MTA Construction & Development

MTA 125th Street Subway

Feasibility Study

Final Report

Prepared for

MTA Construction & Development Company

Prepared by

AECOM Imagine it. Delivered.

December 2025

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1 Introduction

1.1 Project Overview

The Metropolitan Transportation Authority (MTA) identified in its 2023 Twenty-Year Needs Assessment (TYNA) significant benefits from a new crosstown subway connection in Harlem, northern Manhattan, that would connect to the Second Avenue Subway (SAS) Phase 2 terminal station at 125th Street and Lexington Avenue, currently in early stages of final design and construction. Extending the Second Avenue Subway west along 125th Street scored as highly cost-effective, offering a new east-west connection, reducing travel time, and serving many riders, particularly in lower-income neighborhoods. This project, referred to as 125th Street Subway (the Project) in this Report, would provide subway service along Harlem's main commercial corridor with a future terminal station at 125th Street and Broadway and two intermediate stations at Lenox Avenue and St. Nicholas Avenue. These stations would link the 125th Street Subway with seven existing north/south MTA subway lines and 27 routes in the MTA bus networks.

In her 2024 State of the State address, Governor Kathy Hochul announced support for the Project and initiated the 125th Street Subway Feasibility Study (the Study) that further explores the initial appraisal of the Project conducted in the TYNA. In addition to refreshing the assessment of benefits with updated assumptions, the Study investigates the constructability of a tunnel and up to three new stations along 125th Street, and whether the tunnel can be aligned both physically and temporally with construction activities of SAS Phase 2.

The goals of the 125th Street Subway Feasibility Study were to:

- Determine the overall viability of extending SAS along 125th Street from 125th/Lexington Avenue to a point west of Broadway.
- Evaluate the comparative benefits of having the line terminate at one of three possible station locations:
    - 125th Street at Broadway
    - 125th Street at Saint Nicholas Avenue
    - 125th Street at Lenox Avenue
- Identify potential Project sequencing aligned with SAS Phase 2 construction and revenue service schedules.

The evaluation was based on ridership, service operations, constructability, ease of connectivity with existing stations and transit network, and potential opportunities to sync with SAS Phase 2 construction so as not to preclude a future buildout of 125th Street Subway.

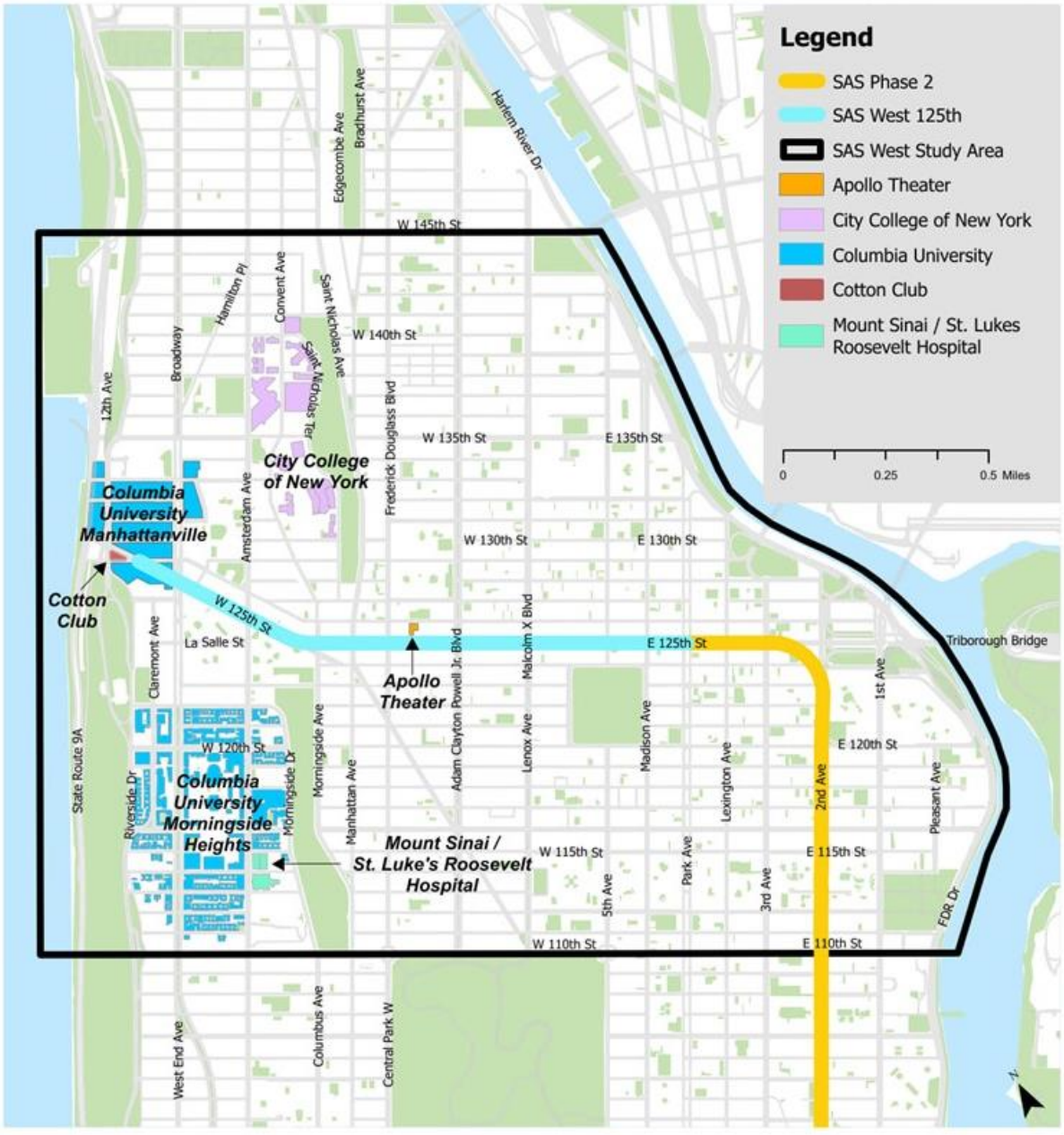
This Report presents a summary of the analyses performed during the Study, including:

- Market Analysis and Ridership
- Geotechnical Conditions
- Constructability Analysis
- Screening of Tunneling Options
- Capital and O&M Cost Estimates
- Key Findings and Next Steps

1.2 Study Area

The 125th Street Subway Study Area (Study Area) in Upper Manhattan extends from the Hudson River in the west to the Harlem River in the east, and between 110th Street and 145th Street as shown in **Figure 1**. The Study Area is centered on 125th Street, a major mixed-use residential and commercial area that serves as the connection between East Harlem and West Harlem/Morningside Heights.

Figure 1: 125th Street Subway Study Area and Major Attractions

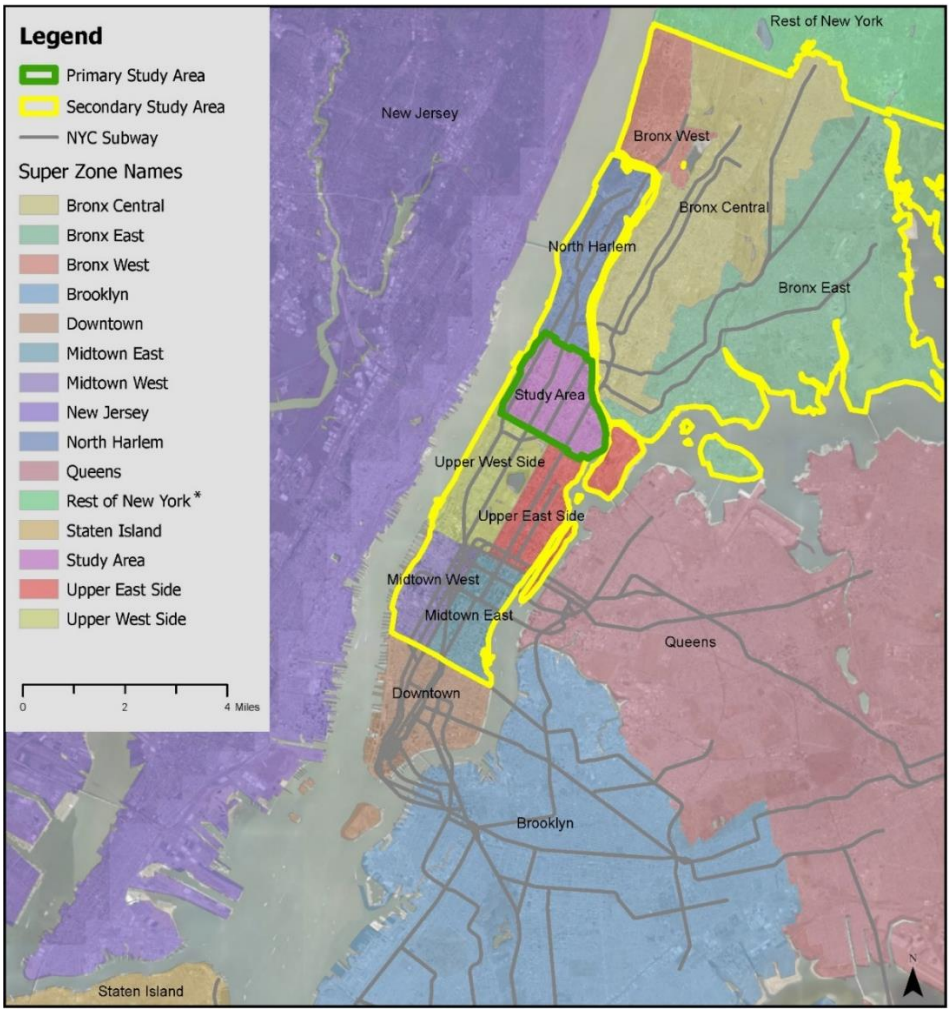


At the western end of 125th Street, Broadway is also a corridor for major travel destinations within the Study Area for thousands of students, faculty, and hospital staff. Major attractions in the Study Area include:

- City College
- Columbia University
- Mount Sinai St. Luke's Hospital
- The Apollo Theater
- The Cotton Club

In this Report, most general references to the Study Area correspond to the Primary Study Area. Additionally, a larger Secondary Study Area was identified specifically for market analysis, transit demand, and ridership assessments to evaluate impacts and benefits resulting from transfers and mobility improvements the Project could bring. The Secondary Study Area consists of all of the Bronx and areas of Manhattan north of 14th Street excluding the Primary Study Area. The Secondary Study Area is illustrated in Figure 2. References to the Secondary Study Area are highlighted as such whenever relevant.

Figure 2: Super Zones, Primary Study Area, and Secondary Study Area



* Rest of New York includes Westchester, Putnam, Dutchess, Rockland, and Orange Counties

2 Market Analysis

The Study investigated market conditions and forecasted travel demand in the Study Area. This section summarizes updated ridership forecasts and key findings for 125th Street Subway. Ridership forecasts that were originally assembled during MTA's TYNA using 2019 figures were updated using newer assumptions that apply to post-COVID-19 pandemic conditions. Additionally, these ridership forecasts were prepared for a one-station, two-station, and three-station buildout of 125th Street Subway to understand the effects of the terminal station location on ridership.

2.1 Population and Employment Trends

The Study Area around 125th Street is dense, diverse, and transit dependent. According to the New York Metropolitan Transportation Council (NYMTC), there are about 253,000 residents and 110,000 jobs as of 2020. About 80% of residents are people of color, and roughly 40% have incomes that put them below the New York City poverty line.[1] NYMTC projects demographic growth in the region, forecasting 10% growth in population, 13% increase in employment, and 10% expansion of the labor force between 2020 and 2045.[2] Within the Primary Study Area, the population is forecast to grow by 8%, employment by 3%, and labor force by 12% between 2020 and 2045. **Table 1** highlights these key demographic forecasts for the region[3] and how those characteristics are represented in the Study Area.

Table 1: Key Demographic Trends

Forecast	2020	2045	2020-2045 Change	Study Area	Region
Population Growth	253,000	279,500	26,500	10%	8%
Growth in Employment	81,500	87,000	5,500	7%	18%
Growth in Labor Force	111,000	138,000	27,500	25%	15%

Source: NYMTC 2020 and 2045
Subject to rounding

2.2 Travel Demand

About 1,000,000 total trips are made into, out of, or within the Study Area on an average weekday. Approximately a quarter of these trips are work-travel. Transit trips make up about 50% of the total trips[4].

Ten MTA subway lines and one Metro-North line make stops in the Study Area. These lines and their stops are described in **Figure 3.**

Centered in the Study Area, 125th Street serves as an important transit corridor and is crucial to MTA's bus, subway, and regional rail services, as well as to how people in the region travel:

[1] 2023 American Community Survey 5-year estimate
[2] The NYMTC socioeconomic data is used in their Best Practices Model (BPM) with population, labor force, and employment projections between 2010 and 2055.
[3] NYMTC's region is defined as its ten-county planning area, which includes the five boroughs of New York City, Nassau and Suffolk counties of Long Island, and Westchester, Rockland, and Putnam counties in the Lower Hudson Valley
[4] Several data sources were used to analyze current travel markets in the region including 2019 trip data from the Regional Transit Forecast Model (RTFM) base year trip tables, Census Transportation Planning Product and American Community Survey (ACS) 2012-2016 data, and 2018 New York City Travel Survey.

- All but two bus routes that stop in the Study Area either travel along or intersect with 125th Street.
- Subway lines travelling through the Study Area stop at four different stations along 125th Street.
- Harlem-125th Street is the last Metro-North station before Grand Central and many Hudson, Harlem and New Haven Line trains stop at this station. The availability of Metro-North service in the Study Area is also important for reverse commuting and travel to suburban areas north of NYC.
- There is a direct connection to LaGuardia Airport via the M60 bus route along 125th Street.

The subway stations within the Study Area are high usage stations with about 210,000 average weekday boardings in 2019, 78,000 of those at stations along 125th Street serving the 1, 2, 3, 4, 5, 6, A, B, C, and D trains.

Figure 3: Existing MTA Lines and Stations in the Study Area

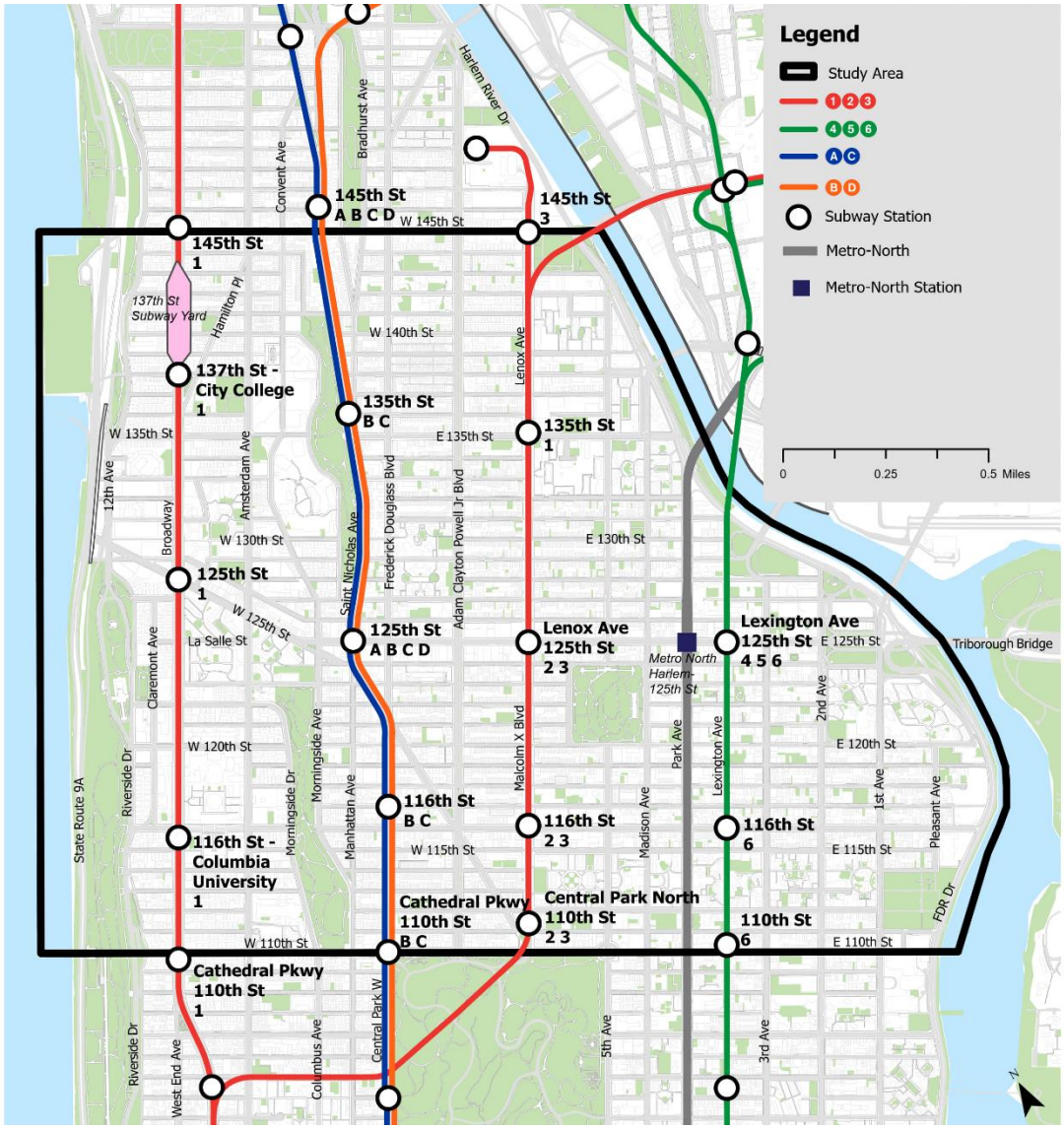


Table 2 shows the average weekday paid boardings for subway stations in the Study Area between 2018 and 2023 collected by the MTA. Boardings at 125th Street stations showed about 8% year over year growth from 2022.

Table 2: Observed Study Area Subway Station Average Weekday Paid Ridership 2018-2023

Study Area Stations	2018	2019	2020	2021	2022	2023
125 St (1)	7,679	7,599	2,973	3,677	5,494	6,175
125 St (2,3)	14,746	14,703	5,644	6,422	7,741	8,198
125 St (4,5,6)	27,605	27,231	11,469	11,943	14,398	15,497
125 St (A,B,C,D)	27,677	28,267	11,888	13,324	16,097	17,239
125th Street Stations Subtotal	***77,707***	***77,800***	***31,974***	***35,366***	***43,730***	***47,109***
Central Park North-110 St (2,3)	8,815	8,470	3,257	3,694	4,542	4,915
110 St (6)	10,851	10,580	4,647	5,513	6,564	6,704
116 St (2,3)	10,707	10,592	4,246	4,939	5,904	6,164
116 St (6)	14,715	14,394	6,366	7,390	8,829	8,766
116 St (B,C)	7,613	7,249	2,822	3,346	4,302	4,555
116 St-Columbia University (1)	15,079	14,777	4,277	5,814	9,372	11,001
135 St (2,3)	14,343	13,799	5,856	6,412	7,156	6,985
135 St (B,C)	5,490	5,657	2,173	2,433	3,336	3,563
137 St-City College (1)	13,371	12,464	5,073	5,763	7,952	8,428
145 St (1)	9,433	9,219	3,981	4,840	6,165	6,447
145 St (3)	2,105	3,193	1,428	1,614	1,876	1,890
145 St (A,B,C,D)	23,047	22,937	9,415	10,513	13,211	14,613
Rest of Study Area Subtotal	***135,569***	***133,330***	***53,542***	***62,272***	***79,210***	***84,031***
Study Area Total	**213,276**	**211,130**	**85,516**	**97,637**	**122,940**	**131,140**
System Total	**5,437,969**	**5,493,858**	**2,040,580**	**2,369,655**	**3,189,904**	**3,625,326**

Source: MTA

As of June 2025, MTA operated 27 bus routes (including 17 local, 8 express, and 2 Select Bus Services) that regularly stop in the Study Area. In 2023, these routes served an average weekday ridership of 160,000 passengers and an average weekend ridership of about 200,000 passengers (combining Saturday and Sunday ridership). Details of each route's weekday paid weekday ridership from 2018 to 2023 can be found in **Table 3**.

Table 3: Observed Average Weekday Paid Ridership 2018-2023 for Bus Routes Serving the Study Area

Routes	2018	2019	2020	2021	2022	2023
M15Lcl/SBS	44,725	46,087	25,399	24,927	30,009	32,298
M101	22,642	22,398	13,864	12,472	13,910	13,509
M4	14,905	15,189	5,074	8,426	10,141	11,166
M3	12,324	12,516	4,935	7,842	8,521	8,913
M11	9,271	9,562	3,433	6,029	7,734	8,446
M102	11,868	12,131	8,118	7,179	8,264	8,381
M1	9,568	9,322	2,983	4,596	6,367	7,362
M7	12,190	10,806	3,663	5,576	6,803	7,328
M103	8,979	9,489	5,675	5,413	6,698	7,166
M60SBS	16,018	14,778	7,190	6,730	7,591	7,109
M2	8,504	8,446	3,033	5,080	6,125	6,609
M100	14,596	13,816	8,873	8,370	7,230	5,777
M5	6,944	8,657	2,513	4,425	4,929	5,186
M104	7,136	7,095	2,349	3,814	4,579	5,001
M125	-	-	-	-	2,598	4,622
M116	9,071	8,943	3,324	5,168	5,442	3,835
M10	6,083	5,184	1,841	3,058	3,415	3,328
M98	1,523	1,465	551	876	1,041	1,133
M35	664	614	239	176	122	119
MTA NYCT Subtotal	***217,011***	***216,497***	***103,057***	***120,157***	***141,518***	***147,288***
BxM2	689	682	298	388	510	599
BxM3	674	646	330	416	590	689
BxM4	385	363	239	286	365	418
BxM6	595	539	331	416	526	594
BxM7	2,424	2,272	1,245	1,437	1,841	2,118
BxM8	1,501	1,365	739	924	1,235	1,434
BxM9	1,990	1,842	883	1,041	1,359	1,634
BxM10	1,455	1,377	758	893	1,173	1,361
MTA Bus Company Subtotal	***9,712***	***9,087***	***4,823***	***5,801***	***7,599***	***8,847***
Study Area Routes Total	**226,723**	**225,584**	**107,880**	**125,958**	**149,117**	**156,135**
System Total	**2,204,222**	**2,158,469**	**1,187,416**	**1,213,290**	**1,362,290**	**1,361,665**

Notes:
M116 was on a fare-free pilot program, and no ridership was recorded from Sep. 24, 2023 to Aug. 31, 2024.
M125 (formerly Bx15) began operation in 2022.
Source: MTA

Figure 4 is an adapted version of MTA's Manhattan Bus Map, illustrating the bus lines serving the Study Area.

Figure 4: MTA Bus Lines in the Study Area

In addition to its importance for public transit, 125th Street serves as a critical corridor for vehicular traffic. It is one of the few local streets offering a continuous cross-town connection between East Harlem and Manhattanville. Its strategic location also provides extended regional accessibility via the Willis Avenue Bridge, Robert F. Kennedy Bridge, and FDR Drive. According to data from New York City Department of Transportation (NYC DOT) and Transcom, in 2021 the Annual Average Daily Traffic (AADT) along 125th Street ranged from 12,000 to 23,000 vehicles.

2.3 Ridership Forecasts

The MTA forecasted average weekday ridership for the Project for the year 2045 average weekday using the MTA's Regional Transit Forecasting Model (RTFM). The RTFM is a travel demand model that predicts future travel patterns and transit ridership in response to socioeconomic, demographic, and transportation system changes in the region, including 28 counties in New York, New Jersey, and Connecticut.

Estimates were prepared for one-station, two-station, and three-station buildouts to compare how daily ridership in 2045 may vary based on the number of stations and the benefits of being able to connect to more north/south subway and bus routes. The forecasted Project trips are composed of existing transit riders who divert from bus or other transit and *new* transit riders who switch from non-transit modes, such as driving.

Updates to the Ridership Model

The RTFM used for the TYNA Comparative Evaluation, released in 2023, was updated and recalibrated to reflect post-COVID shifts in ridership and markets. The base year was changed to 2024 (from 2019) and more recent data from NYMTC was used to build future trip tables. Similarly, more detail was integrated into the travel time assumptions to reflect concept station design work performed in this Study.

In a one-station scenario with a terminal at Lenox Avenue, it was estimated that 125th Street Subway would have about 57,300 average daily weekday trips, which includes 500 new daily transit riders.

In a two-station scenario with an in-line station at Lenox Avenue and a terminal at St. Nicholas Avenue, it was estimated that there would be about 115,900 average daily weekday trips on 125th Street Subway, of which about 2,700 are new daily transit riders.

In a three-station (full-buildout) scenario with in-line stations at Lenox Avenue and St. Nicholas Avenue, and a terminal station at Broadway, ridership forecasts indicate about 163,900 average daily weekday trips, of which about 5,500 are new transit riders.

Table 4 shows average daily ridership and the number of daily new transit riders for each of the terminal station scenarios considered.

Table 4 - 2045 Average Weekday Trips and Percent New Transit Ridership

Scenario	Daily Trips on the Project	Daily New Transit Riders	% Daily New Transit Riders
Lenox Avenue Terminal Station (1 Station)	57,300	500	0.9%
St. Nicholas Avenue Terminal Station (2 Stations)	115,900	2,700	2.3%
Broadway Terminal Station (3 Stations)	163,900	5,500	3.4%

Source: MTA RTFM (2025)

The ridership analysis confirmed that the three-station buildout of 125th Street Subway with Broadway as the terminal station would provide the greatest overall ridership, and greatest proportion of new transit riders compared to the one-station and two-station options.

Table 5 shows the 2045 average weekday entries and exits for each of the three stations. Broadway is the station that provides the highest ridership of the three 125th Street Subway stations.

Table 5 – 2045 Average Weekday Entires and Exits at Each Station (Broadway Terminal Scenario)

Station	Daily Entries + Exits
Lenox Avenue	41,400
St Nicholas Avenue	49,500
Broadway	84,300

Source: MTA RTFM (2025)
Subject to rounding
The sum of Daily Entries + Exits of the three stations is higher than total daily trips as some trips are expected to both begin and end within these three stations.

2.4 Project Benefits

In addition to ridership, the Comparative Evaluation (CE) from MTA's TYNA quantified several metrics that provided further indication of the benefit of a three-station buildout of 125th Street Subway. The CE criteria and their associated metrics are summarized in **Table 6**, along with the benefits associated with a one-, two- and three-station buildout.

Additional benefits to the corridor from 125th Street Subway include economic development in the neighborhood, such as:

- Improved access to jobs,
- Greater development potential for housing,
- Growth in new businesses,
- Opportunities for public/private partnerships.

Table 6 Comparative Evaluation Metrics for Three Terminal Station Scenarios

Criteria	Metrics	Terminal Station		
		Lenox Ave.	St. Nicholas Ave.	Broadway
Ridership	2045 Daily ridership	57,300	115,900	163,900
2045 New transit riders	2045 New transit riders	520	2,700	5,500
Time Savings	Total Daily Time Saved (hours)	1,800	4,800	4,900
Sustainability	Change in 2045 Daily Vehicle Miles Traveled (VMT) (mi.)	-5,700	-11,000	-21,600

Source: MTA

These metrics further made the case for a three-station buildout to Broadway, as they provide the greatest overall time saving for the system and the greatest reduction in daily VMT. 125th Street Subway could not only enhance transit connectivity but also offer a meaningful opportunity to alleviate vehicular congestion, reduce reliance on car travel, and improve overall mobility across the corridor.

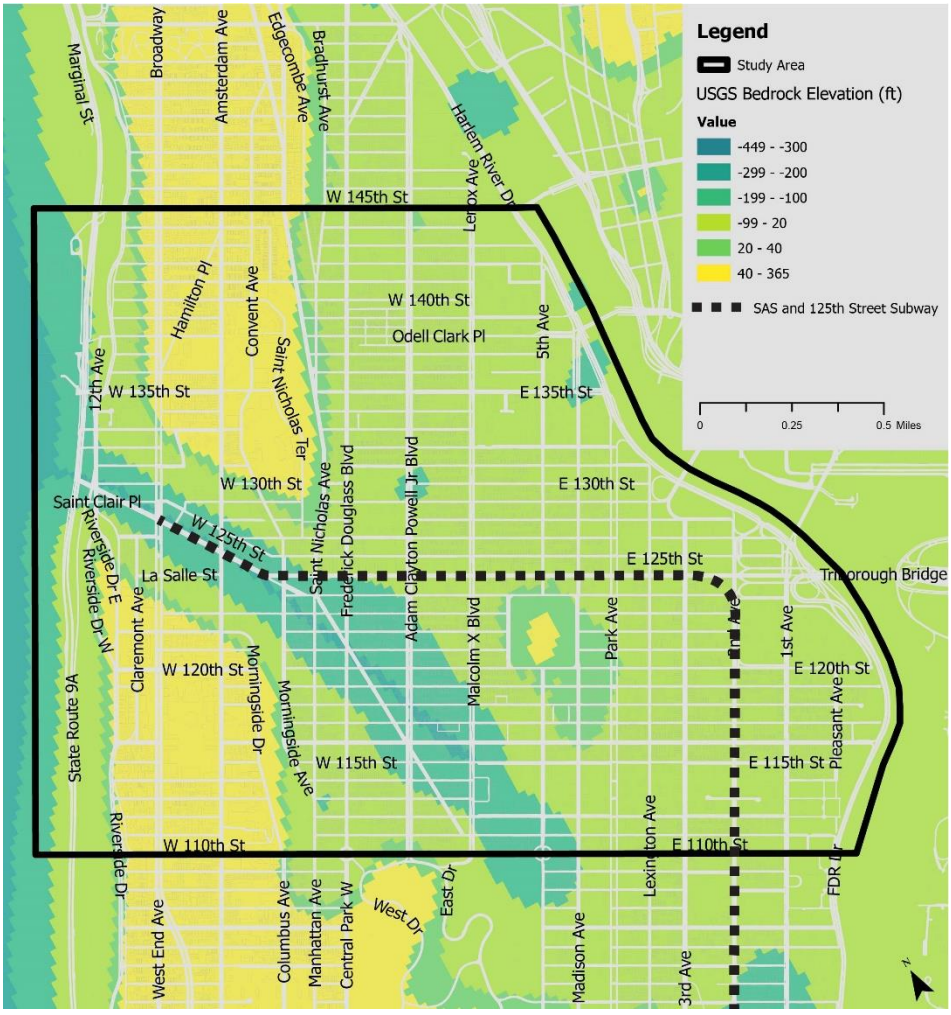
The MTA therefore focused its constructability analysis and evaluation on the three-station buildout.

3 Geotechnical Conditions

The MTA relied on available data from the United States Geological Survey (USGS) and from data collected for SAS Phase 2 to identify the approximate bedrock elevation along 125th Street from Park Avenue to Riverside Drive.

The bedrock elevation in the 125th Street corridor east of St. Nicholas Avenue ranges from 20 to 99 feet below ground level. The bedrock is between 200 and 299 feet deep west of St. Nicholas and even deeper as it continues northward. The bedrock elevation is illustrated in **Figure 5**.

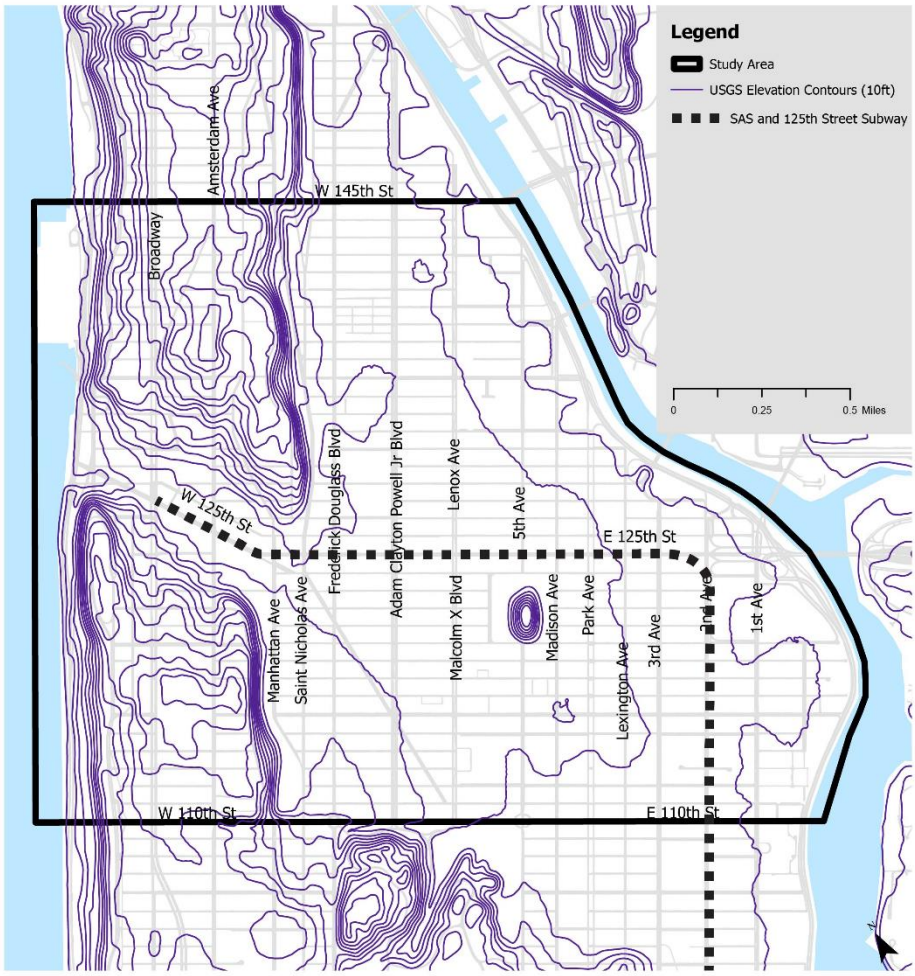
Figure 5: Bedrock Elevation in the Study Area



Source: USGS

The area's topography mirrors this pattern. The eastern and central sections of the Study Area are relatively flat, while the western portion starting around St. Nicholas Avenue features steeper terrain due to its proximity to Hamilton Heights and Morningside Heights. A topographic map of the Study Area is presented in **Figure 6**.

Figure 6: Contour Map of the Study Area

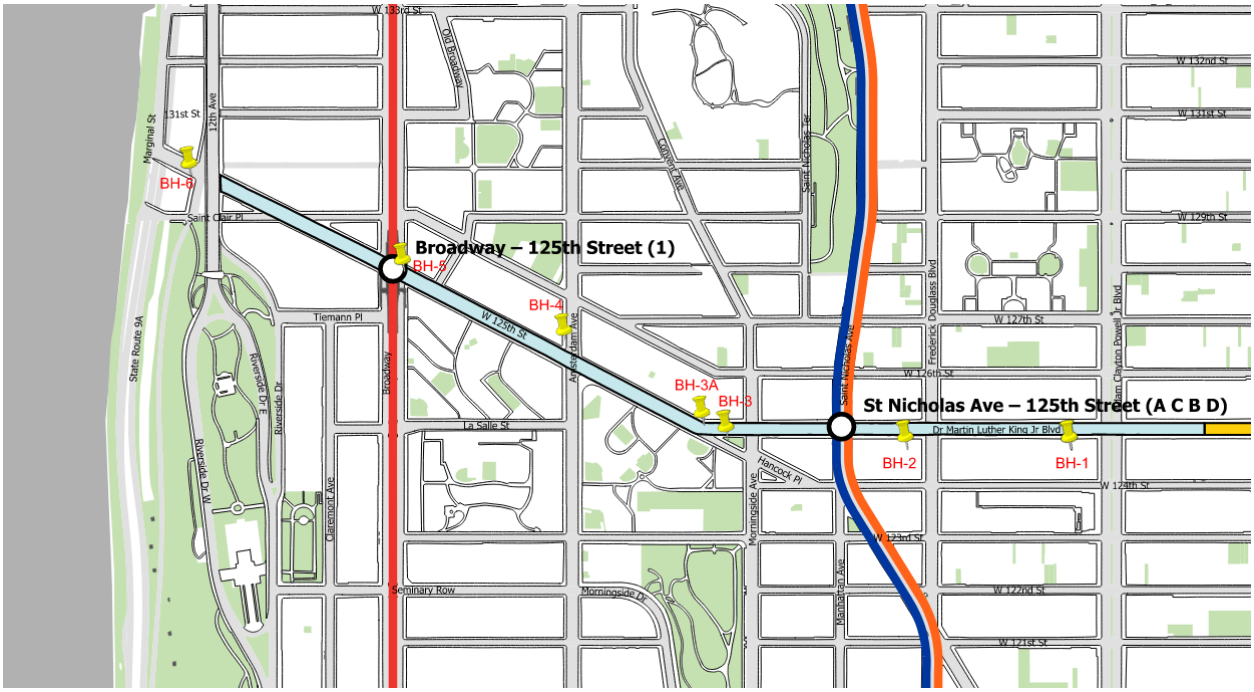


Source: USGS

3.1 Subsurface Investigation and Conditions

The MTA also completed a subsurface investigation program consisting of seven (7) soil test borings at locations along 125th Street between Lenox Avenue and Broadway (see **Figure 7**). Laboratory testing of these borings confirmed that the subsurface material in the area where new stations are planned is mostly made up of loose sand and gravel, with some softer clay and silt. This makes construction more difficult and requires special techniques to safely dig and support underground spaces. Additionally, groundwater is found about 10 to 20 feet below the surface, and in some areas, it can trigger running or flowing conditions during excavation. Managing this water through dewatering and grouting will be required during construction to keep the site safe and stable.

Figure 7: Subsurface Investigation - Soil Test Boring Locations

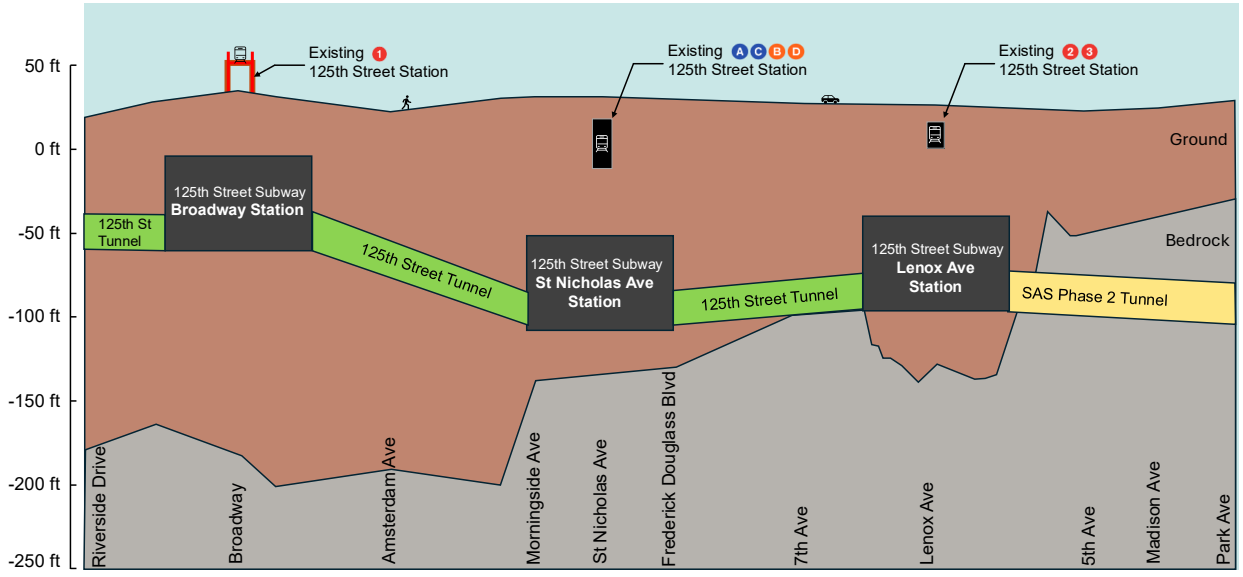


4 Constructability Analysis

The Constructability analysis of 125th Street Subway from the terminus of SAS Phase 2 to Broadway considered the feasibility of constructing a tunnel and three new stations west under 125th Street. The tunnel depth or profile would need to align with the SAS Phase 2 tunnel while maintaining acceptable grade tolerances for MTA subway operations (+/- 3% grade). A key requirement for the 125th Street Subway would be to connect to the seven (7) existing north-south subway lines at Lenox Avenue, St. Nicholas Avenue, and Broadway stations. The constructability analysis also considered the potential impacts to the construction and opening day schedules for SAS Phase 2.

4.1 Tunnel Profile and Alignment Considerations

Analysis of the subsurface conditions along the 125th Street Subway alignment indicated that a tunnel profile that enables a connection to SAS Phase 2 would require construction in predominantly granular soils (referred to as mixed face), presenting several technical challenges. Similarly, the station caverns would also need to be constructed in mixed face soils. Based on these findings, the MTA analyzed the feasibility of alternative construction techniques for excavating the 125th Street Subway tunnel and station caverns, sketched out conceptual station layouts for each of the potential stations, and documented potential constraints related to the construction of 125th Street Subway .



4.2 Tunnel Construction Methods

The two main methods for construction of below grade tunnels are drill-and-blast and tunnel boring machine (TBM). Considering the soft soil conditions, the necessity to cross under existing infrastructure (e.g., major utilities and existing subway tunnels), and the United States tunneling industry experience, a mixed-face TBM was determined to be the appropriate construction method for the tunnels, with several options for sequencing and staging.

Several tunneling approaches were developed that varied by number of TBMs used, direction of tunneling, and impacts or opportunity to sync with tunneling for SAS Phase 2.

TBMs could be launched from either the east (120th Street/2nd Avenue and Ancillary A[5]) or the west (125th Street/12th Avenue) and could involve one or two machines operating simultaneously. Four one-TBM options were evaluated. Two options would sync with SAS Phase 2 construction – continuing Phase 2 tunnelling from the east to the west. Two options would be independent from SAS Phase 2, one tunneling from the east and one tunnelling from the west.

Tunneling approaches considered in the Study are summarized in **Table 7** categorized by the direction of the excavation and the logistical relationship to SAS Phase 2.

Table 7 - Summary of Tunneling Approaches

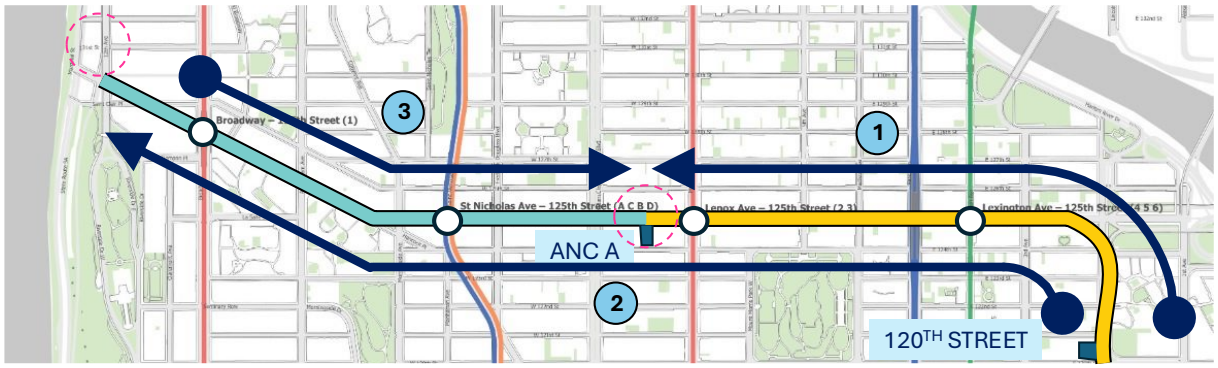
# of TBMs	Option	Direction	Relation to SAS Phase 2
One TBM	1	West & East	Synced
	2	West	Synced
	5	East	Independent
	6	West	Independent
Two TBMs	3A*	West	Independent staging sites, reuse of TBMs
	4	East	Synced

* Note the Study originally considered a Tunneling Option 3 that would have been synced with SAS Phase 2. Upon additional consideration to avoid conflicts with the construction activities of SAS Phase 2, the option evolved with independent staging sites and was renamed Option 3A. This option was taken forward for consideration.

Details about the tunneling options are provided below: The MTA investigated the compatibility of these tunneling options with SAS Phase 2 engineering, operating, and schedule constraints in **Section 5**.

[5] Ancillary A is a parcel on 125th Street near Lenox Avenue at the end of the tunneling limits of SAS Phase 2 that will be used for staging activities during SAS Phase 2 construction and will be repurposed to house vital equipment for daily operations of the subway system.

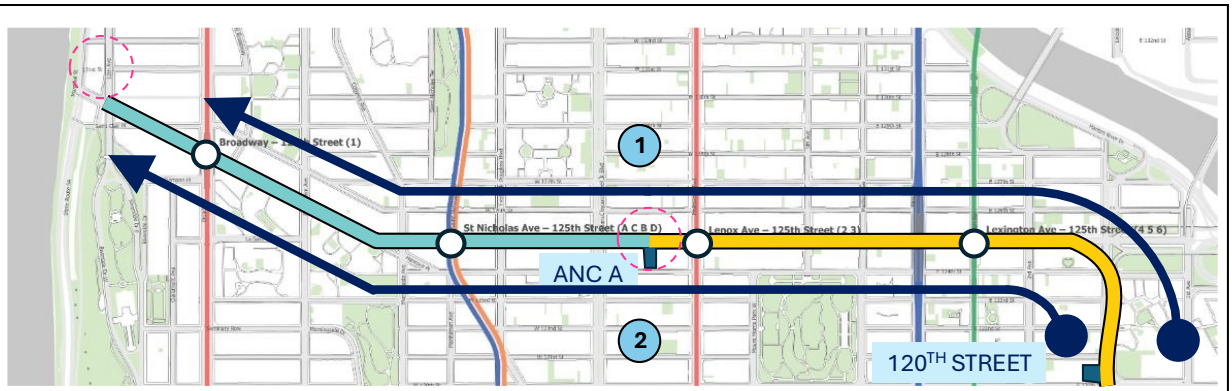
Option 1: One TBM Tunneling West & East



1: SAS Phase 2 Tunnel 1 from 120 th St /2nd Ave to Ancillary A
2: SAS Phase 2 & 125th Street Subway Tunnel 2 from 120 th St /2nd Ave to 125th St /12th Ave
3: 125th Street Subway Tunnel 1 from 125 th St /12th Ave to Ancillary A

In option 1, the SAS Phase 2 TBM would be launched at 120th St. tunneling westward, and retrieved at Ancillary A. It would be relaunched at 120th St. to excavate the second tunnel for SAS Phase 2 and then continue the length of tunneling required for 125th Street Subway (depicted in the image above to extend to 12th Ave.) before turning around and returning eastward to Ancillary A for retrieval.

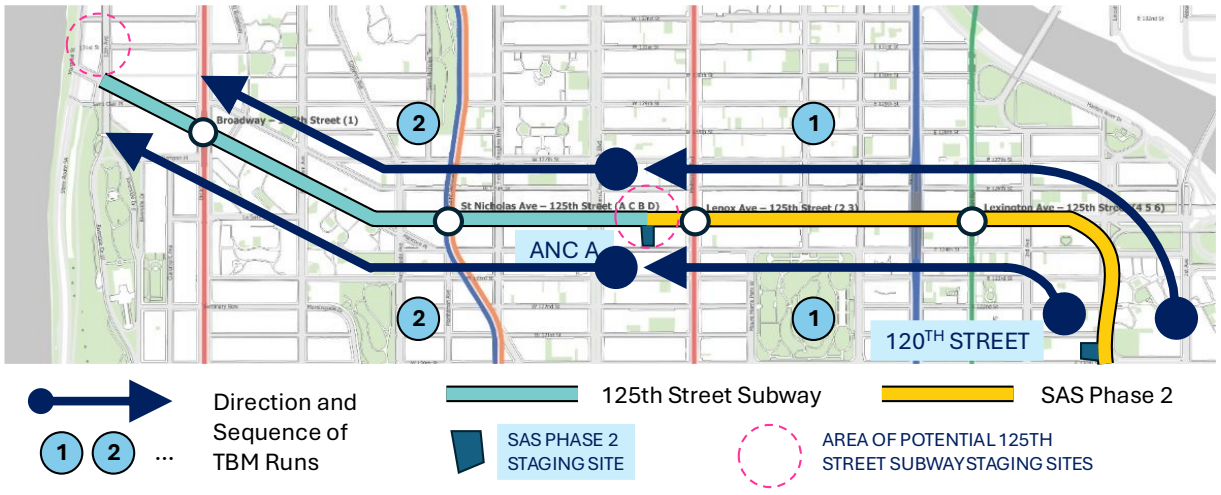
Option 2 – One TBM Tunneling West



1: SAS Phase 2 & 125th Street Subway Tunnel 1 from 120 th St /2nd Ave to 125th St /12th Ave
2: SAS Phase 2 & 125th Street Subway Tunnel 2 from 120 th St /2nd Ave to 125th St /12th Ave

In Option 2, the SAS Phase 2 TBM would be launched at 120th St. tunneling westward and would continue past Ancillary A to its ultimate retrieval site at the end of the 125th St Subway alignment. It would be relaunched at 120th St. to excavate the second tunnel for both SAS Phase 2 and the 125th Street Subway.

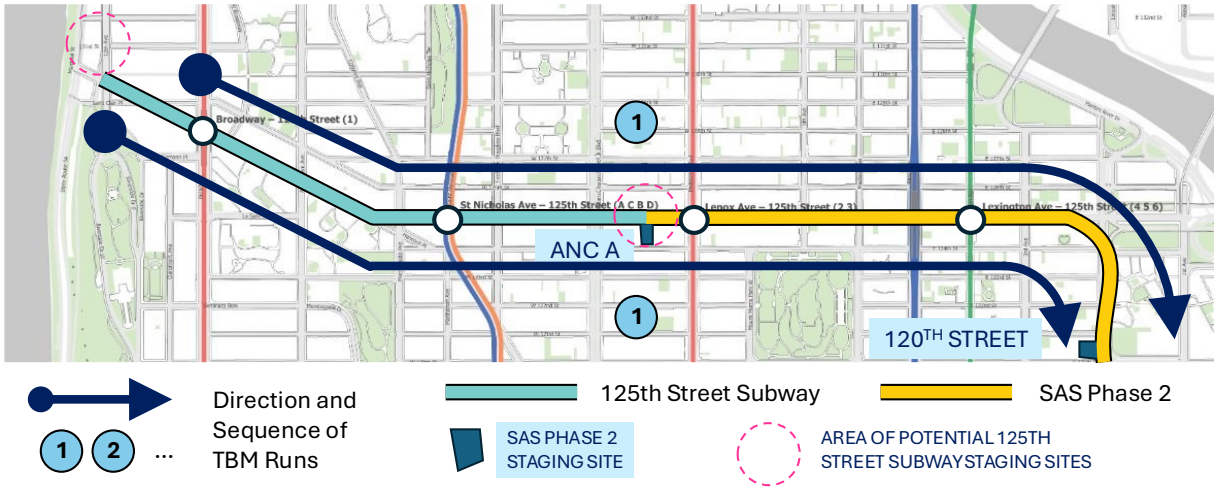
Option 3A - Two TBMs Tunneling West, Independent Staging Sites, Reuse of TBMs



1: SAS Phase 2 Tunnel 1 & 2 simultaneously from 120 th St /2nd Ave to Ancillary A
2: 125th Street Subway Tunnel 1 & 2 simultaneously from new launch site near Ancillary A to 125 th St/12th Ave

Option 3A would continue to advance the two TBMs used for SAS Phase 2. New staging sites (exact locations to be determined) in the vicinity of Ancillary A will be prepared for the125th Street Subway, from which the same TBMs will complete the remainder of the runs required to excavate the alignment for 125th Street Subway.

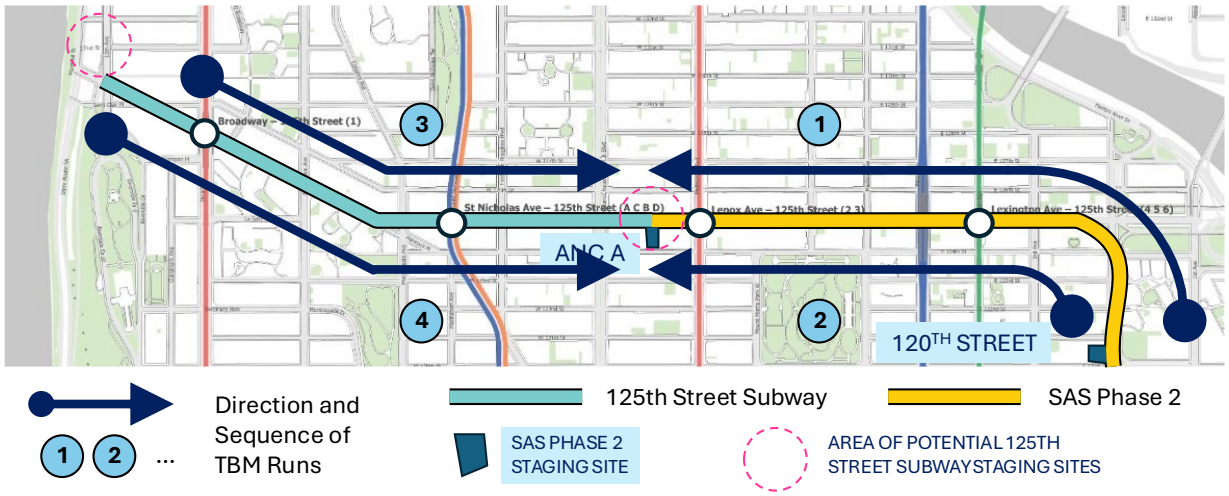
Option 4 - Two TBMs Tunnel East



1: 125th Street Subway & SAS Phase 2 Tunnel 1 & 2 simultaneously from 125 th St /12th Ave to 120th St /2nd Ave

Option 4 would utilize two TBMS launched simultaneously at the western extent of 125th Street and tunneling eastward past Ancillary A to 120th St., completing in a single pass the full run required to excavate the alignment for 125th Street Subway.

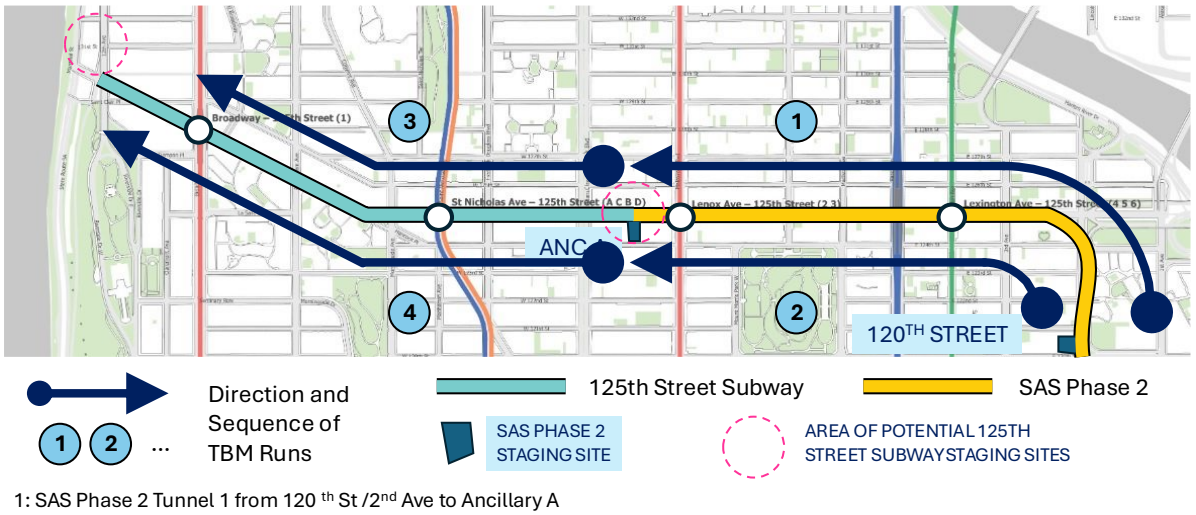
Option 5 - One TBM, Independent from SAS Phase 2, Tunneling East



1: SAS Phase 2 Tunnel 1 from 120 th St /2nd Ave to Ancillary A
2: SAS Phase 2 Tunnel 2 from 120 th St /2nd Ave to Ancillary A
3: 125th Street Subway Tunnel 1 from 125 th St /12th Ave to new staging site near Ancillary A
4: 125th Street Subway from 125 th St /12th Ave to to new staging site near Ancillary A

Option 5 separates the tunneling for SAS Phase 2 from 125th Street Subway. One TBM would be launched at 120th St. tunneling westward to excavate the first tunnel for SAS Phase 2 and would be retrieved at Ancillary A. It would be relaunched at 120th St. to excavate the second tunnel for SAS Phase 2 and retrieved once more from Ancillary A, completing the excavation for SAS Phase 2 and enabling it to proceed to further phases of construction and operationalization. The TBM would then be launched at the western extent of 125th Street to tunnel eastward until it is retrieved at a new staging site (location to be determined) near Ancillary A. It would be launched for a final pass at the western extent of the alignment and retrieved at the new staging site.

Option 6 - One TBM Independent from SAS Phase 2, Tunneling West



1: SAS Phase 2 Tunnel 1 from 120 th St /2nd Ave to Ancillary A
2: SAS Phase 2 Tunnel 2 from 120 th St /2nd Ave to Ancillary A
3: 125th Street Subway Tunnel 1 from Ancillary A to 125 th St /12th Ave
4: 125th Street Subway Tunnel 2 from Ancillary A to 125 th St /12th Ave

Option 6 separates the tunneling for SAS Phase 2 from 125th Street Subway. One TBM would be launched at 120th St. tunneling westward to excavate the first tunnel for SAS Phase 2 and would be retrieved at Ancillary A. It would be relaunched at 120th St. to excavate the second tunnel for SAS Phase 2, completing the excavation for SAS Phase 2 and enabling it to proceed to further phases of construction and operationalization. The TBM would then be relaunched (at a location to be determined) near Ancillary A to tunnel eastward until it is retrieved at the western extent of 125th Street Subway. It would be launched at Ancillary A for a final westward pass and retrieved at the western extent of the alignment.

4.3 Station Construction Methods

Stations would be built as deep caverns, about 75 feet wide and 100 feet deep, using sequential excavation method (SEM) optimized for soft ground conditions, compatible with the SAS Phase 2 tunnel profile. In the SEM method, shafts would be excavated from street level, typically at station entrances or ancillary sites. The cavern excavation would then proceed in stages, with small sections excavated at a time, allowing for immediate ground support and observation. As the cavern excavation advances, support systems, such as rock bolts, shotcrete, or steel ribs, would be installed to stabilize the surrounding soil mass and prevent collapses or deformations. Continuous monitoring of ground conditions and support performance allows for adjustments to the excavation and support systems as needed. Cut-and-cover, while more traditional and potentially faster for shallow stations, causes more surface-level impacts, including utility relocations and traffic disruptions. Deep stations at Lenox Avenue and St. Nicholas Avenue would primarily use SEM, while Broadway may allow cut-and-cover methods.

The sequencing of station construction is closely tied to the tunneling strategy and the location of the terminal station. In each case, the stations would be constructed after tunnel completion, with varying configurations of crossover caverns and ancillary facilities. Groundwater control is a critical consideration throughout, requiring engineered solutions to manage hydrostatic pressures and prevent settlement-related damage to adjacent structures. Overall, the construction methods proposed aim to balance technical feasibility, cost, schedule, and community impact.

Storage/Tail Track Concepts

The storage tail tracks at the northwestern end of the route must accommodate at least six 600-foot train sets, with no more than four trains on any single track. These requirements support the proposed full SAS build-out of 30 trains per hour. Four options were considered for tail track layout at the Broadway Station terminal. These options include:

- **Two-tube extension west of 12th Avenue**, curving north under Columbia University-owned parcels between Riverside Drive Viaduct and Amtrak viaduct. The final alignment and elevation of the tail tracks would be subject to the constraints imposed by the viaduct foundations or any future buildings on these parcels.
- **Mined cavern west of 12th Avenue**, accommodating three parallel tracks under Columbia University-owned parcels. This concept would reduce the length of excavation but provides less flexibility to work with the future building foundations.
- **Under Broadway**, using TBM or SEM, with challenges related to viaduct foundations and property impacts.
- **Cut-and-cover under 12th Avenue**, with constraints from existing utilities and historic structures.

4.4 Proposed Station Concepts

A three-station configuration is recommended for 125th Street Subway based on the market analysis and ridership benefits presented in Section 2. A priority for each station is to create convenient transfers to the existing north-south subway lines. Conceptual designs for each of the proposed stations were developed using a prototypical underground station model. These stations would include a platform level for boarding and a mezzanine level for circulation and transfers. The concept includes vertical circulation elements (VCE) such as elevators, escalators, and stairs, tailored to accommodate projected ridership demand and fit within site constraints.

Each station would include public areas for passengers and non-public "back of house" spaces for essential systems like ventilation, power, and communications. Ancillary facilities would be located at both ends of the station cavern and serve functions such as tunnel ventilation, fire life safety, and traction power substations (TPSS).

Lenox Avenue Station

Located under the existing 2/3 subway station, Lenox Avenue Station would offer connectivity to the existing station. It would have a center platform and end-loaded mezzanine. There would be a new northeast corner entrance and upgrades to existing sidewalk entrances. Ancillary facilities are planned at both ends, with options for corner or mid-block locations. In addition to escalators and stairs, elevators would provide speedy vertical connections to the new station. This is an important design feature because the escalators and stairs would require multiple switchbacks and long transfer times to connect to the surface and existing platforms. The conceptual plan and 3D views of Lenox Avenue Station are presented in **Figure 8** and **Figure 9**.

Figure 8: Lenox Avenue Station Plan View

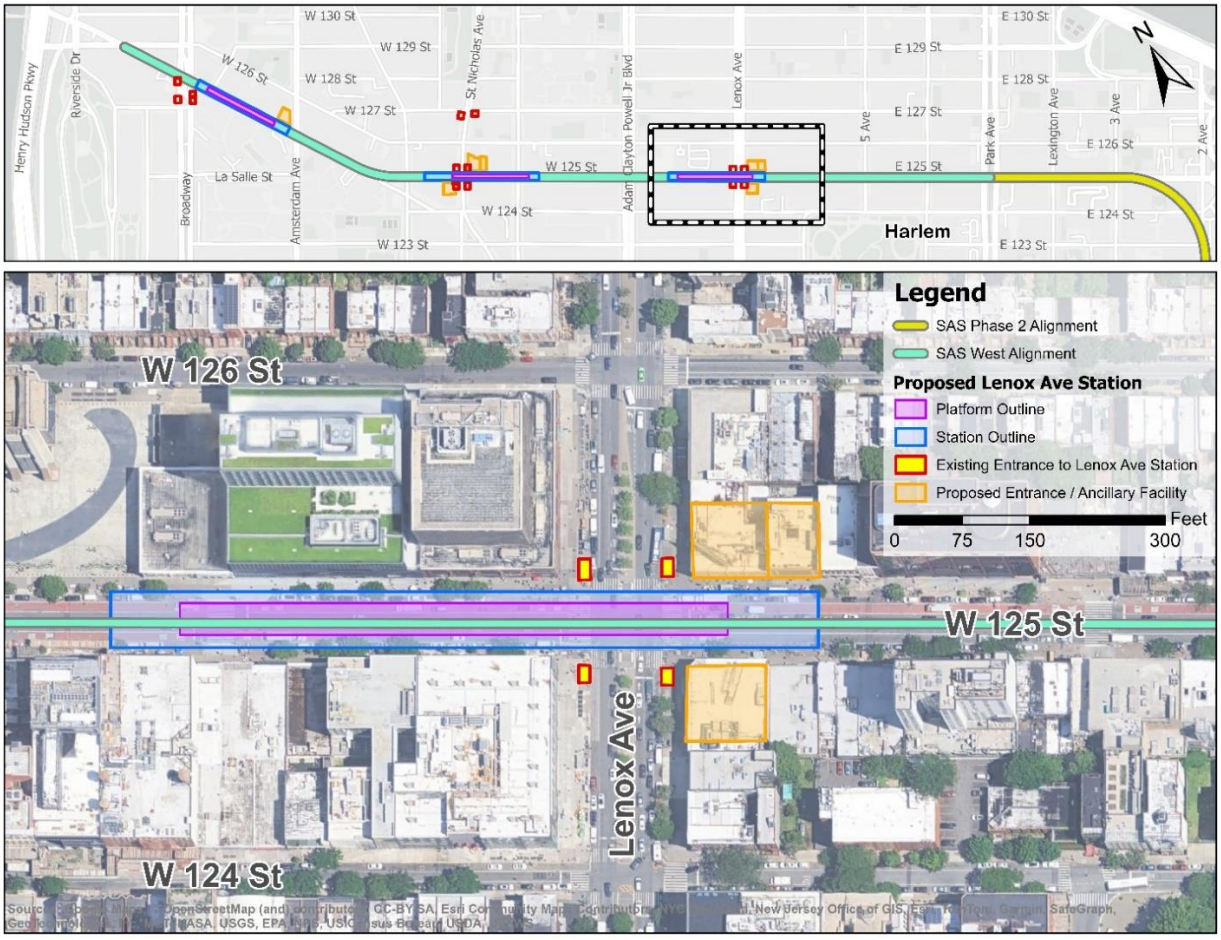
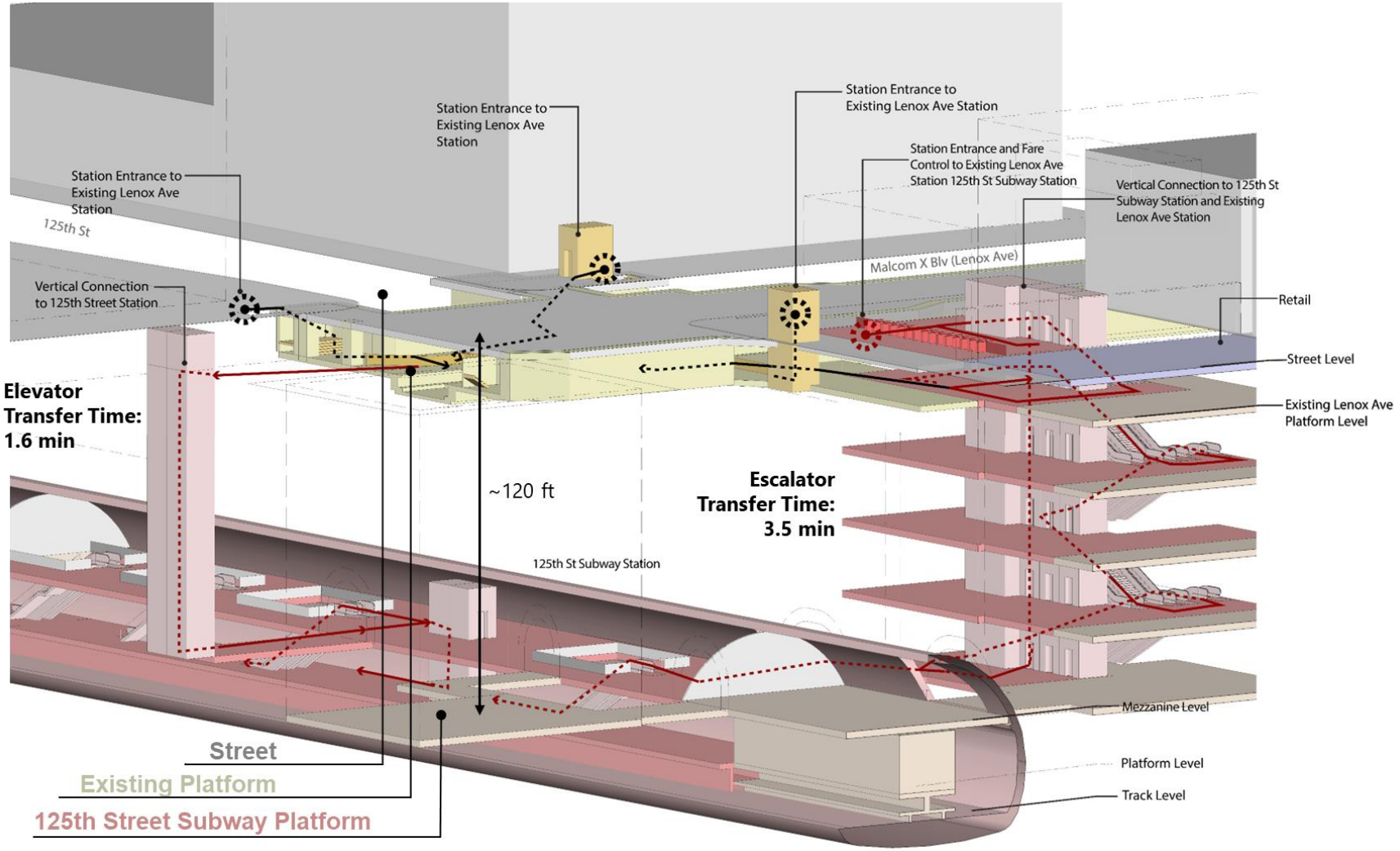


Figure 9: Lenox Avenue Station 3D View



St. Nicholas Avenue Station

This station would connect to the existing A/C/B/D lines and would be situated beneath the current station. It would feature a center platform and eastward-extending mezzanine. Entrances are planned at the northeast and southwest corners of Saint Nicholas Avenue and 125th Street. Ancillary facilities would be located on through-lots between 125th and 126th Streets. Deep shafts to connect the 125th Street subway mezzanine to the existing mezzanine would require structural modifications to the existing station. The conceptual plan and 3D views of St. Nicholas Avenue Station are presented in **Figure 10** and **Figure 11**.

Figure 10: St. Nicholas Avenue Station Plan View

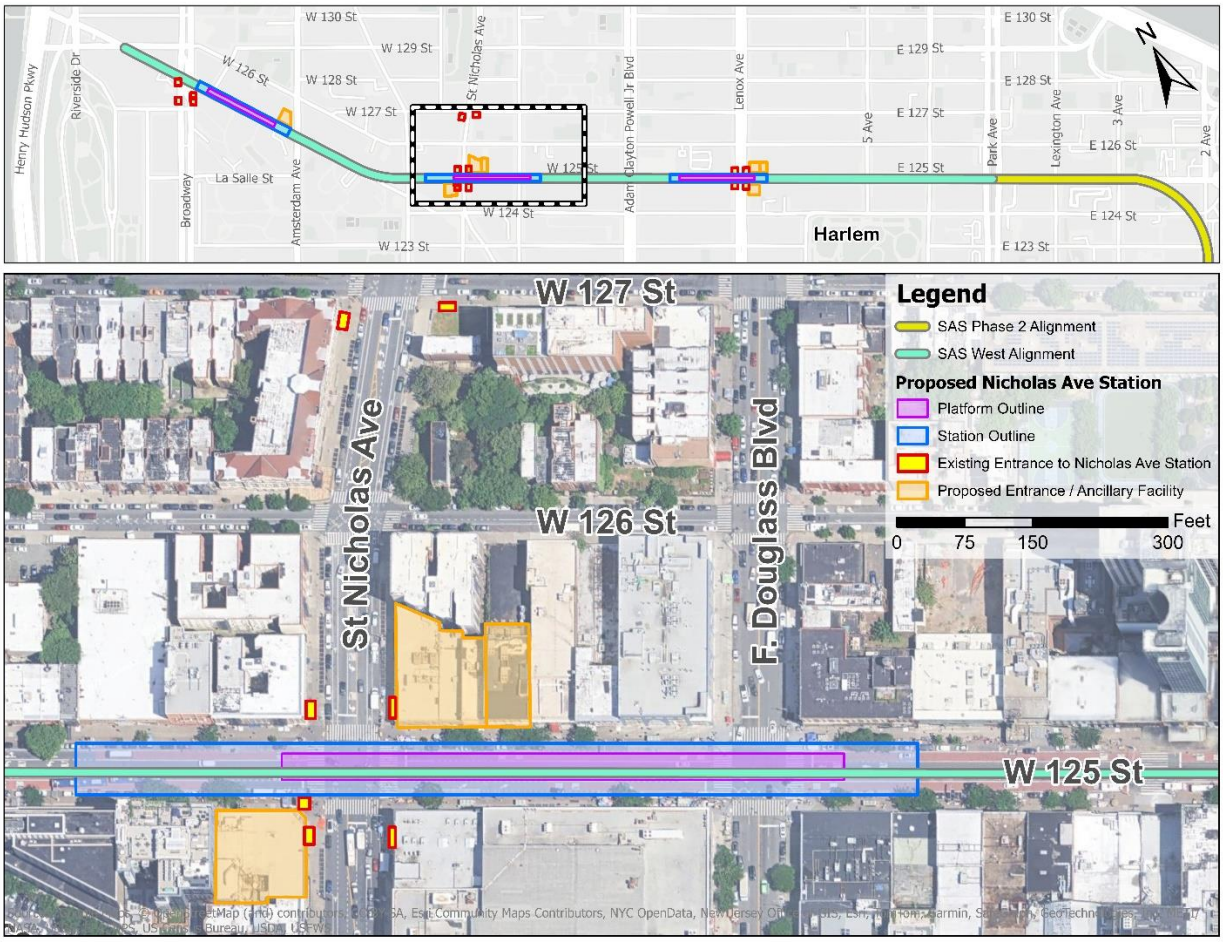
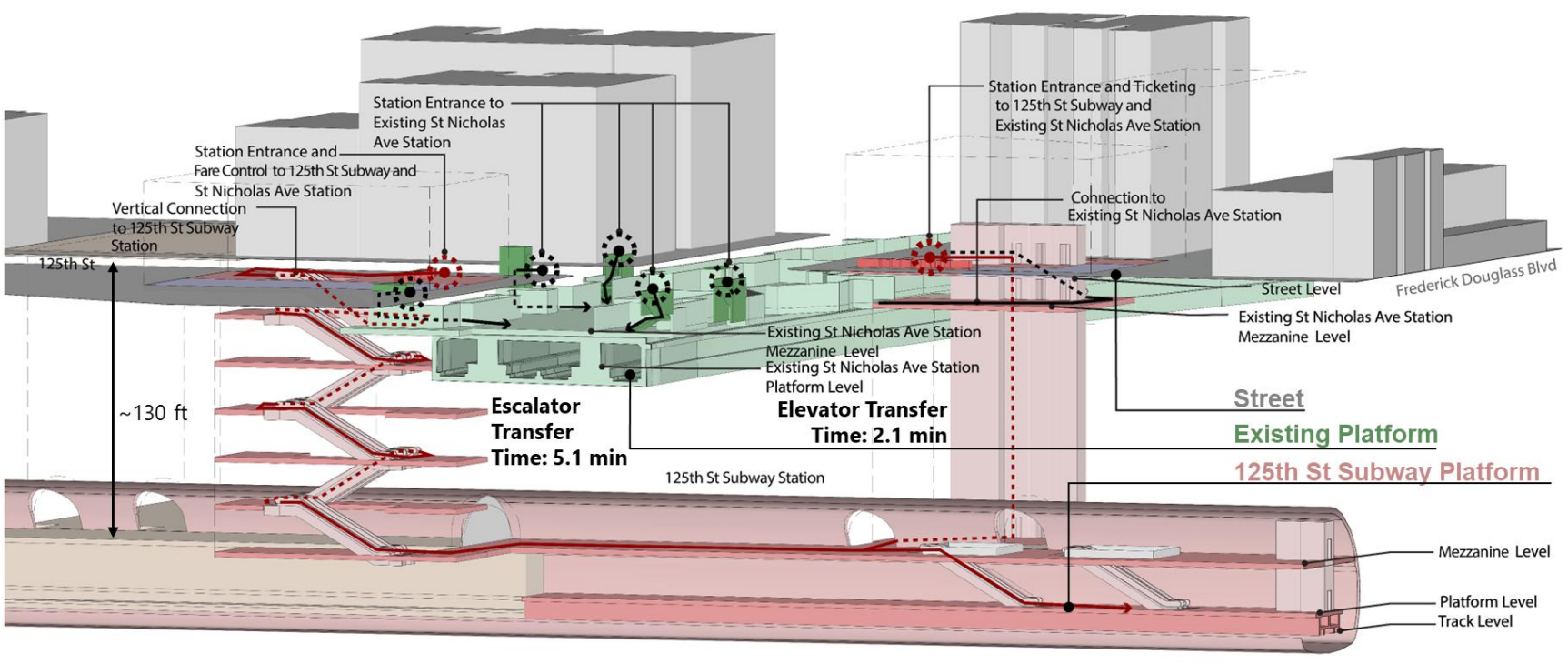


Figure 11: St. Nicholas Avenue Station 3D View



Broadway Station

Broadway Station, a terminus by design, offers the highest connectivity potential, linking to the elevated 1 Train and serving West Harlem, Columbia University, and the City College of the City University of New York. It would feature a center platform and end-loaded mezzanine with entrances at Broadway and Amsterdam Avenue. The west entrance would be integrated with the existing elevated station, requiring upgrades and structural modifications to the existing station for compliance with the Americans with Disabilities Act. Ancillary facilities would be embedded at the entrance locations, with additional space for operations and control. The conceptual plan and 3D views of Broadway Station are presented in **Figure 12** and **Figure 13**.

Figure 12: Broadway Station Plan View

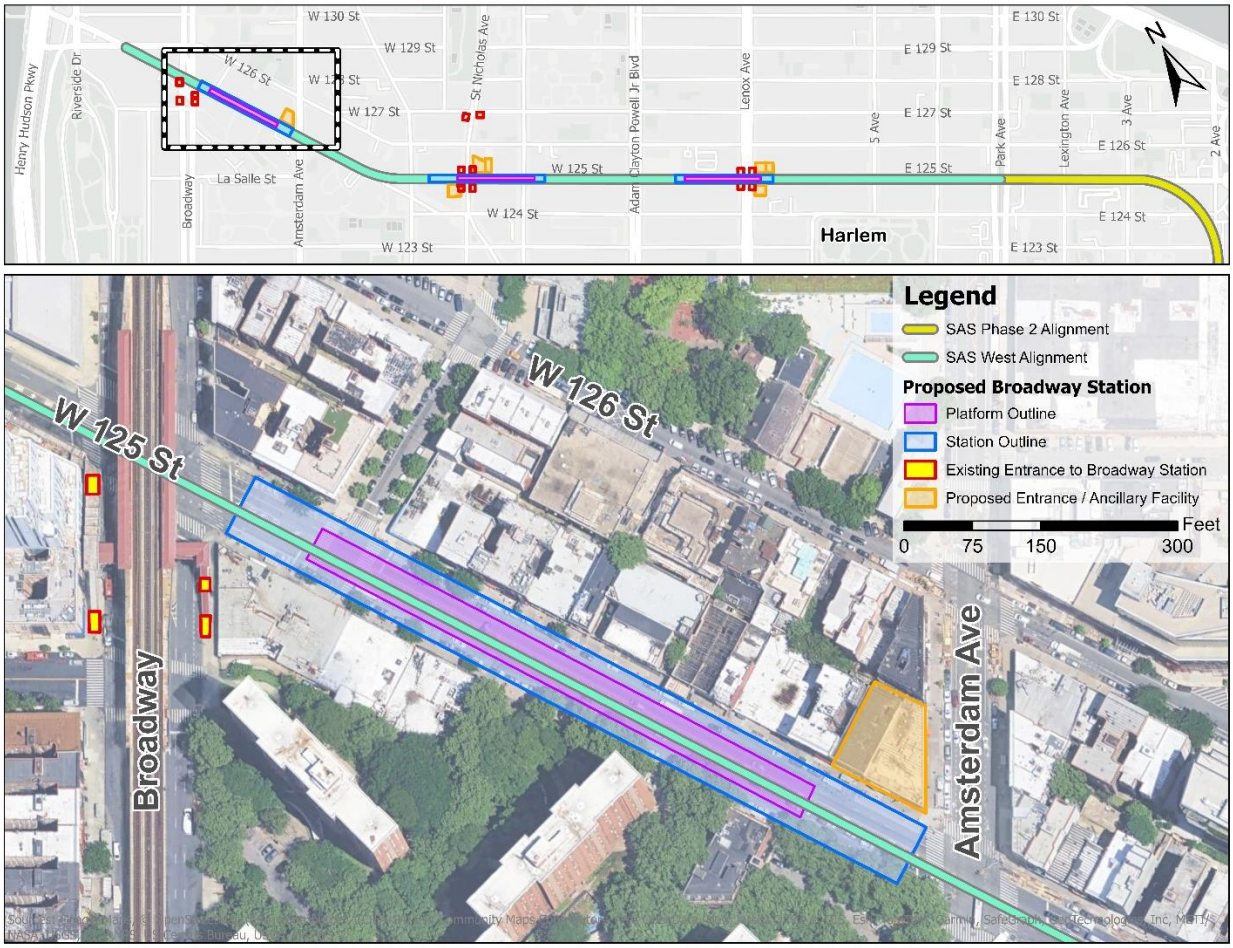
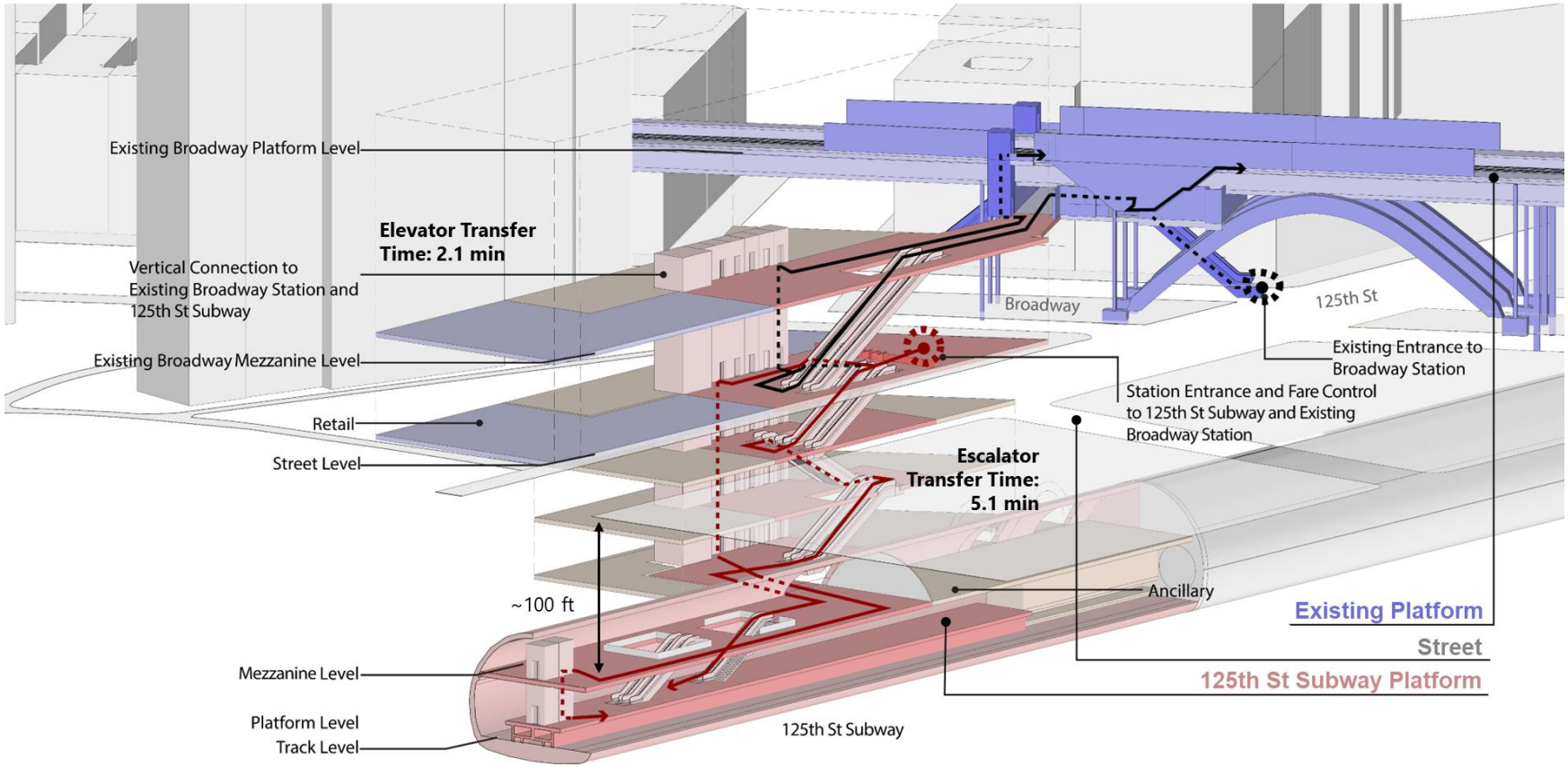


Figure 13: Broadway Station 3D View



4.5 Construction Impacts and Mitigation, SAS Phase 2 Considerations

Construction logistics will require complex staging areas to support key functions such as tunnel muck treatment and storage, a TBM power station, ventilation systems, precast liner storage and TBM retrieval. The MTA identified several locations for staging and TBM retrieval areas needed for the construction of 125th Street Subway, depending on the direction of the tunnel excavation, the level of coordination with SAS Phase 2 staging sites, and the available real estate. Each site presents its own benefits and challenges from an access, constructability and overall logistical standpoint.

For all sites, trucking in and out of the staging areas will be the primary means of provisioning the construction with precast elements and removing muck and will follow NYC-approved routes. Barging on the Hudson River may be an alternative to trucking for staging areas at the west end of 125th Street. Utility coordination is critical due to the dense infrastructure along 125th Street, including major water, sewer, electrical, and telecom lines.

There is the potential for construction-related noise, vibration, and visual disruptions, including near historic buildings. Mitigation measures would include the use of temporary sound barriers, vibration monitoring, and adherence to NYC Department of Buildings requirements and guidelines.

The design and construction of 125th Street Subway would need to account for the interface with SAS Phase 2 operations at 125th Street/Lexington Avenue Station. The station, tail tracks and their ancillary facilities would need to remain operational for the duration of the interfacing work. In particular, the functions that are to be hosted in Ancillary A at the end of SAS Phase 2 tail tracks may need to be relocated to allow for the construction of the new Lenox Avenue Station. A carefully planned and phased relocation strategy will be required to ensure continuity of operations.

One key criterion would be to maintain minimal train storage capacity at the west end of SAS Phase 2 during the construction of 125th Street Subway. SAS Phase 2 tail tracks consist of a 2-track configuration extending directly from SAS Phase 2 125th Street/Lexington Avenue Station long enough to accommodate a total of six trains. This storage capacity aligns with the overall storage need of the full SAS program[6] that will increase incrementally as all four phases are placed into service (SAS 125th Street/Lexington Avenue Station serves as the north terminal as part of SAS Phase 2). While temporary reductions in storage are possible before all four phases are built, maintaining storage capacity for at least four trains at the west end of SAS Phase 2 during the construction of the 125th Street subway is considered the minimum requirement.

[6] SAS was designed as a four-phase project. The first phase extended the Q train along 2nd Avenue from 72nd Street to 96th Street. Phase 2 extends this line to 125th Street and Lexington Avenue. Phase 3 will extend the line south from 72nd Street to Houston Street, and Phase 4 will extend it further south to Hanover Square.

5 Screening of Tunneling Options

As described in the Constructability Analysis, six potential tunneling options were designed to excavate the tunnels for 125th Street Subway. This section reviews the feasibility of each tunneling approach in relation to their potential impacts on SAS Phase 2 construction activities, cost, or start date for revenue service.

SAS Phase 2 Context

With the award of the SAS Phase 2 Tunnel Design-Build Contract, the selected contractor's execution plan utilizes two TBMs for excavation traveling west from 120th Street. This decision creates the opportunity (but not requirement) to use the same two TBMs for 125th Street Subway excavation. The SAS Phase 2 Design-Build Contract also includes burying components of the TBMs beyond the tunneling limits of SAS Phase 2 under 125th Street rather than extracting them from the ground via a construction site referred to as Ancillary A on 125th Street near Lenox Avenue. The downstream implications of these recent SAS Phase 2 decisions were considered in the screening of tunneling approaches for the 125th Street Subway.

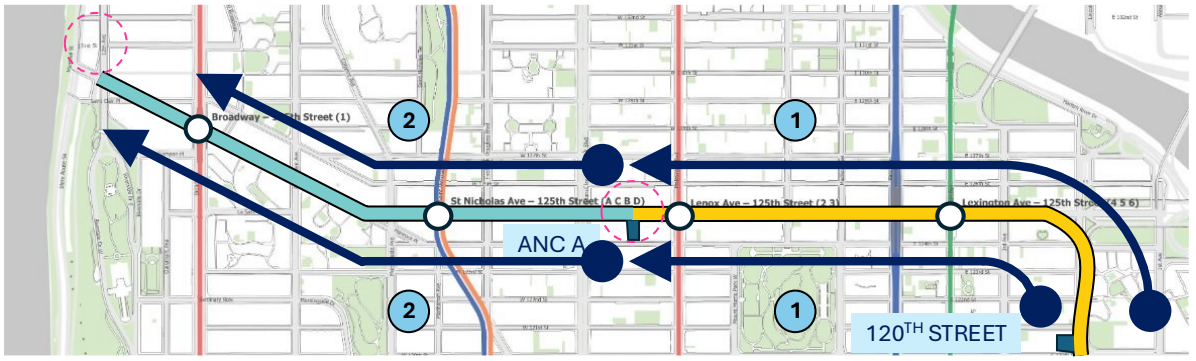
5.1 Feasible Options

Of the six tunneling options considered, two were identified as feasible because they could be accomplished with no material impact on the construction schedule and revenue service date of SAS Phase 2. These options are described in more detail below, and illustrations describing the tunneling approach are reproduced from **Section 4.2**. While the burial of components of the SAS Phase 2 equipment creates complexities, with appropriate identification and management of these issues, Options 3A and 5 were found to be constructable without delay to the revenue start date of SAS Phase 2.

Options 3A

Option 3A involves the re-use/continuation of the two SAS Phase 2 TBMs tunneling westward. As originally defined, Option 3 would re-use the SAS Phase 2 staging/launch sites at 120th Street and 125th Street/Lexington Avenue. Upon further analysis, Option 3 was refined into Option 3A, and a new staging/launch site in the vicinity of Ancillary A was proposed in lieu of the SAS Phase 2 sites further east. In this way, tunneling for 125th Street Subway can be kept largely separate from the construction activities of SAS Phase 2. In this concept, the TBMs could be removed or buried at 12th Avenue.

Option 3A - Two TBMs Tunnel West, Staging Site Shifts to New Sites Near Ancillary A



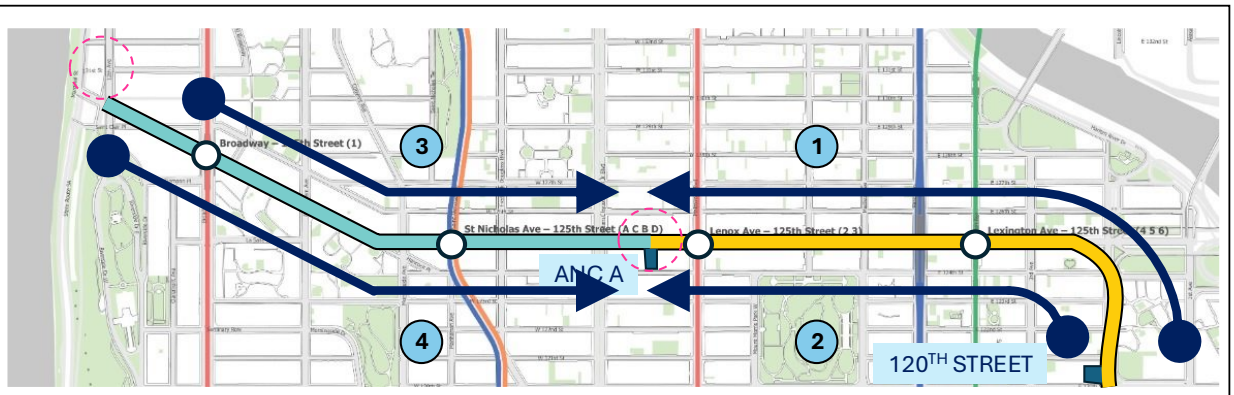
1: SAS Phase 2 Tunnel 1 & 2 simultaneously from 120 th St /2nd Ave to Ancillary A
2: 125th Street Subway Tunnel 1 & 2 simultaneously from new launch site near Ancillary A to 125 th St/12th Ave

The feasibility of this option depends on the appropriate planning and maintenance of the SAS Phase 2 TBMs before the conclusion of Phase 2 tunneling to ensure that re-launching the TBMs from this area in the future remains feasible. This option is not feasible if the TBM components are buried underground.

Option 5

Option 5 involves the use of one TBM being launched from 12th Avenue and tunneling eastward towards Ancillary A. The TBM would be retrieved near Ancillary A and relaunched at 12th Avenue to excavate the second tunnel. This option can be completed independent of SAS Phase 2, but the burial of components of the SAS Phase 2 TBMs near Ancillary A poses additional technical challenges. Any remaining TBM equipment would need to be removed from the path of eastward tunneling to ensure this option remains feasible.

Option 5 - One TBM, Independent from SAS Phase 2, Tunneling East



1: SAS Phase 2 Tunnel 1 from 120 th St /2nd Ave to Ancillary A
2: SAS Phase 2 Tunnel 2 from 120 th St /2nd Ave to Ancillary A
3: 125th Street Subway Tunnel 1 from 125 th St /12th Ave to new staging site near Ancillary A
4: 125th Street Subway from 125 th St /12th Ave to to new staging site near Ancillary A

Although the SAS Phase 2 TBMs create complexities, with appropriate identification and management of these issues, Options 3A and 5 were found to be constructable without delay to SAS Phase 2.

5.2 Infeasible Options

Although the remaining four tunneling options are constructable, they were screened out and deemed infeasible because of impacts to the revenue service date of SAS Phase 2. These options are described in more detail below. Illustrations of the infeasible tunneling options can be found in **Section 4.2**.

Options 1 and 2:

Option 1 involves using a single TBM that would tunnel westward for the first tunnel of SAS Phase 2 relaunched for a single long TBM run to excavate the second tunnel of SAS Phase 2 and the first tunnel of 125th Street Subway ending at 12th Avenue. The TBM would then turn around and return eastward to excavate the second tunnel of 125th Street Subway, stopping at Ancillary A.

Option 2 involves using a single TBM that would tunnel westward from 120th Street/2nd Avenue to excavate the first tunnel of SAS Phase 2 and 125th Street Subway in a single long run ending at 12th Avenue. The TBM would be relaunched for a second long run to complete the remaining tunnel for both projects.

These options were estimated to cause a nine- to twelve-month delay to SAS Phase 2. Continuing the TBM run to complete the first tunnel of 125th Street Subway using the same staging sites as SAS Phase 2 would impact downstream construction activities in the SAS Phase 2 tunnels. These options were screened out because they were estimated to cause a nine- to twelve-month delay to SAS Phase 2.

Option 4

Option 4 involves using two TBMs launched from 12th Avenue and tunneling eastward to excavate the tunnels for 125th Street Subway first and then SAS Phase 2 tunnels, with the TBMs being retrieved from 120th Street/2nd Avenue.

This option was expected to cause up to a three-year delay to SAS Phase 2, as the start of tunneling would be delayed for both SAS Phase 2 and 125th Street Subway to allow for the completion of the 125th Street subway environmental review and property acquisitions. As a result, this option was screened out.

Option 6

Option 6 involves the use of a single TBM that would complete its westward runs launched on 125th Street near Ancillary A for each tunnel and would be completed independent of SAS Phase 2.

The burial of components of the SAS Phase 2 TBMs would make the constructability of this option challenging, hence it was screened out.

5.3 Phased Implementation (Tunnel Only Option)

The construction of the SAS Phase 2 tunnel is set to begin in 2026. 125th Street Subway is at the "planning" stage in the Project development lifecycle (planning, environmental review, engineering, and construction). It would be difficult to advance the full-build Project in time to take advantage of the SAS Phase 2 construction momentum and mobilization activities that could save time and money for 125th Street Subway in the long term. There is, however, an opportunity to advance the Project incrementally, syncing just the tunnel portion of 125th Street Subway to the tunnel construction for SAS Phase 2. The full-build 125th Street Subway (stations, track, and other rail systems) could be developed and advanced as a future phase.

Advancing the 125th Street Subway tunnel in conjunction with SAS Phase 2 would require that the SAS Phase 2 tunnel contractor not bury and seal any TBM components but instead preserve the path for 125th Street Subway construction. . This approach assumes that one or more TBMs used in SAS Phase 2 would be used to bore the full length of the 125th Street Subway tunnel. Excavation would proceed independently of SAS Phase 2 and be completed to minimize downtime and cost. After excavation, the unused tunnel would be maintained for essential life safety and general maintenance features such as lighting, drainage, and ventilation until funding for the full build-out is secured.

There are several advantages to this "tunnel-only" option:

- Extending the tunnel to Broadway would maximize the utility of the state-of-the-art machinery and complex mobilization processes being deployed for SAS Phase 2.
- Constructing a tunnel now would preserve the right-of-way and expedite the extension of 125th Street Subway service in the future
- Repurposing SAS Phase 2 TBMs would reduce 125th Street Subway mobilization and construction costs and schedule impacts.

6 Capital, Operating and Maintenance Cost Estimates

In the MTA's TYNA, the cost of the project to provide subway service along 125th Street with a three-station buildout was estimated to be approximately $7.5 billion (escalated to 2027$). Using concept-level detail developed in the Study, the project cost is estimated to be $7.7 billion (2027$).

In addition, the tunnel-only option that could be advanced as a first phase of the full buildout is estimated to cost $1.1 billion.

Table 8 below summarizes the capital cost estimates for the three-station buildout and the tunnel-only option. It shows the base cost for major items, new infrastructure, and professional services.

Table 8: Capital Cost Estimates

Description	Full Build-Out with 3 Stations ($Million)	Tunnel Only ($Million)
Estimated Construction Cost Subtotal	$4,400	$800
Estimated Land, Vehicle Acquisition, Professional Services and Contingency Subtotal	$3,300	$300
Estimated Total Project Cost	**$7,700**	**$1,100**

Note: Costs escalated to 2027$ and rounded up to the nearest hundred million.

The MTA developed the Operating and Maintenance (O&M) cost estimates presented in **Table 9** below for each station scenario, consistent with FTA and MTA guidelines. These estimates include Operations, Vehicle Maintenance, Maintenance of Way, Station Operations, and Station Maintenance, and Administration.

Table 9: Operating and Maintenance Cost Estimates

O&M Category	Full Build-Out with 3 Stations ($ Million)	Tunnel Only ($ Million)
Operations and Vehicle Maintenance:	$11	$0
Maintenance of Way, Station:	$63	$21
Total	**$74**	**$21**

Note: Costs escalated to 2027$ and rounded up to the nearest hundred million.

7 Key Findings and Next Steps

This Study updated the previous market and ridership analysis conducted for the MTA's Twenty-Year Needs Assessment Comparative Evaluation and further evaluated the constructability of a one, two or three station 125th Street Subway, considering the ongoing design and construction of Second Avenue Subway Phase 2.The updated market and ridership analysis demonstrated that three-stations with a terminal station at Broadway and intermediate stations at Lenox Avenue and St. Nicholas Avenue would net the highest ridership and bring significant benefits to the Study Area.

Geotechnical field investigations confirmed that the mixed soil conditions of the area could support construction of a tunnel profile connecting to the SAS Phase 2 terminus just west of Lexington Avenue. Several tunneling approaches were developed and screened to determine if they could be advanced without impacting the SAS Phase 2 tunnel construction or revenue service schedules. The MTA also developed conceptual layouts for each new station to confirm constructability and the feasibility of creating convenient connections to each of the seven existing north-south NYCT subway lines.

The study demonstrated that there could be efficiencies in the future construction of 125th Street Subway if components of the SAS Phase 2 TBMs were not buried at completion of SAS Phase 2 tunneling but instead reconditioned and reused for westward tunnel excavation. In contrast, burying these TBM components at the end of SAS Phase 2 would create significant technical and logistical challenges to 125th Street Subway tunnel construction.

Advancing the full-build 125th Street Subway in sync with SAS Phase 2 would require careful coordination of the following activities:

- Environmental review and site preparation mobilization schedules would need to align with the SAS Phase 2 schedule. Permits and easements for 125th Street Subway would need to be secured before the completion of SAS Phase 2 tunneling and the tunneling contractor's handover to SAS Phase 2 stations and facilities contractors.
- The location of the 125th Street TBM staging and muck removal sites would need to be coordinated with SAS Phase 2. The existing SAS Phase 2 staging sites at 120th Street and 125th Street must be vacated after the completion of SAS Phase 2 tunneling to avoid delays in revenue service. Additional engineering and economic analyses are necessary to further refine the staging area concepts for 125th Street West as they interface with SAS Phase 2.
- To enable the continuous use of SAS Phase 2 TBMs while reducing their inactive time underground and associated maintenance costs, a new staging site would need to be ready near 125th Street and 7th Avenue before SAS Phase 2 tunneling ends. A retrieval site at 12th Avenue and 132nd Street would also need to be constructed to extract and dismantle the TBMs. This site would also serve as a long-term access point and potentially house power or ventilation systems.

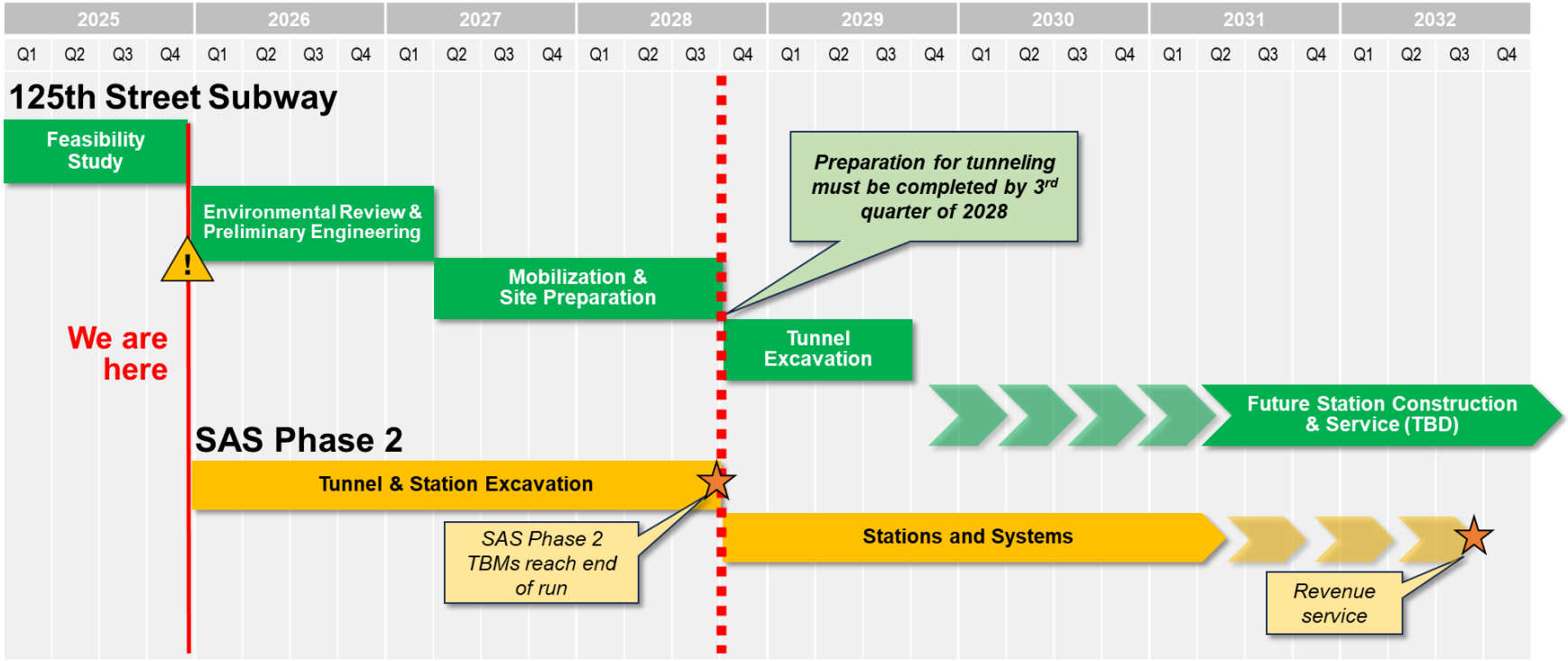
Next Steps

There is an opportunity to advance 125th Street Subway incrementally, starting with a tunnel-only phase that takes advantage of the SAS Phase 2 TBMs and staging sites. The tunnel-only phase could be advanced in sync with the SAS Phase 2 timeline while the necessary planning, design, and environmental review required to proceed with the full build are completed.

Figure 14 presents a conceptual timeline illustrating the key steps in the preparation and execution of tunneling for 125th Street Subway independent from SAS Phase 2 from a logistical standpoint, while maximizing the opportunity of using SAS Phase 2 equipment and materials to continue tunneling westward with minimum interruption. The figure highlights the general status of each project as of the writing of this Report – at the end of the 125th Street Subway Feasibility Study and at the beginning of excavation work for SAS Phase 2. The completion of tunneling for 125th Street Subway will conclude construction activities for this phase of the Project until a future time when construction may be completed and revenue service can be initiated.

The MTA has determined that it is feasible and beneficial to extend 125th Street Subway to a new Broadway terminus. The timing for that effort will depend on how quickly planning, environmental review, stakeholder engagement, and design can be completed. If the SAS Phase 2 tunnel construction contract proceeds as currently defined, without close coordination of design between the two projects, it will be difficult to tunnel west in the future. There is a window of opportunity now to preserve the option for a future 125th Street Subway by advancing a tunnel-only phase in sync with SAS Phase 2 tunnel construction.

Figure 14: Conceptual Timeline



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