

A. INTRODUCTION

This appendix explains the numerous alternatives that have been developed and analyzed for a new Second Avenue Subway since the project was first conceived 75 years ago. It focuses on the recent studies—an extensive Major Investment Study (MIS) and Draft Environmental Impact Statement (DEIS) published in 1999, that analyzed a wide range of possible alternatives to ease transit problems on Manhattan’s East Side before concluding that a new subway under Second Avenue would be preferred. These studies were undertaken in compliance with the National Environmental Policy Act (NEPA) and the MIS process established by the Intermodal Surface Transportation Efficiency Act (ISTEA), now the Transportation Efficiency Act for the 21st Century (TEA-21).

The MIS/DEIS evaluated a large number of possible alternatives, considering the project’s goals and objectives, environmental impacts, cost and feasibility, and public input. Four alternatives were subject to detailed analysis: 1) a No Build Alternative, which included those improvements in the city’s transportation system that were expected to be instituted by the future analysis year; 2) a Transportation Systems Management (TSM) Alternative—intended to meet the project’s goals and objectives to the extent feasible at relatively low cost—which included improvements to station dwell times on the Lexington Avenue Line, introduction of bus priority lanes on First and Second Avenues between Houston and 96th Streets, and improvements to bus service on the Lower East Side; 3) Build Alternative 1, a new Second Avenue Subway from 125th Street at Lexington Avenue to 63rd Street, and continuing south to Lower Manhattan via the existing Broadway Line; and 4) Build Alternative 2, the same subway element as in Build Alternative 1, supplemented by new light rail transit service on the Lower East Side. Following the MIS and extensive public comments, subsequent studies resulted in the determination that a full-length Second Avenue Subway from 125th Street to the Financial District in Lower Manhattan should be pursued. Because that full-length subway was not analyzed in detail in the MIS/DEIS, a Supplemental Draft Environmental Impact Statement (SDEIS) was prepared and circulated to provide such analysis.

Since publication of the SDEIS, a number of additional refinements to the project have been made. These modifications are described in Chapter 2 of this Final Environmental Impact Statement (FEIS), “Project Alternatives.”

This chapter summarizes the process used to develop alternatives both during the MESA study and following that study. The full-length subway alternative that is analyzed in the FEIS is described in detail in Chapter 2 of this document.

B. BACKGROUND

A new subway along Second Avenue has been under consideration since the 1920s. Although routes continued to evolve during that time, three major plans were developed: a 1929 plan with

an alignment under Second Avenue and Water Street, 1940s plans with a similar alignment to the 1929 plan but with additional connections to the Nassau Street Line and the Manhattan Bridge, and a 1968 plan which was partially constructed. These plans for the subway form the basis for the alternatives analysis in the MIS and the alignment of the full-length Second Avenue Subway described in this FEIS. The routes proposed in those three plans are described below.

THE 1929 INDEPENDENT SUBWAY SYSTEM PHASE II PLAN

In 1929, when construction of the first phase of the Independent (IND) subway system was fully under way, the City's Board of Transportation announced plans for a second phase developed around a Second Avenue Line, which would extend from the Bronx into Manhattan, where it would continue under Second Avenue and Water Street to a Pine Street-Wall Street terminal. The new line would connect to other portions of the IND system at 34th Street (via a crosstown subway) and at 63rd Street (to the IND's Sixth Avenue Line), although the 63rd Street connection was eventually shifted to 61st Street. The Second Avenue Line would have six tracks between the Bronx and the 61st Street connection, four tracks between 61st and Chambers Streets, and two tracks south of Chambers Street.

THE 1940s BOARD OF TRANSPORTATION PLANS

In 1940, when the City's three separate subway systems were unified under the municipally operated Board of Transportation, ambitious plans were made for expansion of the combined system. These plans were included in the 1944-1948 Capital Program. Among the new routes proposed was a new Second Avenue line that would begin in the Bronx and continue under Second Avenue to Houston Street. South of Houston Street, it would continue south under Chrystie Street, with two connections at Delancey Street to the Nassau Street Line (now the **J M Z**), one heading west in Manhattan and one heading east over the Williamsburg Bridge to Brooklyn. South of Delancey Street, the proposed Second Avenue Line would stop at a new station at Grand Street. South of Grand Street, two tracks would continue south under St. James Place and then Water Street until Coenties Slip. South of Grand Street two additional tracks would branch off to continue over the Manhattan Bridge.

In the late 1940s, a new plan was developed that included a connection to the Nassau Street Line and the Williamsburg and Manhattan Bridges via Chrystie Street, but no longer called for a Second Avenue Line to continue south of Chrystie Street on Water Street to Coenties Slip. In the 1950s and 1960s, the two-track segment between the Sixth Avenue Line and the Manhattan Bridge was constructed with a two-track Grand Street Station.

THE 1968 PLAN, "METROPOLITAN TRANSPORTATION, A PROGRAM FOR ACTION"

In 1968, the newly established Metropolitan Transportation Authority (MTA) released its program for system improvements, "Metropolitan Transportation, a Program for Action." This plan included a Second Avenue Subway, extending from a new terminal at Dyre Avenue in the Bronx (with a connection to the Pelham Bay Line) via a new Bronx route into Manhattan, continuing under Second Avenue and Water Street to Lower Manhattan. The new Second Avenue line would connect with the plan's new 63rd Street service, permitting connections to the Sixth Avenue and Broadway Lines on the West Side.

This plan for the Second Avenue Subway consisted of a two-track line between 126th Street in Harlem and Whitehall Street in Lower Manhattan. The line would extend under Second Avenue,

Chrystie Street, Chatham Square, St. James Place, and Water Street. The plan included 15 stations in Manhattan: Triboro Plaza (at 125th Street), Franklin Plaza (at 106th Street), 96th Street, Yorkville (at 86th Street), Lenox Hill (at 72nd Street), Midtown East (at 57th Street), United Nations (between 44th and 48th Streets), Kips Bay (at 34th Street), 23rd Street, 14th Street, East Houston Street, Grand Street (sharing the existing Grand/Chrystie Street Station), Chatham Square, Pine Street/Wall Street, and Whitehall Street. A NEPA EIS was completed for this plan.

A combination of Federal and State funding was obtained, and construction was begun on a portion of this subway in 1972 at 103rd Street and Second Avenue. Three segments of tunnel were constructed in the 1970s before work stopped due to lack of funding. Those sections remain in place today, and are kept in good repair by NYCT in anticipation of the eventual completion of the Second Avenue Subway.

C. MANHATTAN EAST SIDE TRANSIT ALTERNATIVES STUDY: DEVELOPMENT OF ALTERNATIVES

In 1995, MTA and NYCT began the Manhattan East Side Transit Alternatives Study (MESA). This study, both an MIS and a DEIS, was implemented to identify and address transportation problems and needs on Manhattan's East Side. The study's primary goal was to develop a long-term strategy that addresses crowding and delays on the Lexington Avenue Line and improves transit accessibility to residents on the far East Side of Manhattan. The study area for MESA consisted of a primary study area, encompassing the entire East Side of the Manhattan (generally the area east of Fifth Avenue, but also including all of Lower Manhattan south of Canal Street), and a secondary study area to the west, extending as far west as Tenth Avenue in Midtown.

MTA and NYCT conducted a combined MIS and DEIS for MESA for the Federal Transit Administration (FTA), pursuant to federal procedures including those of NEPA. This process was conducted with extensive public outreach and participation, beginning in July 1995, when a Notice of Intent was published in the Federal Register. Public meetings to discuss the scope of the study were held in July 1995. A final scoping document that included comments received on the project and the scope of studies was issued in December 1995. After extensive analysis of a wide range of alternatives, the MIS/DEIS for the MESA Study was published in August 1999, and a public hearing was held in September 1999. (Responses to comments are included in Appendix N.) As a result of this process, MTA and NYCT in coordination with FTA are pursuing further study of a full-length alternative to carry into Preliminary Engineering and to be analyzed in this FEIS.

Following completion of the MESA DEIS, additional study of alternatives for a new subway route along the East Side of Manhattan was conducted as part of the MTA's Lower Manhattan Access Study. One of the alternatives considered was a full-length Second Avenue Subway in Manhattan. That preliminary planning work was incorporated into the continuing design for the full-length Second Avenue Subway analyzed in this FEIS.

APPROACH TO DEVELOPMENT OF ALTERNATIVES

The MIS/DEIS process conducted for the MESA Study began with an extensive effort to identify problems and needs in the study area and develop goals and objectives to address those issues. Building on that work, the study then developed options to solve the problems.

At the onset of the study, an extensive inventory of both demographic and socioeconomic characteristics and the physical and operational characteristics of transportation within the study area was completed. Using this information, a problem and needs statement was prepared, which concluded that the need for transit improvement on Manhattan's East Side is clear, as described in Chapter 1.

The MIS/DEIS identified five types of problems in the study area. As detailed in Chapter 1, "Project Purpose and Need," these are:

- *Limited capacity on the transportation system.* The high demand for all transportation system elements in the study area has led to overcrowding and other travel constraints.
- *Limited transit accessibility.* Many neighborhoods in the study area have poor rapid transit accessibility, with more than a 10-minute walk to the nearest rapid transit mode.
- *Travel time problems.* The crowding of all transportation elements in the study area contributes to delays that lengthen commuters' travel times.
- *Decreased flexibility of the system.* The overcrowding on the transit system in the study area leads to unpredictable and unreliable subway and bus service during peak periods and the inability to accommodate future growth in the area.
- *Environmental and socioeconomic concerns.* The lack of capacity and resulting congestion on the city's transportation system in turn leads to the deterioration of a range of environmental and socioeconomic conditions, including air quality, neighborhood character, and economic vitality of the city's regional and local commercial areas.

Based on the problems and needs identified, a list of comprehensive goals and objectives was created to set the direction of the study. The list was developed with input from a Technical Advisory Committee (TAC) and Public Advisory Committee (PAC) convened for the study, the MTA's Long-Range Planning Framework working group, and civic and community groups. The study's goals were: (1) improve mobility on Manhattan's East Side; (2) achieve economic feasibility and cost-effectiveness; and (3) maintain or improve environmental conditions. The objectives attending each goal are listed in Chapter 1.

Once the goals and objectives for the study were developed, the MESA Study undertook an intensive, three-year effort to consider and recommend options to solve those problems. That process is described in detail in the MIS and supporting documents and is summarized below.

The basic alternatives development and evaluation approach for the MESA Study was to consider all options suggested, evaluating each against the project's goals and objectives. NYCT and the project team accepted recommendations from other agencies, the TAC and PAC, members of civic groups, the general public, and the study's planners and engineers. From a large list, these alternatives were grouped and combined into the "long list" of more than 20 project alternatives in 12 broad categories. This long list was subjected to a preliminary screening analysis using relatively broad criteria to eliminate those options that could not reasonably be built and to join others to form several new "combination" alternatives.

The initial long list of alternatives was refined again, with public input, and options were eliminated and combined to create a "reduced long list" of seven alternatives. Using detailed criteria—including engineering and preliminary cost analysis; traffic, environmental, and socioeconomic information; and transportation modeling—the reduced long list was evaluated in three successive screening steps. This process resulted in the selection of the four alternatives

that were analyzed in the MIS/DEIS. The different alternatives considered and the reasons for their elimination during the MIS/DEIS process are summarized below.

LONG LIST OF ALTERNATIVES

DEVELOPMENT OF LONG LIST OF ALTERNATIVES

The first step in the development of alternatives for the MESA Study was to identify as many potential alternative solutions as possible to the existing and future transportation problems and needs in the study area. As described above, the initial long list of alternatives was developed through extensive public outreach. In addition, alternatives recommended in past studies were reconsidered and refined to address current and future problems and needs. These alternatives were developed without regard for cost, feasibility, environmental issues, or neighborhood issues, so that a full range of alternatives could be assessed. The long list of more than 20 alternatives in 12 broad categories is described in Table B-1.

SCREENING THE LONG LIST OF ALTERNATIVES

The initial long list of alternatives was then subjected to a “coarse” screen to eliminate any alternatives that did not meet the project’s goals and objectives, or that had a critical flaw or obstacle that would prevent them from being implemented. As part of that initial screen, each alternative was also evaluated in terms of its ability to satisfy the following major issues, which were developed based on the pre-established goals and objectives:

- *Accessibility, Capacity, and Market Areas Served:* Alternatives should provide increased mass transit into and within the transportation corridor, attract new ridership to mass transit, and expand mass transit services to currently underserved zones in the study area.
- *Economic Feasibility, Cost Effectiveness, and Equity Issues:* The proposed technology had to be practical and implementable; at a preliminary level the expected benefits had to outweigh the order-of-magnitude costs; and the impacts of the candidate alternative, both positive and negative, had to be equitably distributed among those communities that will experience the impacts.
- *Environmental and Community Compatibility Issues:* All alternatives had to be in conformity with the Clean Air Act and State Implementation Plan, respond to the needs of the immediate and larger community, and expand mass transit in the study corridor while protecting the physical and social environment.
- *Street and Subsurface Transportation and Transit Congestion Issues:* All alternatives had to alleviate crowding on existing transit lines, highway corridors, and, specifically, the East Side transportation corridor; reduce travel times; and maintain or improve adequate parking and loading areas throughout the project corridor.

**Table B-1
Long List of Alternatives**

Alternative	Description
1. Rapid Transit Alternatives Under Second Avenue	
1A. Original Full 1974 Alignment of the Second Avenue Subway	New full-length subway beneath Second Avenue, extending from the Bronx to Lower Manhattan. This subway would cross the Harlem River from the Bronx to Manhattan, and then travel under Second Avenue and then Chrystie Street ending beneath Water Street in Lower Manhattan.
1B. Second Avenue Subway North	New subway beneath Second Avenue from Upper Manhattan to Midtown.
1C. Second Avenue Subway South	New subway beneath Second Avenue from Midtown to Lower Manhattan.
1D. Second Avenue Subway Eastward Alignment	New full-length subway beneath Second Avenue, extending from the Bronx to Lower Manhattan. This alignment would be the same as the original alignment (1A, above), except that it would bend eastward to travel along East 10th Street, Avenue B, and East Broadway, so that it would better serve the Lower East Side.
1E. Second Avenue Subway with Southbound Connection to/from GCT	Connection from Grand Central Terminal to Lower Manhattan, either as a subway or direct commuter rail link.
1F. Second Avenue Subway with 43rd Street Inter-Line Connection	New full-length Second Avenue Subway with connection across 43rd Street to the Broadway Line.
1G. Second Avenue Subway with 43rd Street New Jersey Connection	New full-length Second Avenue Subway with a connection to an east-west subway along 43rd Street.
2. Lexington Avenue Subway Service Improvements	
2A. Signal Improvements	Train signal improvements along the existing Lexington Avenue subway line, to increase capacity by allowing more trains per hour.
2B. Platform Extensions	Platform extensions at existing Lexington Avenue Line stations, to allow use of 12-car trains rather than the existing 10-car trains. This would increase the capacity of the system by up to 20 percent.
2C. Segmented Connections to Other Subway Lines	Connection of the northern half of the Lexington Avenue Line (either local or express tracks) with the Broadway Line through a new tunnel connection to the 63rd Street tunnel at Lexington Avenue. The Lexington Avenue Line north of 63rd Street would also be converted to "B" Division service. ("B" Division trains, which run on the Broadway Line, are larger than the "A" Division trains, which run on the Lexington Avenue Line.) Service on the Lexington Avenue Line south of 59th Street would remain in the "A" Division configuration and would terminate near 59th Street. This alternative was intended to increase capacity on the Lexington Avenue Line by increasing train size and adding the Broadway Line tracks.
2D. Local Service Extension	An extension of the Lexington Avenue subway local service to Lower Manhattan.
2E. Skip-Stop Operation	Skip-stop local operation on the Lexington Avenue Line to increase throughput.
3. New Metro-North Railroad Stations in the Bronx and Upper Manhattan	
	New stations along existing Metro-North routes in the Bronx and at Park Avenue and 96th, 86th, and 72nd Streets in Manhattan.

Table B-1
Long List of Alternatives (cont'd)

Alternative	Description
4. Bus Alternatives	
4A. Bus Service on Dedicated Avenue	Dedication of either First or Second Avenue to two-way bus service with other traffic limited to local deliveries. This would allow increased bus speed and reduced travel time.
4B. Bus Service on Paired Avenues	Provision of two primary dedicated bus lanes each on First and Second Avenues.
4C. Trolley Bus on Dedicated Busway	Provision of dedicated lanes for trolley buses in either of the configurations described for 4A and 4B.
4D. FDR Drive Busway	Provision of a dedicated lane for buses and high-occupancy vehicles on the FDR Drive.
5. Light Rail Transit Alternatives	
5A. Light Rail Service on Dedicated Avenue	New light rail transit (LRT) service on an avenue dedicated to its two-way service, extending from 125th Street to South Ferry in Lower Manhattan.
5B. Light Rail Service on Paired Avenues	New LRT service in dedicated lanes on both First and Second Avenues, extending from 125th Street to South Ferry in Lower Manhattan.
6. Private Franchised Jitney Service	Jitney bus service with 10- to 20-seat vehicles operating every 2 to 3 minutes on Park Avenue.
7. Ferry Service on East River with Shuttle Bus Service	Intra-Manhattan ferry service with potential stops at 86th, 59th, and 14th Streets, Williamsburg Bridge, and South Street Seaport, served by local shuttle buses.
8. New East River Stops on Existing East-West Subway Service	New subway stations on three existing east-west subway lines: at First Avenue and 63rd Street on the Q route (now the F); at First Avenue and 59th Street on the Broadway Line; First Avenue at 42nd Street on the 7 route; and Avenue C at 14th Street on the 1 route.
9. Transportation Systems Management (TSM) Improvements	Alternative that meets goals and objectives of study to the extent feasible at relatively low cost. This alternative was a requirement for FTA alternatives analyses. It was not yet defined when the long list of alternatives was developed; to include elements identified during the development and screening of the long list of alternatives.
10. Combination Alternative	Not yet defined when the long list was developed; to be created from alternatives that could not stand alone to meet project goals.
11. Elevated Transit	Elevated transit along Second or First Avenue.
12. No Action Alternative	All transportation facilities and services that will exist in 2020 without implementation of any improvements as a result of the MESA Study. This alternative was a requirement for the FTA alternatives analyses and NEPA.

Second Avenue Subway FEIS

If the alternative adequately satisfied these criteria, it was then subject to a series of questions, as follows:

- *Does this alternative stand alone?* If the alternative adequately addressed the study goals and objectives and was able, by itself, to address the major transportation problems in the study area, it was considered a “stand-alone” alternative.
- *If not, would this alternative better address study area issues if it were combined with another alternative?* Each “does not stand alone” alternative was further evaluated to determine whether it could be combined with other alternatives to form one alternative that addressed the study goals and objectives. Potential components of the Transportation Systems Management (TSM) Alternative were also identified in this way. (The TSM Alternative consisted of transportation improvements that met the goals and objectives of the study to the extent possible at a relatively low cost.)
- *If the alternative does not stand alone, can it be considered a routing or other type of option for a stand-alone alternative?*
- *Are there any major flaws in the alternative that would prevent its implementation?*

Once the coarse-screen evaluation was nearly complete, NYCT presented the alternatives to the PAC and held workshops and focused meetings throughout the study area. These discussions also helped to hone the long list. Long-list alternatives that did not stand alone were either eliminated or combined with other alternatives to help create well-rounded solutions to the transit and transportation issues on the East Side of Manhattan. If, during the screening process, the issues related to an alternative appeared too complex for a quick screen, additional analysis was conducted. The intent of the analysis was to provide the team with more information on an alternative so that the benefits or impediments could be assessed and a well-informed decision (i.e., whether the alternative would be screened out or whether it could be combined with another alternative to better satisfy the study area needs) could be made.

RESULTS OF THE COARSE SCREEN OF THE LONG LIST OF ALTERNATIVES

Using the coarse screening, the long list of alternatives was narrowed as follows:

- *Rapid Transit Alternatives Under Second Avenue (Alternative 1):* The full-length Second Avenue Subway (Alternative 1A in Table B-1 above) and two other subway options—the eastward alignment (Alternative 1D) and the New Jersey connection (Alternative 1G) were found to meet the goals and objectives and passed the coarse screen. The other subway alternatives were eliminated as stand-alone alternatives because they would increase accessibility and increase capacity only to certain portions of the study area, would be difficult to implement, and/or would not be cost-effective compared with other alternatives that would provide similar improvements. In developing the long list of alternatives, rapid transit lines were initially considered for any of the avenues east of Second Avenue, but Second Avenue was chosen early on as most appropriate because a route on Third Avenue would too closely duplicate the Lexington Avenue Line’s service area; a subway route on First Avenue would be difficult near the Queensboro Bridge, the United Nations, and the Queens-Midtown Tunnel; and the Second Avenue route takes advantage of tunnel sections built as part of the 1968 plan.

- *Lexington Avenue Subway Service Improvements (Alternative 2)*: Both the improvements to the Lexington Avenue Line's signals (Alternative 2A) and extensions to the platforms (Alternative 2B) were eliminated as stand-alone alternatives, because neither would make rapid transit more accessible to underserved portions of the study area. Further, because both alternatives would have costs that far outweighed the benefits, they were eliminated from consideration as part of the TSM Alternative. Alternative 2A was retained for possible inclusion in a combination alternative; Alternative 2B was not, given its high cost and difficulties in implementing it. Alternative 2C (segmented connections to other subway lines) was eliminated because it would not address many of the access and service issues of the study area and would be extremely costly and disruptive to rail operations. An extension of Lexington Avenue local service south of City Hall (Alternative 2D) was eliminated as a stand-alone alternative because it would address only a portion of the study area's transportation issues, but this alternative was retained as a component of a combination alternative. Similarly, Lexington Avenue Line skip-stop operation on the local route (Alternative 2E) was eliminated as a stand-alone alternative because it would only minimally address study area transportation issues, but this element was retained as part of a combination alternative.
- *New Metro-North Railroad Stations in the Bronx and Upper Manhattan*: The alternative to add Metro-North Railroad stops in the Bronx and Upper Manhattan (Alternative 3) was eliminated as a stand-alone alternative because it would offer limited access improvements to underserved portions of the study area and would not increase capacity substantially. Also, because the costs would be very high, particularly compared with the benefits accrued, this option was eliminated from consideration as a component of the TSM Alternative.
- *Bus Alternatives (Alternative 4)*: Bus alternatives 4A and 4B (dedicated bus lanes) would meet study area goals and objectives, and were retained.
- *Light Rail Transit Alternatives (Alternative 5)*: Similarly, LRT service in dedicated lanes (Alternatives 5A and 5B) was retained.
- *Private Franchised Jitney Service (Alternative 6)*: This alternative would not provide enough capacity to relieve transit or on-street congestion, and was therefore eliminated as a stand-alone alternative but retained as a candidate for inclusion in the TSM Alternative.
- *Ferry Service on the East River (Alternative 7)*: Similarly, new ferry service on the East River would not materially reduce crowding on the Lexington Avenue Line and would only partially address accessibility needs, but was retained as a potential candidate for the TSM Alternative.
- *New East River Stops on Existing East-West Subway Service (Alternative 8)*: This alternative would improve subway accessibility in underserved areas but would not relieve congestion in the area's north-south transit corridors. Further, this option would have considerable expense and construction difficulties. Most options of this alternative were eliminated from further study, but the proposed station on the **L** route at 14th Street and Avenue C was retained for possible inclusion in the TSM Alternative, because of public interest.
- *Elevated Transit (Alternative 11)*: This alternative would meet the study's transportation goals but would not meet several of the other goals. Its visual impact and community compatibility (third goal) issues would be potentially significant, and community reaction to

this option was quite negative. This alternative was eliminated from further study (although it was retained until a full range of community input could be obtained).

The TSM Alternative (Alternative 9), combination alternatives (Alternative 10), and No Action Alternative (Alternative 12) were retained. These alternatives were developed as the screening analyses proceeded.

REDUCED LONG LIST OF ALTERNATIVES

DEVELOPING THE REDUCED LONG LIST OF ALTERNATIVES

The result of the coarse screen of the long list of alternatives was a preliminary reduced long list of 12 alternatives (including several combination alternatives developed from components of alternatives that could not stand alone). The preliminary reduced long list of alternatives was presented to the PAC and at a series of focused public meetings within the study area. Using this public input and continued evaluation of the alternatives, this list was refined and several alternatives were eliminated, resulting in a “reduced long list” of nine alternatives. That reduced long list of alternatives is presented in Table B-2.

SCREENING THE REDUCED LONG LIST OF ALTERNATIVES

The reduced long list of alternatives was narrowed through several successive screens, as described below. As the screening process proceeded, increasing levels of detail were prepared for alternatives that remained after previous screening levels, to allow further evaluation and comparison of alternatives.

- *Screen 1: Confirmation of Feasibility.* The first screen involved confirmation of feasibility based on early conceptual engineering drawings prepared as necessary to identify alternatives that were clearly infeasible.
- *Screen 2: Definition and Evaluation of Routing Options.* This screening analysis addressed a number of issues related to feasibility and impact. The analysis required refinement in potential routing, alignment, and engineering options for the remaining alternatives. This information was used to evaluate the alternatives against the following criteria:
 - Total cost (comparing relative cost of same-mode options);
 - Average speed;
 - Potential for free subway-to-subway transfer;
 - Impacts on existing transit system, such as eliminating, rerouting, reducing, or increasing existing routes;
 - Other service changes required to existing system;
 - Use of existing tunnels (which was considered an advantage);
 - Engineering complications;
 - Unresolved issues (these were either resolved through further analysis or identified as potentially irresolvable);

**Table B-2
Reduced Long List of Alternatives**

Alternative	Description
1. No Action Alternative	All transportation facilities and services that will exist in 2020 without implementation of any improvements as a result of the MESA Study. Includes elimination of two-fare zones and free transfers between buses and subways.
2. TSM Alternative	To include lower cost improvements that do not pass the screening process as part of other alternatives. Although particular components were not yet defined for the screening, potential elements at this point included bus lane operational improvements; express and local bus operations improvements; Lexington Avenue skip-stop operation; FDR Drive busway/HOV lane; ridesharing on the FDR Drive; private jitney service; ferry service on the East River with shuttle bus service; subway station improvements; new subway passenger transfers between the Broadway/Lafayette Station (then, B D Q F ; now, F V) service and Bleecker Street northbound G service and between the Lexington Avenue/63rd Street Station (then B Q , now F) and the 4 5 6 and N R routes at 59th-60th Street; new L station at 14th Street and Avenue C; and traffic engineering improvements.
3. Full-Length Second Avenue Subway from Harlem to the Battery with Options	New subway under Second Avenue, Chrystie Street, St. James Place, and Water Street with stations every 10 to 15 blocks. Included a potential eastern alignment (traveling eastward through East Village and Lower East Side, potentially along 10th Street, Avenue B, and East Broadway) and potential New Jersey connection (an east-west branch connecting Grand Central Terminal and New Jersey).
4. Bus Service on Dedicated or Paired Avenues with Resignalization of Lexington Avenue Line	Two-way busway along an avenue or one-way pair of busways on two avenues. To use First and Second Avenues in most of the study area and local streets in the Lower East Side and Lower Manhattan. Update signals on Lexington Avenue Line to add capacity.
5. Trolley Bus on Dedicated Busway	Trolley bus on First or Second Avenue with overhead electrical wires.
6. Light Rail Service on Dedicated or Paired Avenues	LRT line in separated right-of-way running two-way on First and/or Second Avenue and on local streets in Lower Manhattan.
7. Northern Segment of Second Avenue Subway with LRT Continuing to the South	Second Avenue Subway from 125th Street to 63rd Street, with LRT on dedicated or paired avenues continuing through East Midtown, Lower East Side, and Lower Manhattan.
8. Northern Segment of Second Avenue Subway with Bus Service Continuing to the South	Second Avenue Subway from 125th Street to 63rd Street, with dedicated busway on dedicated or paired avenues continuing through East Midtown, Lower East Side, and Lower Manhattan.
9. Northern Segment of Second Avenue Subway with LRT in Lower East Side and Lower Manhattan	Second Avenue Subway from 125th Street to 63rd Street or Grand Central Terminal and LRT service on dedicated or paired avenues in Lower East Side and Lower Manhattan.

- Potential for community/public support (based on potential for community-related impacts, such as disruption and traffic congestion);
- Expanded rapid transit area (provision of service to a previously underserved area);
- Ridership (comparison of ridership levels among same-mode options, based on early model results);
- Street/operations impacts (for alternatives once constructed);
- Legal issues (problems in jurisdiction, easements, property takings, etc.);
- Construction impacts;

Second Avenue Subway FEIS

- Possibility of phased construction (given the potential limitations to available capital funds during construction, alternatives that did not allow for reasonable phasing were eliminated); and
- Schedule for implementation.

As a result of this screen, several alternatives were reconfigured and recombined and others were eliminated. Most notably, the full-length Second Avenue Subway with an eastward alignment (bending east on the Lower East Side) was replaced by a Lower East Side subway shuttle with connections to existing subways in combination with a “North Subway” (new construction along Second Avenue from 125th Street to 63rd Street, where it would connect to the Broadway express tracks) for further analysis.

- *Screen 3: Quantitative and Qualitative Evaluation of Alternatives.* The final screen involved an analysis of specific quantitative and qualitative data for each of the remaining alternatives. Preliminary model output (including ridership and travel time information) and capital cost estimates were used to perform a partial cost benefit analysis. This screen also used qualitative screening criteria, including a definition of accessibility; potential for displacement; service to low-income, minority, and transit-dependent populations; community character effects (such as impacts on land use/public policy, visual character, open space, and historic and archaeological resources); hazardous materials issues; traffic impacts; impact on parking and goods delivery; air quality impacts; compatibility with existing transit system; and a general analysis of construction impacts.

RESULTS OF THE SCREENING ANALYSIS

The multi-level screening analysis performed for the reduced long list of alternatives led to refined definitions for several of the alternatives and the elimination of several of the alternatives, as described below and summarized in Table B-3.

As shown in the table, the evaluation conducted for Screen 3 concluded that the full-length Second Avenue Subway would provide the greatest benefit in solving transportation problems on the East Side of Manhattan. It was also found to have the highest capital and operating costs. To address the most critical problems in the study area first, a lower cost alternative that could serve commuters in East Harlem and the Upper East Side—where the greatest proportion of the rush hour commuters in the study area enter the system—who were traveling to Midtown and Lower Manhattan was selected as preferable to the full-length subway at that time. This lower cost subway alternative, which would involve construction of a new tunnel segment between 125th and 63rd Streets and continuation on existing routes from 63rd Street south to Lower Manhattan, did not preclude future extensions of the subway route farther south to provide a full-length subway. To allow for the future development of a full-length subway option, the conceptual engineering of the subway alternatives that were advanced past this point all allowed for the continuation of a full-length subway at a later time without disrupting northern Second Avenue Subway service.

**Table B-3
Refined Long List of Alternatives**

Alternative	Description
1. No Action Alternative	Continued to next phase.
2. TSM Alternative	Continued to next phase.
3. Full-Length Second Avenue Subway with Options	The full-length subway option that had a full eastward alignment and/or east-west connection option was eliminated in Screen 2 because of cost-effectiveness and impact factors. The full-length subway without those options and the North Subway with Lower East Side subway shuttle (which had been developed in Screen 2) were eliminated in Screen 3 because of high capital and operating cost and high cost factors (cost per hour saved and cost per hour spent in less crowded subway).
4. Bus Service on Dedicated or Paired Avenues with Resignalization of Lexington Avenue Line	Eliminated as stand-alone alternative in Screen 2; added to TSM Alternative.
5. Trolley Bus on Dedicated Busway	Eliminated as stand-alone alternative in Screen 2; added to TSM Alternative.
6. Light Rail Service on Dedicated or Paired Avenues	Eliminated in Screen 3 because of substantial potential traffic impacts.
7. Northern Segment of Second Avenue Subway with LRT Continuing to the South	Eliminated in Screen 2 because it would not perform appreciably better than alternatives with shorter LRT segments and thus was not cost-effective.
8. Northern Segment of Second Avenue Subway with Bus Service Continuing to the South	Continued to next phase, but bus component moved to TSM Alternative to allow clearer comparison of impacts.
9. Northern Segment of Second Avenue Subway with LRT in Lower East Side and Lower Manhattan	Continued to next phase.

ALTERNATIVES EVALUATED IN DETAIL IN THE MIS/DEIS

ALTERNATIVES ANALYZED

As a result of the lengthy screening evaluations conducted, four alternatives were advanced for more detailed evaluation in the MIS/DEIS:

- *No Action Alternative*: This alternative included those improvements in the City’s transportation system that were expected to be instituted after 1995 (the base year for the MESA Study) and before 2020 (the future analysis year). This included completion of MTA operating agency initiatives to bring the system into a state of good repair (such as the purchase of new subway cars, rehabilitation of certain stations, track improvements, etc.); the introduction of MetroCard, free transfers between buses and subways, and unlimited system-wide passes; and the service changes associated with completion of NYCT’s 63rd Street Tunnel Connector, which allowed for initiation of **V** service, with more trains operating between Manhattan and the Queens Boulevard Line in Queens.

- *TSM Alternative:* This relatively low-cost option was developed by combining elements of several project alternatives that did not meet project goals and objectives by themselves. The TSM Alternative would include improvements to station dwell times on the Lexington Avenue Line; introduction of bus priority lanes, called “New York Bus Lanes,” on First and Second Avenues between Houston and 96th Streets; and improvements to bus service on the Lower East Side (including creation of two new routes and modification of two others). The New York Bus Lanes proposed with this alternative would reserve one to two moving lanes on the right side of the street for buses (although right-turning vehicles would also be permitted). The curb lane would continue to be used for deliveries, parking, and taxi drop-offs and pickups. At bus stops, the sidewalk would be built out into the delivery and parking lane.
- *Build Alternative 1:* This alternative would provide a new subway extending from 125th Street at Lexington Avenue (parallel to the Lexington Avenue Line), curving east beneath private property to join Second Avenue at approximately 115th Street, and then traveling south beneath Second Avenue and bending westward again at approximately 65th Street to join the existing tunnel beneath 63rd Street (currently used by **F** service). The new service would use the 63rd Street Line, which extends beneath Central Park to reach the Broadway Line (currently serving the **N** **R** and **C** **D** **W** lines). It would then travel down the Broadway Line express tracks to Lower Manhattan and Brooklyn.

Under this option, extensive changes were also proposed on the Broadway Line in the vicinity of Canal Street, so that the express tracks to be used by the new Second Avenue service would connect to the local tracks instead of continuing across the Manhattan Bridge as they do today. This would provide direct express service to the Financial District in Lower Manhattan and therefore help relieve overcrowding on the Lexington Avenue Line. To implement this change, the local Broadway Line service would instead have to be routed across the Manhattan Bridge to Brooklyn. The new Second Avenue express service via the Broadway Line would also serve Brooklyn via the Montague Street Tunnel.

Five new stations were proposed with this alternative: 125th Street (parallel to the Lexington Avenue Line station at 125th Street), 106th Street, 96th Street, 86th Street, and 72nd Street. South of 72nd Street, the new service would use the existing station at Lexington Avenue/63rd Street and continue to Lower Manhattan via the Broadway Line. On the Broadway Line, the new service would make express stops at 57th Street, Times Square, 34th Street, Union Square, and Canal Street; and the local stops at City Hall, Cortlandt Street, Rector Street, and Whitehall Street with continuing service via the Fourth Avenue Line in Brooklyn.

To accommodate the storage needs of the new subway, it was assumed that the NYCT’s existing 36th-38th Street Yard in Brooklyn would be reconfigured.

- *Build Alternative 2:* This alternative would provide the same new subway service as Build Alternative 1, and would also include new LRT service on the Lower East Side and in Lower Manhattan. The new two-way LRT service would operate at street level from Union Square along 14th Street, then south down Avenue D, then bend west along East Broadway and then Canal Street. On Canal Street, it would enter a portal at approximately Allen Street, continue in a tunnel beneath Canal Street to Centre Street and then bend east onto Frankfort Street, where it would emerge from the tunnel in a portal alongside the Brooklyn Bridge. From that portal, it would continue south down Water Street to a terminus at Broad Street.

The LRT would use articulated vehicles powered by overhead wires and operate as one- or two-vehicle trains. It would stop at designated stations with sheltered platforms at Union Square, Irving Place, First Avenue, and Avenue B on 14th Street; at 13th, 8th, and Houston Streets on Avenue D; at Grand Street on Kazan Street; at Strauss Square (Essex Street) on Canal Street; within the existing Chambers Street Station complex (serving the **J M Z** routes); and at Fulton, Pine, and Broad Streets on Water Street.

Storage and repairs for the LRT system would be accommodated at an underground facility, which would be on property along the south side of Delancey Street from Essex Street to just east of Clinton Street.

EVALUATIONS OF THE MIS/DEIS ALTERNATIVES

The four finalist alternatives were evaluated at length in the MIS/DEIS, based on full ridership modeling and conceptual engineering work. Table B-4, below, summarizes the evaluations in the MIS/DEIS related to cost and ridership of the Build alternatives evaluated, relative to the No Build Alternative.

**Table B-4
Comparison of MIS/DEIS Alternatives in Year 2020**

Alternative	Cost (In 1997 Dollars)	Riders Using the New Alternative		Compared to No Action			
				Riders New to Public Transit		Change to Ridership on Southbound Lexington Avenue Line at 86th Street	
		Daily	AM Peak Hour	Daily	AM Peak Hour	Daily	AM Peak Hour
TSM	\$204 million	82,500	10,300	1,300	170	-1,980	-220
Build 1	\$3.88 billion	308,600	38,600	7,800	980	-147,900	-16,430
Build 2	\$5.09 billion	418,300	52,300	9,800	1,230	-163,300	-18,140
Notes: This information was predicted for the 1999 MIS/DEIS, based on 1995 ridership information and 1990 census data. Costs are preliminary estimates developed for the 1999 MIS/DEIS and are in 1997 dollars.							

D. PUBLIC INVOLVEMENT IN THE DEVELOPMENT OF ALTERNATIVES

The MIS/DEIS was conducted with an extensive public outreach effort. NYCT and the project team accepted recommendations from other public agencies, a TAC and PAC convened for the MIS/DEIS, members of civic groups, and the general public. At each milestone of the project, meetings were held with the TAC and PAC, MTA’s Long-Range Planning Framework working group, Community Boards, elected officials, community and civic groups, and other groups to present results and receive input and feedback. Key milestones at which public input was sought included the following:

- Scoping meeting;
- Development of problem and needs statement;
- Development of goals and objectives;
- Development and evaluation of long list of alternatives;

Second Avenue Subway FEIS

- Review of screening of long list and preliminary reduced long list of alternatives;
- Review of reduced long list of alternatives; and
- Review of short list of alternatives.

More than 100 meetings were held throughout the study to keep the community informed and to seek public input as the study progressed. As a result of public input, suggested studies and design alternatives, including new bus routes throughout the study area, were incorporated into the TSM Alternative and Build Alternative 1. Public participation also helped fashion the specific LRT alignment and cross section within Build Alternative 2. It also provided valuable local insights in narrowing the initial set of alternatives to those on the short list. Further, community members suggested that an additional subway stop be included on the new subway line in East Harlem near 116th Street.

NYCT and FTA completed the MESA MIS/DEIS and published a Notice of Availability in the Federal Register in August 1999. A public hearing was conducted in September 1999 to receive comments on the project and the MIS/DEIS. At the hearing, members of the public, community groups, and elected officials voiced their support for a full-length Second Avenue Subway from 125th Street to Lower Manhattan. Of the 45 people who spoke at the public hearing, 40 supported a full-length Second Avenue Subway. During the public comment period, MTA received numerous written comments. Of these, the great majority were in support of a full-length Second Avenue Subway. The MTA also received more than 24,000 postcards expressing support for a full-length Second Avenue Subway. Appendix O of this FEIS, “Response to Comments Received on the 1999 DEIS,” summarizes and responds to comments received during the public comment period for the 1999 MIS/DEIS.

E. FURTHER REFINEMENT TO DESIGN

In November 1997, concurrent with the ongoing MESA Study, the MTA initiated the Lower Manhattan Access Study (LMA) to examine transportation alternatives that would improve access from the New York City suburbs to Lower Manhattan. Although the LMA Study’s goals and objectives were different from those of the MESA Study, an extension of MESA’s subway build alternative under Second Avenue from 63rd Street to Lower Manhattan was one of the five long-list build alternatives developed by LMA, with the support of its Technical and Public Advisory Committees.

In terms of LMA project goals, the full-length Second Avenue Subway would improve access from New York’s suburbs to Lower Manhattan by allowing suburban commuters to make an easier transfer to a less crowded subway line than they have today. Adding a new full-length Second Avenue Subway would reduce crowding on the Lexington Avenue Line and improve travel capacity and reliability to Lower Manhattan.

As part of the LMA Study, engineering, operations, ridership, and cost analyses were performed for the full-length subway, building on those already completed for the segment north of 63rd Street by the MESA Study. The engineering work laid out the mainline route under Second Avenue, the potential station locations south of 63rd Street, and two engineering options south of Houston Street (one via Water Street and the other via the Nassau Street Line). During development of the southern portion of the Second Avenue Subway alignment, several alignment options were also analyzed to identify the most effective Second Avenue route that would minimize construction complexity and costs, and maximize customer benefits and ridership. These key areas were assessed to determine the basic alignment of the route:

- *Second Avenue vs. Third Avenue:* These alignment shift alternatives were examined to investigate the impacts of moving the line closer to the heart of Midtown. Shifting the subway line from Second to Third Avenue in Midtown would have resulted in significant property impacts, increased construction complexity and cost, and increased travel time due to slower operating speeds, crowding, and increased dwell times. Thus, the Third Avenue alignment alternative was eliminated.
- *Second Avenue vs. First Avenue:* A potential alignment was also investigated that shifted the alignment from Second Avenue to First Avenue at 35th/36th Street, continuing south under First Avenue until the connection with the Nassau Street Line. Preliminary ridership estimates showed that shifting the alignment one block did not provide significant improvements when compared with the Second Avenue alignment. The First Avenue alignment attracted slightly more new transit trips but did not perform as well as the Second Avenue alignment in alleviating congestion of the Lexington Avenue express service. The Second Avenue alignment diverted over 100 more peak hour trips from the Lexington Avenue express service at its maximum load point (86th Street). At Grand Central Terminal, the Second Avenue alignment diverted over 700 more peak-hour trips from the Lexington Avenue express. For these reasons, the First Avenue option was eliminated.
- *Grand Central Terminal Spur:* This spur option consisted of a subway shuttle service along 44th Street from the Second Avenue Subway to Grand Central Terminal. This option was examined to assess the benefits of providing direct subway service from Grand Central Terminal to Lower Manhattan via the Second Avenue Subway. Ridership modeling analysis revealed that a shuttle service along a Grand Central Terminal spur could only be effective if it operated frequently enough, with short enough travel time, to be a comparable alternative to the Lexington Avenue express service. However, the ridership analysis demonstrated that riders would continue to use the Lexington Avenue express service from Grand Central Terminal to Lower Manhattan, rather than the new shuttle, because the Lexington Avenue Line could offer more frequent service and shorter travel times.

F. ADVANCEMENT OF THE FULL-LENGTH SECOND AVENUE SUBWAY ALTERNATIVE

SELECTION OF FULL-LENGTH SECOND AVENUE SUBWAY

As the result of the alternatives evaluation process described above, a full-length Second Avenue Subway with several design refinements has advanced into Preliminary Engineering and further analysis required by NEPA. The alternatives analyzed in the 1999 DEIS were not carried forward for further study in the SDEIS (although aspects of Alternatives 1 and 2 are still part of the full-length Second Avenue Subway examined in the SDEIS and FEIS). Figure B-1 summarizes the alternatives evaluation process.

The selection of this full-length subway includes the following commitments and statements of support:

- In April 2000, the MTA Board committed to begin construction of a full-length Second Avenue Subway in the 2000-2004 Capital Program.
- In May 2000, the MTA Capital Program Review Board approved the MTA's 2000-2004 Capital Program, which allocates \$1.05 billion for a full-length Second Avenue Subway.

Second Avenue Subway FEIS

This initial funding level provides for environmental studies, design, and the initiation of construction. (Additional funding will be required for continuation of construction to complete the project.)

- On April 19, 2001, NYCT held a public meeting announcing plans to proceed with the full-length Second Avenue Subway as the selected alternative. At this meeting, NYCT heard comments from elected officials, members of civic groups, and the public on the full-length subway. Speakers at the meeting were overwhelmingly supportive of plans to proceed with a full-length Second Avenue Subway extending from 125th Street to Lower Manhattan.
- On May 17, 2001, NYMTC, the region's Metropolitan Planning Organization, endorsed the advancement of the Preliminary Engineering phase for the full-length Second Avenue Subway.
- The FTA approved the start of Preliminary Engineering on a full-length Second Avenue Subway on December 19, 2001.

Other public meetings and agency coordination held since the start of the SDEIS process in spring 2001 are described later in this document (in Chapter 4, "Public Outreach and Review Process"). The following appendix describes the full-length subway that is analyzed in this FEIS in detail.

After selection of the full-length Second Avenue Subway for continued study, that preferred alternative was further refined through an interactive process involving transportation planning, project design, and community outreach. This process has resulted in design refinements in many areas, including: the design of the northern terminal station at 125th Street; change to the project alignment between 125th Street and 116th Street to reduce the number of easements required under private property and allow for a new 116th Street Station; alignment and station location considerations between 72nd and 42nd Streets, which would permit connections at 63rd Street to and from the 63rd Street Tunnel tracks; development of alignment options between Houston and Canal Streets; and the Lower Manhattan alignment and southern terminal, as described below.

ALIGNMENT DECISIONS AND STATIONS BETWEEN 125TH AND 106TH STREETS

The subway alternatives analyzed in the 1999 DEIS proposed two stations between 125th and 106th Streets—one at 125th Street, and the other at 106th Street. The 125th Street Station would have been located parallel to the existing 125th Street Station on the Lexington Avenue Line, just east of Lexington Avenue (see Figure B-2). From 125th Street, the alignment would have curved south and east under private property in an S-curve that reached Second Avenue at 115th Street. This alignment was favored because it would permit an eventual extension of the Second Avenue Subway Line to the Bronx via the Pelham Line (6), while still providing a convenient transfer at 125th Street to the Lexington Avenue Line. No new station was proposed at 116th Street, but the MIS/DEIS indicated that at the request of community members in East Harlem, studies would be completed for MESA's Final Environmental Impact Statement (FEIS) to determine the feasibility of such a station.

Therefore, one of the early design studies conducted for the full-length subway was the feasibility of including a new 116th Street Station as part of the project. The SDEIS evaluated some six different options for locating a station at or near 116th Street. Options studied included various changes to the S-curve under private property to allow the new station to be located either along the curve or on Second Avenue. Because of the large curve radius (i.e., wide curve)

required for efficient and speedy subway operation, those S-curve options could not place a new station directly at 116th Street on Second Avenue; instead, the new station would have to be under private property west of Second Avenue or farther south on Second Avenue. These options all presented construction difficulties as well. As a result, the option selected for inclusion in the full-length Second Avenue Subway is a different alignment than that studied in the MIS/DEIS.

As detailed in Chapter 2, the solution proposed for the full-length Second Avenue Subway option is to continue north under Second Avenue to 125th Street, where it would curve under a small number (12) of private properties and continue west under 125th Street. (The number of buildings that would be affected has been reduced since the SDEIS was issued.) This solution eliminates the S-curves between Lexington and Second Avenues under many private properties (see Figure B-3). This is the only alignment that would allow for a station at 116th Street and Second Avenue while still providing for a convenient transfer to the Lexington Avenue Line. This option would allow for a future connection to the Bronx from Second Avenue, rather than from Lexington Avenue. It presents fewer construction difficulties as it would not pass beneath as many buildings as the original MIS/DEIS alignment, and also would not require as many property acquisitions. Among the additional benefits of this option are that it would provide direct vertical transfer connection to the Metro-North Railroad station at 125th Street, it would use more of the existing subway tunnel already constructed under Second Avenue, and it would allow creation of underground storage tracks north of 125th Street under Second Avenue (discussed later in this appendix). Manhattan Community Board 11 in East Harlem reviewed and endorsed the selected alignment and station location plan in a board meeting in September 2001. In addition, the Manhattan Borough President endorsed the selected alignment.

OTHER ALIGNMENT OPTIONS CONSIDERED FOR 125TH STREET CURVE

As mentioned above, numerous other alternatives to the preferred alignment option—which would affect 10 buildings at the southwest corner of Second Avenue and 125th Street—in this area have been examined to ensure that property impacts are minimized to the maximum extent practicable (see Figures B-4 to B-7). This analysis has continued beyond the SDEIS, with the results presented here. However, as presented in more detail below, all of these alignment options were eliminated from further consideration because they would have considerably more disadvantages than the preferred alignment. Any advantages they might have had would have been outweighed by the significant problems they would pose in terms of construction and impacts to the surrounding community.

- *Westerly alignment option*—Compared with the preferred alignment option, this option would have had the advantage of not requiring a tunnel beneath the existing Lexington Avenue Line 125th Street Station or construction along 125th Street east of Park Avenue (see Figure B-4). However, it would have presented serious deficiencies: 1) the 116th Street Station would not have been located on Second Avenue, 2) no connection to the Metro-North station at 125th Street would have been provided, 3) the existing tunnel section already constructed under Second Avenue would not have been used, 4) the absence of rock cover along this alignment would have created major property impacts, and 5) future expansions of the subway line to the east and west would have been extremely difficult. For these reasons, this alternative was eliminated.
- *Easterly alignment option*—Compared with the preferred alignment option, this option would have affected fewer properties at the southwest corner of Second Avenue and 125th

Street (see Figure B-5). However, it would have affected more buildings overall. In addition to affecting three properties on the southwest corner of Second Avenue and 125th Street, it would also create significant property impacts at 13 properties between 119th and 120th Streets. In addition, 1) the existing tunnel section already constructed under Second Avenue would not have been used in its entirety, 2) tunneling through and under the high-rise Robert F. Wagner Houses would have been necessary, and 3) construction impacts would have resulted to the approaches to the Triboro Bridge, a historic structure. For these reasons, this alternative was eliminated.

- *Northerly alignment option (station and connection)*—This alignment would have had the benefit of avoiding the need to tunnel beneath the southwest corner of 125th Street and the resulting property impacts in that area (see Figure B-6). However, its considerable disadvantages eliminated this option from further consideration: 1) it would have required lengthy connections beneath 125th Street from Second to Lexington Avenues to link the existing Lexington Avenue Line and Metro-North stations, 2) it would have required more costly and disruptive cut-and-cover construction along Second Avenue, 3) it would have made any future extensions of the subway to the west or east extremely difficult, and 4) it would have caused greater impacts to local parks than the preferred alignment.
- *Northerly alignment option (loop track)*—This alignment option would have offered efficient connections to the existing Lexington Avenue Line and Metro-North stations on 125th Street (see Figure B-7). However, it would not satisfy the principal goals of the project because of the significant problems it would have posed: 1) it would have still created property impacts at the southwest corner of Second Avenue and 125th Street while affecting additional nearby properties, 2) it would have resulted in longer travel time to access the Second Avenue Subway, 3) it would have added additional impacts and associated costs for train storage and access, and 4) it would have provided only a two-track station at 125th Street (which could result in shut-downs and delays in service if a problem were to occur on one of the tracks). Consequently, the alignment would have been unable to handle the up to 30 trains per hour required for efficient subway operation.

ALIGNMENT DECISIONS AND STATIONS BETWEEN 72ND STREET AND 42ND STREET, INCLUDING 63RD STREET CONNECTIONS

Plans to run a portion of the proposed Second Avenue Subway service on the Broadway Line to Lower Manhattan have long been part of the Second Avenue Subway concept. The existing four-track 63rd Street Line, constructed in the 1970s and 1980s, includes two pairs of bellmouths¹ that would allow for a connection between a future Second Avenue Line and the existing 63rd Street Line. One pair, located just north of 63rd Street and just east of Third Avenue, was designed so that Broadway Line trains west of Second Avenue could connect with the proposed Second Avenue Line north of 63rd Street. The other pair of bellmouths, located just south of 63rd Street at roughly First Avenue, was designed to permit future subway service between Queens and Lower Manhattan to operate on the proposed Second Avenue Subway south of 63rd Street.

¹ Bellmouths are provisions built into the existing structure for future connections with limited impacts on service. They allow for tracks to branch off an existing line and connect to another line.

Together, the two pairs of bellmouths would facilitate the construction of connections between the Second Avenue and 63rd Street Lines with little disruption to existing 63rd Street Line service and, as such, would be a valuable asset. At the same time, however, only a certain limited range of geometric tunnel and track alignments can satisfy both station location and operational requirements and still use the previously constructed bellmouths to connect the Second Avenue Line with the 63rd Street Line.

Given the complexity of the required terminal and turn-back facilities, connections to the existing tunnels, and proposed station locations in the 63rd Street area, a focused study of this area was undertaken. Several options were examined to address grade and construction complexities at the 63rd Street connection of the potential new route and the existing subway tunnel. In total, nine main options and six variations were reviewed in this area. Eventually, as shown in Figure B-8, an alignment was identified that would allow NYCT to do the following:

- Route trains to and from Queens via the existing 63rd Street Line with minimal inconvenience to passengers. If the capacity of the Queens subway network is increased in the future, or if existing service is reconfigured, this connection, along with the available track capacity on the planned Second Avenue Line south of 63rd Street, would enable additional subway service between Queens, Midtown, and the Financial District to be provided. The connecting tunnel design selected for inclusion in the full-length Second Avenue Subway alternative would be designed to standards that would permit expanded passenger operations in the future. In the near term, this connection would also be used for non-passenger service diversions and reroutes due to disruptions. In the case of a service diversion, such as currently exists due to construction of the Manhattan Bridge, trains may be diverted up the Broadway Line, and capacity north of 63rd Street would be exceeded.
- Terminate or turn around some northbound Broadway Line trains at Second Avenue without interfering with Second Avenue service. Provide a third track through the 72nd Street Station that could be used for Broadway Line service. The third track at 72nd Street allows trains not continuing to 125th Street to reverse without interfering with through service on the Second Avenue Line. The third track would provide operational flexibility accommodating special long-term construction projects and would also be used for non-passenger moves, train storage, and equipment.
- Locate stations in this area where most appropriate for residents, businesses, and institutions in the corridor at: 72nd Street with an entrance at 69th Street, 57th/56th Street with an entrance at 54th/53rd Street, and 42nd Street with entrances between 44th and 41st Streets. The 72nd Street Station could be positioned to have a second entrance near 69th Street, providing access to major institutional uses nearby. It cannot be shifted farther south because of the curvature of the connecting track to the 63rd Street Line and the required switches in the approach tracks to accommodate reversing Broadway Line trains. The 57th Street Station would also provide for pedestrian connections and entrances to the existing **E V** trains at the 53rd Street Station on Lexington Avenue, which is expected to be an important transfer point to the Second Avenue Subway and would also accommodate eventual passenger service to and from Queens.

STATION DECISIONS AT OTHER LOCATIONS

Most Second Avenue Subway stations would be located at or near major crosstown streets at intervals of approximately 10 blocks. In addition, most would also have street entrances at two

distinct locations—one at the major cross street for which the station is named, and a second entrance one or two blocks north or south of the main entrance. In general, the locations of these secondary entrances were determined based on engineering considerations (depth of station, location and size of ventilation and mechanical equipment), land use issues (community input, proximity to major crosstown streets, intermodal connections, transfers to existing subway lines), and passenger safety requirements. In some cases (for example, the stations at 57th Street, Grand Street, and Seaport), the existence of existing tunnels and bellmouths imposed considerable restriction on where stations could be placed, while in others (such as 96th Street, 34th Street, and 14th Street), the existence of fewer engineering and geological constraints allowed MTA/NYCT to consult with the local Community Boards regarding station locations.

ELIMINATION OF DEIS “CANAL FLIP” PROPOSAL

As described above, the 1999 MIS/DEIS proposed new subway operation from 125th Street to 63rd Street via Second Avenue, with service continuing from 63rd Street via the Broadway Line to Lower Manhattan. That proposal did not include any new tunnel construction under Second Avenue south of 63rd Street. All trains would have been routed via the 63rd Street connection described above to the express tracks of the Broadway Line. As noted earlier, the Broadway Line express tracks connect to the Manhattan Bridge and continue on to Brooklyn bypassing Lower Manhattan south of Canal Street. To provide service over the full length of Manhattan, the MESA DEIS subway options proposed a change to Broadway Line service at approximately Canal Street. The change, termed the “Canal Flip,” would have “flipped” the Broadway Line express and local tracks at Canal Street. New MESA subway trains would continue south on the Broadway Line, serving Lower Manhattan with the Canal Flip in place. The trains on the Broadway local tracks north of Canal Street would be routed across the Manhattan Bridge.

The Canal Flip would have resulted in substantial passenger and community disturbance during construction and would have been relatively costly in relation to the benefits provided to passengers. Once in place, it would have affected service for riders using the existing local service on the Broadway Line to Lower Manhattan who would have to change trains to continue their journeys to the Financial District.

Ridership models of the full-length Second Avenue Subway showed that the Canal Flip was no longer necessary to meet travel demand for service between the Upper East Side and East Harlem and Lower Manhattan. The Flip had been needed to allow trains to travel from East Harlem the whole way to Lower Manhattan, but now the proposed full-length Second Avenue route would provide that service. Consequently, the full-length Second Avenue Subway does not include the Canal Flip.

ALIGNMENT DECISIONS SOUTH OF HOUSTON STREET

At the beginning of the SDEIS process, the full-length Second Avenue Subway had two possible alignment options south of Houston Street for service to Lower Manhattan—one would create new service via Water Street and the other would connect the service to the existing Nassau Street Line (see Figure [B-9](#)).

The Water Street alignment would involve continuation of the route directly south from Houston Street via Chrystie or Forsyth Street (see discussion below), Chatham Square, St. James Place, Pearl Street, and Water Street. This alignment is generally the route proposed for the original 1929 plan for the Second Avenue Subway, as well as the 1970s plan on which construction began. Some variations of this Water Street alignment would use the existing tunnel section that

was constructed for the new subway in the 1970s near Canal Street. The Water Street alignment option would better serve the Lower East Side and would bring passengers to the eastern part of Lower Manhattan, to an area currently without subway service. This option would not preclude a potential future extension to Brooklyn using a new East River tunnel.

The Nassau Street Line option would connect the Second Avenue Subway to the existing Nassau Line (**J****M****Z** service) at Kenmare Street, south of Houston Street. This option was considered in earlier plans for the Second Avenue Subway in the 1940s and 1950s. The Nassau Street Line carries trains into and out of Manhattan from Brooklyn via the Williamsburg Bridge and Montague Street Tunnel; between these points, trains on the Nassau Line travel north-south from roughly Kenmare and Centre Streets to Nassau and Broad Streets, with stops at the Essex Street, Bowery, Canal Street, Chambers Street, Fulton Street-Broadway-Nassau, and Broad Street Stations. With some reconfiguration of tracks, lengthening of platforms in existing stations approximately 120 feet to a length of 615 feet, increasing the passenger circulation capacity at some of the existing stations, and modification of service plans south of Chambers Street, the existing Nassau Street Line could provide sufficient capacity to accommodate the additional trains that Second Avenue Subway service would require. The Nassau Street alignment option would bring new subway service to the heart of the Financial District and allow the new service to continue into Brooklyn with no new construction. However, it would not provide a station in the Grand Street or Chatham Square areas like the Water Street alignment option. With respect to relative station locations south of Canal Street between the two options, the Water Street option's Chatham Square station would be approximately 1,200 feet northeast of the Nassau Line Chambers Street station, the Water Street option's Fulton/Seaport Station would be approximately 1,000 feet east along Fulton Street from the Nassau Line Fulton Station, and the Water Street Hanover Square Station would be approximately 1,000 feet east along Wall Street of the Nassau Line Broad Street Station.

WATER STREET ALIGNMENT

Alignment Between Houston and Canal Streets

The area immediately south of the Houston Street Station was a focus of study for both the Water Street and Nassau Street alignments for several reasons. First, there are two existing subway lines in this area that require special consideration during construction of the Second Avenue Subway to avoid creating excessive service disruptions for existing passengers. At the same time, ridership projections indicate that transfers between the Second Avenue service and existing **F****V** service at Houston Street and **B****D** service (currently served by **S**) at Grand Street would be heavily used by Brooklyn passengers. Finally, construction in this area poses a number of potential environmental concerns, such as possible impacts to private properties, and businesses that are part of several important commercial districts—the restaurant equipment district, the Bowery lighting district, and Chinatown. These three districts are not only vital business areas but also anchors for the surrounding neighborhood. Construction could also affect Sara D. Roosevelt Park, a large neighborhood park. The early studies, described below, were intended to identify options that would reduce impacts to these residences, businesses, and community facilities, while in the case of the Water Street alignment still creating an efficient transfer between subway routes at Grand Street.

Shallow Chrystie Option. Several options were explored that locate the alignment along Chrystie Street. One such option, called the “Shallow Chrystie Option,” would construct the Second Avenue Subway alongside the **B****D** tracks under Chrystie Street and connect into the existing

tunnel segment beside Confucius Plaza. A cross-platform transfer to Sixth Avenue Line service at the Grand Street Station (the **B D** trains, but currently operating with the Grand Street **S**) would also be provided. This option provides the most convenient transfer at Grand Street, which is projected to be heavily used. However, this option, which was included in the 1970s Plan, could result in impacts to the adjacent buildings, which could lose access for a period of up to six months and may require acquisition, and to Sara D. Roosevelt Park, because most or all of the mature trees along the entire western edge of the park would need to be removed during construction, but could potentially be replaced following construction. In addition, some service impacts to the existing **B D** lines would occur during construction.

Deep Chrystie Option. An alternative would place the Second Avenue Subway beneath the Chrystie Street tracks—this option is thus called the “Deep Chrystie Option.” The Deep Chrystie Option would reduce property impacts as compared with the Shallow Chrystie Option. The option would result in different construction impacts to the park. Construction would be limited to the five-block area adjacent to the Grand Street Station, as opposed to the entire length of the park, which would occur with the Shallow Chrystie Option. Portions of the park in this area could be closed to public access at times, and trees along both the western perimeter and some of the interior would be removed. The depth of the tunnel with the Deep Chrystie Option would not allow the use of the existing Confucius Plaza Tunnel segment for subway service; however, the tunnel segment may be used instead for ancillary subway facilities. In addition, some service impacts to **B D** service could result from this option, as it might be necessary to underpin a portion of the existing line during construction. Finally, while a transfer to the **B D** service would be provided, this transfer would require changing platform levels.

Bowery Option. Options that took the alignment underneath the Bowery were also developed. These options would require the underpinning or demolition of numerous buildings, including a nine-story residential building. The Bowery options would also require an extensive amount of cut-and-cover construction on the Bowery at Grand Street.

Forsyth Option. In an effort to minimize these impacts and impacts to the park, the study effort included development of an alignment option that would travel east of the park underneath Forsyth Street. This option would curve below the park to reach Forsyth Street, and would therefore need to be deeper than the existing tunnel segment at Confucius Plaza. Therefore, as with the Deep Chrystie Option, the Forsyth Street Option may use the existing Confucius Plaza tunnel segment for ancillary subway facilities (such as ventilation plants and electrical power substations), as the track tunnels would pass below this tunnel segment. The Forsyth Street Option would have fewer impacts on adjacent properties than the Shallow Chrystie Option, but could affect a comparable number of properties as the Deep Chrystie Option. As with the Deep Chrystie Option, construction in the park would be limited to the area between Delancey and Hester Streets. Portions of the park would be closed to public access. Trees adjacent to the station excavation area would still need to be removed, because ancillary facilities might need to be placed in the park, and because it would be necessary to reconstruct the existing Grand Street Station in order to accommodate the anticipated passenger movements between the two subway lines. These impacts are more thoroughly discussed in Chapter 7, “Public Open Space.” The Forsyth Street Option would also result in a 200-foot-long transfer passageway at Grand Street between the Second Avenue Subway station under Forsyth Street and the existing Grand Street Station, which is under Chrystie Street. This transfer would be less convenient for passengers than the cross-platform transfer possible with the Shallow Chrystie Option or the transfer between the upper and lower levels with the Deep Chrystie Option.

Selection of a Modified Deep Chrystie Option. As described above, the alternatives evaluation process originally resulted in the selection of three reasonable options for the segment of the Second Avenue Subway between Houston and Canal Streets: the Shallow Chrystie Option, the Deep Chrystie Option, and the Forsyth Street Option. The three alignment options, including their methods of construction and assorted impacts, for the area between Houston and Canal Streets were reviewed in the SDEIS. (See Table B-5 for a summary of the benefits, impacts, and mitigation measures for the three options, and Figures (B-10 through B-12) for an illustrative representation of each option.)

As a result of information gained through the analyses conducted for the SDEIS, the Shallow Chrystie Option was subsequently rejected, as it would have resulted in more significant adverse impacts during construction than the other two options. As described throughout the SDEIS, the Shallow Chrystie Option would have: 1) resulted in more displacement of residential and commercial uses, 2) required more underpinning of adjacent properties, 3) caused more encroachment into and greater impacts to Sara D. Roosevelt Park, 4) generated more dust and noise because cut-and-cover construction would have been required along a longer segment of the proposed alignment, and 5) potentially affected possible burial remains at five former cemeteries. Although no longer under consideration, the Shallow Chrystie Option was nevertheless discussed throughout the SDEIS for comparative purposes.

Since completion of the SDEIS, upon completion of further engineering studies in the area south of Houston Street, a decision was also made to eliminate the Forsyth Street Option from further consideration and to select a refined version of the Deep Chrystie Option for the alignment in this area instead (see Figure B-13). The Forsyth Street Option is no longer being considered because it would have created street-level construction disturbance in a wider area than the Deep Chrystie Option. The Forsyth Street Option would have also attracted fewer transfers between the new Second Avenue Line and the existing B D service at the Grand Street Station. (Chapter 2 presents more information on the Deep Chrystie Option's alignment, and Chapter 3 describes its construction methods in greater detail.)

Alignment from Canal Street to Lower Manhattan

A challenging area for construction of the Water Street alignment is along Water Street between the Brooklyn Bridge and Battery Park. In this area of Manhattan, there are many high-rise buildings, five existing transit tunnels crossing beneath Water Street on their way to Brooklyn, the South Ferry Loop of the 1 9 trains, the Franklin D. Roosevelt Drive, and the Brooklyn-Battery Tunnel. As a result, there are many restrictions on positioning both the running tunnels and the stations. In most cases, the existing transit tunnels are too shallow for a new tunnel to pass above them, thereby requiring the alignment and stations along the Water Street corridor to be very deep, at 70 feet or more below street level. Additionally, options that allow for a future extension of Second Avenue Subway service to Brooklyn would require a tunnel located deep enough to pass beneath all of these lines and the Brooklyn Battery Tunnel if extended. Several options for the alignment and stations were considered for the Lower Manhattan area, with primary concerns being the distance between stations and depth of stations. Generally, the depth and length of the Second Avenue Subway tunnel would vary depending how far south the alignment goes and the location of its stations. Increasing station depth increases travel time for passengers (who must spend more time exiting from the station), making deep stations less

Table B-5
Summary of Benefits, Impacts, and Mitigation Measures for
Alignment Options Along Chrystie Street

Environmental Subject Area	Shallow Chrystie Option (no longer under consideration)	Deep Chrystie Option	Forsyth Street Option	Mitigation
Design and Transportation Benefit	<p>Cross-platform transfer between Second Avenue service and B D lines.</p> <p>Estimated transfer volumes of 9,000 passengers during the AM peak hour.</p>	<p>Two-level station with vertical transfer (stairs, escalators, elevators) between Second Avenue service and B D lines.</p> <p>Estimated transfer volumes of 6,300 passengers during the AM peak hour.</p>	<p>200-foot-long passageway for transfers between Second Avenue service and B D lines.</p> <p>Estimated transfer volumes of 3,500 passengers during the AM peak hour.</p>	Not applicable.
Construction Techniques	<p>Cut-and-cover construction for entire alignment from Houston Street to Hanover Square.</p> <p>Major reconstruction to existing Grand Street Station on B D routes.</p>	<p>Cut-and-cover construction on Chrystie Street at existing Grand Street Station (and at Chatham Square Station and from Seaport to Hanover Square Station). Tunnel boring machine for tunnel between stations.</p> <p>Major reconstruction to existing Grand Street Station on B D routes.</p>	<p>Cut-and-cover construction on Chrystie Street at existing Grand Street Station and on Forsyth Street between Delancey and Stanton Streets (and at Chatham Square Station and from Seaport to Hanover Square Station). Tunnel boring machine for tunnel between stations.</p> <p>Major reconstruction to existing Grand Street Station on B D routes.</p>	<p>See below.</p> <p>See below.</p>
Transportation: Subways	<p>Track outages on B D service on nights and weekends for 1 to 2 years between Houston and Canal Streets for construction work in existing tunnel structure and modification to the Grand Street Station.</p> <p>Service on the F V routes suspended on selected nights and weekends over a 2- to 3-year period.</p>	<p>Track outages on nights and weekends for 1 to 2 years on B D service between Houston and Canal Streets for construction at the Grand Street Station.</p>	<p>Track outages on selected nights and weekends for 1 to 2 years on B D service between Houston and Canal Streets for construction at the Grand Street Station.</p>	<p>Trains rerouted via other lines on nights and weekends during construction.</p>
Transportation: Vehicular Traffic	<p>Significant traffic impacts along the construction zone on Chrystie Street, St. James Place, Pearl Street, and Water Streets.</p>	<p>Some significant vehicular traffic impacts on Chrystie Street, but less than with the Shallow Chrystie Option.</p>	<p>Some significant vehicular traffic impacts on Chrystie and Forsyth Streets, but less than with the Shallow Chrystie Option.</p>	<p>For the Shallow Chrystie Option, narrow construction zone and sidewalk to mitigate significant impacts at the major cross streets (e.g., Delancey Street, Canal Street, East Broadway, and Fulton Street).</p> <p>Standard traffic mitigation measures for impacts in the Deep Chrystie and Forsyth Street Options.</p>

Table B-5 (cont'd)
Summary of Benefits, Impacts, and Mitigation Measures for
Alignment Options Along Chrystie Street

Environmental Subject Area	Shallow Chrystie Option (no longer under consideration)	Deep Chrystie Option	Forsyth Street Option	Mitigation
Social and Economic Conditions	<p>Significant adverse impact to neighborhood character from potential long-term displacement in and possible demolition of buildings along Chrystie Street between Houston and Canal Streets.</p> <p>Significant economic impacts to businesses along Chrystie Street and adverse effects to commercial character of the neighborhood.</p> <p>Significant adverse impacts to neighborhood character from cut-and-cover construction between Houston Street and Hanover Square.</p> <p>Significant adverse impacts to neighborhood character from removal of large number of trees at Sara D. Roosevelt Park.</p>	<p>Disruptions to local businesses on Chrystie Street, but no long-term displacement.</p> <p>Significant adverse impacts on neighborhood character, economic conditions, and visual character at Grand Street Station area during construction.</p> <p>Significant adverse impacts to neighborhood character from removal of large number of trees at Sara D. Roosevelt Park, but fewer trees than with Shallow Chrystie or Forsyth Option.</p>	<p>Disruption to local businesses along Chrystie Street near Grand Street Station and on Forsyth Street south of Delancey Street, but no long-term displacement.</p> <p>Significant adverse impacts on neighborhood character, economic conditions, and visual character at Grand Street and Forsyth Street Station areas during construction.</p> <p>Significant adverse impacts to neighborhood character from removal of large number of trees at Sara D. Roosevelt Park, but fewer trees than with Shallow Chrystie Option, but more than with Deep Chrystie Option.</p>	<p>Coordination with businesses to address access/delivery issues and provision of special loading and unloading areas where access in front of buildings must be curtailed.</p> <p>Relocation of businesses and residences required for Shallow Chrystie Option.</p> <p>Extensive community outreach program to keep the affected neighborhoods informed about construction; high-quality design of sidewalk sheds; traffic maintenance plans to manage the flow of traffic in construction zones; dust suppression program.</p> <p>Replanting of trees removed and restoration of park areas.</p>
Public Open Space	Removal of two rows of trees (approximately 160 trees) along entire western side of Sara D. Roosevelt Park.	Removal of over 60 trees on the western side of Sara D. Roosevelt Park between Delancey and Hester Streets and additional trees where construction extends to the eastern and interior portions of the park.	Removal of over 120 trees along the edges of Sara D. Roosevelt between Delancey and Hester Streets and additional trees in places where construction extends into the interior of the park.	<p>Tree protection plans for trees at edge of construction zones.</p> <p>Replanting of trees in consultation with NYCDPR after construction.</p>

Table B-5 (cont'd)
Summary of Benefits, Impacts, and Mitigation Measures for
Alignment Options Along Chrystie Street

Environmental Subject Area	Shallow Chrystie Option (no longer under consideration)	Deep Chrystie Option	Forsyth Street Option	Mitigation
Public Open Space (cont'd)	Use of narrow portion of entire western edge of Sara D. Roosevelt Park for construction zone.	Use of 30- to 40-foot-wide area along western edge of Sara D. Roosevelt Park between Delancey and Canal Streets and possible use of portion of park extending through to Forsyth Street.	Use of 30- to 40-foot-wide area along western edge of Sara D. Roosevelt Park between Delancey and Canal Streets, narrow area along eastern edge of park in same location, and possible use of park in the center, between those two zones.	Park construction activities would be staged to limit areas closed simultaneously. Temporary, attractive construction barriers for public safety, to muffle noise, limit dust, and shield light emanating from construction zones. Park would be rebuilt in coordination with NYCDPR.
Displacement and Relocation	Possible loss of access for all buildings on Chrystie Street between Houston and Canal Streets, resulting in temporary displacement for up to four weeks or longer at a time, several times during the construction period. Possible permanent displacement required. Possible acquisition of private property for ventilation structure and/or station entrance.	Possible restrictions to access for properties bordering the existing Grand Street Station, from Delancey Street to Hester Street, for up to four weeks at a time several times during the construction period (but less than with Shallow Chrystie Option) Possible acquisition of private property for ventilation structure and/or station entrance.	Possible restrictions to access for properties bordering the existing Grand Street Station (on Chrystie Street) and on Forsyth Street, from Delancey Street to Hester Street, for up to four weeks at a time several times during the construction period (but less than with Shallow Chrystie Option). Possible acquisition of private property for ventilation structure and/or station entrance.	Compensations as set forth in New York State's Eminent Domain Procedure Law and the Federal Uniform Relocation Assistance and Real Property Acquisitions Policies Act. Compensation in accordance with state and federal law.
Historic Resources	No direct effect to historic structures. Properties to be protected against accidental damage during construction include the Manhattan Bridge Arch and Colonnade.	No direct effect to historic structures and no historic structures adjacent to cut-and-cover work on Chrystie Street.	No direct effect to historic structures. Seven historic resources on Forsyth Street to be protected against accidental damage.	Construction protection program to protect historic resources, as set forth in the project's Programmatic Agreement.
Archaeological Resources	Potential impacts to precontact and historic-period archeological resources between Houston Street and Fulton Street (south of Fulton Street, all three options would have the same impact).	Potential impacts to precontact and historic-period archaeological resources between Delancey and Hester Streets and at Chatham Square Station (south of Fulton Street, all three options would have the same impact).	Potential impacts to precontact and historic-period archaeological resources on Chrystie Street and Forsyth Street between Delancey and Hester Streets and at Chatham Square Station (south of Fulton Street, all three options would have the same impact).	Ongoing study in coordination with the SHPO (as set forth in the project's Programmatic Agreement) to confirm the presence of significant archaeological resources that would be adversely affected and seek avoidance or develop and implement mitigation (such as excavation) where avoidance is not possible.

Table B-5 (cont'd)
Summary of Benefits, Impacts, and Mitigation Measures for
Alignment Options Along Chrystie Street

Environmental Subject Area	Shallow Chrystie Option (no longer under consideration)	Deep Chrystie Option	Forsyth Street Option	Mitigation
Archaeological Resources (cont'd)	<p>Potential impacts to precontact and historic-period archeological resources between Houston Street and Fulton Street (south of Fulton Street, all three options would have the same impact).</p> <p>If these archaeological resources are present, impacts to historic burials at four former locations of cemeteries: the Presbyterian Cemetery in northern end of Sara D. Roosevelt Park and adjacent sidewalks, the Negro burying ground on Chrystie Street between Stanton and Rivington Streets, St. Stephen's Church at Chrystie and Broome Streets, and Shearith Israel Cemetery on St. James Place.</p>	<p>Potential impacts to precontact and historic-period archaeological resources between Delancey and Hester Streets and at Chatham Square Station (south of Fulton Street, all three options would have the same impact).</p> <p>If resources are present, impacts to burials at former location of St. Stephen's Church at Chrystie and Broome Streets, and at former location of Shearith Israel Cemetery within the street at St. James Place.</p>	<p>Potential impacts to precontact and historic-period archaeological resources on Chrystie Street and Forsyth Street between Delancey and Hester Streets and at Chatham Square Station (south of Fulton Street, all three options would have the same impact).</p> <p>If resources are present, impacts to burials at former location of St. Stephen's Church at Chrystie and Broome Streets and at former location of Shearith Israel Cemetery within the street on St. James Place.</p>	<p>Ongoing study in coordination with the SHPO (as set forth in the project's Programmatic Agreement) to confirm the presence of significant archaeological resources that would be adversely affected and then seek avoidance or develop and implement mitigation (such as excavation) where avoidance is not possible.</p> <p>Avoidance of burials wherever possible. Where they cannot be avoided, a testing and excavation plan will be developed in consultation with the SHPO</p>
Air Quality	Greater potential for release of particulate matter because of extensive cut-and-cover excavation from Houston Street to Hanover Square.	Less particulate matter than with Shallow Chrystie Option, because smaller excavation area.	Less particulate matter than with Shallow Chrystie Option, because smaller excavation area.	Dust suppression programs, mandatory use of ultra-low sulfur diesel fuel, and requirements for diesel particle filters for all heavy equipment.

attractive to riders. Goals in this area were to provide two stations in Lower Manhattan south of the Brooklyn Bridge, while minimizing the depth of the stations, environmental impacts, and allowing for future connections to Brooklyn. In addition, the southernmost station on the new route must operate as a terminal station, allowing as many as 30 trips per hour (tph) to reverse. As described below, five alternatives were evaluated for this section of the alignment.

The first two alternatives considered would provide service as far south as Whitehall Street and allow for transfer passageways to the **N R** service and to the **1 9** routes. These options would have two stations south of the Brooklyn Bridge: one at either Wall Street or Maiden Lane, and the other at Whitehall Street. In both options, the tunnel and station would be very deep (85 feet or more below the surface) to allow the route to pass safely beneath existing tunnels, resulting in long travel times for passengers exiting the station. Only one of these, the option with the Maiden Lane station, would permit future connections to Brooklyn. These alternatives were eliminated in part because they did not attract enough riders, given the Whitehall Street Station's distance to large office buildings and depth, to offset their higher cost in relation to the other options. In addition, these options would have resulted in impacts to Battery Park and Peter Minuit Plaza. They would most likely involve construction activities required for the terminal below and for possible vent structures, emergency exits, and/or station entrances into or near one or both of the parks.

The next two options examined had one station south of the Brooklyn Bridge, a southern terminal station at approximately Wall Street. These two options would have a relatively shallow station—25 to 30 feet below the street—but as a result neither would allow trains to continue all the way south to the Battery (the shallow tunnel would not be able to pass beneath the other, existing tunnels). Even though passengers would have to walk a greater distance to reach the **N R** trains and ferries at the Battery, ridership forecasts predicted that these options would attract a significant number of riders, because their stations would be centrally located and shallower. These two options would locate the station in the same place, but one would have a lower level tunnel, extending below the main route beginning at about the Brooklyn Bridge, for possible future connection to Brooklyn. In the interim, the additional tunnel could be used for train storage, possibly for four trains. The single-level option would not have provision for a future connection to Brooklyn. After analysis, both of these options were eliminated because they would only allow for one station south of the Brooklyn Bridge in a less than optimal location. The fifth alternative considered had two stations south of the Brooklyn Bridge, with one near the South Street Seaport at Fulton Street and the southern terminus just south of Wall Street at Hanover Square. With this option, the Hanover Square Station would be approximately 75 feet deep, and thus would be deep enough to permit eventual extension of the Second Avenue Subway to Brooklyn. This option was selected for inclusion in the full-length subway because it would provide two stations south of the Brooklyn Bridge and would minimize the depth of the stations to the extent possible while still permitting a future connection to Brooklyn, yet avoid construction within Battery Park and Peter Minuit Plaza, and the underpinning of four subway tunnels.

NASSAU STREET ALIGNMENT

Alignment Between Houston and Canal Streets

Along with the Water Street alignment, the Nassau Street alignment also considered several options for the area between Houston and Canal Streets.

During the LMA Study, four Nassau Street options were developed to minimize impacts to Sara D. Roosevelt Park. As with the Water Street alignment, those options aimed at avoiding physical changes within the park boundaries. They were also developed with the intent of minimizing property impacts, especially in the area where the Second Avenue and Nassau Street Lines would be linked; reducing construction along the existing Nassau Street Line; and improving coordination with NYCT's planned Nassau Line reconfiguration, which affects service to and between the Chambers Street Station and Essex Street Station.

Following the LMA work, the Second Avenue Subway project team conducted further study of the potential Nassau Street alignment connections to identify options that would reduce the permanent impacts to private properties and businesses along the route. Similar to one of the alternatives developed for the Water Street alignment discussed above, a new alternative was developed that would connect the Second Avenue Subway to the Nassau Street Line through a new tunnel that first turns to the east to align under Forsyth Street before turning west and joining the Nassau Street Line along Kenmare/Delancey Street. As with the Forsyth Street Option for the Water Street alignment, this option for the Nassau Street alignment would pass relatively deep beneath Sara D. Roosevelt Park, minimizing surface disruption. By aligning with Kenmare/Delancey Street before crossing Chrystie Street, it is unlikely that this alternative would require any demolition of buildings, while the LMA design would require the demolition of approximately 15 buildings. This alignment would also limit the extent of temporary surface impacts to the park. Based on these improvements, the Forsyth Street Option was selected as the Nassau Street alignment for evaluation.

Alignment from Canal Street to Lower Manhattan

As described above, with the Nassau Street alignment, the Second Avenue Subway would join the existing Nassau Street Line on Kenmare Street, immediately west of the Bowery Station, and then travel south along that route either to Brooklyn via the Montague Street Tunnel or to a terminus at Broad Street. With Second Avenue Subway service, some **M** trains, which currently all go to Brooklyn, would have to terminate at Broad Street as well, or at Chambers Street. The **12** service would have to terminate at Chambers Street rather than at Broad Street, forcing some customers to transfer to reach the Financial District. No new stations would be constructed in Lower Manhattan; service would instead be provided from the four existing Nassau Street Line stations: Canal Street, Chambers Street, Fulton Street, and Broad Street. To accommodate the new Second Avenue Subway trains, however, the platforms would need to be lengthened by approximately 120 feet to a length of 615 feet, as would the Broad Street tail tracks, and changes to track geometry would be required. In addition, particularly at the Canal Street Station, station entrances/exits and transfer passageways would need to be expanded to accommodate new Second Avenue Subway riders. While some construction could occur within existing stations, considerable excavation at street level would also be required, and substantial underpinning and ground improvements would also be needed (see Chapter 3, "Description of Construction Methods and Activities," for a description of these techniques).

Selection of Water Street Alignment as the Preferred OptionThe following discussion summarizes the reasons for selecting Water Street as the preferred alignment for the Second Avenue Subway south of Houston Street. While each alignment would provide significant benefits and would generate adverse impacts during construction, the Water Street alignment would better meet the goals and objectives of the project in terms of reducing crowding on the Lexington Avenue Line and improving subway access to the far East Side of Manhattan. The Water Street alignment would also create a new subway service where none currently exists, and

would expand transit access eastward in the Lower East Side and the Financial District. Although the Water Street alignment would cost \$360 million more than the Nassau Street alignment, the added benefits associated with Water Street offset the additional expenditures.

Following is a more detailed comparison of the Water and Nassau Street Alignment Options, focusing first on transportation-related issues, and then on other concerns.

Comparison of Key Transportation-Related Issues

Subway System. As with the Water Street Option, the Nassau Street Option would relieve crowding on the Lexington Avenue Line, but it would leave 1,700 more riders in the AM peak hour on the crowded southbound Lexington Avenue 4 5 express services and would not bring crowding levels on the 4 5 express trains below NYCT's passenger loading guidelines at Grand Central Station, compared with the Water Street Option. On the other hand, the Nassau Street Option would establish increased subway service to the center of the Financial District and would provide extended service to Brooklyn. As a result, it would carry 1,500 more southbound riders and 3,200 more northbound riders in the AM peak hour than would the Water Street Option.

When complete, the Nassau Street Option would result in major changes in J M Z train service. Under the preliminary operating plan, M trains would be suspended between Broad Street and Bay Parkway, Brooklyn, and J and Z trains would terminate at Chambers Street rather than at Broad Street. While some Second Avenue trains would provide service to Bay Parkway, commuters entering Manhattan from the Williamsburg Bridge would have to transfer trains for access destinations in other parts of Brooklyn. Furthermore, increased traffic on the Nassau Line may cause delays, particularly during peak periods. The Water Street Option would not require changes to existing transit service in this area.

Construction on the Nassau Line would require the suspension of service on J M Z trains during late night and/or weekend hours over a two- to three-year period, which would be more severe than any of the disruptions required with the Water Street Option. Like the Water Street Option, the Nassau Street Option would also require disruption of B D trains. The communities directly affected by these disruptions contain significant populations of minority and low-income residents, which may constitute a significant environmental justice impact. Chinatown and the Lower East Side are currently without B D service due to rehabilitation work on the Manhattan Bridge, and J M Z service via the Williamsburg Bridge was only recently restored following a year-long outage.

Although the Nassau Street Option could provide sufficient capacity for basic Second Avenue Subway service (12 trains per hour between 63rd Street and the Financial District), it could not handle the future growth that could be provided with the Water Street Option, unless there was a corresponding reduction in J M Z service. The Water Street option would also have sufficient capacity to allow for a future Queens service via the 63rd Street connection, while the Nassau Street Option would not since additional trains could not operate on the Nassau Street Line without a reduction in existing service to Brooklyn. In addition, the Nassau Street Option would not meet the project's goal of providing new service to areas east of existing subways, including South Street Seaport, Chatham Square, and along the densely developed Water Street corridor.

The estimated construction costs for the Nassau Street Option are lower in part because the existing stations would not be renovated to the same standards as the new stations proposed for the Water Street Option. For example, while they would be ADA-compliant for altered stations,

they would not meet the accessibility standards for new construction as would the new Water Street stations because of the constraints of the existing infrastructure. To renovate the stations to these standards would require additional surface and underground construction, resulting in greater impacts and a considerable increase in associated costs. Further, it may not be feasible to expand the existing Nassau Street Stations, especially the Canal Street Station, to accommodate the significant increase in users of these stations that would result from the addition of Second Avenue Subway riders.

Comparison of Key Environmental-Related Issues

While the Nassau Street Option would involve fewer and smaller construction zones, and would avoid some of the disruptions to Sara D. Roosevelt Park, construction activities would be very disruptive and would often occur in more sensitive areas than with the Water Street Option. Potential physical impacts to historic resources from ground-borne construction vibration, changes in ground or groundwater conditions, or damage by heavy machinery are a significant consideration, as is potential displacement in the areas of Kenmare, Delancey, and Centre Streets. Construction required for the Nassau Street Option would be adjacent to a greater number of historic and visual resources that greatly contribute to the character of Lower Manhattan, which may be adversely affected by ground-borne construction vibration, changes in ground or groundwater conditions, or damage from heavy machinery. Such impacts are of particular concern at Foley Square, which was recently renovated by the New York City Department of Parks and Recreation (NYCDPR), and at the intersection of Wall and Nassau Streets. Physical improvements at the Chambers Street Station around and beneath Foley Square could impact the sensitive, subterranean portions of this historic station. Furthermore, this construction zone would be within the boundaries of the African Burial Ground and The Commons Historic District, and could permanently impact potential below-grade resources in this area. There is a significant risk that the construction of the subway would require complete cessation if intact skeletal remains were uncovered.

The four buildings at the intersection of Wall and Nassau Streets—the New York Stock Exchange, the Bankers Trust Building, the J.P. Morgan & Company Building, and Federal Hall National Memorial—are significant historic and visual resources that would be visually and, potentially, structurally affected by the reconstruction of the Broad Street Station with the Nassau Street Option. Federal Hall National Memorial in particular would require special protection, as it has recently been identified by the National Parks Conservation Association as one of “America's Ten Most Endangered National Parks.”

Although fewer buildings would be underpinned with the Nassau Street Option than with the Shallow Chrystie Option, some of the related construction activities would be very complex, resulting in a longer period of displacement. Although it is unlikely that any buildings would require demolition with the Nassau Street Option, significant underpinning and other ground improvement techniques would be required. These activities would result in temporary displacement. Some of the affected buildings are occupied by tenants that are part of the cluster of wholesale supply merchants, which are characteristic of the area. Displacement of these businesses could have a significant adverse economic effect on individual businesses as well as the overall character of the neighborhood. In addition, the Nassau Street Option would be expected to generate fewer jobs and secondary economic activity than would the Water Street Option.

Summary

In conclusion, the Nassau Street Option would not meet the goals and objectives of the project as well as the Water Street Option. It would not reduce crowding levels on the Lexington Avenue Line to the same degree as the Water Street Option. With the Nassau Street Option, crowding levels on the Lexington Avenue 4 5 express routes would continue to exceed NYCT's loading guidelines at Grand Central Station. The Nassau Street Option would also not improve subway access to the Lower East Side and the easternmost areas of Lower Manhattan as well as the Water Street Option. Three new station areas—Chatham Square, South Street Seaport, and Hanover Square—would be served by the Water Street Option. Also, access to a new north-south subway service would be provided at Grand Street with the Water Street Option. Under the Nassau Street Option, it would not be possible to accommodate future growth by adding trains without an equivalent reduction in J M Z service over the Williamsburg Bridge. The estimated costs for the Nassau Street Option could rise considerably if the existing stations were fully expanded and upgraded to accommodate the additional riders (and it may not be completely feasible to do so), eliminating one of the major advantages of this Option. The Nassau Street Option also has the potential to create significant adverse impacts to historic, visual, and archaeological resources, as the areas of construction would be very disruptive and are often in more sensitive areas than the Water Street Option. Finally, with the Nassau Street Option, there would be significant construction-period and permanent impacts to existing Nassau Line (J M Z) service, a potential significant environmental justice issue as well as a transit impact.

From a community outreach standpoint, consultation with Community Board 1 and local interest groups—the South Street Seaport and South Street Seaport Museum, The Downtown Alliance, and Regional Plan Association (RPA)—indicates that these groups prefer the Water Street alignment, as it provides new service in the eastern portion of Lower Manhattan and has provisions for future growth, benefits not provided by the Nassau Street Option. In consideration of the engineering, economic, environmental, transportation, and planning considerations presented in the foregoing, NYCT has selected the Water Street Option as the preferred option for the Second Avenue Subway. Therefore, unless otherwise stated, all analyses in the remainder of this FEIS assess the Water Street Option.

CHOOSING POTENTIAL STORAGE AND MAINTENANCE FACILITY SITES

The Second Avenue Subway would require the addition of new trains to the NYCT subway fleet. These trains must be stored during the off-peak periods (and particularly at night), inspected at regular intervals, and maintained, repaired, and overhauled periodically. Thus, NYCT's existing storage facilities would need to be improved or expanded to accommodate the new subway line. Without the Second Avenue Subway, such activities would not be required. The facilities and operations required to meet these needs represent important investments of resources that could be addressed by several configurations of new and existing facilities.

STORAGE FACILITIES

NYCT currently operates 13 yards on the B Division where trains are stored during the midday and overnight. Additional storage is provided on-line throughout the system and in terminals. After accounting for projected purchase of additional cars, no extra capacity will exist under no build conditions in the B Division for storing the additional trains required for the Second Avenue Subway. Consequently, one of the early studies for the full-length Second Avenue

Subway was an analysis of potential sites for new storage tracks, either at reconfigured existing facilities or completely new facilities.

NYCT has determined that the typical Second Avenue Subway service would require 330 additional cars (33 10-car trains) including necessary spares. This constitutes an increase in NYCT's total number of cars requiring storage. Based on the following assumptions regarding the peak (overnight) storage period, the proposed system would require overnight storage capacity for 25 trains, each 600 feet long. (Of the 33 trains in Second Avenue service, five are assumed to operate overnight between 125th Street and Hanover Square, and one is assumed to be in a shop for overhaul. Two would be stored on the Broadway Line north of 57th Street.) To store the balance of 25 trains, a study of potential storage locations throughout the NYCT subway system was conducted. As a result of this study, a number of existing yards were rejected for various reasons including the distance of these yards from the start of Second Avenue Subway service (requiring long distances of operation without passengers—called “deadheading”—to begin service in the morning), operational conflicts with other services, and location at the middle of the line's route, rather than at the end. Yards considered but rejected for one or more of these reasons included Westchester Yard, Jamaica Yard, East New York Yard, Canarsie Yard, Fresh Pond Yard, and Pitkin Yard.

At the Westchester Yard, no workable access to the yard for B Division trains would be possible without advancing the Pelham Line connection and reconfiguring it for B Division service. Jamaica Yard was rejected because the connection to the Second Avenue Subway through 63rd Street would be long and unsuitable for midday lay-ups, the yard is full, and planned expansion is already dedicated to other services. No space will be available after the currently planned expansions are complete. The East New York Yard, Canarsie Yard, and Fresh Pond Yards were dismissed from consideration because no space will be available after currently planned expansions to meet the needs of other services are completed and the yards would have to be reconfigured to accommodate 600-foot trains rather than the 480-foot trains for which they are designed. The Pitkin Yard was eliminated because its use for Second Avenue Subway service would involve a connection via the 63rd Street Line to the Sixth Avenue Line, or construction of a new 7,000-foot tunnel to connect the Second Avenue Line to the Rutgers Street Tunnel across Houston Street. One additional yard was considered and rejected—Sunnyside Yard, where NYCT is considering building a new subway yard and shop. Because of the difficulty of getting to the Second Avenue Line from Sunnyside and the uncertainty of construction of the new yard, Sunnyside was rejected as a potential storage location for the Second Avenue Line.

The two potential sites identified for overnight storage of Second Avenue trains in the SDEIS are the existing 36th-38th Street Yard between Fifth and Ninth Avenues in Brooklyn, which is currently used for NYCT work trains and limited revenue (passenger) train storage; and a possible expansion of the existing Coney Island Yard on a vacant site owned by KeySpan adjacent to the yard. As described in Chapter 2, the Coney Island Yard concept has since been eliminated, as it would be more expensive and less reliable to operate trains from there than the other storage solutions under consideration. Another possibility examined in the SDEIS and FEIS is use of new underground tracks beneath Second Avenue north of 125th Street that would be built specifically for the Second Avenue Line. Underground tail tracks connecting to the 125th Street and Hanover Square Stations and alongside the main alignment between approximately 21st and 9th Streets are also assessed. A decision about which of these tracks to use would be made during ongoing engineering.

MAINTENANCE FACILITIES

In addition to storage tracks, the Second Avenue Subway would also need access to maintenance facilities. NYCT currently has adequate capacity in its overhaul shops to accommodate additional Second Avenue Subway cars, so no study was conducted for overhaul shops. However, three additional maintenance and inspection tracks would be required for routine servicing of the Second Avenue trains since adequate capacity is not available within the NYCT facilities for the fleet expansion. Therefore, opportunities to build or expand regular maintenance and inspection facilities were sought. The planning studies determined that, from an operational perspective, a new or expanded maintenance and inspection shop would be best located where the Second Avenue Subway fleet could be stored overnight. Since the most likely location for storage of the Second Avenue Subway fleet would be in Brooklyn at the 36th-38th Street Yard or at the expanded Coney Island Yard, opportunities for expanding shop capacity at the Coney Island Yard or freeing up shop space there, through expansion elsewhere such as at Concourse, were investigated. The resulting investigation identified the possibility of expanding the existing Concourse Maintenance Shop located near 205th Street and Paul Avenue in the Bronx, expanding maintenance tracks at the 207th Street Maintenance Shop in northern Manhattan, or building a new shop on the KeySpan site south of the Coney Island Yard.

The planning analysis concluded that as part of the Second Avenue Subway a new maintenance and inspection facility could be located at an expanded Concourse Maintenance Shop or an expanded 207th Street Maintenance Shop. **B** trains expected to be maintained at the Coney Island Maintenance Shop when the Manhattan Bridge is restored to full service could be reassigned to an expanded shop at either yard. These two shops are located at or near the end of the **B** line, which is an operationally desirable situation. If a new maintenance facility could be constructed at either location, it could service trains on other lines, while the existing facility at Coney Island Yard could serve the new Second Avenue Subway trains. As the expansion of either Concourse Maintenance Shop or 207th Street Maintenance Shop, would be a direct result of the Second Avenue Subway project, any potential impacts at these locations from a potential expansion are considered in the FEIS. *