station, while also allowing LIRR to have one train service to both terminals.
- ***Alternative B*** included a new two-track rail line between the Secaucus Transfer Station and Sunnyside Yard in Queens via a new Hudson River tunnel, 49th or 50th Street, Third

Avenue, and the 63rd Street Tunnel, to be used by LIRR and NJ TRANSIT for two-way through operation.

- ***Alternative C*** involved a new subway line from the Secaucus Transfer Station to Queens via 33rd Street, Eighth Avenue, 49th Street, Second Avenue, and the 63rd Street Tunnel. Alternative C evolved into Alternative CC, which realigned the Manhattan segment of the route straight across 49th Street from the Hudson River to Second Avenue.
- ***Alternative D*** consisted of two segments: a Palisades Bus/Truck Tunnel (a two-lane roadway starting from a new NJ Turnpike interchange near the Secaucus Transfer to the Lincoln Tunnel) and a Crosstown Subway Extension (lengthening the #7 subway line from Times Square south and west to Penn Station and the Javits Convention Center).

1.2.2. Phase 2—Analysis of Selected Alternatives

In accordance with federal transit planning requirements in effect at the time, two additional alternatives were developed. The first was a No-Build alternative that involves nothing other than implementing those improvements that were already programmed and budgeted. The analysis of the No-Build alternative concluded that projected future demand for travel to Penn Station by 2020 would outstrip capacity and lead to congested conditions at the Penn Station complex. Adopting the No-Build alternative was not seen as a reasonable or responsible course of action.

The second was the Transportation System Management (TSM) alternative consisting of lower cost actions that achieve project goals through better management of the existing transit network. ARC investigated 16 TSM alternatives. Five of these proved to have merit with respect to improving the existing transit network. These were: (1) expanded use of higher capacity bi-level electric cars and coaches by NJ TRANSIT, (2) direct bus service across the George Washington Bridge to East Midtown, (3) new ferry services on the Hudson and East rivers, (4) introduction of a unified regional fare system and fare media, and (5) reopening the Herald Square pedestrian passageway under 32nd Street between Sixth and Seventh Avenues. The analysis concluded that they did not individually or collectively provide meaningful capacity relief to the Hudson River tunnels and Penn Station, or absorb a significant portion of the forecasted growth in regional demand to qualify as a reasonable or responsible alternative.

The ARC sponsoring agencies concluded that commuter rail was the best approach to resolving the future capacity needs of the Penn Station network, and that Alternative A's general concept of linking the railroads between Penn Station and Grand Central Terminal, combined with additional West-of-Hudson and Penn Station capacity, best met the ARC goals. To be consistent with the LIRR's East Side Access station at Grand Central Terminal, the Phase 2 planning process focused on a refined Alternative A, known as Alternative AA. Its key features were:

1. Through operation for all three regional commuter railroads (NJ TRANSIT, LIRR, and Metro-North) between Grand Central Terminal and Penn Station;

2. Addition of two new tracks to the Northeast Corridor High Line from Secaucus and a new two-track Hudson River Tunnel to Penn Station;
3. The Secaucus Loop, including a fifth track at the Secaucus Transfer Station, providing a one-seat ride from the NJ TRANSIT/Metro-North Main/Bergen, Port Jervis, and Pascack Valley lines to Manhattan;
4. Expansion of Penn Station with the addition of a new two-level station at 34th Street to be shared by the LIRR and Metro-North;
5. Extended Penn Station Tracks 1-6 and Platforms 1 and 3;
6. Expanded West Side Yard North for LIRR storage (coordinated with any Javits Center expansion);
7. New West Side Yard South, between 29th and 31st Streets west of Tenth Avenue, for midday Metro-North storage;
8. Use of the 63rd Street Tunnel by NJ TRANSIT to access Yard "A" in Sunnyside for midday storage; and
9. A possible freight alignment sharing the new Hudson River tunnel and Amtrak's West Side Line to Spuyten Duyvil, thence connecting via the Hell Gate Bridge to freight lines in Queens and points east, and the Bronx and points north.

Alternative B was found to have operational and physical feasibility problems and to be inconsistently aligned with the LIRR East Side Access project. Alternative C/CC was determined unable to ease projected Hudson River tunnel and Penn Station overcrowding. Analysis of Alternative D found that neither modal element would relieve congestion at Penn Station.

At the conclusion of Phase 2, Alternative AA had been developed to a conceptual level, and specific issues and concerns of constructibility and operability were still outstanding. The ARC sponsoring agencies initiated Phase 3 of ARC in July 1999, with the objective of verifying the constructibility and operability of Alternative AA, as well as identifying and analyzing variants to Alternative AA, in case it proved to be infeasible. Another Phase 3 objective was to identify and recommend near-term improvements to meet growing ridership demand prior to completion of a longer-term build alternative.

1.3. NEAR-TERM IMPROVEMENTS

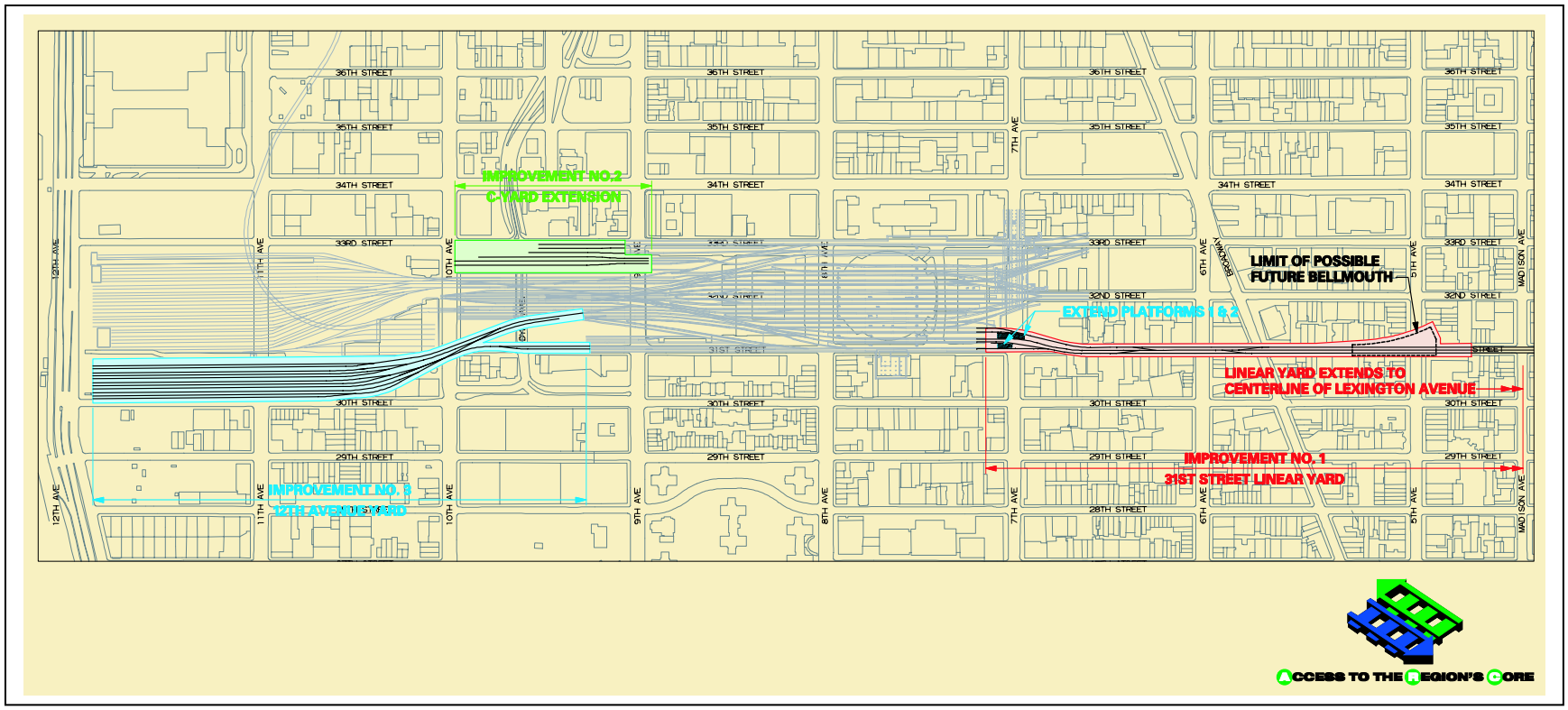
The ARC study team developed a set of 23 potential near-term improvements that could incrementally increase capacity in the Penn Station network in a 5- to 10-year time period. The value of near-term improvements would be to provide capacity enhancements until a long-term build alternative could be selected, designed, constructed, and placed into service. Three of these

improvements (Figure 1.3-1) were selected for additional conceptual engineering studies, refinement of cost estimates, and identification of potential environmental impacts. These were:

1. ***31st Street Linear Yard***. Breakthrough of the wall in the southeast corner of Penn Station and construction of a linear yard for NJ TRANSIT under 31st Street. Included is the easterly extension of Penn Station Tracks 1-5 to a three-track tunnel under 31st Street, providing a new storage yard for six 12-car NJ TRANSIT trains. Platforms 1 and 2 would be extended east under Seventh Avenue, and passenger connections to the street and the 34th Street station of the Seventh Avenue subway would be provided. The estimated construction cost, in 2000 dollars, not escalated to year of construction, is $500 million.
2. ***"C" Yard Extension***. Extension of "C" Yard Tracks 4, 5, 6, 8, 9, and 10, connected to LIRR Station Tracks 19-21, from their western ends at Ninth Avenue west to a new underground terminus that stub ends at Tenth Avenue. This would provide additional storage space for six 12-car LIRR trains north and east of the existing West Side Yard. The estimated construction cost, in 2000 dollars, not escalated to year of construction, is $200 million.
3. ***Twelfth Avenue Yard.*** Construction of a new yard west of Tenth Avenue between 30th and 31st Streets with track access through Yard "A" from Penn Station Tracks 1-9, and Yard "E" from Penn Station Track 1. This new yard would be on MTA-owned property just south of the existing LIRR West Side Yard, and would be connected to Penn Station tracks used by NJ TRANSIT and Amtrak. It would contain 12 tracks, each able to store a 12-car train. The track layout would be similar to the existing LIRR yard, allowing space for the future placement of columns to support potential construction above the yard. The estimated construction cost, in 2000 dollars, not escalated to year of construction, is $300 million.

Each of these three near-term improvements has independent utility and can be developed as a single improvement or in conjunction with one or both of the other improvements. Some are additionally compatible with the long-term build alternatives that were investigated during Phase 3. As service plan data was not available from the railroads at the time the near-term improvements were being developed, no operational analysis was performed to identify the associated extent of potential changes in service capacity. In addition, the feasibility of improvements 2 and 3 in relation to prospective redevelopment of the far West Side of Manhattan would have to be determined.

Figure 1.3-1
Near-Term Improvements



1.4. LONG-TERM BUILD ALTERNATIVES

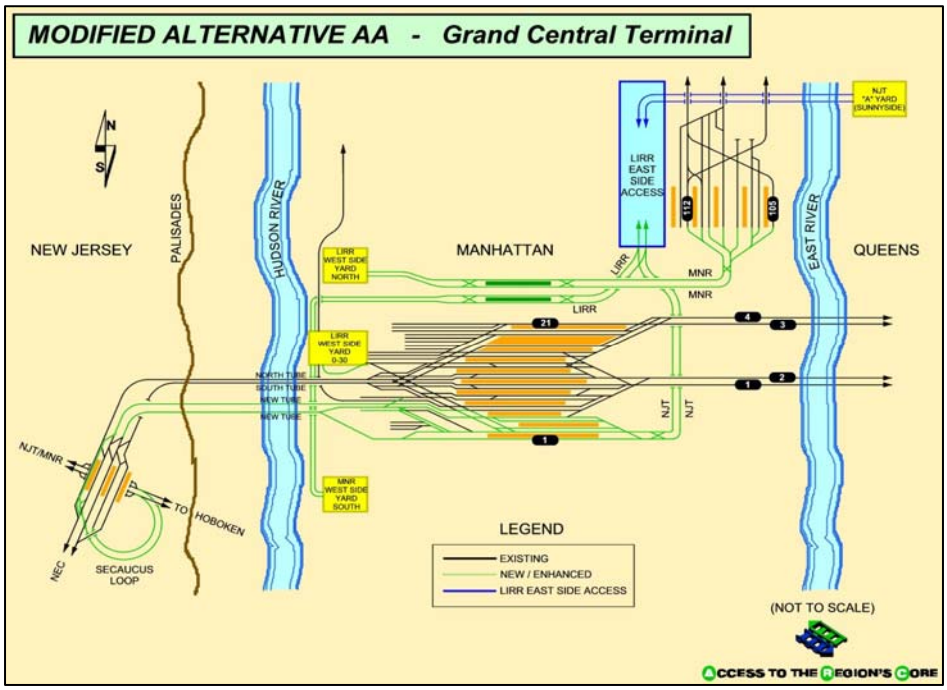
While the near-term improvements represent possible interim measures, a number of long-term build alternatives were also identified and evaluated during Phase 3.

1.4.1. Modified Alternative AA

Between ARC Phases 2 and 3, the location of the LIRR East Side Access terminal had been changed from the Madison Avenue Yard area adjacent to the existing Grand Central Terminal lower level to a deep site directly underneath the existing terminal, with a bi-level configuration. This required that modifications be made to the Grand Central Terminal configuration of ARC Alternative AA. In response, the ARC study team developed a "Modified Alternative AA" (Figure 1.4-1).

The East Side Access reconfiguration suggested a possible new ARC approach, linking NJ TRANSIT to the LIRR East Side Access deep station. Modified Alternative AA would extend NJ TRANSIT from Tracks 1-5 in Penn Station east to a tunnel under 31st Street, then north to the LIRR East Side Access station platform tracks. NJ TRANSIT would then continue via the new LIRR East Side Access tunnels to the lower level of the 63rd Street Tunnel under the East River and on to Yard "A" at Sunnyside. The LIRR would be extended south and then west of Grand Central Terminal in new tunnels to the lower level of a proposed 34th Street Station between Seventh and Eighth Avenues. It would be provided with a new 15-track West Side Yard North between 33rd and 34th Streets from Tenth Avenue to Twelfth Avenue.

Figure 1.4-1
Modified Alternative AA



Metro-North would gain access to the upper level of the new 34th Street Station by the construction of a breakthrough tunnel from its Grand Central Terminal Lower Level Tracks 105-112, running south and then west to the 34th Street Station. It would be provided with a new 20-track West Side Yard South between 29th and 31st Streets and between Tenth and Twelfth Avenues, with lead tracks running from the west end of the 34th Street Station.

After considerable conceptual engineering and operational and cost analyses, Modified Alternative AA was dropped from further consideration for reasons of higher construction complexity, operations risk, and costs.

1.4.2. Three Additional Build Alternatives

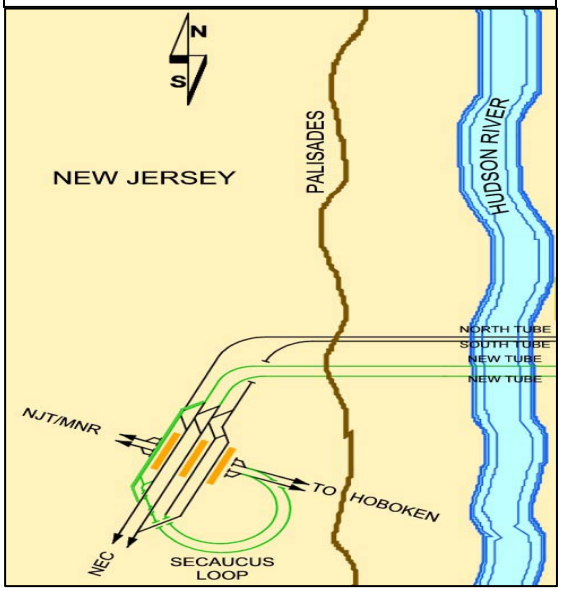
Recognizing that Modified Alternative AA might prove to be infeasible, the ARC study team developed a list of 16 variants and subvariants at the outset of Phase 3. After consultation with LIRR, Metro-North, Amtrak, and NJ TRANSIT, these were screened down to three build alternatives (Alternatives G, P, and S) for further analysis.

1.4.2.1. COMMON INFRASTRUCTURE

Alternatives G, P, and S have common infrastructure west of the Hudson River (Figure 1.4-2) from the Secaucus Transfer Station on the Northeast Corridor High Line to the new Hudson River Tunnel, including:

- Secaucus Loop tracks from the Main/ Bergen, Pascack Valley, and Port Jervis lines to the Northeast Corridor Line;
- Fifth track at the Secaucus Transfer Station;
- Two additional tracks on the Northeast Corridor High Line east of the Secaucus Transfer Station; and
- A two-track tunnel under the Palisades and Hudson River, located immediately south of the existing Hudson River tunnel.

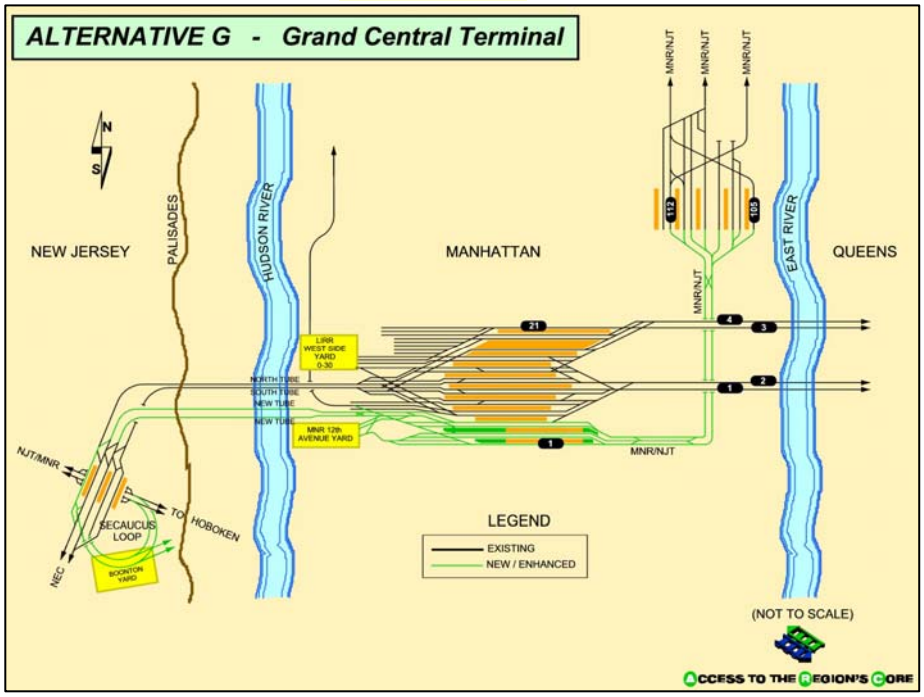
Figure 1.4-2
West-of-Hudson Common Infrastructure



1.5. ALTERNATIVE G

Alternative G would provide through bi-directional operation for NJ TRANSIT and Metro-North between Penn Station and Grand Central Terminal (Figure 1.5-1).

Figure 1.5-1
Alternative G



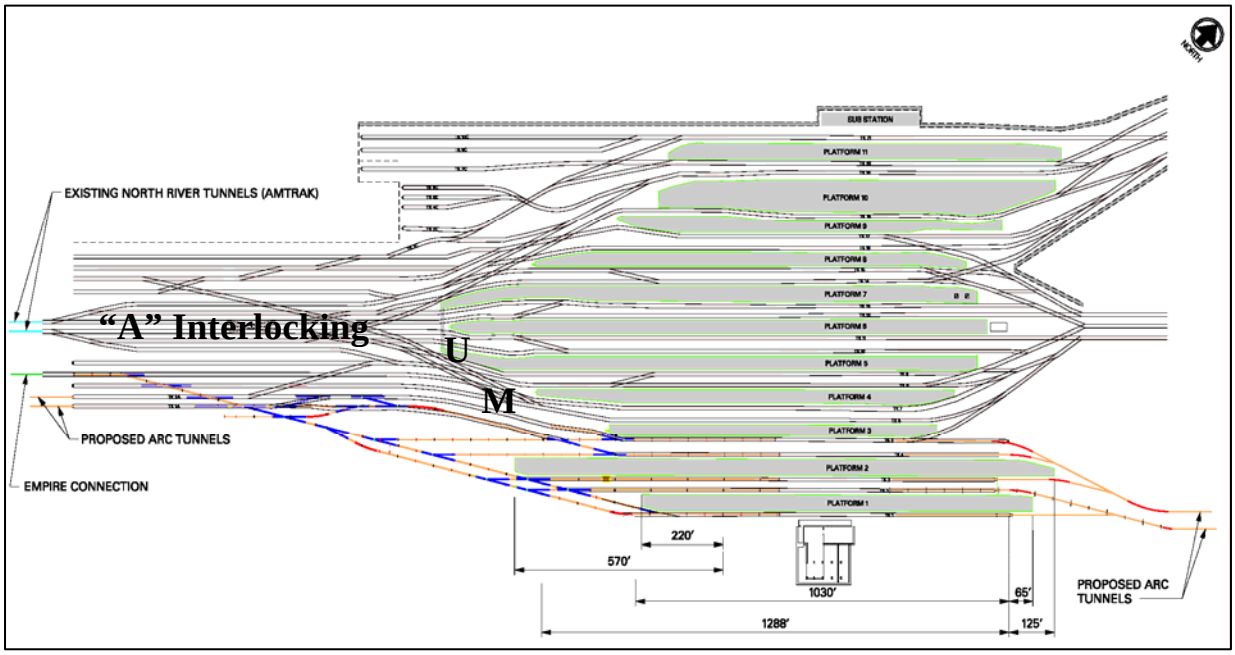
1.5.1. Penn Station Modifications

In Penn Station, trains arriving from the new Hudson River tunnels would be capable of accessing Tracks 1-9 using an expanded "A" Interlocking, though operation would be limited to Tracks 1-5 in peak service (Figure 1.5-2). To accommodate this connection, the "U" and "M" ladders would be truncated at Track 6. The existing Amtrak Mail Express (Diagonal) Platform and associated tracks would be removed to provide for a more efficient track alignment and to permit the extension of Platforms 1 and 2 westward to reach an extended West End Concourse.

The wall at the east end of Tracks 1-4 would be penetrated and a new tunnel from Tracks 1-5 extended eastward under the southwest corner of 11 Penn Plaza through a triangular easement area in the building basement to 31st Street. The foundations and subsurface structural elements of 11 Penn Plaza were constructed in the early 1920s to accommodate such a future easterly extension of the Penn Station tracks through its basement to an alignment under 31st Street. Track 5 would maintain its connection to East River Tunnel Lines 1 and 2 through "JO" Interlocking. If Near-Term Improvement No. 1, 31st Street Linear Yard (Section 1.3.), were

built with a bellmouth heading north, it would serve as a first step towards building the 31st Street alignment of Alternative G.

Figure 1.5-2
Penn Station Key Infrastructure Changes



Platforms 1 and 2 would also be extended to the east, past the Seventh Avenue building line and directly below the 34th Street Station of the Seventh Avenue Subway. This would permit the construction of a direct passenger connection between the extended platforms and the subway mezzanine above.

1.5.2. Grand Central Terminal Modifications

Review of the Alternative AA (Phase 2) alignment at Grand Central Terminal identified design and construction concerns regarding the southward extension of Tracks 105-112. These concerns were studied in greater detail in Phase 3. A field survey was conducted to accurately identify the exact position of the underground structures, including the various subway tunnels in the vicinity. Historical construction documents were researched and compared to survey results. Using the new data and a three-dimensional computer model, the ARC study team concluded that it is physically feasible to break out of the lower level of Grand Central Terminal Tracks 105-112. However, such construction would impact the surrounding subways and buildings, as well as numerous important Grand Central Terminal support facilities located in the path of the proposed connection.

The Grand Central Terminal breakout would require relocation of the existing southbound Lexington Avenue Local track into the abandoned Shuttle Track 2, beginning at the southern end of the existing 42nd Street/Grand Central Terminal subway station (Figure 1.5-3). Construction

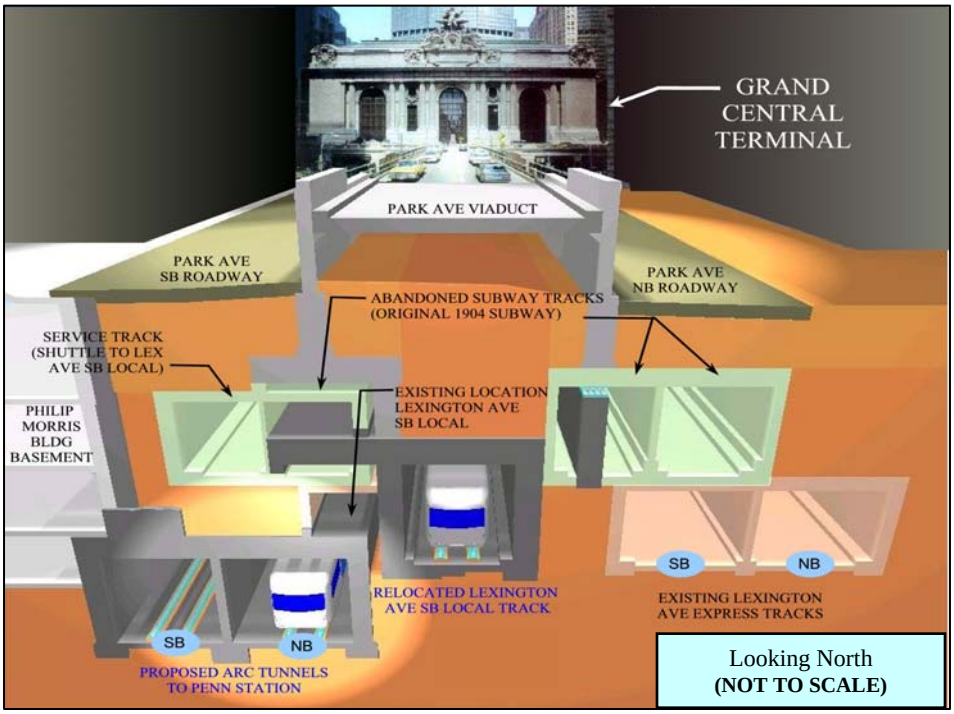
of this option would cause temporary service impacts to the Lexington Avenue Line, perhaps over an extended period of time.

1.5.3 Midday Train Storage

Alternative G requires space for midday storage of both NJ TRANSIT and Metro-North trains. Two primary yard locations have been identified: Twelfth Avenue Yard and Boonton Yard.

The Twelfth Avenue Yard would be identical to that described in Near-Term Improvement No. 3 (Section 1.3.) and would provide storage capacity for Metro-North trains exiting Penn Station. The ARC MIS assumed a track layout incorporating provisions for columns to support an "overbuild" recognizing the potential requirement for compatibility with proposals for West Side development.

Figure 1.5-3
Grand Central Terminal Breakout



The Boonton Yard site is located in Secaucus south of the Northeast Corridor and the Secaucus Transfer Station (Figure 1.5-4). Access to the yard would be from the Northeast Corridor or the NJ TRANSIT Main Line via the proposed Secaucus Loop tracks as well as from Hoboken. The yard would provide space for 20-25 train sets, and be used by NJ TRANSIT and possibly Metro-North should capacity beyond that available in the Twelfth Avenue Yard be necessary.

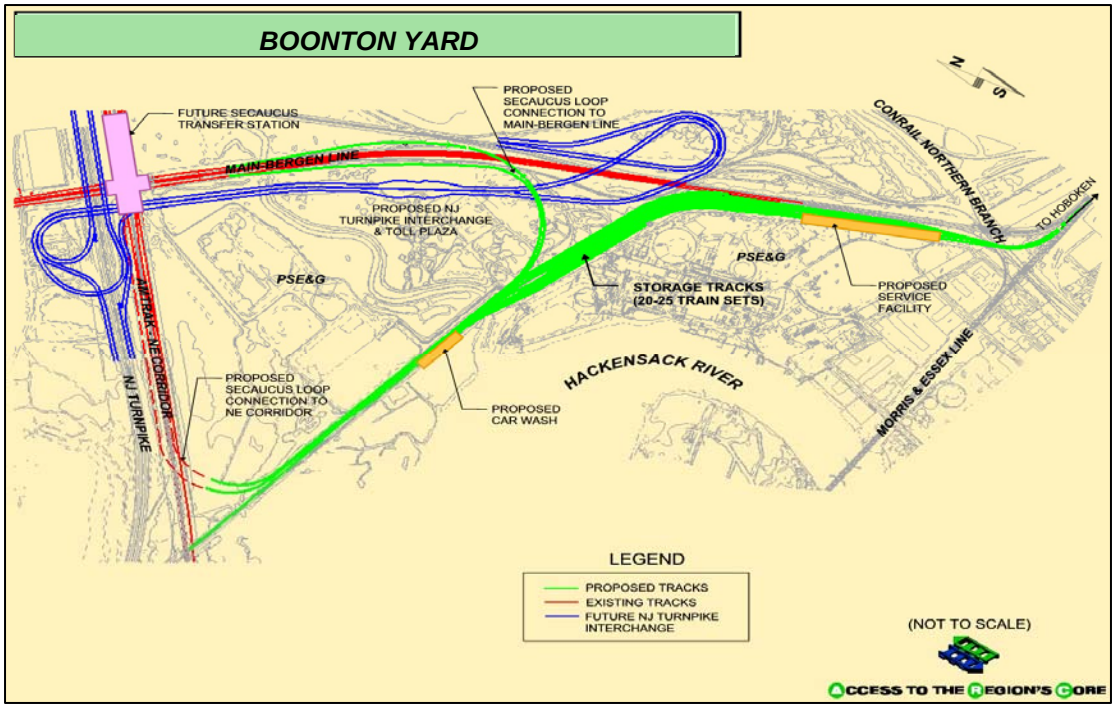
1.5.4. Construction Cost Estimate

The total estimated construction cost for Alternative G, including the Twelfth Avenue and Boonton Yards, is approximately $2.9 to $3.1 billion, in 2000 dollars, not escalated to year of construction. The cost estimates presented here, and for the following alternatives, are based on the conceptual planning performed to date, and may be modified as future engineering analyses are completed.

1.5.5. Operations Analysis

The Post-Secaucus Service Plan consists of schedules and service levels planned for Penn Station after completion of the Secaucus Transfer Project. These schedules, for the AM peak hour, projected 21 NJ TRANSIT trains plus two Amtrak trains (using four slots) to be moving eastbound through the existing Hudson River tunnels, for a total of 23 trains (25 slots). This included a shift of Clocker Service from Amtrak to NJ TRANSIT.

Figure 1.5-4
Boonton Yard



The projected Metro-North 2020 service plan was used as a basis for future train movements into and out of Grand Central Terminal. This service plan included 11 trains in the AM peak hour arriving at the lower level of Grand Central Terminal. The combined Post-Secaucus Service Plan/Metro-North operating plan was the foundation for simulating train movements between the Secaucus Transfer Station, Penn Station, and Grand Central Terminal.

Detailed physical and operating characteristics of NJ TRANSIT, Amtrak, and Metro-North were used to simulate the functional, fully integrated rail network to be in place by 2020. The capacity analysis determined the maximum number of trains capable of operating in the AM peak hour in the key segments, Secaucus to Penn Station and Penn Station to Grand Central Terminal. The results yielded a conceptual service plan that indicated an increase of 13 additional NJ TRANSIT inbound trains (Secaucus to Penn Station) over the Post-Secaucus Service Plan during the AM peak hour, for an inbound total of 36 trains (34 NJ TRANSIT, two Amtrak) occupying 38 slots. Additional service beyond the 13 would make the entire operation unreliable.

During the AM peak hour, 20 NJ TRANSIT trains would travel from Penn Station to Grand Central Terminal. Of these, 13 would turn in Grand Central Terminal and head back south to Penn Station and points west. To allow NJ TRANSIT trains to enter Grand Central Terminal, the conceptual service plan requires that nine of the 11 Metro-North trains arriving at the lower level of Grand Central Terminal in the AM peak hour would continue through the new tunnels to Penn Station and thence to either the Twelfth Avenue Yard or the Boonton Yard for storage. The remaining two Metro-North trains and seven NJ TRANSIT trains would head north from the lower level of Grand Central Terminal in revenue and non-revenue service.

Circulation improvements would be needed at both Penn Station and Grand Central Terminal, the latter having certain landmark preservation considerations, to accommodate incremental pedestrian flows.

1.5.5.1. FLEET REQUIREMENTS AND ACQUISITION COSTS

New rolling stock, a combination of dual power locomotives, cab cars, and bi-level coaches, would have to be acquired by NJ TRANSIT to support the Alternative G service plan. It is estimated that NJ TRANSIT would have to obtain 13 additional train sets after redeployment of its current fleet, while Metro-North would not have to purchase any additional equipment.

As NJ TRANSIT and Metro-North trains will share the same tracks and tunnels between Penn Station and Grand Central Terminal and in operations north of Grand Central Terminal, NJ TRANSIT will have to purchase dual-power diesel/electric locomotives equipped with a transitional (flip) shoe to allow operation on Metro-North under-running third rail. These locomotives would also be able to operate on over-running third rail on Penn Station Tracks 5 and above.

Depending on the average consist of the added train sets, the estimated cost of this equipment is approximately $186 to $255 million in 2000 dollars, not escalated to year of purchase.

1.5.5.2. OPERATING AND MAINTENANCE COSTS

NJ TRANSIT's estimated annual operating and maintenance costs would increase under Alternative G by approximately $43 to $54 million, in 2000 dollars. Rail operating and maintenance costs would be partially offset by incremental fare revenue of approximately $54 million to be generated from passengers attracted to Alternative G service. Thus, the net change

in estimated operating and maintenance costs is projected to either remain unchanged or decrease by up to $13 million, in 2000 dollars. A fuller accounting would include incremental operating and maintenance costs and revenues associated with the extension of Metro-North Railroad service to Penn Station and storage sites on the West Side and in New Jersey. These figures were not developed.

1.6. ALTERNATIVE P

Alternative P would provide a new terminal station underneath and operationally separate from the existing Penn Station. Figure 1.6-1 presents a cross-section of the revised Penn Station infrastructure at a point between Seventh and Eighth Avenues, looking west. The new station would be comprised of eight, 12-car tracks with four island platforms in two large caverns, each housing four tracks (two over two), two platforms (one over one) and a mezzanine above both levels. Significant new pedestrian spaces would be created to link the new mezzanine with the existing Penn Station and with local streets, providing adequate circulation. In Manhattan, a flexed approach was developed to transition from two tracks at the Hudson River bulkhead (indicated in yellow in Figure 1.6-2) to eight tracks at the new station area.

1.6.1. Tail Tracks

The feasibility and benefits of an optional design feature was explored, extending eight, 12-car tail tracks east from the new lower level station terminus to Broadway, between 31st and 32nd Streets. The benefits of constructing tail tracks would include:

- Improved service performance and reliability,
- Means for disposing of disabled trains,
- Ability to stage trains for the afternoon peak, and
- First stage of possible future extension to either Sunnyside Yard or the vicinity of Grand Central Terminal.

Figure 1.6-1
Alternative P

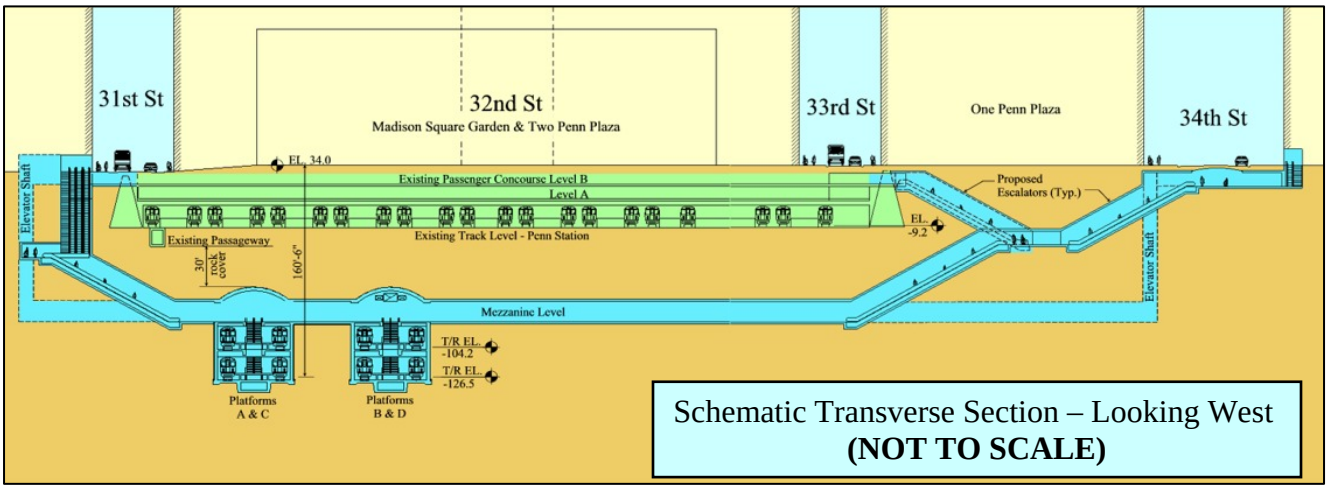
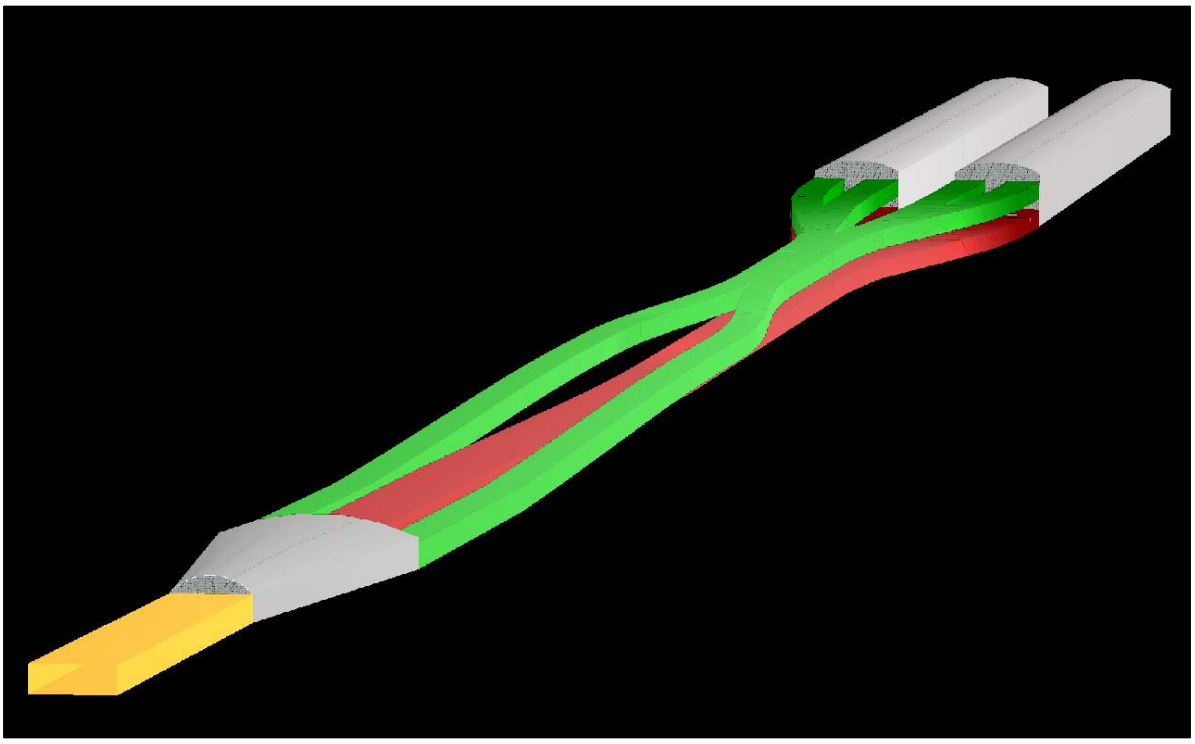


Figure 1.6-2
Alternative P – Flexed Approach



1.6.2. Midday Train Storage

Alternative P requires that approximately 20-25 NJ TRANSIT trains be stored during midday between the AM and PM peak periods. Boonton Yard (Section 1.5.3.), with a capacity of approximately 240 cars or 20-25 train sets, would accommodate this need.

1.6.3. Construction Cost Estimate

The total estimated construction cost for Alternative P at this level of conceptual planning, including Boonton Yard, is approximately $2.9 to $3.2 billion, in 2000 dollars, not escalated to year of construction. The addition of eight tail tracks would add about $350 to $380 million to this cost estimate.

1.6.4. Operations Analysis

The Post-Secaucus Service Plan was used as the basis for specifying future levels and frequencies of train movements between Secaucus and Penn Station. This analysis considered the Post-Secaucus Service Plan neutral to Alternative P operations, with the existing areas of Penn Station operating as they would have under the Post-Secaucus Service Plan. The baseline analysis was performed with eight tracks stub-ending at the eastern end of the new lower level station. A second analysis was performed assuming the addition of the optional eight tail tracks.

As the Alternative P station tracks would be on two levels, the dynamics of train operation are inherently different than those involving a station with a single-track level. The operational advantage of the bi-level concept for eight tracks is that four inbound and four outbound trains can be moving simultaneously: two trains to and from the upper level and two trains to and from the lower level. The resulting throughput optimizes train movements and, therefore, capacity using the new Hudson River tunnel.

Under the baseline stub-ended configuration, the conceptual service plan indicated that 21 additional NJ TRANSIT inbound trains could be operated during the AM peak hour, for a total of 44 trains (42 NJ TRANSIT, two Amtrak) using 46 train slots. Additional trains beyond the 44 would make the operation subject to delays and compromise reliability. Under the optional tail track configuration, terminal capacity could be increased by 29 trains in the AM peak hour for an inbound total of 52 trains (50 NJ TRANSIT, two Amtrak) using 54 train slots. In each case, the incremental train service would operate to the new station facility, separate from the existing facilities.

1.6.4.1. FLEET REQUIREMENTS AND ACQUISITION COSTS

In Alternative P, NJ TRANSIT will not share track or right-of-way between Secaucus and Penn Station with any other railroad, making it possible to utilize overhead catenary to supply propulsion power, and thus allowing use of NJ TRANSIT's locomotives, coaches, and electric multiple units (EMUs). Additional rolling stock would have to be acquired to support the

Alternative P service levels, including dual-powered locomotives to provide one-seat service on non-electrified line segments. The estimated number of additional train sets required after redeployment of its current fleet is 29 with the stub-ended tracks and 37 with the tail tracks. The estimated cost is approximately $410 to $563 million for the stub-end configuration. For the optional tail track configuration, the estimated cost is $522 to $716 million. These equipment cost estimates are in 2000 dollars, not escalated to year of purchase.

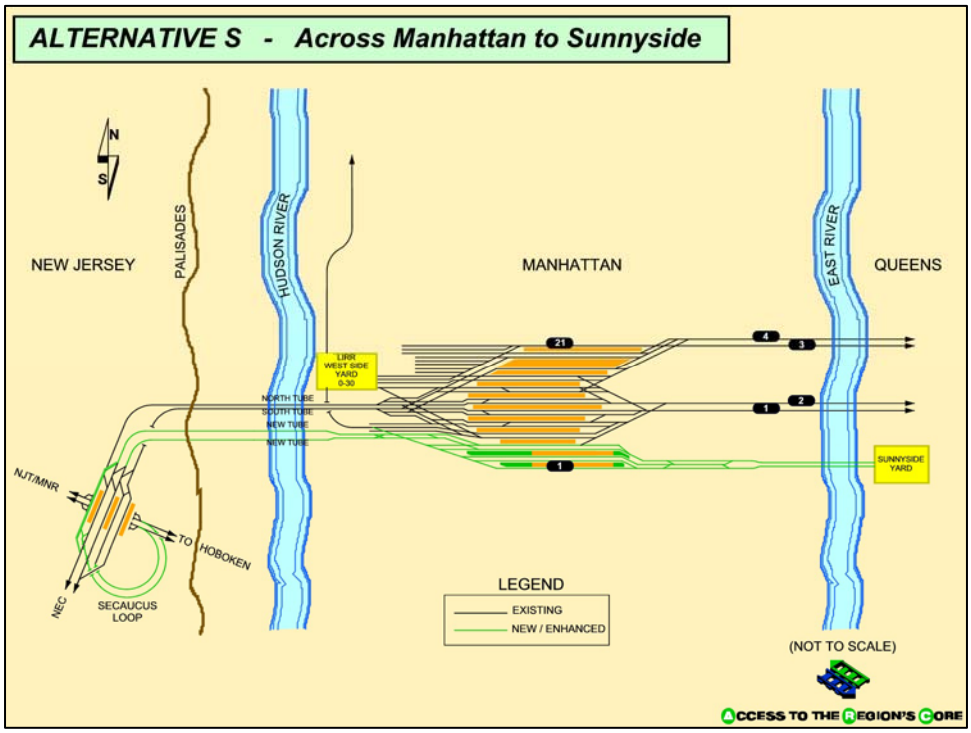
1.6.4.2. OPERATING AND MAINTENANCE COSTS

The annual estimated operating and maintenance costs would increase by approximately $77 to $94 million for the stub-end configuration and $94 to $115 million with tail tracks. Operating and maintenance costs would be partially offset by incremental fare revenues of approximately $37 million (stub-end) or $41 million (tail tracks). Thus, the net change in annual operating and maintenance costs for the stub-end operation is approximately $40 to $57 million in 2000 dollars. The net annual change for the tail track option is approximately $53 to $74 million. Operating and maintenance costs were estimated in 2000 dollars.

1.7. ALTERNATIVE S

Alternative S would provide added facilities for through operation at Penn Station, and for access to Sunnyside Yard for midday storage (Figure 1.7-1).

Figure 1.7-1
Alternative S



1.7.1. Penn Station Modifications

The Alternative S alignment and modifications in and west of Penn Station are identical to those described in Alternative G (Section 1.5), and thus the associated challenges and benefits are similar. Should the three-track Linear Yard Near-Term Improvement (Section 1.3) be constructed in advance of Alternative S**,** two tracks would continue east of Lexington Avenue when Alternative S is implemented.

1.7.2. Sunnyside Yard Approach

In Queens, the new tunnel would be aligned under 54th Avenue to Vernon Boulevard, then curve north, beginning a gradual ascent to Sunnyside Yard. It would pass below the Pulaski Bridge, the Long Island Expressway elevated structure, and the Hunters Point Avenue Bridge. Within Sunnyside Yard, it would pass below the elevated LIRR Montauk Branch aerial structure and ascend to a tunnel portal just north of Newtown Creek.

1.7.3. Midday Train Storage at Sunnyside Yard

Sunnyside Yard is a critical element of Alternative S. If the yard is incapable of storing additional NJ TRANSIT trains, Alternative S is infeasible. The Sunnyside Yard complex is divided into five distinct areas (Figure 1.7-2):

A. The Joint Use Yard shared by Amtrak and NJ TRANSIT;

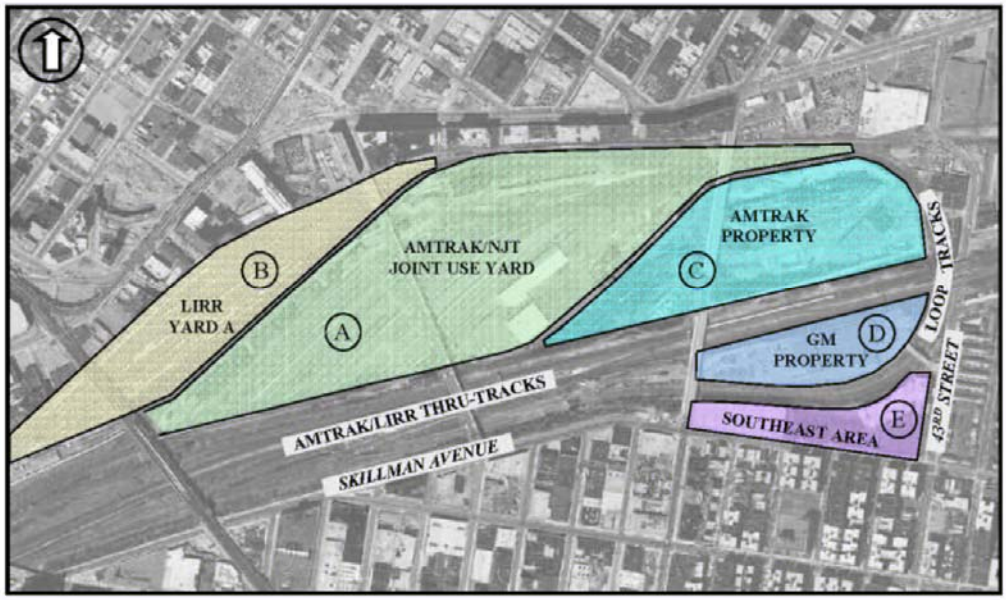
B. LIRR's Yard A north and west of the Joint Use Yard;

C. The Amtrak property south and west of the Joint Use Yard owned by Amtrak and not currently used for train storage;

D. A built up parcel, known as the General Motors property between the LIRR Main Line and the Sunnyside Yard Loop Tracks; and

E. The Southeast Properties outside of but adjacent to the Sunnyside Yard boundaries, bordered by the Loop Tracks on the north, 39th Street on the west, Skillman Avenue on the south, and 43rd Street on the east.

Figure 1.7-2
Sunnyside Yard



Each of these five areas was studied to determine the feasibility of developing a new midday train storage facility for use by NJ TRANSIT. These investigations concluded that the Amtrak property is the best option for use as a midday storage yard in Alternative S, assuming that MTA/New York City Transit (NYCT) does not purchase this site. Acquisition and development by NJ TRANSIT could nearly double the current storage capacity of the Joint Use Yard. The site would accommodate 35-38 train sets and the required support facilities and functions, including a car wash and a maintenance building. Negotiations for transfer of the unused Amtrak property from Amtrak to NYCT for use as a subway storage yard are ongoing, and thus the availability of that site for ARC purposes is uncertain. LIRR's Yard A is reserved for mid-day storage of East Side Access trains. No other viable space for midday storage of NJ TRANSIT trains east of Penn Station emerged from this analysis.

1.7.4. Construction Cost Estimate

The total estimated construction cost for Alternative S at this level of conceptual planning, including the Amtrak property at Sunnyside Yard, is approximately $3.2 to $3.4 billion in 2000 dollars, not escalated to year of construction.

1.7.5. Operations Analysis

The Alternative S conceptual service plan was developed in a manner similar to the service plans for Alternatives G and P. The capacity analysis indicated an increase of 17 additional NJ TRANSIT inbound trains (Secaucus to Penn Station) over the Post-Secaucus Service Plan during

the AM peak hour, for an inbound total of 40 trains (38 NJ TRANSIT, two Amtrak) occupying 42 slots. Additional service beyond this level would compromise the entire operation's reliability.

1.7.5.1. FLEET REQUIREMENTS AND ACQUISITION COSTS

NJ TRANSIT will not share track or right-of-way between Secaucus and Sunnyside Yard with any other railroad, and equipment procurements will conform to both the fleet specifications presently utilized and to dual-mode locomotives operable on electrified and non-electrified lines. The estimated number of additional train sets required after redeployment of its current fleet is 22. The estimated cost is approximately $306 to $410 million, in 2000 dollars, not escalated to year of purchase.

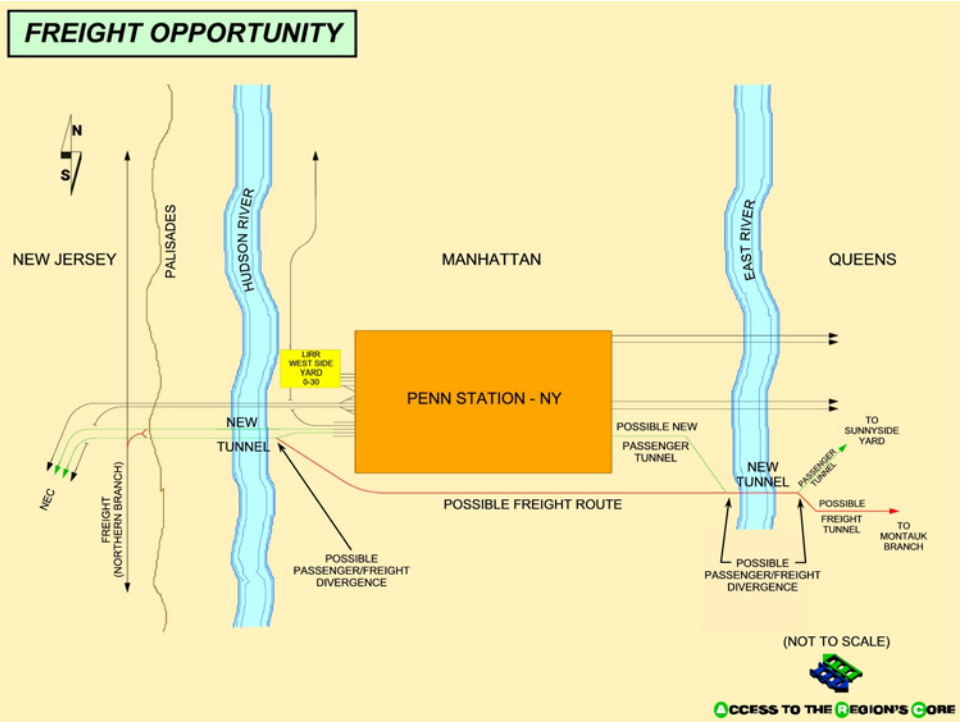
1.7.5.2. OPERATING AND MAINTENANCE COSTS

The estimated change in annual operating and maintenance costs would be approximately $57 to $71 million in 2000 dollars. These cost increases would be partially offset by increased fare revenue of approximately $33 million generated from passengers attracted to the proposed Alternative S service. This would result in a net increase in annual operating and maintenance costs ranging from $24 to $38 million.

1.8. FREIGHT OPPORTUNITY

Although the ARC long-term build alternatives analyzed during Phase 3 provide only for passenger rail services, construction of a new Hudson River tunnel offers an opportunity to make provision for future freight service in addition to commuter rail service. A freight alignment capable of being implemented with all build alternatives was developed. It consists of a shared passenger/freight Hudson River tunnel and a dedicated cross-Manhattan freight tunnel deep under 31st Street connecting to a new East River tunnel (either dedicated freight or shared with passenger trains in Alternative S), and then connecting to the LIRR Montauk Branch in Queens (Figure 1.8-1). Because of the high density of commuter rail operations, freight service could not operate during peak hours and could be limited even during off-peak hours.

Figure 1.8-1
Freight Opportunity Alignment



This freight opportunities analysis was coordinated with the sponsor of the NYC Economic Development Corporation's Cross Harbor Freight MIS/DEIS and with the respective federal oversight agencies. ARC's freight effort was limited to an examination of the physical modifications and incremental costs of constructing the new Hudson River tunnel to accommodate modern rail freight equipment, and to the development of a conceptual alignment, compatible with the ARC build alternatives, linking the new tunnel with available rail freight routes in New Jersey and Queens. The estimated incremental cost to modify the tunnel and track connections to handle freight traffic is in the range of $146 to $158 million in 2000 dollars.

1.9. TRAVEL DEMAND RIDERSHIP FORECASTS

As ARC is a bi-state study with overlapping jurisdictions, the ridership forecasts were developed based upon two travel demand models:

- The North Jersey Travel Demand Forecasting Model, which estimates future transit demand to Midtown Manhattan from areas west of the Hudson River; and
- The MTA Regional Transportation Forecasting Model, which estimates demand for areas east of the Hudson River.

Adjustments to the models were made to avoid any double counting of Rockland and Orange County commuters.

A ridership demand of 28,500 trans-Hudson rail passengers from NJ TRANSIT and Metro-North market areas west of the Hudson River is forecast for the 2020 AM peak-hour No-Build condition. This figure reflects unconstrained trans-Hudson demand and is in excess of the 23,000-24,000 seats expected to be available to Penn Station. Therefore, this rail passenger demand could not be accommodated without new infrastructure.

The 2020 ridership forecasts of AM peak-hour trans-Hudson rail passengers for the build alternatives ranged from approximately 35,400 to 37,800, figures considered to be equivalent at this level of planning. Each of the build alternatives provides new infrastructure that cannot only accommodate the 2020 No-Build demand forecast, but can also meet growth in demand resulting from the new trans-Hudson tunnel and other investments.

1.9.1. Alternative G

In Alternative G, about 37,800 trans-Hudson passengers have been forecast for the 2020 AM peak hour. Of these passengers, more than 13,400, or 36%, would continue on to Grand Central Terminal (Table 1.9-1).

Table 1.9-1
Alternative G Ridership Forecast – NJ TRANSIT

AM Peak Hour			
Facility	**1990 Base**	**2020 No-Build***	**Alternative G**
Penn Station	11,436	28,539*	24,344
Grand Central Terminal	0	0	13,415
Total	11,436	28,539*	**37,759**
***Unconstrained demand, Penn Station one hour capacity is approximately 23,000-24,000**			
AM Peak Two Hours			
Facility	**1990 Base**	**2020 No-Build**	**Alternative G**
Penn Station	15,414	40,457	34,244
Grand Central Terminal	0	0	18,870
Total	15,414	40,457	**53,114**

Alternative G also extends Metro-North service from Grand Central Terminal to Penn Station. This is estimated to attract nearly 2,600 Metro-North passengers (6% of the 44,300 total Metro-North passengers to Grand Central Terminal) in the AM peak-hour forecast to continue on to Penn Station (Table 1.9-2).

Table 1.9-2
Alternative G Ridership Forecast - Metro-North Railroad

AM Peak Hour			
Facility	**1995 Base**	**2020 No-Build**	**Alternative G**
Grand Central Terminal	34,751	44,277	41,716
Penn Station	0	0	2,593
Total	34,751	44,277	**44,309**
AM Peak Two Hours			
Facility	**1995 Base**	**2020 No-Build**	**Alternative G**
Grand Central Terminal	55,585	71,165	67,049
Penn Station	0	0	4,157
Total	55,585	71,165	**71,206**

Compared to the ARC No-Build alternative, Alternative G will transfer approximately 9,400 daily auto trips to NJ TRANSIT commuter rail, and will also transfer approximately 27,000 more trans-Hudson trips to rail from all other transit modes (Table 1.9-3).

Table 1.9-3
Alternative G Average Weekday Modal Diversions - NJ TRANSIT

Mode	Alternative G
Total Auto	**(9,402)**
Total Transit	**9,402**
Rail	36,204
PATH	(3,393)
Bus	(22,234)
Ferry	(1,175)

1.9.2. Alternative P

In Alternative P, about 35,800 NJ TRANSIT trans-Hudson railroad passengers are forecast in the 2020 AM peak hour for the stub-end configuration. The option with tail tracks, which permits up to eight more peak-hour trains to New York, would attract about 36,900 railroad passengers, or about 1,100 more than the stub-end operation (Table 1.9-4).

Table 1.9-4
Alternative P Penn Station Ridership Forecast - NJ TRANSIT

AM Peak Hour					
	1990 Base	2020 No-Build*		Alternative P	
	Passengers	Trains	Passengers	Trains	Passengers
Stub-Ended	11,436	21	28,539*	42	35,804
Tail Tracks	11,436	21	28,539*	50	36,944
*Unconstrained demand, Penn Station one hour capacity is approximately 23,000-24,000					
AM Peak Two Hours					
	1990 Base	2020 No-Build		Alternative P	
	Passengers	Trains	Passengers	Trains	Passengers
Stub-Ended	15,414	40	40,457	77	50,378
Tail Tracks	15,414	40	40,457	85	51,983

Compared to the ARC No-Build alternative, Alternative P would attract approximately 4,600 (stub-ended) or 5,500 (optional tail tracks) daily trans-Hudson auto trips to transit, and will also transfer approximately 21,000 (stub-ended) or 24,000 (tail tracks) trans-Hudson trips from all modes to NJ TRANSIT commuter rail (Table 1.9-5).

Table 1.9-5
Alternative P Average Weekday Modal Diversions - NJ TRANSIT

Mode	Stub-Ended	Tail Tracks
Total Auto	**(4,647)**	**(5,614)**
Total Transit	**4,647**	**5,614**
NJ TRANSIT Rail	21,339	24,321
PATH	(1,062)	(1,249)
Bus	(14,646)	(16,278)
Ferry	(984)	(1,180)

1.9.3. Alternative S

Alternative S is forecast to attract about 35,400 trans-Hudson passengers to Penn Station in the AM peak hour (Table 1.9-6).

Table 1.9-6
Alternative S Penn Station Ridership Forecast - NJ TRANSIT

AM Peak Hour				
1990 Base	**2020 No-Build***		**Alternative S**	
Passengers	**Trains**	**Passengers**	**Trains**	**Passengers**
11,436	21	**28,539***	38	35,353
***Unconstrained demand, Penn Station one hour capacity is approximately 23,000-24,000**				
AM Peak Two Hours				
1990 Base	**2020 No-Build**		**Alternative S**	
Passengers	**Trains**	**Passengers**	**Trains**	**Passengers**
15,414	40	40,457	70	49,744

Compared to the ARC No-Build alternative, Alternative S would attract approximately 4,200 daily trans-Hudson auto trips to transit, and will also transfer approximately 19,000 daily trans-Hudson trips from all modes to NJ TRANSIT commuter rail (Table 1.9-7).

Table 1.9-7
Alternative S Average Weekday Modal Diversions - NJ TRANSIT

Mode	Alternative S
Total Auto	**(4,192)**
Total Transit	**4,192**
NJ TRANSIT Rail	18,927
PATH	(828)
Bus	(13,172)
Ferry	(735)

1.10. COMPARATIVE SUMMARY OF RESULTS

The primary results of the rigorous quantitative analyses that were undertaken are summarized below.

1.10.1. Capital Costs

A comparison of the estimated capital costs for the build alternatives is presented in Table 1.10-1. These costs are estimated based on the conceptual-planning level of information developed in this phase of analysis, and are likely to change as further engineering, operations, and community impact analyses are undertaken. They provide a good basis for comparison among the ARC alternatives.

Table 1.10-1
Estimated Capital Costs

(2000$)

Alternative	Construction Costs*	Equipment Costs**	Real Estate Costs***
G	$2.9-$3.1 billion	$186-$255 million	Highest
P (Stub-ended)	$2.9-$3.2 billion	$410-$563 million	Lowest
P (Tail tracks)	$3.3-$3.6 billion	$522-$716 million	Middle
S	$3.2-$3.4 billion	$306-$410 million	Middle

*In 2000 dollars, not escalated to year of construction.
**Net cost after reallocation of NJT equipment from Hoboken Division.
***Costs for real estate acquisitions and easements TBD in DEIS. Anticipated rankings shown.

1.10.2. Operating and Maintenance Costs

A comparison of the annual incremental operating and maintenance costs incurred by NJ TRANSIT for the build alternatives is presented in Table 1.10-2.

Table 1.10-2
Estimated Annual Incremental Operating and Maintenance Costs

(2000$)*

Alternative	Gross Operating Costs	Passenger Revenue	Net Operating Costs
G**	$43-$54 million	$54 million	($0-$13 million)
P (Stub-ended)	$77-$94 million	$37 million	$40-$57 million
P (Tail tracks)	$94-$115 million	$41 million	$53-$74 million
S	$57-$71 million	$33 million	$24-$38 million

*In 2000 dollars, not escalated to year of implementation.
**Alt. G figures do not include any changes in MNRR costs and revenues.

1.10.3. Trans-Hudson Capacity Increase

All of the build alternatives would provide the capacity to accommodate their respective forecast 2020 West-of-Hudson AM peak-hour railroad ridership demands. These demands are presented in Table 1.10-3.

Table 1.10-3
Trans-Hudson 2020 Ridership Forecast – AM Peak Hour

Alternative	Total Peak Hour Trains	1990 Base	2020 Total T-H Passengers
G	34	11,436	37,759*
P (Stub-ended)	42	11,436	35,804
P (Tail tracks)	50	11,436	36,944
S	38	11,436	35,353

*24,344 to Penn Station and 13,415 to Grand Central Terminal. In addition to trans-Hudson passengers, an additional 2,593 persons would travel to Penn Station via Metro-North trains from Grand Central Terminal.

1.10.3.1. MODAL DIVERSIONS

Compared to the ARC No-Build alternative, all build alternatives would transfer significant numbers of daily West-of-Hudson trips from auto, PATH, bus, and ferry to commuter rail (Table 1.10-4). This will free up capacity in the Lincoln and Holland tunnels, PATH, and trans-Hudson ferry operations, as well as on buses in the XBL to the Lincoln Tunnel and the Port Authority Bus Terminal.

Table 1.10-4
Average Weekday Modal Diversions - NJ TRANSIT

Mode	Alt. G	Alt. P (Stub)	Alt. P (Tail)	Alt. S
Total Auto	**(9,402)**	**(4,647)**	**(5,614)**	**(4,192)**
Total Transit	**9,402**	**4,647**	**5,614**	**4,192**
Commuter Rail	36,204	21,339	24,321	18,927
PATH	(3,393)	(1,062)	(1,249)	(828)
Bus	(22,234)	(14,646)	(16,278)	(13,172)
Ferry	(1,175)	(984)	(1,180)	(735)

1.11. CONCLUSIONS AND RECOMMENDED NEXT STEPS

The technical work of the ARC project has ranged from regional systems planning to conceptual design of three potential alignment alternatives. After concluding in Phases 1 and 2 that rail capacity at Penn Station should be expanded to serve growing demand, the primary aim of Phase 3 was to evaluate specific alignment alternatives and select one or more for advancement to the next phase of the project development process (i.e., preparation of a Draft Environmental Impact Statement). The work included the preparation of alignment configuration conceptual design plans, cost estimates, operations analyses, ridership forecasts and transportation and environmental impact analyses.

The results described in this report indicate that Alternatives G, P, and S would meet the key goal of ARC—providing increased rail capacity between Midtown Manhattan and points west of the Hudson River. The analyses demonstrated that each has attractive points as well as drawbacks. The results are summarized below.

1.11.1. Alternative G Conclusions

Penn Station and Grand Central Terminal were both designed to be expandable to accommodate future operating changes. Penn Station was built to enable tracks 1-5 to be extended eastward into a future tunnel under 31st Street. Grand Central Terminal was designed to allow for a breakout from its lower level southward. Alternative G was configured to take advantage of these opportunities, accommodating in concept both Metro-North and NJ TRANSIT trains at both stations and providing one-seat service to both the east and west sides of Midtown Manhattan for their customers. As in Alternative S, the ARC trans-Hudson tunnel would permit off-peak closure (for maintenance) of one tunnel serving Penn Station while maintaining service in the other. Other benefits include provision of a direct pedestrian connection between Platforms 1 and 2 and the Seventh Avenue subway line (34th Street Station), and increased capacity at those platforms. Two of the near-term improvements (the 31st Street Linear Yard and the Twelfth Avenue Yard) could serve as preliminary phases of Alternative G.

Although the conversion of Metro-North and NJ TRANSIT operations from stub-end to flow-through movements was determined to be physically feasible, there would be impacts on NYCT subway structures and the operations support systems at Grand Central Terminal. Uncertainties over the extent to which these impacts could be mitigated could not be resolved satisfactorily during the Phase 3 effort. Alternative G would offer the smallest incremental increase in trans-Hudson train capacity among the alternatives and would create complex train operations that could affect the operational reliability of the respective railroads. Construction of Alternative G would require negotiation of easements or purchase of a large number of Manhattan properties. In addition, the physical impacts of construction on the ability to maintain existing operations appear to be significant.

1.11.2. Alternative P Conclusions

After considering and rejecting expansion of facilities to the immediate south of Penn Station, this alternative was designed to create a major new stub-ended station facility underneath the existing tracks and platforms to accommodate increased train operations. This concept avoids the problem of disturbing significant numbers of neighboring structures.

Alternative P would provide the largest service capacity increase of the build alternatives evaluated. The existing station and new deep station facilities would operate independently, allowing one operation to continue in the event of a major disruption to the other. Although not analyzed under ARC, it is conceptually possible that service from the new station to an East Midtown station or to Sunnyside Yard could be provided at a later time, if additional infrastructure were built.

Although the Alternative P configuration is feasible, the depth of the new trans-Hudson tunnel does not allow its tracks to connect with the existing tracks at Penn Station. Trains to either the existing or new tunnels would diverge east of the Secaucus Transfer Station. The drawback of this separate operation is that the new tracks would provide limited flexibility for daily operations, and would not allow for universal station operations during any tunnel closure for maintenance purposes. Passengers using the new station facility would need to traverse long distances from deep underground to reach the surface or subways, creating an inconvenience and requiring particular attention during design to ensure adequate emergency egress.

1.11.3. Alternative S Conclusions

As in Alternative G, Alternative S was designed to create a flow-through train operation to increase Penn Station capacity. Alternative S would likewise allow off-peak closure of one trans-Hudson tunnel while maintaining operations to most platforms in the other, and would create direct pedestrian links between the Seventh Avenue subway line (34th Street Station) and Platforms 1 and 2.

This alternative requires the construction of new tunnels eastward under 31st Street, the East River and western Queens to reach an expanded Sunnyside Yard for midday train storage, similar to NJ TRANSIT's current operating procedures. This significant new infrastructure would be constructed for the sole purpose of operating non-revenue trains and it would serve only Penn Station Tracks 1-5.

Concurrent with the planning for ARC, the MTA has been in negotiations with Amtrak for the use of the same area of Sunnyside Yard (for future subway train storage) that Alternative S proposes to use. To date, Amtrak, the owner of Sunnyside Yard, has not reached a decision on the use of this site. If it is not available for NJ TRANSIT use, then it is unlikely that Alternative S as currently defined will be viable.

1.11.4. Baseline Alternative Conclusions

New FTA procedures mandate that project sponsors identify a baseline improvement condition that does not include the build alternative, so that the incremental costs and benefits of the build alternative can be quantified above the baseline condition. Based on the Phase 1 and 2 investigations of TSM options (Section 1.2.2), the ARC sponsoring agencies found that there are no strategies short of the build options that would meet the ARC project goals and needs. Therefore, it is proposed that the ARC baseline alternative be the No-Build alternative.

1.11.5. Recommendations

This study has established the need for new trans-Hudson rail capacity to Midtown Manhattan. It is recommended that, of the three alternatives evaluated in the final study phase, options P and S be advanced to the Draft Environmental Impact Statement phase for further analysis toward the ultimate implementation of a capital solution.

The drawbacks related to Alternative G (concerning the risks surrounding construction and operations) indicate that the alternative, as devised, is not acceptable for implementation. As a result, Alternative G is not recommended for further development in the Draft Environmental Impact Statement. Although both Alternatives P and S also have some deficiencies, the findings indicate that these options, or perhaps variations of them, have potential to acceptably meet the goal of expanding Penn Station train capacity for increased trans-Hudson rail service.

In the Draft Environmental Impact Statement, these alternatives and variants should be further refined with the goal of defining a specific project for continued advancement toward implementation. Based on issues raised earlier in this report, the new work should focus on such issues as train operating flexibility, while continuing to focus on the overall need to provide added trans-Hudson rail capacity in a timely manner.

By definition, the ultimate capital solution will take many years to implement and, as stated earlier in the report, it would be advantageous if smaller scale improvements that begin to address the larger capacity need could be developed in the meantime. For this reason, it is also recommended that the 31st Street Linear Yard and the Twelfth Avenue Storage Yard alternatives be further evaluated.