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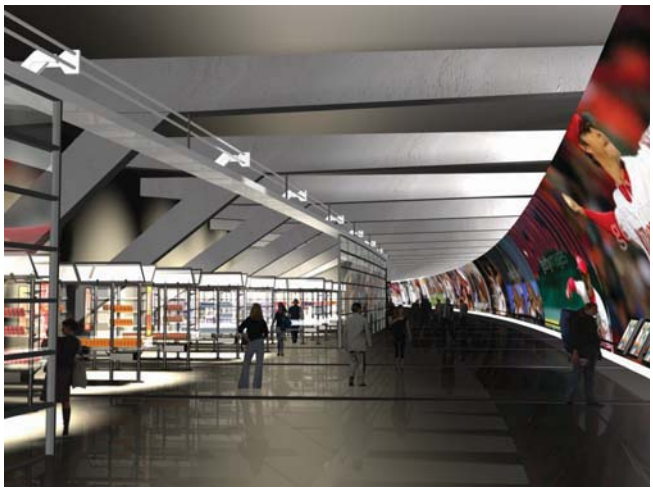

GALLERY PLACE / CHINATOWN - METRO CENTER PEDESTRIAN PASSAGEWAY TUNNEL STUDY

Prepared for

THE WMATA OFFICE OF PLANNING AND PROJECT DEVELOPMENT

July 2005

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I. Introduction and Description of Project

The Pedestrian Connection between Metro Center and Gallery Place is conceived as a free area (outside the paid area of the Metro System) that will connect not only these two Red Line Stations but also the Blue, Orange, Yellow and Green Lines that pass through these two stations. This connection will allow patrons to transfer between all these lines without having to wait for a red line train. This is especially beneficial when there are events at the MCI Center where patrons are headed to or from the Orange and Blue lines by eliminating the one stop ride on the Red Line. The connection is anticipated to carry approximately 12,000 patrons a day by 2030 with increases as ridership continues to grow.

The free tunnel concept assumes an adjustment to the fare card system that allows patrons to leave through one fare gate and enter another at the other end of the passage without being charged a fee.

The pedestrian tunnel connects the east mezzanine at Metro Center to the west mezzanine at Gallery Place. There is an intermediate stair connection to G Street with an entrance located under the arcade of the Martin Luther King Library. As part of this project a mezzanine to mezzanine bridge connection is proposed in Gallery Place Station to ease congestion on the Red Line Platforms for patrons walking from Gallery Place to Metro Center and vise-versa. When an event is taking place at MCI the Red Line Platforms become very crowded. The bridge over the platforms will prevent people pushing their way from one end of the station to the other to walk toward Metro Center. This bridge will help the pedestrian tunnel passage but is not essential to the construction of the tunnel.

The passageway and bridge are designed for ADA accessibility at both stations. New street elevators are added at Metro Center from the passageway to the north side of G Street, next to the escalators at the Grand Hyatt Hotel entrance and are located in the Washington Center Building. Elevators are also added from the same passageway to both Red Line platforms. The kiosk and fare gates are moved east to place the new platform elevators in the paid area. At the Gallery Place end of the passageway there are new street elevators located next to the 9th and G Street entrance. New mezzanine to platform elevators are added to each Red Line platform just inside the existing fare gates. The passage is basically level between the two stations but due to the structural depth of the slab over the existing tunnel the floor of the passageway will have a ramp at each end to adjust the structural levels. This change in level will meet ADA accessibility requirements.

All elevators are WMATA standard elevators except the two street elevators at 9th and G Street. These elevators meet ADA requirements but are minimal in size to accommodate the existing structure of the west entrance to the Smithsonian National Portrait and American Art Museums. This will require a variance from WMATA criteria for these two elevators to be built. One full size elevator can be used as alternative if required by WMATA.

Next to the elevator at 9th and G Streets is an emergency exit stair to the surface. The stair comes out a "pedestrian hatch" located in the sidewalk along 9th Street. This is a standard escape hatch used in many WMATA stations in the system.

There are station information panels toward each end of the tunnel to relate train arrival times, directions and other important information as you approach each station.

The pedestrian connection is examined as three alternatives: 1) pedestrian tunnel, 2) pedestrian tunnel with moving walkways in both directions and 3) pedestrian tunnel with commercial space. The three tunnel alternatives all connect with the existing stations using exactly the same configurations, only the tunnel sections change.

Prior to the final solutions, many options were studied including locations of entrance stairs, escalators and elevators. This was all part of the process to create the best and most cost effective solutions. The background and decision process will be discussed in Section IV.

II. Pedestrian Connection Alternatives

The final solutions have evolved with common elements in each alternative. The circulation elements and egress as well as the general architectural character are similar in all the alternatives, while only the tunnel section and service areas change.

The following outlines the connections at each station, the tunnel alternatives between the connections and the bridge options between the mezzanines at Gallery Place.

A. Connections at Metro Center

The tunnel connection at Metro Center is through the existing east passageway end-wall just beyond the connection to the Grand Hyatt Hotel and former Woodies Department Store. Due to a difference between passageway and mezzanine floor elevations, a sloped floor is required to accommodate the higher level of the passageway. These

floor elevations need to be determined exactly for final design. The tunnel connection has no direct impact on the station or its operation.

The elevators to the street are placed in the same lobby area being used for the escalator to the Grand Hyatt Hotel. An elevator machine room is located next to the elevators at the mezzanine level. This location will allow some flexibility for the exact location depending on the owners of the Washington Center Building. An optional location is on the south side of G Street in the Woodies Building.

Elevators from the Mezzanine to the Platform are placed in the existing service rooms. This will require some rearrangement but adequate space can be found within the existing service areas by moving the rest rooms and cleaner's room on the north east mezzanine as well as moving and replacing some mechanical equipment in all the other rooms. A new elevator machine room is located in this same area. See Mechanical Section for more details. The elevators will be entered from a new hallway at the mezzanine level and from a passageway thru the end-wall at platform level.

Modifications are needed to the fare gate arrangement to accommodate the new platform elevators. The kiosk and fare gates will be moved east out of the train room into the existing passageway. This will allow the new platform elevators to be inside the paid area and create more queuing space at the fare gates.

B. Connections at Gallery Place

The connection to the tunnel is through the west end wall of the station above the tracks and service rooms. The floor will slope to accommodate the higher level of the passageway due to the existing tunnel section below. The exact tunnel roof height must still be determined in relationship to the existing mezzanine. An extension to the mezzanine floor is required in the station room to connect to the new pedestrian passage.

The elevators to the street are placed next to the existing escalators in an area that has a WMATA easement just outside the Smithsonian American Art Museums and National Portrait Gallery on 9th Street. These elevators connect below grade to an enlarged passageway, through an existing service area, that connects to the existing west mezzanine at the same point where the escalators connect. Service rooms in this area will need to be modified to accommodate the passageway. The elevator machine room will be located on a second level. Due to the length of the connection to the elevators a new emergency stair will be placed next to the elevators that will lead up to

the elevator machine room on the second level and on to the street through a standard WMATA street emergency hatch. This stair contains an area of rescue for persons not able to climb the stairs. This new passage reflects the typical metro entrance passage with curved concrete base and bronze railings.

In the existing Gallery Place Station two new elevators are added, one to each platform, from the mezzanine paid area. These elevators would be built outside the station vault with openings punctured into the vault for access to the elevator cabs. These are small openings approximately the size of an elevator door, 3 feet by 7 feet at each level. The parapet and railings at the mezzanine and platform will need to be modified to allow access to the elevators. The elevator machine room is located at the mezzanine level, in the new pedestrian tunnel.

C. Pedestrian Tunnel Alternatives

The new pedestrian tunnel plan is not able to follow the simplest solution, which would be to remain on top of the existing train tunnel, due to the substation and the fan shaft both located over the tracks. For this reason the tunnel veers off to the south side of the tunnel. The simple tunnel, (1), and commercial tunnel, (3), follow a long shallow curve to keep sight lines as direct as possible. This shape provides visual connection from Metro Center or Gallery Place throughout the tunnel. The tunnel with moving walkway, (2), is straight due to the mechanics of the moving walkway.

All the tunnel alternatives follow the same general esthetic with concrete walls and concrete floors, a look that is different from the existing metro system. The intent is to create something that compliments Metro without copying its design. This passage is not part of the paid system and the design is meant to be different and to stimulate interest and activity. The concept is to make this feel like an interactive museum announcing events, shows and performances as well as selling tickets for many different venues around town.

The tunnel alternatives are all a simple concrete tunnel with beams and supporting concrete braces along the north wall that will reduce the overall span of the structure of the roof. These angled braces will be spaced at approximately 33’-4” feet on center. The width of the walkway in all cases is approximately 27 feet and the length of the new construction is approximately 710 feet long. At the Metro Center end of the tunnel there is an existing 191-foot passageway that will become part of this connection making the total length between stations approximately 840 feet. The ceiling is approximately 20 feet high for

the length of the new tunnel section except where an air duct crosses at the Gallery Place West Vent Shaft.

Lighting in the tunnel is meant to be “theatrical” with up and down lighting along the south wall where advertising, displays, murals and interactive displays will be placed the length of the tunnel. This wall will be protected by a railing, or shelf that is approximately 36 inches above the floor, which will be part of the exhibition/display area. The north wall will vary with each of the three tunnel schemes.

Mechanical ducts are located along the north wall as well as acoustic panels and down lights used to highlight specific areas. Behind several of the ceiling acoustic panels are the AC return grills that will be used as exhaust in emergencies.

1. Alternative 1 – Pedestrian Tunnel
   The simple tunnel shifts to the south side of the tunnel in the same shallow curve. At the Metro Center end the tunnel becomes wider as it moves east due to the structural limitations of building on top of the existing train tunnel. The foundation of the south wall is south of the existing train tunnel, while the north wall is located on top of the existing train tunnel wall. This space allows the Metro Center Ticket Office to be moved to this location. There will also be additional space for the ac mechanical room, electric room, storm water ejector room, storage, maintenance or other uses.

   The center section of this tunnel is located completely south of the existing train tunnel from the fan shaft to the substation but uses the south train tunnel wall as a foundation for the new north passage wall above. The area on top of the train tunnel in this area will have to be excavated to support the construction of the wall on top of the south train tunnel wall. This area will remain excavated and be used by WMATA maintenance. At the substation the existing south wall will be used as the new passage north wall and will need to be “finished” with concrete or plaster depending on existing conditions. A new wall will have to be built along portions of the substation, which is open to the vent shaft at this time.

   At the east end of the tunnel the space again becomes large due to the train tunnel below. Service rooms will be located in this area including an elevator machine room, an ac mechanical room and an electrical room.

2. Alternative 2 – Pedestrian Tunnel with Moving Walkway

This tunnel is similar to Alternative 1 but is straight with a central jog and has a bigger section and two moving walkways, one in each direction. This tunnel needs to be in straight sections due to the moving walkway. The jog in the middle is located where the stair to G Street provides a new entrance into the tunnel. People will be able to access the moving walkways in either direction from this point. The moving walkway stops before Gallery Place Station due to the existing vent shaft. There is not enough clearance to go past this point in the tunnel.

The tunnel is 39 feet wide with 2 walkways, which are 12 feet. The walkways are both located on the south side of the tunnel. This is required to allow room for the mechanical operation that needs approximately 3 feet below the walking surface. There is no room in the middle of the tunnel due to the roof of the existing train tunnel below.

AC air ducts, lighting and general esthetics are similar to Alternative 1. Additional lighting is required in the ceiling due to the extra width of the tunnel.

3. Alternative 3 – Pedestrian Tunnel with Commercial Space

The Commercial tunnel is similar to the other alternatives and takes the shape of the shallow curve. At the Metro Center end of the tunnel the commercial space begins along the north wall and becomes larger as the walkway curves away from the train tunnel below. This area can be used for carts, displays or small shops (possibly set up by the museums, theaters, sporting arenas) that would be oriented toward activities in the city. Once the tunnel has become approximately 50 feet wide an area is reserved for venders with tickets for concerts, plays, sporting events, museums, and other activities in the DC area. Just past this area is the G Street Stair leading to the Martin Luther King Library arcade. Beyond the existing fan shaft the west ac mechanical and electrical rooms are located along with the Metro offices and ticket area. Adjacent to this is the Metro Museum. (A similar museum has just opened in New York for the MTA.) The museum is a space that can display the construction methods and technology of the stations, lines and systems. There are fantastic construction photos, equipment (part of the mol) and even formwork that could be displayed in this area. This space would also be used as a Metro Museum shop with maps, hats, model trains, T-shirts, etc. Next to this are the east ac mechanical and electrical rooms.

Moving toward Gallery Place, the wall of the existing substation that was open prior to the pedestrian tunnel might be glazed to allow views into the room that powers the system and give the public a view of the internal engineering of the train system. A large "train board" could be mounted that would locate the trains as they travel throughout the system with colored lights indicating each train line.

Beyond this point the tunnel becomes lower where an existing mechanical duct passes over the pedestrian tunnel. The employee restrooms and cleaner's room are located on the north side of the passage. Once past this point the tunnel opens into a large room with retail along the north wall. This space is visible when coming from the 9th and G Streets entrance.

The commercial tunnel is similar to Alternatives 1 and 2 with concrete walls and ceiling. The north wall is generally behind an enclosure wall of glass and steel. This wall, which almost completely opens during hours of operation, separates the passage from the commercial, ticket and museum spaces.

The commercial space will have floating acoustic panels hung from the ceiling with lighting directed toward displays. Mechanical ducts will be worked into the panels and the main duct will float near the dividing wall to supply both the commercial areas and the passage.

The walls behind the commercial will have advertising and displays that will work in a system with lighting provided from the ceiling above or from back lit panels.

Commercial vending carts will be used in the space just east of Metro center. The size of the vending carts may vary, but the general space allowed is 10 feet by 16 feet. These spaces will be arranged in the commercial area and each location will be provided with power and communication connections.

D. Bridge Connections Between Mezzanines at Gallery Place Station

The pedestrian bridge between mezzanines is designed to relieve pedestrian congestion along the Red Line Platforms in Gallery Place Station specifically before and after an event at the MCI arena. This bridge will allow free flow from MCI through Gallery Place Station to Metro Center and vise versa. The new Pedestrian Tunnel can be an independent project from the Pedestrian Bridge.

Safety on the bridge is a concern for patrons in the station but the existing mezzanines in the stations present the same set of potential

hazards. The railings and floor materials will all meet code and safety standards to minimize any risk to patrons.

The bridge spans approximately 450 feet between mezzanines. Due to the continuous operation of the Red Line, the bridge components will be prefab as much as possible and brought in on a work train. This includes floor panels, columns, brackets, cables, etc. The only major work in the station will be the foundations for the central column scheme and the installation of cables and supports in the other schemes.

Due to the height of the bridge in the station air conditioning is required to keep patrons cool and to circulate air in this area. All the schemes will affect the lighting of the station and additional fixtures will be required.

To keep the open feeling of the stations the railings will be glass (possibly metal mess) with a bronze railing on top to match the others in the station. This will allow maximum views and light penetration between spaces. The floor is meant to be as light as possible and allow light to penetrate. For this reason, the floor will be frosted structural glass panels set into steel frames that are prefabricated for installation.

There are four structural options each with advantages and disadvantages. They all function exactly the same way, but the structure, air conditioning and lighting vary.

1. <u>Option 1 (Recommended) – Center Bridge with Diagonal Columns</u>
   This bridge is supported from the center of the tracks with diagonal columns spaced at 50 feet on center. Foundation work for these columns will need to take place during non-revenue hours and will affect the central lighting in the station. The bridge structure is also steel and fabricated in sections that can be assembled in the station.

   All the central bridge schemes will have two oval tubes hanging over the edge of the bridge, which will contain a chilled water line for AC and a continuous air duct diffuser with continuous fluorescent lighting on the top shining up into the vault.

   Air conditioning will be furnished by installing fan coil units in coffers every 25 feet located above the bridge. The chilled water pipe will be routed through one hanging tube and air will be supplied through the other tube in an alternating pattern every 25 feet.

2. Option 2 – Center Bridge with Hangers
   To help eliminate major work in the center of the tracks, a hanging scheme was developed where a hole would be drilled though the upper vault ribs (behind the acoustical panels), that would allow cables to be hung from each side of the rib. These would connect to steel outriggers along the bridge every 25 feet. These connections correspond to the fan coil connections.

   The only work required to take place in the station prior to assembling the system would be to drill the holes through the ribs in the vault and mount a bracket between the tracks used to secure a tie rod every 25' that will stabilize the bridge. The construction method is very simple in this case with very little work required between the tracks.

3. Option 3 – Center Bridge Hung from Arched Frame
   In this case the concept is to hang the bridge from a frame placed inside the vault which is only attached to the vault at the lowest point on the outside of the platform parapet. Again a prefabricated "arched ring" would be brought into the station and assembled along with the cables, hangers and bridge structure during non-revenue hours.

   Lighting and air-conditioning are provided by the same method as in Alternative 1.

4. Option 4 – Side Bridges with Corbels and Hangers

   To eliminate all conflict with the train operation and lower the impact on the station lighting the side bridges were studied. In this case the bridges are supported from a corbel attached to the vault along the side every 25 feet, (similar to the central mezzanine at Farragut North). To help stabilize the bridges hangers are installed every 25 feet at the outer edge over the platform. At the east mezzanine the bridges come directly off the mezzanine while on the west mezzanine the bridge begins just outside the escalators and curves toward the wall to align with the platform below.

   In this case the air-conditioning fan coil units are set in a coffer on the side of the bridge and the chilled water lines at the edge of the bridge structure near the vault. The fan coil units would blow directly onto the walkway without ductwork. Lighting would be added to the vault side of the bridge on an outrigger to allow up-light on the vault similar to the parapet lighting along the parapet

over the Green and Yellow Lines at the lower east end of the station.

5. Option 5 – Center Bridge with Columns

   As a base line solution that would match the construction of the existing mezzanines, the simple center column bridge was studied. In this case there are concrete columns every 25 feet with a concrete bridge on top. To soften the impact a glass railing is used which will allow light and views to continue through to the vault. The air-conditioning and lighting will be the same as in Option 1.

   The amount of work between the tracks is greatest in this scheme due to the number of columns required to support the structure. This work will have to be preformed during non revenue hours, which will limit the available time to work.

III. Codes and Data

The Codes that were analyzed included NFPA 130, (Appendix D) and the District of Columbia International Building Code, 2000 edition. Once the decisions were made about the alternatives it was determined that NFPA 130 would apply to the pedestrian tunnel in all cases and not the International Building Code. This was determined due to the use of the tunnel as a passage between the stations. Even in the case of the commercial in the tunnel, the amount of commercial and the nature of the commercial is allowed in the NFPA regulations. This tunnel is part of the Metro System and is not considered to fall into another use category.

The additional stair entrance along G Street improves egress from both stations and conforms to NFPA regulations. The emergency stair added also improves egress and provides an exit from an otherwise “dead end corridor”. This stair is 48 inches wide as prescribed in the WMATA criteria. The minimum size for NFPA 130 is 44 inches. This stair width works with the standard WMATA surface emergency hatch that is provided in the sidewalk.

IV. Background Analysis and Decision Process

A. Initial scope and alternatives

Due to the configuration of the existing sub-station and fan vent shaft and the buildings along G Street the decision was easily made to move the pedestrian tunnel to the south side of the existing train tunnel. A discussion took place with all the engineering consultants considering alternatives that would move these service areas but cost

and continued train operation made any alteration very impractical. The decision was made that tunnel would follow along the existing train tunnel as much as possible and shift to the south to avoid the service rooms. The end walls of the east Metro Center Passageway and the west Gallery Place Mezzanine made the shortest connections for the tunnel and the easiest method for construction.

The alternative with the moving walkway required mechanical space below the floor so this scheme starts south with the existing tunnel to allow room for the mechanical equipment. There were no other choices.

Several tunnel options were studied with jogs, angles and curves but the gradual curve was selected for the best site lines between the stations and the simple esthetics of the tunnel.

The “free tunnel” verses the “paid tunnel” was discussed. Due to the existing entrances to the Hyatt Hotel, Woodies and other proposed entrances and knockout panels the decision was to make the tunnel a “free tunnel”, outside the Metro Paid Area, to make allowances for these access points. If the tunnel had been a “paid tunnel” each of these entrances would require fare gates and possibly a kiosk, which made that solution impractical.

The general tunnel shape and “free tunnel” decision was agreed to by representatives of WMATA, the consultants, NCPC, Office of Planning, DDOT and the Commission of Fine Arts.

B. Entrances to the tunnel

Many entrance options were examined to determine exactly where new escalator, stair and elevator entrances would work best. All options were placed in the 1st discussions which took place with representatives of WMATA, the consultants, NCPC, Office of Planning, DDOT and the Commission of Fine Arts and SHPO.

The stair/escalator options included new entrances at the northeast corner of 10th and G Streets, entrances on the north and south side of the center of the 900 block of G Street, the northeast corner of 9th and G Streets. All these entrances had options of stairs and escalators.

The decision was made to only create one new entrance from the tunnel to the street. This entrance would be located central to the tunnel and come to the street level under the arcade of the Martin Luther King Library at the west end of the building. This was the least intrusive entrance and would not require a canopy. The decision was

made to use stairs only to eliminate the escalator problem and to create maximum exiting capacity under the NFPA 130 guidelines.

Knock out panels were discussed and located at both the north and south side of 10th Street. The north knockout panel would serve a connection to future development at the old Convention Center Site and the south knockout panel would serve a connection to development along F Street. Another panel is located between the YWCA Building and the Mather Condo Building where a current air-conditioning unit is located for the YMCA. This might lead to new development along F Street.

Elevators placed near existing station entrances were considered necessary design features. Elevators coinciding with main station entrances enable passengers who require elevator access to readily find and use the elevators. At the Metro Center end of the tunnel it was agreed that elevators located in the Washington Center Building were the most desirable and least intrusive in the surrounding context. If this location were not accepted, the Woodies building across the street would be examined.

At the Gallery Place end of the tunnel every corner was discussed for the elevator entrance. The public sidewalk areas on all four corners were considered too narrow to house the elevator head-house. The YWCA corner was the most desirable from an aesthetic and tunnel convenience viewpoint, but the building configuration with low floors and the lobby on the corner did not allow easy installation of the elevators. Elevators were discussed at the Martin Luther King Library but CFA, NCPC and SHPO did not want elevators in front of this historic building. The PEPCO building plaza was discussed but the newly designed plaza and restaurant would have been greatly altered to allow the elevators to be placed in this location. Also a long curved tunnel would have been required underground to access this location. . A mid tunnel solution was considered with the elevators located just west of the Martin Luther King Library in the same passageway as the new stair entrance. The problem with the elevators located in this position was the distance from WMATA personnel if someone was caught in the elevator and for general safety of the patrons. The final solution was elevators located adjacent to the existing escalator at the Smithsonian site.

All these options are shown on drawing A-2 and in the appendix drawings. These decisions were made with the help of all the advisors and the staff of the Smithsonian who preferred the elevators as close to their building as possible to help their goal of increasing patrons to the museums.

V. STRUCTURAL FEATURES

A. Modification of Metro Center Station East Entrance and Ancillary Area

Minimal modification will be required within the platform area inside the Metro Center Station for the three alternatives. The existing kiosk and fare gates at the mezzanine level at the east end of the station will be relocated eastward to the existing passageway. The removal of the existing kiosk and fare gates will have minimal impact on the 1'-8½" deep reinforced concrete mezzanine slab. The proposed kiosk and fare gates will be constructed on the 1'-10½" concrete slab at the existing east passageway.

Two proposed elevators from the platform level to the mezzanine level would be constructed on each side of the existing east service room near the proposed fare gate area. Openings will be provided at the 1'-6" mezzanine slab for the elevators. Edge beams will be constructed around the opening for the elevators. Openings at the station end wall will be constructed to provide access from the station platform to the proposed elevators. The construction will be performed inside the service rooms, the work area will be enclosed to control dust from the construction activities.

Two elevators from the mezzanine level to the Washington Center Building lobby will be furnished at the northeast corner of the ancillary area near the existing escalator. A machine room may be constructed at the mezzanine level. Openings will be constructed at the existing building for the elevators and edge beams will be constructed around all openings. The existing building will be monitored for any movement for the entire duration of construction.

B. Modification of Gallery Place - Chinatown Station West Entrance and West Mezzanine

Proposed elevators will be provided at both platforms of the station to mezzanine level at approximately 60 feet from 2'-0" thick west end wall of the station. The openings for the elevator doors will be located between the vault ribs to minimize the impact to the existing concrete vault. The proposed shafts will consist of thick and heavily reinforced concrete walls and slabs. The shaft walls will extend from the top of the station vault to the invert slab. The shaft will provide additional structural strength for the existing vault with elevator openings. The construction of the elevator shafts will be performed from the street level at the intersection of G Street and 9th Street. Temporary support of the excavation such as soldier piles and lagging will be used. Based on existing available soil boring information, the water table appears to be around 15 feet below ground, dewatering may be required during construction. Openings will be provided at both the platform level and

mezzanine level for the elevators. The elevator openings will be constructed inside the station, the work area will be enclosed to control dust from the construction activities. Displacement of the existing vault will be monitored for the duration of the construction to ensure the safety of the structure.

Two proposed elevators from the street level to the mezzanine will be constructed at the southwest corner of the station adjacent to the Smithsonian National Portrait Gallery and American Art Museums near the existing escalator. The area adjacent to the existing service rooms will be modified at the mezzanine level to provide access to the elevators. A proposed passageway will be built leading to the proposed elevator lobby at the mezzanine level. An emergency stair will be built adjacent to the proposed elevators at 9th Street sidewalk. Additional beams and walls will be constructed to support the shafts. It appears that the room extension and the elevator shaft foundation will be spread footing. The construction will be performed at the 9th Street sidewalk on the street level. The water table appears to be around 18 feet below ground, dewatering may be required. Portion of the Portrait Gallery Museum below grade may be exposed during the construction of elevator shaft. The adjacent museum building will be braced and monitored during construction to ensure the safety of the structure. Portion of the 9th Street sidewalk will be closed to pedestrian traffic for the duration of the construction.

C. Pedestrian Bridge Between Mezzanines – Gallery Place-Chinatown Station

A proposed pedestrian passageway will be constructed connecting the mezzanines at both sides of the station. The following options of passageway supporting schemes have been considered:

1. Option 1 - Center Bridge with Diagonal Columns

   The 16’ wide center bridge with frosted structural glass floor would be supported on steel beams with diagonal columns spaced at 50 feet along the center of the vault. The columns, either structural steel with precast concrete cladding or precast concrete, will be constructed along the existing lighting trough between the third rails along the station. The construction will be performed during non-revenue hours and portion of the existing central lighting inside the trough will be removed. The proposed for the support of ventilation and lighting system above the bridge will be hung from the ribs of the vault near the crown of the vault.

2. Option 2 - Center Bridge with Hangers

   The 16’ wide center bridge with frosted structural glass floor supported on steel beams will be hung from the 2’-0” wide upper vault concrete ribs.

Holes will be drilled through the ribs between the #11 reinforcing bars to connect the hangers. The hangers will support the steel beam at approximately 25 feet along the vault.

3. Option 3 - Center Bridge Hung from Arched Frame

   Structural steel arch rings connecting to the vault wall behind the existing platform parapet will be constructed along the vault. The bridge will be hung similar to Option 2 but from the arch rings instead of the vault ribs.

4. Option 4 - Side Bridge with Corbels and Hangers

   Two 13' wide side bridges will be constructed above the existing platforms. The bridges will be supported on corbels spaced at 25' on one side of the bridge and with hangers hung from the vault ribs on the other.

The four options were investigated and it was concluded that option 1, consisting of a center bridge with diagonal columns, is recommended.

D. Pedestrian Passageway between Stations

Three (3) different passageway alternatives are presented in this report. Alternative 1 has a pedestrian walkway connecting the stations. Alternative 2 has a passageway and a moving walkway at the south side of the passageway. Alternative 3 has passageway with commercial space option at the north sides of the walkway.

The passageway for all three alternatives will be connecting the east entrance and ancillary area of the Metro Center Station to the west entrance of the Gallery Place Station.

The proposed pedestrian passageway in general will be constructed above the existing Red Line concrete box structure along G Street, cut-and-cover type of construction method is recommended. Temporary support of the excavation such as soldier piles and lagging or slurry walls may be used. G Street will be closed to traffic for the duration of the passageway construction. Concrete or timber decking can be utilized at the G Street and 9th Street intersection to minimize the impact to the 9th Street traffic during construction of the passageway. Pedestrian traffic on the sidewalks along the G Street will be maintained during construction.

Based on existing available soil boring information, the water table varies from fifteen to thirty feet below grade. Dewatering may be required during construction. Underpinning of adjacent buildings may be required due to the close proximity of construction to the adjacent buildings. Possible

displacement of the adjacent buildings should be monitored for the entire duration of construction.

The soil around the invert slab of the passageway is mainly silty clay with blow count of less than ten blows per foot. It is recommended that the south side of proposed passageway to be supported by 10 to 15 feet of drill shafts.

Alternative 1 – Pedestrian Tunnel

The north wall of the proposed structure will rest on exterior north wall of the existing structure while the south wall of the structure will be a curved wall as shown in Figure A-02. The horizontal clearance of the proposed structure is approximately 33 feet at the east end wall of the Metro Center station. The 2'-3" minimum thick existing reinforced concrete top slab will serve as the bottom slab of the proposed passageway. The 2'-0" thick existing exterior concrete walls will be extended to become the proposed exterior wall with pilaster of the passageway. A concrete top slab with beams and diagonal bracings at 25 feet spacing designed to support soil load and live load will be constructed connecting the two proposed exterior walls.

The proposed tunnel will become wider as it is further east from the Metro Center Station. The southern portion of the proposed passageway will overhang from the existing vertical wall below. As the width of the tunnel becomes larger, drilled shafts will be constructed to support portion of proposed box structure. Knockout panel will be constructed the proposed walls below 10th Street for potential future connection.

The existing fan shaft will remain in place. The north wall of the proposed tunnel will connect to the existing fan shaft walls. The proposed south tunnel curved wall will be supported on drill shafts. An egress stair will be constructed at the north tunnel wall west of the fan shaft, the construction will be performed on the G Street sidewalk.

The proposed passageway structure will continue to be above the existing structure. The north wall of proposed tunnel will be on the top of the existing north wall. The south wall of the tunnel will be supported on drill shafts.

The northern part of the substation will remain in place and portion of the existing south wall at the substation will be demolished to provide room for the passageway. The interim columns in the substation will remain in place. The passageway will be extended to the Gallery Place Station as shown on Figure A-02.

Alternative 2 – Pedestrian Tunnel with Moving Walkway

The primary difference between Alternative 1 and Alternative 2 is the moving walkway at the south side of the passageway for Alternative 2. The south wall of the proposed tunnel will be straight to accommodate the moving walkways.

The north wall of the proposed tunnel will rest on exterior north wall of the existing structure while the south wall of the proposed structure will be a straight wall at the south side of the existing structure as shown in Figure A-03. The southern portion of the bottom slab will be approximately three (3) feet lower than the northern portion of the slab to support the moving walkway mechanical operation.

The proposed tunnel will become wider at the existing fan shaft. The proposed passageway will be on the south side of the existing structure. The north portion of the passageway will support regular pedestrian live load while the south side of the tunnel will support the moving walkway and pedestrian. The east end of the tunnel will be wider in this alternative and modification will be made at the existing service room at the west entrance of the Gallery Place Station. The south wall of the tunnel will mainly be supported on drill shafts.

Alternative 3 – Pedestrian Tunnel with Commercial Space

The proposed structure configuration for Alternative 3 as shown in Figure A-04 is similar to the structure for Alternative 1. The north wall of the proposed tunnel will connect to the north wall of the existing structure. Top slab will be constructed on reinforced concrete beam to form a tee-beam to reduce the slab thickness. The proposed south wall will be curved and will be supported on drilled shafts.

VI. UTILITIES

There are a number of public/private utilities in the study area that must be dealt with during the construction of any pedestrian passageway tunnel alternative. Based on the available utility record, these utilities are shown on the Utility Plans. The smaller lines can be temporarily relocated to the sides of the tunnel during construction:

A. Gas

There are two 12” diameter gas lines that run along 9th Street, both within 8’ of the west curb line. Another 8” diameter gas line runs along 9th Street approximately 24’ from the east curb and turns west, 31.5’ north of the south curb line on G Street and continues to the west of 11th Street. Running parallel to this gas line is a 8” diameter gas line that tees off of one of the 9th street gas lines and runs west, 2’ north of the south curb line, then turns southwest and runs under the south sidewalk area thru the 10th Street

intersection before turning back under the roadway close to the south curb line until it turns south at the 11th Street intersection. A 6" diameter gas line runs along 10th Street near the centerline and becomes 4" thru the G Street intersection. A 3rd gas line runs along G Street 5' south of the north curb line and turns northward at the 11th Street intersection. There are additional lines running under the roadway along 11th Street but should be clear of any future construction. All other lines mentioned will need to be supported or relocated during construction depending on the final design. There are a number of abandoned (or remnants of) gas lines, primarily along G Street between 9th and 10th Streets that may be removed.

B. Electric

There are 2 underground Pepco power distribution lines that run under G Street between 9th and 10th Street approximately 15' apart and feed the street light system. A single line runs between 10th and 11th Street and beyond. Just prior to 11th Street it splits off 2 additional lines that continue north and south under 11th Street. The lines below G Street and additional lines running under 9th and 10th Street will be directly impacted by the tunnel construction and will have to be supported or relocated during construction depending on the final design. The Pepco power distribution lines that run along 11th may be affected by the tunnel construction depending on final design details. There are additional electric lines under the sidewalk areas north of G Street that may remain in place. Overhead electric lines exist but only between 2 poles at the northwest corner of 11th and G Streets.

C. Sanitary Sewer/Stormdrain

There is a 54" diameter stormdrain pipe that runs under 9th Street approximately 24' west of the east curb line and becomes 48" above G Street and 5' x 4'9" below G Street. From this main, an 18" diameter storm drain line tees off and runs under G Street, approximately 24' north of the south curb line, ending at a manhole about halfway to 10th Street. A 12" diameter sanitary sewer line crosses diagonally across the roadway in the same area and becomes 24" as it turns and runs parallel under the curb-line and sidewalk area then continues down 9th Street. A 2' x 3' box stormdrain pipe runs under 10th Street approximately 18' west of the east curb line. These lines will not clear the proposed tunnel and will have to be relocated to the side of any future pedestrian tunnel alternative. A 36" diameter storm drain line runs under 11th Street approximately 12' west of the east curb line and becomes 18" north of G Street. This line may not be affected during construction.

D. Water

There is a 16" diameter water main that runs along 9th and a 12" diameter water main that runs along 10th and 11th Streets. The 11th Street line may be unaffected by the construction because it is above the existing Metro Center Station area but the 9th and 10th Street lines will cross the proposed

pedestrian tunnel and will have to be supported during construction if they clear the tunnel limits. Along G Street, there is a 12"diameter water main that tees off of the 9th Street line and runs under the south sidewalk, then turns northwest and continues parallel just inside of the south curb-line past 11th Street. An 8" diameter water main tees off of the 10th Street line and runs just inside of the north curb line. It crosses 11th Street and continues running under G Street. These lines will need to be supported or relocated during construction depending on the final design. There are a number of abandoned (or remnants of) water lines, primarily along G Street that may be removed.

E. Other Utilities

There may be some fiber optic communication, underground cable TV and telephone lines that will require relocation during the future pedestrian tunnel construction. The Fiber optic lines run primarily along 9th Street.

VII. MECHANICAL FEATURES

A. General Mechanical Issues Common to All Alternatives

1. Passageway Air Conditioning

   All three passageway alternatives will be air conditioned. Heating is typically not provided for WMATA station public areas and will be used only for Passageway Alternative three where the potential exists for people to spent significant amounts of time in the passageway. However, sufficient electrical capacity will be provided to allow for future addition of heating for the non commercial alternatives in the event that experience shows that it is required. Options for a suitable air conditioning system consist of the following:

   - An air conditioning system utilizing the existing station chilled water systems. The components involved would consist of the additional chilled water piping, air handling units and/or fan coil units. Unless the capacity of the chiller plants serving Gallery Place and Metro Center station were increased, this option would divert chilled water from the stations into the passageway and would result in a loss cooling capacity in each of the stations. Maintaining the current station chilled water capacity would require an upgrade to the Jackson Graham Building (JGB) chiller plant that serves Gallery Place Station and the chiller plant that serves Metro Center station. In addition to Gallery Place, the JGB chiller plant also serves Judiciary Square and Archives stations. The Metro Center chiller plant serves Federal Triangle and Smithsonian stations.
   - An air conditioning system utilizing chilled water provided by a dedicated air-cooled liquid chiller. This system would be sized to

provide the required cooling for the passageway and would operate independently of the station chilled water systems. The components involved would consist of the chiller, associated chilled water piping, chilled water pump and fan coil units spaced throughout the passageway. The air cooled chiller would preferably be located on the roof of a nearby building. In addition, mounting a chiller on a building roof would also require a pipe chase within the building for routing chilled supply and return piping. While it is possible to mount a chiller in an open areaway, this option would complicate maintenance and could also adversely impact performance as a result of short circuiting of condenser intake and discharge air.

- An air conditioning system utilizing a split system type air conditioner that consists of a fan coil unit and a remotely located condensing unit. Air distribution would utilize supply and return air ductwork routed through the length of the passageway. As is the case with an air cooled chiller, the condenser unit would preferably be located on the roof of a nearby building. The building would also require a pipe chase for routing refrigerant piping. Due to restrictions on refrigerant piping lengths, the condenser would have to be mounted relatively close to the fan coil unit.
- An air conditioning system utilizing a self contained type air conditioner that can be completely installed within a mechanical equipment room. Air distribution would utilize supply and return air ductwork routed through the length of the passageway. Condenser air intake and condenser air discharge shafts to the surface are required.

2. Gallery Place Mezzanine Bridge Air Conditioning

   All four bridge alternatives will be air conditioned. Heating is typically not provided for WMATA station public areas. Options for a suitable air conditioning system consist of the following:

   - An air conditioning system utilizing the existing Gallery Place station chilled water system. The components involved would consist of additional chilled water piping and fan coil units. This air conditioning option would also require an increase in Jackson Graham Building chiller plant capacity to prevent a reduction to the cooling provided in the remainder of Gallery Place station.
   - An air conditioning system utilizing chilled water provided by a dedicated air-cooled liquid chiller. This system would be sized to provide the required cooling for both the passageway and the bridge. The components involved would consist of the chiller, associated chilled water piping, chilled water pump and fan coil units spaced along the bridge.

   Of the passageway and mezzanine bridge air conditioning options listed above, the air cooled chiller air conditioning system option is preferred

and is included in the cost estimate. This system would utilize an air cooled chiller located either on the roof of an adjacent building or possibly in the alleyway adjacent to the YWCA building. This chiller would be sized for the total cooling load associated with the selected passageway and mezzanine bridge alternatives. The passageway would be served by two air conditioning units equipped with chilled water coils, while the mezzanine bride would be cooled with fan coil units. This option was selected for the following reasons:

- The split system and the self contained air conditioning system options are not suitable for the mezzanine bridges. Provisions for directing self contained unit condenser discharge air to a point outside of the conditioned space are not practical. Split system air conditioning systems units require a mechanical space to accommodate the evaporator unit while space outside of the station is required for placement of the air cooled condensers.
- Rebalancing the existing chilled water systems will result in a reduction in the chilled water available for cooling other areas in Metro Center and Gallery Place stations, and will also reduce the cooling provided to the to the other station served by Metro Center and the JGB chilled water plants. A capacity increase at both the JGB and Metro Center would be necessary to accommodate the additional cooling load.
- The use of the air cooled chiller option would not impact the existing chilled water systems.
- Using chilled water fan coils for the mezzanine bridge eliminates the need for additional mechanical space in Gallery Place station and minimizes the amount for exposed ductwork required.
- The use of chilled water air conditioning units for passageway cooling provides a simple means of providing outside air to pedestrians using the passageway and to people employed in the commercial area associated with passageway alternative 3.

The primary disadvantage of this option is the requirement for space within or adjacent to an existing building.

Ventilation, cooling and heating will be provided for the service spaces connected to the passageway in accordance with the WMATA design criteria. Air conditioning and heating will be provided for the elevator machine rooms associated with each of the three alternatives. Per WMATA criteria, underground mechanical and electrical rooms do not require ventilation or heating with the exception that ventilation is required if the electrical room space contains heat producing equipment. Requirements for the Cleaner's, Men's and Women's rooms contained in Alternative 3 are exhaust ventilation at the rate of 2.5 cubic feet per minute (cfm) per square foot and sufficient heating to maintain a room temperature of 70 degrees Fahrenheit.

3. Station Mechanical Room Modifications

   Required modifications to existing Metro Center station east platform level mechanical equipment rooms consist of the following:

   - Relocate the existing station platform air conditioning unit serving both platforms (ACU-3 and ACU-4) and reconfigure the ductwork. Due to the apparent age and condition of this equipment item, a new unit equipped with bag filters should be provided per current WMATA criteria.

   Required modifications to existing Gallery Place station west mezzanine level mechanical equipment room consists of the following:

   - Relocate the existing station mezzanine air conditioning unit (ACU-5) and reconfigure the ductwork. Due to the apparent age and condition of this equipment item, a new unit equipped with bag filters should be provided per current WMATA criteria.
   - Replace existing air handling unit AHU-1 serving the west platform underplatform exhaust system with an axial fan sized to deliver 30,000 cfm. Replacing the existing unit with a fan of the same capacity requires a variance to the design criteria. The existing underplatform exhaust system utilizes two non-reversible air handling units, each of which serve half the platform and are sized to exhaust 30,000 cfm each. Current WMATA criteria require two reversible, 60,000 cfm axial fans. Compliance with these criteria requires replacement of both existing air handling units with new fans and the provision of significantly larger ductwork.

   Required modifications to existing Gallery Place Traction Power Substation ventilation system consist of the following:

   - Relocate the existing ventilating units (V-6 and V-7) serving the substation to a level above the passageway ceiling. Due to the apparent age and condition of this equipment item, new units should be provided. In addition, a means of servicing the new units will need to be incorporated into the final design.

4. Fire Protection

   Due to the length of the pedestrian passageway, a dry standpipe system will be provided in the passageway with angle hose valves located in the vicinity of each exit stairway and an additional angle hose valve located at the approximate center of the walkway. Options for this system consist of either extending the existing standpipe systems serving Metro Center and Gallery Place stations or the provision of an entirely separate dry standpipe system. Per NFPA 130 (reference NFPA 130 2003, paragraph 5.7.4.4), cross connections are necessary where stations involve more than one platform. While NFPA 130 does not directly address two stations connected by a passageway, it is assumed that the local

jurisdiction would find it desirable to extend the existing standpipe systems into the passageway such that the passageway can be served from either the Metro Center or Gallery Place station.

NFPA 130 (reference NFPA 130, 2003, paragraph 5.7.3.1) requires provision of an automatic sprinkler system in station concession areas. In addition, WMATA criteria require the provision of sprinklers in washrooms. The sprinkler requirement applies to Alternative 3, which is the only alternative that contains commercial areas and washrooms. Sprinklers are not provided in Alternative 1 and 2.

NFPA 130 also contains requirements for emergency ventilation in the event of a fire. The addition of a return air fan to the air conditioning system described above provides a means of providing smoke exhaust capability in the event of a fire within the passageway. If a fire occurs within either of the stations, the air conditioning system can be used to pressurize the passageway in the event the roll down fire door separating the passageway from the station is closed. With the roll down door open, the same unit will produce airflow into the station in a direction opposite to that of evacuating passengers.

5. Plumbing and Drainage

   In general, area drains will be provided in all shafts and the exit stairways. Due to problems associated with connecting to the existing station drainage systems, sump pumps will be provided and will discharge to the city sewer.

   Due to the presence of washrooms, a sewage ejector and a water service are required for Alternative 3. In addition to provision of domestic water, the water service will also need to supply the sprinkler system.

B. Mechanical Work Associated with Each Alternative

All three alternatives require modification of the existing Metro Center east platform level mechanical rooms and the Gallery Place station west mezzanine level mechanical rooms. Specific mechanical work associated with each alternative is described below.

1. Passageway Alternative 1

   The mechanical, plumbing and fire protection features associated with this alternative consist of the following:

   - The pedestrian passage will be air conditioned with two air handling units equipped with chilled water coils. The estimated air conditioning requirement is approximately 107 tons with each unit having a nominal capacity of 55 tons. This is based on a floor area of approximately

26,000 square feet, a passenger heat load of 1000 British Thermal Units per hour (Btuh) per person, a density of 40 square feet per person, and a miscellaneous electric and lighting load of 3 watts per square foot.

- The air distribution system will utilize both supply and return air ductwork.
- Two mechanical rooms are required and associated air intake and exhaust shafts are required to house the air conditioning equipment and provide outside air for the passengers using the passageway.
- Passageway heating will not be provided. This is consistent with existing station HVAC systems serving public areas and the design criteria.
- Area drains will be provided at each of the exit stairways and the mechanical room. Due to the subterranean location and problems associated with connecting to the existing station drainage systems, sump pumps will be provided to discharge the collected drainage water and condensate.
- A dry standpipe system will be provided in the passageway with angle hose valves located in the vicinity of each exit stairway and an additional angle hose valve located at the approximate center of the walkway.
- All elevator machine rooms will be provided with air conditioning and heating.

2. Passageway Alternative 2

   The mechanical, plumbing and fire protection features associated with this alternative are the same as Alternative 1 with the following exceptions:

   - The pedestrian passage will be air conditioned with two air handling units equipped with chilled water coils. The estimated air conditioning requirement is approximately 136 tons with each unit having a nominal capacity of 68 tons. This based on a floor area of approximately 33,000 square feet, a passenger heat load of 1000 Btuh per person, a density of 40 square feet per person, and a miscellaneous electric and lighting load of 3 watts per square foot.
   - The air distribution system will utilize both supply and return air ductwork.
   - Two mechanical rooms are required and associated air intake and exhaust shafts are required to house the air conditioning equipment and provide outside air for the passengers using the passageway.
   - Passageway heating will not be provided. This is consistent with existing station HVAC systems serving public areas and the design criteria.

- Area drains will be provided at each of the exit stairways and the mechanical room. Due to the subterranean location and problems associated with connecting to the existing station drainage systems, sump pumps will be provided to discharge the collected drainage water and condensate.
- A dry standpipe system will be provided in the passageway with angle hose valves located in the vicinity of each exit stairway and an additional angle hose valve located at the approximate center of the walkway.
- All elevator machine rooms will be provided with air conditioning and heating.

3. Passageway Alternative 3

   The mechanical, plumbing and fire protection features associated with this alternative consist of the following:

   - The pedestrian passage will be air conditioned with two air handling units equipped with chilled water coils. The estimated air conditioning requirement is approximately 180 tons with each unit having a nominal capacity of 90 tons. This based on a floor area of approximately 39,000 square feet, a passenger heat load of 1000 Btuh per person, a density of 40 square feet per person, and a miscellaneous electric and lighting load of 3 watts per square foot.
   - The air distribution system will utilize both supply and return air ductwork.
   - Two mechanical rooms are required and associated air intake and exhaust shafts are required to house the air conditioning equipment and provide outside air for the passengers using the passageway.
   - Passageway heating will be provided in the vicinity of the commercial area.
   - All elevator machine rooms will be provided with air conditioning and heating.
   - The Cleaner's, Men's and Women's rooms will be provided with exhaust ventilation and heating.
   - Area drains will be provided at each of the exit stairways and the mechanical room. Due to the subterranean location and problems associated with connecting to the existing station drainage systems, sump pumps will be provided to discharge the collected drainage water and condensate.
   - A dry standpipe system will be provided in the passageway with angle hose valves located in the vicinity of each exit stairway and an

additional angle hose valve located at the approximate center of the walkway.

- A dry sprinkler system will be provided to serve the passageway commercial areas and the washrooms.
- A sewage ejector per WMATA standards is required to serve the Men's and Women's rooms.

4. The mechanical, plumbing and fire protection features associated with the Gallery Place mezzanine bridge alternatives consist of the following:

   - The pedestrian bridge will be air conditioned with fan coil units equipped with chilled water coils. This system is similar to that used at both Forest Glen and Wheaton stations and is preferred since additional mechanical room space at Gallery Place station is not necessary. The estimated air conditioning requirement is based on WMATA station air conditioning criteria.
   - Option 1 (recommended) – Center Bridge with Diagonal Columns - The bridge will be air conditioned with 18 fan coil units mounted on approximately 25 foot centers. The estimated air conditioning requirement is approximately 22 tons with each unit having a nominal capacity of 14,500 btuh. This based on a floor area of approximately 7,200 square feet, a passenger heat load of 1000 Btuh per person, a density of 40 square feet per person, and a miscellaneous electric and lighting load of 3 watts per square foot.
   - Option 2 – Center Bridge with Hangers - The air conditioning requirements for Alternative 2 are the same as for Alternative 1.
   - Option 3 – Center Bridge hung from Arched Frame - The air conditioning requirements for Alternative 3 are the same as for Alternative 1.
   - Option 4 – Side bridges with Corbels and Hangers - The pedestrian passage will be air conditioned with 36 fan coil units mounted on 25 foot centers. The estimated air conditioning requirement is approximately 33 tons with each unit having a nominal capacity of 11,000 btuh. This based on a floor area of approximately 10,800 square feet, a passenger heat load of 1000 Btuh per person, a density of 40 square feet per person, and a miscellaneous electric and lighting load of 3 watts per square foot.

VIII. ELECTRICAL/SYSTEMS FEATURES

A. General Electrical Issues Common to All Alternatives

All three passageway options will require the following:

1. New electrical equipment in a room near the walkway to provide power to lights, emergency lights and mechanical equipment. Electrical distribution equipment will be required in each of the elevator machine rooms and in the new electrical equipment room. Electrical circuits installed in conduit would run from the nearest source of power in the existing passenger station AC switchgear rooms. Some modifications will be required in the AC switchgear rooms such as adding new circuit breakers, evaluating the impact of adding new loads on the existing equipment and increasing the size of the UPS where necessary. Conduits would be concealed or embedded wherever feasible.
2. Electric power to drive the new elevators plus additional power for associated elevator equipment requiring electricity. This would come from the passenger station where the new elevators are being installed.

Adjacent to Gallery Place entrance, the new pedestrian tunnel infringes into the traction power substation room. Traction power equipment will not have to be moved because they are in an area of the room not being disturbed. Ventilation equipment and associated duct work serving the substation will have to be relocated. The new pedestrian tunnel will impact traction power feeders that go down to the tracks through cable slots in the floor. The traction power cables will have to be replaced from the DC switchgear to the tracks. This will involve cutting new cable slots in the substation floor. Other items such as the existing cable tray and some wall mounted panels will also have to be relocated.

B. Electrical Work Associated with Each Alternative

1. Alternative 1

   - No additional electrical equipment is anticipated for this alternative.

2. Alternative 2

   - The moving walkway will required additional electrical equipment, either at the new service room or at the existing AC Switchgear room. There will also be some additional lighting and mechanical equipment loads.

3. Alternative 3

   - The commercial area will require some additional electrical equipment within the service rooms. Power for additional heating will come from the passenger station's non-essential switchboards. There will also be additional lighting and mechanical equipment loads specifically for the commercial areas.

C. General Systems Issues Common to all Alternatives

All three passageway Alternatives will require the following system equipment:

- Closed-Circuit Television (CCTV) cameras to monitor elevator access and areas along the walkway. Conduits/cables will be required between these cameras and the corresponding communication room. Additional conduits/cable may be required to go from the communication room to the passenger station kiosk.

- Intrusion devices on all access doors. Conduits/cables will be required between these devices and the corresponding communication room. Additional conduits/cable may be required to go from the communication room to the passenger station kiosk.

- Fire alarm devices in station service rooms and with elevator equipment. Conduits/cables will be required between these devices and the corresponding communication room. Additional conduits/cable may be required to go from the communication room to the passenger station kiosk.

- Passenger Information Display System (PIDS). Conduits/cables will be required between these displays and the corresponding communication room.

- Public address speakers. Conduits/cables will be required between the speakers and the corresponding communication room.

- 2-way communication system in the Area of Rescue. Conduits/cables will be required between this system and the corresponding communication room. Additional conduits/cable may be required to go from the communication room to the passenger station kiosk.

- Modifications to kiosks in both passenger stations to accommodate additional elevators, CCTV camera, intrusion, fire and communication equipment.

Location of equipment will be based on WMATA's latest Design Criteria.

D. Systems Work Associated With Each Alternative

1. Alternative 1

- No additional system equipment is anticipated for this alternative.

2. Alternative 2

   - The moving walkway will require additional CCTV cameras and modifications to both passenger station kiosks. Fire alarm devices associated with the moving walkway would require additional conduits and modifications to the fire alarm system.

3. Alternative 3

   - The commercial area will require additional CCTV cameras, intrusion and communication equipment. Additional conduits and modifications to the passenger station system will be required. Telephone service for commercial vendors will require a dedicated telephone closet.

E General Electrical Issues for Bridge Connection between Mezzanines at Gallery Place Station.

1. Additional lights and mechanical equipment require new electrical circuits run from the nearest source of power in the existing passenger station AC switchgear rooms. Some modifications will be required in the AC switchgear rooms such as adding new circuit breakers, evaluating the impact of adding new loads on the existing equipment and increasing the size of the UPS where necessary. Conduits would be concealed or embedded wherever feasible.

F General System Issues for Bridge Connection between Mezzanines at Gallery Place Station.

1. Closed-Circuit Television (CCTV) cameras to monitor areas along the walkway. Conduits/cables will be required between these cameras and the corresponding communication room. Additional conduits/cable may be required to go from the communication room to the passenger station kiosk.

2. Passenger Information Display System (PIDS). Conduits/cables will be required between these displays and the corresponding communication room.

3. New and/or modification of public address speakers. Conduits/cables will be required between the speakers and the corresponding communication room.

4. Modifications to kiosks in both passenger stations to accommodate additional CCTV camera and communication equipment.

IX. RIDERSHIP ANALYSIS

A. Market Definitions

All Metrorail trips were assigned to one of 12 "markets" based on their origin and destination stations. Trips in the same market are expected to have similar likelihood of using the pedestrian tunnel. The markets were defined as follows:

1. Part A: Non-users

   - **Market 0** consists of riders whose routes do not pass near Gallery Place or Metro Center and riders who do not transfer at either station. Most Metrorail trips fall into this market.

2. Part B: Passengers transferring between Orange/Blue Lines and Green/Yellow Lines

   - **Market 1** consists of riders who travel between a Green Line station north of Gallery Place and an Orange Line Station west of Metro Center. The shortest-distance path for these trips involves transfers at both Metro Center and Gallery Place, with only a short ride on a Red Line train between the two stations. By using the tunnel, these riders could eliminate the Red Line portion of their trips. (Example trip: Greenbelt to Vienna.)

   - **Market 2** consists of riders who travel between the Federal Triangle Station and a Green Line station north of Gallery Place, and riders who travel between the Archives Station and an Orange Line Station east of Metro Center. This market is similar to Market 1, because the shortest trip for Market 2 riders involves a three-train trip with only a short trip on the Red Line, but Market 2 riders can also choose to transfer at L'Enfant Plaza, reducing their number of transfers but increasing their trip length. The tunnel would allow these riders to either avoid a three-train trip, as in Market 1, or to shorten their two-train trips by avoiding a transfer at L'Enfant Plaza. (Example trip: Archives to Vienna.)

   - **Market 3** consists of riders who travel between a Blue Line station south of King Street and a Green Line Station north of Mount Vernon Square. The shortest-distance trip for these riders is a three-train trip using the Yellow Line between the Pentagon and L'Enfant Plaza. The proposed tunnel would be unlikely to affect a large number of Market 3 trips, but it could cause some trips to divert through Rosslyn, reducing

the number of transfers but lengthening the trips by four stations. (Example trip: Greenbelt to Van Dorn.)

- **Market 4** consists of riders who travel between the Arlington Cemetery Station and a Green Line Station north of Mount Vernon Square. Much like Market 3, Market 4 riders must make a three-train trip, using either the Yellow Line over the Potomac River or the Red Line between Gallery Place and Metro Center. The tunnel would allow these riders to choose a two-train trip through the tunnel, although the trip would be two stations longer than the three-train trip using the Yellow Line. (Example trip: Arlington Cemetery to Greenbelt.)

3. Part C: Passengers using only the Red Line, entering or exiting the system near the tunnel

    - **Market 10** consists of riders who pass through Metro Center on the Red Line and enter or exit the system at Gallery Place, and riders who pass through Gallery Place and enter or exit the system at Metro Center. Some Market 10 riders may choose to shorten their train trips by using the tunnel. (Example trip: Dupont Circle to Gallery Place.)

    - **Market 11** consists of riders who enter or exit the system at Metro Center without passing through Gallery Place, and riders who enter or exit the system at Gallery Place without passing through Metro Center. These riders may already be choosing to shorten their train trips by walking at street level parallel to the tunnel for at least a portion of their walk. Some of these riders may choose to use the tunnel instead. (Example trip: Dupont Circle to Metro Center.)

4. Part D: Passengers entering or exiting the system near the tunnel whose trips involve a Metrorail transfer

    - **Market 20** consists of riders who transfer at Metro Center to enter or exit the system at Gallery Place, and riders who transfer at Gallery Place to enter or exit the system at Metro Center. Some Market 20 riders may be convinced to use the tunnel to eliminate the Red Line portion of their trips. (Example trip: Vienna to Gallery Place.)

    - **Market 21** consists of riders who enter or exit the system at Metro Center without passing through Gallery Place, and riders who enter or exit the system at Gallery Place without passing through Metro Center. These riders may already be choosing to avoid using the Red Line by walking at street level parallel to the tunnel for at least a portion of their walk. Some of these riders may choose to use the tunnel instead. (Example trip: Vienna to Metro Center.)

- **Market 22** consists of riders who travel between Metro Center and a Yellow or Blue Line Station between the Pentagon and King Street, inclusive. Market 22 riders' shortest-distance trip would involve using the Yellow Line over the Potomac and a transfer at Gallery Place. However, Market 22 riders could also reach Metro Center on a longer single-train trip via the Blue Line through Rosslyn. The proposed tunnel could allow some Market 22 riders to access Metro Center on the shorter Yellow Line trip, eliminating the Gallery Place transfer. (Example trip: National Airport to Metro Center.)

- **Market 23** consists of riders who travel between Gallery Place and an Orange or Blue Line Station east of L'Enfant Plaza. These riders' shortest trip includes a transfer at L'Enfant Plaza. The tunnel could cause some riders to avoid the transfer, instead lengthening their trips by one station via Federal Triangle. (Example trip: New Carrollton to Gallery Place.)

- **Market 24** consists of riders who travel between Gallery Place and Arlington Cemetery. These riders' shortest trip includes a transfer at the Pentagon. The tunnel may cause some Market 24 riders to divert through Rosslyn and use the tunnel, lengthening their trips by two stations but eliminating a transfer.

The number of Metrorail trips in each of the 12 market types was determined using matrices of Metrorail origin and destination stations (O-D matrices). The rows of each O-D matrix correspond to the stations where riders enter the Metrorail system (trip origins), and the columns correspond to the stations where trips end (trip destinations). Each matrix has a total of 83 rows and 83 columns, matching the number of stations in the system in 2003, the study's baseline analysis year.

WMATA prepared and supplied O-D matrices for the month of May 2003. In the year 2003, passenger volume in May was the closest to the annual average volume, so May was selected as the most representative month for the analysis. A total of four O-D matrices were supplied, one each for the four Metrorail time periods, as follows:

- Morning peak, opening to 9:30 a.m.
- Midday off-peak, 9:30 a.m. to 3:00 p.m.
- Afternoon peak, 3:00 to 7:00 p.m.
- Evening off-peak, 7:00 p.m. to closing

The complete O-D matrices are 83-by-83 grids, but they were simplified by grouping stations on common branches of the Metrorail system. For instance, riders entering the system at Vienna are equally likely to use the proposed tunnel as riders entering at Dunn Loring, West Falls Church,

and all other Orange Line stations east of Metro Center. By grouping stations, the complete O-D matrices were reduced to 18-by-18 grids.

Exhibit 1 presents a simplified O-D matrix showing the markets assigned to each group of O-D pairs.

In Exhibit 1, the rows and columns are labeled with a single Metrorail station, but they apply to all other Metrorail stations in the same group of stations. For instance, the column labeled “McPherson Square” applies to the Orange Line Stations between McPherson Square and Vienna, inclusive. A complete list of the stations included in each station group is presented in Appendix A.

It is clear from Exhibit 1 that the majority of Metrorail O-D trip pairs fall into Market 0; in fact, about 91 percent of O-D pairs belong to Market 0 and would thus not use the proposed tunnel. However, every Metrorail station has some O-D pairs that fall into other markets as well.

B. Market Sizes

The number of trips in each market in the year 2003 was determined by adding the number of trips in the O-D matrices that have common market types. The total number of trips in each market is shown in Exhibit 2.

Exhibit 1: Market Types of Groups of Metrorail O-D Pairs

		Destination Station Group																		
		McPherson Square	Metro Center	Federal Triangle	Smithsonian	L'Enfant Plaza	Largo Town Center	Van Dorn	Pentagon	Huntington	Arlington Cemetery	Waterfront	Archives	Gallery Place	Mt. Vernon Square	Georgia Ave	Greenbelt	Glenmont	Farragut North	McPherson Square
Origin Station Group	McPherson Square	0	21	0	0	0	0	0	0	0	0	0	2	20	1	1	1	0	0	0
	Metro Center	21	21	21	21	21	21	21	22	20	21	20	20	10	20	20	20	10	11	21
	Federal Triangle	0	21	0	0	0	0	0	0	0	0	0	0	20	2	2	2	0	0	0
	Smithsonian	0	21	0	0	0	0	0	0	0	0	0	0	20	0	0	0	0	0	0
	L'Enfant Plaza	0	21	0	0	0	0	0	0	0	0	0	0	21	0	0	0	0	0	0
	Largo Town Center	0	21	0	0	0	0	0	0	0	0	0	0	23	0	0	0	0	0	0
	Van Dorn	0	21	0	0	0	0	0	0	0	0	0	0	21	0	3	3	0	0	0
	Pentagon	0	22	0	0	0	0	0	0	0	0	0	0	21	0	0	0	0	0	0
	Huntington	0	20	0	0	0	0	0	0	0	0	0	0	21	0	0	0	0	0	0
	Arlington Cemetery	0	21	0	0	0	0	0	0	0	0	0	0	24	0	4	4	0	0	0
	Waterfront	0	20	0	0	0	0	0	0	0	0	0	0	21	0	0	0	0	0	0
	Archives	2	20	0	0	0	0	0	0	0	0	0	0	21	0	0	0	0	0	2
	Gallery Place	20	10	20	20	21	23	21	21	21	24	21	21	21	21	21	21	11	10	20
	Mt. Vernon Square	1	20	2	0	0	0	0	0	0	0	0	0	21	0	0	0	0	0	1
	Georgia Ave	1	20	2	0	0	0	3	0	0	4	0	0	21	0	0	0	0	0	1
	Greenbelt	1	20	2	0	0	0	3	0	0	4	0	0	21	0	0	0	0	0	1
	Glenmont	0	10	0	0	0	0	0	0	0	0	0	0	11	0	0	0	0	0	0
	Farragut North	0	11	0	0	0	0	0	0	0	0	0	0	10	0	0	0	0	0	0

Exhibit 2: Average Number of Daily Metrorail Trips by Market Type, 2003

Market	*Time Period*				
	AM Peak	*Midday*	*PM Peak*	*Evening*	*Total*
0	184,809	105,126	189,925	70,158	**550,018**
1	2,349	1,180	2,166	935	**6,631**
2	431	272	492	96	**1,291**
3	118	85	132	90	**425**
4	10	23	19	6	**57**
10	5,553	4,351	6,835	2,680	**19,418**
11	6,681	4,429	7,376	2,966	**21,451**
20	2,985	1,703	3,277	1,153	**9,118**
21	9,288	6,376	10,782	4,143	**30,589**
22	899	654	1,153	448	**3,153**
23	672	697	828	297	**2,494**
24	3	21	19	1	**45**
MARKETS 1-24	**28,988**	**19,791**	**33,078**	**12,815**	**94,672**
MARKETS 0-24	**213,797**	**124,917**	**223,003**	**82,973**	**644,690**

Exhibit 2 shows that about 85 percent of Metrorail trips fall in Market 0. Markets 1 through 4, the transfer markets, account for a combined total of about 1 percent of trips. Markets 10 and 11, the single-line local trips, account for about 6 percent of trips, and Markets 20 through 24, the multi-line local trips, account for the remaining 7 percent of trips.

The size of the markets in the design year of 2030 was determined by assigning growth rates to each Metrorail station and updating the 2003 O-D matrices to 2030 levels.

The following assumptions were made in forecasting travel on the Metrorail system in 2030:

1. The growth in Metrorail system ridership would average 1.25 percent per year between 2003 and 2030, excluding trips generated by the three new

stations. This rate corresponds to the annual growth rate in passenger trips observed by the Metrorail system since 1987.1

2. The three Metrorail stations that opened in 2004 (New York Avenue, Morgan Boulevard, and Largo Town Center) would be the only new Metrorail stations open in the year 2030. Metrorail would not be extended to Tysons Corner and Dulles Airport, and the Orange Line would not be extended west toward Chantilly. No new Metrorail lines would be operational by 2030. (If this assumption is incorrect and additional Metrorail facilities are in place by 2030, pedestrian traffic in the tunnel would tend to be higher than forecast in this study.)

Growth rates at individual stations were determined by reviewing and consolidating station growth rates that have been assumed in recent WMATA studies, such as the Core Capacity Study and the Dulles rail extension study. The raw growth rates were then factored to match the assumed 1.25 percent average systemwide growth rate. The station-by-station growth rates assumed in this study are presented in Appendix B.

For the three new stations, WMATA provided the number of weekday station boardings in the year 2025. The boardings were increased to 2030 levels using the systemwide 1.25 percent growth rate.

The growth rate forecast for each station was applied to both the station's origins and destinations to compute the expected 2030 total station boardings and alightings. Complete O-D matrices for the year 2030 were then computed using the Fratar method, an iterative approach that forecasts the future values of cells in an O-D matrix according to the growth trends at both origin and destination stations.

For the three new stations, origin trips were assigned to destination stations according to patterns similar to nearby stations, and destination trips were assigned to origin stations in the same manner.

Exhibit 3 presents the forecast size of each market in the year 2030.

1 Other studies have forecast larger annual growth rates; for instance, the Core Capacity Study (CCS) forecast annual passenger growth at core-area stations of 2.91 percent per year between 2000 and 2025. However, the intent of the CCS was to forecast demand for Metrorail service so that capacity bottlenecks could be identified. Actual ridership could only reach demand levels if massive capacity improvements are made, as noted in the CCS. The CCS further assumed that the Dulles and Chantilly extensions would be in place by 2025, increasing the study's growth rates.

Exhibit 3: Average Number of Daily Metrorail Trips by Market Type, 2030

Market	*Time Period*				
	AM Peak	*Midday*	*PM Peak*	*Evening*	*Total*
0	271,571	152,866	277,241	103,333	**805,011**
1	3,421	1,785	3,152	1,354	**9,712**
2	632	372	712	137	**1,852**
3	181	129	196	134	**641**
4	13	32	24	7	**77**
10	10,508	8,892	13,425	5,638	**38,463**
11	11,652	7,882	13,257	5,334	**38,124**
20	5,732	3,633	6,487	2,423	**18,275**
21	19,097	12,281	22,079	8,610	**62,067**
22	1,217	937	1,613	632	**4,398**
23	2,266	1,976	2,612	920	**7,774**
24	7	56	50	4	**117**
MARKETS 1-24	**54,726**	**37,974**	**63,609**	**25,193**	**181,502**
MARKETS 0-24	**326,298**	**190,840**	**340,850**	**128,525**	**986,513**

Trips in the Metrorail system as a whole are predicted to grow by 53 percent between 2003 and 2030. However, Market 0 trips are expected to grow by 46 percent, a slightly lower rate than the system-wide average. Markets 1 through 4 are also expected to grow at below-average rates of between 34 and 51 percent. Markets 10 and 11 are faster-growing, at 78 to 98 percent growth, but Markets 20 through 24 are the fastest-growing, with average growth rates of 104 percent. By 2030, Market 0 is expected to account for about 82 percent of all Metrorail trips, down from the 85 percent in 2003.

C. Elements Influencing Use Rate

Different use rates were assigned to each market according to the estimated probability that riders in each market would use the tunnel. Several factors may encourage passengers to use the tunnel. A primary factor is travel time savings, but the wide variety in human behavior means that not all riders would use the tunnel even if it would shorten their travel time. The following lesser influences were considered as well:

1. Out-of-vehicle time. Passengers perceive travel time inside a transit vehicle differently than travel time outside a vehicle. The Metropolitan Washington Council of Governments (MWCOG) Transportation Planning Model, Version 2.1D, assumes that an out-of-vehicle travel time increase is perceived by passengers as 2.5 times that of an in-vehicle travel time increase of the same duration. Some passengers, particularly senior or disabled riders, may not be willing to shorten total trip time if the amount of walking increases substantially.

2. Avoidance of transfers. The need to transfer between transit vehicles is perceived as a deterrent by passengers, in addition to the increase in travel time the transfer requires. In the MWCOG model, passengers are assumed to perceive an additional 6 minute delay in total travel time for each transit transfer.

3. Avoidance of congestion. Some passengers may prefer to avoid heavily-congested stations. Some riders may also attempt to board at stations where trains are less congested.

Use rates were determined for each market by weighing the importance of factors such as these to the pedestrians in each market. The MWCOG model was used to compute the percentage of riders who would choose to use the tunnel; however, results of the MWCOG computations were adjusted subjectively to account for factors the model does not represent well.

Pedestrians using the tunnel would experience changes in travel time from the following three sources:[2]

1. **Train travel time.** Time spent traveling on a train and making intermediate stops.

2. **Transfer walk time.** Time required to walk from the platform of the arriving train to the platform of the departing train.

3. **Waiting time.** Time spent waiting on the departure platform for the next train to arrive. As noted earlier, in the MWCOG model, passengers are assumed to perceive transfer walk time and waiting time as 2.5 times less desirable than train travel time.

Each of these three elements is analyzed in detail in the balance of this section.

2 Another possible source of differences in travel time is queuing delay, or the time spent waiting in queues to use escalators, stairways, or other station infrastructure. It is difficult to predict the level of queuing that will exist in the year 2030 because of the uncertainty in future ridership levels and station improvements.

Train Travel Time

Metrorail train travel times were collected for segments relevant to the markets under study. The train travel times used in the study are presented in Exhibit 4; train travel times were assumed to remain unchanged in 2030.

Exhibit 4: Average Train Travel Times

Metrorail Line	***Metrorail Trip***	***Average Train Travel Time (minutes)***
Red	Metro Center – Gallery Place	2
Green/Yellow	Archives – Gallery Place	2
	Archives – L'Enfant Plaza	2
Orange/Blue	Federal Triangle – L'Enfant Plaza	3
	Federal Triangle – Metro Center	2
Yellow	Pentagon – Gallery Place	8
Blue	Arlington Cemetery – Pentagon	3
	Arlington Cemetery – Metro Center	10

Transfer Walk Time

Average transfer walk times are based on walking speeds of 4 feet per second (2.7 mph) and actual observed times both walking and riding up and down escalators. Transfer times were determined at four Metrorail stations relevant to the markets, based on the configuration of the stations' platforms, escalators and stairways and the position of stopped trains. Average transfer walk times are presented in Exhibit 5.

Transfer walk times are assumed to remain unchanged in 2030.

Exhibit 5: Average Transfer Walk Times

Transfer Station	*Transfer Direction*	*Transfer Movement*	*Average transfer walk time (minutes)*
Pentagon	Upstairs	From outbound trains to inbound trains	1
	Downstairs	From inbound trains to outbound trains	1
Metro Center	Upstairs	From Orange/Blue Lines to Red Line	1
	Downstairs	From Red Line to Orange/Blue Line	1
Gallery Place	Upstairs	From Green/Yellow Lines to Red Line	1
	Downstairs	From Red Line to Green/Yellow Lines	2
L'Enfant Plaza	Upstairs	From Orange/Blue Lines to Green/Yellow Lines	1
	Downstairs	From Green/Yellow Lines to Orange/Blue Lines	1

At a walking speed of 4 feet per second, the proposed 800-foot pedestrian tunnel could be navigated in 3.3 minutes. However, for passengers transferring between the Green/Yellow Lines at Gallery Place and the Orange/Blue lines at Metro Center, the actual travel distance is much longer than the tunnel's length. The Green/Yellow Line platform is about 1700 feet from the Orange/Blue Line platform, and a transfer movement would need to traverse this entire distance. In addition, a transfer movement using the tunnel would need to make four distinct vertical movements to move from lower to upper platform, to mezzanine/tunnel level, to upper platform, and again to lower platform. The tunnel's transfer walk time is forecast to be 7 minutes, in addition to the appropriate transfer walk times at both Metro Center and Gallery Place.

The speed of moving walkways is assumed to be 3 feet per second, and it is assumed that average passenger speeds relative to the walkways would also be 3 feet per second, for a total average speed of 6 feet per second (4.1 mph). At these speeds, 600 feet of moving walkway segments would reduce the tunnel's transfer time from 7 minutes to 6 minutes.

Waiting Time

Some passengers arrive at their departing platform at the same time as a train; these passengers have no waiting time. Passengers arriving slightly later must wait for the next train; these passengers' waiting time is equal to a

full train headway. On average, assuming random arrivals and constant headways, passenger waiting time equals half the headway.

WMATA supplied typical headways for Metrorail operations in 2030, for both peak and off-peak operations; average wait times were computed from these headways and are presented in Exhibit 6. A passenger's wait time depends on whether the passenger has a preference about which train to board. For instance, a passenger may be waiting for the Orange Line or the Blue Line, or may be waiting for whichever train arrives first, as noted in Exhibit 6.

Exhibit 6: Average Waiting Times

Metrorail Line	***Average Waiting Time (minutes)***	
	Peak	***Off-peak***
Yellow	3	7
Blue	3	7
Orange	2	6
Red	2	5
Green	3	7
Yellow/Green	2	5
Orange/Blue	1	4
Blue/Yellow	2	5

D. Use Rates by Market Type

1. Market 1

During peak hours, the travel time to use the tunnel would nearly equal the travel time to use the Red Line because of the high frequency of Red Line service and the relatively long walking distance required. During off-peak hours, the tunnel offers slightly faster travel time, by about one minute, because of the lower frequency of train service.

The MWCOG model predicts that the tunnel would be used by 46 percent of passengers during peak periods and 53 percent during off-peak periods, increasing by two percent if moving walkways are installed. The MWCOG model tends to overestimate use rates of undesirable trips and underestimate use rates of shorter trips. As such, for the purposes of this analysis, the use rates were adjusted to 40 percent during peak periods and 55 percent during off-peak periods. The two-percent gain for moving walkways was retained for all periods.

2. Markets 2 and 3

   The travel time differences and the MWCOG model's use rate predictions are nearly identical for Markets 2 and 3. For both markets, the tunnel would require a longer overall trip time than at least one other path. The difference in trip time ranges from 2 to 5 minutes, depending on specific route, time of day, and presence of walkways.

   Despite the longer trip time, the MWCOG model predicts use rates of 25 to 26 percent in the tunnel during peak periods and 27 to 33 percent during off-peak periods. Again, moving walkways tend to increase use rates by about two percent. For this study, the MWCOG rates were reduced to 15 percent during peak periods and 20 percent during off-peak periods.

3. Market 4

   Market 4 passengers are also unlikely to reduce total travel time much by using the tunnel. The tunnel would offer a savings of about one minute over the existing shortest path in the best case—off-peak conditions with moving walkways. During peak periods with no walkways, the tunnel travel time becomes about two minutes longer than the shortest path.

   The MWCOG model predicts 29 percent use rate during peak hours and 32 percent during off-peak hours. The travel time savings in Market 4 are similar to Market 1, but the MWCOG use rates are lower because there are two viable alternative routes to the tunnel in Market 4; Market 1 has only one alternative. Again in market 4, the MWCOG model suggests that use rates would increase by about 2 percent if moving walkways were installed. In this study, Market 4 rates were taken to be 30 percent for peak periods and 35 percent for off-peak periods, acknowledging the nearly equal travel times between the alternative routes.

4. Market 10

   Passengers in Market 10 are already aboard the Red Line as it passes through either Metro Center eastbound or Gallery Place westbound, deliberately riding the train parallel to the proposed tunnel to exit at the farther station. Since these passengers could already choose to exit at the nearer of the stations, it is unlikely that the tunnel would change a large number of these riders' patterns. Travel time differences are highly variable, because these riders' ultimate destination lies somewhere in the vicinity of the Metro Center or Gallery Place Stations. If these passengers used the tunnel, they would likely take advantage of intermediate entrances or exits, rather than traversing the tunnel's entire length.

WMATA faregate data shows that about 23 percent of Gallery Place patrons use the west portal, nearest the tunnel, and that about 17 percent of Metro Center patrons use the east portal, nearest the tunnel. About a third of these patrons are expected to walk parallel to the tunnel at street level for at least a portion of their trip to or from the station, for an average of about 7 percent of Metro Center and Gallery Place traffic. Market 10 riders are some of the least likely to use the tunnel because of their existing ridership patterns, but for the purposes of this study, it was assumed that 40 percent of the candidate pedestrians would use the tunnel, for a use rate of about 3 percent. This use rate would not change according to time of day, because train waiting time is not a factor.

Moving walkway usage in Market 10, as well as all other local markets, was evaluated indirectly using MWCOG model predictions. In the transfer markets, MWCOG predicted use rate increases of about 2 percent when a moving walkway was installed. This change in use rate translates to an increase of about 8 percent in passenger traffic, which was based on transfer passengers' use of the tunnel for its entire length. Local passengers are likely to enter or exit the tunnel at an intermediate point, perhaps using the walkways on average for only half their length. As such, a passenger gain of 4 percent was assumed for Market 10 and other local markets.

5. Market 11

   Market 11 passengers are the complement to Market 10 passengers. They exit at either Metro Center or Gallery Place without passing through the other station on a Red Line train. Still, only about 7 percent of Gallery Place and Metro Center traffic is expected to walk in a direction that would make the tunnel useful, but a larger fraction of Market 11 trips are forecast to use the tunnel because of their ridership patterns. For this study, it is estimated that 75 percent of the candidate Market 11 trips would use the tunnel, for a use rate of 5 percent.

6. Markets 20 and 21

   Market 20 passengers fit the same profile as Market 10 passengers, except that their trips include Metrorail lines other than the Red Line. Likewise, Market 21 passengers fit the same profile as Market 11 passengers, but they too make at least one transfer. However, because passengers in Markets 20 and 21 behave in the same way as passengers in Markets 10 and 11 in the vicinity of the tunnel, it is expected that the use rates will be similar. As such, a 3 percent use rate was assigned to market 20 and a 5 percent use rate was assigned to Market 21.

7. Market 22, 23 and 24

   The final three local markets are relatively small in size, and their passengers have little to gain from using the tunnel. Market 22 is similar to Market 20, except that its passengers have an additional alternative route that would avoid the need to use the tunnel. Markets 23 and 24 could use the tunnel to eliminate a transfer from their trips, but the route would require 2 to 4 minutes of additional train travel time in addition to the walking time through the tunnel. As such, low use rates were established for these three markets: 2 percent for Markets 22 and 23 and 1 percent for Market 24.

E. Use Rate Summary

Exhibit 7 presents the use rates by market type as discussed above.

F. Pedestrian Forecast Computation

With the market sizes and use rates established, the pedestrian forecast was calculated by multiplying the market size by the use rate for each market and summing the products. The daily pedestrian forecast for the year 2030 is presented in Exhibit 8 for the condition without moving walkways.

Exhibit 7: Pedestrian Tunnel Use Rates by Market Type

Market	*Without Walkways*		*With Walkways*	
	Peaks	*Off-peaks*	*Peaks*	*Off-peaks*
0	0%	0%	0%	0%
1	40%	55%	42%	60%
2	15%	20%	16%	22%
3	15%	20%	16%	22%
4	30%	35%	32%	38%
10	3%	3%	3%	3%
11	5%	5%	5%	5%
20	3%	3%	3%	3%
21	5%	5%	5%	5%
22	2%	2%	2%	2%
23	2%	2%	2%	2%
24	1%	1%	1%	1%

Exhibit 8: Pedestrian Tunnel Passenger Forecast, Without Walkways, 2030

Market	*Time Period*				
	AM Peak	*Midday*	*PM Peak*	*Evening*	*Total*
0	0	0	0	0	**0**
1	1,368	982	1,261	745	**4,356**
2	95	74	107	27	**303**
3	27	26	29	27	**109**
4	4	11	7	3	**25**
10	315	267	403	169	**1,154**
11	583	394	663	267	**1,906**
20	172	109	195	73	**548**
21	955	614	1,104	430	**3,103**
22	24	19	32	13	**88**
23	45	40	52	18	**155**
24	0	1	1	0	**1**
Total	**3,589**	**2,536**	**3,854**	**1,772**	**11,750**

The trip forecast shows a total of about 12,000 (11,750) pedestrians per day using the tunnel, of which the largest share are part of Market 1. Altogether, the transfer markets account for about 40 percent of trips, while local markets account for about 60 percent.

The pedestrian tunnel is expected to attract about 1,400 trips during the morning peak hour and about 700 trips in the peak half-hour (PHH), according to existing Metrorail temporal patterns. Total annual passenger traffic would measure about 3.4 million trips.

The passenger forecast for the condition with moving walkways is presented in Exhibit 9.

Exhibit 9: Pedestrian Tunnel Passenger Forecast, With Walkways, 2030

Market	*Time Period*				
	AM Peak	*Midday*	*PM Peak*	*Evening*	*Total*
0	0	0	0	0	**0**
1	1,437	1,071	1,324	812	**4,644**
2	101	82	114	30	**327**
3	29	28	31	30	**118**
4	4	12	8	3	**27**
10	328	277	419	176	**1,200**
11	606	410	689	277	**1,982**
20	179	113	202	76	**570**
21	993	639	1,148	448	**3,227**
22	25	19	34	13	**91**
23	47	41	54	19	**162**
24	0	1	1	0	**1**
Total	**3,749**	**2,693**	**4,024**	**1,884**	**12,351**

Moving walkways are predicted to increase total traffic by about 5 percent, to just over 12,000 (12,351) trips per day. Transfer traffic increases at a slightly higher rate because the walkways impart more benefit to passengers who travel longer distances. Transfer traffic increases to about 41 percent of total traffic.

More detailed forecasts, including both 2003-level and 2030-level data, are included in Appendix C.

A brief analysis of conditions in 2010, the predicted year of opening, shows that the tunnel would be expected to carry about 7,900 passengers per day without moving walkways or about 8,300 per day with moving walkways.

G. Use Rate Sensitivity

In this section, the effect of minor changes to use rate on the total pedestrian forecast is examined. The results of the analysis, expressed to the nearest two significant digits, forecast pedestrian traffic to the nearest 1,000 passengers per day. Changes to use rate that affect the pedestrian forecast by less than 1,000 passengers per day are thus not significant changes.

Exhibit 10 presents the threshold of significance for the use rate of each market type, according to the 1,000 passenger-per-day threshold.

Exhibit 10: Use Rate Sensitivity by Market Type

Market	*Weighted average use rate used for 2030 passenger forecast*	*rate that would result in a 1,000-passenger-per-day change in passenger*	*Lower boundary of significant use rate range*	*Upper boundary of significant use rate range*
1	44.8%	10.3%	34.6%	55.1%
2	16.4%	54.0%	0.0%	70.4%
3	17.1%	100.0%	0.0%	100.0%
4	32.5%	100.0%	0.0%	100.0%
10	3.0%	2.6%	0.4%	5.6%
11	5.0%	2.6%	2.4%	7.6%
20	3.0%	5.5%	0.0%	8.5%
21	5.0%	1.6%	3.4%	6.6%
22	2.0%	22.7%	0.0%	24.7%
23	2.0%	12.9%	0.0%	14.9%
24	1.0%	100.0%	0.0%	100.0%

Exhibit 10 shows that if the use rate selected for Market 1 is within plus or minus 10.3 percent of the actual use rate, the pedestrian forecast will be accurate to within 1,000 passengers per day. The right-most columns of Exhibit 10 show the boundaries of the actual use rates that would allow the passenger forecast to remain within these limits.

Because of the small sizes of some markets, such as Markets 2, 3 and 4, these markets' use rate sensitivity is very low. The pedestrian forecast remains within 1,000 trips per day even if the actual use rates are much higher or lower than the expected rates. Sensitivity is much tighter for Markets 10,11, 20 and 21, where the passenger forecast is much more sensitive to small changes in use rate. However, these markets also have very low use rates, minimizing the chance of a large difference between expected and actual use rate.

H. Tunnel Benefits

The total travel time savings produced by the tunnel are small, because no markets observe significantly shorter travel times. However, several additional benefits can be achieved through construction of the tunnel.

1. Red Line Incident Management

   In the event of a service disruption on the Red Line, the tunnel would offer an attractive alternative route for passengers who ride the Red Line only between Gallery Place and Metro Center. About 18,000 passengers per day use the Red Line exclusively for this segment, increasing to over 30,000 per day by 2030. Although few of these passengers would choose to use the tunnel under normal circumstances, the use rate would be much higher if Red Line service were limited or unavailable.

2. Reduction of Transfers

   The tunnel would reduce the number of passengers transferring at the L'Enfant Plaza Station. According to the Core Capacity Study, the L'Enfant Plaza Station is expected to handle about 265,000 transfer passengers per weekday; the tunnel would be likely to capture about 1 percent of those passengers.

   The Pentagon Station may also observe a reduction in transfer traffic, but the reduction would be of a much smaller magnitude than at L'Enfant Plaza.

3. Reduction of Platform Crowding

   At Metro Center, the proposed configuration of the tunnel would require tunnel users to navigate the east end of the Red Line platform, so tunnel users would not be expected to reduce platform congestion significantly.

   At Gallery Place, a proposed new mezzanine has been suggested that would connect the east and west ends of the station, allowing tunnel users to avoid the Red Line platform. This mezzanine would reduce the number of passengers on the Red Line platforms at Gallery Place.

   However, the effectiveness of the mezzanine would be limited by passengers' desire to minimize their trip travel time. For instance, passengers transferring from the Green/Yellow Lines to the Orange/Blue Lines would likely prefer to walk along the Red Line platform to reach the tunnel, in case a Red Line train should happen to arrive during their walk along the platform. If they were to use the mezzanine, they would not be able to catch an arriving Red Line train. This effect would be prominent

for westbound transfer movements; eastbound movements would be more likely to use the mezzanine level.

Even if the mezzanine were not installed, the tunnel would allow transfer movements to choose the least-congested of the Red Line platforms at Gallery Place and Metro Center. For instance, passengers emerging from the tunnel at the Gallery Place Station would be able to observe congestion levels on both the eastbound and westbound Red Line platforms, and they could choose to avoid a heavily-congested platform, since either would allow them to reach the Green/Yellow Line platforms.

X. JOINT DEVELOPMENT ANALYSIS

A. Introduction

This report contains an evaluation of the potential for retail space in a pedestrian passageway linking the Metro Center and Gallery Place Metro Stations. This is part of an overall feasibility study of creating a pedestrian passageway to interconnect these two Metro Stations.

1. Purpose

   The purpose of this analysis is to determine demand for lease space in the pedestrian passageway, based primarily on Metro rail ridership and projected non-transit visitor foot traffic to a potential visitor information center/Metro museum and entertainment ticket outlet/reservations center, as the passageway as currently proposed is within a fare free zone of the transit system. The analysis is also to provide information on suggested tenant mix and evaluate feasibility issues.

2. Work Completed

   In the process of undertaking this analysis Basile Baumann Prost & Associates (BBPA) participated in a series of work sessions with consultants and Metro staff. These work sessions examined feasibility issues related primarily to the construction, operation and ridership implications of alternative pedestrian tunnel configurations. Retail input was provided in these work sessions concerning the initial sizes of supportable retail space and the sources of retail demand.

   BBPA also conducted field surveys of competitive and comparable retail space within the walkshed of the two Metro stations. BBPA held discussions with area property owners, property managers and retail operators to determine the characteristics and performance of retail space in the general area.

   BBPA also reviewed publications and data from the Downtown DC

Business Improvement District (BID) that represents business interests in the area. The business improvement district is a private non-profit that provides cleaning, safety, hospitality, marketing, economic development and homeless services to Washington's city center. Its mission is to help raise Downtown to world-class standards as a commercial, cultural and residential destination. The BID has specific marketing and image enhancement strategies and has prepared a full inventory of retail and service space within the area.

BBPA also examined comparable retail facilities in other transit systems and comparable small-scale retail cart, kiosk and retail merchandising unit operations. Information was gathered on sales volumes and lease rates as well as operational characteristics.

BBPA estimated sales volumes as derived from ridership projections provided by the consultant team. The sales volumes were in turn translated into estimated supportable square footage and likely supportable occupancy costs. This information was provided as input to the Consultant Team and WMATA as part of the iterative work process. This served to help define the required space within the pedestrian connector to accommodate supportable retail. The refinement of the space configuration also served to help define the likely characteristics of the retail space.

This report follows the outline of the scope of services contained in the WMATA work program.

B. Retail Market Demand

1. Market Context

The primary market of the midpoint between the Metro Center and Gallery Place Metro Stations is generally consistent with the borders of the Downtown DC Business Improvement District (BID). The 140-block BID contains approximately 825 properties and is bounded by the National Mall to the south, Massachusetts Avenue to the north, the U.S. Capitol to the east and the White House to the west. The area encompasses all or parts of the Penn Quarter, Gallery Place, Chinatown, McPherson Square, Federal Triangle and Franklin Square neighborhoods.

The area has a strong daytime population with an order of magnitude of 175,000 employees or 26 percent of the District's total employment. A number of new residential projects have contributed to the evening population. Between 2001 and 2004, 16 projects totaling 2,079 residential units began construction within the BID. According to ESRI Business Solutions estimates, the total population in 2004 was 5,281.

The area contains approximately 600 retail and service establishments with over 8,000 employees. Estimated retail sales in 2004 were $615 million. A majority of the retail component are classified as eating and drinking establishments. Sales at these establishments accounted for approximately $300 million in 2004 or nearly half of the total sales within the BID.

The area is well served with convenience type retail establishments that would normally be found within transit areas such as the pedestrian tunnel. Various coffee, snack and convenience stores are located proximate to station portals. Reflecting the daytime orientation of the retail environment, these limited service (i.e. convenience) restaurants catering to workers generated $210 million in sales or 70 percent of total eating and drinking sales.

The number of restaurants and retailers appealing to the growing nighttime resident population of renters, condominium dwellers and lodgers within the BID's 9,336 hotel rooms is increasing. New restaurants have been attracted by the potential to generate sales from $500 to $1,500 per square foot. New retail space at the Gallery Place project constitutes 250,000 square feet including Aveda Institute, Urban Outfitters, Benetton, City Sports, Ann Taylor Loft, and a 14-screen Regal Cinemas.

There is approximately 1.9 million square feet of potential ground floor retail and services space within the BID, 265,000 square feet or 14 percent of which is reported to be vacant. The general retail lease rates range from a low of approximately $25 per square foot per year to a high-end of $80 per square foot per year within an effective average rate of $52. Median store sizes are approximately 2,500 square feet.

2. Transit Retail

Given the nature of retail in the area and the potential foot traffic within the pedestrian tunnel, BBPA has supplemented its retail demand analysis with an examination of similar retail within other transit facilities and an examination of the performance and characteristics of small-scale carts, kiosks and what is referred to in the retail industry as "retail merchandising units" (ministores larger than traditional carts and kiosks providing a self-contained environment for storage, merchandise handling, lighting, cash wraps, security, signage etc.).

Parsons undertook a detailed data evaluation of retail uses in other major transit systems, which has been provided to WMATA in a separately bound volume. Most information was available from the New York,

Chicago, Boston and San Francisco systems. These systems have an established tradition of providing retail services in their stations. Many of the establishments have a long history and have established and defined consumer patterns. The size of these retail facilities varies from approximately 100 to 1,500 square feet. Most of the retail operations are found **outside** of the fare zone. The **highest sales performances**, however, were experienced by facilities at the **platform level**, literally on the platform.

The data on the retail sales volumes for transit systems is extremely limited. Estimated retail sales range from $100 to $1,400 per square foot per year, averaging approximately $600. More comprehensive data is available on lease rates. Annual rent per square foot ranges tremendously from a low of $9 per square foot to a high of $264 per square foot.

An examination of sales per rider revealed no discernible pattern, ranging from $.03 per rider to $0.36 per rider. From our discussions and a review of the location of the facilities it appears that **location** is the key factor in determining sales potential. “Forcing” or funneling the transit patron by the retail establishments appears to optimize revenue potential. Riders are not likely to deviate from their normal pedestrian path to make impulse purchases. An average of 5,000 transit patrons per day appears also to be the " threshold" for retail success.

3. Sales Projections

In estimating the sales potential for retail facilities within the pedestrian passageway we have examined the ridership projections. Based upon the experience of other transit systems and the nature of area retail we have assumed that the potential market for retail services in the passenger tunnel would primarily be derived from primary and secondary transfer market.

Passenger tunnel users who enter or exit the systems at Gallery Place or Metro Center have so many more convenience retail options that it is highly unlikely they would go out of their way to patronize retail facilities within the tunnel unless they offered specialty goods or services. This assumes that the market for convenience retail activities exists primarily during the AM, midday and PM peaks. With relatively limited retail activity beyond these periods, it would be unlikely that the retail operator would choose to remain open during weekends and after 7 PM on weekdays (All the transit retail use agreements we examined restricted time of retail operation to the hours of transit service but did not require merchants to remain open during the entire service period).

The presence of year-round activity generators including a visitor

information center/Metro museum and entertainment ticket outlet/reservations center as well as the relatively high proportion of non-work trips which might occur at and between these two stations may result in operators opting to extend hours both on weekdays and the weekends.

Given the tourist and destination orientation of the proposed retail component, retail activity with the Gallery Place-Metro Center pedestrian tunnel could benefit significantly from strong demand during the theatre runs of popular productions at any one of the participating venues and during large conventions, holidays, and other high visitation periods (e.g. National Cherry Blossom Festival). Given the seasonality of activity, many retail carts/kiosks may operate only on a seasonal basis. Higher rents could be charged during peak seasons to offset off-season vacancies.

For analysis purposes we have utilized a 2030 projected average daily potential pedestrian tunnel retail client figure of approximately 6,000 per business day (1.7 million passengers per year) which represents approximately half of the overall pedestrian tunnel passenger forecast.

The presence of selected destination activities including a one-stop visitor information center and Metro museum should attract additional non-transit foot traffic. Located on the lower level of Hallidie Plaza near the Powell Street Bay Area Rapid Transit District (BART) station, San Francisco's Visitor Information Center attracts approximately 400,000 visitors annually. With its comparable tourist activity (e.g. number of annual overnight visits in 2003), the District could also eventually draw a large number of visitors to a transit related visitors center. Since a potential subterranean pedestrian tunnel location is less accessible and visible, it is assumed that it could attract 200,000 visitors per year, or half of the annual traffic at the BART-related facility. This could generate an average of approximately 550 non-transit pedestrians through the tunnel per day.

In addition to foot traffic generated by a potential visitor information center and Metro Museum, an entertainment ticket outlet (e.g. TICKETplace in the Seventh Street Arts Corridor, TicketMaster) and reservation center could also attract a significant number of non-transit pedestrians to the tunnel. The range of potential visitors to such an outlet will vary substantially depending on the selection of tickets, prices (e.g. half-price day-of-show, full-price), and venues. A well established reduced-price day-of-show outlet such as TKTS in New York can sell up to 20 percent of a theatre district’s total annual tickets and generate 10 percent of its annual sales at an average of $40 ticket.

Attendance at the five primary theatre venues within the Downtown BID was 838,152 in 2003. Assuming a conservative capture rate of 5 percent

of ticket sales, a ticket outlet in the pedestrian tunnel could generate an additional 42,000 non-transit pedestrians per year or approximately 115 per day.

Despite offering free covered passage, few other non-transit passengers are expected to use the tunnel to avoid walking at street level. A free tunnel would potentially offer pedestrians a grade-separated passageway between 9th and 11th Streets. However, the route would significantly lengthen pedestrians' trip times because of the need to use escalators or stairs to drop below street level. By contrast, the existing at-grade crosswalks are pedestrian dominated and easy to use.

The destination nature of the visitors center/Metro museum and the ticket outlet should have retail spillover effects. Given the competing retail at ground level, however, average retail sales per pedestrian within the pedestrian tunnel are expected to be at the lower end for transit systems. For the adjusted transit and non-transit pedestrians we have assumed annual retail sales per passenger of $0.10. In addition, we have assumed ticket outlet patrons will spend an average of $25 per person on tickets.

In 2030, a combined total of approximately 2 million tunnel pedestrians could generate an estimated $200,000 in annual retail sales (2005 constant dollars). The 42,000 ticket outlet patrons could generate an additional $1.1 million in ticket sales. Assuming targeted sales volume in the $500 to $600 per square foot range, reflective of both transportation system and mall kiosk midpoints, approximately 300 to 400 square feet of retail space could be supported in addition to the visitor information center/Metro museum and entertainment ticket outlet/reservation center.

C. Likely Retail Market Venue

1. Concepts

The pedestrian connection would primarily:

- Serve as a transfer point between the two stations,
- Commercial space would include two larger spaces of approximately 3,600 square feet (120 x 30) and 6,000 square feet (240 x 25) and a number of smaller spaces at the Gallery Place end of the tunnel
- Create an activity generator by attracting approximately 550 daily or 200,000 annual visitors to a visitors center/Metro museum,
- Support relatively limited retail space beyond the potential visitors center/Metro museum and ticket outlet/reservation center,
- Experience periodic sales jumps during high visitation periods and

fluctuate significantly depending on venue offerings.

- Discourage the sale of food items,
- Operate in a relatively constrained space (height/width), and
- Present a high quality image but would have no natural light

It is our understanding that in addition to generating revenue, the pedestrian tunnel and its commercial component should:

- Create a unique tourist attraction and information center and a retail destination for visitors and residents alike,
- Provide services to transit patrons which will reduce the amount of travel required to purchase convenience goods and services,
- Create visual connections including lighting, visitor center and Metro museum signage and posters, and advertising to draw pedestrians through the tunnel,
- Increase transit ridership to reduce air quality impacts, traffic congestion, and energy consumption,
- Enhance the perception of safety and security by generating additional activity at and between stations, and
- Introduce development opportunities for the private sector and small and minority businesses.

Assuming the potential visitors center/Metro Museum and ticket outlet occupy the larger commercial spaces, we have explored a focus on small retail facilities for the more modest commercial spaces closer to the Gallery Place end of the pedestrian tunnel, which: occupy minimal space; can be wheeled away for storage, or attractively secured; enhance customer flow and decrease customer waiting time; provide self-contained lighting; have relatively modest cost; can flexibly be moved or relocated; have minimal maintenance costs; and present specialized security opportunities.

2. Unit Types

To meet the retail objectives listed above, the pedestrian tunnel could implement a number of strategies to attract transit and non-transit pedestrians alike. Small vendors are not likely to attract destination traffic by themselves. Unique tourist and retail destinations unavailable at street level, on the other hand, could anchor the commercial component and could help support small retailers by generating non-transit foot traffic.

i. Visitors Center/Metro Museum

Many visitors to the Washington, DC metropolitan area utilize Metro to access the region's many tourist attractions and landmarks. Given the high ridership levels among tourists, it makes sense to locate a satellite

visitors center in direct relation to and accessible by the Metro system. Although the capture rate of non-transit riding visitors is likely to be significantly lower, the presence of a visitor center with a unique exhibit could draw additional tourist traffic to the tunnel.

Through exhibitions, tours, educational programs and workshops, national and international transit museums (e.g. New York, London) present the cultural, social and technological history of public transportation. As a leading example of modern efficient, urban transportation since its inception as "America's subway" in the late 1960s, the Metro system has the potential for a museum of its own by highlighting its planning, engineering, construction, operations, and its impact on the built environment (e.g. transit oriented development). Located within the system itself, a Metro museum developed in conjunction with a visitors center could attract a significant number of transit and non-transit riding visitors to the pedestrian tunnel. Advertising and historic photos related to the museum can also help draw visitors through the tunnel to other commercial areas and the two Metro stations.

ii. Entertainment Ticket Outlet/Reservation Center

Another potential attraction and service for transit and non-transit pedestrians is a one-stop entertainment ticket outlet and reservation center serving area performing arts venues, ticketed attractions, and restaurants. Similar vendors in other major cities have helped generate tourist activity and increase revenues for theatre exhibitors by offering both convenience and value (e.g. reduced-price day-of-show sales) for patrons. A dining reservations component would increase the appeal by providing recommendations and contact information for area restaurants. An outlet of this type can be expected to attract visitors to the area and residents alike.

In addition to these unique activity generators, there are a variety of retail unit types which could be used:

a. Carts

Retail carts are designed for efficiency, safety, mobility, and appeal for almost any venue. Carts occupy minimal space and are secured or wheeled away for storage. Custom carts include unique merchandising fixtures, materials, cash wraps, canopies, lighting, and various specialized features.

b. Kiosks

Custom kiosks provide the ability to merchandise or sell a variety of products. Custom kiosks can be designed with wheels, knock down walls, or interchangeable modular fixtures. A kiosk may be designed to complement the architecture of the location or they may be designed to market specific products. Kiosks occupy slightly more space than carts and are generally less mobile than carts.

c. Retail Merchandising Units (RMU)

Retail Merchandising Units (RMU) serve as “mini stores” for many retail products. An unlimited number of options are available to satisfy all requirements for size, materials, storage, merchandise handling, lighting, cash wraps, security, signage, and mobility.

d. Dual Use Security/Merchandising Carts

The dual-use security cart system enables combining revenue generating point-of-sale and a digital video security system simultaneously to a commercial spaces. The Security-Cart can be mobilized on a retail basis, security basis, or both.

e. Wi-Fi Station

The WI-FI Station is a wireless broadband internet delivery system which can attract and retain customers, connect PDA’s and laptops and contain broadband Megabit Feed.

f. Electronic Kiosks

Electronic Kiosks are self service computer touch pads occupying a minimum of space. This “self service” market includes retail and point of sales (POS) applications. This includes ATM; airport ticketing; information; bookstore kiosks; building directory kiosks; clothing retailers e.g., virtual sales assistants; customer electronic stores (web awareness-internet access to their on-line store); convenience store kiosks; and customer service kiosks (e.g. Photokiosk).

3. Target Store Types

Most carts, kiosks and RMUs are non food based. From discussions with retailers and suppliers and review of sales data, it is our understanding that popular offerings with above average sales should target:

- Newsstand/sundries
- Mobile phones
- Sunglasses
- Cosmetics
- Health supplements
- Flowers/gift baskets
- Hat/toques
- Jewelry/rings/pendants
- Key chains
- Perfume/after shave
- Children's books
- Coffee mugs/products
- Scarves/ties
- Sports jerseys/hats
- T-shirts/boxers
- Umbrellas
- Wallets/purses
- Watches

D. Feasibility Issues

This section discusses feasibility issues in terms of how the tenant mix could be translated into a retail configuration within the pedestrian tunnel, likely rentals to be received by WMATA and potential capital and operating costs to WMATA.

1. Retail Configuration

   As noted above, a variety of retail configuration could be utilized. A typical cart or kiosk is four to six feet wide and would require approximately four to eight feet additional on the perimeter to accommodate sales areas.

   The most likely configuration would be kiosks likely occupying a four to six foot area. Ideally the lease footprint of the kiosk would be 20 foot by 16 foot area (320 square feet). The 16 foot depth would provide eight feet of "sales space" along the pedestrian flow, 4 feet for the cart/kiosk and an additional 4 feet between the cart/kiosk in the wall for supplemental sales area.

   This 16 foot depth would fit within the configuration of the tunnel but would either require a single loaded corridor with potential modifications in the current design to place the wider area of the tunnel all on one side. From a retail marketing perspective, a preferred approach may be for the kiosks to be placed on both sides of the tunnel in a staggered fashion creating a

more serpentine pedestrian flow which would maintain a 16 foot pedestrian way, enhance retail visibility, and create a more attractive and interesting walk for pedestrians.

The 20 foot lengths would allow for the cart and a stool and provide space between the carts. Given the market demand for 1,400 to 1,650 square feet, 4 to 5 sales units could be supported.

The retail units would likely provide their own lighting and signage. The only requirements for the transit system would be to provide standard electrical power and telephone hookups for credit card and Internet connections. This design would likely not require storage space. The provision of exclusively nonfood vendors would reduce any maintenance, health, and trash requirements. Servicing of the retail facilities would be by elevators during non-transit operating hours.

2. Lease Revenues

Likely lease rates will reflect a combination of transit type lease rates, kiosk lease rates, lease rates for smaller square footage operators within the downtown area, and lease rates supportable by retail sales volumes of small retail venues. For smaller type uses, as proposed, lease rates generally would be in the ten to 18 percent of retail sales range. Smaller size facility lease rates in the Downtown DC area generally are in the $50 to $85 per square foot range. Transit agency lease rates vary greatly. For smaller spaces, lease rates can be over $100 per square foot for prime locations.

Kiosk lease rates also vary greatly depending upon the venue. Kiosk rates are generally quoted on a monthly basis and often are differentiated between the holiday season (November/ December) and the rest of the year. Off-season monthly rates generally range from approximately $800 to $2,400 per month for the nonholiday season, with the high end of the range reflective of major regional and super regional malls.

During the holiday season monthly lease rates can be 3 to 9 times the monthly rate for the remainder of the year. Kiosks and carts in more successful venues generally also are charged an "overage" or percentage lease amount, charging an additional occupancy cost for sales over a minimum threshold. Usually, occupancy costs are the greater of a base rent (for example $800 to $2400 per month) or 15 percent of retail sales.

Given the proposed average size allocation of 320 square feet per unit these lease rates would translate into an annual rates ranging from $40 to $210 per square foot. Most of the lease rates would be in the $60 to $80 per square foot range plus an overage rent. These rents are generally all-

inclusive and include the kiosk and common area maintenance charges. Electricity is sometimes included and sometimes an additional expense. Kiosks are typically provided electrical and telephone hookups.

Assuming a midpoint of 350 square feet of retail space (in addition to the larger spaces for the visitors center/museum and ticket outlet/reservation center) are supportable within the pedestrian connection, projected lease rates sales volumes as a percentage of sales (10 to 18 percent) would range in the $57 to $102 per square foot rate. In monthly terms this would range from approximately $1,650 to $3,000. Given the uncertain nature of sales performance in the pedestrian tunnel it is suggested that lease rates be placed in the low-end of the percent calculation or 10 percent of sales generating a projected per square foot lease rate of $50 to $60 per square foot or $1450 to $1750 per month.

This rate combined with the provision of a ready-to-operate retail facility should attract potential operators and potentially create incubator opportunities for small and disadvantaged businesses. The potential seasonal nature of retail sales and operations should be taken into consideration in order to encourage lively activity approaching and including the holiday season. In addition to monthly charges, retail operators would typically pay a security deposit equivalent to one to six months rent. Operators also would be required to maintain their own liability insurance. Typically units are also charged a startup or turnkey/opening fees generally ranging from $300 to $1500.

Assuming the public oriented visitor center/ museum and ticket outlet/reservations center pay only nominal fees, projected lease rates for retail space would generate annual revenues for the transit agency of $17,400 to $21,000 in 2005 constant dollars, based on 350 square feet leased and excluding any percentage rents or premium for holiday rentals.

Growth in revenues related to increases in ridership would be relatively modest given the projected 1.25 percent per year change in ridership. Growth in sales unrelated to ridership would likely grow at least at or near the rate of inflation to as high as growth in real sales per square foot of 3 to 5 percent per year.

This does **not** include additional revenues from percentage rents or premium rents for holiday rentals. Initially, these premiums would likely not be charged but clearly could be generated once the basic performance of the facilities has been established. These premiums could boost rentals by 40 to 100 percent assuming holiday lease rates three to six times average monthly rates and modest overage rental representing an additional 5 to 10 percent of base lease rates.

4. Advertising Revenues

In addition to creating visual interest and connections to commercial areas, advertising in the pedestrian tunnel creates the opportunity to generate additional revenue for WMATA. Metro related advertising provides opportunities to reach the out-of-home market in the Washington metropolitan area. The Metrobus and Metrorail system covers all of the District of Columbia and the suburbs of Maryland and Northern Virginia. According to Metro marketing materials, for instance, exterior bus advertising penetrates 90% of the daily population and provides exposure throughout the region's business districts, residential areas, and tourist attractions.

Advertising in the Metrorail system between the Gallery Place and Metro Center stations provides a unique opportunity to strategically target the large volume of demographically diverse business executives, federal employees, tourists, destination retail shoppers, conventioneers, and entertainment patrons. In addition to backlit advertising dioramas at and near station platforms, poster displays and banners are available in Metro stations.

The sale of advertising for the Metro system is currently under contract with the advertising division of Viacom, the global media conglomerate. Viacom Outdoor is the world's largest out-of-home media company with a major North American presence throughout the United States. It currently serves a majority of the large transit systems in the nation's major media markets including New York, Chicago, Boston, Philadelphia, Los Angeles, and San Francisco.

A potential advertising medium within a pedestrian tunnel could be 2-sheet (46" x 60") posters. Based on interviews with Viacom Outdoor, these posters penetrate major retail and trade zones and are well suited for targeting key transit demographics including higher income commuters and ethnic audiences as they move along platforms and through passageways. Posters would have to adhere to Metro standards and would not advertise competitors of the tunnel's retail component.

As of 2005, Viacom Outdoor's rate card, or "published rate", for a 2-sheet poster in the Metro system is $1,000 per month. Discussions with industry professionals suggest that these rates can vary significantly with supply and demand. During lower traffic periods such as January and February, rates can drop to as low as $500 per month.

Assuming one side of the pedestrian tunnel consists of the visitor's center/Metro museum, ticket outlet/reservation center, an existing substation, retail kiosk space and a potential performance area, there is a total of 840 linear feet for potential advertising on the opposite side.

At a spacing of four feet, the commercial and noncommercial sides of the tunnel could **theoretically** accommodate up to 95 posters. Assuming the low end of $500 per month per poster, the tunnel could potentially generate total advertising revenues of approximately $47,500 per month or $570,000 per year. Since more than 80 percent of transit agencies have contracts that call for a percentage of the annual net billings and most of these are in the 50 to 60 percent range, advertising in the pedestrian tunnel could **theoretically** generate up to $28,500 per month or $342,000 per year for WMATA. Given the untested nature of extended pedestrian tunnel advertising within the Metro system, it is assumed that revenues could be between $34,200 and $85,500 per year or 10 and 25 percent of these theoretical estimates.

A second advertising scenario assumes the pedestrian tunnel could support a multimedia advertising campaign. In addition to potentially generating additional advertising revenue, linear campaigns with unified design themes could help draw pedestrians through the tunnel and to commercial areas by creating a sense of excitement. According to Viacom Outdoor, its “Station Saturation”, or “Station Domination”, offering enables a single advertiser to blanket the traditional media products of a station and to enhance the display with special sites strategically placed in high-traffic areas.

The overall concept of “Station Saturation” is to create a “surround-site” experience. The result is a virtual exhibit that surrounds the consumer with multiple messages throughout their commute. Using a multimedia approach in a high profile station, these potential sponsorship venues are attractive to advertisers who have an umbrella message to impart with multiple facets.

On behalf of Metro, Viacom Outdoor currently offers “Station Saturation” packages at seven of the Metrorail stations. Included among these stations are Gallery Place-Chinatown and Metro Center. For $60,000 gross per month, a multimedia saturation investment at Gallery Place-Chinatown includes twenty six (26) backlit dioramas, twenty seven (27) 2-sheet posters, 2 medium banners (6’ x 11’4”), and 2 small banners (4’ x 10’). For $85,000 gross per month, a multimedia saturation investment at Metro Center includes thirty six (36) backlit dioramas, thirty seven (27) 2-sheet posters, and 2 large banners (7’ x 18’).

The pedestrian tunnel connecting the two stations could potentially support a more linear “Station Saturation” environment. Banners could be mounted on either end of the tunnel and a well designed combination of 2-sheet posters and backlit dioramas along the noncommercial wall could tie their advertising message together. With strategic marketing, the

tunnel's ability to convey a continuous linear advertising theme could potentially be more attractive to advertisers than the stations themselves.

A more exciting and ambitious advertising campaign for the pedestrian connection could utilize some of the latest developments in transit related media. Instead of a traditional series of 2-sheet posters and dioramas, the Gallery Place-Metro Center tunnel could be wrapped with dramatic floor-to-ceiling backlit stable or moving advertising images. One of the most revolutionary technologies being employed are motion picture displays. Transit riders in major global markets are exposed to fifteen second-long motion-picture advertisements in and along pedestrian connections and within subway tunnels themselves. Independent studies demonstrate that these unique displays have the highest recall rate of all transit advertising, with exceptional value in branding. This creative media is currently being used in systems across the globe including New York City, Atlanta, Tokyo and Hong Kong, with new displays unveiling soon in major cities in the U.S., South and Central America, Europe, and Asia.

Although a multimedia advertising campaign could take a number of unique forms, the noncommercial side of the tunnel could **theoretically** accommodate the traditional "Station Saturation" equivalent of 95 posters and backlit dioramas. Assuming the mix includes 50 posters at the low end of $500 per month, the tunnel could potentially generate poster revenues of approximately $25,000 per month or $300,000 per year. As of 2005, Viacom Outdoor's rate card for a backlit diorama in the Metro system is $1,120 to $1,500 per month depending on the number displayed and the campaign's duration. Assuming the mix includes 45 dioramas at the low end of $1,120 per month, the tunnel could potentially generate diorama revenues of approximately $50,400 or $604,800 per year. Total revenues could be up to $75,400 per month or $904,800 per year.

Since more than 80 percent of transit agencies have contracts that call for a percentage of the annual net billings and most of these are in the 50 to 60 percent range, advertising in the pedestrian tunnel could **theoretically** generate up to $45,240 per month or $542,880 per year for WMATA. Given the untested nature of "Station Saturation" pedestrian tunnel advertising within the Metro system, it is assumed that revenues could be between $54,288 and $135,720 per year or 10 and 25 percent of these theoretical estimates. This range would approximate 1 to 2 months of traditional "Station Saturation" campaigns at individual Metro's stations.

5. Feasibility Issues

While there is no established track record for retail within the Washington Metro system, based on the experience of other transit systems, the

unique development program, and the likely level of pedestrian traffic through the proposed Gallery Place and Metro Center connector, there appears to be sufficient activity to attract and incubate retail operators over time.

Assuming relatively minimal startup costs in terms of a modest opening fee and the cost of inventory, there could be sufficient interest, particularly if initially, short-term monthly leases were provided and kiosks were made available on a turnkey basis.

The relative attractiveness of starting up a business in the pedestrian tunnel would be enhanced if the initial leasing period were limited to the holiday season. Prospective lease revenues of 10 percent of sales would be feasible from a tenant's prospective, particularly given the minimum required startup capital requirements.

The key from the transit agency's perspective is to attract the select quality tenants and a quality tenant mix which will attract retail customer interest. Initially it may be more appropriate to master lease to a single experienced retail operator or leasing agent who would be responsible for creating, monitoring and maintaining quality tenant operations. Once quality tenants had been identified and the operational mix tested, it could then be possible for the transit agency to operate and manage the retail as do other major transit agencies (Boston, New York, Chicago and San Francisco).

Initial annual lease revenue would be relatively modest, on the order of magnitude of $17,400 to $21,000. Over time even modest increases in annual sales volumes could double these revenues over approximately a 20 year timeframe.

This broad and somewhat speculative potential revenue stream must be measured in terms of any incremental capital and operating cost to effectuate the retail operations. The primary cost is any incremental capital costs to construct and/ or adopt the underground retail area. The incremental cost of the Pedestrian Tunnel with retail is approximately $1.9 million more than a pedestrian tunnel only ($32.6 million vs. $30.7 million).

The incremental capital costs of adapting this additional space to retail operations is fairly minimal consisting primarily of additional domestic electrical and telephone service. The costs of the actual carts and or kiosks are also relatively modest. These units can range in costs from $2000 to $10,000 each with the high-end range of costs of retail units approximately $80,000 equivalent to approximately 1 year’s lease income.

Direct incremental operating costs in terms of utilities, cleaning, maintenance and management should also be relatively modest given the nonfood nature of the facilities and will not materially impact the analysis. Transit agencies typically do not pass these costs to the retail operators. Discussions with WMATA personnel concerning any special labor costs implications and or union related maintenance and operation costs will have to be determined. Likewise potential security issues need to be examined. Metro security cameras and or specialized security systems integrated into the retail units could be provided.

E. Summary

In summary, there appears to be potential modest retail and advertising opportunities within the transit connector. These initially would generate modest annual retail lease revenues in the $17,400 to $21,000 range and advertising revenues of $34,200 to $135,720. With a successful operation retail lease revenues could be expected to more than double over a 20 to 25 year timeframe. With utilization of retail kiosks, flexible lease terms (monthly lease arrangements), and lease rates of approximately 10 percent of projected sales there should be private sector interest.

The potential transit agency revenues are relatively modest and must be weighed against relatively modest operating costs and capital costs associated with obtaining carts or kiosks and adapting space to accommodate them. The most significant costs would be the incremental costs of constructing additional underground space. Operating and management issues must also be carefully examined as they obviously are not typical Metro functions. Retail lease revenues must also be compared to the potential loss in advertising revenues to competing retailers.

The table and chart below displays the projected annual returns for the incremental investment on a pedestrian tunnel with capacity for commercial operations. Scenario #1 assumes the low end of projections for retail lease and traditional advertising revenues (i.e. 2-sheet posters). Scenario #2 assumes the low end of projections for retail lease and “Station Saturation” advertising revenues. Scenario #3 assumes the high end of projections for retail lease and traditional advertising revenues. Scenario #4 assumes the high end of projections for retail lease and “Station Saturation” advertising revenues. For an incremental investment of $1.9 million, the potential annual returns are likely to range from 2.67% (Scenario #1) to 8.10% (Scenario #4).

Table :
Annual Return on Commercial Pedestrian Tunnel Incremental Cost
Gallery Place - Metro Center Pedestrian Tunnel
2005 Constant Dollars

Impact	Scenario #1	Scenario #2	Scenario #3	Scenario #4
Annual Lease Revenue	$17,400	$17,400	$21,000	$21,000
Annual Advertising Revenue	$34,200	$54,288	$85,500	$135,720
Total Revenue	$51,600	$71,688	$106,500	$156,720
Incremental Cost	$1,934,000	$1,934,000	$1,934,000	$1,934,000
Annual Return on Incremental Capital Cost	2.67%	3.71%	5.51%	8.10%

Source: BBP Associates