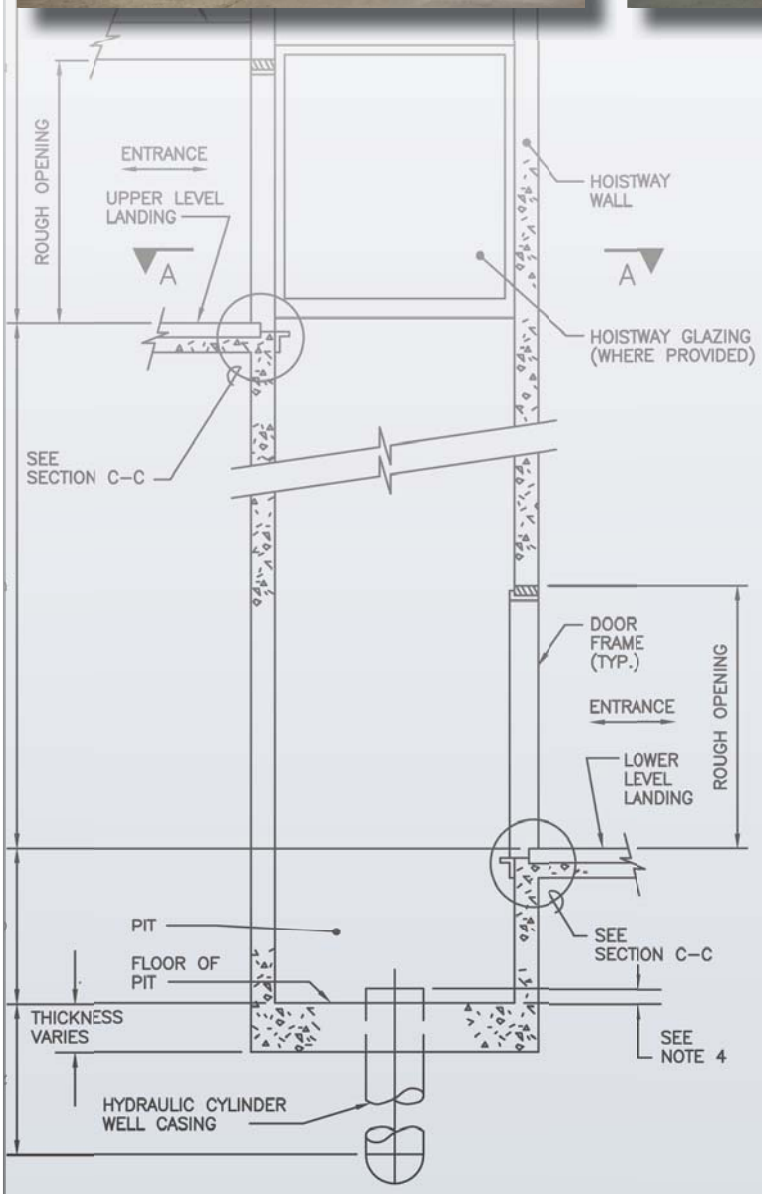
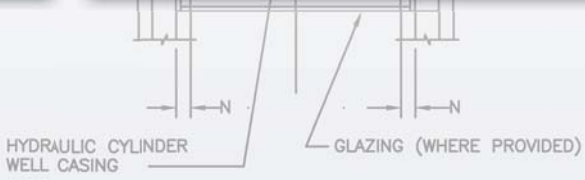
Pentagon City Station

Elevator Feasibility Study

October 2010



SECTION B–B



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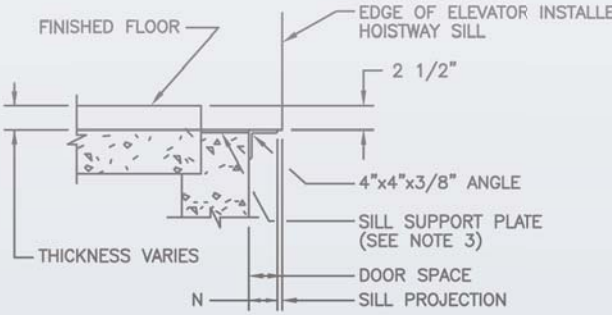

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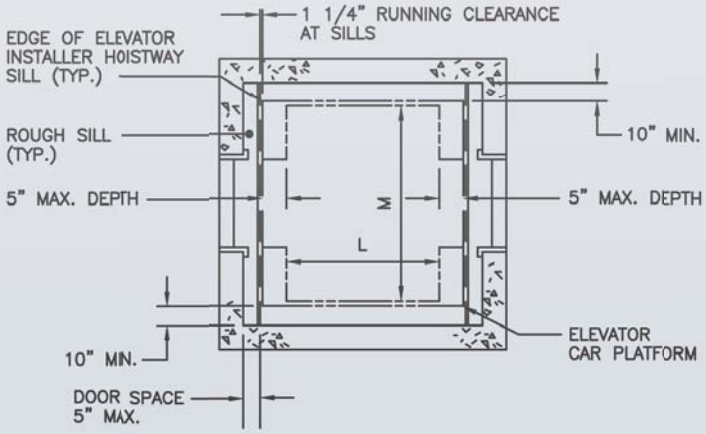


HOISTWAY/CAR INTERIOR DESIGN ALLOWANCES

Purpose

Arlington County requested that Metro evaluate the feasibility of building a second elevator between the passageway and street on the west side of Hayes Street to improve accessibility to the station and serve the growing ridership demand. This report focuses on potential locations for the new elevator and conceptual plans for the recommended location.

Pentagon City Metrorail Station

The Pentagon City Metrorail station (Pentagon City station) is on Metro's Blue and Yellow Lines (See Figure 1) and ranks second in highest ridership of the northern Virginia stations. The Pentagon City station is located under the northbound lanes of Hayes Street with a passageway connecting the station mezzanine to both sides of Hayes Street. The station has two side platforms with the tracks running in the center. There are two mezzanine-to-platform elevators, one for each side platform. On the east side there are two escalators and one elevator connecting the passageway to the street. On the west side there are two escalators connecting the passageway to the street. All passengers needing to use the street elevator must enter or exit the station on the east side.

Table 1: Existing Station Access Points

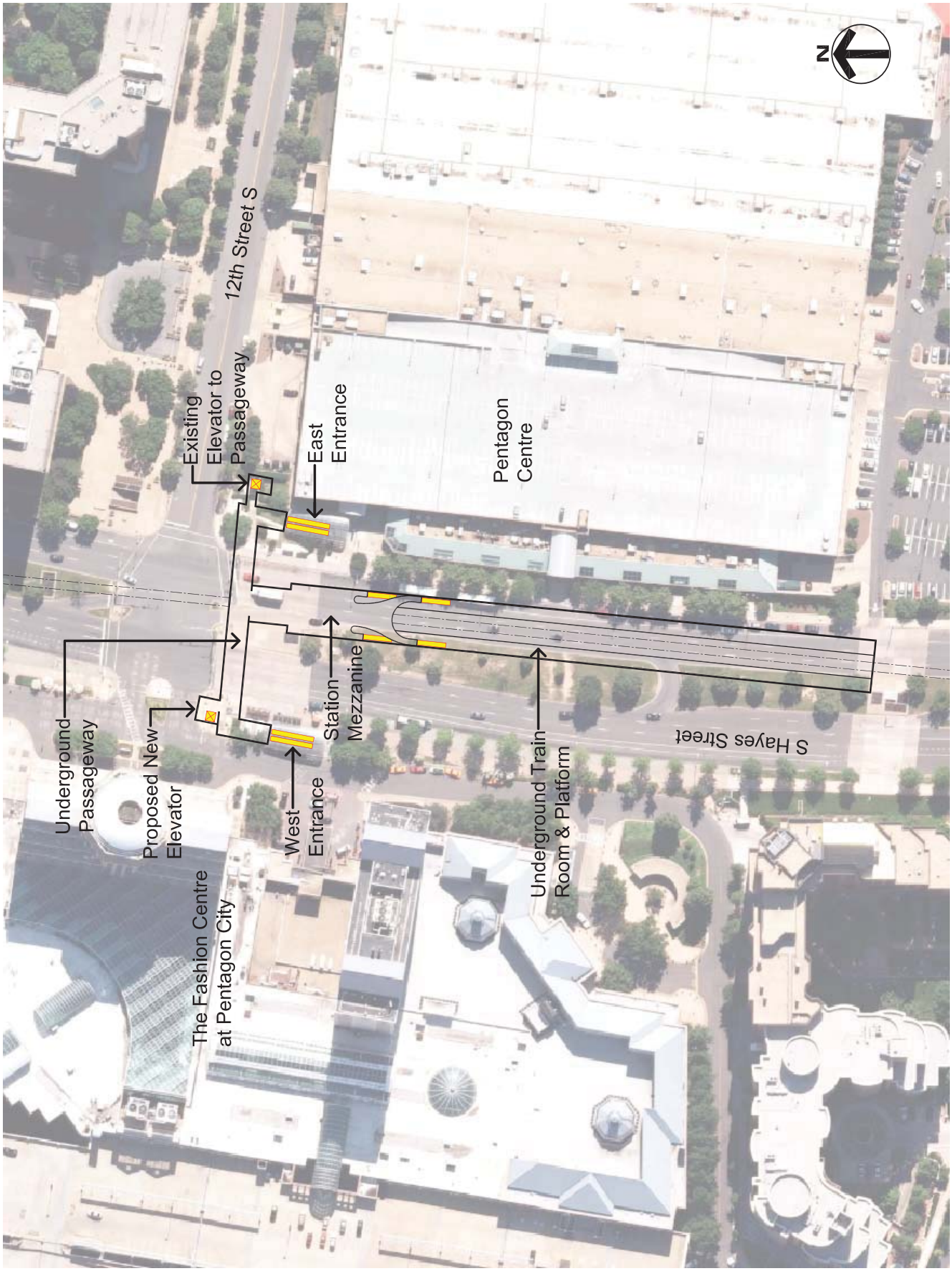
Station Access Point	Description
East Entrance	2-escalators and 1-elevator between passageway and street
West Entrance	2-escalators between passageway and street
Underground Passageway	Connecting east and west entrances to station mezzanine
Existing Tunnel (not open)	Tunnel connecting existing passageway to the corner of 12th and Hayes Streets

The Pentagon City Metrorail station currently handles approximately 36,000 combined daily entries and exits on an average weekday, second only to the Rosslyn Metrorail station of the Northern Virginia stations. In the AM peak period, there are 5,916 entries and 2,198 exits. In the PM peak period, there are 5,211 entries and 8,272 exits. This represents a 13 percent growth in ridership since 2006.

Pentagon City Station Mezzanine

Table 2: April 2010 Weekday Ridership

	Entry	Exit
AM Peak	5,916	2,198
AM Off-Peak	4,452	4,072
PM Peak	5,211	8,272
PM Off-Peak	2,645	3,229
Total	18,224	17,771



Scale: NTS

Figure 1: Pentagon City Station Aerial Plan

The vast majority of station passengers arrive on foot. The Metro 2007 Rail Passenger survey found that 59% of passengers access the station by walking in the AM peak period while the remaining passengers arrive by bus (24%), private automobile (13%), bike (2%), taxi (1%) and other (less than 1%). These percentages are based on survey data and are approximate.

According to the 2008 Metro Station Access and Capacity Study the ridership is forecasted to increase to approximately 37,000 combined daily entries and exits on an average weekday by 2030. Given the 2010 ridership is nearing the 2030 forecast indicates ridership is growing faster than anticipated.

Hayes and 12th Streets

Table 3: Pentagon City Mode of Access, 2007

Time Period	Walk	Bus	Auto	Bike	Taxi and Other
AM Peak Period	3,490	1,420	770	118	118
Percentage	59%	24%	13%	2%	2%

Source: Metro 2007 Metrorail Passenger Survey
Note: AM Peak Period from 5:30AM-9:00AM

New Elevator

Access Improvements

Current Metro design criteria require two elevators between all levels of a station to maintain access for passengers using a wheelchair or passengers with strollers and luggage in the event that one elevator is shut down for repairs or maintenance. This design criteria applies to new stations or existing stations undergoing major expansion.

Though the Pentagon City station does not meet this threshold for a second elevator between the passageway and street other important factors that need to be considered are passenger accessibility and convenience along with elevator maintenance and reliability. Additional elevator service would be more convenient for those passengers requiring an elevator particularly passengers accessing the station from the west. Today, those passengers must use the elevator on the east side of Hayes Street which requires crossing Hayes Street, a busy six-lane roadway, and backtracking through the passageway to the station entrance. This route could increase the passenger travel time several minutes in each direction.

In addition, elevators go out-of-service for scheduled maintenance and unscheduled repairs. Between August 2009 and 2010 there were 13 elevator outages resulting in approximately 24 out-of-service hours. Today, if the existing elevator is out-of-service passengers needing the elevator must travel to a nearby station where Metro provides shuttle bus service back to the Pentagon City station. This results in passengers being delayed in reaching their destination and increased Metro operating costs to provide this service. A second elevator would minimize the need for this shuttle bus service thereby reducing operating costs.

Occasionally, and without much warning the Pentagon closes the Pentagon Bus Facility. During these times, the bus service is relocated to Pentagon City greatly increasing the overall station demand including the elevator usage. A second elevator between the street and passageway would increase the overall access to the Pentagon City station and better accommodate these additional passengers.

Capacity and Demand

This study addressed the existing elevator capacity and demand. In general, the elevator capacity between the passageway and street at the Pentagon City station was not seen as an issue given the new elevator would serve an existing station entrance rather than a new entrance. To verify this assumption an elevator capacity analysis and site visit were conducted.

Existing Elevator and Vestibule

The elevator capacity analysis (See Appendix) shows that one new elevator would serve approximately 334 people in a 30-minute period based on the higher-speed, larger capacity traction elevator. A larger capacity hydraulic elevator would also serve the same number of people. However, the smaller existing hydraulic elevator only serves 224 people in a 30-minute period. The main advantages of a traction elevator are the higher-speed and the opportunity to locate the elevator equipment on top of the elevator head house.

Traction powered elevators can travel up to 400 feet per minute while hydraulic elevators travel 150 feet per minute. Hydraulic elevators are the existing Metro standard for locations with less than a 50-foot rise. This standard is based on economic and performance factors. The hydraulic elevator offers costs savings of approximately $100,000. In addition, the higher-speed benefit of the traction elevator is not fully realized for short vertical rises.

At the Pentagon City station the distance between the passageway and street is approximately 26-feet. Based on Metro standards a hydraulic elevator would be appropriate. At this distance the round trip travel time for the traction elevator would be 10 seconds less than the hydraulic elevator which represents less than 10% travel time savings.

A site visit was conducted in May 2010 during the PM peak half-hour period (5:00 PM - 5:30 PM) to assess the current elevator usage. Thirty-five people were observed using the elevator (twenty-five people entering and ten people exiting the station). Several people were in wheelchairs and others were pushing strollers. While these numbers represent a modest elevator demand these people clearly relied on the elevator to meet their access needs.

Existing Elevator and Headhouse

Based on the capacity of a new elevator and the existing demand one new elevator would be sufficient to accommodate the elevator demand. This new elevator would ensure elevator access at all times, accommodate the additional passengers during Pentagon Bus Facility closures and minimize the need for bus shuttles when the elevator is out-of-service.

Alternative Locations

The location of the new elevator is largely determined by the location of the existing passageway, particularly in the north/south direction since the elevator vestibule must align with the passageway either on the north or south side. Locating the new elevator on the north side of the passageway corresponds to the new elevator being in the general area of the pedestrian path for people crossing Hayes Street on the plaza. Locating the new elevator on the south side of the passageway provides the opportunity to shift the elevator closer to the escalator parapet on the plaza, outside of the main pedestrian path.

Alternative 1 considers one new elevator on the north side of the passageway. In general, this alternative would require:

- Cutting through the existing passageway wall
- Excavating for the new elevator shaft, elevator vestibule and elevator machine room
- Installing the elevator and associated equipment
- Installing the interior finishes for the elevator vestibule
- Repaving the sidewalk around the elevator on the plaza
- Relocating bicycle lockers and racks on the plaza

Location of Proposed Elevator Vestibule

Alternative 1 includes a separate machine room located adjacent to the new elevator at the passageway level. This configuration would be applicable for both the hydraulic and traction elevators. There are traction elevators that locate the elevator equipment on top of the elevator head house. These 'machine-room-less' elevators are more difficult to maintain due to the equipment location and space constraints. At Pentagon City a 'machine- room-less' traction elevator would require maintenance staging to occur on the plaza potentially impacting pedestrian flow. For these reasons, Metro's elevator maintenance staff prefers a separate machine room. Alternative 1 shows the machine room adjacent to the elevator on the passageway level, requiring 26-feet of excavation for this space; this represents a conservative approach. However, there is flexibility in locating the machine room and as the design advances other potential locations could be identified.

The elevator including the waiting areas shown in Alternative 1 would require approximately 200 square feet on the plaza and approximately 600 square feet for the elevator, associated mechanical room and vestibule on the passageway level.


Exiting Passageway


Existing Vendors on the Plaza


Train Control Equipment

Alternative 2 considers a new elevator on the south side of the passageway in existing Metro service rooms. This alternative would utilize existing space thereby requiring less excavation. However, it would require relocating train control and communications equipment. This equipment is vital to Metrorail operations, therefore a replacement location and equipment would have to be constructed, tested and operational before the existing systems could be demolished. The costs for reconstruction would be upwards of $15 Million. This estimate is largely based on costs for relocating the train control equipment at the Silver Spring Metro station in support of the new Transit Center currently under construction. This cost was considered prohibitive and as a result Alternative 2 was eliminated from further consideration.

Figure 3, 4 and 5 show the conceptual plans for Alternative 1.


Communications Equipment

Metro Service Room Hallway

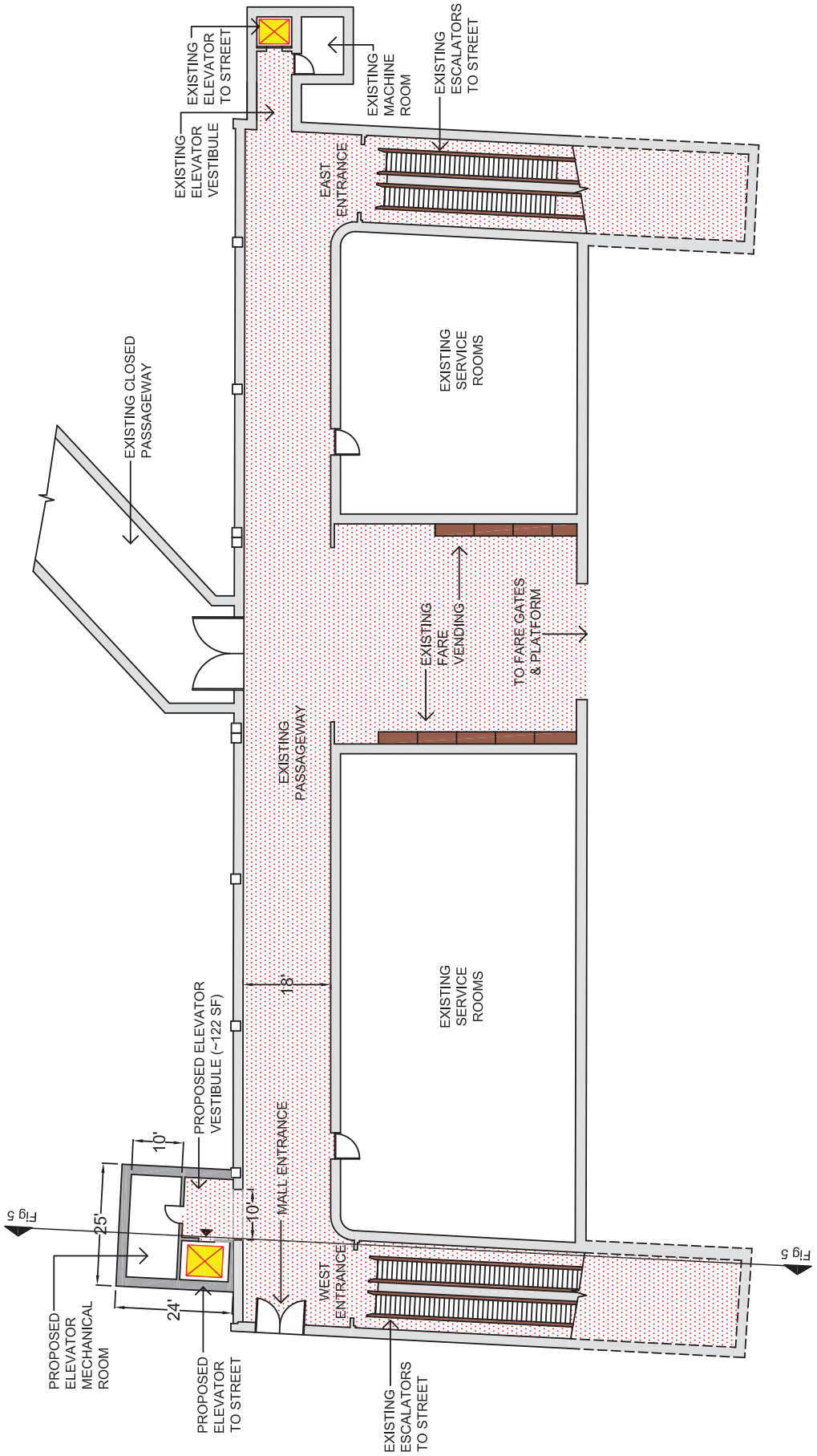


Figure 2: Existing Conditions - Passageway/Mezzanine Level

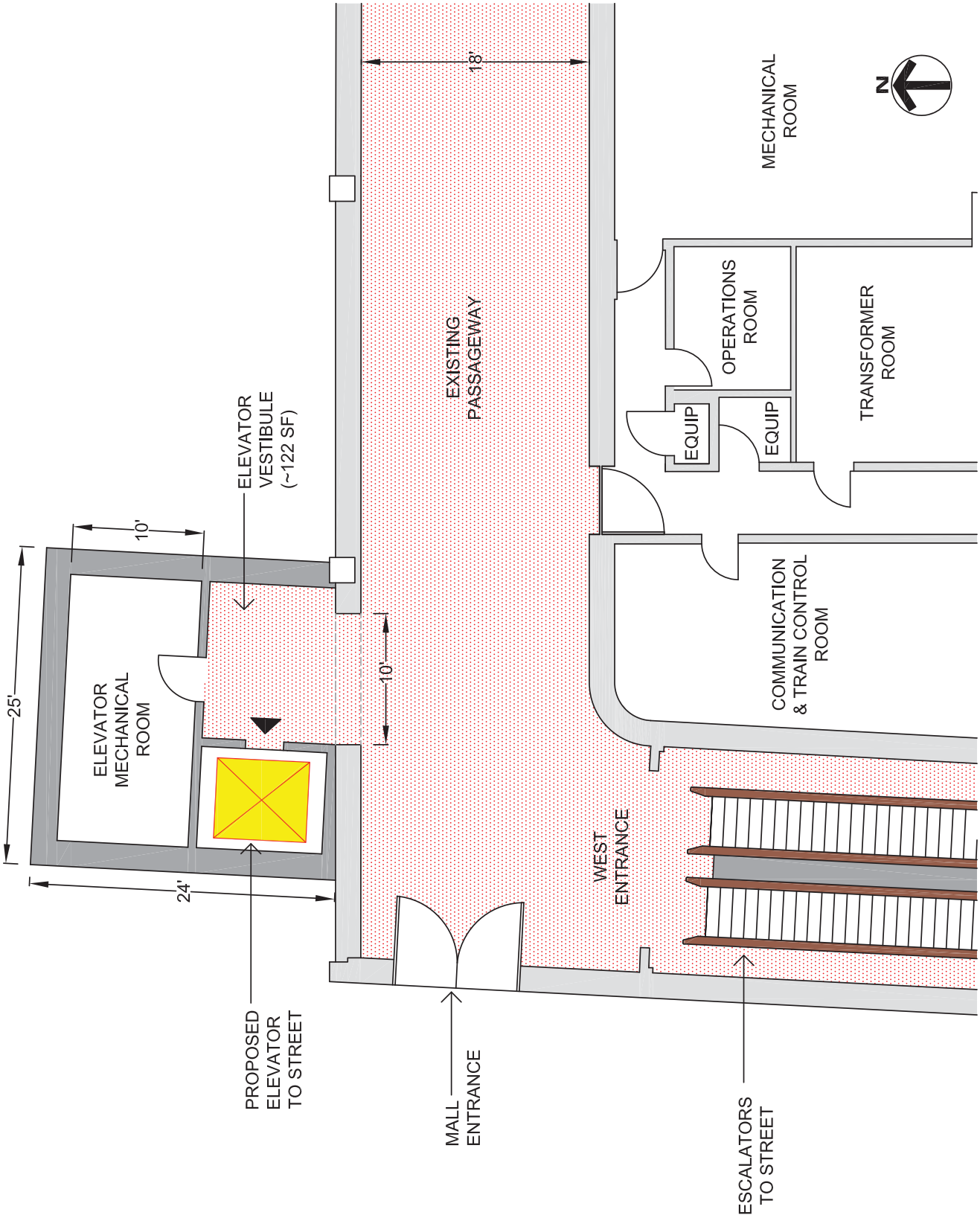


Figure 3: Proposed Elevator - Passageway/Mezzanine Level

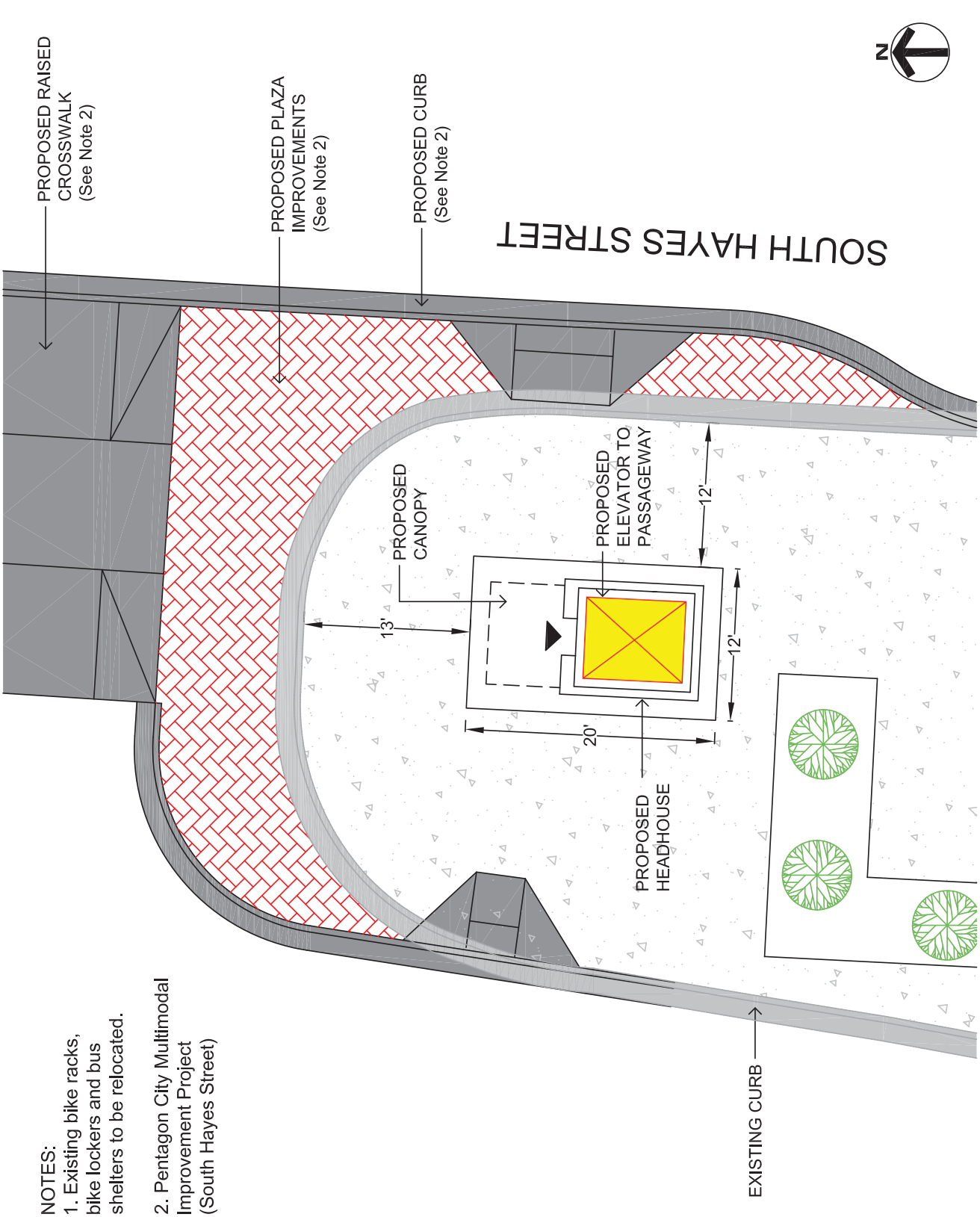
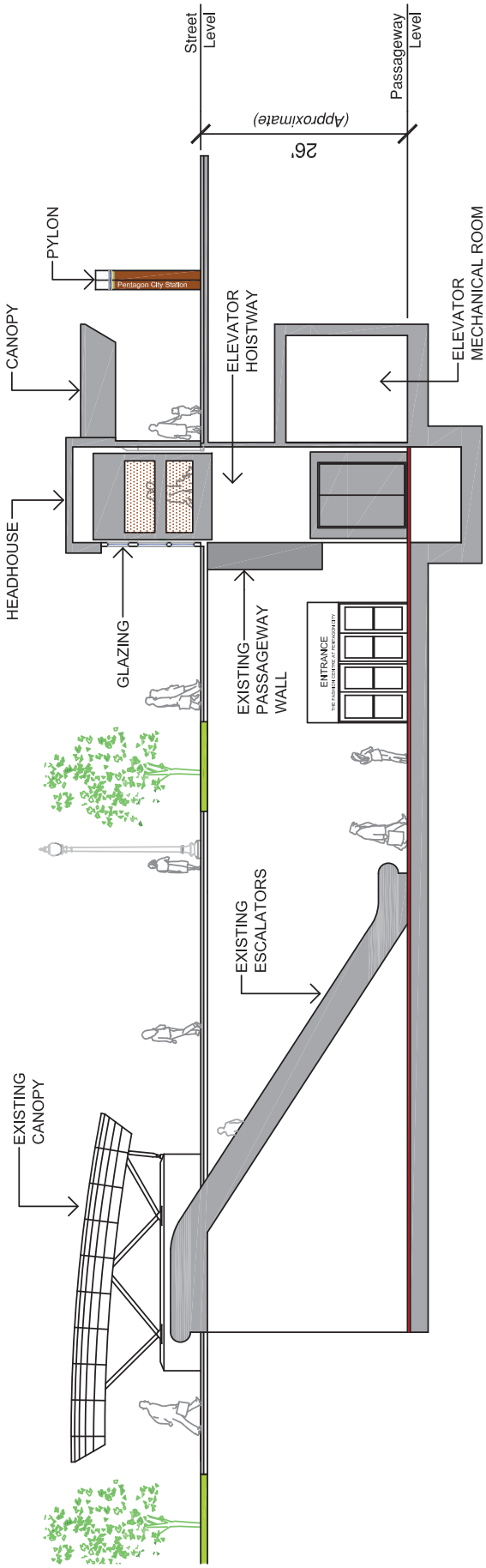


Figure 4: Proposed Elevator - Street Level



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Scale: NTS

Figure 5: Proposed Elevator - Section

Order of Magnitude Cost Estimates

The order of magnitude cost estimate for the new elevator between the passageway and street at the Pentagon City station is shown in Table 2. The total project cost is estimated to be $2.6 Million (2009 dollars) including both 'hard' construction costs and 'soft' costs (e.g. design and engineering, administration and insurance/bond costs). This estimate is only preliminary and includes many assumptions. The range of accuracy at this conceptual level is -10% to +40%. Factoring in this cost range, results in a total project cost between $2.3 - $3.6 Million (2009 dollars).

This estimate is based on a traction elevator with a separate machine room which represents the more conservative estimate.

Table 4: Order of Magnitude Cost Estimates

Element	Cost (FY09$)
Demolition and Excavation	$400,000
Elevator Shaft and Interior Build-out	$583,100
Elevator - High Speed Electric	$641,700
Communications System Integration	$87,400
Utility and Sitework at Street Level	$50,900
Labor Costs	$145,200
Total Hard Cost	$1,908,300
Soft Costs: Design/Engineering (10%); Project Administration (10%); Construction Support (10%); and Insurance/Bond (15%)	$667,905
Total	**$2,576,205**

Notes: A hydraulic elevator would result in cost savings on the order of $100,000.
The utility relocation estimate presents an allowance, not a detailed estimate.

Environmental Screening

This study assumes that Federal funds will be used to construct the new elevator at the Pentagon City station. Initially, it was anticipated that a documented Categorical Exclusion (CE) would be the appropriate level of NEPA analysis given no major impacts were anticipated. However, Arlington County has already received a CE from FTA for this project and no further environmental review is anticipated. The issue of whether a Metro Compact Public Hearing would be requireed was raised. Metro staff has confirmed that a Compact public hearing would be not required for a new elevator at the Pentagon City station.

Next Steps

The next steps involve initiating the design for the new elevator to a level appropriate for a design build contract and securing funding for construction of the new elevator.

Appendix

Elevator Capacity Analysis

	New Traction Elevator
Passengers Per Elevator Car (entering and exiting station, 15 each direction)	**30**
Passenger unloading top(sec)	15.75
Passenger loading top(sec)	15.75
Doors closing (sec)	2.50
Travel time (sec)	5.20
Leveling time (sec)	1.00
Doors opening (sec)	1.50
Passenger unloading bottom(sec)	15.75
Passenger loading bottom(sec)	15.75
Doors closing (sec)	2.50
Travel time (sec)	5.20
Leveling time (sec)	1.00
Doors opening (sec)	1.50
Round trip time =	83.40
Number of Elevators	**1**
Entering	
Passenger capacity per 30 minutes (entering)	324
Exiting	
Passenger capacity per 30 minutes (exiting)	324
Interval Between Elevators	**83.40**

	New Hydraulic Elevator
Passengers Per Elevator Car (entering and exiting station, 15 each direction)	**30**
Passenger unloading top(sec)	15.75
Passenger loading top(sec)	15.75
Doors closing (sec)	2.50
Travel time (sec)	10.40
Leveling time (sec)	1.00
Doors opening (sec)	1.50
Passenger unloading bottom(sec)	15.75
Passenger loading bottom(sec)	15.75
Doors closing (sec)	2.50
Travel time (sec)	10.40
Leveling time (sec)	1.00
Doors opening (sec)	1.50
Round trip time =	93.80
Number of Elevators	**1**
Entering	
Passenger capacity per 30 minutes (entering)	324
Exiting	
Passenger capacity per 30 minutes (exiting)	324
Interval Between Elevators	**93.80**

Appendix (Cont'd)

Capacity Assumptions

Traction Elevator (High-Speed)

Boarding/Alighting Per Passenger (sec)	1.05	
Doors closing (sec)	2.50	
Travel time (sec)	5.20	300 feet per minute for Traction (High-Speed). *
Levelling time (sec)	1.00	
Doors opening (sec)	1.50	
Doors closing (sec)	2.50	
Travel time (sec)	5.20	300 feet per minute for Traction (High-Speed).
Levelling time (sec)	1.00	
Doors opening (sec)	1.50	

Hydraulic Elevator (Lower-Speed)

Boarding/Alighting Per Passenger (sec)	1.05	
Doors closing (sec)	2.50	
Travel time (sec)	10.40	150 feet per minute for Hydraulic (Lower-Speed). *
Levelling time (sec)	1.00	
Doors opening (sec)	1.50	
Doors closing (sec)	2.50	
Travel time (sec)	10.40	150 feet per minute for Hydraulic (Lower-Speed).
Levelling time (sec)	1.00	
Doors opening (sec)	1.50	

* Based on WMATA Design Manual

Pentagon City Station 2030 Ridership Forecast	Half Hour Peak Ridership
AM	
Entries	1,088
Exits	424
PM	
Entries	904
Exits	1,402