

RECOMMENDATION PAPER TO THE DULLES CORRIDOR COMMITTEE

**ANALYSIS OF ALTERNATIVE AIRPORT ALIGNMENTS FOR METRORAIL
AT WASHINGTON DULLES INTERNATIONAL AIRPORT**

MARCH 2011

PURPOSE

This paper presents an update and recommendation on the review and evaluation of alternative Metrorail alignment and station locations at Washington Dulles International Airport (Dulles International). Since the update, additional work to advance the engineering designs and assess the construction requirements and to estimate costs of each alternative has been completed.

BACKGROUND

The currently approved alignment (Baseline Tunnel) for Phase 2 of the Dulles Corridor Metrorail Project includes a tunnel segment that runs through Dulles International with an underground station located in the hourly parking lot in front of the Main Terminal. Preliminary Engineering designs for this alignment and station location are currently being advanced. In April 2010, following review of an initial study of Airport alignment options, the Committee authorized further development and engineering of an aerial alignment and station in the vicinity of Daily Garage 1. Work to assess the technical feasibility and operational effects of this design option was completed in September 2010. In October 2010, staff was directed to further evaluate additional alternatives that would locate the Metrorail alignment and station closer to the Main Terminal.

Subsequently, the Office of Engineering initiated a full evaluation of the four Airport alignment and station alternatives identified in the table below. At the same time, Preliminary Engineering of the currently approved alignment and station was continued.

Alternative	Description	Alignment/Station Type
Modified Baseline Tunnel	Mined or Excavated Tunnel and Excavated Station in Hourly Parking Lot	Tunnel/Underground
Terminal Tunnel	Mined Tunnel and Station under the Main Terminal	Tunnel/Underground
North Garage Aerial	Elevated Guideway and Station at Daily Garage 1	Elevated/Aerial
Arrivals Level Aerial	Elevated Guideway and Aerial Station on Main Terminal Arrivals Roadway	Elevated /Aerial

Since late October 2010, staff and its consultants have advanced the evaluation of these alternatives with the support and participation of representatives from, other Airports Authority offices, Dulles International, Washington Metropolitan Area Transit Authority (WMATA), Fairfax County, Loudoun County, and an independent consultant provided by the Committee.

This process, a series of workshops to develop potential technical issues and operational impacts, review proposed solutions and engineering designs, and identify the most cost-effective construction approaches. The initial workshop was held in early November 2010 and focused on defining the alternatives to be studied and identifying specific technical issues for further study. The second workshop was conducted in December 2010 where participants reviewed and discussed the proposed design concepts and technical feasibility of each alternative. A third workshop was conducted in late January 2011 to review detailed construction planning for each alternative and cost estimating methodology. A final workshop in late February focused on a review of comparative costs, impacts, and benefits of the alternatives considered.

As a part of this study, the following activities have been completed to date:

- A range of design options has been considered for each alternative and configuration selected;
- The technical feasibility of each alternative has been reviewed and the measures necessary for construction and operations have been identified;
- Initial designs (engineering and architectural) for the alternative alignments and station locations have been developed to support construction planning and cost estimating effort;
- The type and extent of potential impacts (construction and long-term) to Airport operations, passengers, and businesses from each alternative have been identified;
- The requirements for ensuring continued compliance with applicable Federal laws and regulations (e.g., environmental impacts and historic preservation) have been determined for each alternative;
- Cost estimates have been developed for each alternative based on the initial designs prepared during the study; and
- A comparative analysis summarizing the relative benefits and impacts of the alternatives has been completed.

In January 2011, the Committee approved a staff recommendation to eliminate the Arrivals Level Aerial alternative from further study. Since then, the focus has been on completing the initial engineering designs for the remaining alternatives (Modified Baseline Tunnel, Terminal Tunnel, and North Garage Aerial), assessing construction requirements, and determining the total program costs for each alternative.

The remainder of this paper summarizes the study findings to date. For each of the alternatives still under consideration, the following information is provided:

- **Description.** A brief summary of the alternative, including the locations of key facilities and proposed construction methods;
- **Key Issues and Considerations.** A discussion of the benefits and challenges associated with the design, construction, and operation of the alternative;

- **Estimated Project Costs.** A summary of estimated costs for the Dulles International segment and the alternative's total project costs;
- **Implementation Schedule.** A summary schedule depicting the durations required to: 1) complete Preliminary Engineering and obtain required approvals, 2) complete the design-build solicitation and award process, and 3) complete construction; and
- **Implementation Risks.** An assessment of the risks associated with the implementation of the alternative. These risks have the potential to extend the project schedule, disrupt Airport operations, and increase project costs. A table rating the alternative in several risk categories is provided:
 1. Institutional Risks, such as National Environmental Policy Act (NEPA), Section 106, WMATA, and funding partner approvals.
 2. Construction Risks, including the potential for encountering unknown conditions or the occurrence of a catastrophic event during construction.
 3. Airport Operations Risks, including disruptions and/or interference with Main Terminal operations, passenger usage, cargo and tenant operations, traffic circulation and parking.
 4. Commercial/Legal Risks, such as the potential for delays due to impacts to tenant facilities and operations, or legal challenges to the alternative.

The result of higher risks associated with an alternative is reflected in the cost and schedule of the alternative. Schedules for alternatives with higher risks have time added to account for the risk involved. Longer durations mean higher overall costs because the cost is escalated to the midpoint of construction. Similarly, more contingency is added to the cost estimate for the element that has an elevated risk. For example, tunneling is considered a higher construction risk than an aerial structure. The amount of contingency added at this state of design may be 10 to 15 percent for low risk elements but may be raised to 30 percent or 35 percent for a high risk element. The increased contingency only applies to the cost of that element (i.e., tunneling). It is not applied to the total cost of the entire alternative.

FINDINGS

1. MODIFIED BASELINE TUNNEL ALTERNATIVE

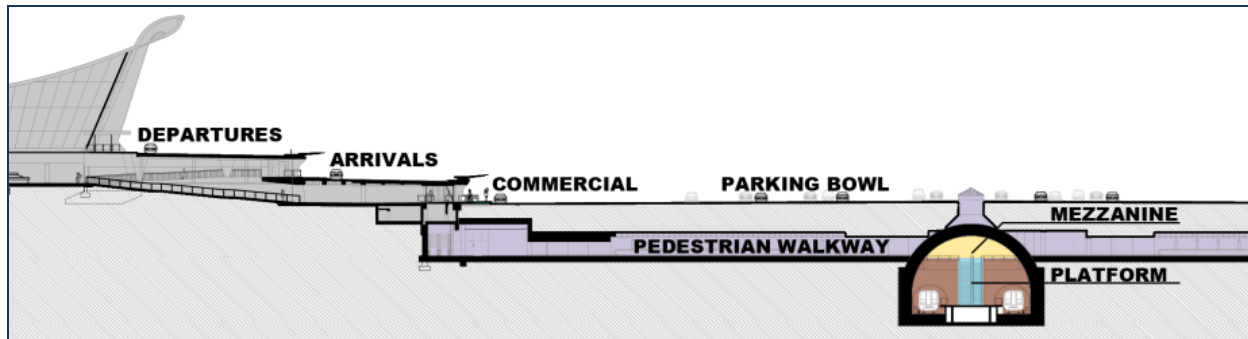
Description

The Modified Baseline Tunnel alternative would retain the same alignment and station location as the currently approved alignment, but would incorporate changes to the engineering design and construction methods in order to reduce costs. These changes include:

- Constructing a shallower tunnel and station to reduce the amount of excavation required.

In both of these options, the station would be located in the same location as the Baseline Tunnel (under the Hourly Parking lot), but the station would not be as deep underground (50 feet instead of 65 feet). The station entrance would be located at the pedestrian tunnel node which would provide direct climate-controlled access to each side of the Main Terminal via moving walkways. Ancillary facilities, including a traction power substation, four ventilation fan shafts, and two tunnel portals would be located above ground.

Modified Baseline Tunnel Station Location



Key Issues and Considerations

The Modified Baseline Tunnel alternative offers a more cost-effective version of the Baseline tunnel that retains the features and location of the originally-adopted Airport alignment.

This alternative would not require permanent modifications to the Airport roadway system or Main Terminal building that would impede Airport traffic circulation, passenger flows within the Main Terminal, or Airport operations. No major effects to existing cargo or car rental operations are anticipated with this alternative. It would, however, result in the permanent loss of 100 parking spaces in the Hourly Parking Lot and 50 spaces East Employee Parking Lot due to the above-ground placement of ventilation fan shafts and the new traction power substation, and the relocation of the existing Valet Parking operation to a new location within the Hourly Parking lot.

During the construction of this alternative, a portion of the Hourly Parking lot would be closed, temporary closure of the pedestrian tunnel between the Main Terminal and Daily Garage 1 may be required, and continued pedestrian access to the Main Terminal from the Hourly Parking Lot would require temporary structures to cross the construction area.

If the all cut-and-cover option is selected, there would be additional disruptions to Airport operations, traffic circulation, and passenger convenience due to the nature of this construction method and the need to cross more than 15 active roadways.

The Modified Baseline Tunnel alternative is consistent with the alignment and station location already approved in the Records of Decision issued by the Federal Transit Administration (FTA) and Federal Aviation Administration (FAA), and is included on the adopted Airport Layout Plan. Based on consultations with the Virginia Department of Historic Resources, no new Section 106 Memorandum of Agreement would be required to advance this alternative to construction.

Estimated Project Costs

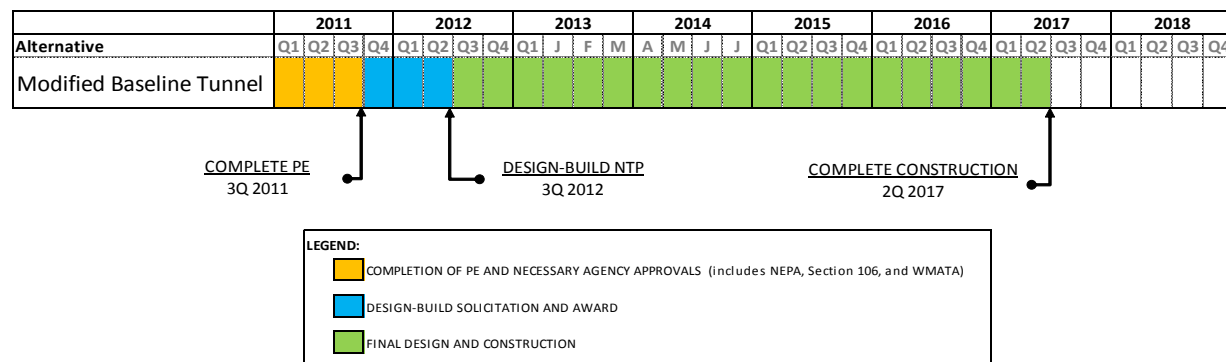
The estimated costs for the Modified Baseline Tunnel alternative are summarized below. The costs for the Airport segment under this alternative will vary depending on the construction method used. For the mined tunnel option and cut-and-cover station option, the estimated costs are \$330 million less than the estimated costs for the Baseline Tunnel. For the all cut-and-cover option (for both station and tunnels), the estimated costs are \$290 million less expensive than the Baseline Tunnel. Total project costs with this alternative are estimated to be \$3.50 billion (for the mined and cut-and-cover option) and \$3.54 billion (for the all cut-and-cover option).

Dulles International Segment Cost – Modified Baseline Tunnel	\$ 912 million (Mined and Cut-Cover Option) \$ 949 million (All Cut-Cover Option)
Total Phase 2 Project Cost – Modified Baseline Tunnel	\$ 3.50 billion (Mined and Cut-Cover Option) \$ 3.54 billion (All Cut-Cover Option)

Major cost drivers for the Modified Baseline alternative include: tunneling (\$350 million depending on the construction method used), an underground station (\$115 million), five at-ground stations (\$350 million), five parking structures (\$200 million), rail systems (\$320 million) aerial guideway (\$270 million), rail yard (\$330 million), and professional services and agency costs (\$715 million).

Implementation Schedule

The projected schedule and key milestones for completion of Phase 2 with the Modified Baseline Terminal alternative are summarized below. Under both construction options being considered, an additional three to four months will be required to complete Preliminary Engineering and secure all necessary agency approvals. Anticipated construction durations for the two options would be similar. The all cut-and-cover option would allow construction to occur simultaneously in multiple locations however, it also requires extensive measures to maintain the operation of Airport roadways and traffic circulation.



If this alternative is chosen, Phase 2 is forecast to be for completion three months later than the Baseline Tunnel. This schedule assumes use of the Design-Build contract packaging approach recommended by the President and Chief Executive Officer (CEO).

Implementation Risks

An assessment of the risks associated with implementing the Modified Baseline Tunnel alternative is presented below. These risks could result in a longer project schedule, disrupt Airport operations or increase project costs.

MODIFIED BASELINE TUNNEL RISKS	LOW	MODERATE	HIGH	VERY HIGH
Institutional Risks	◆			
Construction Risks		◆		
Airport Operations Risks		◆*		
Commercial/Legal Risks	◆	◆		

* Higher for the All Cut-and-Cover construction method

For the Modified Baseline option which uses the mined tunnel construction method, the greatest risks are associated with an unforeseen site conditions or a catastrophic event during construction. These risks are comparable to those anticipated with the Baseline Tunnel. Overall, the implementation risks associated with either option of the Modified Baseline alternative are not very different from those that would be expected with the underground construction proposed for the Baseline Tunnel:

- Low Institutional and Commercial/Legal Risks, as this alternative is nearly identical to the Baseline Tunnel already approved by FTA and FAA. No additional mitigation measures would be required for compliance with federal environmental and historic preservation laws.
- Moderate Construction Risks due to construction complexity with mined tunneling and relatively shallow ground cover, and interface with the existing pedestrian tunnel. If an all cut-and-cover construction method is used, the risk profile would increase somewhat due to the use of multiple and potentially adjacent construction areas.
- Moderate Passenger and Airport Operations Risks due to closure of a portion of the Hourly Parking lot and construction of the tunnel portals. If an all cut-and-cover construction method is used, there would be additional risks in these areas due to the need for extensive roadway diversions and temporary closures.

2. TERMINAL TUNNEL ALTERNATIVE

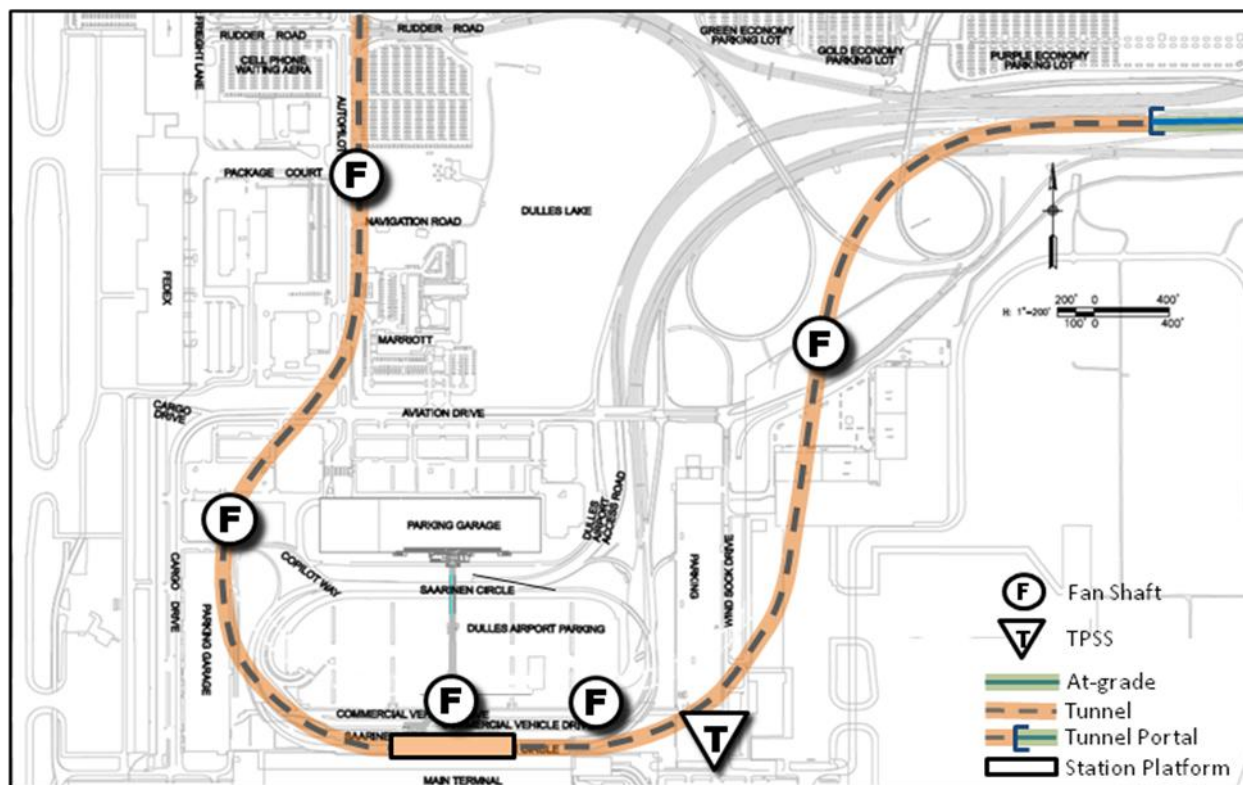
Description

The Terminal Tunnel alternative includes a mined tunnel through Dulles International and an underground station beneath the Main Terminal. This alternative places the Metrorail alignment station directly below the Ground Transportation Center of the Main Terminal, instead of under

the Hourly Parking lot. Due to the depth required and the station location, the use of the cut-and-cover construction method for this alternative is not practical or cost-effective.

This alternative would include approximately 11,500 feet of tunneling, 700 feet more than the Baseline Tunnel (and 3,300 feet more than the Modified Baseline alternative). A deeper tunnel would be required to go underneath both the Main Terminal building and the Daily Garage 2 (West); this extends the point of transition from tunnel to an aerial alignment along Autopilot Drive to north of Cockpit Court, in the vicinity of the existing car rental operations. Work inside the Main Terminal would also be required to construct the station entrances, equipment rooms, and vertical circulation connections between the station platform and the entrances.

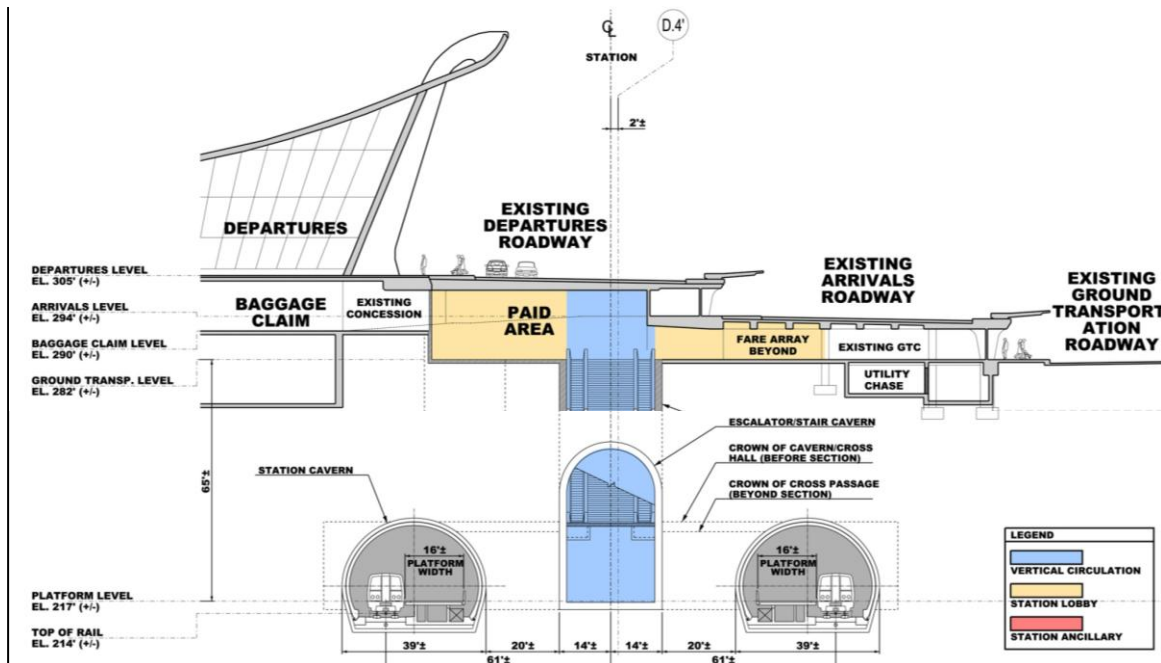
Terminal Tunnel Alignment and Ancillary Facility Locations



With the Terminal Tunnel alternative, the underground station would be located approximately 70 feet beneath the ground floor of the Main Terminal and a station entrances would be located at the both east and west ends of the building. Metrorail passengers departing or entering the station would do so through areas of the Main Terminal located between the baggage claim and ground transportation curb. Escalators, stairs and elevators would provide access between the station lobbies and the inbound and outbound station platforms. For Airport passengers not using the rail station, access to and from the baggage claim area and the Arrivals roadway would remain available using the existing walkways (ramps). Ancillary facilities, including a traction power substation, four ventilation fan shafts, and two tunnel portals would be located above ground in the same locations used for the Modified Baseline alternative.

To reduce the amount of tunneling required, the placement of the Metrorail station equipment rooms within the Main Terminal building was evaluated in detail. Due to the constraints (height, location) space available in the Main Terminal and the need to displace (and relocate) existing Airport operations rooms, most of this equipment has been located within the station itself. Also, the Main Terminal's existing environmental conditioning systems would service the station's public areas and equipment rooms, and ancillary areas.

Terminal Tunnel Station Location



Key Issues and Considerations

The Terminal Tunnel would provide enhanced access to the Main Terminal building for Airport passengers and employees using Metrorail. It would also require alterations and permanent reconfiguration of existing spaces within the Main Terminal building, relocation of critical building utilities and services, and modifications to passenger movements and tenant operations.

This alternative would require mined tunnel construction under the foundations of the Main Terminal to create the running tunnels, station platforms, passenger circulation, and subsurface equipment rooms. The vertical circulation necessary and station entrance lobbies necessary for rail passengers to travel between the Main Terminal and the station can be accommodated, but their construction would permanently displace space and equipment rooms currently used for Airport operations. Reconfiguration of the Washington Flyer and Super Shuttle concession counters and relocation of the displaced Airport operations space would be required. In addition, approximately 100 parking spaces in the Hourly Parking lot and 50 spaces in the East Employee Parking lot would be lost permanently to make room for the new ventilation fan shafts and traction power substation.

Of all the alternatives, the Terminal Tunnel alternative would have the greatest impact on Dulles International Airport operations both during construction and while the Metrorail station was operational. This alternative also has the added complications of working under and within the Main Terminal building while maintaining Airport operations and acceptable levels of customer service. Compared to the Baseline Tunnel and Modified Baseline Tunnel alternative, construction of the Terminal Tunnel alternative would require: additional and more complex tunneling, modifications to the Main Terminal foundations and structure, relocation of critical building services and utilities within the Main Terminal, more complicated construction staging, constrained work areas (restricted headroom) for constructing station entrances, and careful construction sequencing in order to protect the Main Terminal building and maintain Airport operations. There will be construction impacts inside the Main Terminal building, along the adjacent Commercial Roadway, and in the Hourly and East Employee parking lots.

Within the Terminal, extended closure of one or more entrance doors and ramps would be necessary to construct the station entrances and vertical circulation (elevators and escalators). Dust, vibration, and noise control within these areas and designated paths for the removal of excavation materials would be needed. A portion of the Hourly Parking Lot will be closed for construction of the ventilation fan shafts and contractor staging. This alternative would not affect passenger use of the pedestrian tunnel between the Main Terminal and Daily Garage 1 and no major effects to existing cargo or car rental operations are anticipated during construction or operations.

The Terminal Tunnel alternative requires a supplemental environmental review to ensure continuing compliance with federal environmental and historic preservation laws, and an amendment to the currently approved Airport Layout Plan. Although no new impacts on historic resources which might require mitigation are anticipated, an amendment to the existing Section 106 Memorandum of Agreement would be necessary to advance this alternative to construction. A public hearing to review potential environmental impacts would also be required.

Estimated Project Cost

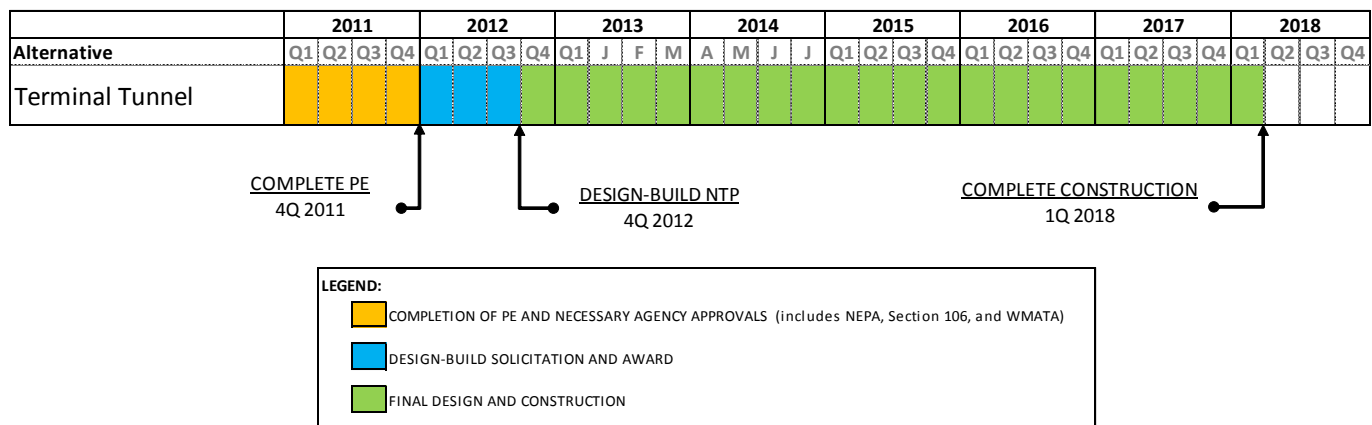
The estimated costs for the Tunnel Terminal alternative are summarized below. The Airport segment costs for this alternative are \$200 million higher than the costs for the Baseline Tunnel than the currently approved alignment. Total project costs with the Tunnel Terminal alternative are estimated to be \$4.03 billion. The additional costs are due to the additional tunneling required, added construction complexity, and the need to maintain Airport operations while working within and under the Main Terminal building.

Dulles International Airport Segment Cost – Terminal Tunnel	\$1.44 billion
Total Phase 2 Project Cost – Terminal Tunnel	\$4.03 billion

Major cost drivers for the Terminal Tunnel alternative include: tunneling (\$485 million), an underground station beneath the terminal (\$310 million), five at-grade stations (\$350 million), five parking structures (\$200 million), rail systems (\$330 million), aerial guideway (\$250 million), rail yard (\$330 million), and professional services and agency costs (\$835 million).

Implementation Schedule

The projected schedule and key milestones for completion of Phase 2 with the Tunnel Terminal alternative are summarized below. An additional six months will be required to complete Preliminary Engineering and secure all necessary agency approvals for this alternative, primarily due to the additional geotechnical investigations and design efforts required to tunnel under both the Main Terminal building and the Daily Garage 2.



Under this alternative, Phase 2 is forecast to be completed one year later than the Baseline Tunnel. This schedule assumes use of the Design-Build contract packaging approach recommended by the CEO. The estimated construction duration would be approximately six months longer due to additional staging and sequencing requirements necessary to maintain Airport operations (limited work hours) and to accommodate passengers during peak holiday travel periods.

Implementation Risks

An assessment of the risks associated with implementing the Terminal Tunnel alternative is presented below. These risks could result in a longer project schedule, disrupt Airport operations or increase project costs.

TERMINAL TUNNEL RISKS	LOW	MODERATE	HIGH	VERY HIGH
Institutional Risks		◆		
Construction Risks			◆	
Airport Operations Risks			◆	
Commercial/Legal Risks		◆		

The Terminal Tunnel option has the most complicated design, and most challenging construction setting of all the alternatives considered. It is also the most expensive alternative. Major implementation risks associated with this alternative include:

- Moderate Institutional Risk, as this alternative is similar to the Baseline Tunnel already approved by FTA and FAA and enhances access to the Airport for rail users. No additional mitigation measures are anticipated for compliance with federal environmental and historic preservation laws.
- High Construction Risk due to amount of mined tunneling, the construction of mined tunnels and a station under the existing Main Terminal building foundations, and interfaces with the Main Terminal utilities and mechanical/electrical equipment.
- High Airport Operations Risks due to construction activities within (and under) the Main Terminal building, added and longer inconvenience to Airport passengers, and the need to move equipment necessary to maintain Airport operations. This alternative also retains the operational risks associated with the closure of a portion of the Hourly Parking lot and construction of the tunnel portals.
- Moderate Commercial/Legal Risks, as the longer tunnel and its construction would require the construction of new entrances to several rental car facilities.

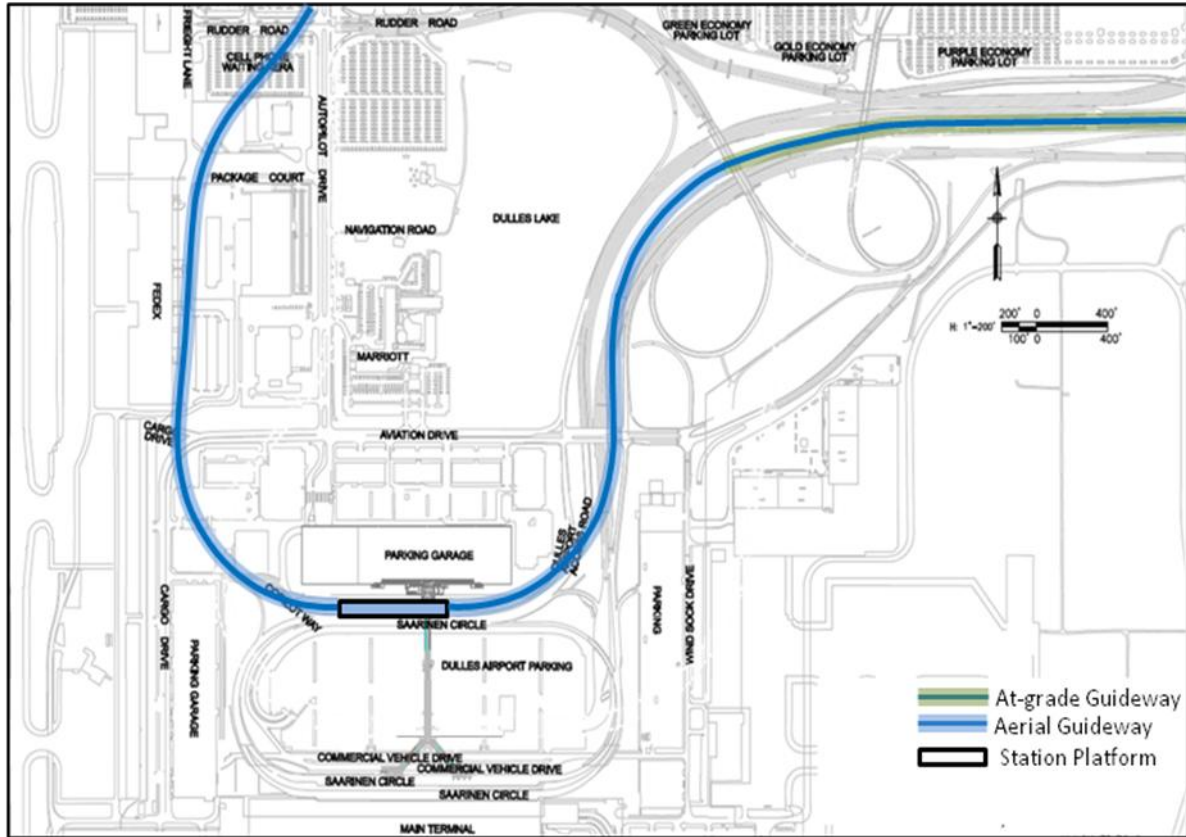
3. NORTH GARAGE AERIAL ALTERNATIVE

Description

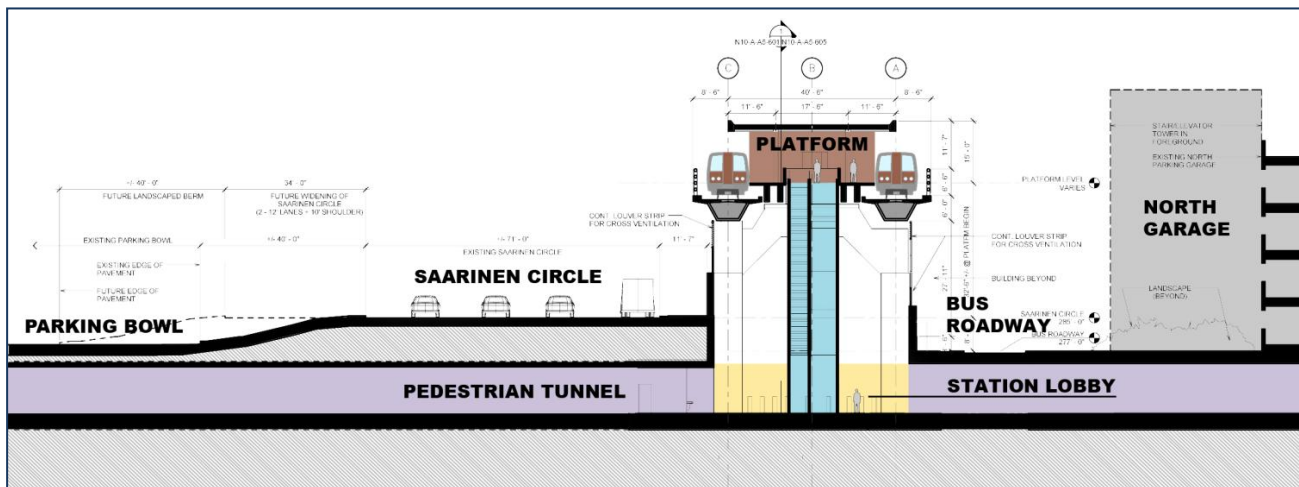
The North Garage Aerial alternative would replace the Baseline Tunnel alignment and underground station in the Main Terminal Hourly Parking lot with an aerial (elevated) alignment and station adjacent to the Daily Garage 1 building. The aerial alignment would enter the Airport in the median of the Access Road and cross over Saarinen Circle to the station location between the south face of the North Garage and Saarinen Circle. Within the Airport property, it would add an elevated rail structure along the Access Road, an aerial station adjacent to the North Garage, and an elevated rail structure along the existing roadway serving the Cargo #5 building and commercial flight kitchens.

This alternative is located farther from the Main Terminal than other alternatives. It would utilize the existing pedestrian tunnel which provides moving walkways and a direct climate-controlled connection between the North Garage and the Main Terminal. Under this alternative, these walkways would be extended to reduce the walk distance. A facility for remote ticketing and baggage check-in for rail users and daily parkers could be accommodated in the pedestrian tunnel adjacent to the station entrance. The traction power substation would be located within the station building. No ventilation fan shafts or tunnel portals are required.

North Garage Aerial Alignment and Ancillary Facility Locations



North Garage Aerial Station Location



Key Issues and Considerations

The North Garage Aerial alternative would provide a more cost-effective solution to serving Dulles International than the Baseline Tunnel, but does not offer the same level of access to the Main Terminal for Metrorail users as the other alternatives considered. It does provide a similar level of access to the Main Terminal as the Daily Parking garages.

Under this alternative, the overall distance between Metrorail station and the Main Terminal is approximately 1,100 feet, or 600 feet further than Baseline Tunnel station. This alternative would utilize the existing moving walkways in the pedestrian tunnel, which are available for over 340 of the additional 600 feet. These walkways could be extended to further reduce the additional walk distance required and shorten travel times. Other improvements, such as artwork, lighting, and signage, could be made along the walkway tunnel to enhance the passenger experience. This alternative also includes an area for remote baggage check-in near the Metrorail station, which could be available to both rail and parking garage users. A check-in facility and an automated baggage handling system utilizing tunnels between the North Garage and the Main Terminal could be added at an additional cost to the Authority of \$170 to \$190 million. Operating costs for the remote baggage facility are estimated to be around \$2 million annually.

The North Garage Aerial alternative presents a central Metrorail station location that would serve not only air passengers accessing the Main Terminal, but also users of other current and future Airport facilities, including possible office, hotel and other development north of the garage along Aviation Drive and Autopilot Drive.

The North Garage Aerial alternative would not require any permanent modifications to the Airport roadway system that would affect Airport user traffic circulation, changes to the Main Terminal building that would impede passenger flows or Airport operations, or the permanent loss of spaces in the Hourly Parking lot. However, unlike the other alternatives, this alternative would add significant new and visible aerial structures to Dulles International – an aerial station adjacent to the south side of the North Garage, and an elevated rail structure approaching the station along the Dulles Airport Access Road and departing the Airport along the Air Freight Lane which serves the Cargo #5 building. Some of these new elevated structures would impact historic resources located within Dulles International Airport Historic District, and, in particular, the viewshed available to persons approaching the Main Terminal by vehicle and looking north from within the Main Terminal. These impacts would need to be mitigated in a manner acceptable to the Virginia Department of Historic Resources.

In addition, the elevated rail line's impacts on the Cargo #5 building would require a reconfiguration of the building's vehicular access and parking in order to maintain existing cargo operations. Cargo #5 building is privately owned and subject to a ground lease agreement that expires in 2017 at which time the building ownership transfers to the Airports Authority. The major tenant is Federal Express (FedEx). The aerial alignment would require two or three cargo bays to be closed permanently to accommodate pier support for the rail line. Modifications to the specialized sorting equipment inside the facility FedEx would likely require changes. Cargo #5 building does not provide growth capacity for FedEx, however; the Airport's Master Plan offers flexibility for additional cargo development on the designated Cargo 7 land area or on the

Western Lands. Either alternative, if needed, offers beneficial flexibility and enhancements to the Airports Authority in mitigating Cargo #5 impacts while also addressing the Airports long-term cargo plans.

During construction, temporary road closures or detours would be required to build the foundations for the elevated rail structure. Once these were in place, most of the construction would be done from the top (as is currently in the case with the elevated structure in Tysons Corner). No portion of the Hourly Parking lot would be used for contractor staging or construction activities. The existing Daily Garage shuttle bus stop would be temporarily relocated to the north side of the garage to allow room for construction of the rail station; service patterns and routes would be adjusted accordingly. Additional coordination with the tenants and owners of Cargo #5 building would be required to determine the improvements and measures that would be required to maintain their access and current operations during the construction period.

The North Garage Aerial alternative is not consistent with the alignment and station location already approved in the Records of Decision issued by the Federal Transit Administration and Federal Aviation Administration, or shown on the adopted Airport Layout Plan. Completion of the NEPA, 106, and FAA processes and revisions to these approval documents would be required to advance this alternative. A public hearing on environmental impacts and negotiation of a new agreement with the Virginia Department of Historic Resources to mitigate effects to the Dulles Airport Historic District would also be required.

Estimated Project Cost

The estimated costs for the North Garage Aerial alternative are summarized below. The Airport segment costs for this alternative are \$655 million lower than the costs for the Baseline Tunnel and \$325 to \$360 million lower than the Modified Baseline Tunnel alternative. Total project costs with the North Garage Aerial alternative are estimated to be \$3.17 billion. The lower costs are due to the elimination of tunneling, replacement of the underground station with an aerial station, reduced construction complexity, and shorter construction duration.

Metrorail Project Cost

Dulles International Airport Segment Cost – North Garage Aerial	\$587 million
Total Phase 2 Project Cost – North Garage Aerial	\$3.17 billion

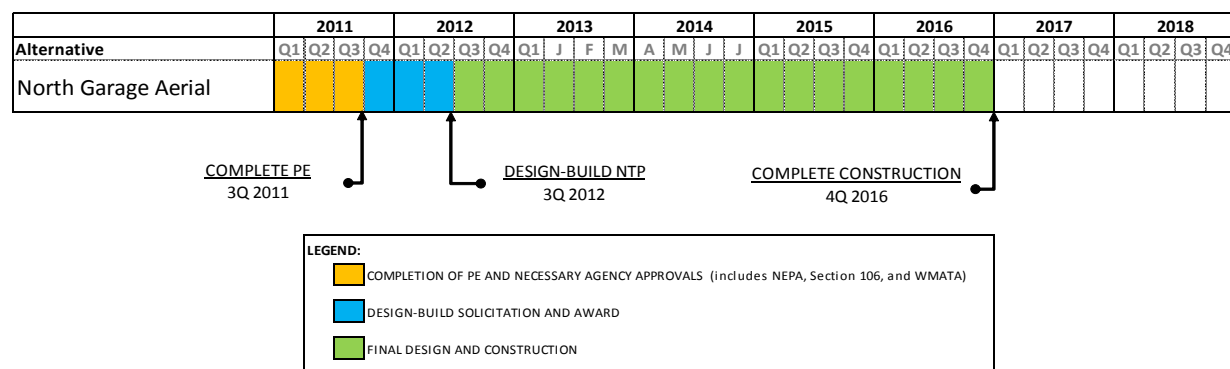
Aviation Enterprise Cost

Baggage Tunnel and Automated Baggage Handling System	\$170 million to \$190 million	Capital Cost
	\$2 million per year	Annual Operating Cost

Major cost drivers for the North Garage Aerial alternative include: aerial guideway (\$380 million), one aerial station (\$110 million), rail systems (\$315 million) five at-grade stations (\$350 million), five parking structures (\$200 million), rail yard (\$330 million), and professional services and agency costs (\$640 million).

Schedule

The projected schedule for completion of the North Garage Aerial alternative and key milestones are summarized below. Compared to the Baseline Tunnel, an additional 3 to 4 months will be required to complete Preliminary Engineering and secure all necessary agency approvals for this alternative, primarily due to the impacts to historic resources and design efforts required to finalize appropriate mitigation measures. Additional coordination with the cargo tenants would also be required to determine the optimal construction sequencing approach.



If this alternative is selected, Phase 2 forecasted for completion sooner than for the Baseline Tunnel because the estimated construction duration would be approximately 6 months shorter because of the elevated rail structure and aerial station. This schedule assumes use of the Design-Build contract packaging approach recommended by the CEO.

Implementation Risks

An assessment of the risks associated with implementing the North Garage Aerial alternative is presented below. These risks could result in a longer project schedule, disrupt Airport operations or increase project costs.

NORTH GARAGE AERIAL RISKS	LOW	MODERATE	HIGH	VERY HIGH
Institutional Risks			◆	
Construction Risks	◆			
Airport Operations Risks		◆		
Commercial/Legal Risks		◆		

The North Garage Aerial alternative would eliminate the need for any tunneling and its associated risks. While it would avoid any impacts (or use of) the Main Terminal building and

Hourly Parking lot, it has a greater potential to disrupt cargo operations. Major implementation risks associated with this alternative include:

- Low Construction Risks due to the reduced construction complexity and elimination of all tunneling, and lack of work in the vicinity of the Main Terminal.
- Moderate Airport Operations Risks due to greater disruption of cargo operations and the construction activities away from the Main Terminal. Construction impacts of this alternative are more likely to affect Airport tenants and users of non-passenger facilities.
- Moderate Commercial/Legal Risks due to the changes to cargo access and operations, the potential need to modify existing tenant leases, and possible legal challenges.
- High Institutional Risk, as this alternative would require a new agreement with the FTA and the Virginia Department of Historic Resources to mitigate additional impacts to historic resources. Completion of the federal environmental (NEPA) process cannot be completed until the historic issues are resolved.

RECOMMENDATION

Based on the technical findings of the Airport Alignment Alternatives Study, the Office of Engineering supports selection of either the Modified Baseline Tunnel or the North Garage Aerial alternative as a more cost-effective solution for the Metrorail alignment and station at Dulles International. Although there are substantial differences in the costs and impacts associated with these two alternatives, either could be constructed while maintaining airport operations and minimizing disruption to Airport users and tenants.

Should the Board prefer a tunnel alignment and underground station, the Office of Engineering recommends selection of the Modified Baseline Tunnel alternative which utilizes a mined tunnel alignment and cut-and-cover station. This alternative retains the same alignment and station location previously approved by federal agencies and local funding partners, but incorporates several changes to the engineering design and construction methods to reduce costs. The total amount of tunneling is reduced by approximately one-half mile and the station design has been modified to simplify construction. The use of a mined tunnel will reduce the extent and duration of disruption to Airport operations and users during the construction period. Most of the visible construction activity would occur within the Hourly Parking Lot and along Autopilot Drive. No additional mitigation measures would be required for compliance with federal environmental and historic preservation laws.

Neither of the two other tunnel options are considered to be a cost-effective technical solution. The use of an all cut-and-cover construction method for the Modified Baseline Tunnel alternative building is more disruptive to Airport operations (due to the needs to temporarily close several roadways and relocate multiple utilities) and includes additional costs to mitigate these impacts during construction. Although the Terminal Tunnel alternative would provide enhanced access to the Main Terminal for rail users, this alternative is the most challenging and expensive to implement. It is estimated to cost 15 percent more (\$530 million) than the recommended tunnel alternative and would require substantial modifications to the Main

Terminal foundations, relocation of building services and utilities, and loss or reconfiguration of interior spaces.

Should the Board prefer an alternative that provides the maximum cost savings, the Office of Engineering recommends selection of the North Garage Aerial alternative. This alternative provides both cost and schedule benefits by eliminating all tunneling. Construction costs are estimated to be 20 percent (\$655 million) less than the current tunnel alignment and 10 percent (\$325 million) less than the recommended tunnel alternative. Construction activity would occur next to Daily Garage 1 and along Air Freight Lane and Autopilot Drive. The Hourly Parking Lot would not be disturbed during construction. The North Garage Aerial alternative offers a station location that would serve not only air passengers accessing the Main Terminal, but also users of other current and future Airport facilities, including possible office, hotel and other development north of the garage along Aviation Drive and Autopilot Drive.

Compared to the recommended tunnel alternative, the North Garage Aerial alternative would have additional impacts on Airport users and cargo operations. These can be mitigated at an additional cost to the Airports Authority. To reduce the additional walk distance required and shorten travel times, the moving walkways now available in the pedestrian tunnel could be extended by about 100 feet. Anticipated disruptions to FedEx operations at the Cargo #5 building would likely require some modifications to their sorting equipment and possibly alternative accommodations to maintain their operations. The Airport Master Plan offers flexibility for cargo operations. If the Board wishes to add a remote baggage check-in facility at the North Garage station location, this would be an additional cost to the Airports Authority. Various other solutions have been identified with a range of costs.

This alternative will require a public hearing, and negotiation of a new agreement with the Virginia Department of Historic Resources to mitigate the alternative's impacts to the Dulles International Airport Historic District.

Once the Board selects a preferred Airport alignment and station alternative, the design of the current tunnel alignment and underground station would be suspended and the ongoing Phase 2 Preliminary Engineering effort would be completed based on the selected alternative. Approximately 4 to 6 months and \$2 to \$2.5 million would be required to finish the additional design work needed to support a design-build solicitation and complete the federal and local approval processes. Any necessary environmental and historic preservation reviews, public hearings, and funding partner approvals would be conducted concurrently with the completion of Preliminary Engineering on the selected alternative.

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