

WASHINGTON
UNION STATION
STATION EXPANSION

Draft Environmental Impact Statement for Washington
Union Station Expansion Project

Appendix A5b – Action Alternatives Refinement Report

**Appendix A-2 – Compendium of Relevant
Studies**



U.S. Department of Transportation
Federal Railroad Administration

January 2020

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Appendix A-2: Compendium of Relevant Studies



A-2.1: TERMINAL INFRASTRUCTURE (TI)

The Alternatives Refinement process involved close coordination with Amtrak, USRC, and FRA to integrate track and platform planning (Terminal Infrastructure) and Cost and Constructability analysis.

There are two final options for the Track and Platform layout: Option 14 and Option 16. The platform and track layout largely defines the planning of the SEP. Each option provides 19 tracks: 12 stub-end and

7 run-throughs. The stub-end platforms are at the same elevation as Concourse A allowing direct access for passengers coming in through the southern end of the station. The run-through platforms are lower in elevation than Concourse A and would be accessed through vertical circulation elements from the northern edge of that concourse. There are additional vertical circulation elements in the middle of all platforms to bring passengers down to the H Street Concourse. Service elevators on the northern end of the platforms would allow for Amtrak rail support to service the trains and tracks without any cross over with passengers.



FIG. 1 VIEW OF CENTRAL CONCOURSE IN TI-14



FIG 2. VIEW OF CENTRAL CONCOURSE IN TI-16
WASHINGTON UNION STATION EXPANSION PROJECT

The two TI options create different spatial qualities for the Central Concourse on the level below (see Figs. 1 and 2 below).

TI OPTION 14

TI Option 14 would provide 19 revenue tracks, including seven run-through tracks. This option also would feature 30-foot-wide platforms with an opening to provide light and air for a concourse beneath the track level. The opening would be between the stub-end and run-

through tracks and would narrow from the terminal northward into the rail terminal.

TI OPTION 16

TI Option 16 has the same number of tracks but features a large central platform with the potential to accommodate openings for skylights at track level to let light into the concourse below. The easternmost stub-end track would be to the east of the large central platform.

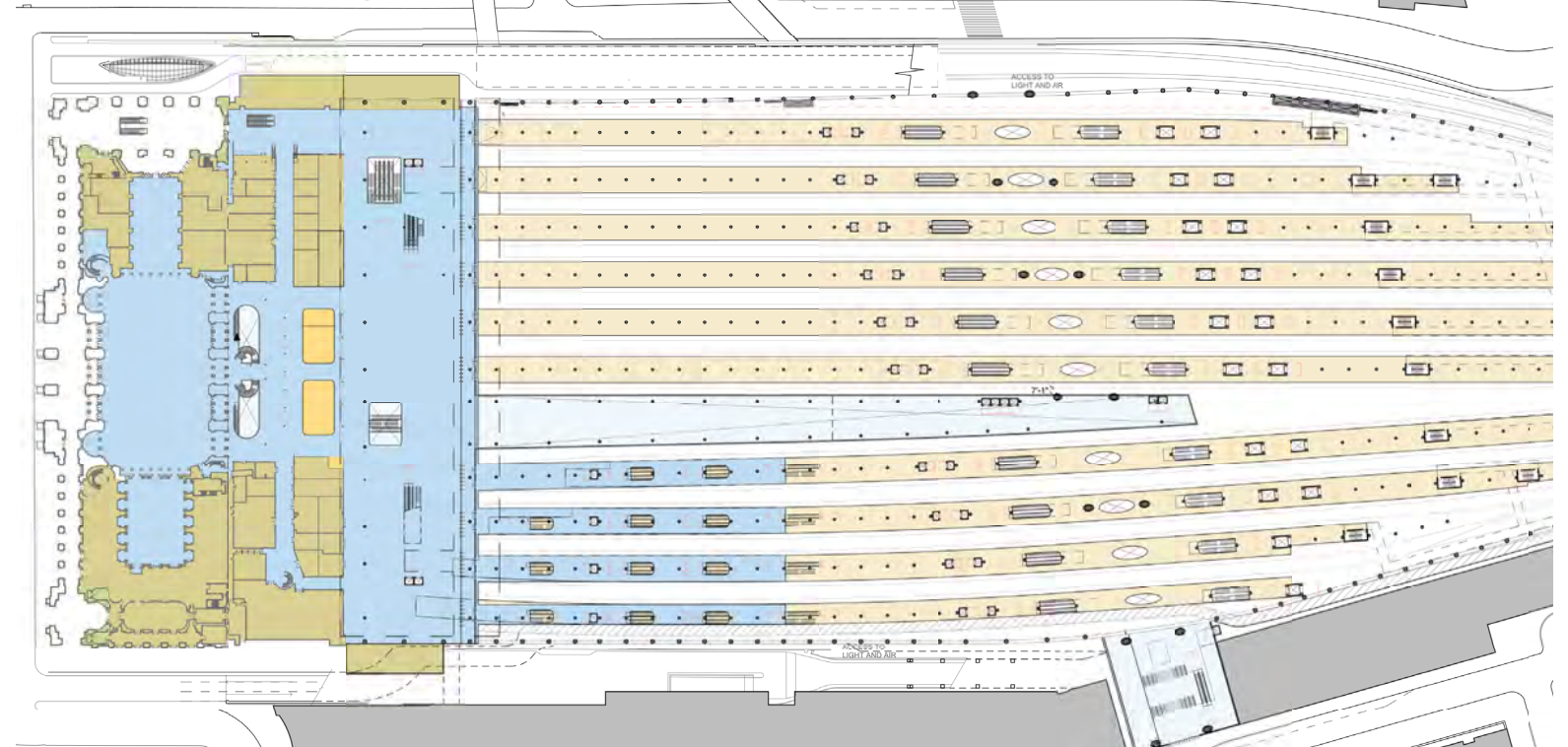


FIG 3. PLATFORM LEVEL PLAN - TI-14 SCENARIO

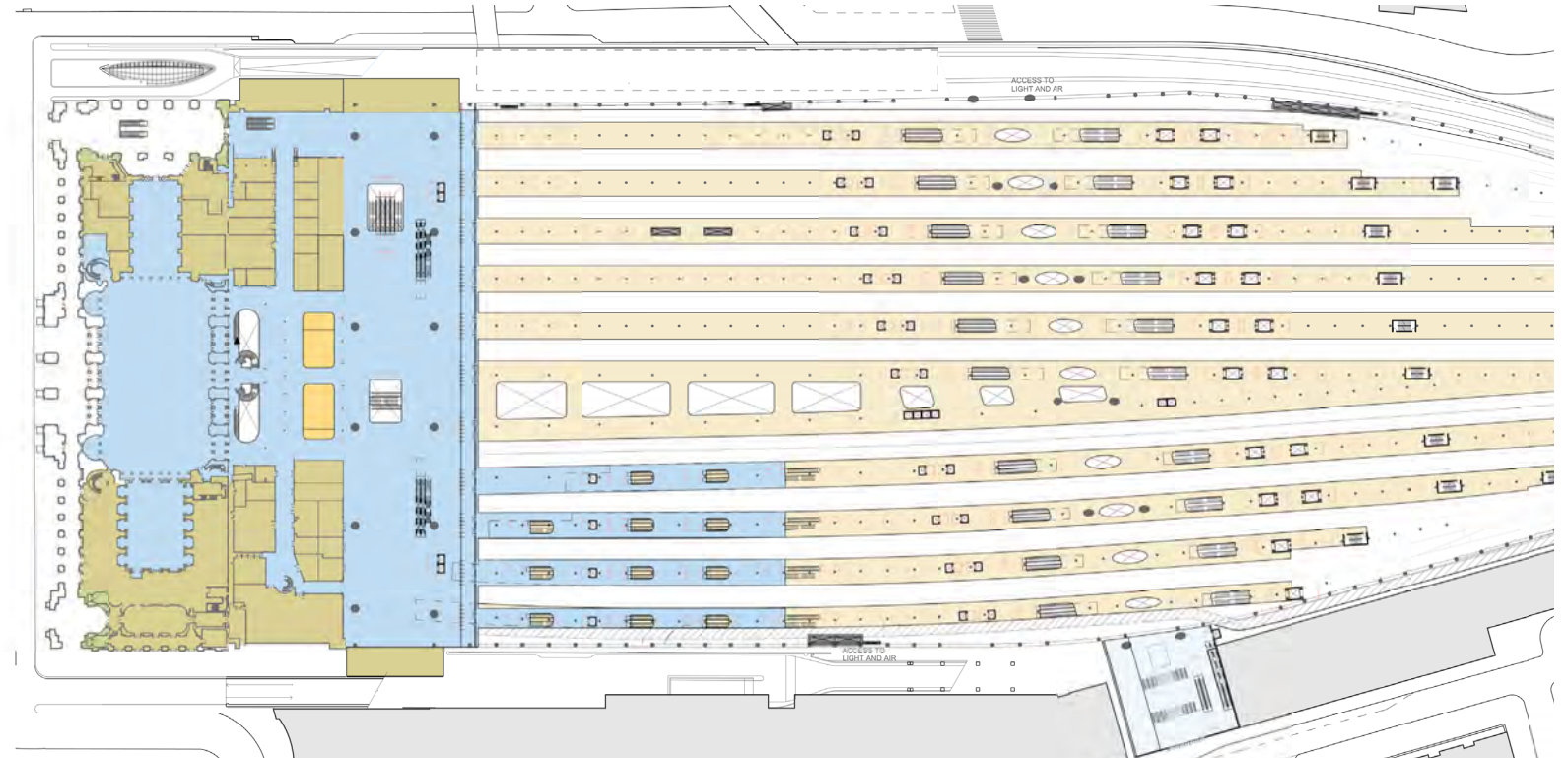


FIG 4. PLATFORM LEVEL PLAN - TI-16 SCENARIO

A-2.2: ACCESSIBILITY AND EGRESS

Both TI options and all of the Action Alternatives include similar assumptions regarding passenger access. Passengers would be able to move onto and from the platforms at the southern ends near the historic station. Additionally, they would be able to take advantage of a significant set of access points near the mid-point of the platforms from the H Street Concourse.

Platform lengths, widths and means of egress comply with the Americans with Disability Act (ADA) Standards for Transportation Facilities and National Fire Protection Association (NFPA) 130: Standard for Fixed Guideway Transit and Passenger Rail Systems.

In order to provide a 60" accessible route on the platform (ADA 403.5.3), a platform needs to be a minimum of 20' wide if one-sided (half-width) and 30' wide if two-sided. Note that at least 23' may be needed for a one-sided platform if sufficient space is to be provided for both overbuild structure and two Vertical Circulation Elements (VCEs), though final VCE locations have not been set.

Egress from the lower levels and concourse spaces is provided through the concourses to various points along First and 2nd Streets.

Egress from the platforms is provided through several means:

- From the south ends of the stub-end platforms through Concourse A to the historic station and Columbus Plaza
- From the south ends of the run-through platforms to a safe area within a public space above adjacent to the loading dock behind Station Place
- From the approximate midpoints of each platform through the H Street Concourse to First or 2nd Street
- From the north end of each platform to First or K Street (with the exception of the eastern-most platform, whose north end is closer in proximity to the H Street Concourse)

A maximum distance of 650' is proposed to be set between means of egress on each platform in order to maintain a travel distance not to exceed 325' (NFPA 130 5.3.3.5). A means of egress is set within 82' from the northern end of each platform, which is the maximum length of a common path of travel.

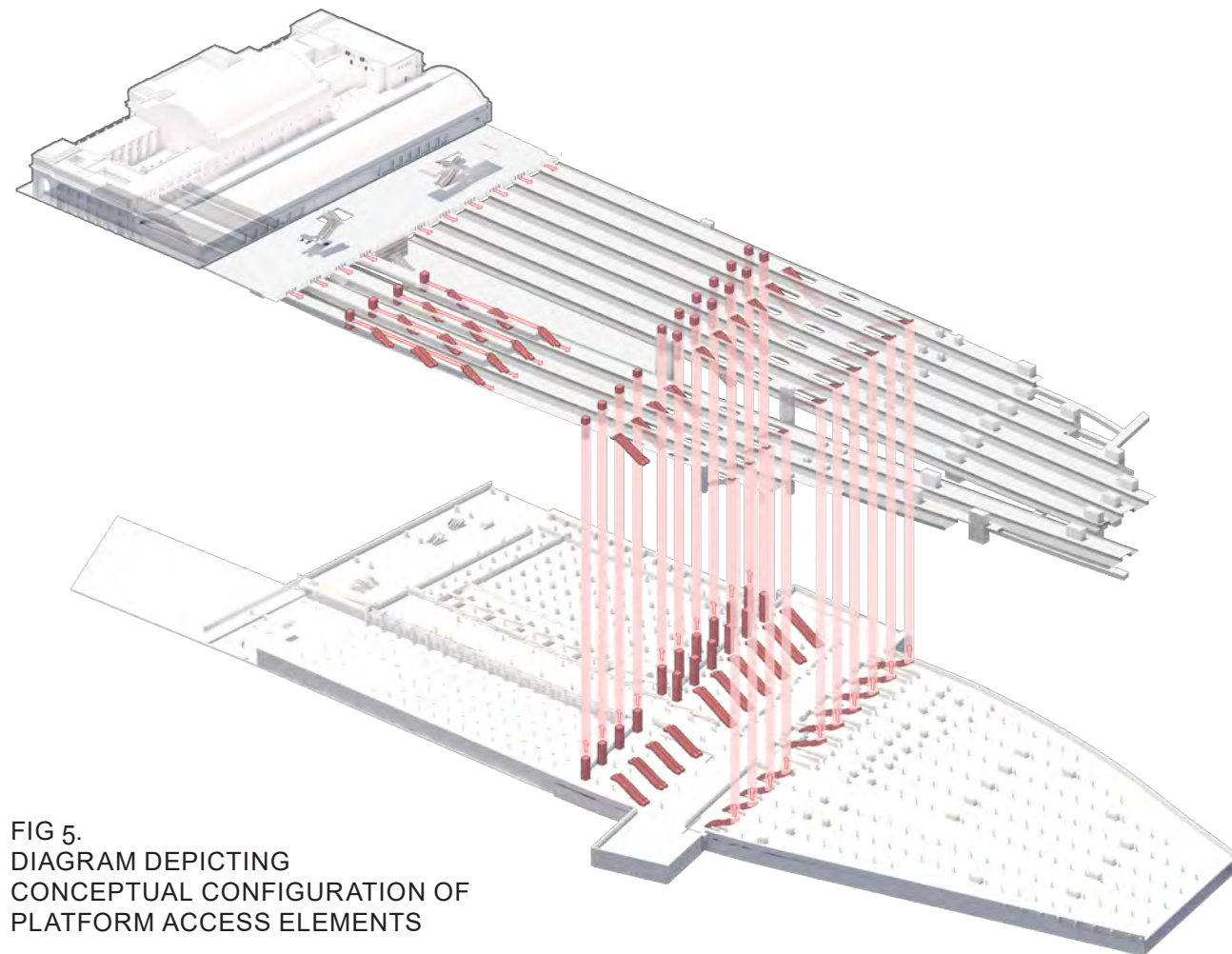


FIG 5.
DIAGRAM DEPICTING
CONCEPTUAL CONFIGURATION OF
PLATFORM ACCESS ELEMENTS

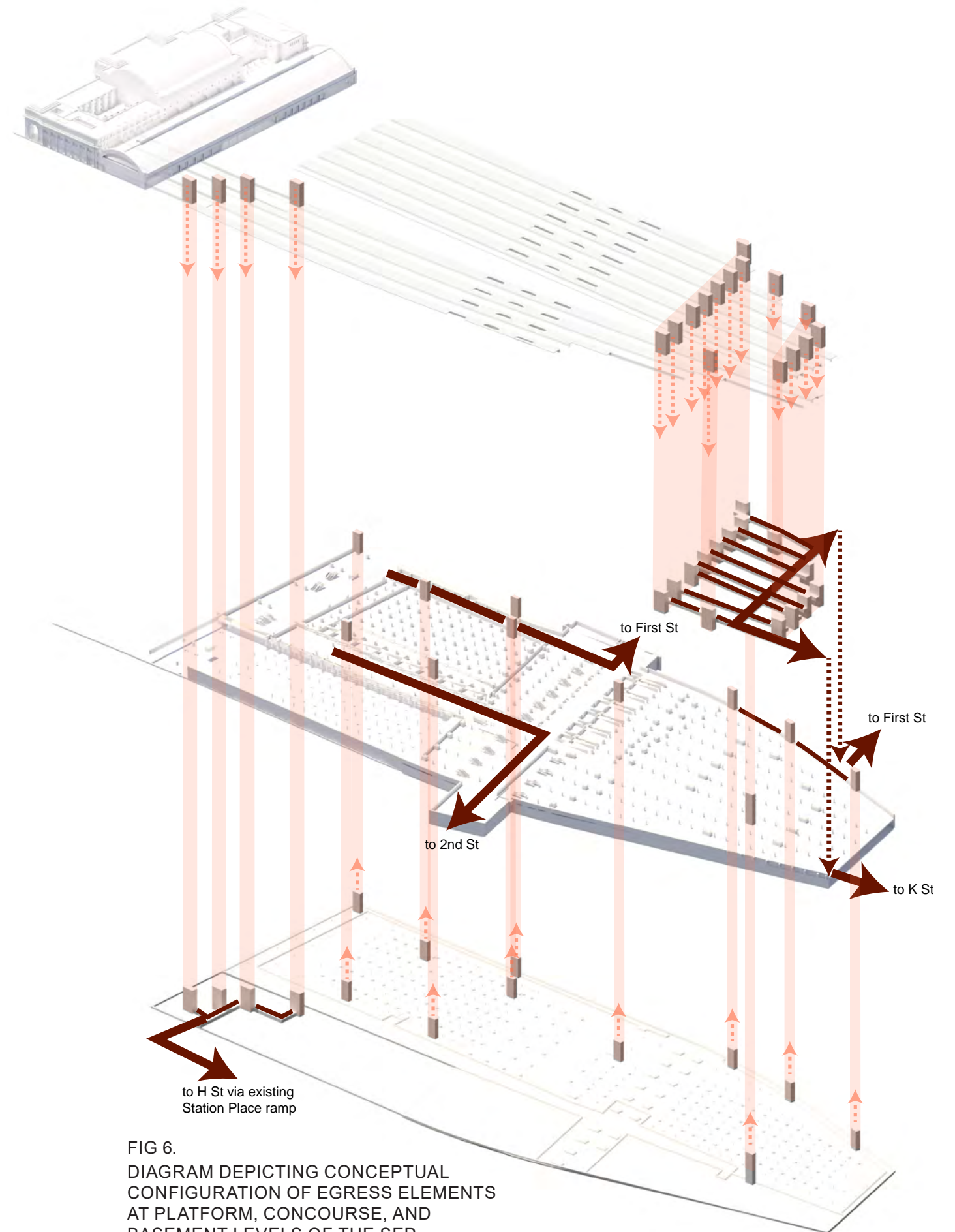


FIG 6.
DIAGRAM DEPICTING CONCEPTUAL
CONFIGURATION OF EGRESS ELEMENTS
AT PLATFORM, CONCOURSE, AND
BASEMENT LEVELS OF THE SEP

A-2.3: PASSENGER BOARDING AND CONTROL

During the Alternatives Refinement step, FRA and the Proponents considered different approaches to improve future screening and boarding procedures. These approaches included individual-platform screening, screening for groups of platforms, or screening for all platforms through a few central screening areas. Given that an operational standard will not be identified at this stage of planning, a more controlled level of access would be assumed, in order to allow for more flexibility in increasing the level of access to platforms in advance of track assignment.

In Scenario 1 (Fig. 8), access would be controlled proximate to the idealized southern edge of the H Street Concourse based on a concourse width of 60'. There would be dedicated access and egress fare arrays for both boarding and alighting passengers, respectively. Waiting areas associated with each platform would sit south of the

VCEs, allowing queuing along the sides of the escalators and an unencumbered movement area immediately in front.

In Scenario 2 (Fig. 9), access would be controlled further south along a flipped configuration of the VCEs that would face south. There would be dedicated access fare arrays for boarding either controlled by attendant or electronically. Alighting passengers would move internally within the controlled area east and west to gain access to either the First Street or Central Concourses. Waiting areas associated with each platform would sit north of the VCEs, allowing queuing along the sides of the escalators. There is some potential for overlapping paths between boarding and alighting passengers.

In Scenario 3 (Fig. 10), access would still be controlled further south along a flipped configuration of the VCEs that would face south. There

would be dedicated access fare arrays for boarding either controlled by attendant or electronically. Alighting passengers would make a reverse move to gain access to the H Street concourse. Waiting areas associated with each platform would sit north of the VCEs, allowing queuing along the sides of the escalators within the controlled area. This arrangement reduces the potential for overlapping paths between boarding and alighting passengers.

In Scenario 4 (Fig. 11), access is similar to that in scenario 3, except the line of control that includes the fare arrays is moved north closer to the H Street Concourse, reducing the amount of waiting area provided and the distance to transit through it. Alighting passengers would still make a reverse move to gain access the concourse, with an additional exit access point on the west wall that would deliver passengers into First Street Concourse.

And finally, in Scenario 5 (Fig. 12), access control would be immediately in front of north-facing VCEs, as in Scenario 1, with waiting areas and queuing zones running parallel to the VCE banks all within the controlled or ticketed area. There would be dedicated access fare arrays for boarding either controlled by attendant or electronically. Alighting passengers would have direct access to the H Street Concourse within the same path of travel. An arrangement with parallel compartments on either side of the VCEs for movement and waiting would also reduce the potential for overlapping paths between boarding and alighting passengers.

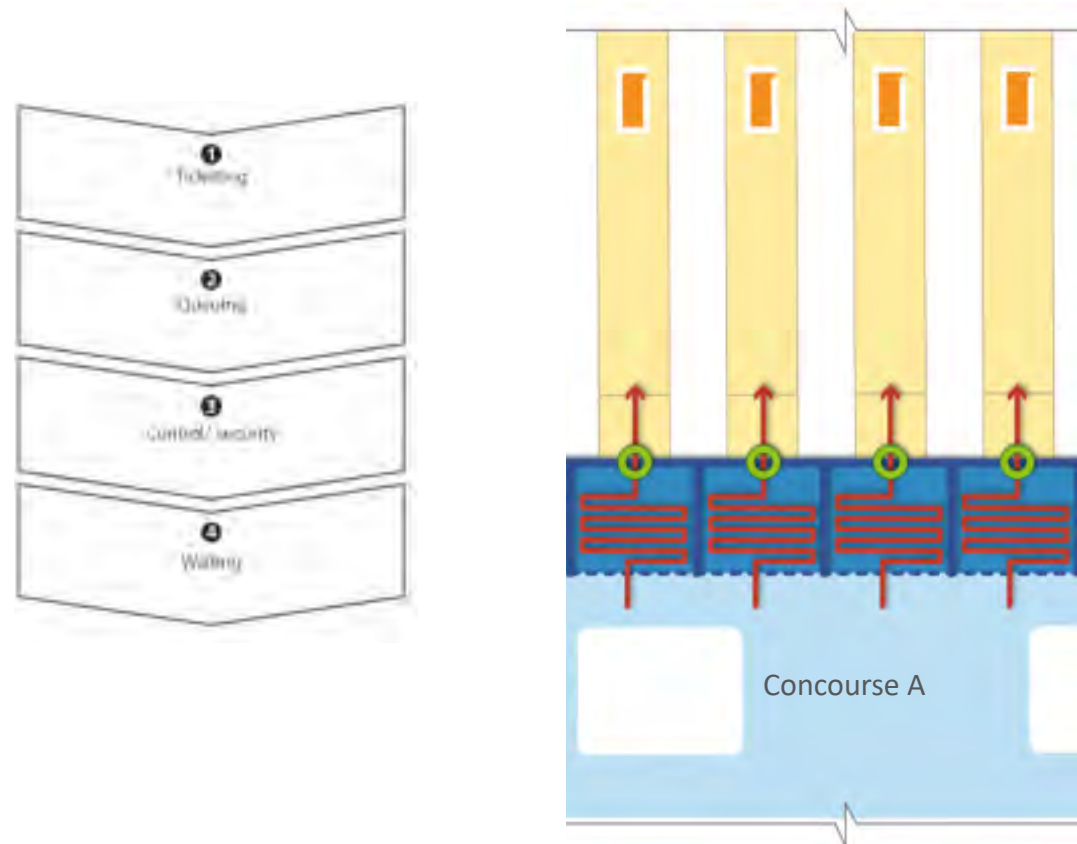


FIG 7. POTENTIAL PLATFORM ACCESS FROM CONCOURSE A

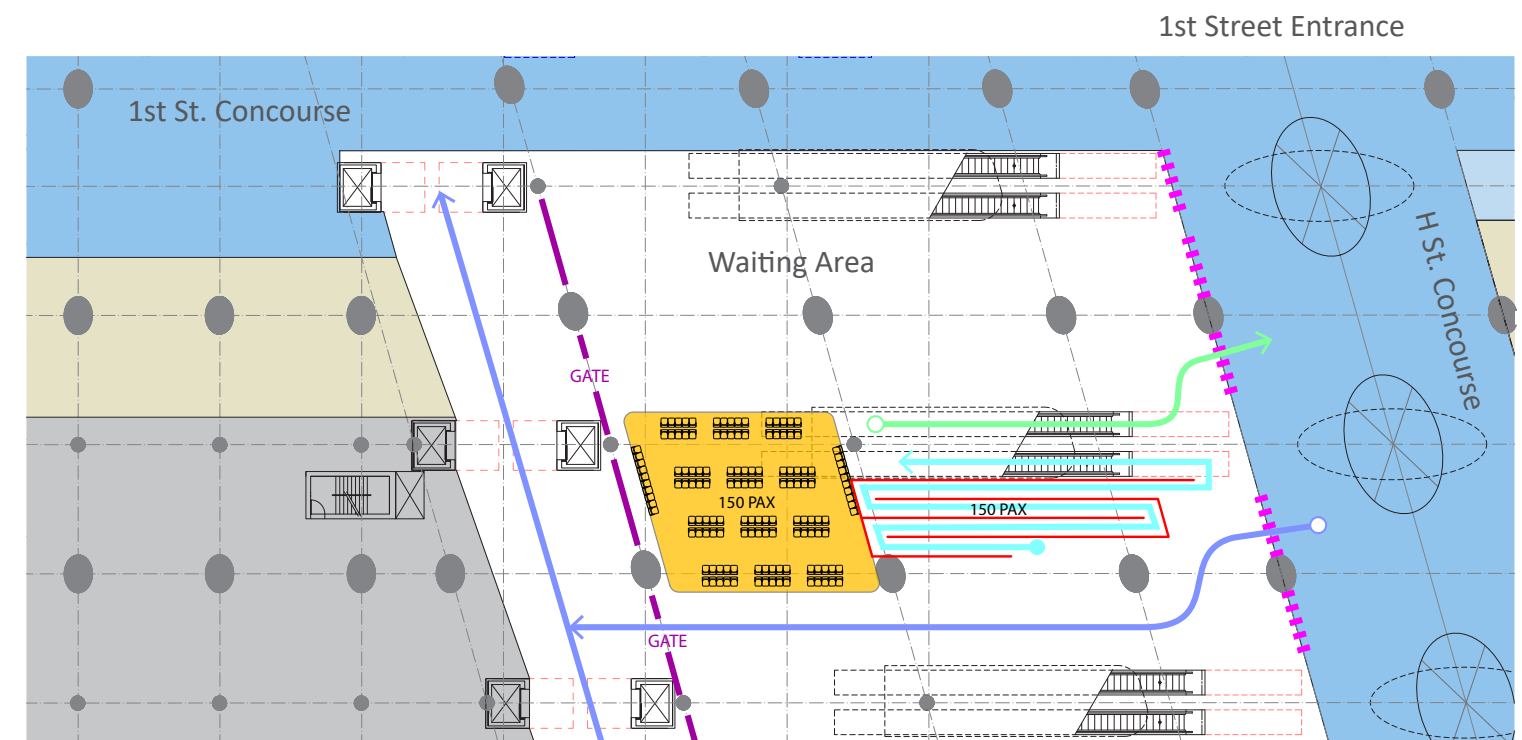


FIG 8. SCENARIO 1

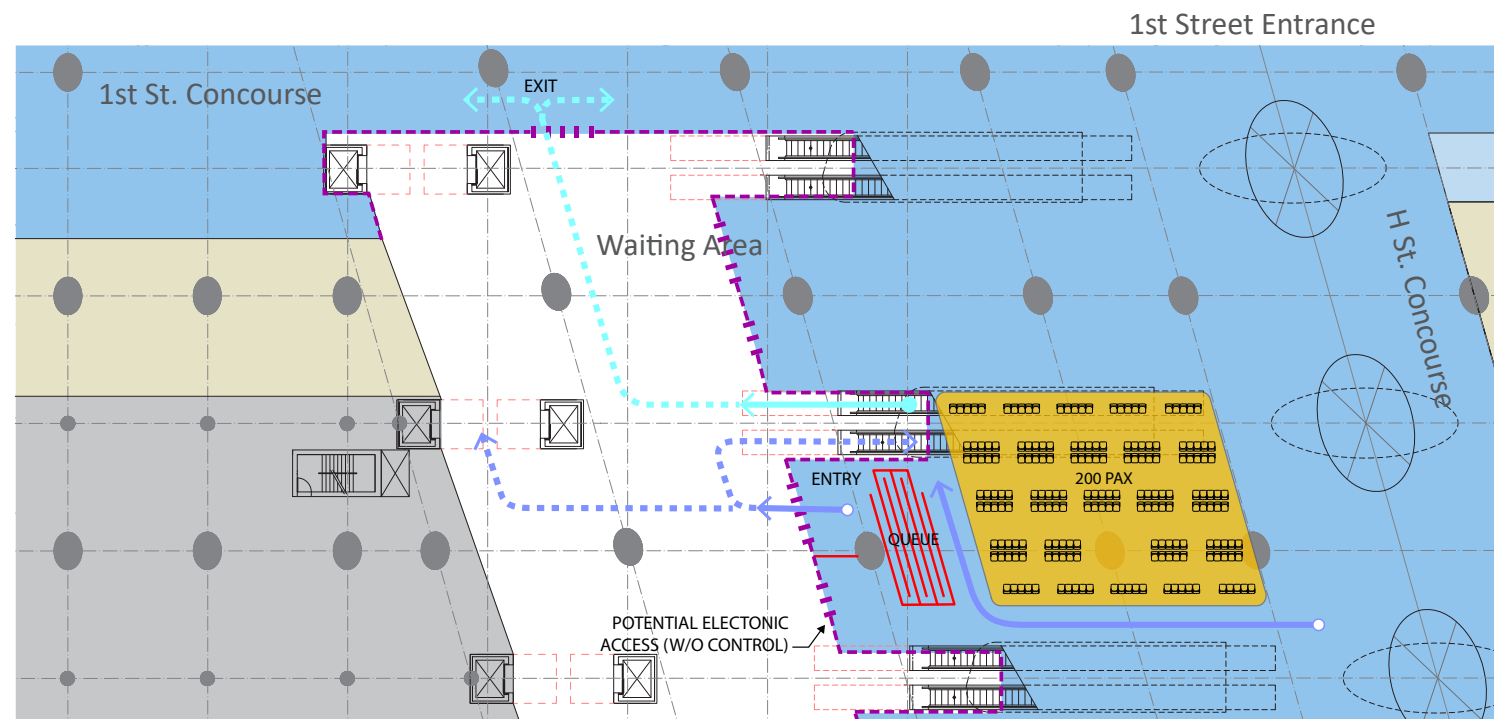


FIG 9. SCENARIO 2

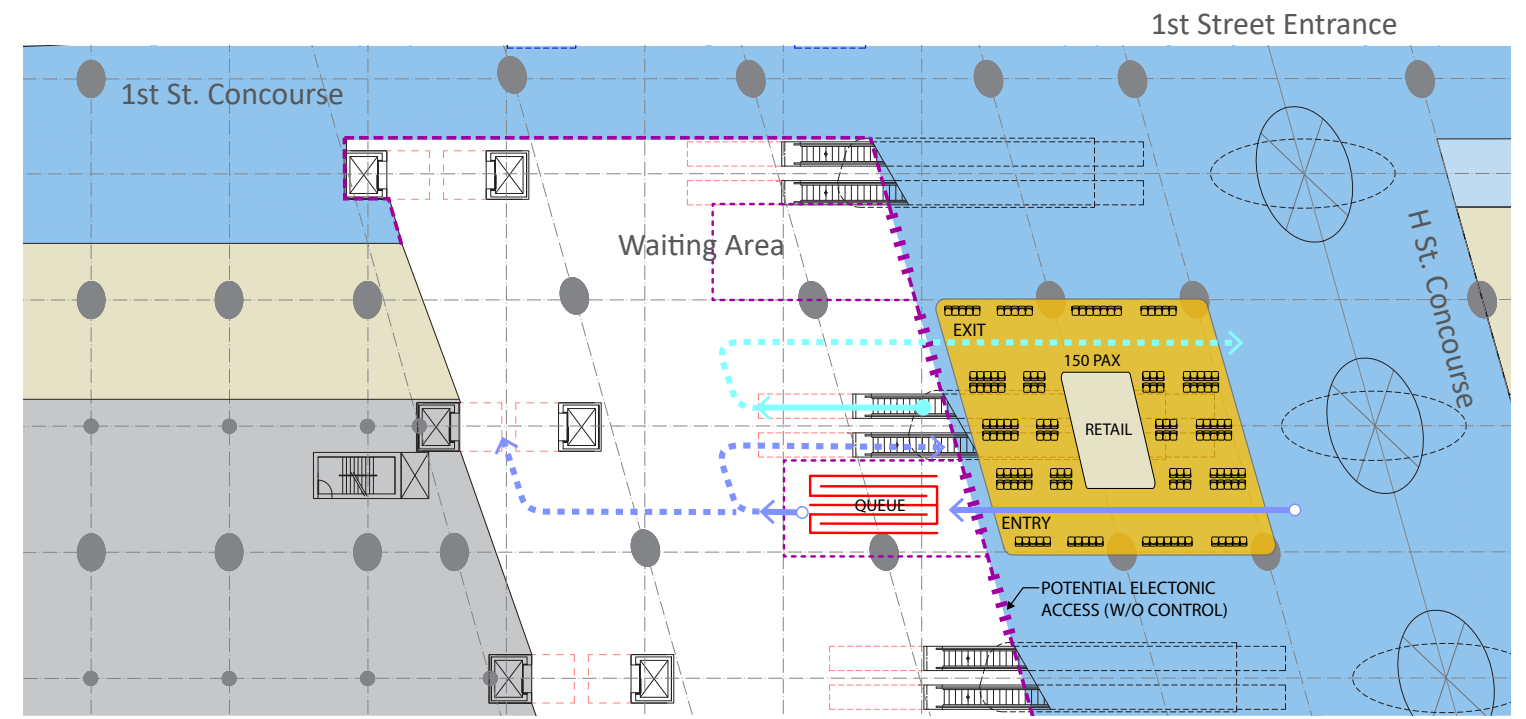


FIG 10. SCENARIO 3

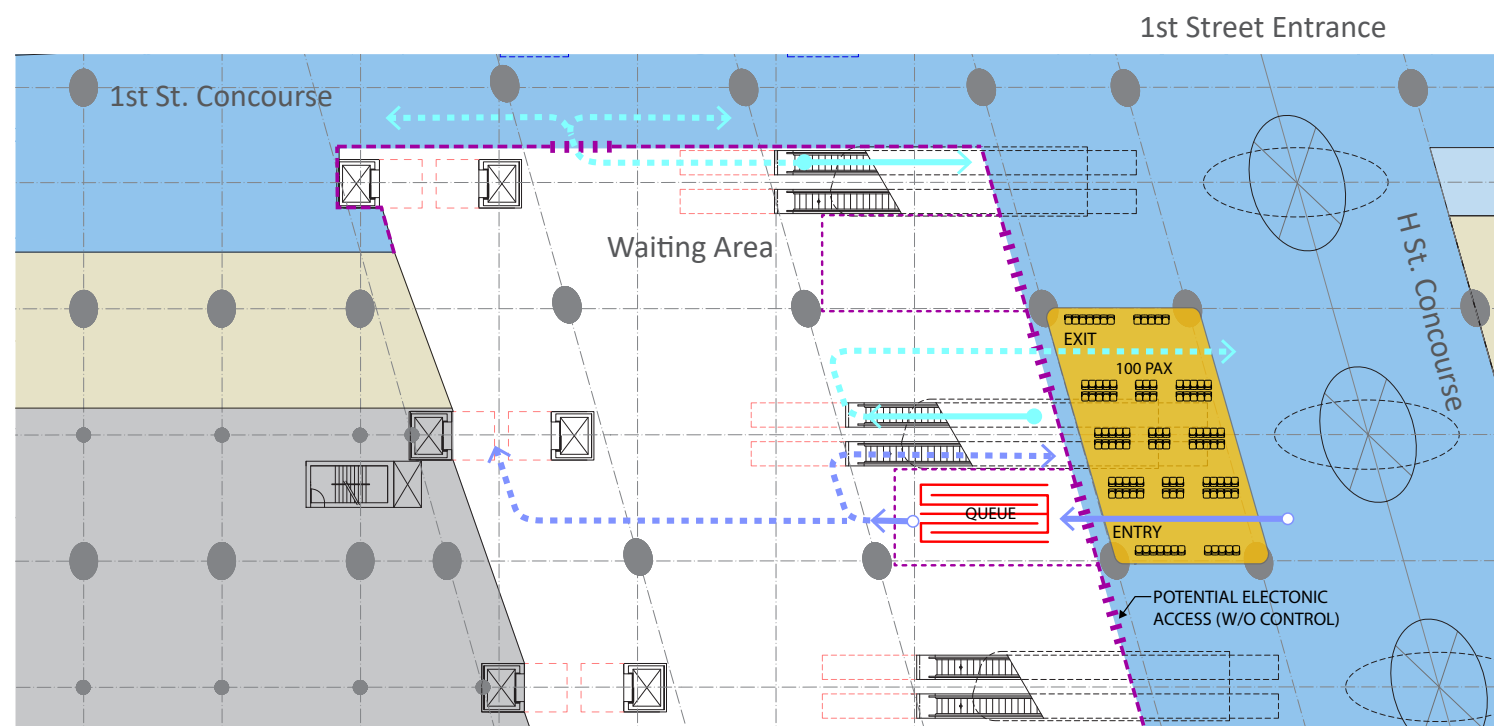


FIG 11. SCENARIO 4

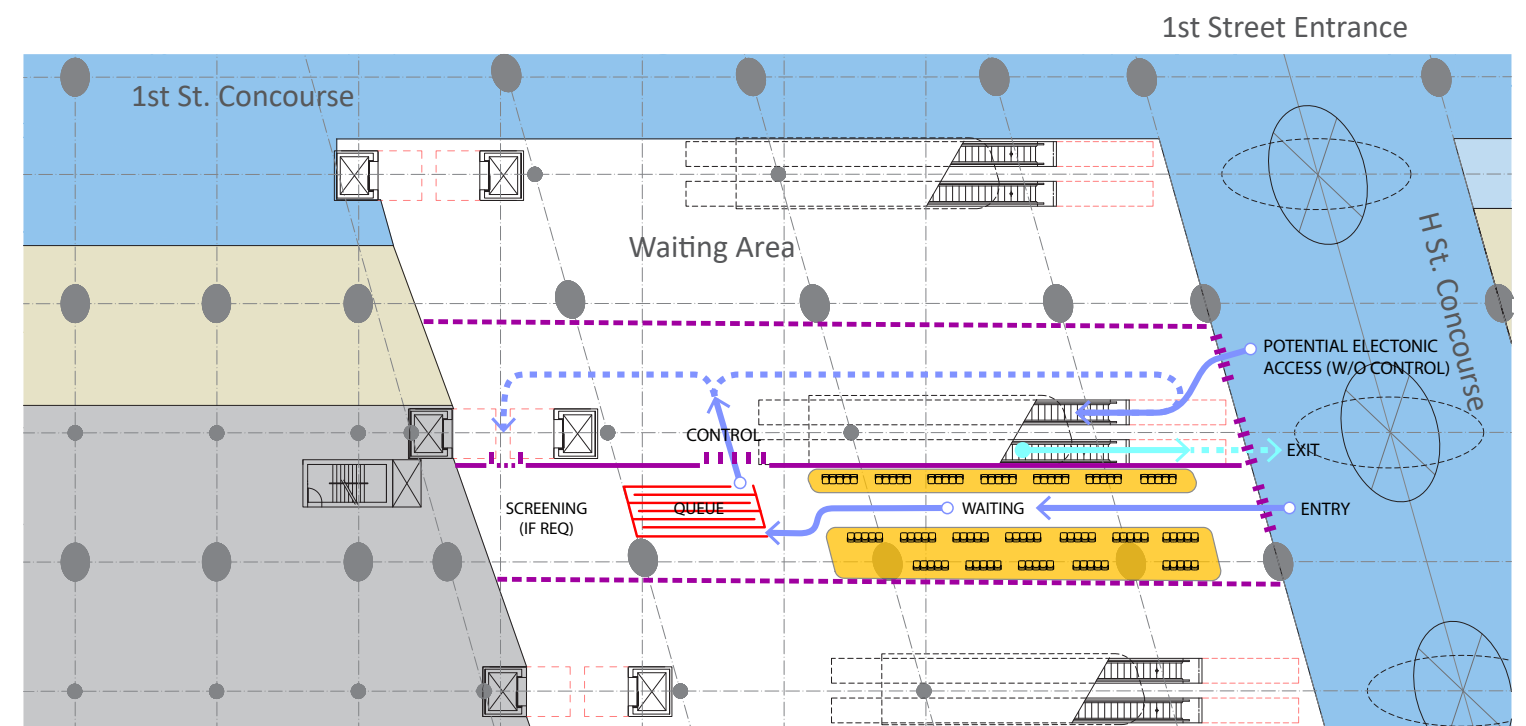


FIG 12. SCENARIO 5

A-2.4: RAIL SUPPORT FUNCTION

Rail Support Function includes back of house (BOH) services, support services, and a distribution network for Amtrak operational needs that are proposed at the concourse level. All Action Alternatives would place support spaces primarily north of the H Street Concourse, on the lower concourse level and just below existing street grade. Rail Support would have access to the tracks and platforms via dedicated service elevators without having to cross any tracks and with minimal disruption to passengers. This would also support more efficient train servicing and, therefore, shorter dwell times. Amtrak would use these service elevators for train servicing, baggage movement to trains, and commissary support.

The plan below (Fig. 13) illustrates that Amtrak commissary areas and other support spaces would be contiguous with the loading dock service circulation and the main distribution artery from the service elevators to the platforms. Forklifts or other small vehicles/carts would be required to pick up loads from the dock itself and descend a half-level from grade to concourse level and then transport loads to each respective platform and other BOH service areas, including proposed new retail BOH areas. Distribution of retail goods would continue to the south, ramping down to the B1 level, reaching the Central Concourse and WUS service cores along it.

Alongside the commissary at the concourse level, Amtrak mechanical and engineering spaces is currently planned to be placed on the northwest portion of the plan. Located between K Street and the H Street Concourse, the mechanical and engineering areas could have

direct access to street level via the proposed K Street access point for larger equipment transportation. In addition, personnel allowed to enter restricted mechanical areas are currently planned to have direct access to the WUS through the Central and First Street Concourses.

Amtrak crew base and police functions are currently planned to be located adjacent to the mechanical and engineering spaces, between K Street and the H Street Concourse. This location would allow direct access to street level and all levels of the SEP. Crew base is currently planned to also have direct access to the H Street Concourse to easily access every platform.

WUS Loading Facilities

During Concept Development, a series of options were developed that explored both on-site and off-site options for the accommodation of service access, screening, and loading docks. The two existing loading docks for the historic station building would continue to support the unloading and distribution of goods at WUS. Additionally, a new loading dock would be provided on 2nd Street NE, adjacent to the REA building. The new loading dock would have approximately 12 loading slips.

Larger retail vehicles would dock and unload at the proposed new loading area at the northeast, as depicted in Figure 15, and move goods onto smaller vehicles, such a forklifts or mechanically assisted hand trucks, which would pick up loads and transport them to the Amtrak service and retail areas. Smaller trucks would continue to utilize the

existing east and west loading docks. A reconfigured western loading dock would also be available for use for existing functions, such as Package Express. Direct access to a back-of-house corridor behind the food court could be maintained. A visual screening would continue to be performed prior to pulling into the loading dock. This configuration would depend on the potential WMATA Metrorail mezzanine improvement plan implemented by WMATA in the future.

The need for screening of trucks arriving at the station was studied and the conclusion was that the space available on site could not efficiently accommodate such an operation. Off-site consideration led to multiple consultations with Federal Protective Services (FPS) to discuss the feasibility of having trucks serving WUS screened at either an existing or future FPS facility.

The conclusion of the consultations was that off-site screening for larger retail trucks would be feasible for FPS and completed at a facility that would be determined at some future date. See memo, *2040 Loading Dock Volume Analysis* (Jan, 2018) for more information.

Retail BOH

Retail BOH and support space would be located adjacent to retail areas. Existing retail would be serviced by the existing loading docks on First Street and the existing eastern loading dock off of H Street. The new loading dock would connect to the BOH spaces of new retail via a distribution tunnel in the basement level of the station.

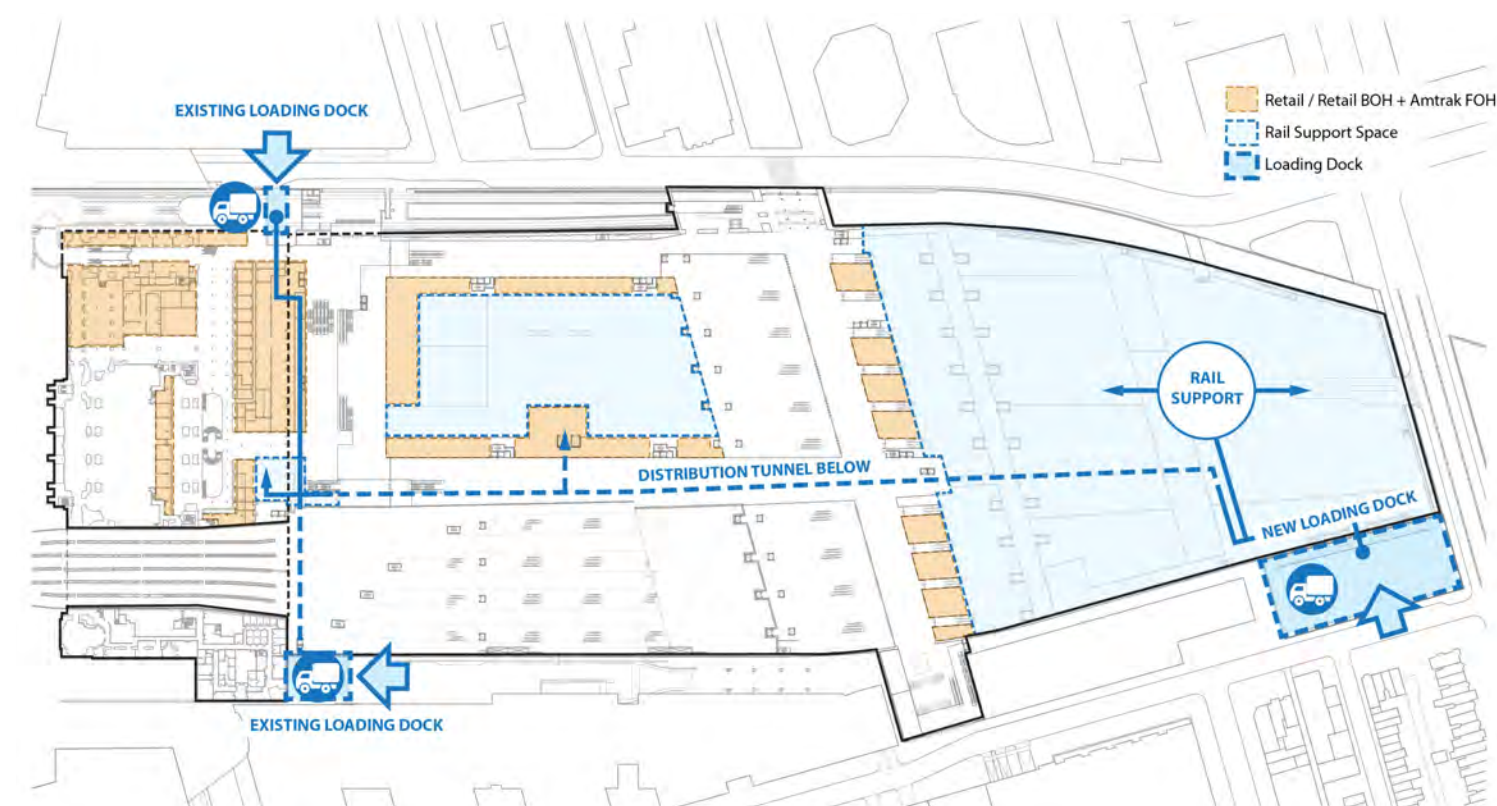


FIG 13. SCREENING AND LOADING AT CORNER OF K AND 2ND STREET

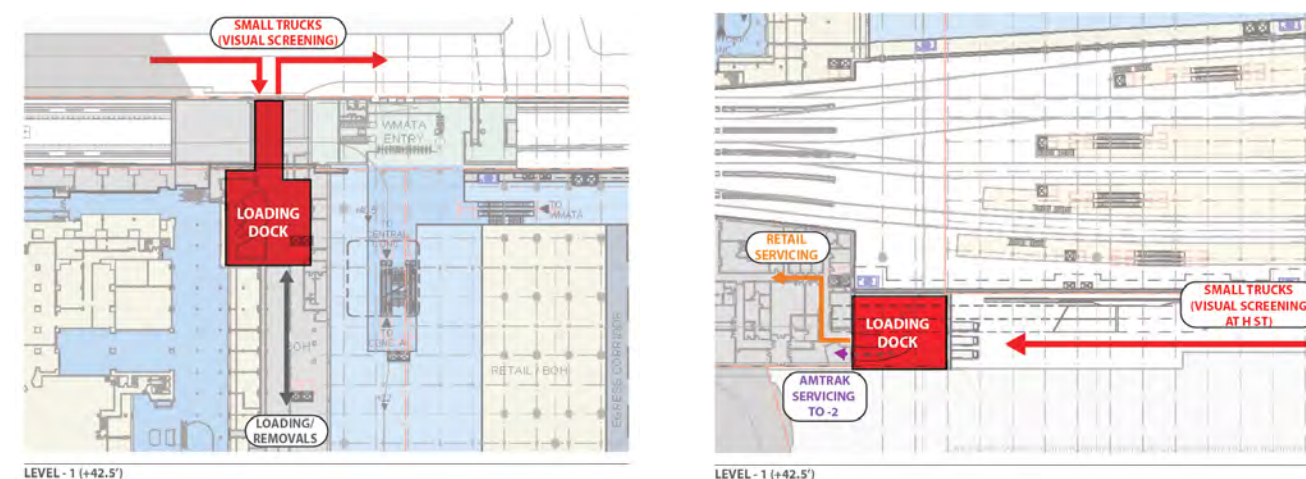


FIG 14. EXISTING EAST AND WEST LOADING DOCKS

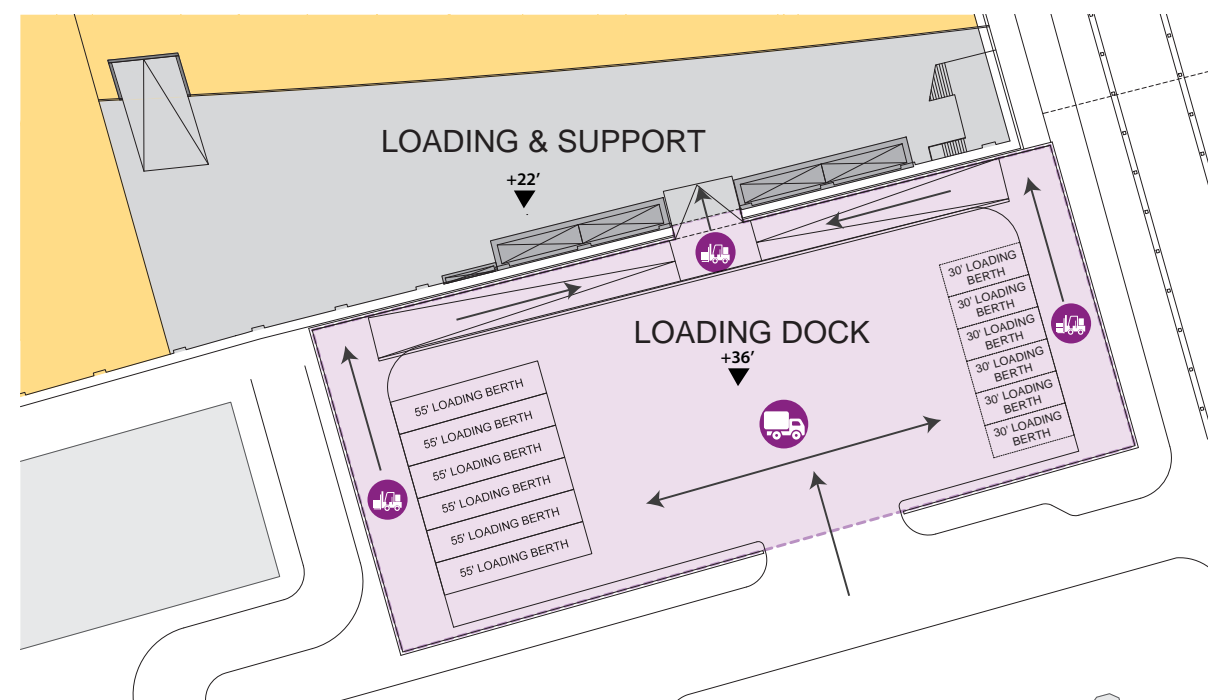
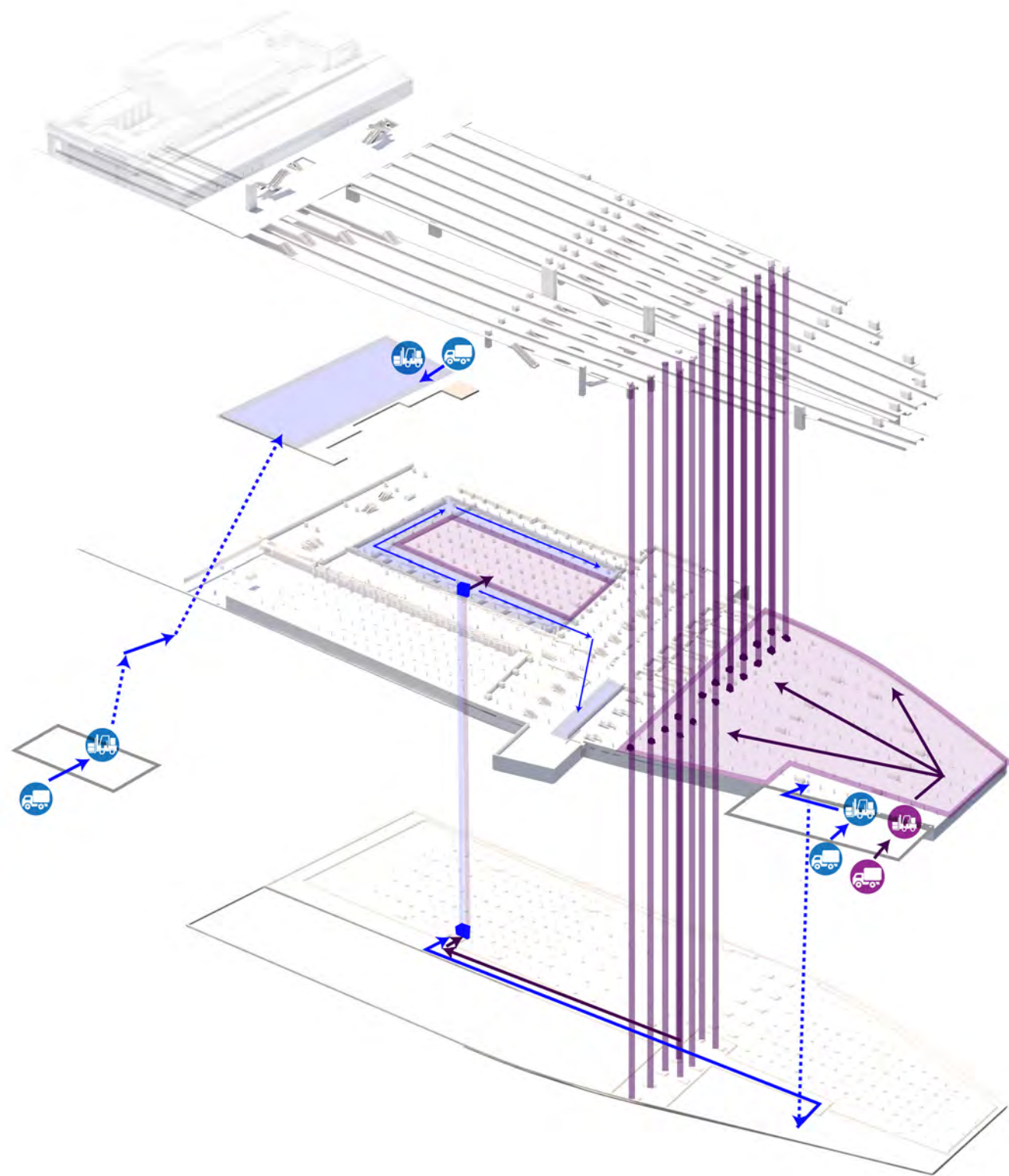


FIG 15. LOADING AT CORNER OF K AND 2ND STREETS



1 | 2

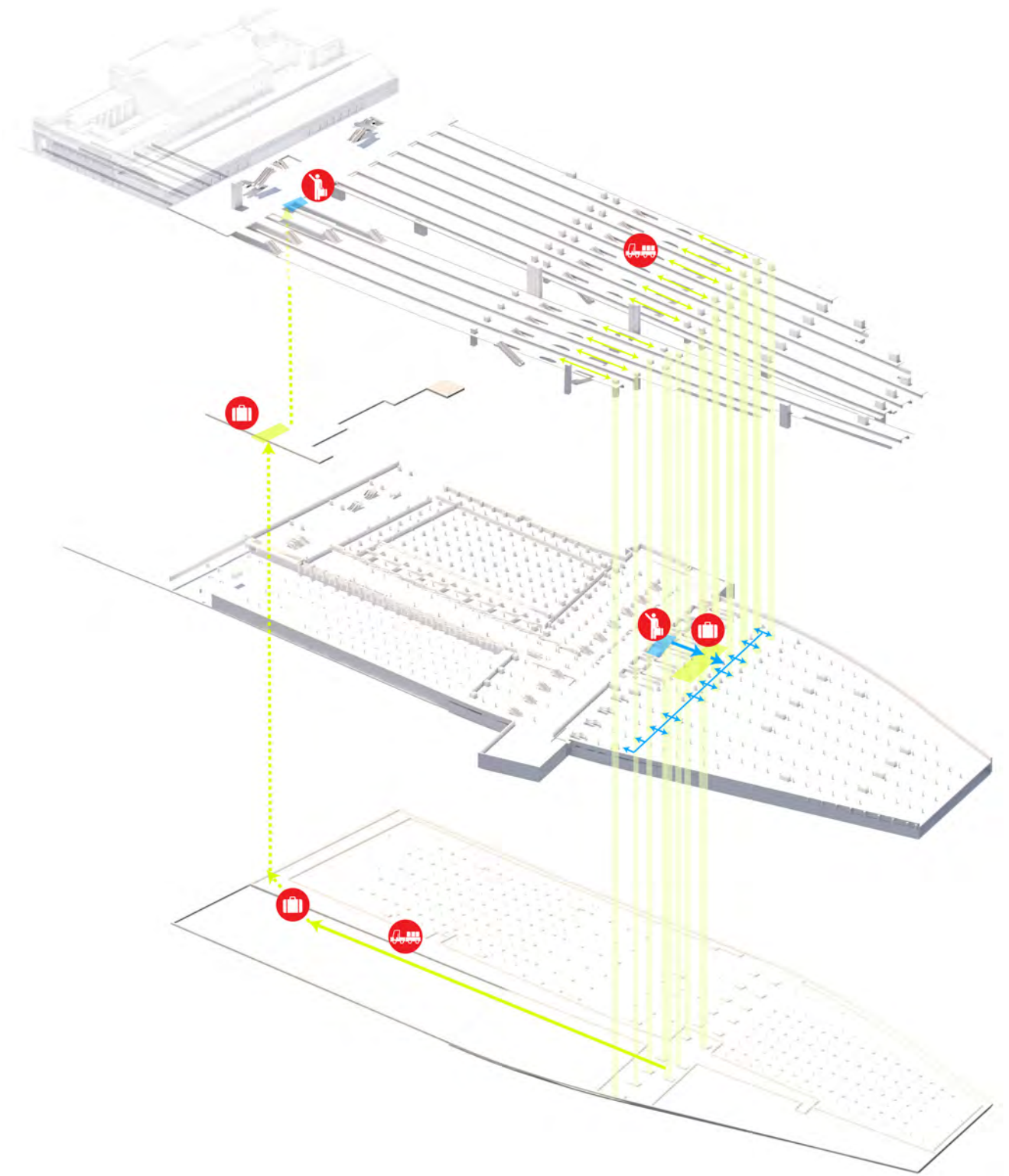


FIG 16. SCREENING AND LOADING AT CORNER OF K AND 2ND STREETS

FIG 17. SCREENING AND LOADING AT CORNER OF K AND 2ND STREETS

A-2.5: TRAIN HALL COMPARTMENTALIZATION

Due to the presence of trains and buses that burn diesel fuel, it would be necessary to compartmentalize the train hall and Concourse spaces. During the Alternatives Refinement phase, the Proponents, in coordination with FRA, analyzed several compartmentalization options.

Generally there are three types of zones that would occur:

- Unconditioned but Ventilated – In exterior or semi enclosed areas, such as on platforms and parking, mechanical ventilation would be provided but the temperature would be +/-5 degrees F from outside.

- Conditioned – Interior areas, such as ticketing, lounge, and waiting areas, retail spaces, and Concourse A, would be fully conditioned with heat and air conditioning to optimize thermal comfort.
- Partially Conditioned – In other spaces, there would be a mix of air between a conditioned space and an unconditioned space. A partially conditioned environment can reduce overall energy costs and the visual impacts associated with compartmentalization of spaces needed to support full conditioning. This approach would be applied to circulation concourses (such as the H and First Street Concourses)

which would only be occupied in a transitory fashion. The Central Concourse in Alternatives C, D, and E (featuring an East/West train hall) would be partially conditioned, whereas the Central Concourse in Alternatives A and B (featuring a North/South train hall) would be fully conditioned due to the full-height glazed walls of the train hall envelope.

After considering the balance of cost, passenger comfort, safety, and passenger experience, the Proponents and FRA decided on a mix of fully conditioned, unconditioned but ventilated, and tempered spaces within WUS.

- Full-height glazed walls separate fully-conditioned Concourse A from the unconditioned-but-ventilated platforms at platform level. These walls would provide full environmental separation while allowing shared access to views and natural light throughout the train hall.

- Full-height glazed walls separate fully-conditioned Concourse A from the partially-conditioned North-South concourse spaces at the lower level.
- Fully-conditioned H Street waiting areas would be separated from the partially-conditioned lower concourse level and from the unconditioned-but-ventilated platform level. Enclosure would be provided for waiting area VCEs at either platform or concourse level.
- Partially-conditioned concourse spaces would have some openings to unconditioned-but-ventilated platform areas. Approaches to reduce impacts from train exhaust, noise, and dust include partial-height walls at the top of concourse level and/or glazed floor areas at platform level.

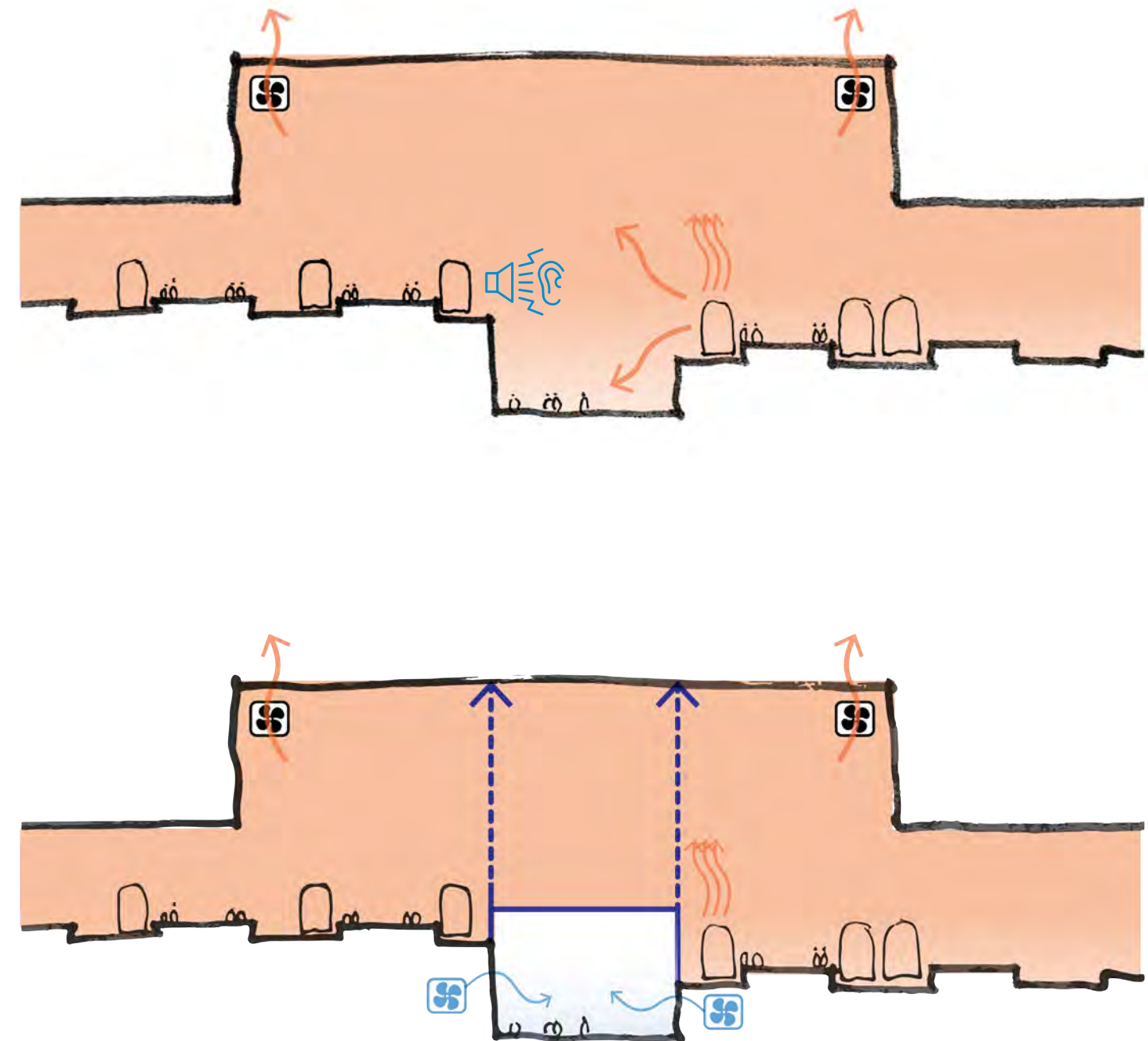
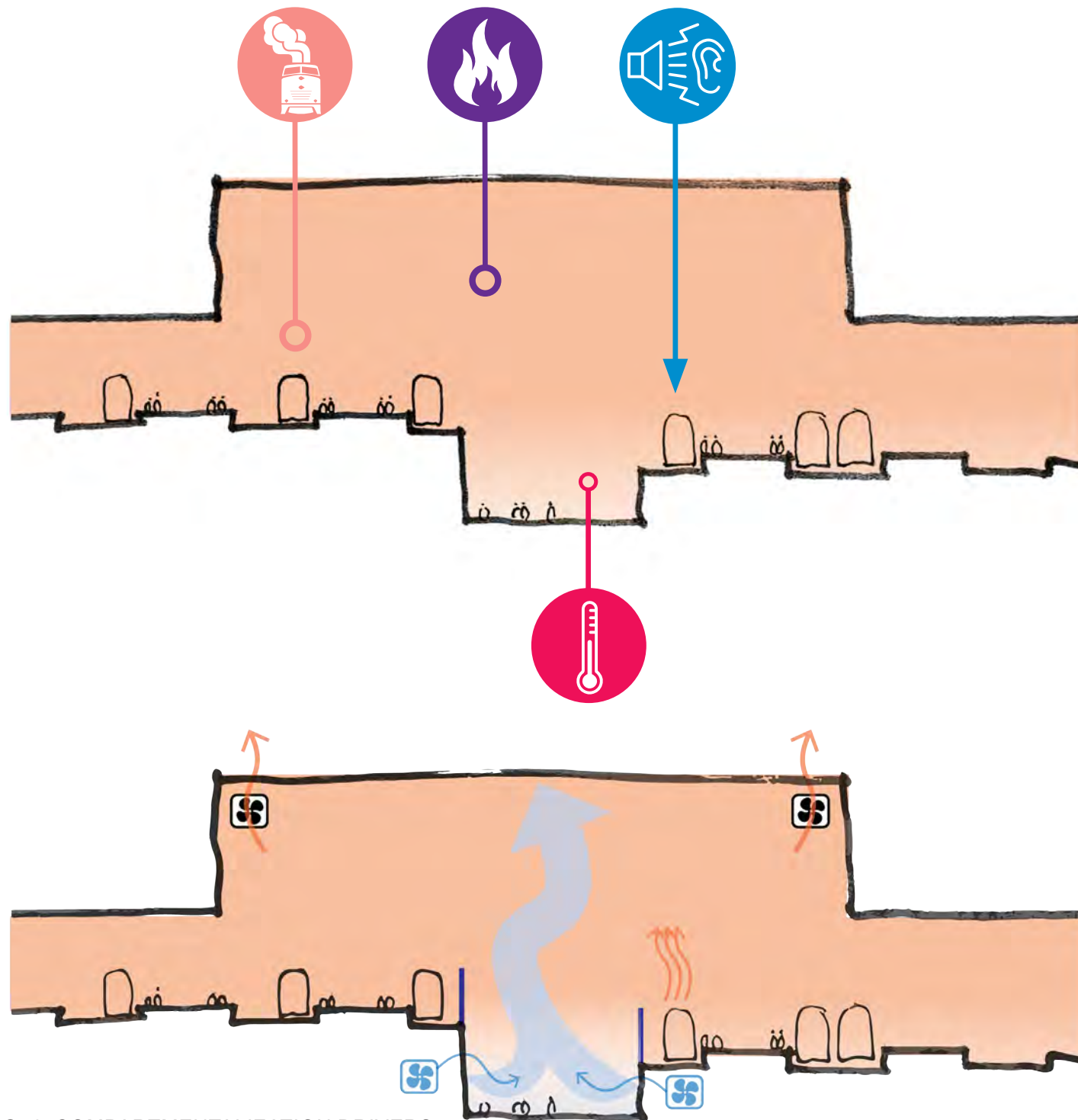


FIG 18. COMPARTMENTALIZATION DRIVERS

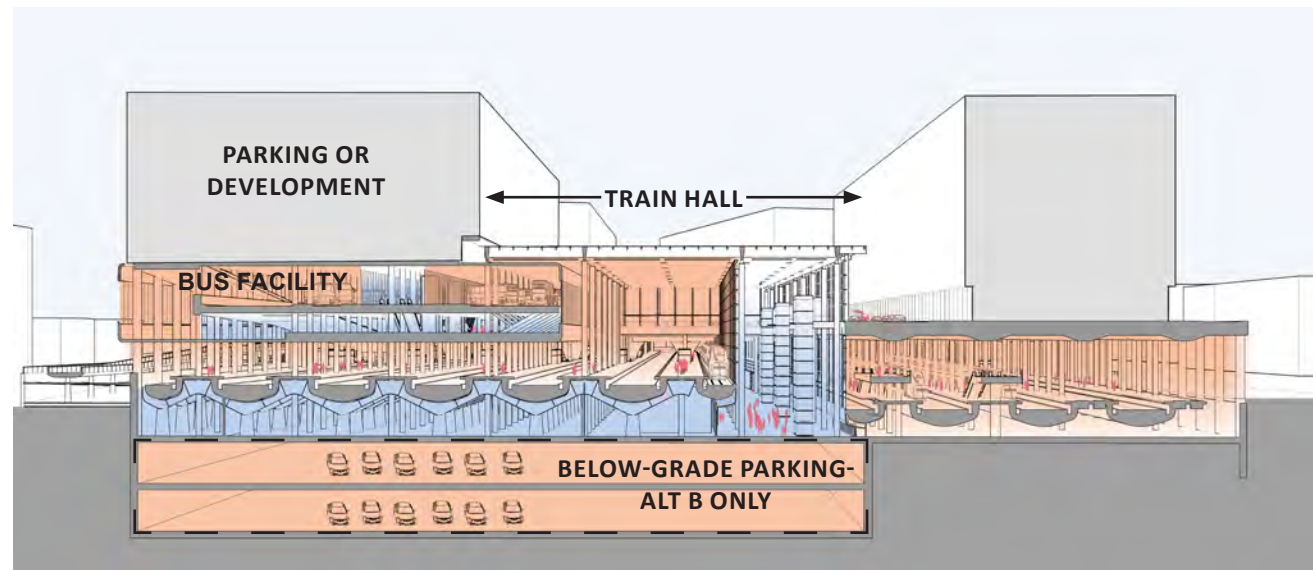


FIG 19. ALT A/B SECTIONAL PERSPECTIVE AT CENTRAL CONCOURSE AND TRAIN HALL LOOKING NORTH

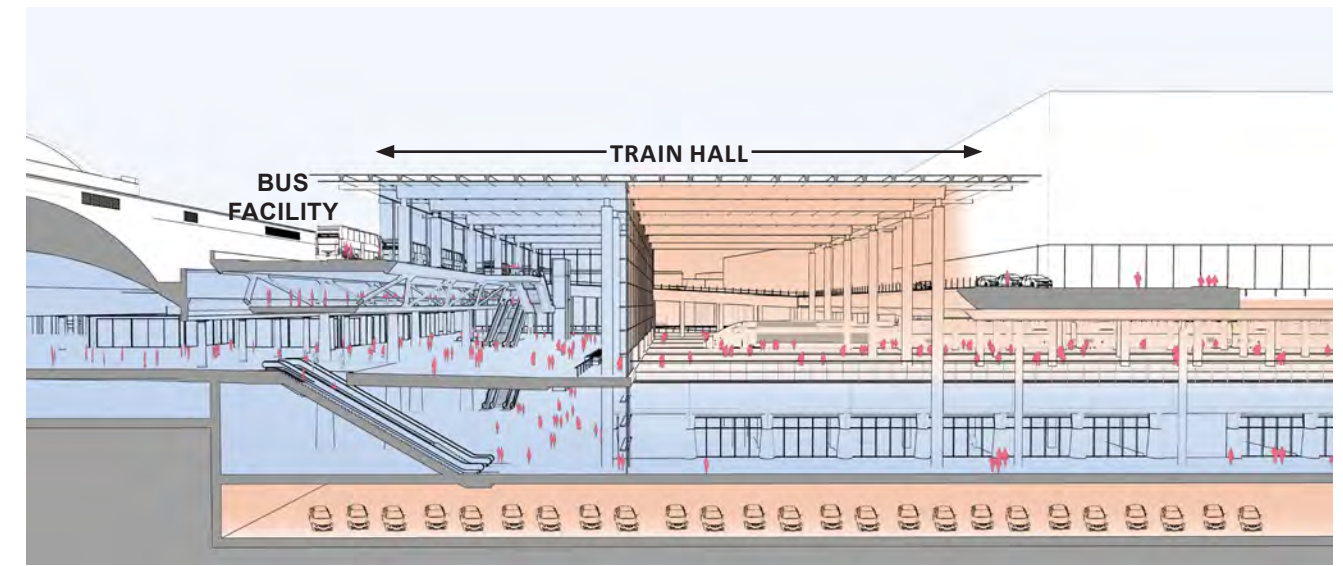


FIG 20. ALT C SECTIONAL PERSPECTIVE AT CONCOURSE A AND TRAIN HALL LOOKING WEST

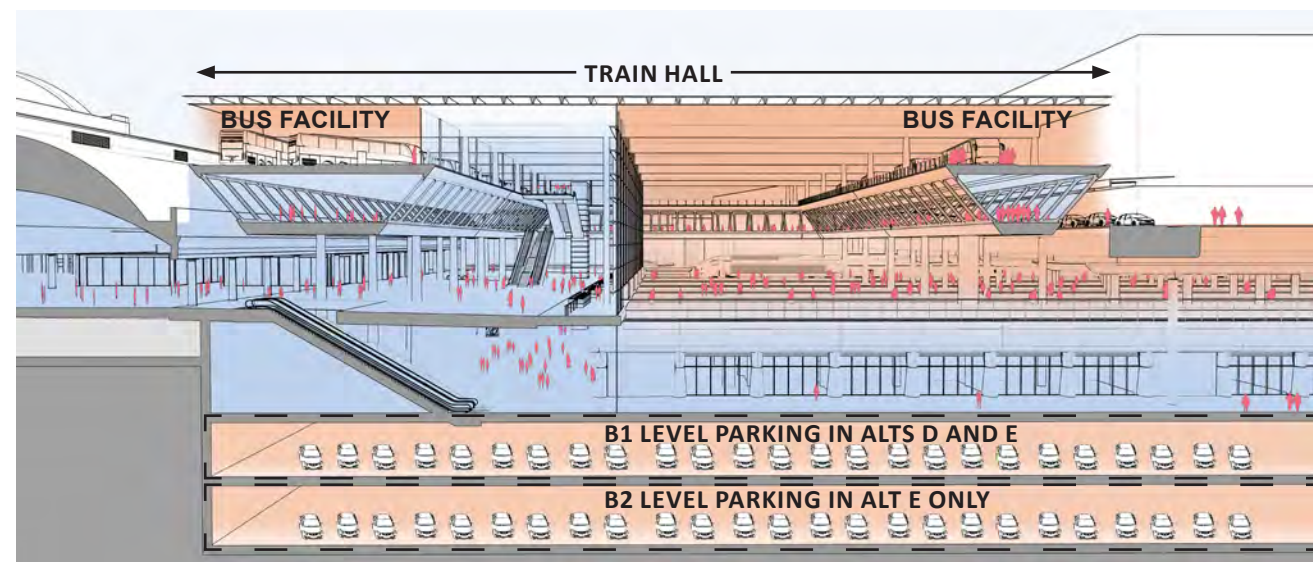


FIG 21. ALT D/E SECTIONAL PERSPECTIVE AT CENTRAL CONCOURSE AND TRAIN HALL LOOKING WEST

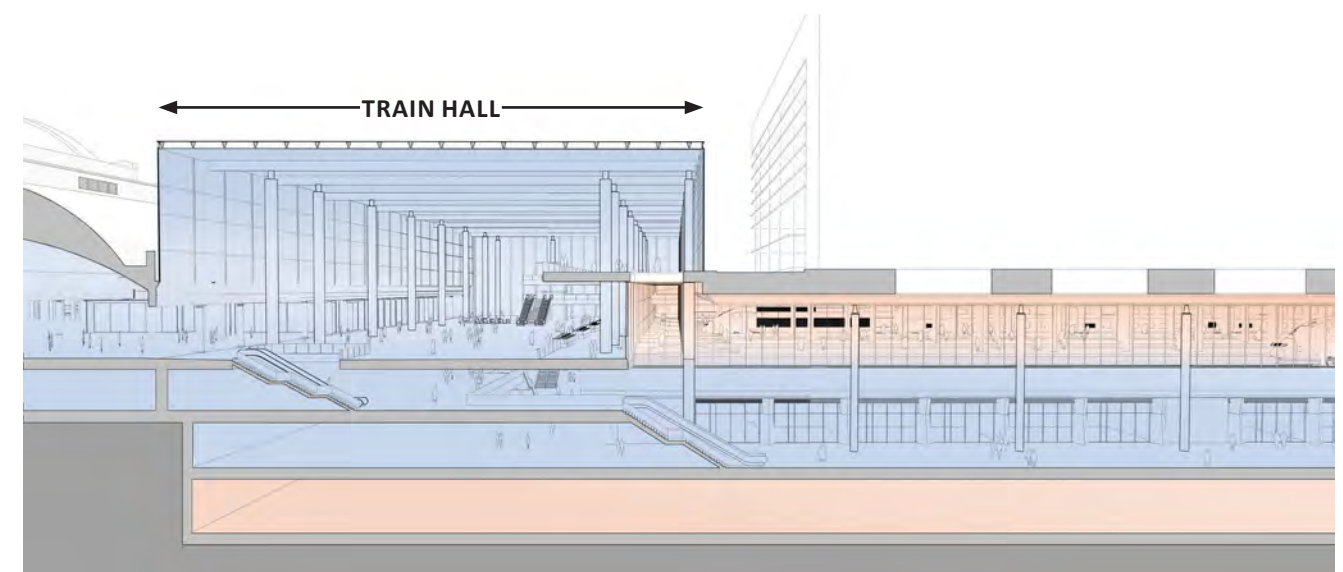


FIG 22. ALT A-C SECTIONAL PERSPECTIVE AT CENTRAL CONCOURSE AND TRAIN HALL LOOKING WEST

A-2.6: ZONING ASSUMPTIONS

The project site is currently within the Production, Distribution & Repair Zone 3 (PDR-3) and Union Station North (USN) zoning designations. FRA has assumed that the development of the Federal air-rights would be consistent with the USN zoning applied to the adjacent private air-rights. This assumption is consistent across all Action Alternatives. FRA determined that a change to USN zoning in the Federal air-rights parcel was reasonably foreseeable based on input from the District of Columbia Office of Planning (DCOP) letter dated March 6, 2018 regarding "Zoning Information Concerning Washington Union Station Expansion Project EIS;" the limitations of the existing zoning (PDR-3 precludes residential development), which is inconsistent with the adjacent USN zoning; and the goals of the DC SHPO to promote a symmetrical development north of the historic station. The nature of the potential future air-rights development is undetermined. In addition, the National Capital Planning Commission (NCPC) is the zoning entity responsible for Federal property in DC, so continued coordination with both DCOP and NCPC would be required to inform the final parameters of the overbuild.

All alternatives utilize various portions of the private air-rights development and federal air-rights areas for Program Elements, such as the train hall, parking, and bus facilities. However, the allocation of SEP and the private air-rights reflect different assumptions and vary between alternatives.

The DC Municipal Regulations USN Zoning regulations state that the maximum permitted building height, not including the penthouse, shall not exceed 130 feet and that the "measurement of building height shall be taken from the elevation of the sidewalk on H Street at the middle of the front of the building, to the highest point of the roof or parapet rather than from grade as would otherwise be required by [DCMR regulations]" [DCMR Section 11-K305. HEIGHT (USN)]. The 130' steps down to the south where the zoning envelope is in closer proximity to the historic station.

The bus facility in Alternatives A, B, and A-C would be built within the Federal air-rights volume. Alternatives C and D would use a portion of the private air-rights development area north of H Street for parking and/or for the bus facility. There is an opportunity to integrate private development with the parking structures in Alternatives C and D and potential Federal air-rights development above the parking in Alternatives A, B, and A-C. Alternatives A, C, E, and A-C would not utilize any private air-rights north of H Street. Note that private air-rights development is not part of this project and that Federal air-rights are made available for potential development by this project but not being developed as part of it. Please refer to Appendix A for more detail.

The zoning designations have implications for the development of the various alternatives.

The bus facility and parking garage sit above the rail terminal on the southwest side allowing for some limited development within the remaining potential Federal air-rights lot area.

Action Alternative B

The bus facility is situated above the rail terminal on the southwest side, allowing for development above within the potential Federal air-rights lot area. All parking is below grade.

Action Alternative C

The bus facility and parking garage is on the northern side of H Street, either on the western (West Option) or eastern edge (East Option) of the Project site, with the possibility of overbuild above the parking garage. In either the West or East Option, parking and the bus facility would have four (4) floors. With the West Option, private development could be built over the parking garage to a maximum height of 130 feet. With the East Option, development could be built above the parking garage to a maximum of 130 feet as well but with a stepdown to 90 feet North of I Street.

Action Alternative D

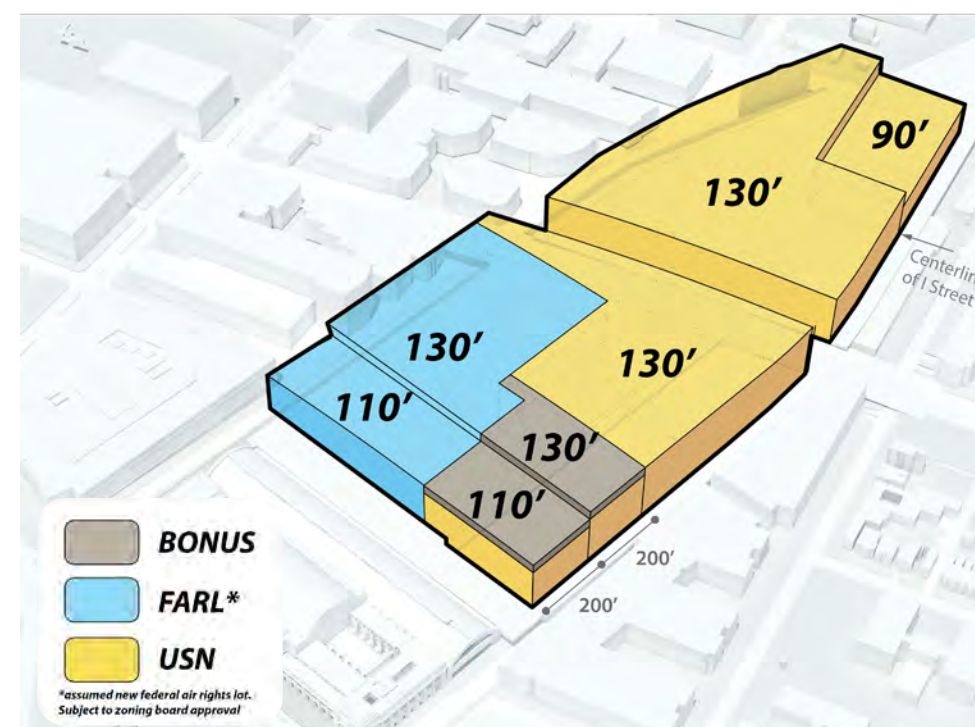
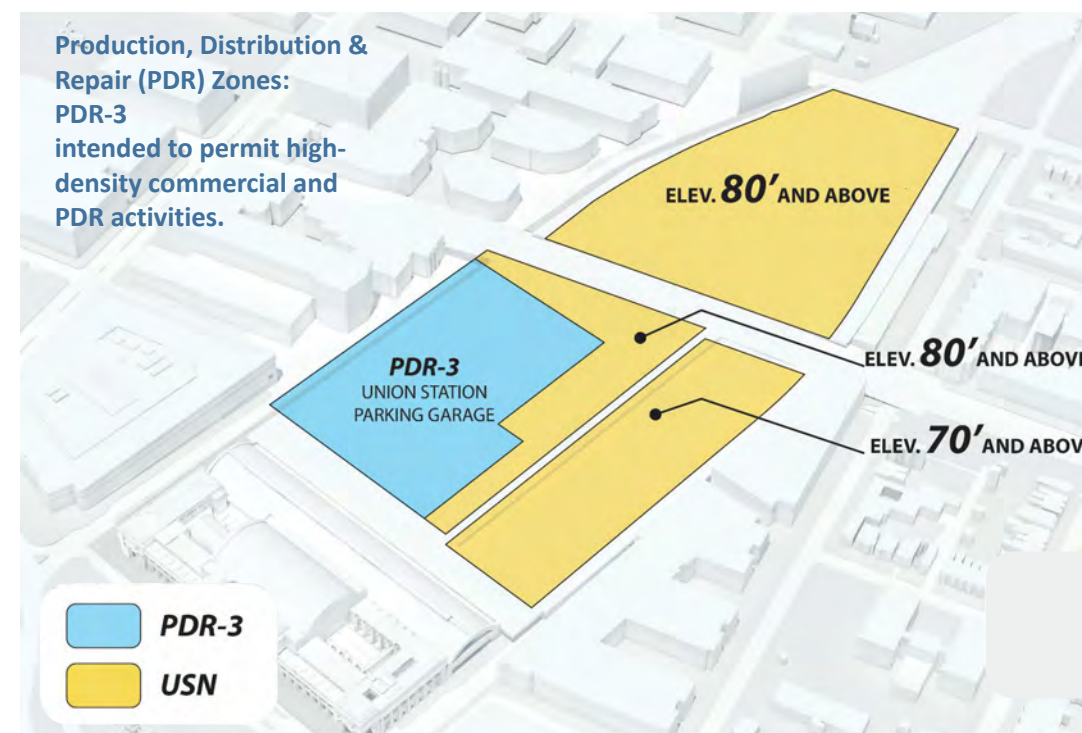
This alternative integrates the bus facility with the train hall. Parking is located on the northern end of the private air-rights development area north of H Street and would include three (3) floors. These floors are necessary to achieve the parking program. Private development could be built to a maximum of 130 feet on the western side or 90 feet on the eastern side of the site.

Action Alternative E

This alternative integrates the bus facility with the train hall. All parking would be below grade. Alternative E reduces the amount of private air-rights development area needed south of H Street and would not require any private air-rights north of H Street.

Action Alternative A-C

In Alternative A-C, the bus facility and parking garage would almost entirely fit within the existing Federal air-rights. In Alternative A-C, the two-level bus facility includes 40 slips (20 per level) and the parking garage occupies six levels. The remaining Federally owned air-rights above and next to the new bus facility and garage are available for potential Federal air-rights development (such development is not part of the Project).



1. PARKING GARAGE LOT DATUM: 80'

2. USN SUBLOTS' MAX HEIGHT DOES NOT EXTEND TO PDR-3

3. FEDERAL AIR-RIGHTS LOT MAXIMUM HEIGHT MEASUREMENT WOULD BE THE SAME AS THAT OF USN, SUBJECT TO ZONING APPROVAL.

11-K DCMR 305.5

The measurement of building height shall be taken from the elevation of the sidewalk on H Street at the middle of the front of the building.

FIG 23. ZONING DATUMS AND AIR-RIGHTS BUILDABLE ENVELOPE

STRUCTURAL DECK ASSUMPTIONS

The following Figures 24-35 represent the SEP assumptions for the integration between structural systems for the overbuild and SEP.

- 1 30x60 GRID
- 2 60x60 GRID, Limited High-Density/Multi-Story Overbuild
- 3 LONG SPAN FRAMING, Limited High-Density/Multi-Story Overbuild
- 4 SPECIAL ARRANGEMENT

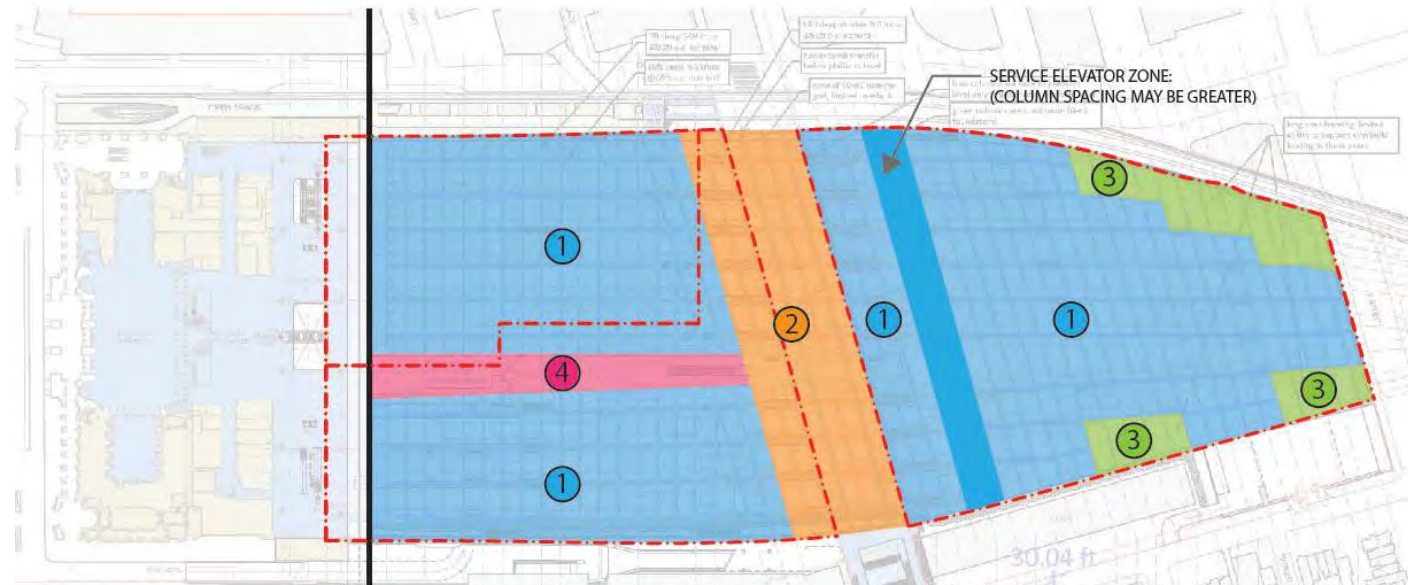


FIG 24. STRUCTURAL ZONES AT DECK LEVEL

STRUCTURAL DECK ASSUMPTIONS

2 60x60 GRID

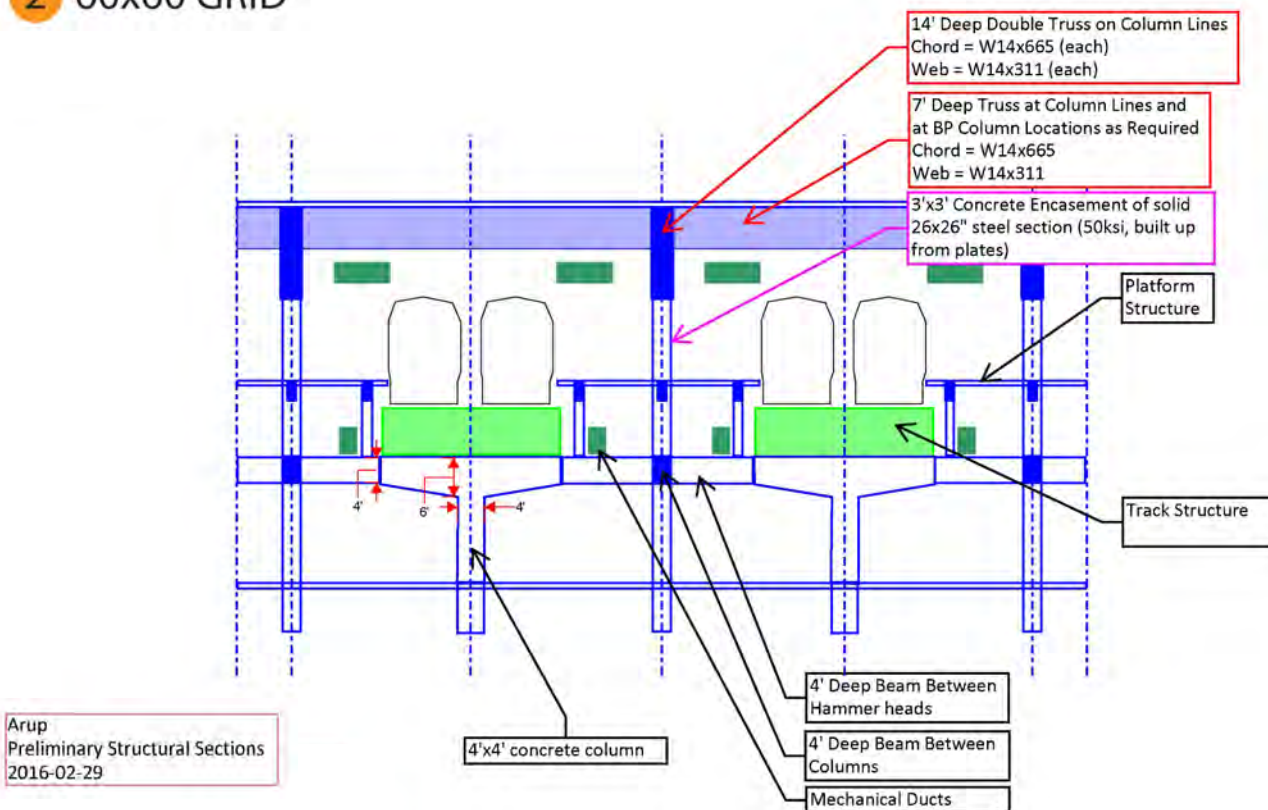


FIG 26. SECTION THROUGH 60x60' GRID ZONE

STRUCTURAL DECK ASSUMPTIONS

1 30x60 GRID

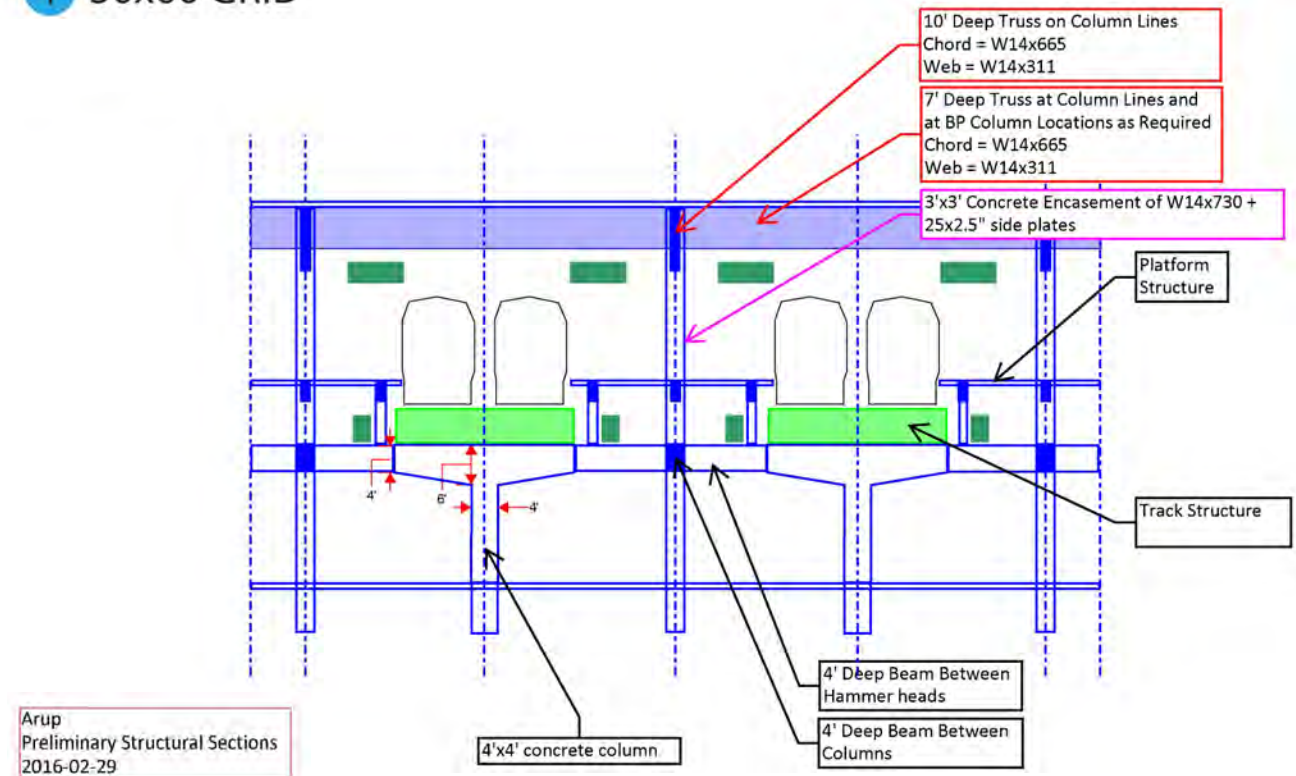


FIG 25. SECTION THROUGH 30x60' GRID ZONE

STRUCTURAL DECK ASSUMPTIONS

3 LONG SPAN FRAMING

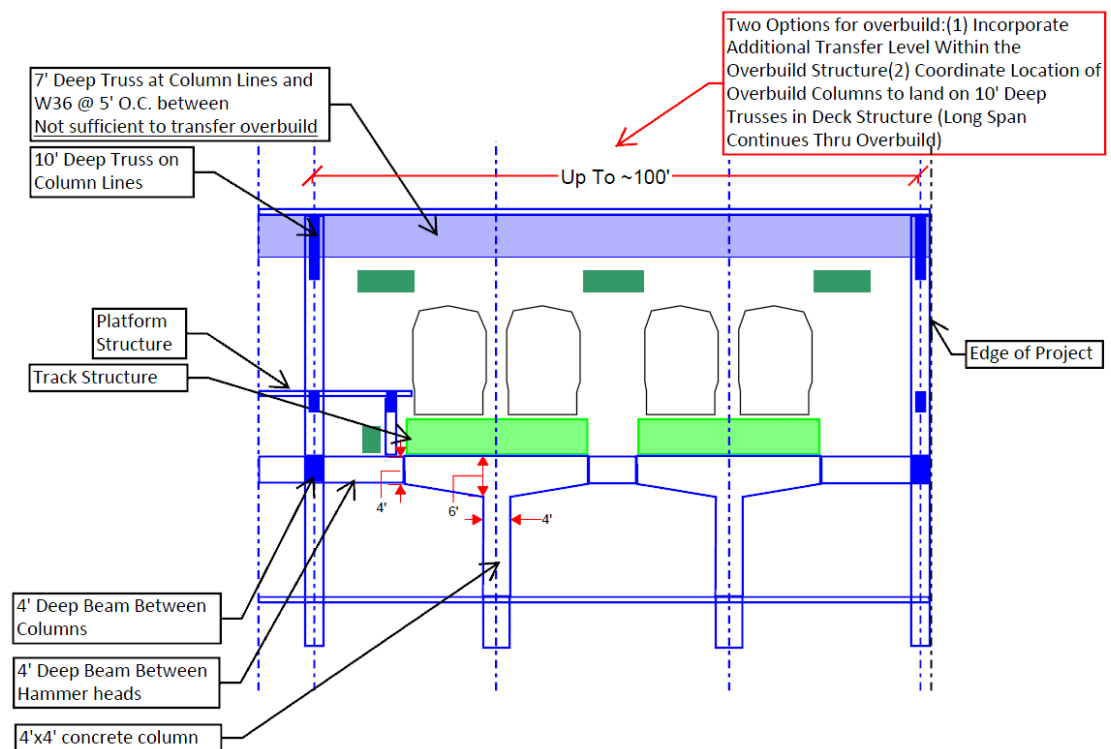


FIG 27. SECTION THROUGH LONG SPAN FRAMING ZONE

SECTION DIAGRAM @ SOUTH OF H (@ PARKING GARAGE)

PROPERTY DATUM, MATTER OF RIGHT HEIGHTS, SEP DESIGN ELEVATION AT +86.25'

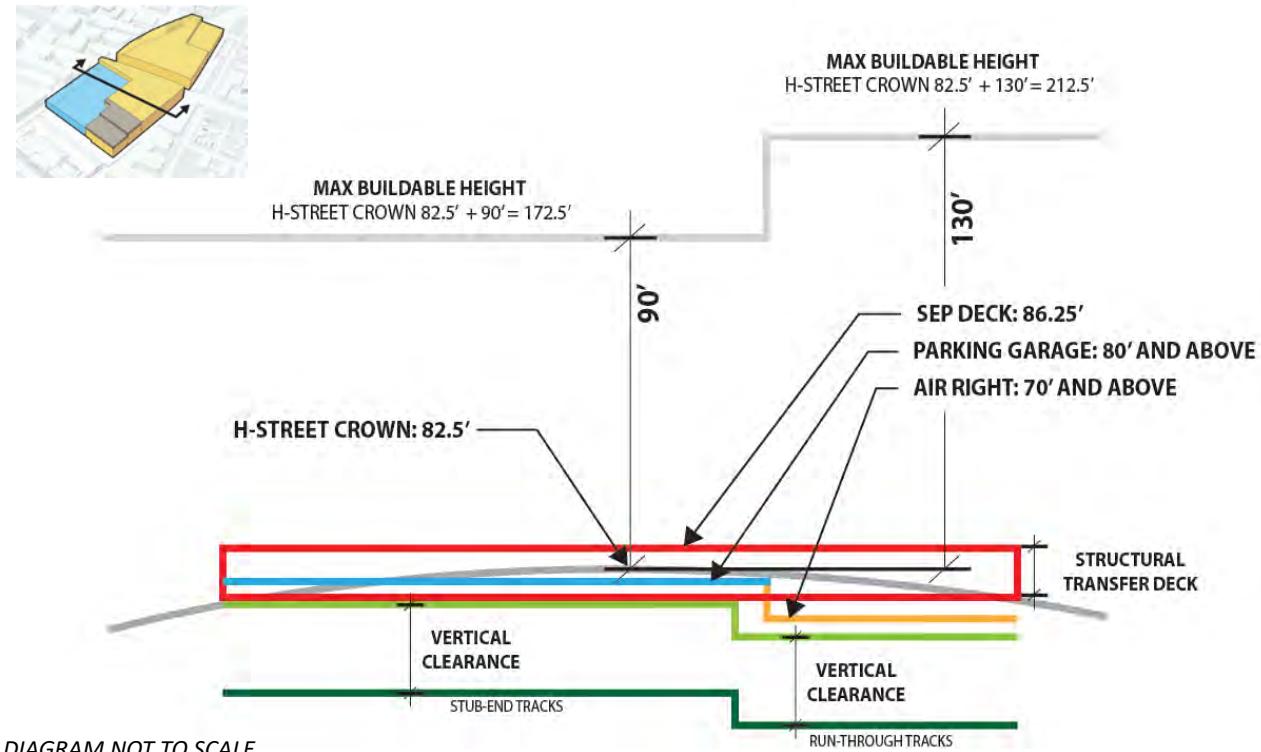


DIAGRAM NOT TO SCALE

FIG 28. SECTION DIAGRAM SOUTH OF H STREET AT PARKING GARAGE

SECTION DIAGRAM @ SOUTH OF H (@ AIR RIGHT)

PROPERTY DATUM, MATTER OF RIGHT HEIGHTS, SEP DESIGN ELEVATION AT +86.25'

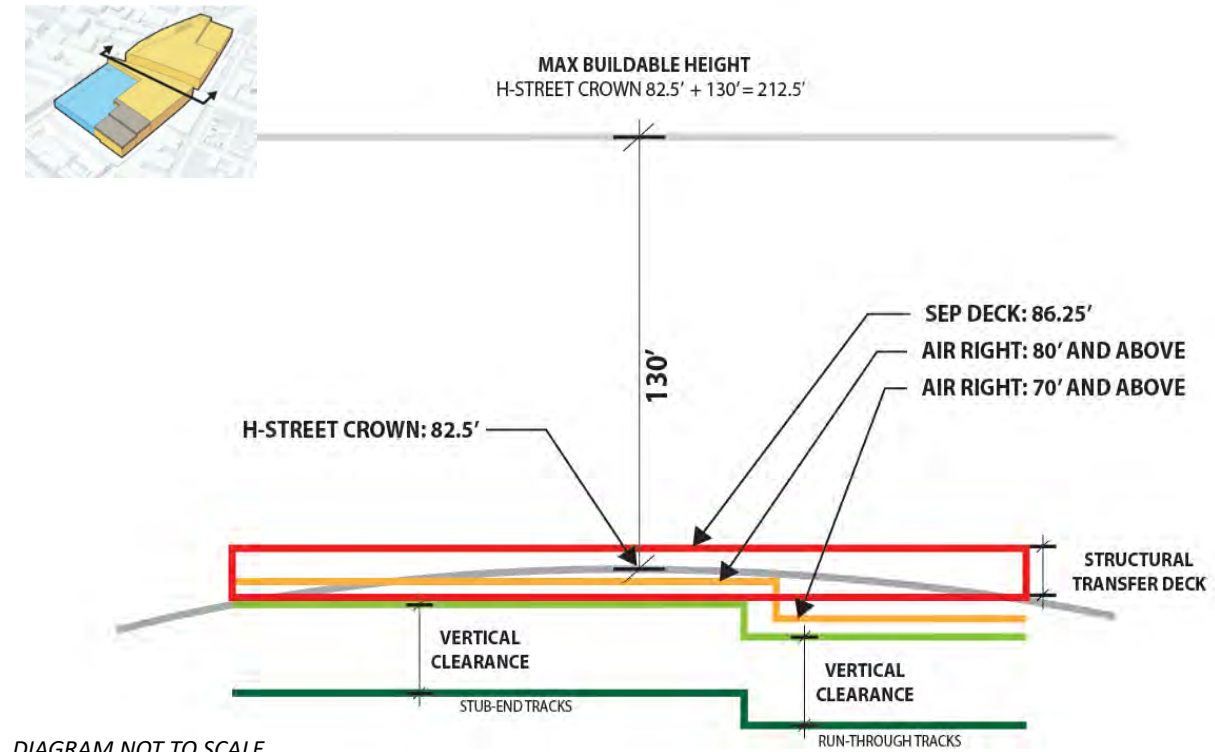


DIAGRAM NOT TO SCALE

FIG 29. SECTION DIAGRAM SOUTH OF H STREET AT AIR-RIGHTS DATUM



SECTION DIAGRAM @ NORTH OF H (@ AIR RIGHT)

PROPERTY DATUM, MATTER OF RIGHT HEIGHTS, SEP DESIGN ELEVATION AT +86.25'

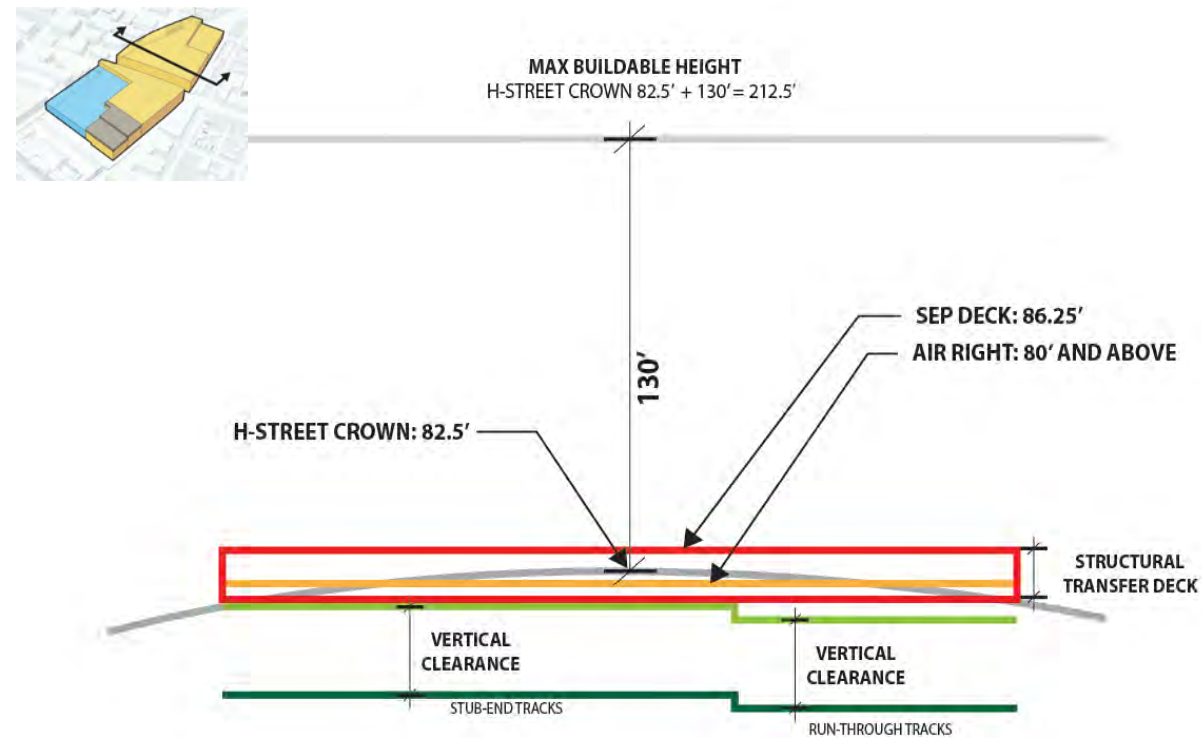


DIAGRAM NOT TO SCALE

FIG 30. SECTION DIAGRAM NORTH OF H STREET AT AIR-RIGHTS DATUM

CROSS SECTION DIAGRAM @ H STREET LOW POINT

PROPERTY DATUM, MATTER OF RIGHT HEIGHTS, SEP DESIGN ELEVATION AT +86.25'

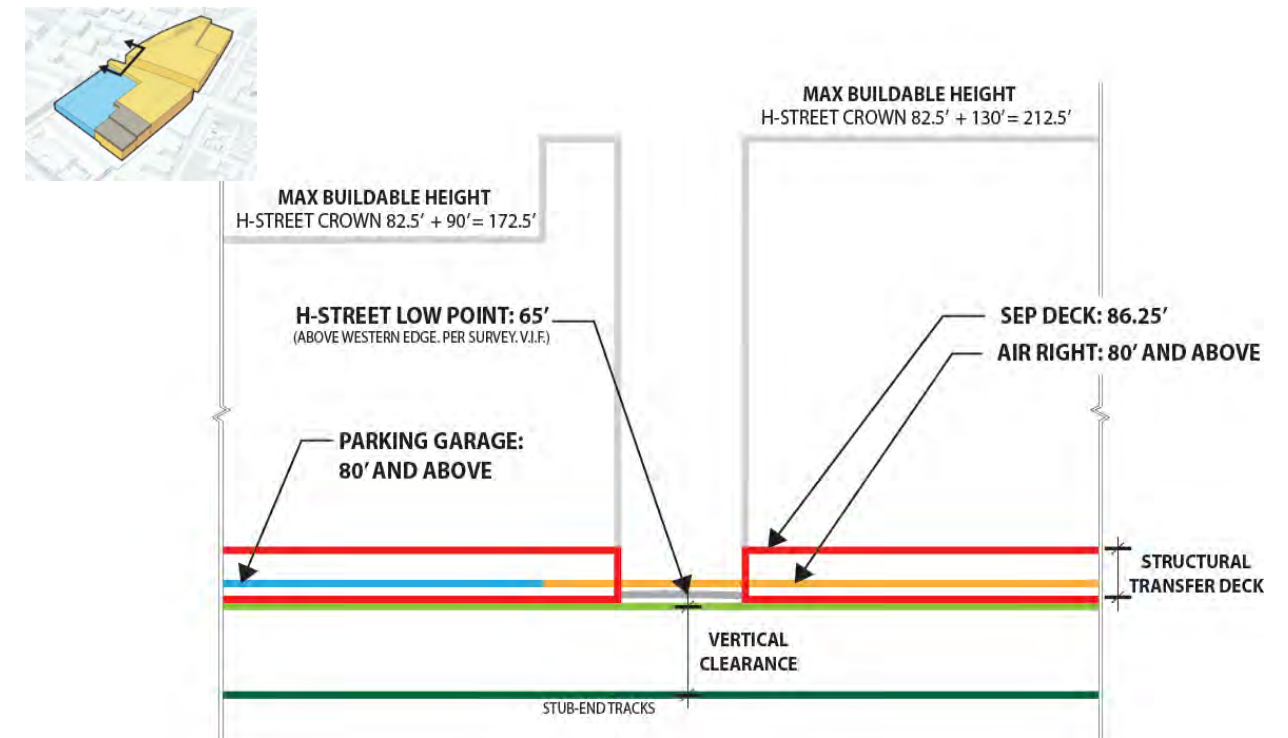


DIAGRAM NOT TO SCALE

FIG 31. SECTION DIAGRAM AT H STREET LOW POINT

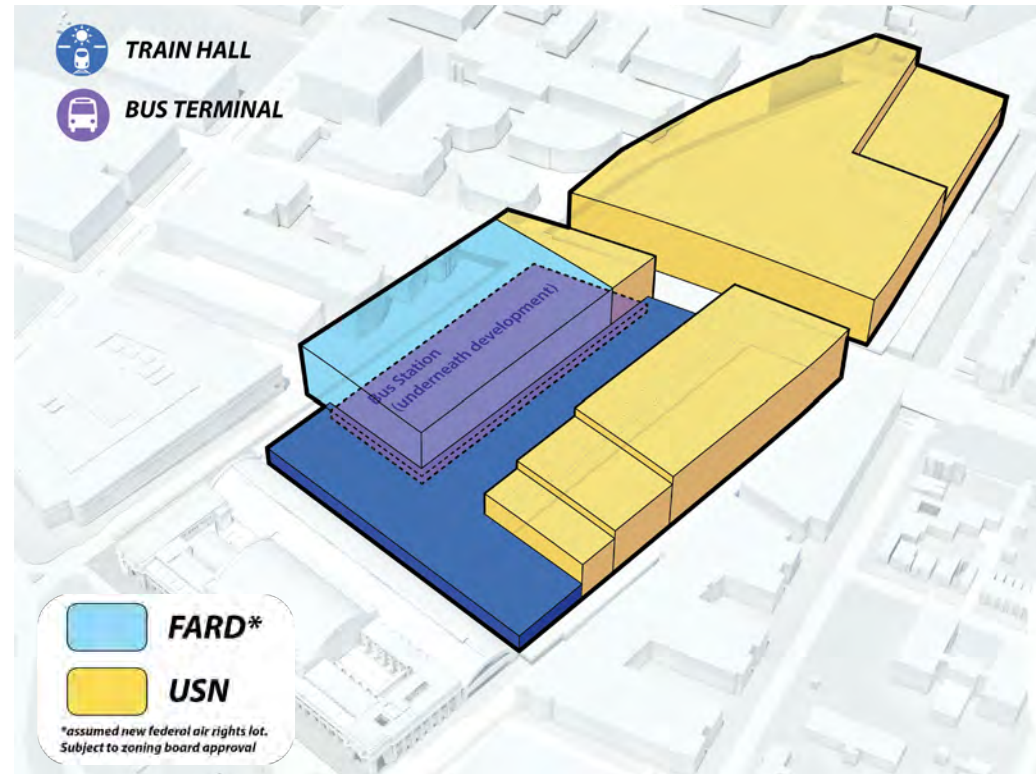


FIG 32. ALT A/B MAXIMUM BUILDABLE ENVELOPE

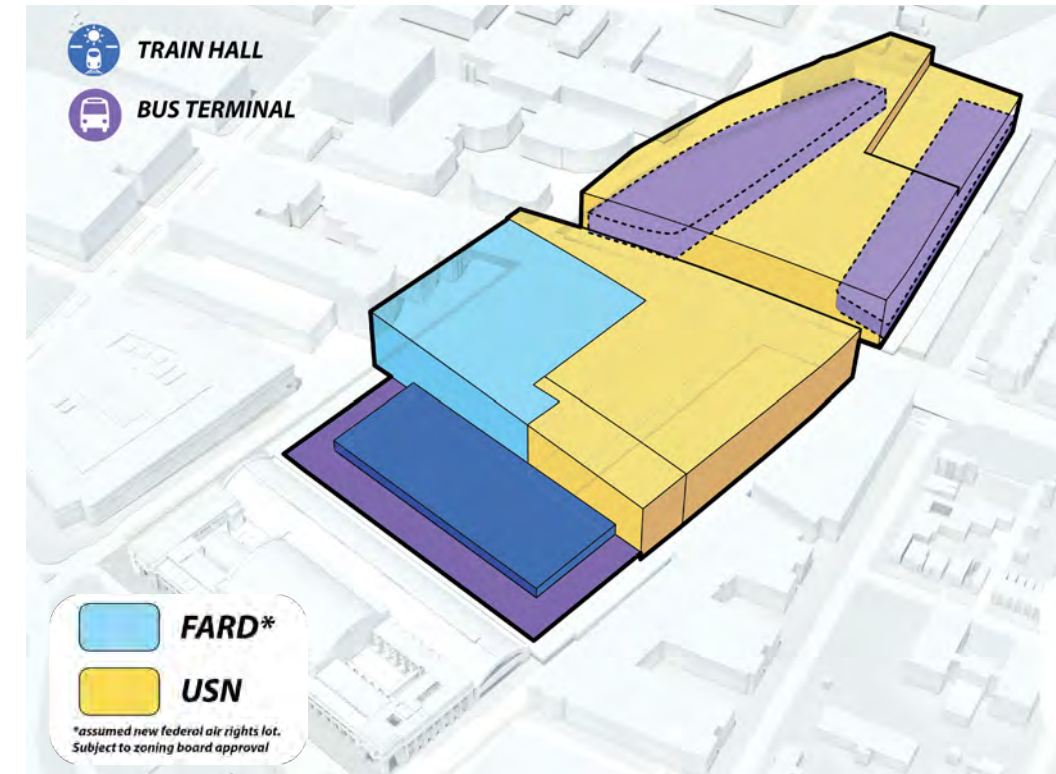


FIG 33. ALT C EAST-WEST MAXIMUM BUILDABLE ENVELOPE

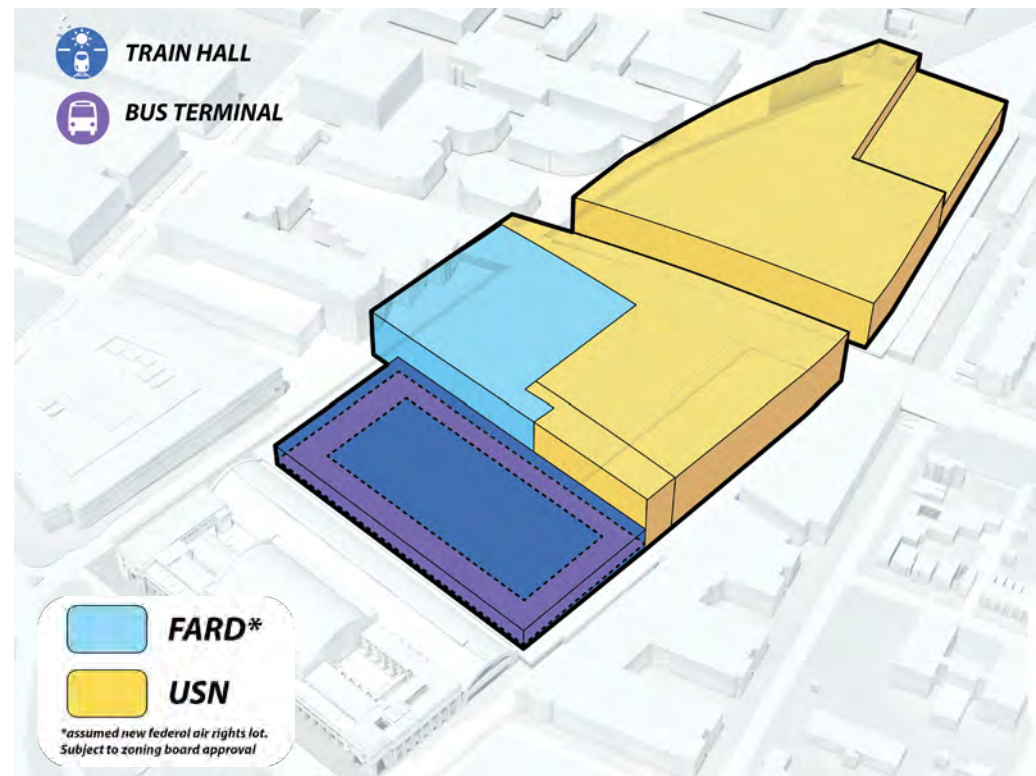


FIG 34. ALT D/E MAXIMUM BUILDABLE ENVELOPE

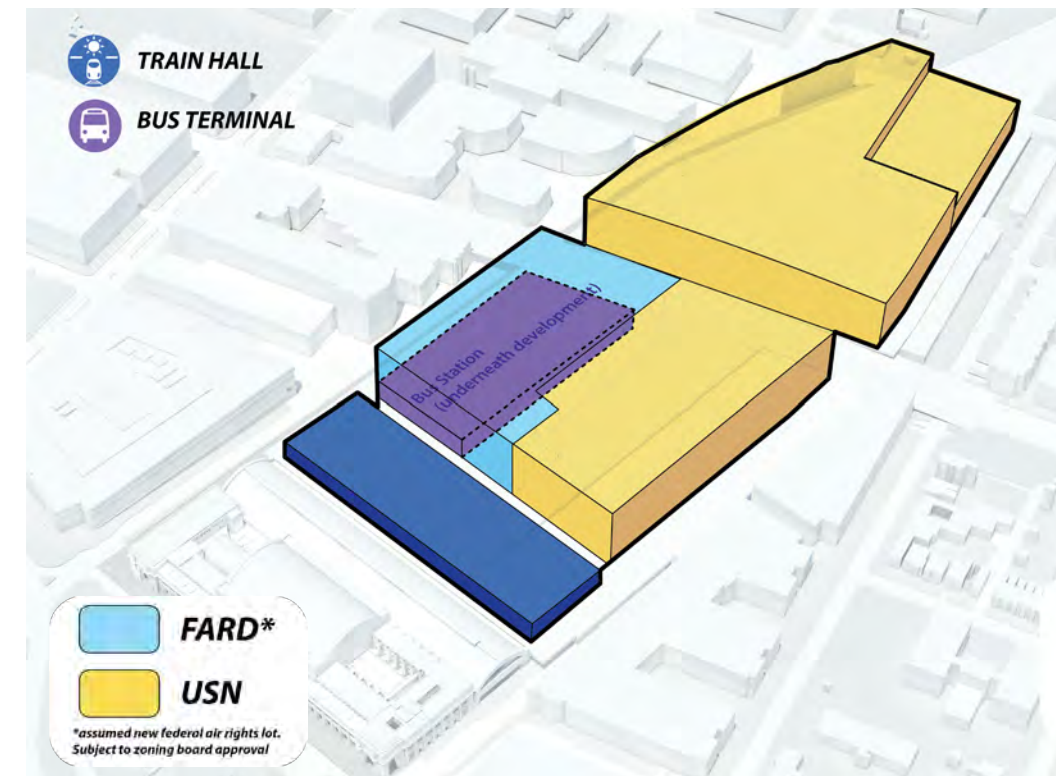


FIG 35. ALT A-C MAXIMUM BUILDABLE ENVELOPE

A-2.8: K STREET ACCESS AND OPERATIONS

Three of four preliminary alternatives would provide parking below the rail terminal. FRA and the Proponents assessed multiple potential locations for below-ground parking access. Following this effort, they found that the only feasible location for a parking ramp would be on K Street NE, between First and 2nd Streets NE.

Because this location still posed several challenges, FRA and the Proponents continued to evaluate K Street parking access during the Alternatives Refinement step. K Street NE between First and 2nd Streets NE runs under the railroad tracks, which cross the street on two bridges. Bridge-supporting columns are located between the street's two through lanes in each direction. In addition, the north and south masonry walls of the K Street NE underpass are contributing features to WUS as a historic property.

FRA and the Proponents considered four options for parking access in the K Street underpass: two single-entrance options and two double-entrance options. One single-entrance option was a right-in, right-out intersection on the south side of K Street NE. The other was a full-movement intersection, also on the south side. One double-entrance option provided two separate entrances on the south side of K Street NE. The other featured an entrance on each side of the street.

1. Single entrance, right-in/right-out: This option includes a single opening on the wall on the south side of K Street NE with one lane in each direction. Without removing any columns, this option only allows vehicles traveling eastbound to turn right into the parking entrance, and vehicles exiting the parking to head eastbound. The right-most eastbound lane would be designated as a Union Station access only to allow a smooth flow of vehicles in and out of the parking level.

It has been estimated that 80% of vehicles accessing the station would enter and exit to/from the west of the station. For this reason, the ingress to the parking level would be adequate but the egress would not. All vehicles leaving the station would head east while 80% need to go west. This would add additional traffic to street network which could result in high delays. In addition, having only one lane into the station and one lane out does not meet the capacity necessary for the forecasted demand. For these reasons, this option is not feasible.

2. Single entrance, full movement intersection: This option places a single entrance on the wall on the south side of K Street NE, requires the removal of two columns between the eastbound lanes, and places a full movement intersection. Placing a full movement intersection under the bridges has several challenges regarding lighting, visibility, and signage. The segment is currently dark, but this can be addressed by installing better lighting. There are visibility concerns due to the placement of the columns. Due to the structural properties of the bridges, only two columns can be removed (with the installation of additional support). This eliminates the possibility to remove additional columns to improve visibility; only two columns can be removed to allow the necessary movements through the intersection. And finally, the low clearance and the column layout may make it difficult to install adequate signage and signaling.

3. Two entrances on south side: This option has two entrances to the parking level on the south side of K Street NE. The west intersection has a right turn in for vehicles heading east and allows vehicles exiting to head west. The east intersection allows westbound vehicles to turn into the entrance and allows vehicles exiting to head east. This arrangement minimizes the number of vehicles that use both intersections, as vehicles entering and exiting only take one, and only vehicles passing through K Street NE pass through both intersections. Like Option 2, this option has concerns with having signalized intersections under the bridges. Having two intersections creates more conflicts and more challenges. In addition, this would create two openings on the wall which is undesired for the historic preservation of the Station.

The opposite layout was also considered, but quickly discarded as unfeasible. In this layout, the west intersection allows westbound vehicles to enter and vehicles to exit eastbound, while the east intersection would allow eastbound vehicles to enter and vehicles to exit westbound. This would create queuing problems in the segment between the intersections and would have challenges in signal timing to prevent vehicles from queuing onto First and 2nd Streets NE.

4. Two entrances, north and south side: This option suggests an entrance on the north side of K Street NW and an entrance on the south side of K Street NE. Each entrance would only allow movements of vehicles turning right-in and right-out. This is, vehicles traveling westbound to enter or exit the parking facility use the north entrance and vehicles traveling eastbound to enter (or after exiting) the parking facility use the south entrance. This option does not require the removal of any columns and if through movements are prohibited on the outermost lanes (by making them Union Station access only lanes), there are not conflicts at all. From a traffic engineering perspective, this is the most functional option; however, the structural changes are substantial. The entrance on the north side would have a tunnel that turns southbound and travels under K Street NE to reach the parking level (since it would be south of K Street). There is uncertainty on whether tunneling under the columns would risk the structural integrity of the bridges. Major structural improvements would need to be made. In addition, this would create two openings on the walls which is undesirable for historic preservation reasons.

Analysis showed that the single-entrance, right-in, right-out option would not adequately accommodate the anticipated volumes of exiting vehicles. Among the double-entrance options, the south-side one would create unnecessary conflicts and require making two openings in the historic wall. The other double-entrance option would do the same, and additionally face substantial structural challenges. Therefore, FRA and the Proponents selected the single-entrance, full-movement intersection option as the option that would move forward. The access road to the garage would consist of two lanes out and one lane in on the southern side of K Street NE. Constructing the new intersection would require removal of two bridge supporting columns and the addition of a transfer beam to allow for left turns into or from the parking garage entrance. The removal of the two columns is currently adequate to continue to support train loads.

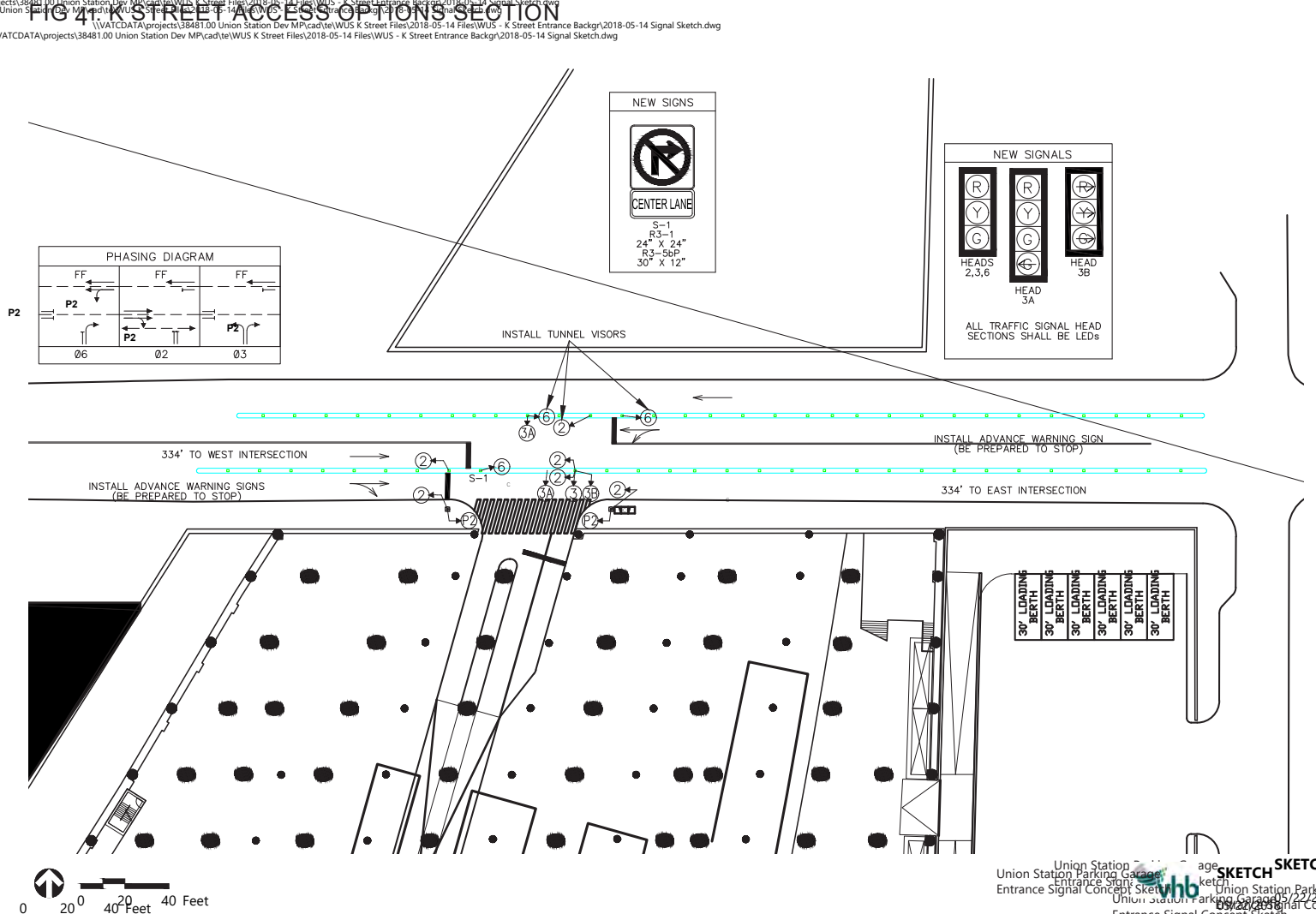
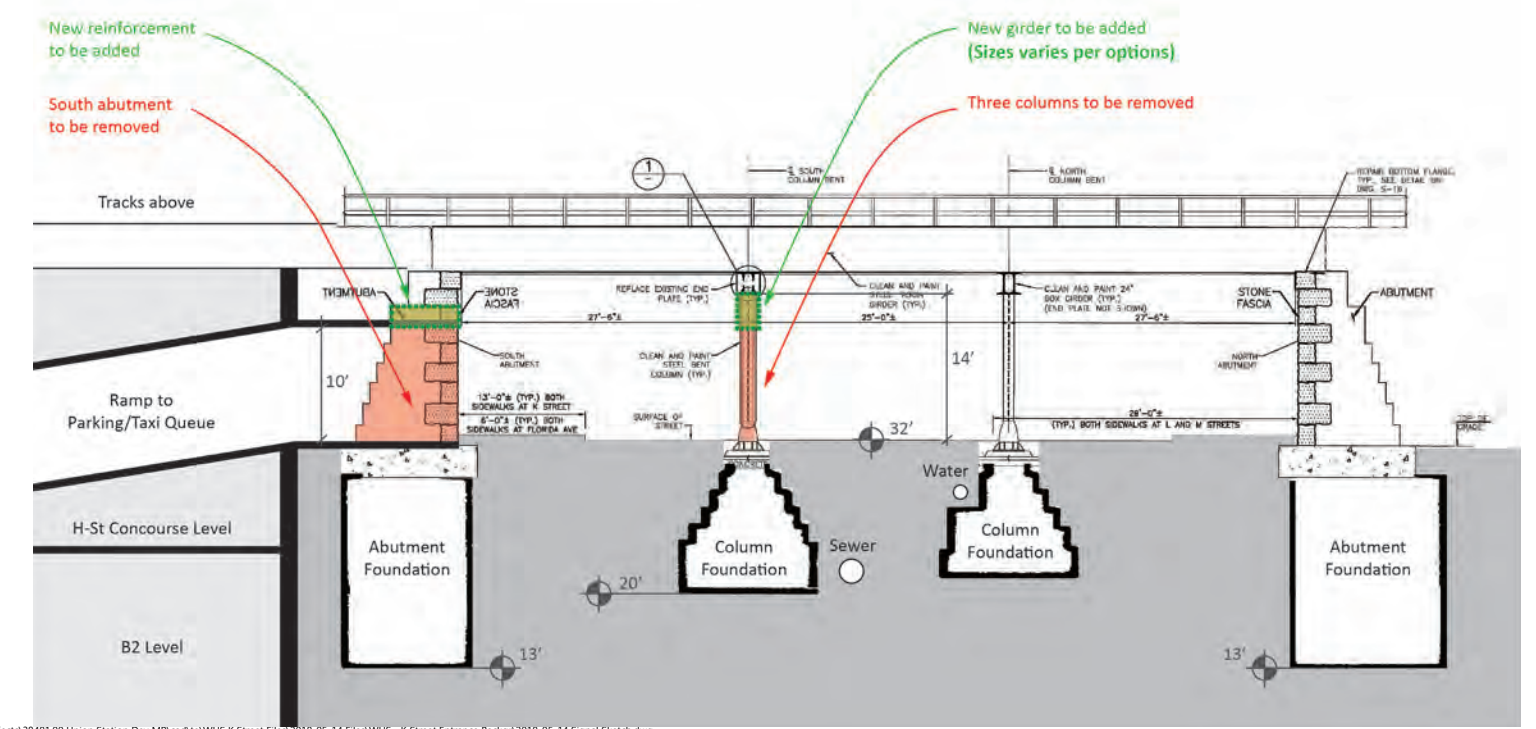


FIG 42. K STREET PARKING ENTRANCE SIGNAL CONCEPT SKETCH

A-2.9: CONSTRUCTABILITY INPUTS

From July 2017 to April 2018, Amtrak's Cost and Constructability consultant team led an extensive process with the Proponents and FRA to analyze and evaluate the constructability of the Preliminary Alternatives. Ultimately, the Amtrak team determined that three key project components drive the project cost and duration of construction.

- The extent of excavation, such as the depth and footprint of excavation
- The type of foundation that is appropriate for the depth of excavation
- Limitations of work zones restrict what can be taken out of service at one time and are complicated by setbacks to enable construction vehicle maneuvering and movements.

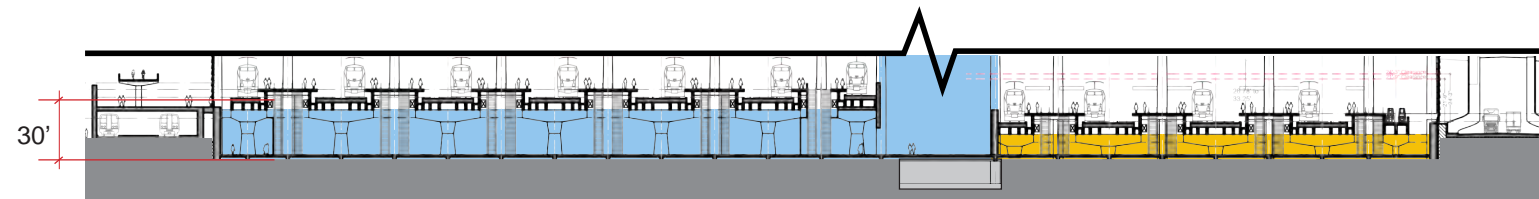
The cost and constructability analysis, as well as adjustments to Amtrak operational space requirements, prompted modifications to the Preliminary Alternatives such as the elimination of below-ground construction other than concourse space around the run-through tracks. Additionally, to further reduce the amount of below-ground construction, FRA and the Proponents defined new alternatives.

The elimination of excavation below the run-through tracks resulted in a split parking program with some above grade parking to accommodate the full program.

1 PARKING ABOVE

ALT A, A-C: 0 CARS BELOW

EXCAVATION:
+22' SEA LEVEL
(-30' FROM TRACK LEVEL)



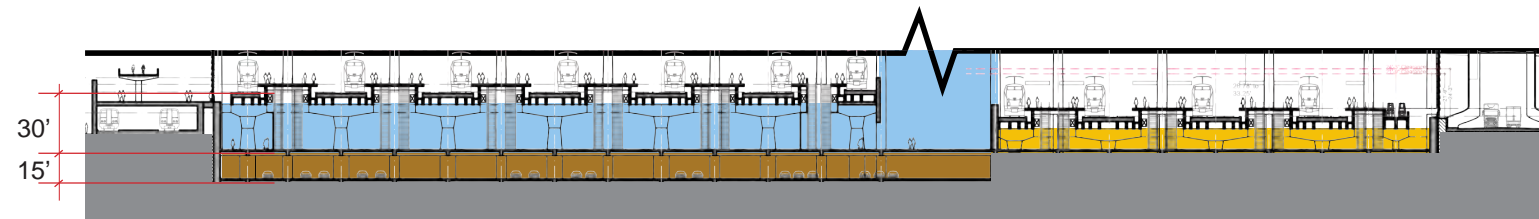
ALT A: 1659 CARS ABOVE
ALT A-C: 1626 CARS ABOVE



2 PARKING ABOVE AND BELOW

ALT C EAST: 917 CARS BELOW
ALT C WEST: 917 CARS BELOW

EXCAVATION:
+7' SEA LEVEL
(-45' FROM TRACK LEVEL)



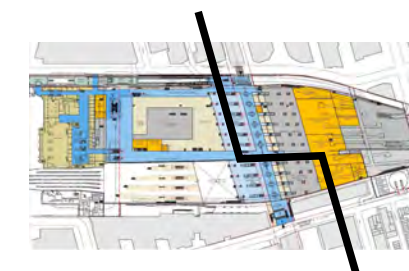
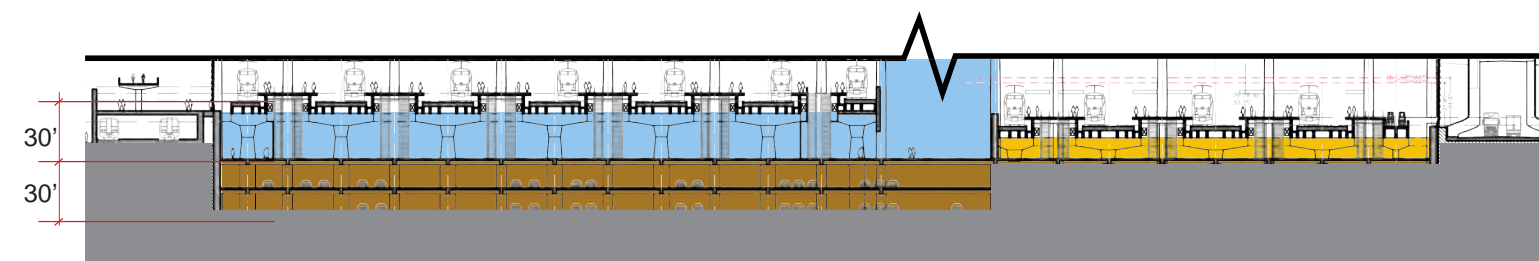
ALT C EAST: 264 CARS ABOVE
ALT C WEST: 250 CARS ABOVE



3 PARKING BELOW

ALT B: 2017 CARS BELOW
ALT E: 2017 CARS BELOW

EXCAVATION:
-5' SEA LEVEL
(-60' FROM TRACK LEVEL)



- CONCOURSE
- AMTRAK SERVICE
- PARKING

FIG 43. EXTENT OF EXCAVATION

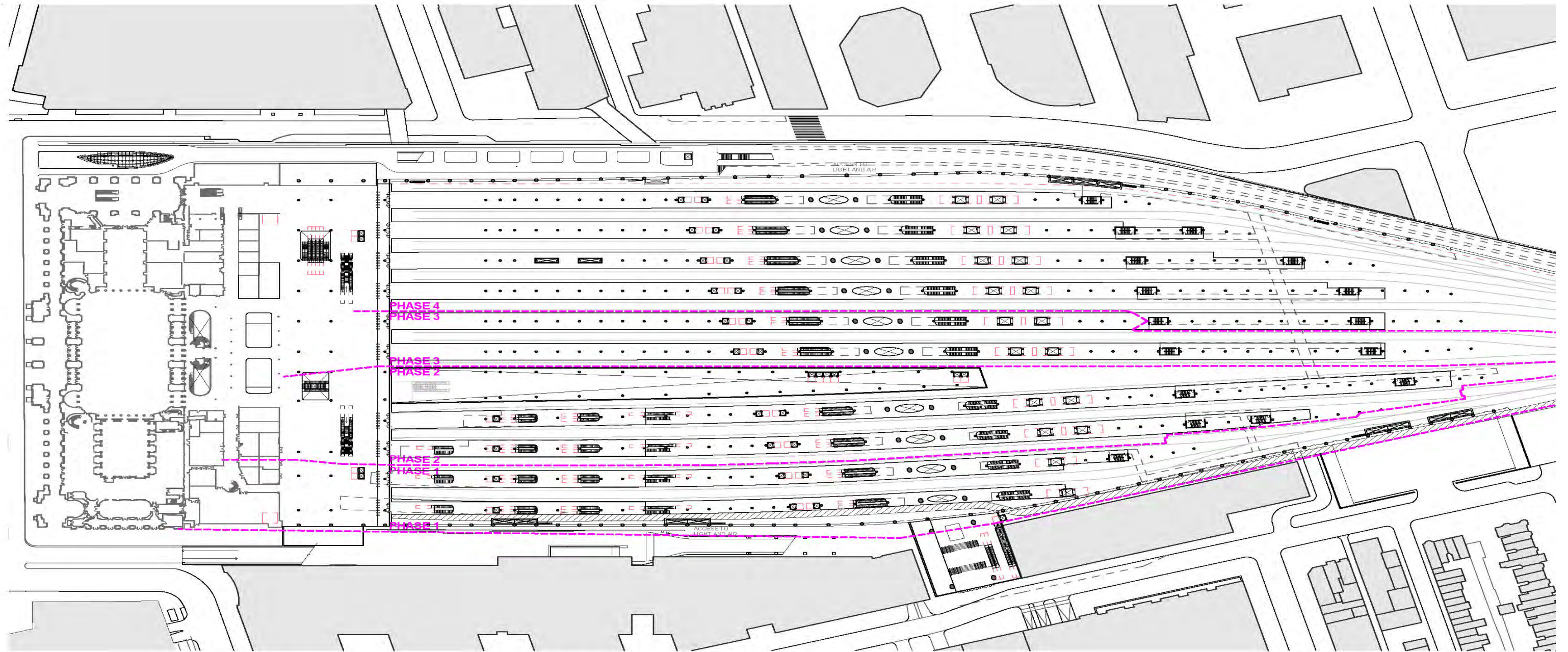


FIG 44. CONSTRUCTION PHASING PLAN

Column Type Key Plan

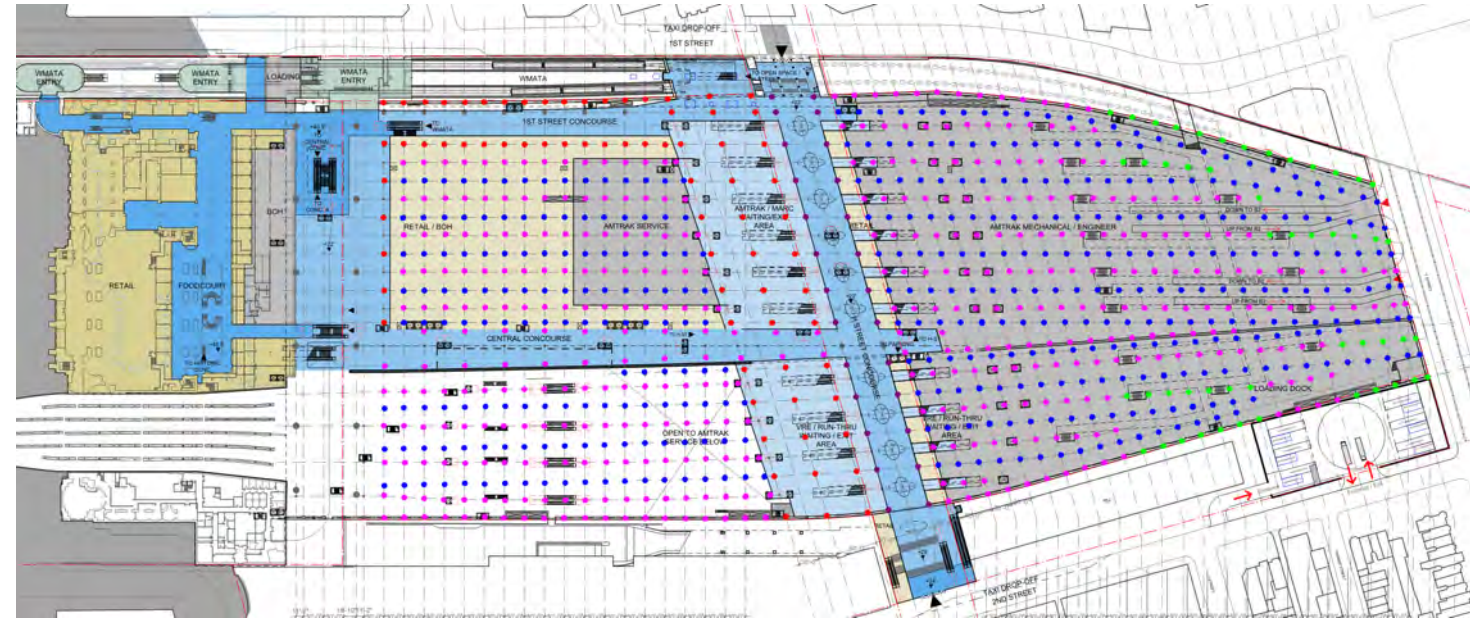


FIG 45. COLUMN TYPE KEY PLAN

Foundation Quantities – Drilled Shafts

Foundation Type	Color	No. Column Foundations
30x30 Overbuild Supporting	■	410
30x30 Track Supporting	■	386
Longspan Overbuild Supporting	■	50
60x60 Honeycomb Supporting	■	73*
Bridge Supporting	■	26
Total Number of Column Foundations		945

*Drilled Shaft to Rock

Foundation Quantities – Drilled Shafts

Foundation Type	No. Col	Shaft Diameter (ft)	Bottom of Shaft Elevation (ft)
30x30 Overbuild Supporting	410	6	-140
30x30 Track Supporting	386	5	-140
Longspan Overbuild Supporting	50	10	-140
60x60 Honeycomb Supporting	73*	12*	-192*
Bridge Supporting	26	9	-140
Total Number of Drilled Shafts	945		

*Drilled Shaft to Rock

FIG 46. FOUNDATION QUANTITIES - DRILLED SHAFTS

Micropile Quantities (Potential Alternate to Drilled Shafts)

Foundation Type	No. Col	No. Micropile	Total No. Micropiles	Bottom of Micropile Elevation (ft)
30x30 Overbuild Supporting	410	17	6970	-90
30x30 Track Supporting	386	13	5018	-90
Longspan Overbuild Supporting	50	32	1600	-90
60x60 Honeycomb Supporting		Not Applicable*		
Bridge Supporting	26	28	728	-90
Total Number of Micropiles			14316	

*Requires Drilled Shaft to Rock

Excavation Matrix

Excavation Type	Excav Elev	Water Head	Perimeter SOE	Temporary Internal SOE	Mat Slab Thick	Duration of Below Grade Work
Concourse Only	+19'	0'	Secant	Sheeting	2.5'	**
Concourse + 1	+3'	4'	Slurry	Sheeting	3.5'	**
Concourse + 2	(-10)'	17'	Slurry	Sheeting	4.5'	**

* Assumed Ground Water Elevation = +30ft
 ** Cost and Constructability Consultant to Advise

FIG 47. MICROPILE QUANTITIES AND EXCAVATION MATRIX



EXCAVATION DEPTH DATUMS**

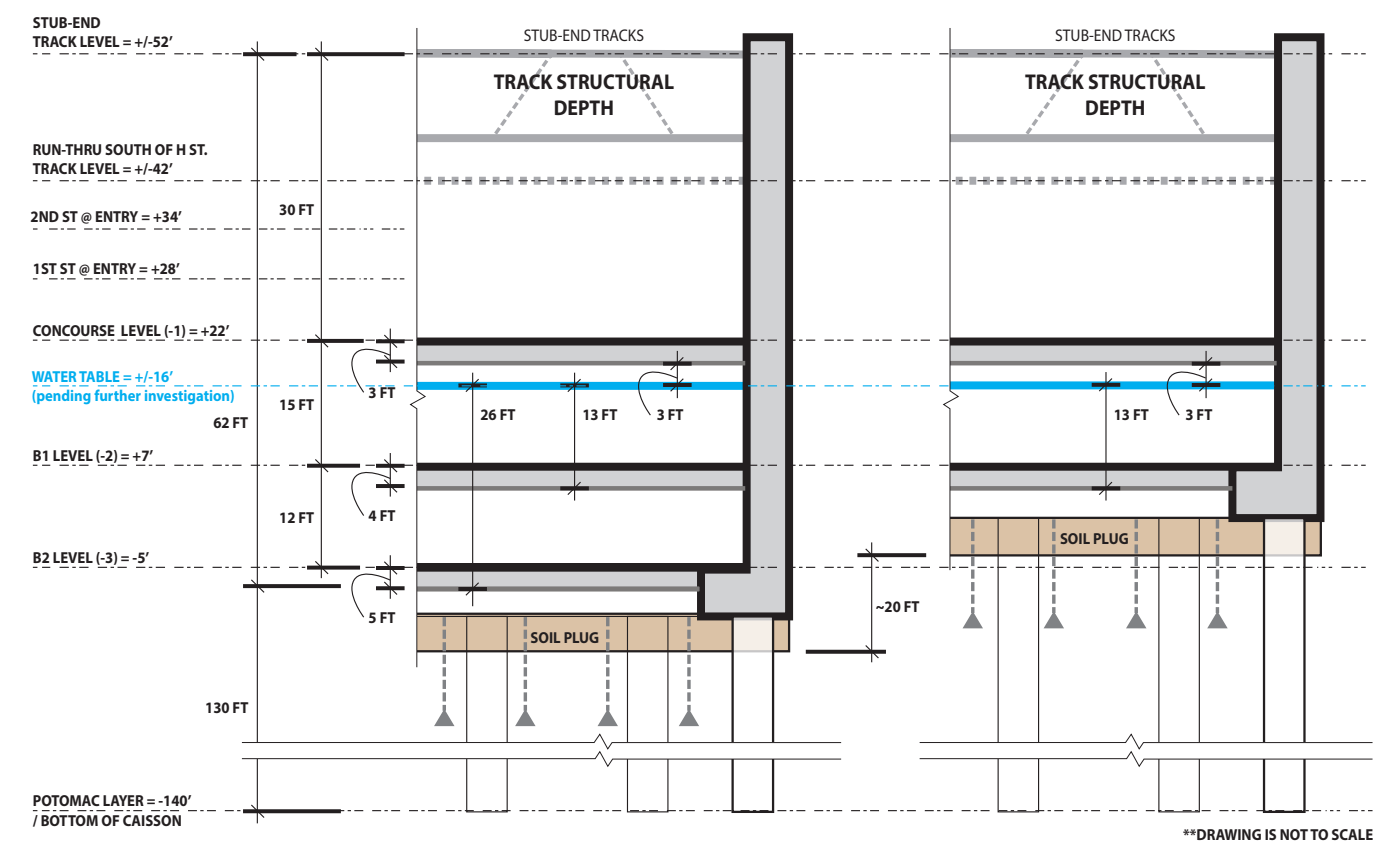


FIG 48. SECTION OF EXCAVATION DEPTHS

A-2.10: DECK LEVEL AREA ALLOCATION

The Proponents, in coordination with FRA, modified the east-west train hall to better connect the SEP to H Street, both physically and visually. The physical connection of the east-west train hall to H Street is provided by a subsurface Central Concourse for pedestrians. This connection is enhanced by natural daylighting which is provided via a daylighting access zone. An agreement with the private air-rights developer would be needed for the placement of access zones' features.

As part of the expansion of WUS, an additional primary entrance to the station would be created off of H Street to transition visitors from the H Street Bridge and Streetcar down into the station's lower level concourses. A new proposed headhouse would be located at the H Street Bridge to provide ingress and egress to and from the SEP. A headhouse is an entrance to a train station that provides access to tracks, platforms, and/or passenger concourses. The proposed H Street headhouse would also provide an attractive entrance to WUS adjacent to the DDOT Streetcar and could integrate with a range of potential approaches to allow access for pedestrians between H Street and the entrance to the east-west train hall. The exact nature and design of this area would be advanced throughout the development of the Project.

Also proposed is repurposing both of the existing ramps along the west and east side of WUS, which would provide connections from H Street NE to the western and eastern ends of Columbus Circle. In Alternatives A-E, the west ramp would provide pedestrian and bicycle access and one southbound vehicular lane accessible from H Street NE. For Alternative A-C, the west ramp would be maintained but would provide northbound access from First Street to the deck and H Street.

The east ramp of the station would be converted to southbound traffic only, simplifying the network, as northbound access would add through vehicles in the front of the station and add more traffic to H Street NE. See Section A-2.11 for more information.

Note: The following graphics represent the outcome of several workshops and meetings with various participants over the course of the Alternatives Refinement process on a wide range of topics, as outlined in Table 1.1 in the AARR.

The alternatives have different relationships with the surrounding Federal and private parcels. The area, currently Federally-owned, is designated on the following diagrams. The area above the rail terminal that is not Federally-owned is designated "Private Air Rights Developable Area."

ACTION ALTERNATIVES A & B

This linear north-south oriented train hall would extend toward H Street, the proposed facade stopping with a setback from H Street. The proposed entrance would allow passengers to access the train hall and the bus facility proximal to H Street. There is an opportunity to create a public plaza at the front of the H Street entrance and storefront retail lining the entry to the train station. Two additional entrances to the bus facility would be located to the west, directly off of H Street.

The area directly off of H Street facing the bus facility is private air-rights. In Alternative A, the area would be acquired to accommodate access to the bus facility and the parking garage. In Alternative B, access to the bus facility and potential Federal air-rights above would be via the Federal easement. Ownership of the area would be retained by the private development.

ACTION ALTERNATIVES A-C, C, D, & E

These alternatives would provide an additional station connection to the bus facility and parking structure, which are located north of H Street, via elevators serving the north end of the Central Concourse. South of H Street, an enclosed headhouse with elevators would bring passengers down to the H Street Concourse. The proposed headhouses would serve the station, but could potentially be incorporated into the larger network of placemaking and private development on the deck. A visual access zone between H Street NE and the new train hall would be centered on the historic station building and could include station access and a visual connection. A daylight access zone would be reserved south of the proposed H Street headhouse to allow daylight into the lower level platforms and concourses of the SEP. See "Station & Visual Access & Daylighting Access Zone" identified in the figures below.

The daylighting features would only use a portion of the daylight access zone. An agreement with the private air-rights developer would be needed for the access zone.

A portion of the deck adjacent to the H Street Bridge must be occupied by the Action Alternatives A-C, C, D, and E to accommodate ingress and egress to the station. The proposed headhouses would be approximately 60 feet wide and their approximate location is delineated in the figures below.

The daylight access zone would allow for private development, as only a portion of its area would be required for openings to below for natural light, not including setbacks required for that area to receive direct daylight. This zone may be concentrated generally over the proposed SEP Central Concourse. The following illustrations provide examples of how the access zones' spaces may be developed in the future, in coordination with others to allow for the integration of SEP elements. These illustrations are neither intended to represent specific design intent for the private development area, nor are they intended to prescribe a specific design direction for non-SEP areas. An agreement with the private air-rights developer would be needed for the placement of the access zones.

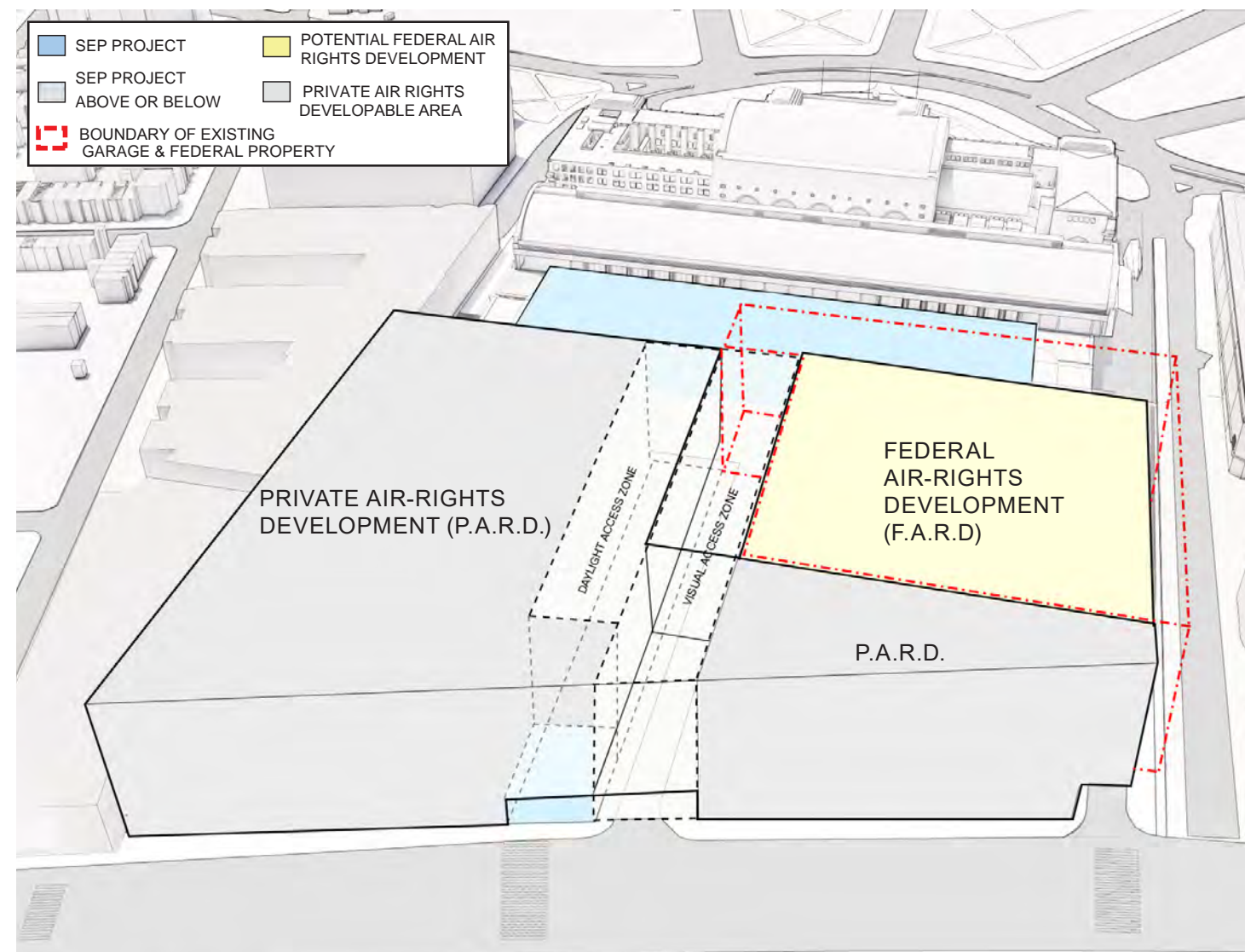


FIG 49. TYPICAL DECK LEVEL AREA ALLOCATION

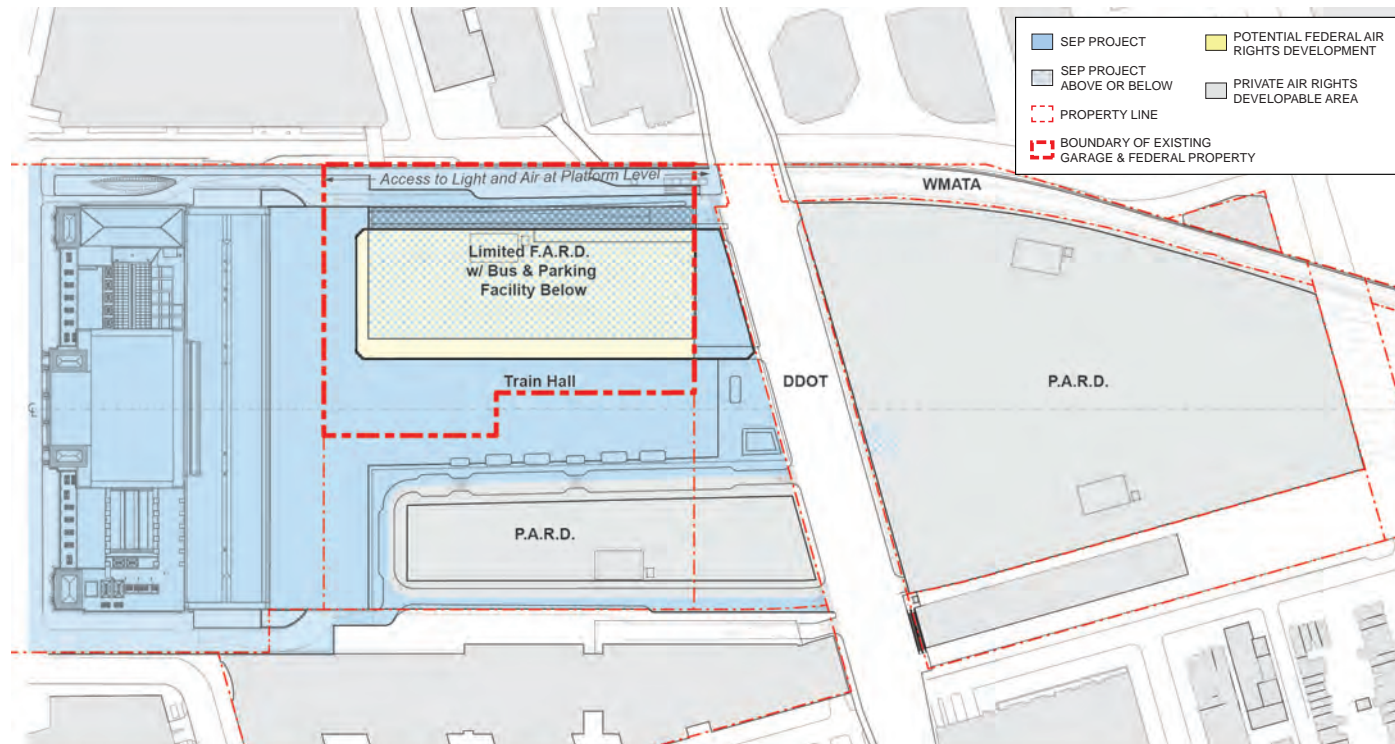


FIG 50. ACTION ALTERNATIVE A DECK LEVEL AREA ALLOCATION

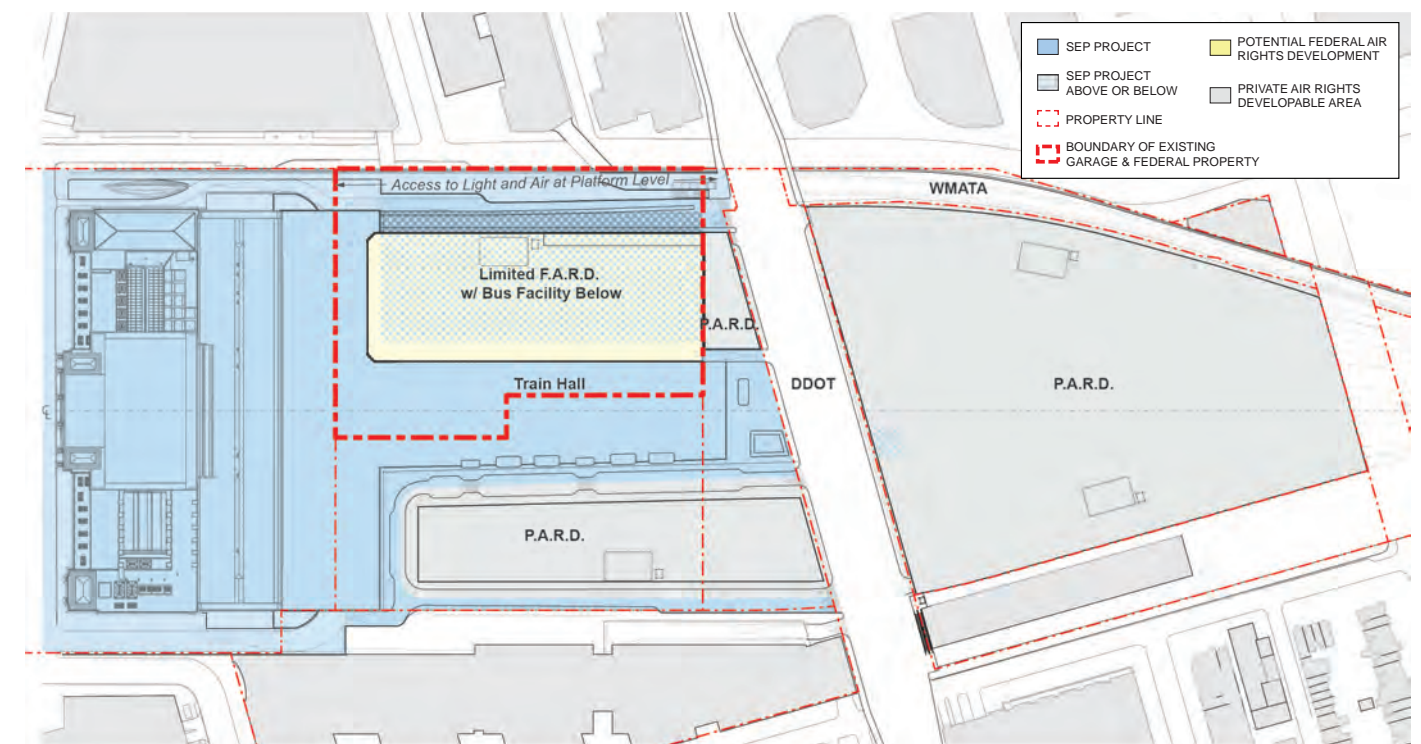


FIG 51. ACTION ALTERNATIVE B DECK LEVEL AREA ALLOCATION

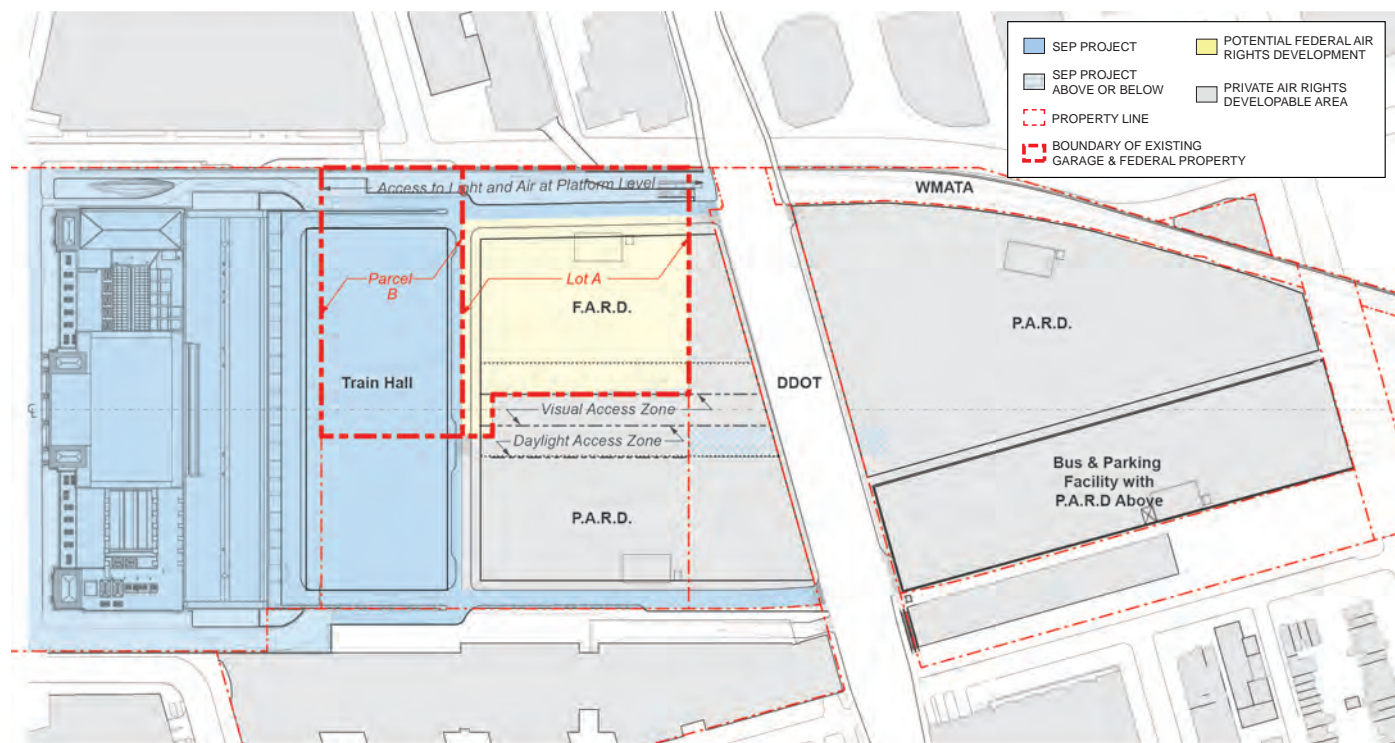


FIG 52. ACTION ALTERNATIVE C-1 DECK LEVEL AREA ALLOCATION

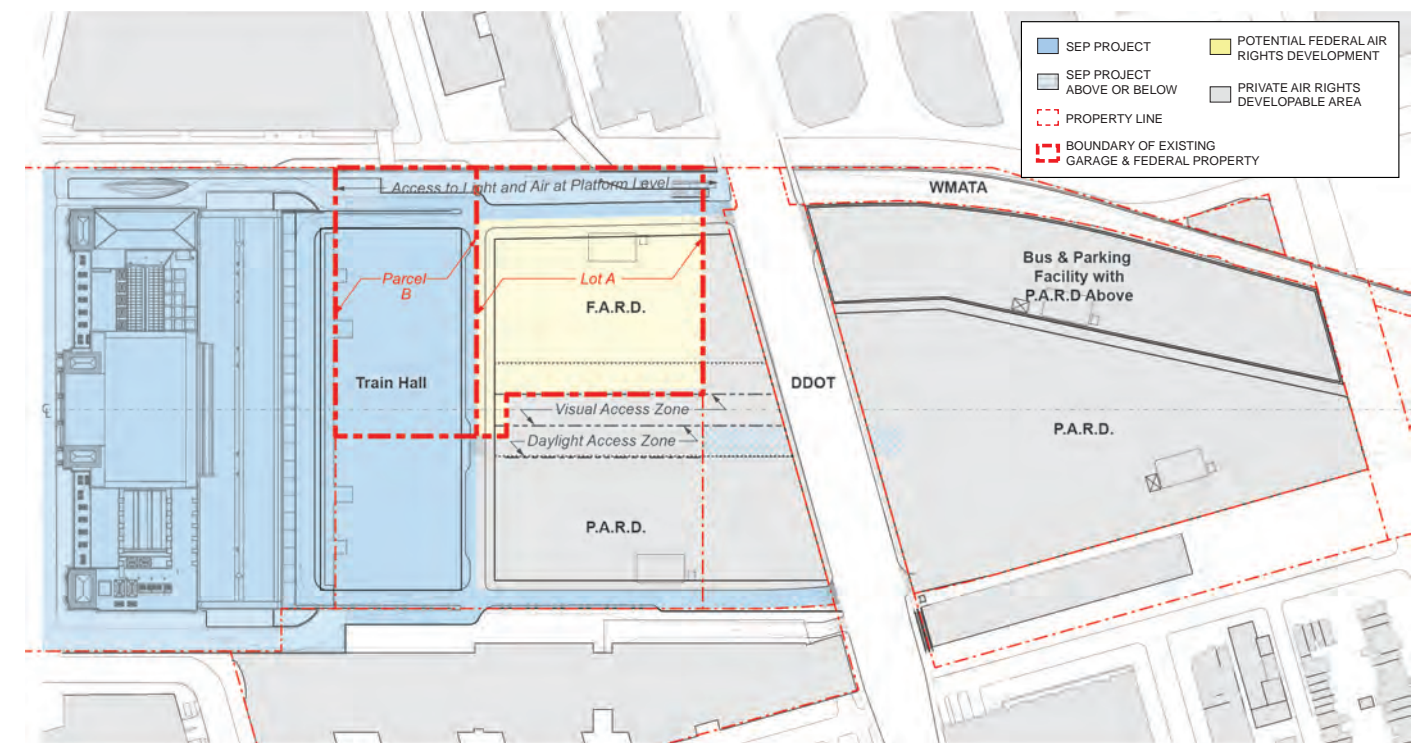


FIG 53. ACTION ALTERNATIVE C-2 DECK LEVEL AREA ALLOCATION

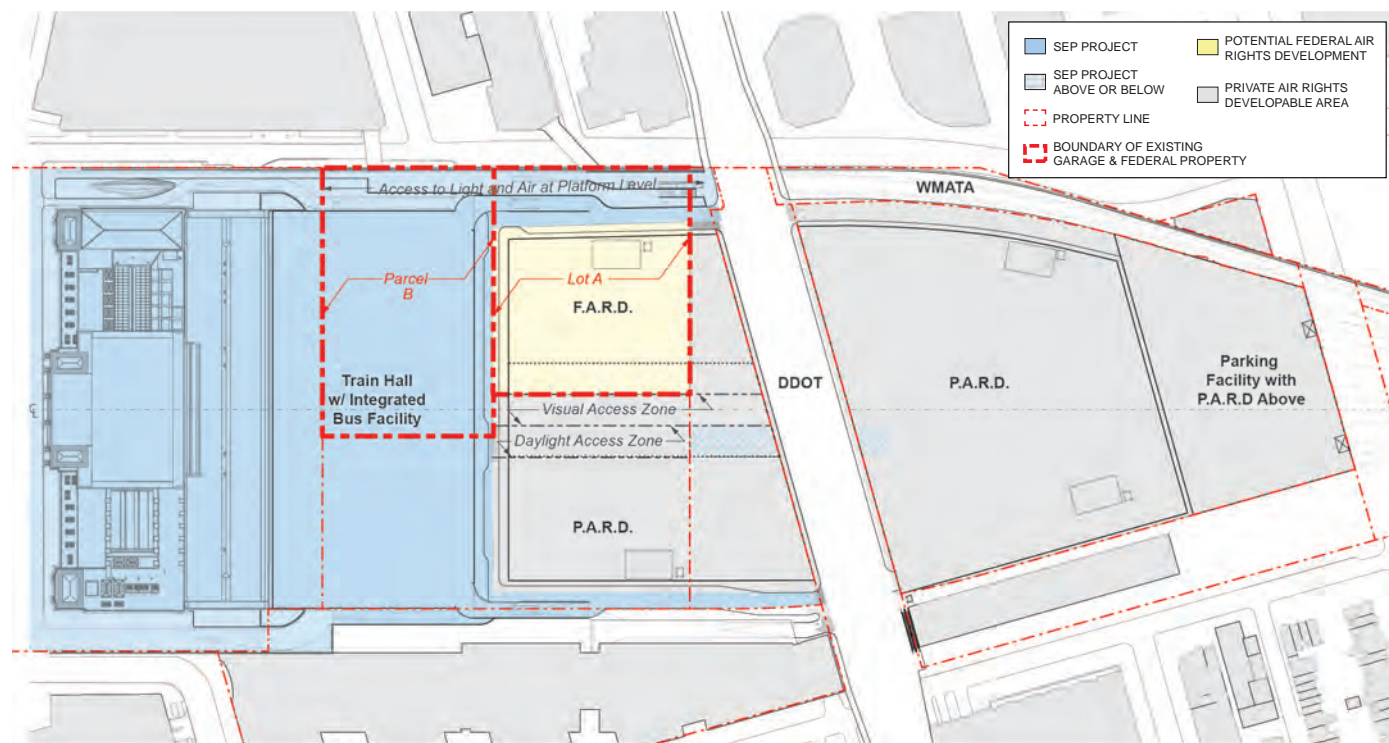


FIG 54. ACTION ALTERNATIVE D DECK LEVEL AREA ALLOCATION

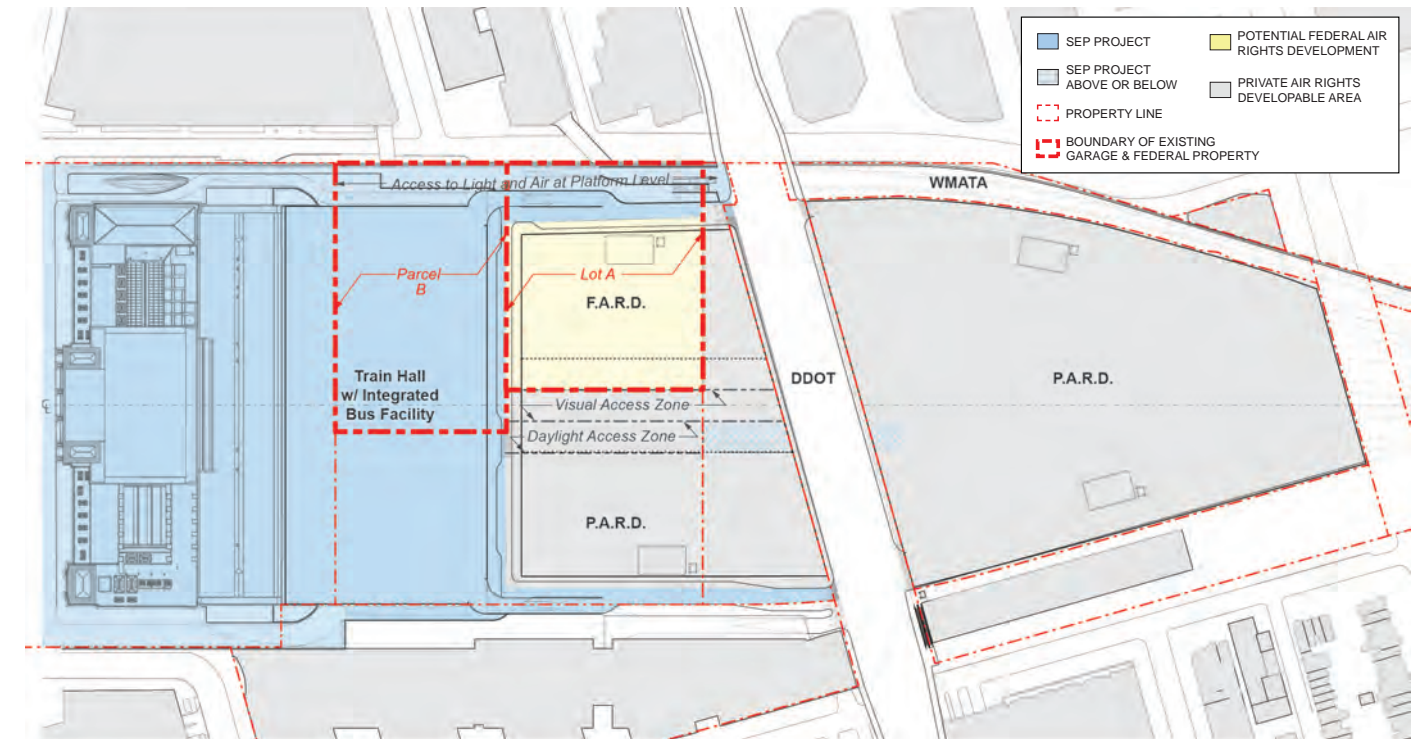


FIG 55. ACTION ALTERNATIVE E DECK LEVEL AREA ALLOCATION

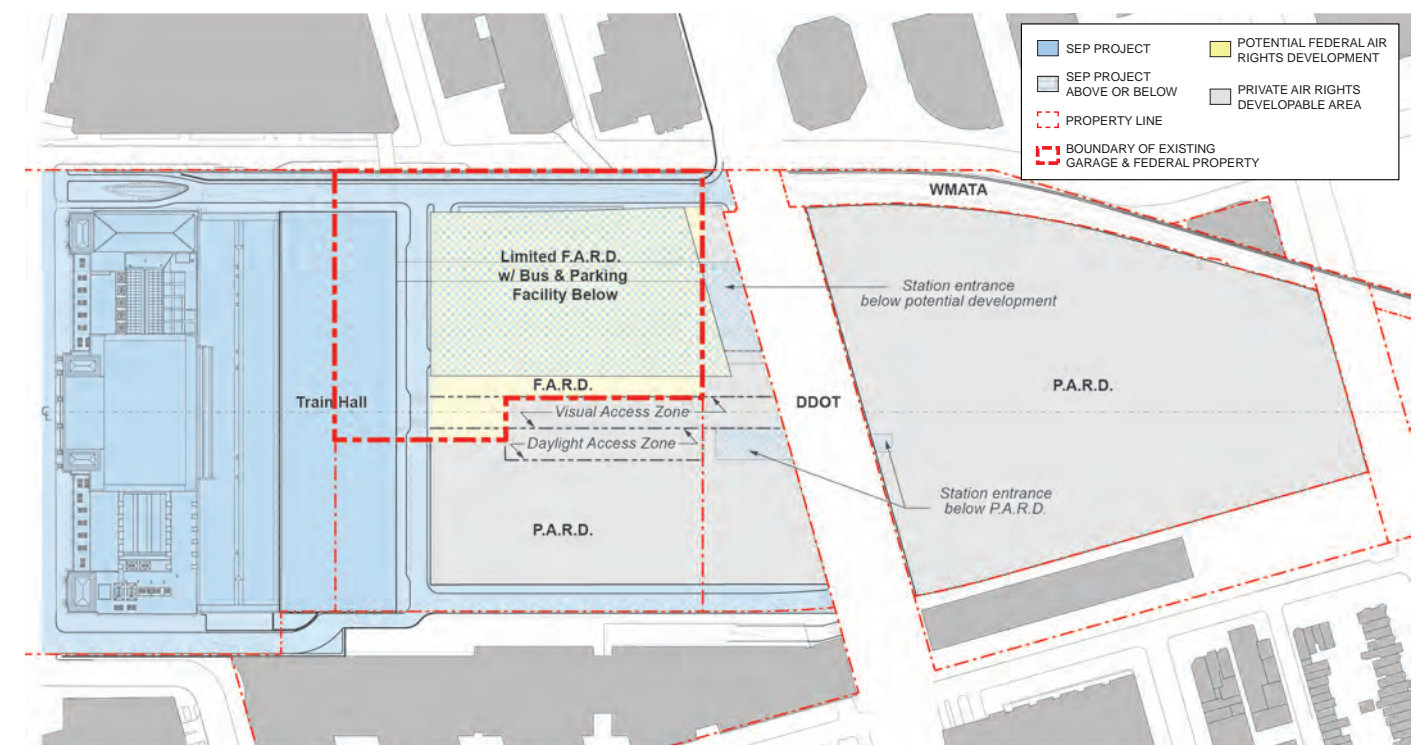
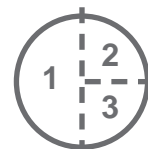


FIG 56. ACTION ALTERNATIVE A-C DECK LEVEL AREA ALLOCATION

A-2.11: COLUMBUS CIRCLE ROADWAY MODIFICATIONS

Columbus Circle currently provides the main access to the station for pick-up/drop-off activity. The summary of existing conditions and operations is included in Chapter 3 of the DEIS.

In all Action Alternatives, the six existing lanes in front of the historic station building would remain but with modified widths. Hop-on/hop-off bus activity would move to G Street NE, which would free up several lanes for pick-up and drop-off. Taxis would continue to have the exclusive use of the north lanes as they do now and they would continue to use the east ramp to reach the front of WUS.

At the western end of the circle, three exit lanes to Massachusetts Avenue and E Street would be maintained. The existing connection with the southbound West Ramp would be eliminated and replaced with a fourth exit lane providing northbound access to First Street NE. (Under all Action Alternatives, First Street NE, which is currently one-way southbound between G Street NE and Columbus Circle, would become one-way northbound.)

Repurposing the southern portion of the existing ramp along the west side of WUS, which connects H Street NE to the western end of Columbus Circle, would provide one pedestrian and bicycle lane and one southbound vehicular lane accessible from H Street NE for use as required by traffic conditions. The traffic lane would connect to First Street NE northbound. When the ramp is not open to vehicular traffic, the connection to First Street would function as a shared space with pedestrians.

There would be changes to the circle's approaches on the east side as well. A third lane would be added to the approach from the southeast to minimize queuing. Modification of the east ramp to allow southbound traffic only would minimize queuing from H Street NE and provide an exit from the ramp to F Street NE. The exit from the ramp to F Street NE would only be installed if it can be accommodated between the historic elements present in that area such as the historic station and the Burnham Wall. With traffic only flowing southbound, the network would be simplified, as northbound access would add through vehicles in the front of the station and add more traffic to H Street NE.

The connection for vehicles traveling northbound from Massachusetts Avenue NE and Columbus Circle to F Street NE would stay as it is now. However, on the left side of that segment, there would be two pick-up/drop-off spaces for use by WUS commercial tenants. The design team found this to be the best location for commercial office-related activity to take place. Any other location at the front of the station would conflict with station-related pick-up/drop-off activity.

Figure 57 illustrates the proposed improvements in all Action Alternatives.

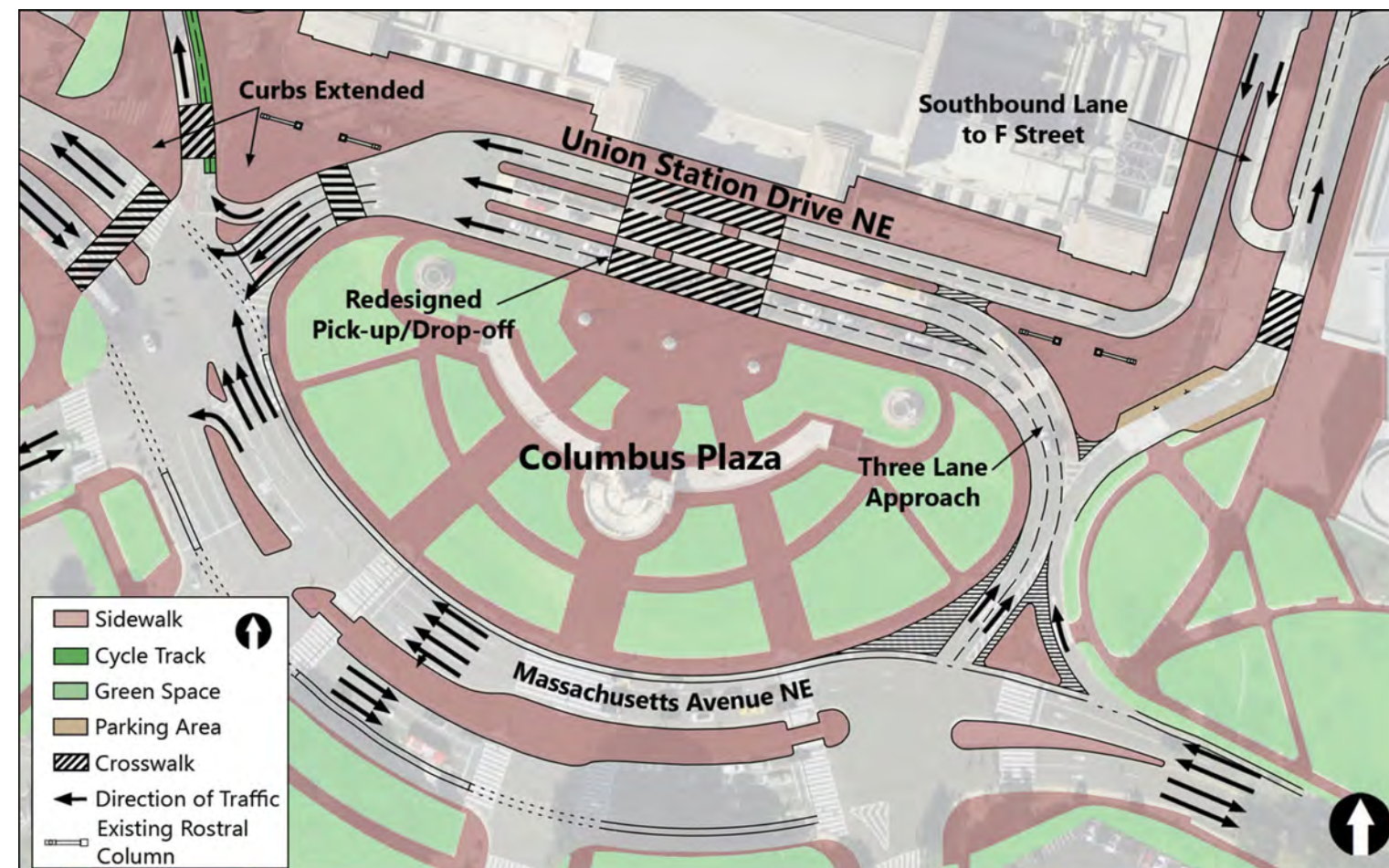


FIG 57. PROPOSED COLUMBUS CIRCLE ROADWAY MODIFICATIONS