Chapter 3: Construction Methods and Activities

3.1 INTRODUCTION

This chapter describes the construction methods and activities for the Hudson Tunnel Project's Preferred Alternative. The Preferred Alternative has two overarching components: (1) the construction of a new trans-Hudson tunnel (the Hudson River Tunnel) and associated surface and rail system improvements; and (2) the rehabilitation of the existing North River Tunnel. To ensure that the passenger rail system continues to operate at existing service levels during construction, the new tunnel would be constructed and put into operation before the rehabilitation of the North River Tunnel occurs.

Following completion of the Draft Environmental Impact Statement (DEIS), the Port Authority of New York and New Jersey (PANYNJ) became the Project Sponsor for the Hudson Tunnel Project (see Chapter 1, "Purpose and Need," Section 1.1.2, for more information). Consistent with the roles and responsibilities defined in Section 1.1.1, as the current Project Sponsor, the PANYNJ will comply with mitigation measures and commitments identified in the Record of Decision (ROD). The Project Sponsor will conduct a procurement process for the Project contractor(s) that will construct the Project.

This chapter provides an overview of the likely construction methods that would be used for the Preferred Alternative, a discussion of locations where construction would occur, and a description of the potential sequencing and schedule for construction. This chapter was prepared by FRA and NJ TRANSIT. The PANYNJ, in its role as Project Sponsor, has accepted and relied on the evaluations and conclusions of this chapter.

Information presented in this chapter and analyzed throughout this Environmental Impact Statement (EIS) is based on preliminary engineering and is likely to evolve further as engineering advances. Accordingly, the preliminary sequencing approach and overall construction schedule developed for the proposed construction activities represents a reasonable estimate of how the Preferred Alternative could be constructed, based on preliminary engineering; this approach is likely to change as engineering evolves. The evaluations that FRA and NJ TRANSIT conducted of potential environmental impacts that could result from Project construction, as well as mitigation measures to lessen their effects, are presented in subsequent technical chapters of this EIS, based on reasonable and conservative assumptions about the Project's construction activities.

Since publication of the DEIS, the Preferred Alternative has been refined from what was presented in the DEIS as a result of design advancement and changes made in response to comments received on the DEIS. Amtrak has continued to advance the design of the Preferred Alternative, including incorporating design refinements based on further engineering analysis and information, resulting in some modifications to the design presented in the DEIS. FRA and NJ TRANSIT, in response to comments made during the public comment period and working with the other Project Partners, have identified ways to reduce the impacts of Project construction on local communities near the construction sites in New Jersey and Manhattan. Therefore, some of the information about likely methods for Project construction has been revised in this FEIS from what was provided in the DEIS. As final design and construction advances, the Project Sponsor will continue to identify opportunities to advance the Project more efficiently and with reduced impact through innovation and use of improved technologies, and to leverage private-sector partnerships for procurement methods, project delivery, and long-term maintenance, where practicable.

This chapter reflects the design modifications related to the permanent features of the Project (e.g., modifications to surface tracks and tunnel alignment) and changes to construction methods and staging that the Project Sponsors have incorporated into the Preferred Alternative since the DEIS.

This chapter contains the following sections:

3.2 OVERVIEW OF CONSTRUCTION METHODS

Construction activities for the Preferred Alternative would include construction of a new Hudson River Tunnel and its supporting infrastructure, followed by rehabilitation of the North River Tunnel. For the new Hudson River Tunnel, this includes the following:

- Construction of two new tracks alongside the existing surface alignment of the Northeast Corridor (NEC) in New Jersey from Secaucus to the western slope of the Palisades at Tonnelle Avenue in North Bergen;
- Construction of a new tunnel consisting of two tracks in two separate tubes extending from a portal (tunnel entrance in the western slope of the Palisades) beneath the Palisades, the Hudson River, and the waterfront area in Manhattan;[1]
- Installing tracks and infrastructure within the Hudson Yards Right-of-Way Preservation Project in Manhattan, which is a tunnel alignment beneath the large-scale redevelopment known as Hudson Yards that is being developed on a platform above the Metropolitan Transportation Authority (MTA) Long Island Rail Road (LIRR) John D. Caemmerer West Side Yard;
- Extension of the tunnel alignment from the Hudson Yards Right-of-Way Preservation Project beneath Tenth Avenue to A Yard near PSNY in Manhattan;
- Track modifications in A Yard (near PSNY) in Manhattan; and

[1] The new Hudson River Tunnel would consist of two separate single-track tunnels, referred to as “tubes” throughout this EIS. This is similar to the North River Tunnel, which also consists of two separate single-track tubes.

- Construction of ventilation shafts and fan plants in Hoboken and Manhattan.

The rehabilitation of the North River Tunnel would include conventional demolition and construction methods to replace or rehabilitate tunnel elements and rail systems.

In general, construction of the Preferred Alternative's new Hudson River Tunnel would proceed from west to east, starting with construction of the surface alignment through the Meadowlands in Secaucus and North Bergen, New Jersey. Construction also includes establishing tunnel staging areas at the new tunnel portal location near Tonnelle Avenue in North Bergen and at the Hoboken/Weehawken border in Hoboken, New Jersey, where a new ventilation shaft for the tunnel would later be built. The new Hudson River Tunnel would be constructed using Tunnel Boring Machines (TBMs) working from New Jersey to New York. Excavated materials from the new Hudson River Tunnel and deliveries to the tunnel would be made primarily through the Tonnelle Avenue staging area. At the Hoboken staging area, construction would occur: (1) to create a vertical shaft at the site that would become a permanent ventilation shaft and emergency access point for the Hudson River Tunnel; (2) to use the vertical shaft to support the major tunneling activities that would occur at Tonnelle Avenue; and (3) to build a permanent ventilation fan plant for the new Hudson River Tunnel above the shaft.

In New York, a staging area at Twelfth Avenue between West 29th and West 30th Streets would support the ground improvement and tunneling between the river's edge and West 30th Street, the tunneling across Tenth Avenue to connect with the PSNY approach tracks at A Yard, and other construction activities in New York related to fitting out the tunnel. A vertical shaft from the surface to the tunnel would also be constructed at the Twelfth Avenue staging area for access to the tunnel during construction, for removal of the TBMs after they have bored the tubes of the Hudson River Tunnel, and to serve as a permanent ventilation shaft and emergency access point for the new Hudson River Tunnel. A permanent ventilation fan plant would be constructed above or near the shaft.

Once the tunnel excavation activities are complete for the new tunnel and ventilation shafts, the permanent fan plants at the ventilation shafts would be constructed, and construction related to track work and railroad systems and finishing would occur. The rehabilitation of the existing North River Tunnel would begin after train traffic has moved to the new Hudson River Tunnel. Construction for the tunnel rehabilitation would be staged from a single staging area, the same staging area on Tonnelle Avenue in North Bergen, New Jersey used for construction of the new Hudson River Tunnel.

As described later in this chapter, other than the above-ground features of the Project in the area of new surface alignment and where new fan plants are located, or where measures to implement ground stabilization or river-bottom soil improvement are effected from the surface, the construction activity for this Project would occur underground. Where possible, construction activities and associated worker and trucking movements would be concentrated at construction staging areas to minimize disruptions at the surface. The three principal staging sites, described in greater detail below, would be located at: (1) the location of the new and existing tunnel portals in New Jersey, with staging areas on either side of Tonnelle Avenue (U.S. Routes 1 and 9) in North Bergen, New Jersey (see Sections 3.3.2.6 and 3.3.10.1); (2) the Hoboken shaft site and staging area in Hoboken, New Jersey (see Section 3.3.3); and (3) the Twelfth Avenue shaft site and staging area in Manhattan, New York (see Section 3.3.7).

The new Hudson River Tunnel would be constructed underground in hard rock beneath the Palisades, and continuing east of the Palisades through a mix of rock and soft soils under the New Jersey waterfront area and the Hudson River to the Manhattan bulkhead. East of the Manhattan bulkhead, the tunnel would be constructed through soil to the Twelfth Avenue shaft site. Additional short tunnel sections in soil would be constructed east of the Twelfth Avenue shaft site, in West

30th Street and in Tenth Avenue. All of these construction activities would be accomplished by one of several mining techniques, described below in Section 3.2.1. In some areas of Manhattan (e.g., at West 30th Street and at Tenth Avenue), limited excavation from the surface would also be needed, primarily for the relocation of underground utilities located within the construction zone for the new tunnel alignment. Approximately 1.3 million loose cubic yards of rock and soil would be removed as part of the construction of the new Hudson River Tunnel.

Surface construction would also be required where the new surface alignment would be constructed (on a combination of embankment, viaducts, and bridges, and in open and retained cuts); at the staging areas (where shafts would be excavated, tunneling supported, and new fan plant structures built); and where ground improvement and underpinning of buildings, roadways, or other structures would occur.

Based on comments received on the DEIS, design refinement, and coordination with representatives and residents of the Townships of North Bergen and Weehawken and the Cities of Hoboken and Union City, FRA and NJ TRANSIT, working with the other Project Partners, evaluated alternative methods for constructing the Preferred Alternative and have incorporated modifications to the construction methods into the Project that will reduce impacts on local residents associated with construction at the Hoboken staging area. The revised construction methodology involves removing excavated material from the new Hudson River Tunnel (tunnel spoils) primarily at Tonnelle Avenue rather than at the Hoboken staging area. This change in the location where the majority of the tunnel spoils would be removed would substantially reduce the construction activities at the Hoboken staging area. At the same time, this modification would not substantially increase the duration of construction activities at the Tonnelle Avenue staging area, and the increased activity there would not result in substantial changes to the traffic, noise, or air quality effects that would occur there during Project construction, based on the conclusions of analyses presented in other chapters of this EIS (see Chapter 5A, “Traffic and Pedestrians;” Chapter 12A, “Noise,” and Chapter 13, “Air Quality”).

The potential methods and techniques for construction of the Preferred Alternative are described below. **Figure 3-1** provides an overview of the construction methods that would be used for the Preferred Alternative. **Figures 3-2a** and **3-2b** show more detailed views of the Project construction sites and activities in New Jersey and New York, respectively. Chapters 5 through 22 of this EIS describe the effects of the Project’s construction activities on nearby communities and the natural environment, as well as mitigation measures to lessen adverse effects, based on the potential construction methods and schedule described in this chapter.

3.2.1 MINING OR TUNNELING TECHNIQUES

Most of the alignment for the new Hudson River Tunnel would be constructed using a combination of three principal mining or tunneling techniques:

- Bored tunnel construction with a tunnel boring machine (TBM);
- Mined tunnel construction using Sequential Excavation Method (SEM);
- Open excavation, including cut-and-cover construction.

In some areas, protective measures would be used to support a variety of foundation structures (e.g., roadways, bridges, viaducts, buildings, bulkheads, and sewers), as necessary, before tunnel or ventilation shaft excavation.

Bored or mined tunnel construction, including the use of a TBM, SEM, and other mining techniques, allows for tunnel excavation to occur below the surface without substantially disrupting the surface above. Typically, the only visible evidence of a mining operation to the general public occurs where a vertical shaft connects the ground surface to the tunnel below, and where

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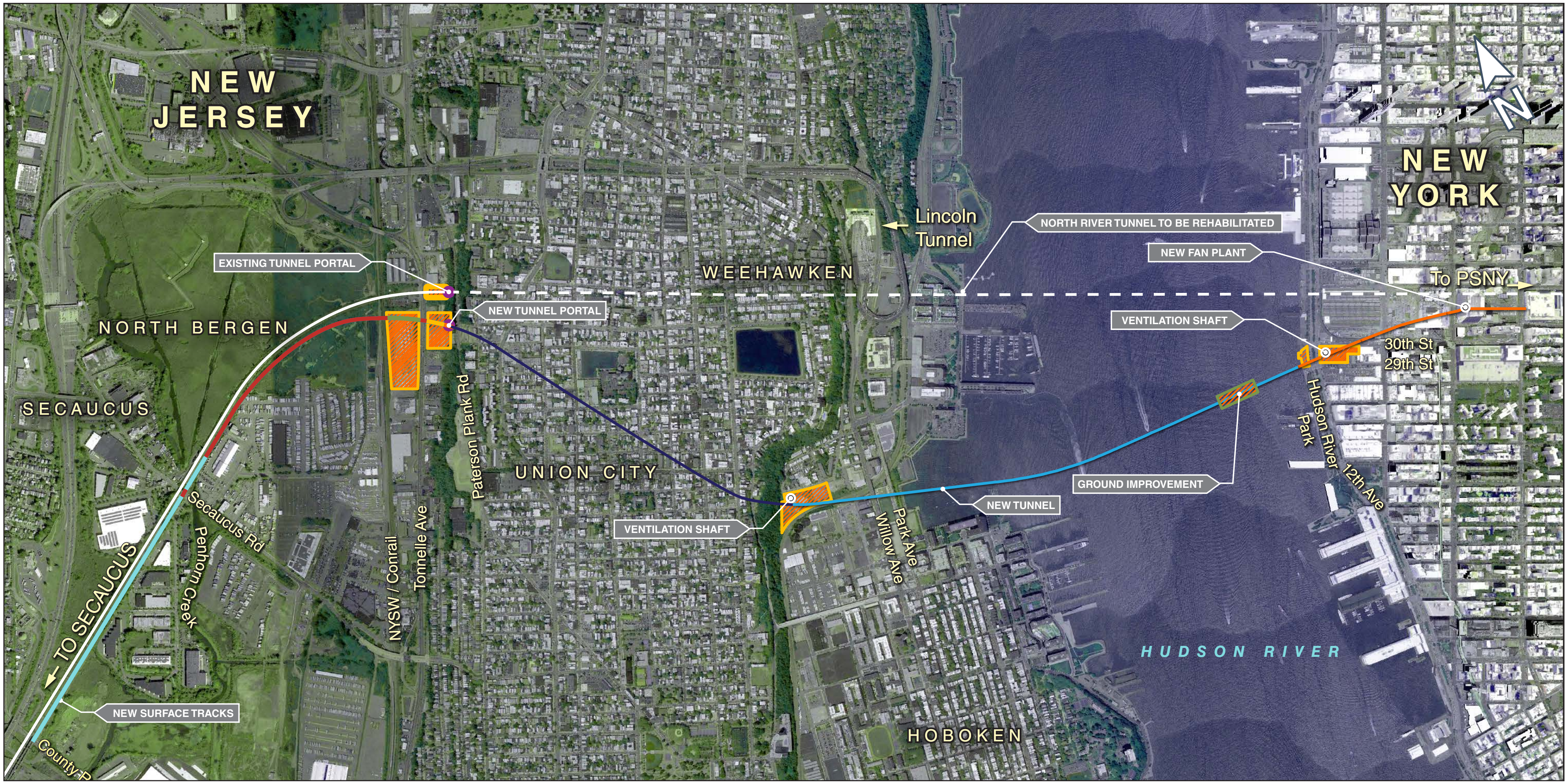

	Existing Northeast Corridor		*Construction Staging Area*		*New Surface Tracks (Retained Fill)*		*Tunnel Boring Through Hard Rock Conditions Using TBM*
	North River Tunnel to be Rehabilitated		*In-Water Construction*		*New Surface Tracks (Viaduct)*		*Tunnel Boring Through Mixed Face Conditions Using TBM*
	Tunnel Portal		*Ventilation Shaft*		*New Surface Tracks (Embankment)*		*Tunnel Sections in New York (see Figure 3-2b for detail)*
					New Surface Tracks (Retained Cut)		

HUDSON TUNNEL PROJECT

Overview of Construction Methods

Figure 3-1

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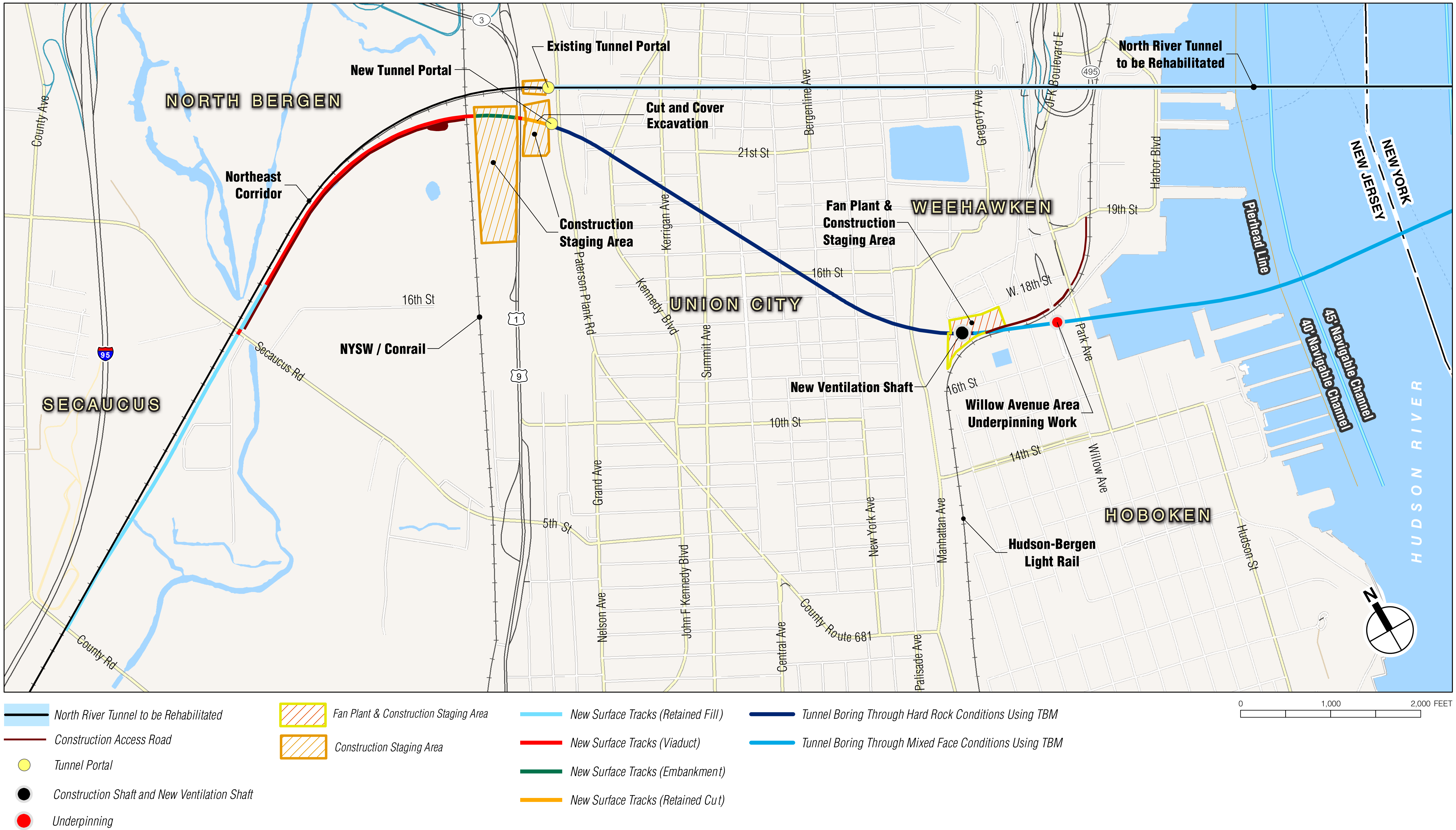
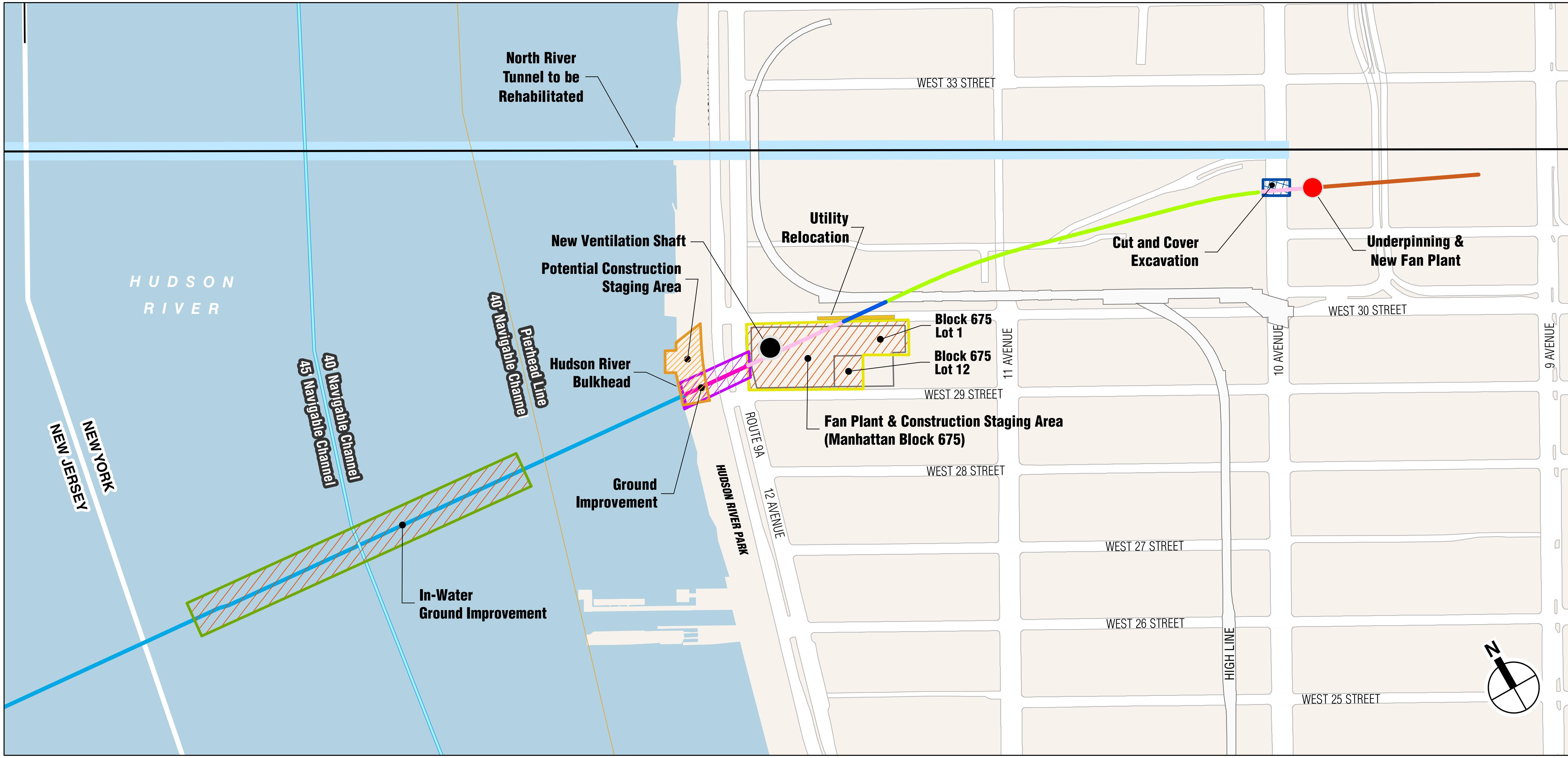


HUDSON TUNNEL PROJECT

Construction of the Preferred Alternative: New Jersey

Figure 3-2a



Existing Northeast Corridor

North River Tunnel to be Rehabilitated

Construction Shaft and Permanent Ventilation Shaft

Underpinning

Fan Plant & Construction Staging Area

Construction Staging Area

Ground Improvement

Cut-and_cover Excavation

In-Water Construction

Utility Relocation

Tunnel Boring Using Tunnel Boring Machine (TBM)

Tunnel Construction Using TBM with Ground Improvement and Potential Sequential Excavation Method (SEM)

Tunnel Construction Using Cut-and-Cover

Fit-Out of Previously Constructed Tunnel Box with Track and Rail Systems

Track Work

Tunnel Construction Using SEM or Cut-and-Cover

0 200 400 600 FEET

HUDSON TUNNEL PROJECT

Construction of the Preferred Alternative: New York

Figure 3-2b

associated lay-down areas for equipment and supplies are located. For the Hudson River Tunnel, two vertical shafts would be constructed, one in Hoboken, New Jersey and one in New York. Generally, the shaft sites would be enclosed or protected by fencing, and would be open to the surface level to permit materials and workers to enter and exit the tunnel. Cranes and other construction machinery would be located alongside each shaft. As explained in detail below, these shafts would be used during construction for access to the tunnel for workers and supplies; for the completed project, these would become ventilation shafts that are a critical component of the tunnel ventilation system and would provide emergency access points for the new tunnel.

A basic description of tunnel construction methods is provided below.

3.2.1.1 TUNNEL BORING MACHINES

TBMs are large-diameter horizontal drills that continuously excavate circular tunnel sections. Different machines are designed for different geological conditions. In rock, a rock TBM is used; in soil and degraded rock, a different type of TBM is used that is specifically designed for drilling through materials that are not self-supporting. Examples of TBMs used in soil include earth-pressure-balance boring machines (EPBs) and slurry shield TBMs, discussed below. Multi-purpose machines that combine the attributes of both rock and soft-ground machines can also be used through both ground types, as well as through mixed-face (i.e., rock and soil within a single excavation section) conditions. Multi-purpose machines could be used for different segments of the new Hudson River Tunnel.

A TBM is able to move below ground, generally avoiding removal of surface elements, although construction with a TBM may require local ***underpinning*** (i.e., stabilizing or reinforcing the support of a structure from below) or removal of subsurface elements and obstructions in advance of tunnel boring.

Both rock and soft-ground types of TBMs consist of a cutter head followed by several hundred feet of support machinery with different functions (called “trailing gear”). High-voltage electricity powers the cutter head, which in turn conveys the excavated rock and soil (referred to as “spoils”) to the back end of the TBM. Hydraulic thrusters propel the TBM forward. Soft-ground TBMs also include a shield at the cutter head that temporarily supports the ground until the tunnel lining is erected. **Figure 3-3** illustrates a typical TBM. Behind the cutter face, TBMs also have a computerized control center from which the boring operations are conducted. This trailing support equipment supports the boring operations. This equipment includes pumps, transformers, ventilation, and grouting equipment, as well as mechanisms for removing the excavated rock or soil and conveying it back behind the machine either by rail or conveyor. Using either type of TBM, precast concrete tunnel segments are typically immediately put in position to complete the tunnel’s permanent support; in rock tunnels, cast-in-place concrete tunnel liners are also used. After the concrete tunnel liner is in place, any voids between the lining and the ground are filled by injecting cement grout, under pressure, into the voids. The grout fills any voids between the exterior of the tunnel lining and the ground, thereby reducing the amount of settlement at or near the ground surface.

TBMs are powered by electricity brought to the machine from substations near or along the tunnel route. This power is supplied to a substation generally located at the ground surface by a direct feed from the local electric utility provider (PSE&G in New Jersey or Con Edison in New York).

With all these components, TBMs are very large pieces of equipment that are brought to the starting point of the tunnel construction in pieces and assembled at the tunnel portal. Larger components can weigh several hundred tons and are lifted by cranes and placed in a specific order and position in a launch pit to achieve the basic TBM configuration. Launch pits can be 300 to 400 feet long, although in some situations they are much shorter. The delivery of TBM components for each of the TBMs to be used for the Hudson River Tunnel would occur over

Hard Rock TBM **1**

Mixed-Face TBM **2**

Examples of Tunnel Boring Machines (TBMs)

Figure 3-3

approximately one month, and the TBM assembly and testing process would take approximately two additional months.

The TBMs for the Preferred Alternative would be approximately 30 feet in diameter, with trailing gear extending several hundred feet behind the cutting face. Based on geological conditions for the new Hudson River Tunnel alignment, it is likely that a hard rock TBM would be assembled and begin tunneling at the Tonnelle Avenue tunnel portal, advancing through the portion of the tunnel beneath the Palisades, and would then be modified in the tunnel to allow its use for mixed-face conditions through the mixed rock and soil of the river segment of the tunnel east of the Palisades. Alternatively, it is possible that the TBM for the segment of the Hudson River Tunnel beneath the Palisades (between Tonnelle Avenue and Hoboken) would be a hard rock TBM that would be assembled and begin tunneling at the Tonnelle Avenue tunnel portal, and the TBM for the segment of the new Hudson River Tunnel between the Hoboken shaft site and the Twelfth Avenue shaft site would be a mixed-face TBM that would be assembled at the bottom of the Hoboken shaft and begin tunneling from there.

To expedite completion of the new Hudson River Tunnel, two separate TBMs would bore the two separate tubes of the new tunnel. If separate TBMs are used for the hard-rock (Palisades) segment of the tunnel and the mixed rock and soil (Hudson River) segment of the tunnel, tunnel construction would involve a total of four different TBMs (two for the two rock tubes and two for the two mixed-face tubes). When each TBM reaches the end of its run, it would be disassembled and removed in pieces over approximately a month, similar to the way it was installed. This would occur at one of the Project's ventilation shafts (either at the Hoboken shaft or the Twelfth Avenue shaft), where cranes would remove the machine components as they are dismantled.

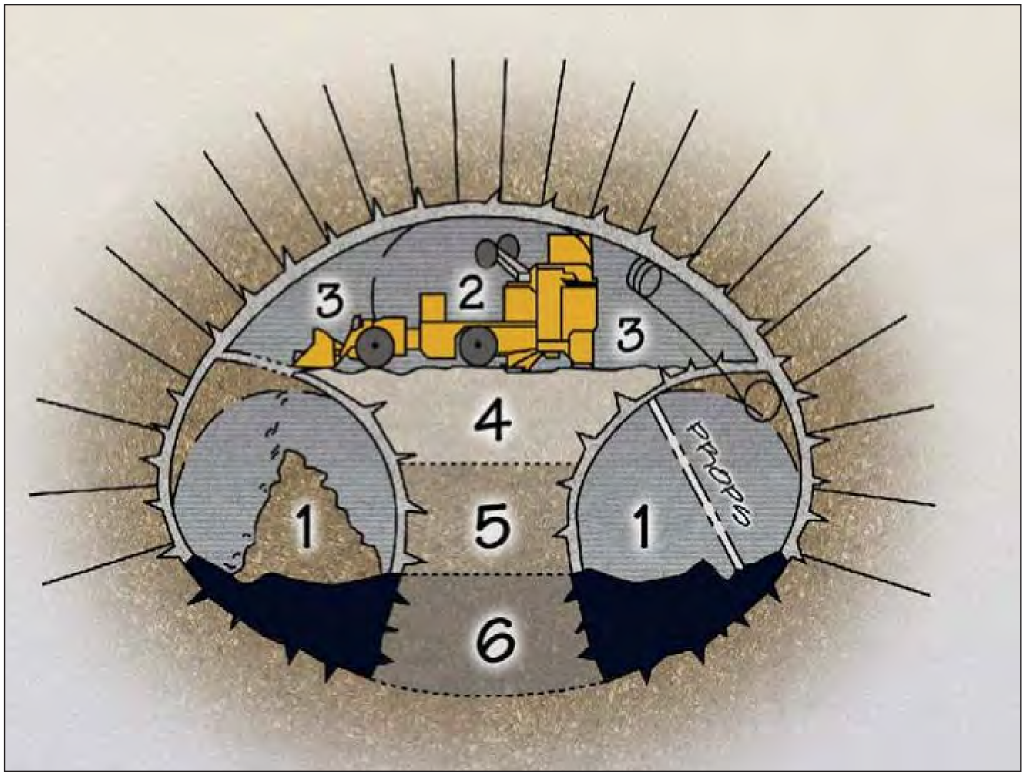
3.2.1.2 SEQUENTIAL EXCAVATION METHOD MINING

Sequential Excavation Method (SEM) *mining* is a technique in which a tunnel is sequentially excavated in phases and supported in a controlled manner. The excavation can be carried out with ***conventional mining methods*** and equipment, chosen according to the ground conditions. This underground method of excavation divides the space to be excavated into segments, then mines the segments sequentially, one portion at a time. While TBMs can only excavate a fixed (circular) shape, SEM mining permits a tunnel of any shape or size to be excavated. This makes it useful in areas where ground conditions and obstructions in the ground would not allow for tunneling using a TBM, or where the tunnel shape or size needs to change (see **Figure 3-4**).

SEM involves the sequencing of the excavation as well as installation of supports. Prior to excavation, supports are installed to provide stability where the excavation will occur. ***Shotcrete*** (a kind of concrete sprayed from high-pressure hoses) may be used to temporarily support the tunnel or support the face, and ***grouting*** (the injection of a cementing or chemical agent into the soil) may be used to increase the soil's strength and reduce its permeability. Another technique that can be used to increase the strength of soils in an area where SEM mining is to be used is ***ground freezing***, described below. The permanent support installed for this type of tunnel excavation is usually a cast-in-place concrete lining, placed over any temporary support.

Conventional mining methods refer to a variety of non-mechanized mining methods including drill-and-blast (described below) and excavation by road-header. A road-header is a piece of excavating equipment consisting of a small rotary cutting head mounted on a boom, a loading device usually involving a conveyor, and a crawler traveling on track to move the entire machine forward into the rock face.

Controlled drill-and-blast is also a conventional excavation technique, in which a series of holes are drilled into the rock mass in a distributed pattern and loaded with a small amount of explosives. Under carefully controlled and monitored conditions, the explosives are detonated sequentially,



Typical SEM Excavation Sequence **1**

SEM Operation at a Tunnel Portal **2**

HUDSON TUNNEL PROJECT

Typical Sequential Excavation Method (SEM)
Mining Sequence
Figure 3-4

breaking the rock while spreading the release of energy from the explosives over a period of several seconds.

3.2.1.3 OPEN EXCAVATION

Open excavation requires temporary stabilization of the ground to support the excavation. Types of temporary support for excavation include the following:

- **Soldier piles with timber lagging:** piles (also referred to as king piles) consisting of vertical I-beams installed at regularly spaced intervals, combined with timber planks or steel sheeting between the piles, to create a support wall;
- **Slurry walls:** concrete walls constructed through the use of a slurry of bentonite, a natural, clay-like liquid material that is poured into a narrow, deep trench to temporarily hold the trench open, and then replaced by steel reinforcing and concrete poured afterward;
- **Sheet piles:** steel sheet sections with intersecting edges that are driven in place similar to piles; or
- **Secant piles:** individual drilled holes filled with concrete and steel, reinforced and installed adjacent to one another to form a continuous wall.

One type of open excavation commonly used for tunnels and other excavation beneath city streets is ***cut-and-cover excavation***. In this method, a trench is excavated from the ground surface, supported, and then covered or decked over, allowing work to continue beneath the cover. When the work is complete, the area is backfilled and the surface is restored. During construction at cut-and-cover locations, street crossings and adjacent areas may be decked to allow unimpeded traffic and use of properties above the cut. Cut-and-cover excavation would be used at the Tonnelle Avenue portal and in Manhattan at Tenth Avenue and may be used in Manhattan at West 30th Street. Open excavation would be used west of the Tonnelle Avenue portal and at the Hoboken and Twelfth Avenue shafts.

3.2.2 GROUND IMPROVEMENT TECHNIQUES

In the process of constructing tunnels, strengthening soils where the tunneling would occur can reduce risk or make tunneling more efficient. The three types of ground improvement techniques most likely to be used for the Preferred Alternative are described below.

3.2.2.1 JET GROUTING

Jet grouting consists of drilling a pattern of small-diameter holes into the soil and then injecting cement grout and, optionally, air and water in a mixture under high pressure into the ground. Once the grout sets, it forms columns that are designed to overlap each other and form a block. This process produces a stronger, solidified cemented soil with a consistency equivalent to a hard soil. For the Preferred Alternative, the DEIS described that the majority of jet grouting would be used at a short segment of the alignment where the new tunnel would be relatively shallow beneath the bottom of the Hudson River, discussed below in Section 3.3.5. However, as design of the Preferred Alternative has progressed since the publication of the DEIS, the Project Partners are now proposing to use deep soil mixing (described below) instead of jet grouting for this area in the bottom of the Hudson River. Secondary areas of jet grouting would be at the Hoboken shaft, along some of the Hoboken alignment of the new Hudson River Tunnel, and in the Manhattan waterfront area.

3.2.2.2 DEEP SOIL MIXING

Deep soil mixing is an alternative to jet grouting. While the DEIS described the use of jet grouting for a segment of the tunnel alignment that would be relatively shallow beneath the bottom of the

Hudson River, based on further analysis during Project engineering, Amtrak is now proposing the use of deep soil mixing, a different technique for hardening the soil. Deep soil mixing is a ground improvement methodology where in-place native soils are mixed or blended with cement. Like jet grouting, this technique creates columns of soil-cement with greatly increased strength and reduced compressibility. Deep soil mixing involves the introduction of large diameter augers or paddles. As the augers or paddles turn, cement or cement grout is introduced and is mixed with the native soils to create a "soilcrete." The result is a series of overlapping soilcrete columns that together create a hardened area, similar to jet grouting. Also similar to jet grouting, this technique generates spoil (or waste product) since the cement displaces and replaces some of the native soil. However, in comparison to jet grouting, deep soil mixing is less costly and produces less waste product that has to be removed from the construction area.

For the Preferred Alternative, Amtrak is now proposing to use the deep soil mixing technique rather than jet grouting at a short segment of the alignment where the new tunnel would be relatively shallow beneath the bottom of the Hudson River, discussed below in Section 3.3.5.

3.2.2.3 GROUND FREEZING

Ground freezing is a ground improvement technique in which subsurface pipes are installed and refrigerated brine (e.g., calcium chloride and water) or liquid nitrogen is circulated through the pipes so that the ground is literally frozen. The hardened, frozen soil can then be excavated using a TBM or conventional mining techniques such as SEM or left in place to support adjoining construction activities. For the Preferred Alternative, ground freezing is proposed in two principal areas: the cross passages under the river in soft clay soils discussed in Section 3.3.4.3 and the Manhattan bulkhead area, discussed in Section 3.3.6. It may also be used in the tunnel section between the Manhattan bulkhead and the western edge of the Twelfth Avenue shaft, where the tunnel would be fairly shallow under Hudson River Park and Twelfth Avenue, and where a major sewer on steel piles needs to be underpinned, also discussed in Section 3.3.6.

3.2.3 DESCRIPTION OF SURFACE STRUCTURE ELEMENTS

For the surface alignment component of the Preferred Alternative, the track support systems to be constructed would include the following:

- ***Viaducts*** are multi-span bridges, generally with relatively short spans, consisting of piers with steel or concrete girders spanning between the piers. Viaducts are constructed by driving foundation piles (defined below in Section 3.2.4) into the earth where the viaduct support piers would be located and then constructing the foundations and support piers on top of the piles. Once the piers are built, the individual spans of the viaduct can be constructed and finished with the necessary surface treatment to carry, in this case, the associated track and catenary system.
- ***Embankments*** are sections of railroad right-of-way above the surrounding grade. They are constructed as filled areas of compacted soil. The soil can be compacted mechanically using heavy rollers and other equipment. Embankments can be ***sloped embankments***, which have sloped sides so that they are structurally stable without the use of walls, or ***retained fill segments***, which are supported by retaining walls.
- ***Open cut*** segments of railroad infrastructure are depressed sections where the tracks are below the surrounding grade. Similar to embankments, these can be ***sloped cut segments*** that have side slopes that support the surrounding grade or they can be ***retained cut segments***, where the surrounding grade is supported by retaining walls.

3.2.4 OTHER ANTICIPATED CONSTRUCTION MEASURES

The Preferred Alternative would also involve the use of some other construction methods to address specific conditions along the alignment. These include the following:

- ***Pile foundations*** involve the installation of piles deep into the earth to support various types of structural elements above. Piles are long post-like cylinder foundation members made of a strong material—commonly composed of timber, steel, or concrete—that are driven (by impact or vibratory hammers) or augured (drilled) into the ground to act as a steady support for structures built on top of it. Depths vary depending on soil type, and can either go to bedrock, or to depths of 50 feet or more. For the Preferred Alternative, piles would be used to support the viaducts, bridge abutments, retaining wall and overhead catenary, signals, communications, and other rail systems along the surface alignment in New Jersey. They would also be used for underpinning the Willow Avenue viaduct in Weehawken and Hoboken, New Jersey, and at the shafts and fan plant buildings in New Jersey and New York to support those structures. Piles would also support temporary and new sewer lines that would be affected by construction in Manhattan at West 30th Street and at Tenth Avenue.
- ***Cofferdams*** are watertight structures designed to facilitate construction projects in areas that are normally submerged. A cofferdam creates an enclosure that surrounds a construction zone and keeps water from entering or leaving. They are typically constructed of ***sheet piling***, which consists of steel sheet sections with intersecting edges that are driven in place similar to piles. Cofferdams can be used to allow the construction zone to be dewatered so that the construction area is dry. They can also be used to contain an area of water to prevent waterborne pollutants from migrating to the surrounding area. For the Preferred Alternative, cofferdams would be used in the portion of the alignment that would be relatively shallow beneath the Hudson River (see Section 3.3.5 below).
- ***Underpinning*** is a process in which structural support (often using piles) is added to support an existing foundation and permit project construction below. For the Preferred Alternative, underpinning would be used above the tunnel alignment in Hoboken and Weehawken at and near the Willow Avenue viaduct. Additionally, underpinning would be used in Manhattan in the vicinity of the building at 450 West 33rd Street, where modifications would be made beneath the building, and also to support sewer lines that are above the tunnel alignment.
- ***Dewatering*** is a process used to remove water from a construction site. Dewatering is typically accomplished by pumping groundwater from wells or sumps and conveying to discharge points away from the area to be excavated. For the Preferred Alternative, dewatering would be required in the Meadowlands area of New Jersey where the surface alignment would be constructed. Dewatering may also be required at the Hoboken shaft site. Within the new Hudson River Tunnel, limited inflow of groundwater is expected. Inflow water collection and disposal from the excavations would include some combination of sumps, pumps and sediment-settling tanks at construction staging sites and access shaft sites. Water pumped from excavation sites would be tested and treated before disposal under applicable permits and in conformance with applicable discharge limits.
- ***Utility relocation*** involves moving buried or overhead utilities (i.e., electric, gas, water, sewer, storm water, and communication infrastructure) that fall within the footprint of the construction zone, such as in an area where excavation in or under a streetbed is required. In some cases, utilities can be supported in place; in other instances, they would be relocated in close proximity. Temporary outages to service may occur during relocation.
- ***Soil and erosion control measures and Best Management Practices (BMPs)*** would be used at all the Project construction sites. Erosion and sediment control and stormwater management plans set forth the practices and measures that will be followed to prevent or reduce erosion on construction sites and minimize the impacts of sediment, turbidity, and

hydrologic changes off-site. Such plans are typically part of a Stormwater Pollution Prevention Plan (SPPP) that ensures that erosion and sediment control is appropriate for the planned use of the site. Construction contracts would include provisions for developing and implementing soil and erosion control plans at surface construction sites, to ensure that all applicable laws and regulations pertaining to stormwater pollution prevention are addressed. Standard soil erosion and other control measures (e.g., silt fences and barriers, soil tarps, hay bale checks) would be implemented, as necessary, to prevent soil from leaving the work zone.

- A ***Project-wide Soils and Materials Management Plan (SMMP)*** would be developed to manage contaminated materials encountered during construction. SMMPs provide procedures for materials handling during construction activities, including procedures for stockpiled or containerized material and testing procedures for sampling material prior to off-site disposal or on-site reuse. In addition, the Project contractor will implement BMPs related to landslide prevention as well as other BMPs developed specifically for the various construction sites.
- ***Dust control measures*** would be used at all construction sites to minimize fugitive dust emissions from construction activities. For example, all trucks hauling loose material will be equipped with tight-fitting tailgates and their loads securely covered prior to leaving the Project construction sites; and water sprays will be used for all excavation and transfer of soils to ensure that materials would be dampened as necessary to avoid the suspension of dust into the air. Loose materials will be dampened or covered and stockpiles will be covered with a heavy-duty plastic at the end of the work day and will be bermed to contain water that drains from the soil which will be collected and containerized for disposal as needed. Vehicles will be rinsed at rinsing stations before leaving construction staging areas and mud mats will be used to help protect against dirt being tracked off the sites. In addition, a continuous perimeter air monitoring program will be conducted at the staging areas to identify when additional dust management procedures are warranted.
- ***Rodent control programs*** would be used at all the Project construction sites. Rodents can become a nuisance when construction activities disturb earth. The Project Sponsor will require that construction contract specifications include requirements for a rodent control program. Specifically, prior to beginning any construction or demolition operations, the contract terms will require the Project contractor to conduct a survey for evidence of current rodent activity and initiate a rodent control program by a certified pest control operator if the survey indicates that it is necessary. Before the start of construction, the Project contractor would survey and bait the appropriate areas, including construction staging areas, and provide for proper site sanitation. During the construction phase the Project contractor would carry out a maintenance program, as needed. Coordination would be maintained with appropriate public agencies and the Project contractor would be required to perform rodent control programs in a manner that avoids hazards to persons, domestic animals, and non-target wildlife.

3.3 DESCRIPTION OF SITE-SPECIFIC CONSTRUCTION ACTIVITIES

This section describes the site-specific construction activities that would occur for the Preferred Alternative, including for the surface tracks, new tunnel, fan plants, and other components, and the anticipated schedule for that work. As noted earlier, this description is based on preliminary engineering and is likely to evolve further as engineering advances. Thus, it represents a reasonable estimate of how the Preferred Alternative could be constructed. FRA and NJ TRANSIT have updated this information since publication of the DEIS to reflect modifications to the Project design related to construction methodology and sequencing. Following this section, Section 3.4 of this chapter presents a potential overall construction sequencing and schedule for the Project, based on preliminary engineering. As final design and construction advances, the Project Sponsor will seek to identify opportunities to advance the Project more efficiently and quickly, which may result in a different schedule for construction than the one presented in this chapter. However, the construction schedule presented in this chapter represents a reasonable basis for the assessment of Project impacts, and changes to the construction schedule would not affect the validity of the analysis presented in this EIS.

3.3.1 NEW JERSEY SURFACE ALIGNMENT

The western portion of the new surface alignment would involve construction of two new tracks from Allied Interlocking in Secaucus (located east of Secaucus Junction Station near County Road) to the new tunnel portal in North Bergen. This would include construction of the new raised right-of-way (including segments of retained fill, viaducts, sloped embankments, open cuts, and retained cuts); an adjacent access road; installation of new tracks and modification of existing tracks; installation of drainage systems; and installation of signals, power supply, and other related rail infrastructure. Construction of this segment of the Preferred Alternative would require temporary construction staging areas and temporary construction access roads. **Figure 3-5** shows the types of track support that would be used in this area.

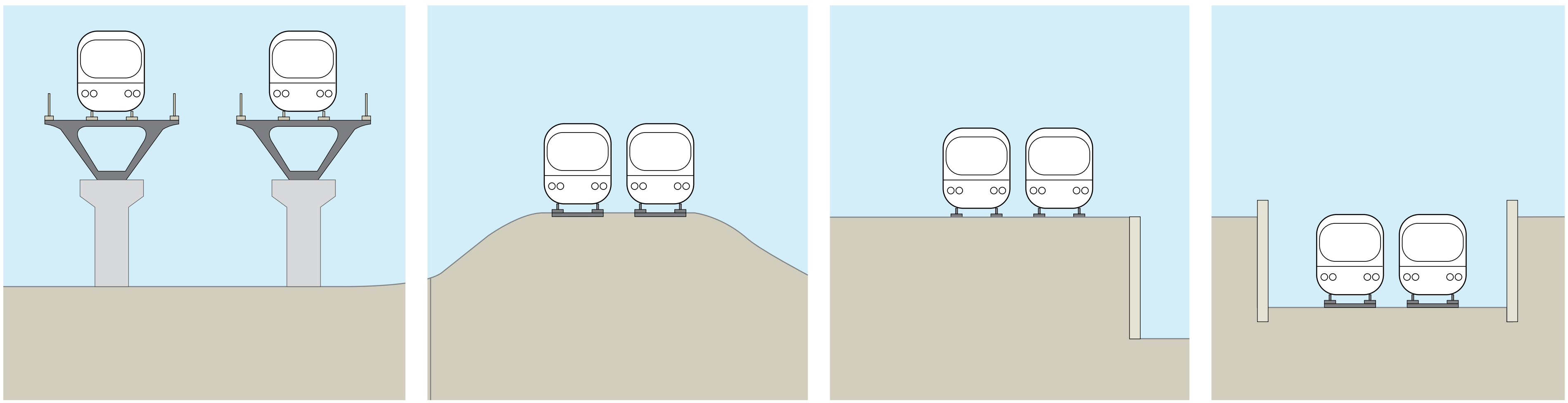
3.3.1.1 CONSTRUCTION OF SURFACE TRACK SUPPORT SYSTEMS

Between Allied Interlocking and approximately Tonnelle Avenue, the existing NEC is on an embankment approximately 20 to 30 feet above the surrounding properties. With the Preferred Alternative, the existing right-of-way would be widened to the south to accommodate two new tracks. The new right-of-way would consist of a mix of retained fill, viaduct, and sloped embankment. **Table 3-1** summarizes the track support elements for the Preferred Alternative.

Table 3-1
Track Support for Surface Alignment

Track Support	Location
Retained fill (supported by retaining wall)	From the east side of County Road to a point approximately 550 feet east of Secaucus Road
Rail viaducts and bridges	• Undergrade rail bridge over Secaucus Road • Approximately 3,100-foot-long rail viaduct segment beginning approximately 550 feet east of Secaucus Road • Undergrade rail bridge over Conrail and NYSW freight tracks
Sloped embankment	Section of new alignment between bridge over NYSW/Conrail freight tracks and Tonnelle Avenue roadway bridge
Roadway bridge	Tonnelle Avenue over new track alignment (overgrade bridge)
Retained cut / open cut	Beneath Tonnelle Avenue to new portal

Between approximately County Road in Secaucus and a point approximately 550 feet east of Secaucus Road in North Bergen, the new right-of way would be on an embankment of retained fill. Using retaining walls to support the embankment would limit the disturbance to adjacent businesses in comparison to a sloped embankment. The retaining walls would consist of precast concrete wall sections set on concrete pile caps that are cast in place. Construction of the retained fill embankment support structures would therefore involve pile driving, concrete deliveries, delivery and setting of precast wall sections, and earthmoving and grading. Access to this construction zone would be made from the parking areas and driveways of adjacent businesses, which abut Amtrak's NEC right-of-way. All fill material imported for embankment construction would be clean soil, as detailed below in Section 3.3.1.5.



NOT TO SCALE

HUDSON TUNNEL PROJECT

Types of Surface Alignments
Figure 3-5

Beginning about 550 feet east of Secaucus Road, a new, approximately 3,100-foot-long rail viaduct would be constructed along the north side of industrial properties over Penhorn Creek and, curving away from the existing NEC, over an undeveloped wetlands area. The viaduct structure would be constructed by installing piles, erecting the viaduct piers, connecting the piers with pile caps, erecting the steel or precast concrete girders, installing a concrete deck to create the bridge superstructure, and finally, installing rails and ties on a ballasted deck. Access to the viaduct section during construction would be from a new construction access road to be created along the south side of the right-of-way (discussed below in Section 3.3.1.7). The access road would ultimately become a permanent maintenance and emergency access road for the new alignment.

As described and analyzed in the DEIS, the Preferred Alternative included a 1,900-foot-long sloped embankment in the eastern portion of the surface alignment segment, where the alignment begins to curve away from the NEC. After completion of the DEIS, Amtrak refined the design to replace the sloped embankment with a rail viaduct. This design refinement would reduce the impacts of the Preferred Alternative on wetlands and the overall footprint of the Preferred Alternative at this location, since a viaduct requires less right-of-way than a sloped embankment. The change would reduce maintenance costs in the long term because a sloped embankment in the soft soils of the Meadowlands would have the potential for settlement and therefore could require reballasting over time.

In addition to the viaduct, the new right-of-way would include two bridges: one parallel to the existing NEC bridge that would carry the new tracks across Secaucus Road, and another over the freight rail right-of-way used by Conrail and New York, Susquehanna & Western Railway (NYSW). Construction activities for the bridges would involve installing piles and concrete bridge abutments and erecting the steel superstructure for the bridge spans, then adding ballast, rails, and ties on the concrete decks. The Project Sponsor will schedule construction activities for the bridge over the Conrail-NYSW rail freight right-of-way in coordination with the freight rail companies to avoid impacts to their operations.

East of the bridge over the freight rail right-of-way, the new alignment would descend on a sloped embankment to Tonnelle Avenue. Construction of this sloped embankment would involve earthmoving and grading. Soil would be imported to the site to create the embankment.

The rail right-of-way would pass beneath Tonnelle Avenue in a cut. A new roadway bridge would be built to carry Tonnelle Avenue over the new tracks. To construct the new Tonnelle Avenue roadway bridge, the existing four roadway lanes would be temporarily shifted in stages to allow the sequenced construction of a new bridge structure to carry the new roadway above the railroad alignment. Any required lane closures would be coordinated to limit impacts to off-peak periods. To provide adequate work-zone widths, it is possible that the travel lanes would be reduced from their current 12-foot widths and the roadway shoulders would be closed throughout the construction zone. Post-construction, lane and shoulder configurations would be restored. Appropriate construction and staging approaches would be incorporated into the Maintenance and Protection of Traffic (MPT) plans for this segment.

Near the new tunnel portal, an open cut area would be constructed for the alignment and kept clear with retaining wall and engineered embankments.

3.3.1.2 DRAINAGE

Construction activity in the surface alignment segment would also include construction of new drainage infrastructure, including culverts and storm sewers. Culverts that currently run underneath the existing NEC in this area would be extended to include the area beneath the new tracks (in the vicinity of Penhorn Creek). In addition, a new 36-inch storm sewer would be installed beneath the parking areas of adjacent properties along the south side of the NEC west of Secaucus Road. Construction of the new culverts and culvert extensions would include the installation of a temporary cofferdam and sump pits to divert water flow around the work area to control infiltration of groundwater during placement and anchoring of culverts or extensions. Water removed during cofferdam dewatering would be treated with temporary sediment control measures before being discharged back to surface waters or wetlands.

The DEIS described that east of Secaucus Road, a tributary to Penhorn Creek would pass beneath the new surface access road (described in Section 3.3.1.7) in a culvert. During review of permit applications for the Preferred Alternative, the New Jersey Department of Environmental Protection (NJDEP) provided comments on this culvert. To address those comments, the culvert is no longer included and instead, a portion of the Penhorn Creek tributary would be relocated slightly to the south in a new, trapezoidal channel with a natural bottom. An inoperable pump station on Penhorn Creek would be demolished and removed, and the existing Penhorn Creek weir just south of the NEC alignment would be removed and replaced with a new weir south of the culvert carrying Penhorn Creek.

3.3.1.3 TRACKWORK AND RAILROAD SYSTEMS

In the surface alignment segment, construction would also include installation of the various railroad systems, including tracks, signals and communication systems, and overhead contact system structures and wires. Foundations for the overhead contact system structures would be on drilled caissons reaching down to native soil or rock; on the viaduct structure, catenary poles would be attached to extended pier bents. Existing tracks and signals within Allied Interlocking east of Secaucus Junction Station would be modified to connect and control the new tracks connecting with the NEC. This work would involve the use of truck-mounted and rail-mounted equipment.

In addition, the Preferred Alternative includes modifications within the existing Amtrak substation (Substation 42) on the west side of Tonnelle Avenue on the south side of the NEC.

3.3.1.4 UTILITY RELOCATION

Before the new rail bridge over Secaucus Road is built, utilities within the roadbed that could be disturbed by construction would be relocated. Utilities in and above Tonnelle Avenue would also need to be relocated to facilitate construction of the roadway bridge over the new alignment. In addition, some PSE&G utility lines on wooden poles adjacent to and within the NEC right-of-way would need to be relocated.

3.3.1.5 EXCAVATED MATERIAL AND DISPOSAL

Construction of the surface alignment would involve import of clean soils to create the retained fill segment (which would be predominantly west of Secaucus Road) and sloped embankment segment east of the freight rail right-of-way. Excavated material from the construction of the retaining walls is not suitable for backfill behind the retaining walls and would be removed from the construction zone by truck. The Project Sponsor will develop protocols during final design to identify spoils that may contain contaminated materials so that they can be handled appropriately and disposed of at a suitable location. Commercial disposal facilities are required to meet all applicable regulations and typically process soils and dredge materials to recycle or beneficially reuse them. Locations for spoils disposal are available in nearby areas of New Jersey. The Project Sponsor will be responsible for working with the Project contractor to find a suitable location for disposal of spoils. Spoils will not be disposed in areas within the jurisdiction of the U.S. Army Corps of Engineers (USACE), to avoid adverse effects related to placing fill in wetlands or navigable waters. In addition, protocols for the transport of spoils from the construction sites would be developed to ensure the safe handling of these materials and would include procedures to secure the material from spilling off trucks, as well as for any inadvertent or accidental spills of materials falling from trucks removing this material from the staging areas. Additional information related to the handling and disposal of excavated materials is provided in Chapter 16, “Contaminated Materials,” Section 16.8.1.1.

3.3.1.6 CONSTRUCTION STAGING AREAS

A construction staging area to support construction of the surface alignment in New Jersey would be established on property owned by NJ TRANSIT on both sides of Tonnelle Avenue in North Bergen (the same property that would be used for staging related to tunnel construction, discussed in Sections 3.3.2 and 3.3.4 below). The properties on both sides of Tonnelle Avenue would eventually be connected via the new underpass beneath Tonnelle Avenue created for the rail alignment; before that time, trucks would move between the two sites via Tonnelle Avenue. This staging area would accommodate storage and delivery of construction materials, truck deliveries of cement, steel, and fill materials, and removal of debris. **Figure 3-6** shows the location of this staging area.

In addition to the Tonnelle Avenue staging area, during construction of the surface alignment, the Project contractor would likely use Amtrak’s existing NEC right-of-way for smaller staging areas or laydown areas; the Project contractor may also elect to obtain other areas close to the right-of-way if additional space is needed. These staging areas in the industrial area close to the existing right-of-way might potentially be in use for up to four years over the course of surface alignment construction (described further in Section 3.3.1.8).

3.3.1.7 TRUCK ROUTES AND ACCESS ROADS

Figure 3-6 shows the location and routes of the temporary access roads and truck haul routes to and from the Project site and staging areas for construction of the surface tracks.

A new 20-foot-wide permanent vehicular access road (providing access to tracks with clearances required by local emergency responders) would be constructed along the south side of the new tracks in the retained fill embankment and viaduct sections east of Secaucus Road. As it passes above a tributary to Penhorn Creek in the Meadowlands, the road would be on a viaduct with an open, grated surface. This road would have a turnaround area approximately 180 feet west of the NYSW rail right-of-way, with a short spur past this turnaround point running under and between the new viaduct structures up to the NYSW rail right-of-way. This private road and the construction zone for the new viaduct and bridge above the freight railroad right-of-way would be accessed through a new controlled access point on Secaucus Road immediately south of the new rail bridge over that road.

In addition to this permanent road, temporary access to the construction site would be made via existing parking lots and driveways in the industrial and warehousing properties that adjoin the NEC for the portion of the new alignment between County Road and Secaucus Road. Trucks using these haul routes would be carrying construction materials to the site and hauling away construction debris, which may include contaminated or hazardous materials encountered during construction (a discussion of practices for handling and transporting hazardous materials is provided in Chapter 16, “Contaminated Materials,” Section 16.8).

Trucks would travel to and from the construction zone for the surface alignment using County Road (at the west end of the surface alignment for the Preferred Alternative) and Secaucus Road (in the center of the surface alignment). Trucks would travel to and from the Tonnelle Avenue staging site (about 2 miles away) using County Road and Secaucus Road. Tonnelle Avenue (U.S. Routes 1 and 9) connects to Route 495 and from there to I-95/New Jersey Turnpike. On average, five to six trucks per hour would travel to and then from the staging site during construction of the surface alignment. Trucks using the haul routes for the Tonnelle Avenue staging site would be carrying construction materials to the site and hauling away construction debris and tunnel spoils, which may include contaminated or hazardous materials encountered during construction.

2/8/2018

Construction Staging Area
Proposed New Tunnel
North River Tunnel to be Rehabilitated
Proposed Surface Tracks
Truck Routes and Access Roads
Existing Northeast Corridor

0 2,000 FEET

Tonnelle Avenue Staging Area:
Truck Routes and Access Roads

Figure 3-6

HUDSON TUNNEL PROJECT

Vehicles will be rinsed at rinsing stations before leaving construction staging areas and mud mats will be used to help protect against dirt being tracked off the sites.

Trucks traveling to and from the construction zone for the surface alignment would use County Road (at the west end of the surface alignment for the Preferred Alternative) and Secaucus Road (in the center of the surface alignment) to access the construction area and to connect to Tonnelle Avenue and I-95/New Jersey Turnpike (via Tonnelle Avenue). On average, one to two trucks per hour would travel to and from the areas where the retained fill embankment would be constructed, and would carry construction materials to the site and haul away any construction and demolition debris generated during the construction of this segment of the alignment. Trucks traveling between the Tonnelle Avenue staging site and the new construction access road off Secaucus Road for access to the new embankment and viaduct segment east of Secaucus Road would travel on Tonnelle Avenue and Secaucus Road. An average of six trucks per hour would travel to and from the viaduct construction zone. Materials may be delivered to and stored on the Tonnelle Avenue staging area to support the viaduct construction. Truck routes would be coordinated with NJDEP and the local municipality, the Township of North Bergen and/or the Town of Secaucus.

The Project Sponsor will be responsible for maintenance, repair, and cleaning of designated truck routes on local streets and will reconstruct any streets damaged by trucking activity associated with construction of the Preferred Alternative.

Potential impacts on traffic conditions, noise levels, air quality, and the surrounding community from the construction-related truck traffic are evaluated in subsequent chapters of this EIS.

3.3.1.8 SCHEDULE

Construction activities for the portion of the alignment from Allied Interlocking to the new tunnel portal would typically occur between 7 AM and 11 PM on weekdays. However, work in close proximity to the existing NEC would be conducted primarily during nights and weekends to avoid disruptions to daytime train service. This work would occur over approximately seven years, currently anticipated to occur as follows (note that certain activities may overlap):

- Surface alignment support, including utility relocation, retained fill embankment construction, viaduct construction, bridge across freight tracks, sloped embankment construction east of Conrail right-of-way: 4 years.
- Tonnelle Avenue roadway bridge: 2.5 years.
- Trackwork and railroad systems: 2.5 years.

During construction of the surface alignment's new retained fill embankments, viaducts, and bridges, approximately 55 to 85 workers would be on site at a time, with an additional 20 to 30 workers on site for the new bridge over the freight railroad right-of-way and 40 workers on site for the Tonnelle Avenue roadway bridge. Once those structures are in place, approximately 25 to 30 workers would be on site installing tracks, signals, catenary, and other railroad infrastructure.

3.3.2 PALISADES SEGMENT OF THE HUDSON RIVER TUNNEL

The new Hudson River Tunnel would begin at the western face of the Palisades at a new tunnel portal (entrance) excavated in the slope of the Palisades. The tunnel through the hard rock of the Palisades would consist of two approximately 5,100-foot-long tubes, each constructed by a TBM operating eastward from the Tonnelle Avenue staging site to the Hoboken staging site (discussed later in this chapter in Section 3.3.3). This segment of the new Hudson River Tunnel through the rock of the Palisades is referred to as the Palisades tunnel.

As discussed in this section, the excavation of the Palisades tunnel segment would be staged from a staging area on both sides of Tonnelle Avenue in North Bergen, New Jersey where the new tunnel would begin. In addition, after the Palisades tunnel excavation is complete, this staging area would also be used to support construction of the tunnel from the Hoboken staging site to New York (referred to as the river tunnel), which is discussed in Section 3.3.4 below.

3.3.2.1 TUNNEL EXCAVATION

The two tubes of the Palisades tunnel would be bored by two TBMs working at the same time, to expedite the construction schedule. Construction worker and truck estimates for the analyses in this FEIS are based on an assumption that two TBMs would be operating in parallel. In this case, one TBM would be launched from Tonnelle Avenue and advanced into the tunnel before the second TBM would be launched, approximately two months after the first TBM. The separation of the two TBMs allows experience gained from the first TBM moving through the ground conditions along the Project alignment to be applied to the work of the second TBM, and provides better control of the ground conditions at the front of each tunnel heading as the excavation progresses. TBMs are very large pieces of equipment that are delivered in pieces for on-site assembly. The delivery of TBM components for each of the TBMs to be used for the Project would occur over approximately one month.

The initial, approximately 50 feet of the tunnel may be constructed using controlled drilling and blasting, to excavate a starter tunnel in which the TBMs could be launched. After the starter tunnel has been excavated, the large components of the TBM would be brought to the Tonnelle Avenue staging site and the TBM would be assembled there.

The TBMs would proceed an average of approximately 30 feet per day through the hard rock of the Palisades, so that each tube of the tunnel through the Palisades would take approximately eight months to bore, with the second TBM lagging behind the first by about two months. Some days, the production rate would be higher, but on other days it would be lower, depending on rock conditions along the alignment. The tunnel liner would be installed after the tunnel has been excavated, either using precast concrete tunnel segments that are put in place as the TBM advances or using a cast-in-place concrete liner with a waterproof membrane that would be cast after the tunneling is complete.

The two tubes would be roughly 20 to 25 feet apart for the full length of the tunnel; this amount of separation would minimize the impact of the second TBM mining operation on the completed portions of the first tunnel.

3.3.2.2 CROSS PASSAGES

The Palisades tunnel segment would have six cross passages connecting the two tubes of the rock tunnel at intervals of approximately 750 feet. Each cross passage would be approximately 20 to 25 feet long (i.e., the distance between the two tubes). The cross passages would be constructed using controlled drilling and blasting from within the tunnel. Permanent lining of the cross passages would be with cast-in-place concrete with a waterproof membrane. Based on the conceptual construction schedule, construction of the cross passages would likely occur for the full Hudson River Tunnel after boring of the Palisades tunnel segment and river tunnel segment tubes are complete.

During blasting, geotechnical and structural monitoring would be used in coordination with the controlled blasting to ensure that vibration from blasting does not have the potential to damage the deteriorated concrete of the North River Tunnel, especially in the western Palisades where the new tunnel would be relatively close (approximately 400 feet) from the North River Tunnel. (For more information, see Chapter 12B, "Vibration," Section 12B.9.2.)

3.3.2.3 TUNNEL VENTILATION DURING CONSTRUCTION

Temporary fire-life safety systems would be installed within the new tunnel as it is excavated to protect workers during construction activities. This would include temporary tunnel ventilation powered by large fans that would operate continuously during construction at the Tonnelle Avenue portal site. A standpipe system would be installed, and sufficient illumination levels would be maintained at the walking surface for worker safety. In addition, fire extinguishers and fire hoses would be provided in the tunnel during construction.

3.3.2.4 EXCAVATED MATERIAL AND DISPOSAL

Excavated rock and soil (referred to as “spoils”) from the tunnel would be removed from the tunnel at the rear of the TBM using a conveyor or similar system within the tunnel, and brought out of the tunnel at the Tonnelle Avenue staging site. Spoils from subsequent cross passage excavation would be hauled through the tunnel in the same fashion. In total, approximately 500,000 cubic yards of loose rock would be removed from the two tubes of the Palisades tunnel and cross passages as they are constructed. Tunnel spoils would be stockpiled on the staging site as necessary to accommodate trucking schedules, before being trucked to a final disposal location. The Project Sponsor will be responsible for working with the Project contractor to find a suitable location for reuse or disposal of spoils from the tunnel mining.

The Project Sponsor will develop protocols during final design to identify spoils that may contain contaminated materials so that they can be handled appropriately and disposed of at a suitable location. Most of the excavated material would be clean, crushed rock, which can be reused beneficially at other locations. The rock is not likely to be contaminated because of both its depth and impermeability—although there is a possibility that some of the rock could contain naturally occurring asbestos-containing materials, which would limit the use of that portion of the spoils. Depending on the gradation (i.e., particle size) of the excavated material from the Palisades tunnel, reuse opportunities for uncontaminated rock could include filling abandoned mines or use in road paving materials. For example, crushed rock from the large water tunnel that the City of New York is constructing, Water Tunnel No. 3, is being transported by rail to Long Island, where it is being used as base material for road construction, and by truck to Staten Island, where it is being used as cover for the Fresh Kills Landfill.

Protocols for the transport of spoils from the construction sites would be developed to ensure the safe handling of these materials and would include procedures to secure the material from spilling off trucks, as well as for any inadvertent or accidental spills of materials falling from trucks removing this material from the staging sites. In addition, the Project Sponsor will require the Project contractor to develop a Project-specific Health and Safety Plan (HASP) prior to earth-disturbing activities to protect workers and the public from potential exposure to contaminated materials. The HASP will set out procedures for handling of contaminated materials and procedures to minimize dust generation, such as the use of water spray, dust retardants, and/or truck wheel wash, during soil disturbance and excavation activities.

For spoils that cannot be reused, commercial disposal sites may be appropriate. These facilities are required to meet all applicable regulations and typically process soils and dredge materials to recycle or beneficially reuse them. Locations for spoils disposal are available in nearby areas of New Jersey. The Project Sponsor will be responsible for working with the Project contractor to determine the commercial disposal site(s) for disposal of spoils. Spoils will not be disposed in areas within the jurisdiction of the USACE, to avoid adverse effects related to placing fill in wetlands or navigable waters.

Additional information related to the handling and disposal of excavated materials is provided in Chapter 16, “Contaminated Materials,” Section 16.8.1.1.

3.3.2.5 TRACKWORK AND RAILROAD SYSTEMS

The various railroad systems, including tracks, signals and communications, and overhead contact system structures and wires, would be installed for the full Hudson River Tunnel once excavation of both the Palisades and river tunnel segments is complete. Construction and finishing of the various mechanical, electrical, and plumbing systems, including tunnel ventilation systems and tunnel lighting systems, would also be installed once both the Palisades segment and the river tunnel segment of the tunnel are complete.

3.3.2.6 CONSTRUCTION STAGING AREAS

A construction staging site would be established on both the east and west sides of Tonnelle Avenue in North Bergen where the alignment of the Preferred Alternative would cross beneath that roadway (see **Figure 3-6**). This staging site is the same as would be used for the surface alignment (discussed above in Section 3.3.1.6). The properties on either side of Tonnelle Avenue would eventually be connected via the underpass beneath Tonnelle Avenue created for the rail alignment. This staging area would be used for storage of construction equipment and material, parking and facilities for construction workers, construction office trailers, and related activities. Construction workers would access the tunnel from this site and deliveries for the tunnel construction would be brought here. The site would also be used for assembling and launching the TBMs and removing spoils from both the Palisades and river tunnel segments of the new Hudson River Tunnel. The staging area would include locations for a construction crane, fuel, TBM water treatment facility, and an electrical substation to power the TBMs. It would also include tunnel fans (at the mouth of the new tunnel) to provide ventilation for workers excavating the tunnel. There would also be areas for storing tunnel spoils until they can be trucked from the site for disposal, including a possible temporary spoils storage area on the west side of Tonnelle Avenue that could extend to a depth of approximately 30 feet below ground surface to allow the storage of a larger volume of spoils on site. If the Project contractor chooses to implement such a pit, the pit would be lined or otherwise managed to reduce groundwater inflow into it and to reduce spoil material from flowing out of the pit.

Following completion of the new Hudson River Tunnel, the rehabilitation of the North River Tunnel (discussed in detail below in Section 3.3.10) would continue to use the Tonnelle Avenue staging area. To support the North River Tunnel rehabilitation, new construction access between the staging area and the existing NEC at the North River Tunnel portal would be constructed across the newly active tracks of the Hudson River Tunnel right-of-way. It may be possible to create such construction access in advance during construction of the new Hudson River Tunnel.

3.3.2.7 TRUCK ROUTES

Trucks would travel to and from the Tonnelle Avenue staging site using Tonnelle Avenue itself (U.S. Routes 1 and 9), which connects to Route 495 (and from there to I-95/New Jersey Turnpike). Trucks at the portion of the staging site on the west side of Tonnelle Avenue would travel south and make a U-turn just south of the site or farther south at Secaucus Road (see **Figure 3-6**).[2] The Project Sponsor may also choose to remove spoil materials by rail using the adjacent rail freight rights-of-way operated by Conrail and NYSW; however, this is unlikely because the additional

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[2] In addition, it is possible that the Project Sponsor would create a new intersection at the driveway of the Tonnelle Avenue staging area, by installing a new traffic signal there and removing the barrier that divides the roadway. This would allow northbound trucks to exit the staging area without heading south to turn around at Secaucus Road. This new intersection would reduce the traffic and noise impacts associated with the Preferred Alternative's construction traffic. A new signal would require approval by the New Jersey Department of Transportation (NJDOT), which has jurisdiction over Tonnelle Avenue (Routes 1 and 9). For more information, see Chapter 5A, "Traffic and Pedestrians," Section 5A.8.1.1.

handling involved to use this method of transport would probably result in multiple handling or operation/construction complexities that could lead to delays as well as additional costs.

An average of approximately 15 to 26 trucks per hour would arrive at and depart from the Tonnelle Avenue construction zone during the most intensive construction activities associated with excavation of the Palisades tunnel segment. These trucks would be carrying construction materials to the site and hauling away construction debris and tunnel spoils, which may include contaminated or hazardous materials encountered during construction. Truck routes would be coordinated with the New Jersey Department of Transportation (NJDOT), NJDEP, and the local municipality, the Township of North Bergen. Vehicles will be rinsed at rinsing stations before leaving construction staging areas and mud mats will be used to help protect against dirt being tracked off the sites.

The Project Sponsor will be responsible for maintenance, repair, and cleaning of designated truck routes on local streets and will reconstruct any streets damaged by trucking activity associated with construction of the Preferred Alternative.

Potential impacts on traffic conditions, noise levels, air quality, and the surrounding community from the construction-related truck traffic are evaluated in subsequent chapters of this EIS.

3.3.2.8 SCHEDULE

To achieve an expedited schedule, the two tubes of the Palisades tunnel segment would be constructed by two TBMs working in parallel, with the second TBM beginning operation approximately two months after the first TBM. The tunneling operation would occur 24 hours a day on weekdays (three shifts a day). Materials excavated during the late-night shift (11 PM-7 AM) would be stored at the staging area at night and then removed during the day. Some weekend work could also occur to support the weekday activities, such as equipment maintenance or grouting to reduce water inflows. In addition, some weekend work could occur for short periods if needed to make up for unplanned schedule delays.

Controlled drill-and-blast construction for the starter tunnel and cross passages would be accomplished in two eight-hour shifts per day (7 AM-3 PM and 3 PM-11 PM) on weekdays. Blasting would not be performed before 8 AM or after 6 PM except under special circumstances and only with permission from the appropriate regulatory agency (i.e., North Hudson Regional Fire and Rescue).[3] Construction work for installation of trackwork and railroad systems would occur from 7 AM-11 PM on weekdays.

The construction activities for the Palisades tunnel would occur over approximately seven years, currently anticipated to occur as follows (note that certain activities may overlap):

- Site preparation: 3 months.
- Open cut and excavation of Tonnelle Avenue portal, and starter tunnels: approximately 1 year.
- Palisades tunnel excavation: approximately 1 year.
- Support of river tunnel excavation through excavated Palisades tunnel: approximately 1 year.
- Palisades tunnel cross passages: approximately 9 months.
- Palisades tunnel internal concrete: approximately 8 months.

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3 Per New Jersey state law, 12 NJAC 190-7.6, except during unusual conditions and when approved by the Commissioner, blasting shall be conducted only during daylight hours, but shall not be conducted before 8 AM or after 6 PM. https://www.nj.gov/labor/lsse/laws/Explosives_Law.html#19076.

- Trackwork, railroad systems, and finishes: approximately 3 years.

During construction of the Palisades segment of the new Hudson River Tunnel, approximately 60 construction workers would be working at the Tonnelle Avenue staging site and in the tunnel itself during each shift. For cross passage construction, approximately 25 to 30 workers would be in the tunnel. In addition, during construction of the river tunnel segment and its cross passages, most or all workers would be based at this site (see Section 3.3.4 below). Once the tunnel is complete to New York, approximately 25 to 30 workers would work in the tunnel during each shift installing tracks, signals, catenary, and other railroad infrastructure.

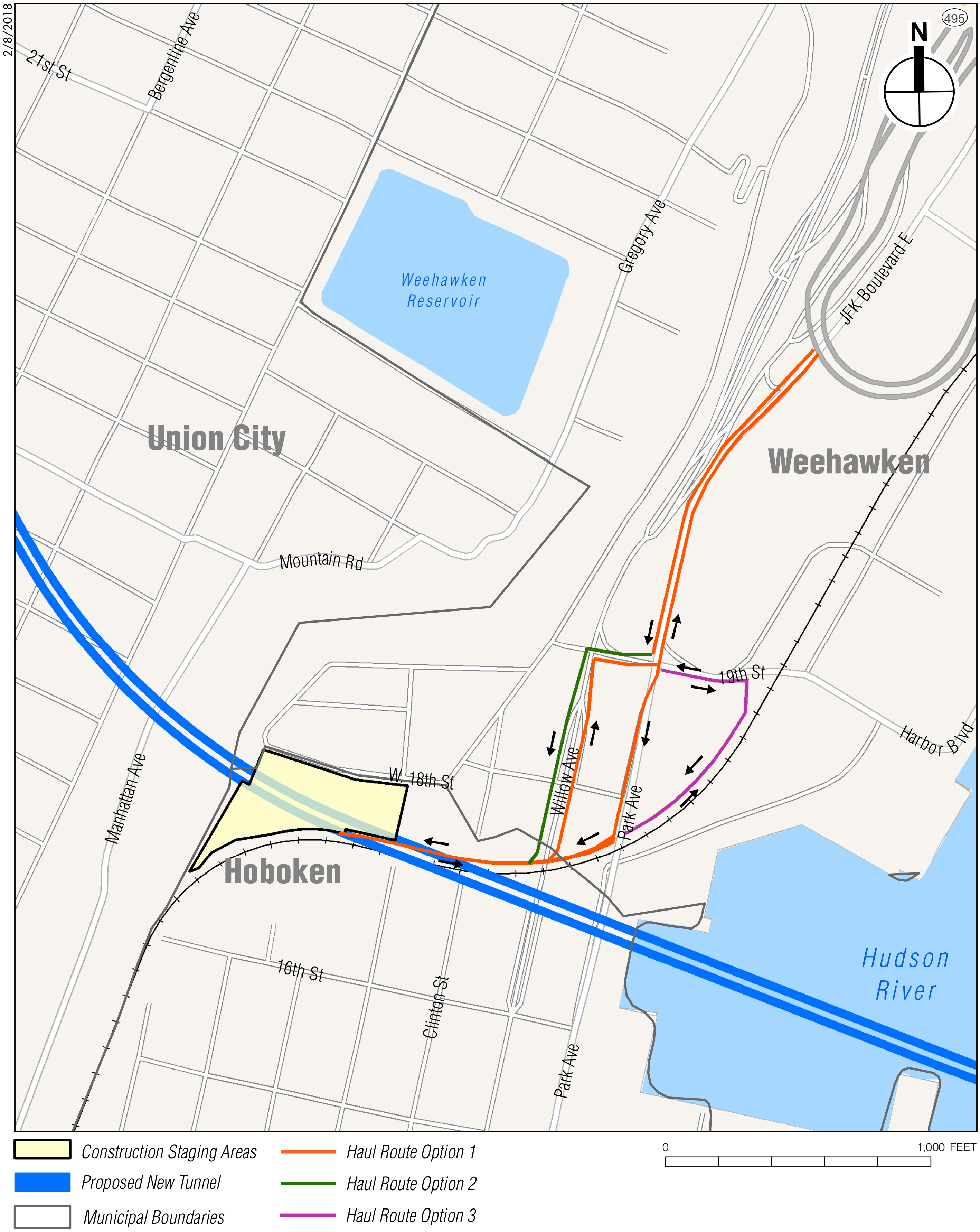
3.3.3 HOBOKEN SHAFT, STAGING, AND FAN PLANT SITE

An approximately 130-foot-diameter ventilation shaft and associated fan plant would be constructed at a site on the south side of West 18th Street at the convergence of the municipal boundaries of Hoboken, Weehawken, and Union City. The site, referred to in this EIS as the Hoboken staging area and shaft site, is located in all three municipalities, but is predominantly in Hoboken. It is bordered on the south by the tracks of the Hudson-Bergen Light Rail (HBLR) and on the north by West 18th Street. North of the site, the Weehawken residential neighborhood known as the Shades is immediately north of West 18th Street. **Figure 3-7** shows the location of the Hoboken shaft site and staging area. The Hoboken shaft would be located at the interface of the Palisades tunnel segment (Section 3.3.2) and the river tunnel segment beneath Hoboken, Weehawken, and the Hudson River to the Manhattan bulkhead (Section 3.3.4).

The Hoboken ventilation shaft would extend from the surface to the tunnel approximately 75 feet below and would ultimately be an integral part of the Preferred Alternative's tunnel ventilation system and a critical emergency access and egress point for the tunnel. To facilitate construction of this shaft and the fan plant above it that would house ventilation functions, a construction staging area would be established at the Hoboken shaft site. During construction of the Hudson River Tunnel, the Hoboken shaft would serve as an access point for certain key construction operations, as discussed below in Section 3.3.3.3 and Section 3.3.4.

In the DEIS, FRA and NJ TRANSIT proposed additional construction activity at the Hoboken staging area, including using the site as the primary point for deliveries to and removal of spoils from construction of the segment of the Hudson River Tunnel between the Hoboken staging area and New York. Following completion of the DEIS, in response to comments made during the public comment period FRA and NJ TRANSIT, working with the Project Partners, have identified ways to reduce the impacts of Project construction on local communities near the Hoboken staging area. As a result of refinements to the Project design and sequencing of construction activities, the scope of activities to be conducted here has decreased. To develop this revised approach, FRA, NJ TRANSIT, and the other Project Partners evaluated a wide range of potential methods to remove excavated materials from the river tunnel with the goal of reducing the number of trucks on local streets in Weehawken. This included the potential use of different truck routes, barging excavated materials from the Weehawken waterfront, and removing excavated materials by freight trains operating on the HBLR right-of-way. The full analysis is included in **Appendix 3-1** to this FEIS.

FRA, NJ TRANSIT, and the other Project Partners have modified the Project's construction staging approach to shift staging and spoils excavation for the river tunnel from the Hoboken staging area to the Tonnelle Avenue staging area. With this modification, the Hoboken staging area would be used for three different phases of construction activities: (1) construction of the vertical shaft from the surface to the depth of the tunnel; (2) as an access point during construction of the new river tunnel segment; and (3) construction of the ventilation fan plant once construction of the tunnel is complete.



Hoboken Staging Area: Truck Routes

Figure 3-7

HUDSON TUNNEL PROJECT

3.3.3.1 SHAFT CONSTRUCTION

The first construction activity at the Hoboken staging area would be excavation of the 130-foot-diameter vertical shaft from the surface to the tunnel below. The vertical shaft would provide direct access for tunneling operations. It must be large in diameter to provide access to both tubes of the tunnel. For tunneling operations, the shaft would be used for demobilization and servicing of the TBMs; and access of crews, equipment, and materials for cross passage construction. Given the geologic conditions, which at shallower levels include soils that are not strong materials, this shaft must be adequately supported to provide safe, stable working conditions for the construction crews, equipment, and materials, which is most effectively achieved by a vertical structure. The same vertical shaft would then be used as a permanent tunnel ventilation shaft because it would provide the shortest direct connection from the tunnel to the associated fan plant building and ventilation system equipment above the tunnel. This would minimizes Project cost and the space required for the ventilation system.

To prepare the site, a sanitary sewer that crosses the site would be relocated. Then, the vertical shaft would be excavated from the surface through soil and rock. Prior to shaft excavation, support walls would be installed to retain the soil. These are likely to be slurry walls. As described in Section 3.2.1.4, slurry walls are concrete walls constructed through the use of a slurry of bentonite, a natural, clay-like, heavy liquid material that is mixed on-site and pumped into the trench during excavation, and then replaced by concrete and steel reinforcing bars placed once the excavation reaches its final depth. The rock portion at the bottom of the shaft would be excavated using controlled drilling and blasting or by mechanical breakage using hydraulic rams. Slurry walls extending into rock for excavation support would also serve to cut off groundwater inflow at the Hoboken shaft. As an additional groundwater cutoff measure, a grouting program to fill cracks and other voids in the rock mass below and adjacent to the shaft may be required in order to minimize groundwater inflow. Ground improvement through injection of grout into the soil and voids in the rock would also be used at the base of the shaft walls to prepare the ground for the subsequent TBM construction through the slurry walls.

3.3.3.2 EXCAVATED MATERIAL AND DISPOSAL

Excavated material from the construction of the vertical shaft would be removed from the Hoboken staging area by truck. A total of approximately 90,000 cubic yards of loose rock and soil would be removed from the vertical shaft. The Hoboken staging area is a site with documented contamination and in 2019, NJ TRANSIT, as property owner, remediated the site in accordance with applicable Federal and state regulations. As described in more detail in Chapter 16, “Contaminated Materials,” Section 16.8, the Project Sponsor will develop a Project-wide Soils and Materials Management Plan (SMMP) to manage contaminated materials encountered during construction. The SMMP would provide procedures for materials handling during construction activities including Best Management Practices (BMPs) to be implemented during construction, such as procedures for stockpiled or containerized material and testing procedures for sampling material prior to off-site disposal or on-site reuse. The transportation and disposal of contaminated material would be conducted in accordance with Federal, state, and local regulations—e.g., regarding proper containers, signage, placards, manifests (waste tracking system), and use of appropriately permitted disposal facilities. See Chapter 16, “Contaminated Materials,” for more comprehensive information on management of contaminated materials.

In addition, the Project Sponsor will require the Project contractor to develop a Project-specific Health and Safety Plan (HASP) prior to earth-disturbing activities to protect workers and the public from potential exposure to contaminated materials. The HASP will set out procedures for handling of contaminated materials and procedures to minimize dust generation, such as the use of water spray, dust retardants, and/or truck wheel wash, during soil disturbance and excavation activities.

The excavated materials from the Hoboken staging area would be disposed of at commercial disposal sites, which are required to meet all applicable regulations and typically process soils and dredge materials to recycle or beneficially reuse them. Locations for spoils disposal are available in nearby areas of New Jersey. The Project Sponsor will be responsible for working with the Project contractor to find a suitable location for disposal of spoils. Spoils will not be disposed in areas within the jurisdiction of the USACE to avoid adverse effects related to placing fill in wetlands or navigable waters.

Additional information related to the handling and disposal of excavated materials is provided in Chapter 16, “Contaminated Materials,” Section 16.8.1.1.

3.3.3.3 STAGING SITE

The Hoboken staging area would be used for construction equipment and material storage, construction worker parking, worker facilities, construction trade facilities, construction office trailers, and related activities. The staging area would include locations for a construction crane, fuel, and treatment facility for groundwater and water from the TBMs. Fans within the shaft would provide ventilation during the tunneling of the river tunnel segment of the new Hudson River Tunnel.

Prior to tunneling east of the Hoboken shaft, the staging area would include a slurry plant to create the liquid clay (bentonite) mixture that would be used to support the excavation of the shaft walls (see Section 3.3.3.1). There would also be an area for storing excavated materials from the shaft construction until they can be trucked from the site for disposal. During construction of the vertical shaft and the fan plant, construction workers would be based at this site and deliveries would arrive at this site. During construction of the river tunnel segment of the new tunnel, some workers may also be based at this site and some deliveries may occur here (see Section 3.3.4 below).

The Project contractor would likely use the same TBMs for the Palisades tunnel segment and the river tunnel segment. In that case, once the Hoboken shaft is completed, the rock TBMs would be modified at the base of the Hoboken shaft for use as mixed-face tunneling machines. This would involve delivery and removal of large TBM components through the shaft for approximately one month for each TBM. Alternatively, the Project contractor may use the shaft as the terminus of the Palisades tunnel, where the hard rock TBMs used to mine the Palisades tunnel segment would be removed from the tunnel via the shaft and new mixed-face TBMs for the river tunnel segment inserted into the tunnel at the shaft. The removal and insertion of TBMs would require about one month for each TBM. Construction activities associated with the river tunnel segment are described in Section 3.3.4 below.

The Hoboken staging area would be laid out to minimize disruption to the adjacent residential neighborhood, the Weehawken neighborhood known as the Shades, which is across West 18th Street from the proposed staging area. An up to 25-foot-high noise wall would run along the entire northern border of the staging area property along West 18th Street; it would wrap at least 100 feet on the western side of the property and extend to the truck haul route on the eastern side of the staging area. This wall would be temporary, but would be in place for the duration of construction at the site. The wall would be clad with aesthetically attractive materials developed in consultation with the local community and would be set back approximately 10 feet from the street curb line, to allow street parking and provide an area for landscaping in front of the wall. This landscaping will also be selected in consultation with the local community (see Chapter 10, “Visual and Aesthetic Resources,” Section 10.8). Truck and worker access to the site would be via an off-road haul route at the back of the site beside the HBLR tracks (see Section 3.3.3.4 below). In addition, lighting at the Hoboken staging area would be no higher than the up-to-25-foot-high noise wall.

3.3.3.4 TRUCK ROUTES

To reduce disruption to the residential neighborhood located across West 18th Street from the site, trucks would not be permitted to use the local streets in that neighborhood (e.g., West 18th Street and Hackensack Plank Road) to access the site. Instead, construction routes that include off-street segments would be established to divert the trucks away from the residential neighborhood.

The off-street construction access road (also referred to as a haul route) would be constructed running along the north side of the HBLR right-of-way between the staging area and Park Avenue. Use of this route would keep trucks away from smaller residential streets immediately north of the shaft site. Trucks and other construction vehicles would reach this access road using the local street system, using one or more of three possible routes (see **Figure 3-7**). These routes are being considered in this EIS to allow a comparison of routing options so that potential impacts from the trucking can be minimized. The final truck route(s) to be used will be determined by the Project Sponsor in coordination with the Project contractor during final design. The three routes are as follows:

- **Haul Route Option 1:** Vehicles leaving the staging area would travel eastward on the off-street construction road along the north side of the HBLR right-of-way, pass under the Willow Avenue viaduct, and turn left (i.e., north) onto the Willow Avenue service road, which runs adjacent to the Willow Avenue viaduct. To accommodate outbound trucks, the curve from the off-street construction road to Willow Avenue would be widened, which would require underpinning the Willow Avenue viaduct to allow a support pier to be moved. At 19th Street, trucks would turn right (i.e., east) and then left (i.e., north) onto northbound JFK Boulevard East, which leads to Route 495 near the Lincoln Tunnel entrance. Trucks headed in the other direction, toward the Hoboken staging area, would travel south on JFK Boulevard East/Park Avenue and after crossing 19th Street would continue on the Park Avenue service road adjacent to the Park Avenue viaduct. At the HBLR tracks, trucks would turn right (i.e., west) onto the off-street construction access road on the north side of the HBLR right-of-way. Between Park Avenue and Willow Avenue, this access road would be constructed on an existing surface easement owned by NJ TRANSIT, procured for the Access to the Region's Core (ARC) Project, that is adjacent to the Gateway apartment building at 1700 Park Avenue. The easement area is currently used by residents of this building as a dog run. The Gateway apartment building is between Park and Willow Avenues, West 18th Street, and the HBLR right-of-way. Haul route Option 1 would thus involve truck access along three sides of this building.
- **Haul Route Option 2:** This option would be the same as Option 1 except that trucks headed to the site would use the southbound Willow Avenue service road rather than the Park Avenue service road. At 19th Street, rather than continuing south on the Park Avenue service road along the east side of the Gateway apartment building and passing through the building's dog run, this route would instead turn right onto 19th Street and then left onto the southbound Willow Avenue service road. This would shift trucks away from the east and south sides of the Gateway apartment building. At the HBLR right-of-way, trucks would turn right onto the off-street construction access road that would run alongside the HBLR tracks. To create an adequate turning radius for southbound trucks, a narrow warehouse building at the southern end of the Willow Avenue service road (1714 Willow Avenue) would have to be demolished for this option. Trucks leaving the shaft site would use the same route as described above, which would include underpinning the Willow Avenue viaduct to create a wider turning radius for outbound trucks.
- **Haul Route Option 3:** FRA and NJ TRANSIT developed this third possible truck route to the Hoboken staging area after completion of the DEIS, to allow a comparison of routing options

so that potential impacts from the trucking can be minimized. With this alternate third route, trucks leaving the Hoboken staging area would travel eastward on the same off-street construction road along the north side of the HBLR right-of-way as with Options 1 and 2, pass under the Willow Avenue viaduct and through the dog run adjacent to the Gateway apartment building. The off-street haul route would continue alongside the northern and western side of the curved HBLR right-of-way beside the Dykes Lumber property to 19th Street, where trucks would join the local street network. With this option, a new intersection would be created where the off-road portion of the haul route meets 19th Street. Trucks would travel between this intersection and Route 495 using 19th Street and JFK Boulevard East. Trucks traveling to the site would use the same route in reverse. This new access road, like the two other haul routes, would make use of NJ TRANSIT's easement through the dog run of the Gateway apartment building but unlike Options 1 and 2, this route would shift trucks away from residences on Willow and Park Avenue service roads. Easements or property acquisition along the edge of the Dykes Lumber property would be required if this haul route is selected.

In this area, the DEIS described that NJDEP was proposing its Rebuild by Design project, which included a new flood wall running along the south/east side of the HBLR right-of-way. Since completion of the DEIS, the Rebuild by Design project has advanced and now the planned flood wall will run along the south side of the HBLR and then cross to the north/west side of the tracks close to 19th Street. The new alignment for the flood wall will occupy some of the area planned for the Option 3 truck route and could make the Option 3 truck route infeasible. The Project Partners are evaluating how to accommodate the presence of the flood wall in conjunction with use of haul route Option 3 and will advance the design for Option 3 to reflect the constraints on available space resulting from the presence of the floodwall in the same area.

Because of the proximity of the access road to the HBLR tracks using any of the haul route options, the Project Sponsor will coordinate with NJ TRANSIT and the operators of the HBLR regarding any special safety protocols to protect the HBLR tracks and vehicles during construction for the Preferred Alternative.

In the DEIS, FRA and NJ TRANSIT estimated an average of approximately 8 to 16 trucks per hour would arrive at and then depart from the Hoboken staging area during the most intensive construction activity. However, as a result of refinements to the Project design and sequencing of construction activities made in response to community feedback related to the intensity of construction at the site, the maximum number of trucks per hour is now reduced by half, from 16 to a maximum of 8 trucks per hour that would arrive at and then depart from the Hoboken staging area. These trucks would be carrying construction materials to the site and hauling away construction debris and soil and rock excavated to construct the vertical shaft; the majority of excavated material from construction of the river tunnel would be removed from the Tonnelle Avenue staging site in North Bergen. Truck routes would be coordinated with NJDEP and the two local municipalities, the Township of Weehawken and the City of Hoboken. Vehicles will be rinsed at rinsing stations before leaving construction staging areas and mud mats will be used to help protect against dirt being tracked off the sites.

The Project Sponsor will be responsible for maintenance, repair, and cleaning of designated truck routes on local streets and will reconstruct any streets damaged by trucking activity associated with construction of the Preferred Alternative.

Potential impacts on traffic conditions, noise levels, air quality, and the surrounding community from the construction-related truck traffic are evaluated in subsequent chapters of this EIS.

3.3.3.5 FAN PLANT CONSTRUCTION

Following completion of the river tunnel, construction of the emergency access and egress components of the shaft and the ventilation fan plant building would occur. This would involve typical construction methods for constructing the building frame, superstructure, core, shell, and finishing work, including the installation of the fans and fire-life safety equipment. It would also involve installing piles to support the foundation for the fan plant at the site.

3.3.3.6 SCHEDULE

In general, work at the Hoboken staging area related to site preparation, utility relocation, shaft construction, and tunnel fit-out would occur in two eight-hour shifts per day (7 AM-3 PM and 3 PM-11 PM) on weekdays. However, trucking activities would not be permitted after 10 PM and before 7 AM, as a result of refinements to the Project design and sequencing of construction activities made in response to community feedback related to the intensity of construction at the site.

Controlled drill-and-blast construction for the vertical shaft would be accomplished in two eight-hour shifts per day (7 AM-3 PM and 3 PM-11 PM) on weekdays. Blasting would not occur before 8 AM or after 6 PM except under special circumstances and only with permission from the appropriate regulatory agency (i.e., North Hudson Regional Fire and Rescue).[4]

Activities at the Hoboken shaft site and staging area would occur over an approximately seven-year period, currently anticipated to occur as follows (note that certain activities may overlap):

- Site preparation, utility relocations, construction of the shaft: approximately 1.5 years.
- Modification of Palisades tunnel TBMs or replacement of TBMs for river tunnel excavation: approximately three months.
- Support the excavation of the river tunnel: approximately 1 year.
- Support the excavation of tunnel cross passages: approximately 1 year.
- Support of river tunnel internal concrete: approximately 1 year.
- Construction of the fan plant structure and fit out: approximately 1 year.
- Trackwork, railroad systems, and finishes: approximately 3 years.

During construction of the vertical shaft and fan plant, approximately 40 workers would be on the site during each shift. During construction of the river tunnel segment, some workers may also be based at this site and some deliveries may occur here (see Section 3.3.4 below).

3.3.4 HUDSON RIVER TUNNEL SEGMENT BENEATH HOBOKEN AND THE HUDSON RIVER

In the DEIS, FRA and NJ TRANSIT described a construction staging approach for the Preferred Alternative that involved using the Hoboken shaft and staging area for removal of excavated materials from the segment of the Hudson River Tunnel between the Hoboken staging area and New York. Based on comments received on the DEIS, design refinement, and coordination with representatives and residents of the Township of Weehawken, FRA and NJ TRANSIT, working with the Project Partners, evaluated alternative methods for constructing the Preferred Alternative and have incorporated modifications to the construction methods into the Project that will reduce the construction impacts on local residents associated with the Hoboken staging area. The revised

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4 Per New Jersey state law, 12 NJAC 190-7.6, except during unusual conditions and when approved by the Commissioner, blasting shall be conducted only during daylight hours, but shall not be conducted before 8 AM or after 6 PM. https://www.nj.gov/labor/lsse/laws/Explosives_Law.html#19076.

construction methodology involves removing spoils from the river tunnel segment primarily at Tonnelle Avenue rather than at the Hoboken staging area. That would substantially reduce the construction activities at the Hoboken staging area.

The tunnel beneath Hoboken and the Hudson River (i.e., the river tunnel) would consist of two approximately 7,300-foot-long tubes, each constructed by a TBM operating eastward to the Manhattan shaft site near Twelfth Avenue (Section 3.3.7 below), where the TBMs would be removed. To achieve an expedited schedule, the two tubes of the river tunnel would be constructed by two TBMs operating simultaneously. The TBMs would work in parallel, with start times staggered by approximately two months. The tunneling operation would occur 24 hours a day on weekdays with some support activities potentially occurring on weekends (see Section 3.3.4.9). In advance of the tunneling, ground improvement and preparation activities would occur along the alignment in Hoboken. Construction of the river tunnel would also involve ground improvement within the Hudson River, discussed in Section 3.3.5 below.

3.3.4.1 GROUND IMPROVEMENT AND UNDERPINNING

The tunnel alignment east of the Hoboken staging area would be located in a combination of soft soil, fragmented rock, and bedrock. In certain locations along the route, ground improvement or preparation work would be conducted in advance of the tunneling.

Prior to TBM tunneling, ground improvement (such as injection of grout into the soil to harden the soil) would be conducted from the Hoboken shaft to strengthen the soil at the interface to the shaft where the new tunnel would be created. Similar ground improvement would also be conducted in the area where the new tunnel alignment would pass beneath the HBLR right-of-way. The work would most likely be conducted from the ground surface.

Where the subsurface tunnel alignment would pass beneath the Willow Avenue viaduct, the pile-supported foundation of the viaduct would be underpinned. Piles would be drilled from the surface alongside the viaduct as part of this work. The roadway would remain open throughout this process, with only short-term, intermittent closures during off-peak hours or weekends.

The alignment of the new tunnel would also cross beneath the planned alignment of the flood wall that will be installed as part of NJDEP's Hoboken Rebuild By Design flood protection project. Coordination between the two projects is ongoing to ensure their mutual compatibility. It is possible that some sort of ground improvement, underpinning, or other measures could be needed at this location.

The tunnel alignment presented in the DEIS would have passed directly beneath a recently constructed PSE&G substation building located between Clinton and Willow Avenues south of the HBLR right-of-way in Hoboken. The DEIS noted that this building would need to be underpinned during construction. As the Project design advanced after completion of the DEIS, Amtrak further developed the construction techniques that would be required to protect the PSE&G substation building. Because of the sensitive nature of the building and its deep foundation supports, Amtrak found that extensive underpinning would be needed and that such work would be complex, risky, time-consuming, and disruptive to the surrounding area. As a result, FRA, NJ TRANSIT, and the other Project Partners, in consultation with PSE&G, determined that the subsurface tunnel alignment for the Preferred Alternative would be shifted northward approximately 30 feet so that the alignment would no longer pass beneath the substation building and no underpinning would be required. This FEIS incorporates that revised location for the tunnel alignment.

3.3.4.2 TUNNEL EXCAVATION

The two tubes of the river tunnel would be bored by two TBMs working at the same time, to expedite the construction schedule. Construction worker and truck estimates for the analyses in this EIS are based on an assumption that two TBMs would be operating in parallel.

The TBMs for the river tunnel east of the Hoboken shaft site would be suitable for mixed-face conditions so that they are able to cut through both rock and soft soil ground conditions. These would likely be the same TBMs as used for the Palisades tunnel segment, which would be modified for the soil conditions of the river tunnel segment. Large components would be removed from and added to the tunnel through the Hoboken shaft. The delivery and removal of TBM components for each of the TBMs to be used for the Project would occur over approximately one month. Alternatively, if separate TBMs are used for the mixed face conditions of the river tunnel segment than for the hard rock Palisades tunnel segment, the components of the TBM would be delivered to the tunnel at the Hoboken staging area, where they would be lowered to the tunnel through the shaft.

No dredging in the Hudson River is proposed as part of the tunnel construction. Other than a segment of the alignment requiring ground improvement at the bottom of the river (Section 3.3.5 below), all river tunnel construction work would occur underground beneath the river bed.

The TBMs would advance an average of approximately 35 feet per day through the mixed conditions of the river tunnel segment of the new tunnel, so that each tube of the river tunnel would take approximately 9 months per tube to bore, with a lag between the start of the first and second TBM of approximately 2 months, for a total of approximately 11 months. Some days, the production rate would be higher, but on other days it would be lower, depending on specific soil conditions along the alignment. The two tubes would be approximately 20 to 25 feet apart for the length of the tunnel and would be supported with precast concrete liners that are installed as the TBM moves forward. The precast concrete liner segments would be delivered to the tunnel in pieces by truck, either at the Tonnelle Avenue staging area or the Hoboken staging area.

3.3.4.3 CROSS PASSAGES

The river section of tunnel between the Hoboken shaft and the Twelfth Avenue shaft in New York would have nine cross passages connecting the two tubes of the tunnel at intervals of approximately 750 feet. Each cross passage would be approximately 20 to 25 feet long (i.e., the distance between the two tubes). Two cross passages would be within the land portion of the alignment and the rest would be beneath the Hudson River. The cross passages, which would be located in both soil and rock conditions depending on location, would be mined from within the tunnel tubes after tunnel boring has been completed. Activities associated with the construction of cross passages in Hoboken and beneath the Hudson River may be staged from the Hoboken staging area or the Tonnelle Avenue staging area.

The first cross passage would be approximately beneath Clinton Street in Hoboken, close to the HBLR right-of-way. Ground improvement through injection of grout from the surface (discussed above in Section 3.3.4.1) would protect the HBLR from damage during construction.

The cross passages beneath the Hudson River would be excavated by mining, generally using SEM techniques, over a period of approximately one year. The cross passages would be excavated after the two tubes are completed and would require breaking through the tubes' concrete liner. For the cross passages in soil, prior to the excavation, the ground would be improved. This may be done through the use of ground freezing, a technique where the ground is injected with a closed system of pipes in which a freezing liquid (calcium chloride brine) is circulated until the ground is frozen solid. To support the ground freezing operation, a portable freeze plant from which the brine is circulated would be located within the tunnel at each cross passage location.

3.3.4.4 TUNNEL VENTILATION DURING CONSTRUCTION

Temporary fire-life safety systems would be installed in the new tunnel as it is excavated, to protect workers during construction activities. This would include temporary tunnel ventilation powered by large fans that would operate continuously during construction at the Tonnelle Avenue portal site. A standpipe system would be installed, and sufficient illumination levels would be maintained at the walking surface for worker safety. In addition, fire extinguishers and fire hoses would be provided in the tunnel during construction.

3.3.4.5 OBSTRUCTIONS

Obstructions may be encountered under the riverbed beneath the Hudson River during the underground boring for the river tunnel. These may include remnants of former waterfront structures close to the Manhattan shoreline, such as the former Piers 68 and 69. Where these features were once located, timber piles may remain below ground that could be encountered by the TBM. If this occurs, the obstructions may be manually removed from the face of the TBM, either with compressed air pumped to maintain tunnel face stability or by applying ground treatment in advance so that work can be conducted under normal atmospheric pressure.

3.3.4.6 EXCAVATED MATERIAL AND DISPOSAL

The conceptual construction approach described in the DEIS involved excavation of the Palisades tunnel at the same time as excavation of the river tunnel, to expedite completion of the new tunnel. In the DEIS construction approach, excavated materials from the river tunnel segment would have been removed at the Hoboken shaft, since the Palisades tunnel segment would not yet be complete and would not connect to the Hoboken shaft when the river tunnel excavation begins. However, the conceptual construction approach for the Preferred Alternative has been modified since completion of the DEIS to reduce the amount of trucking activity at the Hoboken staging area to the extent practicable. In the revised approach, excavated material from the river tunnel would be removed primarily at the Tonnelle Avenue staging area and deliveries to support the tunneling would also be made primarily at the Tonnelle Avenue staging area.

To develop this revised approach, FRA, NJ TRANSIT, and the other Project Partners evaluated a wide range of potential methods to remove excavated materials from the river tunnel with the goal of reducing the number of trucks on local streets in Weehawken. This included the potential use of different truck routes, barging excavated materials from the Weehawken waterfront, and removing excavated materials by freight trains operating on the HBLR right-of-way. The full analysis is included in **Appendix 3-1** to this FEIS.

With the revised construction staging approach, excavated material (i.e., spoils) from the river tunnel would be removed at the rear of the TBM and brought out of the tunnel using a conveyor or similar system to the tunnel portal at the Tonnelle Avenue staging site in North Bergen, as described in Section 3.3.2.4, above. Excavated spoils from the subsequent cross passage excavation would be hauled through the tunnels. In total, approximately 580,000 cubic yards of loose rock and soil would be removed from the two tubes of the river tunnel and its cross passages as they are constructed.

The Project Sponsor will be responsible for working with the Project contractor to find a suitable location for reuse or disposal of spoils from the tunnel excavation. The Project Sponsor will develop protocols during final design to identify spoils that may contain contaminated or hazardous materials, so that they can be handled appropriately and disposed of at a suitable location. Rock and clean fill may be suitable for beneficial reuse, as discussed above for the Palisades tunnel

(Section 3.3.2.4). For spoils that cannot be reused, commercial disposal sites may be appropriate. These facilities are required to meet all applicable regulations and typically process soils and dredge materials to recycle or beneficially reuse them. Locations for spoils disposal are available in nearby areas of New Jersey. Spoils will not be disposed in areas within the jurisdiction of the USACE to avoid adverse effects related to placing fill in wetlands or navigable waters.

Protocols for the transport of spoils from the construction sites would be developed to ensure the safe handling of these materials and would include procedures to secure the material from spilling off trucks, as well as for any inadvertent or accidental spills of materials falling from trucks removing this material from the staging sites.

Additional information related to the handling and disposal of excavated materials is provided in Chapter 16, “Contaminated Materials,” Section 16.8.1.1.

3.3.4.7 TRACKWORK AND RAILROAD SYSTEMS

The various railroad systems, including tracks, signals and communications, and overhead contact system structures and wires, would be installed for the full length of the new Hudson River Tunnel once excavation of both the Palisades and river tunnel segments is complete. Construction and finishing of the various mechanical, electrical, and plumbing systems, including tunnel ventilation systems and tunnel lighting systems would also be installed once both the Palisades segment and the river tunnel segment of the tunnel are complete.

3.3.4.8 CONSTRUCTION STAGING AREA AND TRUCK ROUTES

Construction of the river tunnel segment between the Hoboken shaft and the Manhattan shoreline would be staged predominantly from the Tonnelle Avenue staging area, described in Section 3.3.2.4. Some support and deliveries would occur at the Hoboken staging area. This staging area and associated truck routes are described above in Section 3.3.3. Potential impacts on traffic conditions, noise levels, air quality, and the surrounding community from the construction-related truck traffic are evaluated in subsequent chapters of this EIS.

3.3.4.9 SCHEDULE

Tunnel preparation work, including ground improvement and underpinning, would be conducted generally from 7 AM to 11 PM on weekdays. However, no trucking activities would occur at the Hoboken staging area after 10 PM.

To achieve an expedited schedule, the two tubes of the river tunnel would be constructed by two TBMs working at the same time. The tunneling operation would occur 24 hours a day on weekdays. Excavated material from the tunnel would be transported by a conveyor or similar system to the Tonnelle Avenue staging area, where it would be stored and then removed during the day. Some weekend work could also occur to support the weekday activities, such as equipment maintenance. In addition, when workers need to manually remove obstacles identified within the tunnel alignment, this could also involve weekend work. In areas where tunneling is technically challenging, tunneling may be expedited to minimize the duration, which could also involve weekends for short durations. This could include tunneling through the “low cover area” of the Hudson River (see Section 3.3.5) and construction of cross passages between the two tunnels in soft ground.

Any controlled drill-and-blast construction within the tunnel that is required for portions of cross passages would be accomplished in two eight-hour shifts per day (7 AM-3 PM and 3 PM-11 PM) on weekdays. Blasting would not be performed before 8 AM or after 6 PM except under special circumstances and only with permission from the appropriate regulatory agency (i.e., North Hudson Regional Fire and Rescue).[5]

Construction associated with the river tunnel would last approximately seven years, currently anticipated to occur as follows (note that certain activities may overlap):

- Willow Avenue bridge underpinning: approximately 2 months.
- Modification of Palisades tunnel TBMs or replacement of TBMs for river tunnel excavation: approximately three months.
- Excavation of the river tunnel: approximately 1 year.
- Excavation of tunnel cross passages: approximately 1 year.
- Tunnel internal concrete: approximately 1 year.
- Trackwork, railroad systems, and finishes: approximately 2.5 years.

During construction of the river segment of the new Hudson River Tunnel, approximately 60 construction workers would be working during each shift. For cross passage construction approximately 25 to 30 workers would be in the tunnel. These workers would likely be based out of the Tonnelle Avenue staging area, but some workers may report to the Hoboken staging area instead.

3.3.5 RIVER TUNNEL IN-WATER WORK

The two tubes of the new tunnel beneath the Hudson River would be constructed by TBM well beneath the river bottom. Project construction would not entail any dredging in the Hudson River. With one exception, no work in the Hudson River would occur.

However, in one location in the Hudson River, the Preferred Alternative would involve ground improvement to strengthen the soil of the river bed. This would occur in an area above the tunnel alignment where the tunnel would be relatively shallow below the bottom of the river. Hardening the soil in this area would reduce the risk of difficulties during tunneling and provide long-term protection for the tunnel.

Ground improvement would be conducted in this portion of the river bottom before the TBM excavation occurs. After the soil is improved, the TBM could safely pass through this portion of the alignment, referred to as the “low cover area” because of the relatively small amount of soil (“cover”) above the tunnel in comparison to the rest of the alignment.

The area where in-river ground improvement for the riverbed would occur would be in the New York portion of the alignment beneath the Hudson River (see **Figure 3-2b**). The ground improvement zone would be approximately 1,200 feet long and 110 feet wide (wide enough to encompass both tubes of the tunnel), or a total of approximately 3 acres. It would fall within the designated navigation channel of the river and would not extend past the New York pierhead line. At its closest point, the construction activity would be about 620 feet from the Manhattan bulkhead. The construction activities proposed in the Hudson River to strengthen the riverbed are described below. Section 3.3.5.6 below discusses the construction zone’s location in the designated navigation channel and how navigation would be protected during construction in the riverbed.

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5 Per New Jersey state law, 12 NJAC 190-7.6, except during unusual conditions and when approved by the Commissioner, blasting shall be conducted only during daylight hours, but shall not be conducted before 8 AM or after 6 PM. https://www.nj.gov/labor/lsse/laws/Explosives_Law.html#19076.

3.3.5.1 INSTALLATION OF COFFERDAM

The work area within the river would first be enclosed by a cofferdam—a temporary, watertight structure that would isolate the water affected by construction from the surrounding river water. The cofferdam would consist of sections of sheet piling between king piles, which are large-diameter hollow cylindrical steel piles that provide additional strength and stability to larger cofferdam structures. Construction workers on barges would use vibratory hammers to drive the cofferdam piles (including sheet piling and king piles) into the river bottom. Water within the cofferdam would be maintained at a few feet below the river level to maintain a net water pressure towards the cofferdam rather than outward, so that water within the cofferdam would not discharge into the river. The Project Sponsor would implement a Pollution Prevention Plan for the in-water construction activities, which may include measures such as use of a containment boom and spill socks, to minimize the potential for discharge of materials to the Hudson River during cofferdam installation, ground improvement activities, and cofferdam removal.

As discussed later in this section, construction activities in the low cover area in the Hudson River would be conducted in two stages, each with a separate cofferdam, to limit the amount of the river that is affected at one time.

3.3.5.2 SOIL IMPROVEMENT

Barges would be moored either outside and/or inside the cofferdam with construction equipment mounted on the barges. Working from the barges, the soils of the river bottom would be modified. In the DEIS, FRA and NJ TRANSIT, based on consultation with the other Project Partners, considered jet grouting as the most likely technique for this, which involves injection of a mix of cement grout, water, and compressed air at high pressure to mix with and partially replace the soil.

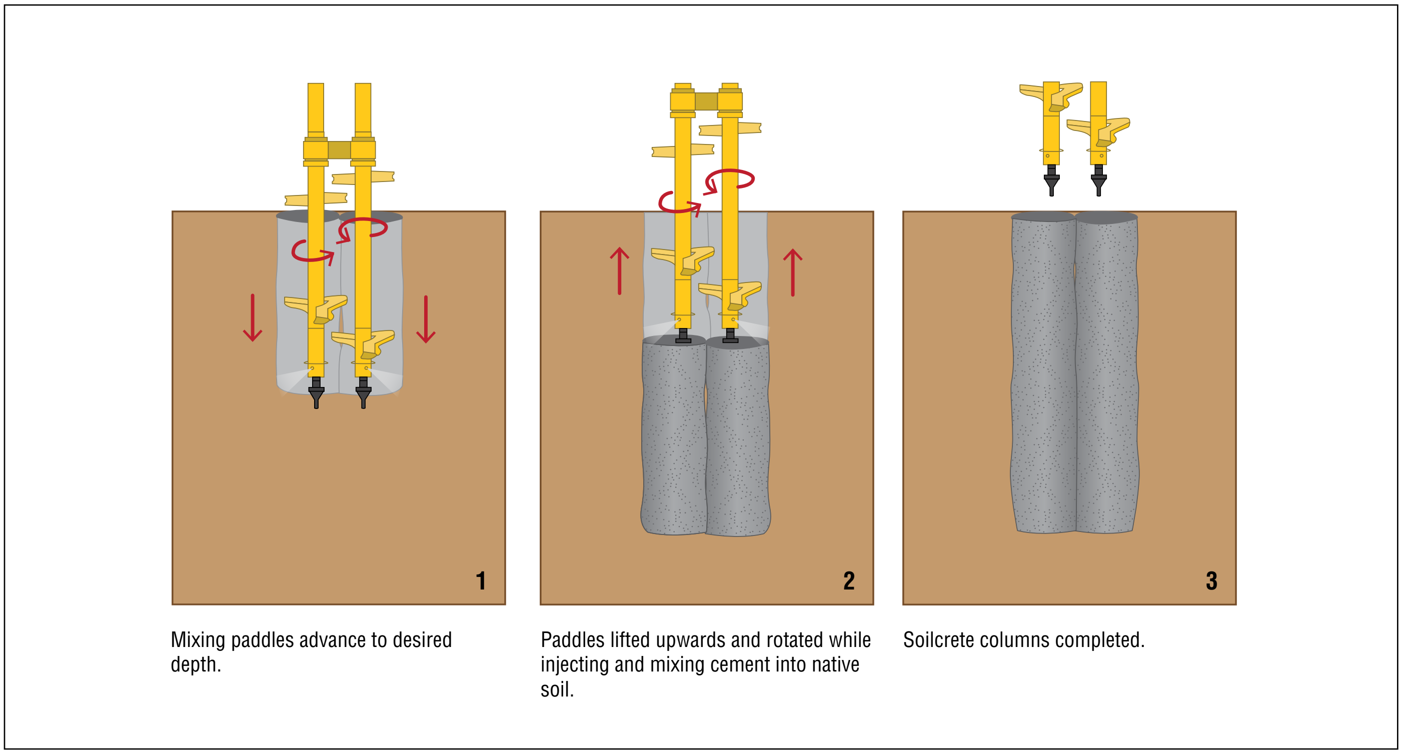
Since completion of the DEIS, the design for the in-water ground improvement of the river bottom has progressed. The Project Partners are now proposing a technique known as deep soil mixing to harden the soil rather than jet grouting. Deep soil mixing is a method in which construction workers use large paddles to mix cement or cement grout with the native soil (see **Figure 3-8**). The advantage of deep soil mixing over jet grouting is that it generates less spoil material, is easier to control, and is more economical than jet grouting (see more detailed descriptions in Section 3.2.2).

Deep soil mixing strengthens the soil by creating columns of moderate strength “soilcrete” (i.e., soil mixed with cement and water). These columns of improved soil can be created adjacent to one another to form an overlapping mass of grouted soil. The material used would have a consistency equivalent to a very hard clay with an anticipated uniaxial compressive strength (UCS) in the range of up to 100 to 200 pounds per square inch (psi) based on prior local experience.

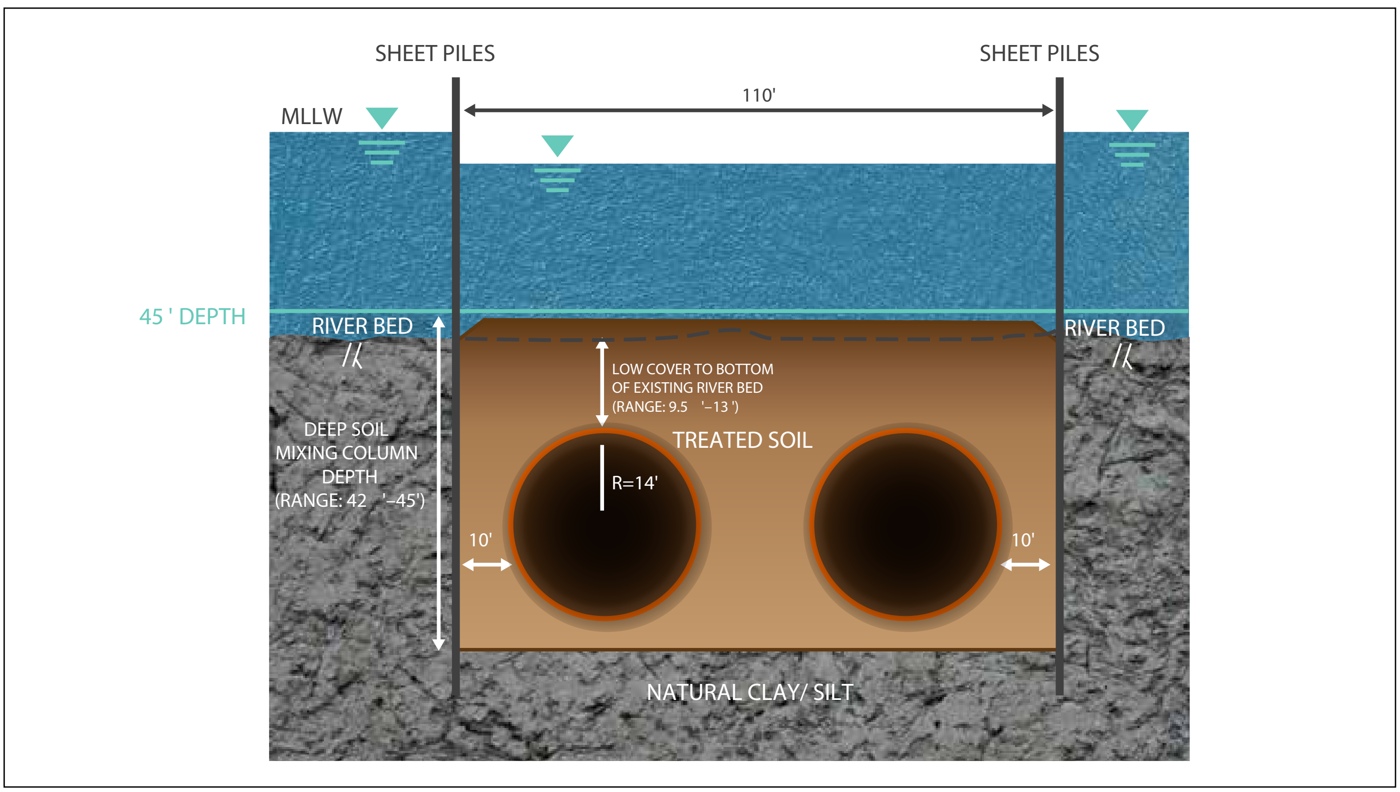
Cement for the deep soil mixing ground improvement would likely be provided from a floating concrete batch plant located on a barge adjacent to the in-water work site. Service vessels (i.e., tugboats), approximately 50 to 75 feet long, would support the construction for material handling (e.g. cement supply, equipment fuel, spoil removal, etc.) during the ground improvement activities in the river.

The area of ground improvement would extend from the river bottom to a depth of 5 feet below the bottom of the tunnel alignment. This area of ground improvement also includes one cross passage location; in this location, the ground improvement would extend to a greater depth below the river bottom.

For about half of the in-river ground improvement zone, the top of the resulting hardened soil would be at approximately the same level as the existing river bottom. For the other half, the



Deep Soil Mixing Process



Typical Cross-Section

Low Cover Area:
Ground Improvement Process
(Deep Soil Mixing) and Typical Cross-Section

Figure 3-8

HUDSON TUNNEL PROJECT

hardened soil would be about 2 feet above the existing river bottom depth. The entire zone would be below the depth of the authorized navigation channel (see Section 3.3.5.6).

3.3.5.3 EXCAVATED MATERIAL AND DISPOSAL

Excess soil displaced by the ground improvement activity would be contained within the cofferdam, removed by excavators on the barges, and then transported by barge for off-site transport to disposal sites. The Project Sponsor will develop protocols during final design to identify spoils that may contain contaminated materials so that they can be handled appropriately and disposed of at a suitable location. Commercial disposal facilities are required to meet all applicable regulations and typically process soils and dredge materials to recycle or beneficially reuse them. The Project Sponsor will be responsible for working with the Project contractor to find a suitable location for disposal of spoils. Spoils will not be disposed in areas within the jurisdiction of the USACE to avoid adverse effects related to placing fill in wetlands or navigable waters. Additional information related to the handling and disposal of excavated materials is provided in Chapter 16, “Contaminated Materials,” Section 16.8.1.1.

3.3.5.4 REMOVAL OF COFFERDAM

As each stage of construction is complete and once the soilcrete has hardened completely, the cofferdam for that section would be removed. The sheet piles would be completely removed from the river bottom. Prior to sheet pile removal, all excess grout would be removed and any excess turbidity of pooled water would be reduced in accordance with the requirements of the Pollution Prevention Plan. To minimize the potential for adverse water quality impacts related to sediment resuspension, turbidity curtains would surround the construction zone during cofferdam removal.

3.3.5.5 STAGING

The Project Partners expect that the ground improvement work proposed would be conducted in stages to minimize the area of water that is disturbed at any one time. As each stage is completed, the sheet piles would be removed. Based on preliminary design, the Project Partners are proposing to conduct the in-river work in two stages, each 600 feet long and 110 feet wide, or a total of about 1.5 acres each. To minimize impacts to aquatic species, based on consultation with the National Marine Fisheries Service (NMFS), installation and removal of cofferdams would occur only within an authorized work window from July 1 to January 20 (see Chapter 11, “Natural Resources,” Section 11.6.3 for additional information on impacts to aquatic species).

Around each cofferdam, there would be a work zone for barges and other equipment. The work zone would be approximately 100 feet wide, but would not extend westward of the in-river zone into the navigation channel or eastward toward the pierhead line. It is anticipated that typical barges that would be used here would be approximately 30 feet wide by 90 feet long. Workers would travel to the construction zone on small boats (e.g., a tugboat or dinghy), from existing piers on the Hudson River shoreline. Several boats are likely to be needed, one for the crew and the others for material handling. No new docking facilities are proposed. All equipment and construction material would be left on a barge at the work site in the river. The barges inside or around the cofferdam would be permanently moored in place until the construction in the river is complete.

The Project Partners will continue to refine the design for the in-river work, in coordination with USACE and NMFS, and will identify the final staging approach in coordination with USACE and the United States Coast Guard (USCG).

3.3.5.6 PROTECTION OF NAVIGATION

The Hudson River from the New Jersey pierhead line to the New York pierhead line is part of the Federal navigation channel that the USACE maintains in the Hudson River. The USACE maintains the main channel of the river to a minimum depth of 45 feet. On either side of the main channel, the USACE maintains side channels (also referred to as “wing” channels) to a minimum depth of 40 feet. Half of the ground improvement zone for the river tunnel (an area approximately 600 feet long and 110 feet wide) would be in the 45-foot-deep navigation channel and half would be in the 40-foot-deep wing channel. Modifications to the river bottom would require a permit from the USACE and must meet conditions imposed by the USACE to protect the navigation channel and maritime safety.

As noted in the previous section, the in-water work would occur in two stages to limit the area of the river affected at any one time. During construction, safety measures would be followed to protect maritime commerce. Measures would include notifications to mariners via the USCG, installation of lighting on barges and the cofferdam, and automatic identification system (AIS) transponders affixed to barges and cofferdams to enable electronic locating of the cofferdam and tracking of the barges. These measures will be developed in coordination with the USCG as the design advances.

3.3.5.7 SCHEDULE

The Project Partners expect that the cofferdam containment structure would be staged in sections. Based on preliminary design, the Project Partners are proposing to conduct the in-river work in two stages, each 600 feet long. To minimize adverse impacts on aquatic species, based on consultation with NMFS, installation and removal of cofferdams would occur only within an authorized work window from July 1 to January 20.

In total, construction activities associated with each 600-foot-long cofferdam would take approximately 13 months to complete, with the following activities occurring during that time:

- Installation of the cofferdam: 14 weeks (3.5 months)
- Deep soil mixing within the cofferdam: 36 weeks (9 months)
- Removal of the cofferdam: 4 weeks (1 month)

Depending on how this work is sequenced, it could take up to approximately 26 months to complete.

The in-water work, including the installation of sheeting to protect the portion of the river and the soil improvement for riverbed stabilization, and the subsequent removal of the sheet piles or cofferdam would be accomplished in two eight-hour shifts (7 AM-3 PM and 3 PM-11 PM) on weekdays.

3.3.6 MANHATTAN WATERFRONT AREA

The TBMs excavating the two tubes of the river tunnel would continue from below the Hudson River bottom, through the underground foundations of the Manhattan bulkhead, beneath Hudson River Park and Twelfth Avenue (also known as Route 9A) to the Manhattan shaft site at Twelfth Avenue, where the river tunnel TBMs would be removed. In advance of the TBMs passing through, ground improvements would be made in the Manhattan bulkhead area and below Twelfth Avenue to improve tunneling conditions and underground obstructions in the tunnel alignment would be removed. These advance preparations would allow the Preferred Alternative to avoid the disruption associated with cut-and-cover construction through Hudson River Park and Route 9A, which is a highly trafficked, eight-lane state highway.

3.3.6.1 GROUND IMPROVEMENT BENEATH HUDSON RIVER PARK AND TWELFTH AVENUE

In the Manhattan waterfront section of the tunnel alignment, Amtrak developed the design for the Preferred Alternative with the specific goal of avoiding any in-water work at the bulkhead or any cut-and-cover excavation across Hudson River Park or Twelfth Avenue, which is a heavily trafficked arterial highway (New York State Route 9A).

To allow tunneling beneath the surface rather than through cut-and-cover excavation, before the TBMs create the circular tubes of the new Hudson River Tunnel in this area, the soft soils in the Manhattan waterfront zone would be strengthened. The Project Partners are considering two options for ground improvement in this area, vertical ground freezing, which was described in the DEIS, and a combination of SEM tunnel excavation and ground freezing, which is a new option developed for consideration following completion of the DEIS. The Project Sponsor will make the final decision on the construction method for this area during final design, in conjunction with the Project contractor. Therefore, both methods are described and evaluated in this EIS.

Both construction options would involve ground freezing, a ground improvement technique in which the ground is frozen solid prior to the excavation. Ground freezing involves installation of a network of underground pipes and then circulation of a freezing agent through the pipe network until the ground around the pipes freezes solid. The piping used would be a closed, sealed system that would therefore not leak any coolant into the surrounding ground. In addition to freezing, permeation grouting (primarily cement with some additives) would be conducted to fill voids in the foundation of the bulkhead, as described in Section 3.3.6.3 below.

3.3.6.1.1 Vertical Ground Freezing Option

With a vertical ground freezing scheme, the freeze pipes would be installed in a grid pattern from the surface, both vertically and diagonally (i.e., at an incline) to minimize disturbance at the surface from pipe installation.

Freeze pipes would be installed under portions of Twelfth Avenue from the median and from either side of Twelfth Avenue. They would also be installed in the southern portion of the West 30th Street Heliport in Hudson River Park, including in the landside portions of the bulkhead. Installation of the pipes would take about three months, with an additional two months for necessary grouting. Once installed, the freeze pipes would remain in place for up to four months while the coolant is circulated through them and the ground gradually freezes; the pipes in place for about another five months as SEM excavation beneath Twelfth Avenue commences and both of the TBMs pass through the area (see Section 3.3.6.2, below). Some freeze pipes would be located inside the perimeter of TBM excavation; just prior to excavation, these pipes would be deactivated and isolated from the freeze system. Subsequently, the TBM would mine through the abandoned pipe. With this option, the TBMs would be designed specifically to be able to mine through this type of pipe.

Freeze plants, typically housed within one or two work trailers, would be located on the nearby Twelfth Avenue staging site. Pipes would connect the freeze plants to the underground pipes in the tunnel alignment. Trenches carrying the freeze pipes would be covered with steel plates or other temporary cover so the area above could be returned to use. Finally, the freeze apparatus would be removed and the areas would be restored, over approximately four months.

Figure 3-9 shows the area where vertical ground freezing would be implemented using this approach.

The total duration for construction activities in Hudson River Park and the West 30th Street Heliport with the vertical ground freezing option would be 18 months:

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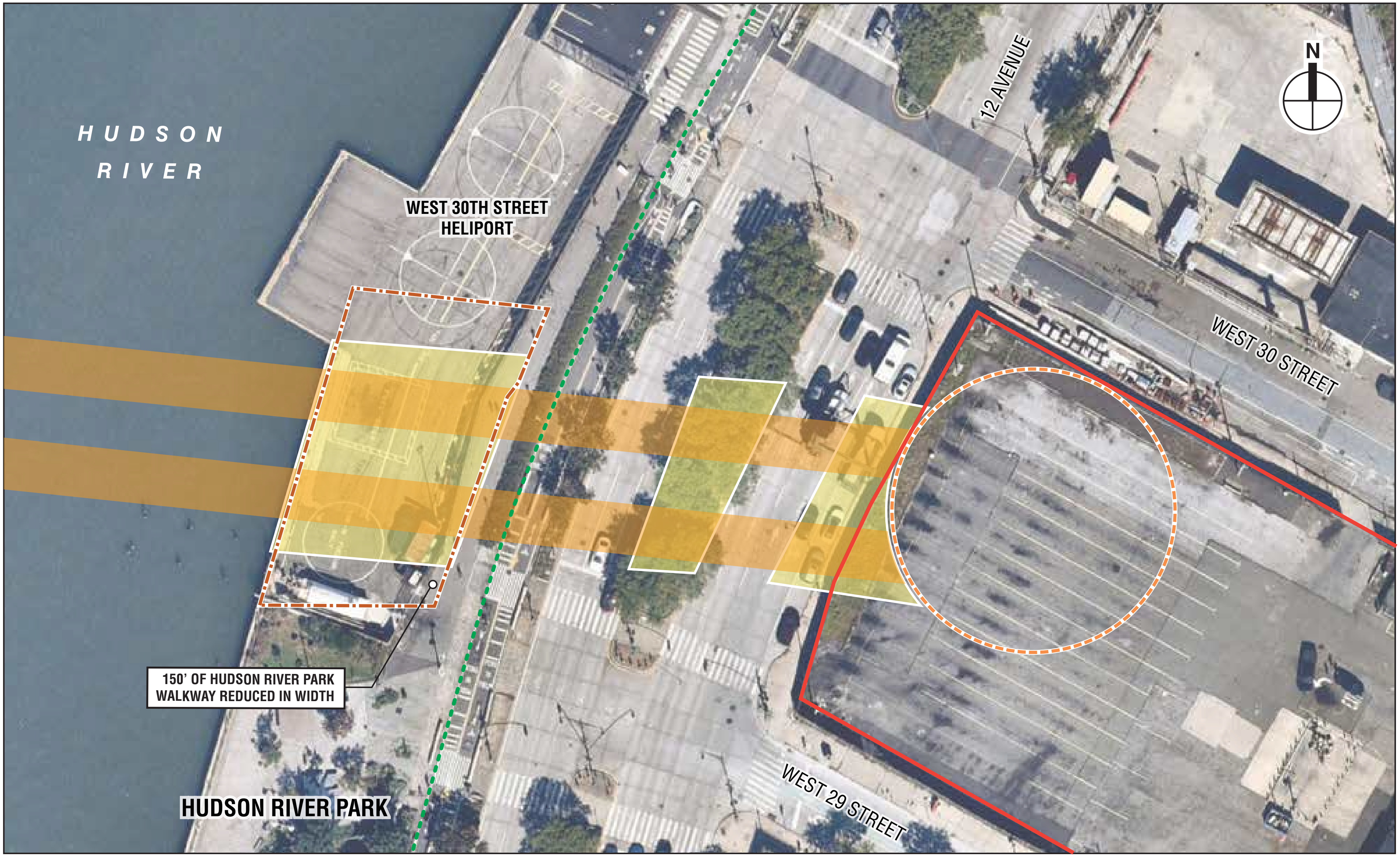

Below-Ground Tunnel Alignment

Shaft Site

Twelfth Avenue Staging Site

Temporary Construction Zone in Park

Surface Work Area for Ground Freezing

Hudson River Park Boundary

HUDSON TUNNEL PROJECT

Potential Construction Zone
for Vertical Ground Freezing in Hudson River Park

Figure 3-9

- Establishing staging site and installing freeze pipes: 3 months
- Grouting: 2 months
- Ground freezing and frozen ground maintained for TBMs: 9 months
- Removal of freeze pipes and demobilization: 4 months

3.3.6.1.2 SEM Excavation with Ground Freezing Option

Based on further analysis during Project engineering, Amtrak is now considering a second option for ground improvement in the Manhattan waterfront zone, using SEM mining below ground in combination with ground freezing and grouting.

Using SEM techniques in this section of the tunnel alignment would reduce the risk associated with tunneling through the Manhattan bulkhead by allowing construction workers to remove portions of the bulkhead structure within the tunnel horizon using an excavator, thereby reducing the amount of bulkhead material that the TBMs would need to bore through when they reach the bulkhead.

With this option, there would be a temporary construction shaft in the southern part of the West 30th Street Heliport. The shaft would be constructed directly above the alignment of the new tunnel's new tubes, so that it could provide access to the tunnel alignment. It would be situated near the bulkhead, but not directly above the bulkhead's foundation, which slopes eastward underground from the water's edge. The shaft would be approximately 110 feet long, to encompass both tubes of the new tunnel, and 25 feet wide, to provide enough space for workers and materials to enter and exit. **Figure 3-10** illustrates the location of the temporary shaft.

The temporary construction shaft would be excavated from the surface through soil. Prior to shaft excavation, support walls would be installed to retain the soil. These are likely to be slurry walls. As described in Section 3.2.1.4, slurry walls are concrete walls constructed through the use of a slurry of bentonite, a natural, clay-like, heavy liquid material that is mixed on-site and pumped into the trench during excavation, and then replaced by concrete and steel reinforcing bars placed once the excavation reaches its final depth. A slurry plant to provide the needed materials for the walls would be located within the construction staging area established at the heliport.

Once the temporary shaft is in place, it would first serve as the location from which freeze pipes could be routed. These pipes would be installed horizontally from the shaft into the tunnel alignment. Some freeze pipes might also be installed vertically or diagonally from the median of Twelfth Avenue, as in the vertical freeze option.

Once the tunnel alignment has been treated through freezing and grouting, the shaft would also be the starting point for SEM tunnel excavation toward the bulkhead and toward Twelfth Avenue, where the SEM tunnel would meet a similar tunnel excavated from the Twelfth Avenue shaft toward the median in Twelfth Avenue (this is discussed in Section 3.3.6.2). Use of SEM excavation would allow construction workers in the below-ground excavation to carefully remove components of the bulkhead foundation and obstructions beneath Twelfth Avenue in advance of the TBMs.

Following excavation, the excavated area for the future tunnel would be backfilled with a controlled low-strength material, to maintain the excavation and provide material for the TBMs to pass through as they tunnel from the river to the Twelfth Avenue shaft, where they would be removed. At this point, the shaft would also be backfilled with soil. The TBMs would then mine through the hardened material and install permanent precast segments.

During excavation of the shaft at the heliport and subsequent construction activities there, the construction staging area in the southern part of the heliport would have support functions for these activities. Trucks would enter and leave the staging area, to bring materials and remove excavated materials. To align with the adjacent street directions, trucks would use a one-way

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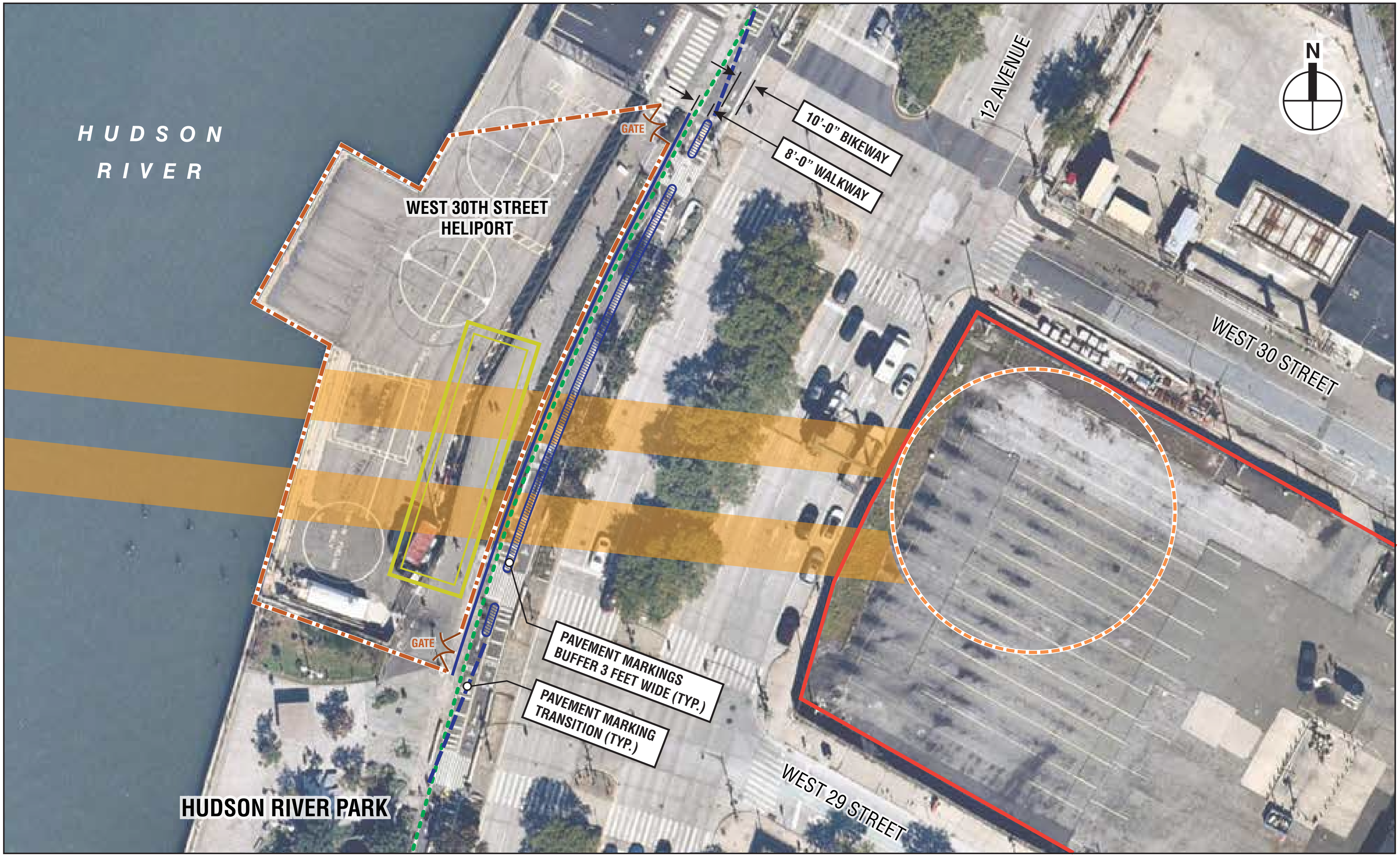


Below-Ground Tunnel Alignment
Shaft Site
Twelfth Avenue Staging Site
Temporary Construction Zone in Park
Temporary Shaft in Park
Hudson River Park Boundary

0 20 60 100 FEET

HUDSON TUNNEL PROJECT

Potential Construction Zone
for Sequential Excavation Method Tunneling in Hudson River Park

Figure 3-10

circulation pattern through the staging area, with trucks entering through a gate from 29th Street and exiting through a gate to 30th Street. Since this would involve truck traffic crossing the Route 9A bikeway and park walkway, flaggers would be present to protect pedestrians and bicyclists.

Figure 3-10 shows the area that would be affected by the SEM with ground freezing option.

The total duration for construction activities in Hudson River Park and the West 30th Street Heliport with the horizontal ground freezing/SEM option would be 18 months, the same as with the vertical ground freezing option. The activities that would occur and the related truck activities would be as follows:

- Mobilization: 1 month (2 trucks per hour)
- Construction of shaft: 4 months (2 trucks per hour)
- Installation of temporary ground improvement, mining SEM tunnels from shaft: 10 months (1 truck per hour)
- Backfill tunnels and shaft: 2 months (4 trucks per hour)
- Demobilization: 1 month (2 trucks per hour)

3.3.6.1.3 Ground Improvement Activities in Hudson River Park

The ground improvement operation with either construction option would involve some disruption to the Hudson River Park walkway and the bikeway that runs parallel to Hudson River Park, which is under the jurisdiction of the New York State Department of Transportation (NYSDOT) as part of the adjacent highway (Route 9A):

- **Vertical Freezing Option:** During installation of the freeze pipes for the vertical freeze option, a portion of the paved pedestrian walkway in Hudson River Park would be closed. A small area near the walkway could also be affected. Specifically, for a length of about 150 feet, the walkway would be narrowed to accommodate part of the staging area. The walkway would remain open during this time, with a minimum width of approximately 8 feet through the construction zone. The adjacent Route 9A bikeway would be subject to potential intermittent short-term closure (up to several days) for trenching of freeze pipes across the bikeway; a detour would be established during the closure, and any trench excavated for this purpose would be immediately decked over and the bikeway reopened. The freeze pipes installed to treat this area would be installed from locations to the east or west of the bikeway at an angle to pass beneath the bikeway.
- **SEM with Ground Freezing Option:** To accommodate the larger staging area, this option would involve closing the full width of the park walkway for approximately 200 linear feet (an area about 20 feet wide and 200 feet long, or 4,000 square feet). To allow continued walkway access, an eight-foot-width of the adjacent Route 9A bikeway would be converted into a temporary walkway. This would narrow the bikeway from 15 feet to 10 feet for the length of the staging area, about 200 feet. Pavement markings would separate the walkway from the Route 9A bikeway. Depending on the stage of construction, 1 to 4 trucks per hour would enter and then leave the staging area, including crossing the park walkway and Route 9A bikeway, flaggers would be present to protect pedestrians and bicyclists.

More information on the effects of construction activities on Hudson River Park is provided in Chapter 8, “Open Space and Recreational Facilities.”

3.3.6.1.4 Ground Improvement Activities in West 30th Street Heliport

Both construction options would involve use of the southern part of the West 30th Street Heliport to accommodate a construction staging area. For both options, the heliport’s fueling area (above-ground fuel tank and two fueling pads) would be closed. Both options would also require that the driveway at West 30th Street and associated parking area be closed. In addition, both options would affect helicopter landing pads: the vertical freezing option would require that one landing pad be closed and the SEM with ground freezing option would require that two landing pads be closed. The fueling facilities for the heliport could either be relocated to a new permanent location, if that location can be identified (possibly near West 30th Street), or to a temporary location either within the heliport property or potentially on a new fueling barge that would be moored at the heliport. The relocated fueling facility would comply with all applicable regulatory restrictions related to siting such a facility.

In addition, it may be necessary to reroute helicopters headed to and from the West 30th Street Heliport to avoid conflicts between aircraft and tall construction equipment during the installation or removal of construction equipment, and during the in-water construction activities. This activity would be subject to a permit from the FAA. Any construction equipment located close to the active portion of the heliport would be designed so as to ensure construction materials and debris on site would not become airborne and interfere with helicopter operation.

More information on the effects of Project construction on heliport operations is provided in Chapter 5B, “Transportation Services.”

3.3.6.2 SEM TUNNEL EXCAVATION BENEATH TWELFTH AVENUE

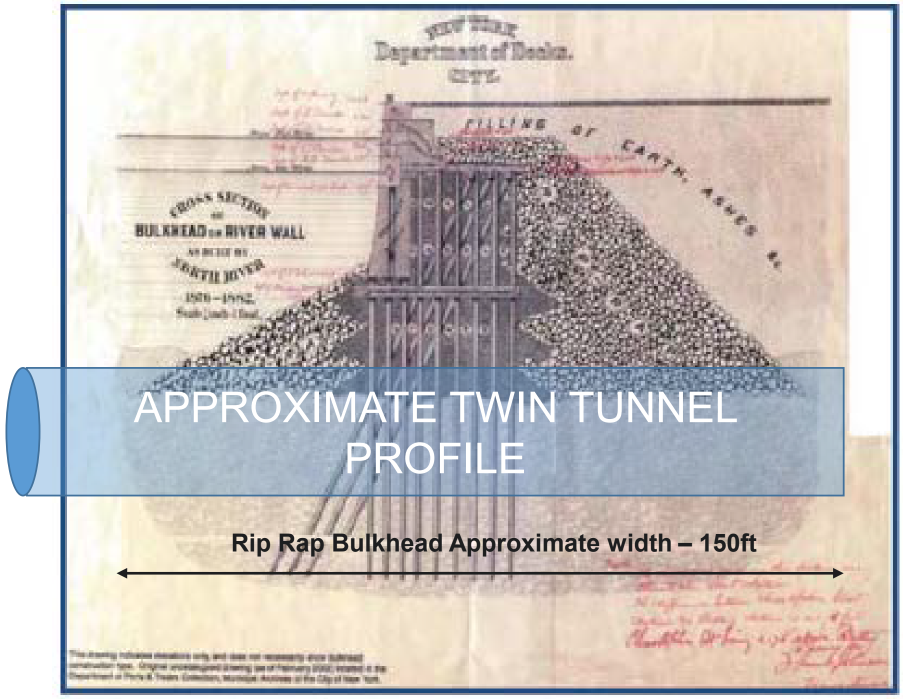
With either construction option in Hudson River Park, installation and removal of freeze pipes could require short-term closures of the easternmost travel lane and parking lane in northbound Twelfth Avenue. In addition, some trenching across Twelfth Avenue may be required as part of the installation of the ground freezing system. This work would likely be conducted during nights, weekends, and other off-peak hours so the lane could be decked and in use during peak hours. These construction activities would be closely coordinated with NYSDOT, which has jurisdiction over Twelfth Avenue/Route 9A.

Also with either construction option, the tunnel alignment from the Twelfth Avenue shaft to approximately the median in Twelfth Avenue would be excavated through frozen ground using SEM mining to permit direct underpinning of a steel pile-supported large-diameter sewer located within Twelfth Avenue (see Section 3.3.6.4). The excavated tunnel would then be backfilled with controlled low-strength material to allow the TBMs from the river tunnel to mine through the tunnel already created by SEM mining and eliminate the need for a cast-in-place waterproof lining. Instead, the TBMs would leave in place a permanent precast concrete tunnel lining as they move through this area. Spoils would be removed and disposed of as described in Section 3.3.7.2 below.

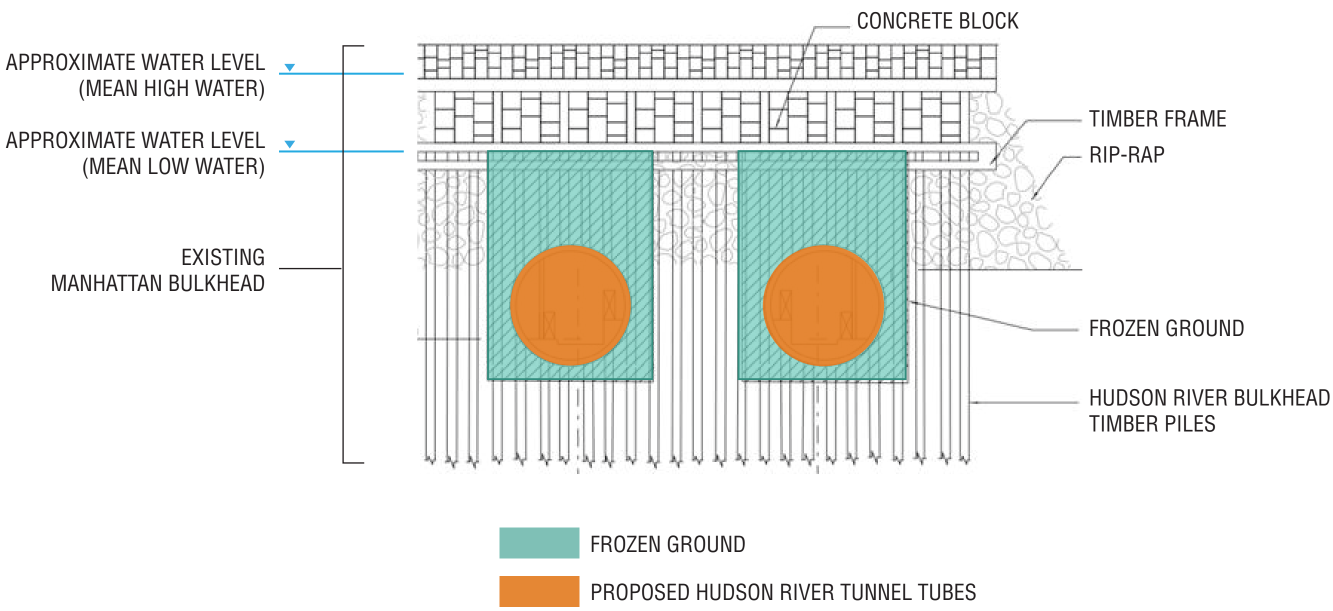
3.3.6.3 TUNNELING THROUGH THE MANHATTAN BULKHEAD

The tunnel alignment would pass through the foundation of the Hudson River bulkhead below the river bottom. In this area, the foundation of the bulkhead consists of riprap, cobbles, and timber support piles. The tunnel would be constructed through the bulkhead by the two staggered TBMs, after ground improvement of the tunnel alignment as described earlier in Section through a combination of grouting and ground freezing (see **Figure 3-11**).

With either a vertical ground freezing option or SEM excavation with ground freezing option in Hudson River Park, permeation (cement-based) grout would be installed from the land side of the bulkhead to fill large voids in the bulkhead riprap prior to ground freezing. The grouting pressures would be as low as possible—high enough to travel horizontally through the riprap voids but low enough not to exceed the resistance of the overlying ground weight of 30 feet of overlying silt and clay—to limit the possibility of grout being released into the river. Instrumentation would be installed that continuously monitors changes of pressures in the ground during grouting. Safe limits of changes of pressures in the ground would be pre-established for specific locations as part of the monitoring plan.



Historic cross section of the Manhattan bulkhead showing the alignment of the new tunnel **A**



Cross section of the new tunnel as it passes through the Manhattan bulkhead **B**

With a vertical ground freezing option, once the ground is frozen at the bulkhead, the tunnel would be constructed through the bulkhead by boring with TBMs continuing from the river tunnel to the west (with a lag time of two months between them). The TBMs would be designed to be capable of cutting through the timber piles and riprap under frozen ground conditions. If other obstacles are present, the TBMs would be designed to be able to pass through those as well. The TBMs would continue beneath Hudson River Park and Twelfth Avenue to the vertical shaft at Twelfth Avenue, where they would be removed.

With the SEM excavation with ground freezing option, the tunnel at the bulkhead would be excavated using SEM techniques. Using SEM mining in this section of the tunnel alignment would reduce the risk associated with tunneling through the Manhattan bulkhead by allowing construction workers to remove portions of the bulkhead structure within the tunnel horizon using an excavator, thereby reducing the amount of bulkhead material that the TBMs would need to bore through when they reach the bulkhead. The SEM tunnel would then be backfilled with controlled low-strength material to allow the river tunnel TBMs to pass through for removal at the Twelfth Avenue shaft.

Based on the conceptual design analyses performed to date, the Project team anticipates that tunneling through the bulkhead and part of its foundation with improved ground conditions (from either ground treatment option) would improve the stability of the bulkhead. The proposed cement grouting would further lock the riprap in place, improving ground stability. It would also help to spread the load of the bulkhead that would rest on the tunnel's tubes after tunneling is complete.

3.3.6.4 REMOVAL OF BELOW-GROUND TUNNELING OBSTRUCTIONS

Two below-ground obstructions present in the Twelfth Avenue roadbed and adjacent bikeway would be removed prior to tunneling: pile supports for the Twelfth Avenue interceptor sewer, and abandoned pile supports for the former West Side Highway.

A large interceptor sewer, 8 feet by 8 feet, is located within Twelfth Avenue, running north to connect to the North River Wastewater Treatment Plant at 137th Street.[6] This sewer is currently supported by steel piles. Where the new Hudson River Tunnel would pass beneath the interceptor sewer, some of those piles would have to be removed. Therefore, the sewer would be underpinned with new pile supports installed from within the new tunnel. Prior to TBM tunneling, the steel pile-supported sewer line in the bed of Twelfth Avenue (Route 9A) would be underpinned from within the tunnel excavated using SEM in frozen ground. **Figure 3-12** illustrates the underpinning of the sewer. As shown in the figure, the supports for the sewers would be structurally integrated with the initial tunnel liner for the new Hudson River Tunnel.

Abandoned piles that formerly supported the viaduct that carried the West Side Highway may remain buried in this area, primarily beneath the southbound lanes of Twelfth Avenue and beneath the Route 9A bikeway. The piles would either be removed by a pile extractor working from the surface of Twelfth Avenue, or manually cut and removed from within the SEM tunnel, if SEM excavation from a shaft in Hudson River Park is conducted. Pile extraction from the surface would take approximately three months, and an MPT plan would be followed to minimize disruption to traffic and the bikeway.

3.3.6.5 EXCAVATED MATERIAL AND DISPOSAL

Excavated material from construction in the Manhattan waterfront area and other construction zones in Manhattan is discussed below in Section 3.3.7.2.

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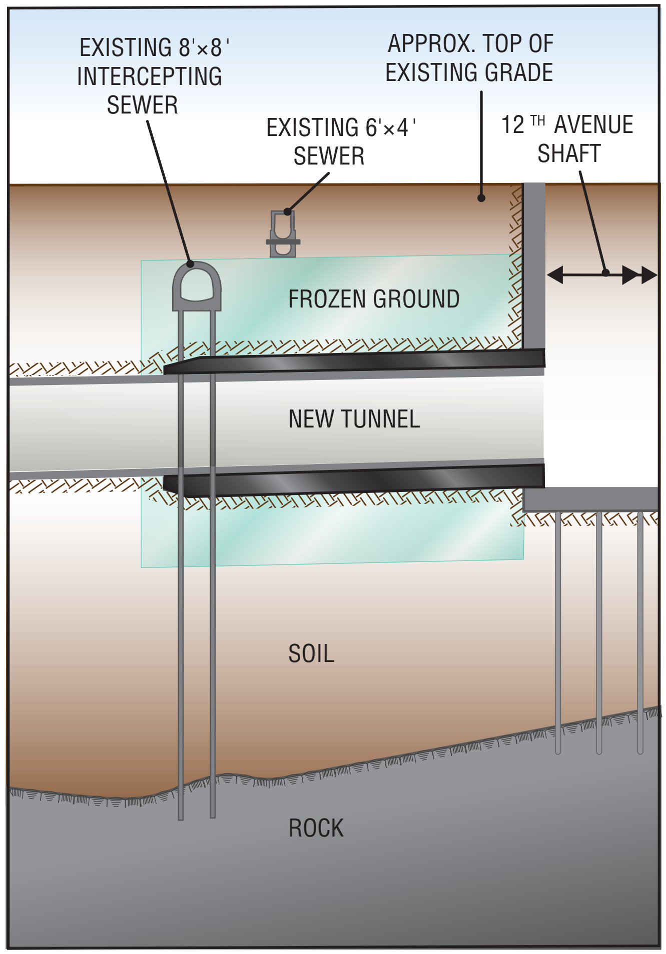
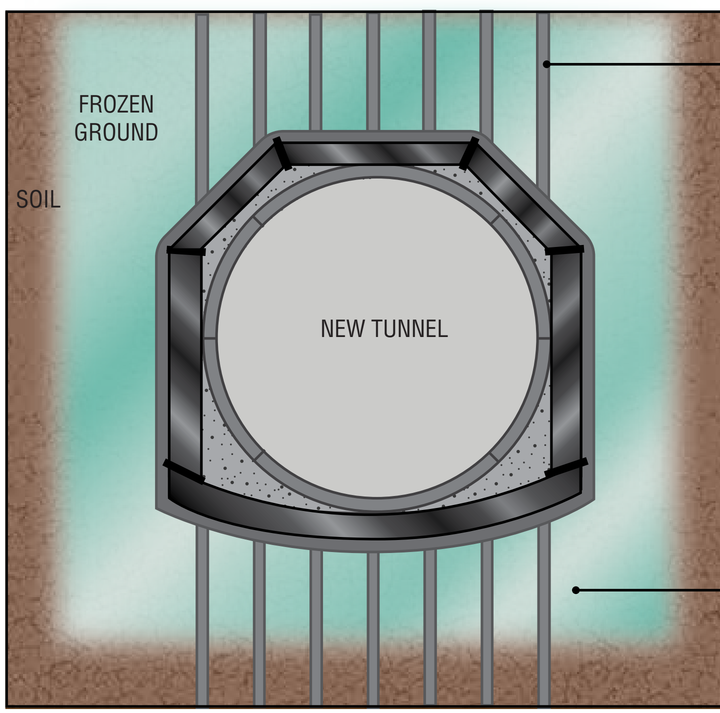
[6] Interceptor sewers are very large sewers that collect wastewater and stormwater at the end of a network of progressively larger main and trunk sewers, and carry the flows directly to wastewater treatment plants.



A. Illustration of the new tunnel where it passes beneath the existing intercepting sewer at Twelfth Avenue, requiring underpinning of the sewer.



B. Detail showing the new tunnel with existing and proposed support piles for the intercepting sewer at Twelfth Avenue.

Underpinning of Sewer in Twelfth Avenue
Figure 3-12

3.3.6.6 CONSTRUCTION STAGING AREA AND TRUCK ROUTES

In addition to the staging site at the West 30th Street Heliport described earlier in this section, construction activities in the Manhattan waterfront portion of the alignment would also be staged from the Twelfth Avenue staging site, discussed below in Section 3.3.7. Potential impacts on traffic conditions, noise levels, air quality, and the surrounding community from the construction-related truck traffic are evaluated in subsequent chapters of this EIS.

3.3.6.7 SCHEDULE

The ground improvement in the Manhattan waterfront area would be accomplished in two eight-hour shifts per day (7 AM-3 PM and 3 PM-11 PM) on weekdays. The SEM excavation in Hudson River Park and beneath Twelfth Avenue/Route 9A would generally occur 24 hours a day on weekdays, with some potential for weekend work to support the weekday activities, such as equipment maintenance. This work would last approximately two years.

3.3.7 TWELFTH AVENUE SHAFT, STAGING, AND FAN PLANT SITE

Construction of the river tunnel would be staged from New Jersey, as discussed above, so that tunnel spoils generated by the TBMs are removed from the tunnel in New Jersey and deliveries to the tunnel are made in New Jersey. The site of the Manhattan ventilation shaft and fan plant for the Hudson River Tunnel would be used as a tunnel access point for retrieval of the river TBMs. It would also be used as a staging site and laydown area for other Manhattan construction activities (Sections 3.3.6 and 3.3.8) and would be the permanent location of an approximately 130-foot-diameter ventilation shaft and associated fan plant for the Preferred Alternative. This site, referred to as the Twelfth Avenue staging area and shaft site, is located on the western end of the block between West 29th and 30th Streets from Eleventh to Twelfth Avenue, as described in Section 3.3.7.4.

3.3.7.1 SHAFT CONSTRUCTION

An approximately 130-foot-diameter ventilation shaft from the surface to the depth of the new tunnel below would be constructed on the western end of the Twelfth Avenue staging area where the tunnel alignment crosses beneath the block. The Manhattan shaft site is located on the east side of Twelfth Avenue between West 29th and West 30th Streets, close to the corner of Twelfth Avenue and West 30th Street. The vertical shaft would provide direct access for tunneling operations. It must be large in diameter to provide access to both tubes of the tunnel. For tunneling operations, the shaft would be used for demobilization and servicing of the TBMs; access of crews, equipment, and materials for cross passage construction; and access of crews, equipment, and materials for construction of the SEM adjacent tunnel sections beneath Twelfth Avenue and West 30th Street. Given the geologic conditions, which at shallower levels include soils that are not strong materials, the shaft must be adequately supported to provide safe, stable working conditions for the construction crews, equipment, and materials, which is most effectively achieved by a vertical structure. The same vertical shaft would then be used as a permanent tunnel ventilation shaft because it would provide the shortest direct connection from the tunnel to the associated fan plant building and ventilation system equipment above the tunnel. This would minimizes Project cost and the space required for the ventilation system.

As the shaft is excavated, support walls would be installed to retain the earth. These are likely to be slurry walls. As described in Section 3.2.1.4, slurry walls are concrete walls constructed through the use of a slurry of bentonite, a natural, clay-like, thick liquid material that is mixed on-site and pumped into a trench, and then replaced by steel reinforcing bars and concrete placed afterward once the trench excavation is completed to the full required depth. A slurry plant would be located on the site temporarily to prepare bentonite slurry required for the installation of slurry walls.

3.3.7.2 EXCAVATED MATERIAL AND DISPOSAL

Excavated material from the construction of the vertical shaft at Twelfth Avenue and the other Manhattan excavation zones (SEM tunnel between either the bulkhead or the median of Twelfth Avenue and the Twelfth Avenue shaft, SEM or cut-and-cover tunnel across West 30th Street, and cut-and-cover tunnel across Tenth Avenue) would be removed from the construction zone by truck. Approximately 200,000 loose cubic yards of soil and rock would be removed from the construction zone. The Project Sponsor will develop protocols during final design to identify spoils that may contain contaminated materials so that they can be handled appropriately and disposed of at a suitable location. For spoils that cannot be reused, commercial disposal sites may be appropriate. These facilities are required to meet all applicable regulations and typically process soils and dredge materials to recycle or beneficially reuse them. Locations for spoils disposal are available in nearby areas of New Jersey. The Project Sponsor will be responsible for working with the Project contractor to find a suitable location for disposal of spoils. Spoils will not be disposed in areas within the jurisdiction of the USACE to avoid adverse effects related to placing fill in wetlands or navigable waters. In addition, protocols for the transport of spoils from the construction sites would be developed to ensure the safe handling of these materials and would include procedures to secure the material from spilling off trucks, as well as for any inadvertent or accidental spills of materials falling from trucks removing this material from the staging sites. Further information related to the handling and disposal of excavated materials can be found in Chapter 16, “Contaminated Materials,” Section 16.8.1.1.

3.3.7.3 STAGING SITE

The Twelfth Avenue staging and laydown site would be established on the western end of the block between West 29th and 30th Streets from Eleventh to Twelfth Avenue (Manhattan Block 675). The Twelfth Avenue staging site would include the full lot where the ventilation shaft and fan plant would be located (Block 675, Lot 1). In addition, the staging site would also include the westernmost 126 feet of an adjacent property on West 29th Street (Block 675, part of Lot 12). **Figure 3-13** shows the location of the Twelfth Avenue staging site. (A more detailed illustration of the lot boundaries on Block 675 is provided in Figure 4-4 in Chapter 4, “Analysis Framework.”)

The Twelfth Avenue staging site would be used to stage all of the Manhattan construction activities for the Hudson River Tunnel, including removal of the TBMs after they have completed the two tubes of the river tunnel, ground freezing activities between the Manhattan bulkhead and the median in Twelfth Avenue (which would also be supported by the small, shorter term staging site at the West 30th Street Heliport described in Section 3.3.6), construction of the tunnel segment between Twelfth Avenue and the north side of West 30th Street, and construction of the tunnel segment that crosses Tenth Avenue. The TBMs would be large pieces of equipment that would be disassembled and removed from the tunnel in pieces. The removal of TBM components would occur over approximately one month for each TBM. These large pieces of equipment would be transported from the staging area by truck, most likely during off-peak and overnight hours, given their large size. As outlined below in Section 3.3.7.6, construction on Block 675 would last approximately seven years.

The staging area would fully occupy all of Lot 1 on Block 675 for the duration of the Hudson River Tunnel’s Manhattan construction. Most of the western portion of the block would be occupied by the 130-foot-diameter ventilation shaft itself, which would be used for access to the Manhattan tunnels. In addition, the staging site would house a variety of construction equipment and materials, including a freeze plant to support ground freezing operations west of the shaft, a slurry plant for installation of slurry walls (a type of excavation support), and laydown and storage for construction materials, including large rebar cages for the concrete support walls, as well as worker support facilities. Once the TBMs have been removed through the construction shaft, the

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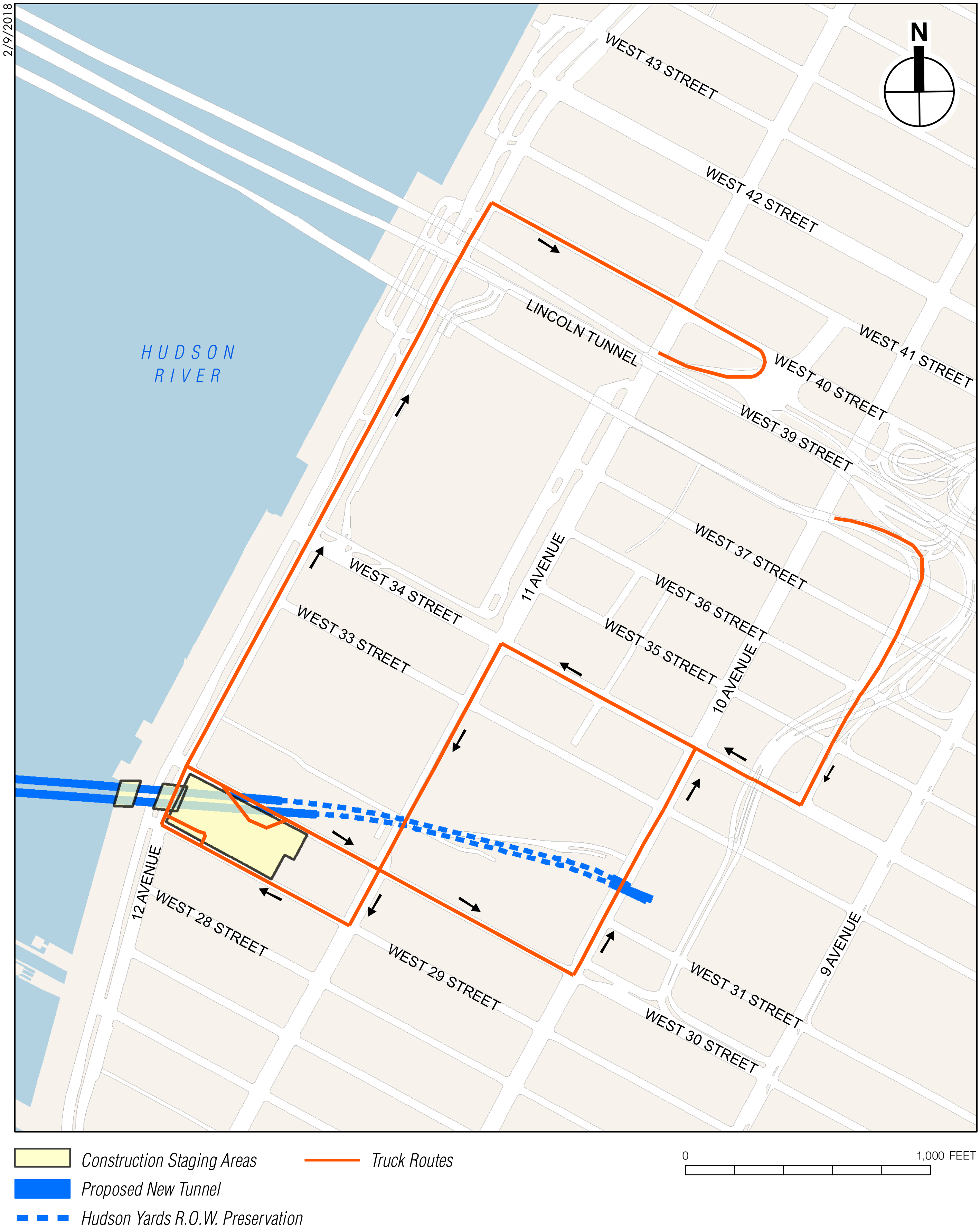

HUDSON TUNNEL PROJECT

Twelfth Avenue Staging Area:
Truck Routes
Figure 3-13

shaft site would continue to be used as an access point for the internal concrete finishing for the tunnel.

In addition to Lot 1, the Twelfth Avenue staging site would include the western portion of Lot 12, extending 126 feet along West 29th Street from Lot 1.[7] This portion of Lot 12 is part of an adjacent property where a private developer is currently constructing a tall residential building fronting on Eleventh Avenue with a shorter section extending along West 29th Street, a project currently called 601 West 29th Street (see Chapter 6A, "Land Use, Zoning, and Public Policy," for more information.) The western 126 feet of the lot's frontage on West 29th Street is currently part of that construction site, but no structure is yet being built there. Ultimately, this portion of Lot 12 may house an Emergency Medical Services (EMS) station for the Fire Department of New York, to replace a station currently located on West 23rd Street, or a one-story parking garage. While the completion date for a new EMS station or parking garage is not known, the new development at 601 West 29th Street will be complete in 2022.

Amtrak has been coordinating and will continue to coordinate with the developer for the adjacent project about use of a portion of Lot 12. Based on current preliminary design and the construction under way on most of Lot 12, the Project Partners anticipate using the western 126 feet of Lot 12 for construction staging for the Hudson Tunnel Project for the duration of the tunnel construction, until the end of 2029. The Project Partners will continue to evaluate the space needs for Manhattan construction staging to determine whether construction activities on Lot 12 can use less space or have a shorter duration than the full Hudson River Tunnel construction period, which could allow completion of the private development's potential EMS facility (or one-story garage) prior to completion of the Hudson River Tunnel construction. Based on coordination to date and the preliminary design information for the Hudson Tunnel Project, this timing is not likely; thus, this EIS assumes that tunnel construction staging would occur on the western 126 feet of Lot 12 until the end of 2029. In that case, the Hudson Tunnel Project may complete the potential EMS facility (or a one-story parking garage) for incorporation into the development project at 601 West 29th Street, if agreed to by the developer.

3.3.7.4 FAN PLANT CONSTRUCTION ON LOT 1

Following completion of the other Manhattan components of the Preferred Alternative, construction of the emergency access/egress components of the shaft and the ventilation fan plant would be undertaken. This would involve typical construction methods for constructing the building frame, superstructure, core, shell, and finishing work, including the installation of the fans and fire-life safety equipment.

Lot 1 may also be developed in the future with a separate development. As described in Chapter 6A, "Land Use, Zoning, and Public Policy," Section 6A.4.3.1.1, the site's current owner may have an interest in redeveloping the site with a large office building consistent with the site's current zoning. Such a building is not proposed as part of the Hudson Tunnel Project, but could be undertaken in coordination with the Hudson Tunnel Project. In this case, it could be constructed together with the Twelfth Avenue fan plant.

3.3.7.5 TRUCK ROUTES

Trucks carrying materials to and from the Twelfth Avenue staging area would use local streets on the West Side of Manhattan to reach the site (see **Figure 3-13**). Access and egress to the site may be provided from West 29th Street, Twelfth Avenue, and/or West 30th Street depending on

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[7] Lot 12 is 525 feet long along its frontage with West 29th Street, and also has frontage on Eleventh Avenue and West 30th Street (see Figure 4-4). The lot's western limit, where it meets Lot 1 along West 29th Street, is located 259 feet east of Twelfth Avenue.

the final staging layout at the site. The route to the staging area proceeds south from the Lincoln Tunnel on Dyer Avenue to West 34th Street, then west to Eleventh Avenue, south to West 29th Street, and west to Twelfth Avenue. Trucks leaving the site would proceed north on Twelfth Avenue to West 40th Street, then east to the Lincoln Tunnel access road at Galvin Avenue, located between Tenth and Eleventh Avenues.

Hauling materials and debris by rail is not practicable, due to the nature and capacity of the NEC, particularly the rail system in the vicinity of PSNY. The NEC in this area and PSNY are used exclusively by passenger rail, with the very limited exception of use by work trains for minor maintenance in the immediate vicinity of PSNY; it is not appropriate to haul materials and debris in this area. Use of barging for hauling away demolition debris may be considered, but is unlikely considering the cost and additional handling involved to use this method of transport and the difficulty of mitigating impacts to Hudson River Park resulting from operation of conveyors that would need to be erected through the park from the Twelfth Avenue staging site.

Based on the current conceptual construction staging approach, an average of approximately 8 to 14 trucks per hour would arrive at and then depart from the Manhattan staging sites during the construction period, with up to 10 trucks per hour at the Twelfth Avenue shaft site and up to 4 trucks per hour at the Tenth Avenue cut-and-cover site. Peak trucking activity would range from approximately 8 to 14 trucks per hour during the peak construction periods, which is anticipated to occur in 2024. Trucking would occur Monday through Friday from 7 AM to 10 PM. These trucks would be carrying construction materials to the site and hauling away construction debris and spoils from the tunnel excavation sites in Manhattan, which may include hazardous materials encountered during construction. Truck routes would be coordinated with the New York City Department of Transportation's (NYCDOT) Office of Construction Mitigation and Coordination (OCMC), NYCDOT, and NYSDOT, as necessary.

The Project Sponsor will be responsible for maintenance, repair, and cleaning of designated truck routes on local streets and will reconstruct any streets damaged by trucking activity associated with construction of the Preferred Alternative.

Potential impacts on traffic conditions, noise levels, air quality, and the surrounding community from the construction-related truck traffic are evaluated in subsequent chapters of this EIS.

3.3.7.6 SCHEDULE

In general, work at the Twelfth Avenue staging site would occur in two eight-hour shifts per day (7 AM-3 PM and 3 PM-11 PM) on weekdays, five days a week. SEM excavation beneath Twelfth Avenue (Route 9A) and West 30th Street would generally occur 24 hours a day on weekdays, with some potential for weekend work to support the weekday activities, such as equipment maintenance. Construction activities at the site would last approximately seven years, as follows:

- Site preparation, Twelfth Avenue shaft, and SEM mining construction: approximately 2 years.
- Fan plant construction, finishing, and fit out: approximately 3 years.
- Trackwork, rail systems, and MEP finishes: approximately 2.5 years.

Overall, an average of approximately 40 construction workers would be based at the Twelfth Avenue staging area during each shift (with a peak of up to about 80 workers during the most intensive activities), including workers for construction of the Twelfth Avenue shaft, SEM mining, fan plant construction, trackwork, and also work on the Manhattan waterfront area (Section 3.3.6) and Tenth Avenue tunnel construction (Section 3.3.8).

3.3.7.7 POTENTIAL BUILD-OUT OF PARKING GARAGE ON ADJACENT PROPERTY (LOT 12)

As described above in Section 3.3.7.3, the analyses in this EIS are based on an assumption that the Hudson Tunnel Project's space needs during construction may not allow completion of the potential EMS facility or one-story garage on the western 126 feet of Lot 12 on the same schedule as the rest of the development, which will be complete in 2022. Instead, the potential EMS facility or parking garage could be delayed until after the Hudson River Tunnel is complete in 2029. In that case, it is possible that after completion of construction on the Twelfth Avenue shaft site, the Project Sponsor would construct the EMS facility or the western 126 feet of the parking garage on Block 675 Lot 12, if agreed to by the developer. Therefore, this EIS analyzes the impacts associated with this potential delay in the schedule for construction and completion of the potential EMS facility or garage that could result because of the Hudson Tunnel Project.

The potential EMS station or garage would occupy the full 126-foot length of the west end of Lot 12, and the full 99-foot depth. It would be approximately 23 feet tall, with a slab foundation (no cellar below). Construction of the garage or potential EMS facility is anticipated to take approximately 18 months, including approximately three months for pre-construction remediation of hazardous materials on the site, if required. Construction activities are currently anticipated to occur as follows:

- Hazardous materials remediation: up to three months;
- Mobilization, excavation, and foundation: five months;
- Superstructure: three months;
- Building envelope: four to five months; and
- Mechanical systems: one to two months.

There would be an average of 62 construction workers per day in the peak month of construction for the Block 675 Lot 12 facility (month 13, during which the building envelope would be constructed). Truck trips would peak at 94 per month, or 5 per day (month 8, during construction of the foundation, when concrete trucks would arrive and depart the site). The total delay in the construction of the garage or potential EMS facility would be approximately nine years—from a completion date of 2022 to a completion date of 2031.

3.3.8 TUNNEL FROM WEST 30TH STREET TO PSNY

East of the Twelfth Avenue shaft site and staging area, several tunnel segments would be constructed. In addition, the Hudson Yards Right-of-Way Preservation Project would be fitted out with track and rail systems. These segments of the Preferred Alternative are discussed below.

3.3.8.1 WEST 30TH STREET EXCAVATION

In the DEIS, FRA and NJ TRANSIT described and evaluated a construction staging approach in New York in which the new tunnel would be constructed across West 30th Street using cut-and-cover construction. With this excavation, slurry walls would be constructed to support the excavation area. Some pile installation would be required (potentially for up to seven months).

Since completion of the DEIS, the design for the new Hudson River Tunnel has progressed. Based on further engineering and in consideration of comments from the New York City Department of Environmental Protection (NYCDEP) related to a large sewer main located in West 30th Street, Amtrak has developed a second option for the construction approach for the tunnel segment crossing West 30th Street. With the new construction option, the segment of tunnel extending from the Twelfth Avenue shaft across West 30th Street would be excavated using SEM mining, and would include a cast-in-place waterproof lining. This would result in less disruption at the street level. Prior to the SEM excavation, the soils would undergo ground treatment to improve the soil strength. Construction workers would conduct the ground treatment from the surface in both vertical and diagonal orientations.

With either construction approach, prior to excavation, utilities in the roadway would be supported or relocated out of the construction zone, which would involve some excavation from the surface. Large combined sewer structures are also located within the West 30th Street streetbed.[8] These are NYCDEP Flat Top Reinforced Concrete (FTRC) combined sewer boxes that are 10-foot by 6-foot and 6-foot by 5-foot. The new tunnel would cross beneath these sewers. To avoid adverse impacts to the operation of these large structures, the combined sewers would be temporarily relocated onto the Twelfth Avenue staging area on the south side of West 30th Street until the new tunnel has been excavated beneath 30th Street. Following utility relocation, the tunnel alignment in West 30th Street would be excavated. After the tunnel is complete, the combined sewers would be reinstalled at their original location in the West 30th Street streetbed.

With either option, spoils from this tunnel segment would be removed and disposed of as described in Section 3.3.7.2 above.

The DEIS described that cut-and-cover construction in West 30th Street would involve full closure of the street at the construction zone for up to three years. During ongoing consultation with Project stakeholders, representatives of Manhattan Community Board 4 raised concerns about disruptions to traffic from a full closure of West 30th Street, which provides a connection from Twelfth Avenue/New York State Route 9A to the Dyer Avenue entrance to the Lincoln Tunnel. As a result, with either proposed construction option for West 30th Street, the Project Sponsor would maintain at least one lane of West 30th Street for traffic throughout construction (other than the potential for short-term outages of up to several days related to sewer relocation). The southern half of West 30th Street would be partially closed to traffic and pedestrians and fully closed to parking for the duration of the ground treatment, installation of the relocated sewer, and SEM mining excavation process, estimated at about two years (from late 2023 through late 2025). This would require the removal of an approximately 250-foot-long area on the south side of West 30th Street that is designated for on-street bus parking spaces, signed as “Non-MTA Bus Layover Only,” that is currently used by tour and charter buses. The Project Sponsor will develop MPT plans in coordination with local authorities, including NYCDOT’s OCMC, that ensure that at least one through travel lane would be maintained on West 30th Street between Eleventh and Twelfth Avenues throughout the duration of construction. The pedestrian diversions in this area during this activity are described in more detail in Chapter 5A, “Traffic and Pedestrians,” Section 5A.6.4.2.

3.3.8.2 CONSTRUCTION IN THE HUDSON YARDS RIGHT-OF-WAY PRESERVATION PROJECT SEGMENT

Separately from the Hudson Tunnel Project, Amtrak is working to complete the third and final segment of the Hudson Yards Right-of-Way Preservation Project to preserve a railroad right-of-way beneath the Hudson Yards overbuild north of West 30th Street between Tenth and Twelfth Avenues. This project consists of a concrete casing that extends from the north side of West 30th Street to the west side of Tenth Avenue. The project is being developed in phases and, once completed, will be available for use as the alignment for the Preferred Alternative.

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[8] New York City’s sewer system uses combined sewers to carry wastewater and stormwater together for treatment, or, in the event of heavy rainfall that exceeds the system’s capacity, for discharge directly to the nearest water body (in this case, the Hudson River).

The alignment for the Preferred Alternative would make use of the concrete casing, and would finish the casing with tracks, communications, signals, and other railroad systems.

3.3.8.3 TENTH AVENUE CUT-AND-COVER CONSTRUCTION

At the eastern end of the Hudson Yards Right-of-Way Preservation Project, the tunnel alignment would extend beneath Tenth Avenue via cut-and-cover construction. Cut-and-cover excavation is most suitable for this segment because of its short distance (about 100 feet) and its relatively shallow depth (about 20 feet below the surface). This portion of the alignment is in mixed rock and soil conditions. The soil segment would be excavated using support of excavation such as secant piles or soldier pile and lagging, and the rock portion would likely be excavated using controlled drilling and blasting. The Tenth Avenue roadway would remain open throughout this process, although temporary lane closures would occur, in compliance with MPT plans that will be developed by the Project Sponsor in coordination with NYCDOT’s OCMC, as necessary. As the construction progresses, the excavation will be staged and temporarily decked over to allow traffic and pedestrian movement.

3.3.8.4 NEW CONNECTIONS TO PSNY APPROACH TRACKS AT A YARD

East of Tenth Avenue, a new tunnel portal would be constructed, which would require demolition of a portion of the A Yard retaining wall and selective underpinning and/or relocation of support columns for the building at 450 West 33rd Street, which are currently supported by a retaining wall.

Constructing new track connections for the Preferred Alternative would involve modifications to the existing approach track system to PSNY. This work would require trackwork and minor excavation to lower the profile of several tracks so they can meet the grade of the new tunnel tracks at the new portal within A Yard. An existing track that runs diagonal to the existing track network to provide connections to the PSNY platform tracks, known as the I Ladder, would be extended to connect to the new tunnel’s tracks, so that connections are available from the new tunnel to PSNY Tracks 1 through 18. In addition, certain tracks within A Yard would be modified. The new tunnel’s tracks would connect to two of the A Yard tracks, which would be connected to the station platform tracks via the extended I Ladder and a shorter connection referred to as the J Ladder. Other switches in A Yard would be modified to support the new tunnel operations.

Track profiles beneath the building at 450 West 33rd Street would be modified to accommodate the new tracks. Specifically, certain tracks in A Yard must be lowered to meet the alignment of the Hudson River Tunnel tracks. NJ TRANSIT would relocate its trains to other storage locations either at Sunnyside Yard in Queens or in New Jersey during Project construction, and permanently, once the new Hudson Tunnel is operational (for more information, see Chapter 5B, “Transportation Services,” Section 5B.6.2.3).

The new extension to the I Ladder would require removal of approximately 10 columns of the existing building at 450 West 33rd Street. New spread footings and columns would be constructed adjacent to the existing columns outside the track clearance zone. A new permanent structural connection would be made at the top of the columns and underside of existing building girders. Once the load is transferred to the new columns at each location, the existing columns and footings would be removed.

Tie-in to existing railroad facilities would be accomplished during night and weekend outages to the extent practicable. However, as this is a constricted area, there may be some disruptions to train service or schedules as a result of construction activities and the corresponding safety measures that would be in place during construction (see Chapter 5B, “Transportation Services,” Section 5B.6.2.3).

3.3.8.5 EXCAVATED MATERIAL AND DISPOSAL

Excavated material from the construction zones in Manhattan is discussed in Section 3.3.7.2.

3.3.8.6 FAN PLANT AT TENTH AVENUE/450 WEST 33RD STREET

A fan plant to provide ventilation for the new tunnel segment from the Twelfth Avenue shaft to the new Manhattan portal at Tenth Avenue would be constructed near Tenth Avenue. The fan plant would be constructed within an existing Amtrak easement area above the tracks of the A Yard. Based on conceptual design, this fan plant would be located beneath the building at 450 West 33rd Street, which spans the A Yard tracks on the east side of Tenth Avenue from West 31st to 33rd Street. The work would require reconfiguration of the area above the tracks to include ventilation fans, power supply for the fans, and equipment rooms for the control of the fans. This area already serves as ventilation for the A Yard area and exhaust for the new fan plant would be through the existing louvers on the west face (Tenth Avenue façade) of the building at 450 West 33rd Street. The new columns supporting the fan plant and the relocated columns of 450 West 33rd Street would be encased in reinforced concrete crash wall sections for protection against a derailed train.

3.3.8.7 TRACKWORK, RAILROAD SYSTEMS, AND MEP FINISHING

The various railroad systems, including tracks, signals and communications; and overhead contact systems structures and wires, would be installed once the tunnel is complete. Construction and finishing of the various mechanical, electrical, and plumbing systems, including tunnel ventilation systems and tunnel lighting systems would also be installed once the tunnel is complete.

3.3.8.8 SCHEDULE

Construction activities for Manhattan components of the Preferred Alternative east of the new ventilation shaft at Twelfth Avenue would generally occur on weekdays in eight-hour shifts per day (7 AM-3 PM and 3 PM-11 PM). Based on the refined Project design and corresponding schedule estimates developed after completion of the DEIS, the overall duration would be seven years, currently anticipated to occur as follows (note that certain activities may overlap):

- West 30th Street SEM mining, including associated utility relocation and reconstruction: approximately 2.5 years.
- Tenth Avenue cut-and-cover and fan plant, including associated utility relocations: approximately 1.5 years.
- Underpinning the building at 450 West 33rd Street, approximately 1 year.
- New connections to PSNY, including track modifications, and regrading of A Yard: approximately 6 months.
- Fit-out of Hudson Yards Right-of-Way Preservation Project: approximately 1.5 years.
- Trackwork, railroad systems and MEP finishing, approximately 2 years.

3.3.9 COORDINATION WITH OTHER CONSTRUCTION PROJECTS

The Project Sponsor would coordinate as necessary with entities responsible for construction activities on sites near the proposed construction sites for the Preferred Alternative to avoid potential conflicts, as necessary. This will include the following:

- In the event that the Lincoln Tunnel Helix Replacement Program is under way at the same time as construction activities for the Preferred Alternative in New Jersey the Project Sponsor for the Hudson Tunnel Project will coordinate with those responsible for the Helix reconstruction to avoid cumulative construction impacts to the extent practicable.

- If construction activities for the Preferred Alternative in Hoboken and Weehawken would overlap with rehabilitation of the Willow Avenue bridge over the HBLR, the Project Sponsor for the Hudson Tunnel Project will coordinate with Hudson County to avoid cumulative construction impacts to the extent practicable.
- The Project Sponsor will coordinate with NJDEP to avoid conflicts during any overlapping construction activities of the Rebuild By Design Project and the Hudson Tunnel Project in Hoboken and Weehawken to the extent practicable.
- The Project Sponsor will coordinate with the responsible party for the concrete casing for efficiency and to avoid conflicts to the extent practicable.
- The Project Sponsor will coordinate with MTA regarding construction activities for the West Side Yard Perimeter Protection project to avoid adverse impacts related to simultaneous construction to the extent practicable.

For construction activities in New Jersey, FRA, the Project Partners, and the local New Jersey transportation agencies all recognize the need for regional construction projects to be coordinated among the various regional transportation agencies in terms of planning and execution. To address this issue, a bi-state multi-agency capital construction and operations working group on construction projects, composed of representatives from the PANYNJ, New Jersey Department of Transportation (NJDOT), and the New Jersey Turnpike Authority, meets quarterly to coordinate construction projects so they do not interfere with traffic flow on the roadway network and to and from municipalities or industrial complexes. Working group member agencies will continue to work together to facilitate transparent sharing of information between agencies and the neighboring communities. The Project Sponsor for the Hudson Tunnel Project will coordinate with these agencies regarding construction activities for the Preferred Alternative.

Similarly, in New York State, a multi-agency capital construction and long-term planning working group composed of representatives from NYSDOT, MTA, the PANYNJ, NYCDOT, New York State Thruway, and the Transportation Operations Coordinating Committee (TRANSCOM), among others, meet on a regular basis to coordinate capital construction and maintenance projects. In New York City, the NYCOT's OCMC performs a similar role, coordinating construction activities that will affect city roadways. The Project Sponsor for the Hudson Tunnel Project will coordinate with OCMC regarding construction activities for the Preferred Alternative.

3.3.10 REHABILITATION OF NORTH RIVER TUNNEL

Once construction of the new Hudson River Tunnel is complete and Amtrak and NJ TRANSIT service is shifted to the new tunnel, rehabilitation of the North River Tunnel would begin. Rehabilitation work would be accomplished by taking one tube out of service at a time for reconstruction while the other tube remains in service. Once rehabilitation of the first tube is complete, that tube would be recommissioned (i.e., put back in service) and the second tube would be taken out service for rehabilitation. Both tubes of the North River Tunnel would not be closed simultaneously for rehabilitation because the new tunnel's two tubes alone, without either North River Tunnel tube, would not provide the same level of peak-hour capacity as the North River Tunnel does today (see Section 2.5.7.1 in Chapter 2, "Project Alternatives and Description of the Preferred Alternative," for more information).

3.3.10.1 STAGING

Before rehabilitation of the North River Tunnel can begin, staging areas would be established. Because hauling demolition debris and construction materials through PSNY is not feasible, the Project contractor would need to transport construction materials and debris via the tunnel portal in North Bergen, New Jersey. The track outside the decommissioned tube would temporarily be "dead" track (i.e., not in service for passenger rail operations) and thus suitable for use by construction work trains. All core rehabilitation activities would take place within the North River Tunnel, with activities in the staging areas outside the portal consisting largely of material conveyance.

Rehabilitation of the North River Tunnel would continue to use the Tonnelle Avenue staging area previously established for construction of the new Hudson River Tunnel. New construction access between the staging area and the "dead" tracks at the North River Tunnel portal would need to be constructed across the newly active tracks of the new Hudson River Tunnel right-of-way. It may be possible to create such construction access in advance, during construction of the new Hudson River Tunnel.

Two staging access options have been developed for accessing the North River Tunnel tracks from the portion of the staging site on the west side of Tonnelle Avenue (see **Figures 3-14 and 3-15**):

- **Deck and crane trestle system at portal.** The Project contractor could build a deck and crane trestle system over the tracks of the NEC at the tunnel portal, where the tracks are located in an open cut. This system would take advantage of the approximately 45-foot vertical clearance above the tracks. The deck area would be at the same elevation as the Tonnelle Avenue bridge over the NEC so the deck could be accessed at grade from Tonnelle Avenue. A vertical partitioning wall would be constructed between the two North River Tunnel tracks in this area to isolate and protect the operational track from the one under construction. The Project contractor would use a large crawler crane on the deck over the dead track to service its work train or conveyance vehicles into the decommissioned tube. Access to the crane would be via the deck over the live track. The use of a deck system would allow the Project contractor to lower construction material onto the construction track and lift debris from the track, and while shielding the active track from debris and protecting the overhead contact system (i.e., catenary).

  To move between the crane and the Tonnelle Avenue staging site on the west side of Tonnelle Avenue as well as any available land left on the portion of the Tonnelle Avenue staging site on the east side of Tonnelle Avenue once the new tunnel is in operation, trucks would use Tonnelle Avenue's U-turn loops.
- **Extended deck and crane system at portal crossing new tracks.** Another option would be to include a deck and crane trestle system as described above, but with a larger deck that extends across the new active tracks leading into and out of the new Hudson River Tunnel. With this extended deck, construction equipment could move easily between the North River Tunnel and the remaining staging area on the east side of Tonnelle Avenue. Cranes would be placed at either end of the decking system to transfer materials. To move between the crane and the Tonnelle Avenue staging site on the west side of Tonnelle Avenue, trucks would use Tonnelle Avenue's U-turn loops.

In addition, the Project team considered several other access options that used staging areas on the west side of Tonnelle Avenue. These included an option with a 350-foot-long conveyor to move materials from the NEC over Amtrak's active substation (Substation 42) and adjacent historic substation building (Substation 3) to the staging area on the west side of Tonnelle Avenue from the NEC; an option in which a decking and crane system is employed on the west side of Tonnelle Avenue, over the active substation and adjacent historic substation building; and an option with a similar deck and crane system on the west side of Tonnelle Avenue west of the substations but adjacent to the freight rail right-of-way. These alternative access options had significant disadvantages compared with the two options described above, including placing cranes in close proximity to an active electrical substation, introducing conveyer systems that are not universally useful for transporting all types of materials necessary at the site, very tight fit of the conveyor system that may require modifications to the substation, need to build the decking system 20 feet

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North River Tunnel Rehabilitation:
Staging Area Option with Platform over North River Tunnel Tracks
Figure 3-14

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North River Tunnel Rehabilitation:
Staging Area Option with Platforms over
North River Tunnel Tracks and Hudson River Tunnel Tracks

Figure 3-15

higher to clear the substation, and/or bringing the decking and cranes very close to the adjacent freight railroad right-of-way. Therefore, these options are not being advanced.

3.3.10.2 PROVISION OF REDUNDANT FIRE-LIFE SAFETY INFRASTRUCTURE AND DECOMMISSIONING

Before work begins in the first tube, redundant fire-life safety infrastructure must be established in the tube that would remain active so the active tube can be operationally independent of the tube to be reconstructed. Redundant fire-life safety infrastructure to be established includes fire standpipes and emergency means of egress. This infrastructure would be installed during temporary, limited weeknight and weekend service outages. The tube that requires the least redundant life-safety infrastructure, as determined by further investigation during the final design stage, would be the first tube to remain active.

Decommissioning of the first tube to be reconstructed would follow and would include the termination of track crossover (i.e., disabling switches to ensure that trains cannot accidentally switch to track entering the decommissioned tube), termination of third rail traction power and the overhead catenary system, and relocating third-party cables in the existing duct bank. This work would initially be performed during temporary, limited service outages and then under a complete service closure, which would occur when the active tube is operationally independent of the tube to be decommissioned.

3.3.10.3 REHABILITATION WORK

Rehabilitation work would include full replacement of the bench walls and track system; full replacement of cables, repairs along the tunnel crown, and repairs above the bench walls; and any necessary work to address cracking and spalling on the interior face of the tunnel liner (i.e., tunnel wall) including repairs to the areas of the tunnel liner behind the bench walls and beneath the tracks and ballast. The work would be conducted in a linear sequence with work beginning at the Manhattan end of the tunnel and moving westward toward the portal in North Bergen. This would give the Project contractor the option to use the existing track bed within the decommissioned tube for conveyance of personnel, construction debris, and construction materials before being demolished and reconstructed. Virtually all of this work would occur underground, with only the materials delivery and debris removal being visible at the Tonnelle Avenue staging site in North Bergen. Materials conveyance via a conveyor belt or other temporary system is also an option. The work would be conducted on a schedule of six days per week, with two 10-hour shifts per day. Work elements include the following:

- **Tunnel ventilation.** During demolition of the existing concrete within the tunnel, temporary ventilation would be necessary to ensure worker safety and compliance with Occupational Safety and Health Administration (OSHA) regulations. The tunnel environment and air quality can differ greatly between demolition and construction, which would result in different amounts of ventilation being required for different activities. The existing ventilation fans as well as temporary infrastructure for dust suppression methods (e.g., water) and supplemental ventilation (e.g., in-line fans/ducts, potentially with use of an enclosure around the construction/demolition zone to contain airborne dust) would be installed. The system would capture silica dust from ventilated air and would be designed so as to not impact air quality outside the tunnel. A full discussion of dust control measures to be employed during construction is provided in Chapter 16, “Contaminated Materials,” Section 16.8.1.2.
- **Bench wall demolition and replacement.** This critical work activity involves the demolition, removal, and replacement of the bench walls, demolition and removal of the embedded duct banks, demolition and removal of associated duct bank cabling and wiring, and replacement of cable and wiring and associated enclosures where required. Bench walls would be

completely demolished down to the tunnel liner. Demolition work would be staggered with one side leading the other by approximately 500 feet to give work crews sufficient clearance. Bench walls would be demolished, with materials bagged for removal. During demolition, the attachment hardware for the new egress walkways (bench walls or otherwise) would be installed.

Because concrete from this century-old tunnel may contain asbestos, protocols developed during final design would be followed to identify spoils that may contain contaminated materials so that they can be handled appropriately and disposed of at a suitable location. The Project Sponsor will be responsible for working with the Project contractor to find a suitable location for disposal of waste generated during the tunnel rehabilitation. Protocols for the transport of materials from the construction site would be developed to ensure the safe handling of these materials and would include procedures to secure the material from spilling off trucks, as well as for any inadvertent or accidental spills of materials falling from trucks removing this material from the staging sites.

Work for new egress walkways (bench walls or otherwise) and cable enclosures (duct banks or otherwise) would begin once demolition has advanced 3,000 to 5,000 feet, with one side leading the other by approximately 500 feet. The new cable and wire would be pulled when bench wall construction is approximately 80 percent complete.

Any work to address cracking and spalling on the interior face of the concrete tunnel liner would be undertaken concurrently with construction of the new egress walkways (bench walls or otherwise).

- **Track system demolition and reconstruction.** Track removal and replacement would start after the bench wall is advanced far enough that the track construction does not interfere with to the bench wall construction. Track system demolition and ballast removal would be performed sequentially in 2,000-foot sections; then halted until that section is reconstructed. The new track system would be assembled and built using the top down method in which the track system is supported and set to grade; the concrete is then placed, encasing the ties, and the concrete surface finished by hand.

  Concrete would either be delivered using a portable concrete mixer on a work train, or pumped from the staging area through a slick line laid in the track bed.

  Environmental characterization of the ballast to be removed has not yet been conducted; however, the ballast has the potential for Polychlorinated Biphenyl (PCB) contamination due to the oil-infused equipment and rolling stock used in the tunnel. If this contamination is verified, the ballast removed from the tunnel would be stored and treated at the staging area prior to being hauled for permanent disposal at an appropriate facility. The Project Sponsor will be responsible for working with the Project contractor to find a suitable location for disposal of waste generated during the tunnel rehabilitation. Special containment would be provided around the perimeter of the contaminated ballast muck pile.

- **Cabling and systems.** After the completion of egress walkway (bench wall or otherwise), lower bench wall, and track construction, all in-tunnel systems would be installed. This would include installing high-voltage and system-critical cabling in the hardened and fire-rated conduits under the walkways; attaching low-voltage communications, signals cables, emergency response systems and associated equipment, which would be fire-rated as necessary, to the tunnel walls; and installing the new catenary system at the tunnel crown.

3.3.10.4 RECOMMISSIONING

Upon completion of all rehabilitation activities, the rehabilitated tube would be recommissioned. Recommissioning activities would include the activation of track crossover (i.e., re-enabling switches that allow trains to enter the tracks approaching the rehabilitated tube), activation of third rail traction power and the overhead catenary system in the tube, testing the signal system, and testing the operation of the reconstructed tunnel. Upon completion of the recommissioning activities, the tube would be returned to active rail service. At that point, the second tube could be decommissioned and the work described above would be undertaken in the second tube.

3.3.10.5 TRUCK ROUTES

All construction materials would be delivered and all debris would be removed from the primary staging area by truck. Trucks would travel to and from the Tonnelle Avenue staging area using Tonnelle Avenue itself (U.S. Routes 1 and 9), which connects to Route 495 and from there to I-95/the New Jersey Turnpike. Trucks at the staging site on the west side of Tonnelle Avenue would have to head south and make a U-turn just south of the site or farther south at Secaucus Road. During peak construction (i.e., when bench wall replacement construction, track demolition, and track construction are happening simultaneously), there would be a maximum of 17 truck trips per hour in each direction during peak construction activities, which would occur during the last six months of the rehabilitation for each tube, with less intensive periods of construction falling in the range of 4 to 9 hourly truck trips. Truck routes would be coordinated with NJDEP and the local municipality, the Township of North Bergen.

Removal of demolition materials would generally be undertaken by truck, with debris going to several facilities, depending on whether it is disposed of, has potential contamination, or is to be recycled. Locations for the disposal/recycling of demolition materials are available in nearby areas of New Jersey. In general, hauling construction materials to the site and removal of debris by rail was not considered due to the nature and capacity limitations of the adjacent railways. The Project Sponsor will develop protocols for the transport of spoils from the construction sites to ensure the safe handling of these materials; these would include procedures to secure the material from spilling off trucks, as well as for any inadvertent or accidental spills of materials falling from trucks removing this material from the staging sites. The NEC is used exclusively by passenger rail in this segment and use by work trains outside the temporary dead track in the immediate vicinity of the tunnel portal is not appropriate. Use of the adjacent freight railroads for hauling away demolition debris may be considered, but is unlikely considering the cost and additional handling involved to use this method of transport.

The Project Sponsor will be responsible for maintenance, repair, and cleaning of designated truck routes on local streets and will reconstruct any streets damaged by trucking activity associated with construction of the Preferred Alternative.

Potential impacts on traffic conditions, noise levels, air quality, and the surrounding community from the construction-related truck traffic are evaluated in subsequent chapters of this EIS.

3.3.10.6 SCHEDULE

Construction for the rehabilitation of the North River Tunnel would be completed in two 10-hour shifts per day (7 AM-5:30 PM and 5 PM-3:30 AM), six days a week (Monday through Saturday). Other than the construction of the staging area and access point at Tonnelle Avenue, the rehabilitation effort would be undertaken for one tube of the North River Tunnel at a time. Overall construction would have a duration of approximately four years, or approximately 22 months for each tube, currently anticipated to occur as follows (note that certain activities may overlap):

- Construction of the access to existing tunnel portal, decking, conveyor and/or trestle system to access temporary dead track at North River Tunnel portal from Tonnelle Avenue staging area: 3 months.
- First tube, decommissioning, installation of redundant life-safety infrastructure and tunnel ventilation, and installation of dust collection/suppression and ventilation systems: 3 months.

- First tube, demolition and reconstruction of bench walls and duct banks: 11 months.
- First tube, installation of new conduit and cabling, including catenary wiring: 7 months.
- First tube, demolition and reconstruction of the track system: 6 months.
- First tube, commissioning activities to place the reconstructed tube back into service: 2.5 months.
- Second tube, set up of construction staging and access: 3 months.
- Second tube, decommissioning, installation of redundant life-safety infrastructure and tunnel ventilation, and installation of dust collection/suppression and ventilation systems: 3 months.
- Second tube, demolition and reconstruction of bench walls and duct banks: 11 months.
- Second tube, installation of new conduit and cabling, including catenary wiring: 7 months.
- Second tube, demolition and reconstruction of the track system: 6 months.
- Second tube, commissioning activities to place the reconstructed tube back into service: 2.5 months.

During rehabilitation of the North River Tunnel, 120 to 240 workers would be on the site and in the tunnel during a single shift, depending on which activities are occurring.

3.4 SCHEDULE

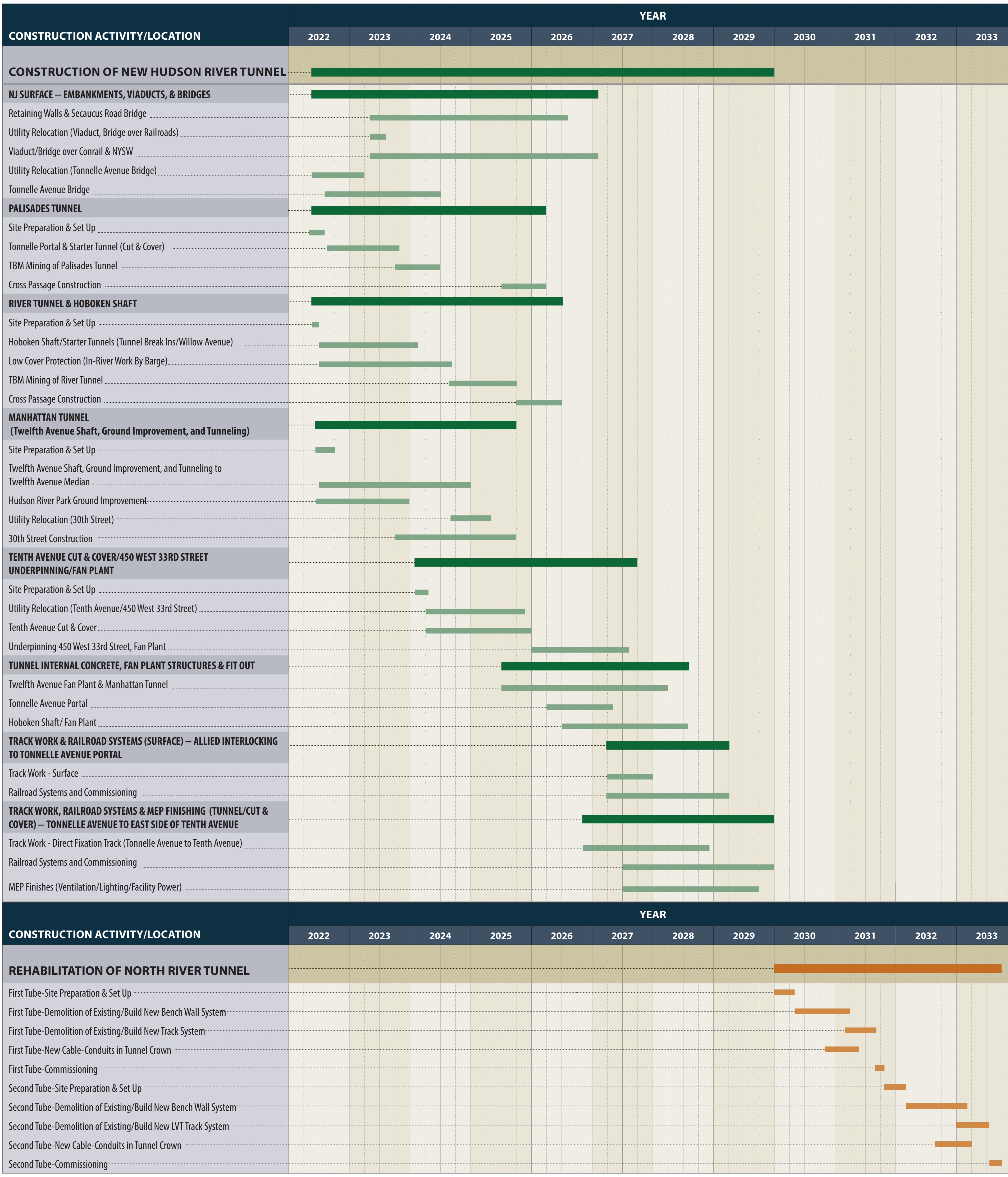
3.4.1 OVERALL CONSTRUCTION SCHEDULE

As noted at the beginning of this chapter in Section 3.1, information presented in this chapter and analyzed throughout this EIS is based on preliminary engineering and is likely to evolve further as engineering advances. Accordingly, the preliminary sequencing approach and overall construction schedule developed for the proposed construction activities represents a reasonable estimate of how the Preferred Alternative could be constructed, based on preliminary engineering; this approach is likely to change as engineering evolves. With this preliminary schedule, construction activities for the Preferred Alternative would begin in 2022 with construction of the new Hudson River Tunnel. Once the new tunnel is completed in approximately 2029 and placed into service, the rehabilitation of the existing North River Tunnel would commence, with both tubes of the North River Tunnel back in service for passenger rail operations in 2033. **Figure 3-16** provides a summary of the overall construction schedule by major construction activity.

The schedule and estimates of daily truck trips and workers at each site are based on the assumption that both tubes of the new Hudson River Tunnel would be bored at the same time, using two TBMs. The Project's contract documents will likely require that the tunneling be completed in a specified amount of time, leaving the means and methods for that completion to the Project contractor. Therefore it is possible that the Project contractor would conduct the tunneling differently than outlined in this chapter and evaluated in this EIS, but to meet the aggressive schedule presented in this EIS, similar tunneling progress, and therefore similar numbers of workers and trucks, would be required.

3.4.2 SUMMARY OF CONSTRUCTION ACTIVITIES BY SITE

The majority of the construction activities would be staged from the three main construction staging areas: (1) staging areas on either side of Tonnelle Avenue (U.S. Routes 1 and 9) in North Bergen, New Jersey, at the new and existing tunnel portals; (2) the Hoboken shaft site and staging area in Hoboken, New Jersey; and (3) the Twelfth Avenue shaft site and staging area in New York. Based on the overall construction schedule for the various construction activities, the peak construction activities (most intensive numbers of workers and truck movements) for the Preferred



Note: This figure was revised for the FEIS

HUDSON TUNNEL PROJECT

Overall Project Construction Schedule
Assumed in the EIS -
By Major Activity

Figure 3-16

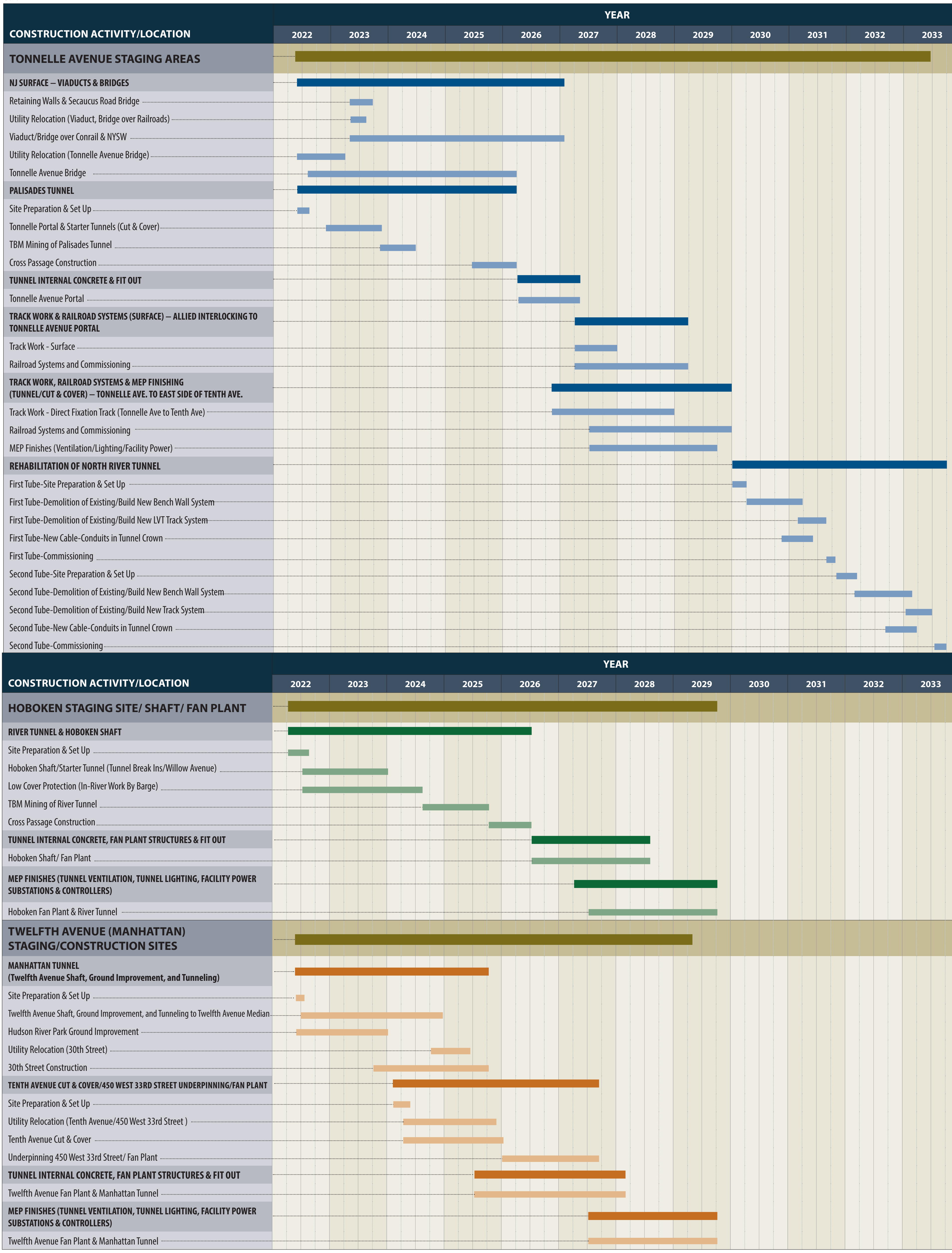
Alternative would occur in 2024 at the Tonnelle Avenue and Twelfth Avenue sites for the Hudson River Tunnel, while the peak construction activities at the Hoboken staging area for Hudson River Tunnel would occur in 2025. The rehabilitation of the North River Tunnel is scheduled to begin in 2030 after the opening of the new tunnel, with peak construction activity for this aspect of the Preferred Alternative occurring in 2032 at the Tonnelle Avenue site.

At the Tonnelle Avenue staging site, construction activities would commence in early 2022 for the new tunnel construction, with new construction for the surface embankments, viaduct, and bridges, as well as the mining of the Palisades tunnel segment followed by excavation of the river tunnel. Construction activity at this staging site would extend to late 2029, when the new tunnel would be completed. Immediately following completion of the new tunnel, construction activities associated with the rehabilitation of the existing North River Tunnel would begin, starting in early 2030 and extending to mid-2033 when the rehabilitation would be complete, and service using the North River Tunnel would be fully restored.

At the Hoboken shaft site and staging area, construction activities would commence in mid-2022 with the construction of the shaft, and would extend until late 2029 as the Hudson River segment of the new Hudson River Tunnel from the shaft site to the Manhattan bulkhead is completed and the new Hoboken fan plant is constructed.

At the Twelfth Avenue shaft site and staging area, construction would begin in early 2023 with shaft construction. Construction activities at this site and in Manhattan would continue until late 2029, as the trackwork, railroad systems, and MEP finishing work is completed for the portion of the new tunnel in Manhattan and connecting to PSNY and the new Twelfth Avenue fan plant is completed.

Figure 3-17 provides a summary of the duration of major construction at each of the three staging sites. ✷



Note: This figure was revised for the FEIS

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Duration of Major Construction Activities Assumed in the EIS - By Staging Site

Figure 3-17