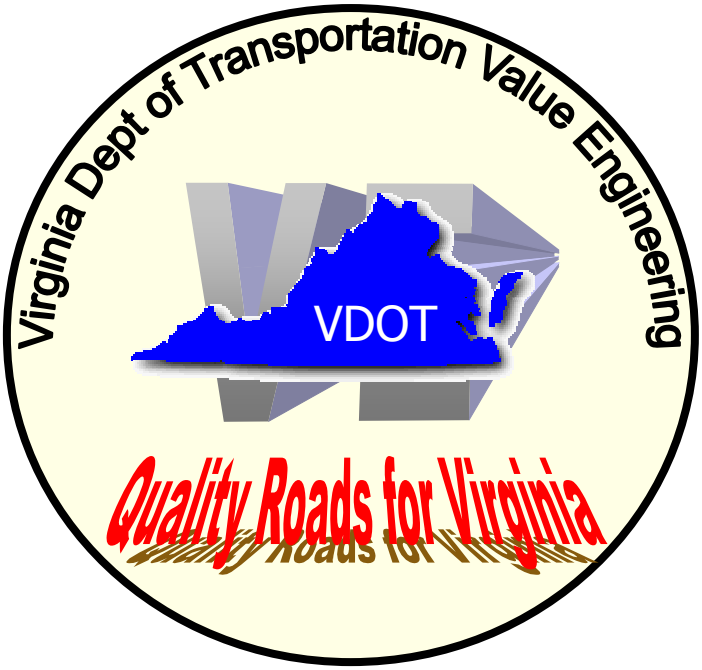
# *Value Engineering Study Report*




## Midtown Tunnel Corridor Project

## Hampton Roads District

0058-965-108, P101

PPMS# 76642

Study Date: 5/10/07 - 5/11/07

We Keep Virginia Moving

A Value Engineering Study of the Midtown Tunnel Corridor project was conducted at the Williamsburg Residency on 5/10/07 to 5/11/07. Members of the VE team were:

| | | |
|---|---|---|
| Alton Yates | Computer Systems Engineer | Hampton Roads District |
| Camelia Ravanbakht | Planning | HRPDC |
| Chung Wu | District Materials Engineer | Hampton Roads District |
| Daniele Noland | Project Manager | Innovative Project Delivery |
| Dwight Farmer | Planning | HRPDC |
| Ed Wallingford | Environmental Program Manager | Central Office Environmental |
| Greg Nataluk | Engineer | Hampton Roads District |
| Ian Johnstson | Design Project Manager | Hampton Roads District |
| James M. Fariss, Jr. | Bridge Engineer | Central Office Structure and Bridge |
| Jeffrey Raliski | Norfolk Planning | City of Norfolk |
| Jesús M. Rohena | Senior Tunnel Engineer | FHWA |
| John Daoulas | Geotechnical Engineer | Hampton Roads District |
| John Deusebio | Geologist | Hampton Roads District |
| John Mazur | Area Engineer | FHWA |
| Loretta Markham | Environmental Specialist | Central Office Environmental |
| George Brisbin | Senior Transportation Planner | City of Portsmouth |
| Morris Pearson | TMS Engineer | Hampton Roads District |
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| Raymond Partridge | Program Manager | Innovative Project Delivery |
| Rick Worssam | Assistant State L&D Engineer | Central Office Location and Design |
| Robert Jacobus | Transportation Engineer | Hampton Roads District |
| Ron F. Garrett | State Value Engineer | Scheduling and Contract Division |
| Mike Finney | Value Engineer | Scheduling and Contract Division |

The Midtown Tunnel Corridor project is located between the interchange of Martin Luther King (MLK) highway and western freeways in Portsmouth and Brambleton Avenue in Norfolk. It will improve traffic movement between Portsmouth and Norfolk at the Midtown Tunnel and alleviate long traffic delays which currently exist. Planned improvements include constructing two additional lanes to the Midtown tunnel, upgrading the Downtown tunnel and extending the MLK Freeway. The Downtown Tunnel on I-264 crosses the Southern Branch of the Elizabeth River in the South Hampton Roads area. It links Portsmouth with Norfolk. Along with the Berkley Bridge, the Downtown Tunnel connects to Interstate 464 to Chesapeake and is a continuation of I-264 to the downtown and Waterside areas of Norfolk, and on to Virginia Beach. The MLK Freeway Extension continues the roadway south to provide a direct connection between Norfolk and Portsmouth from the Midtown Tunnel and Pinners Point Interchange to a new interchange at I-264. These improvements provide enhanced east-west and north-south travel, linking Route 58 and the Western Freeway in Portsmouth to Brambleton Avenue in Norfolk.

The VE Team focused on the following categories in developing recommendations:

- Seasonal and Tidal Flooding
- Accommodate Regional Growth

- System Retrofits
- Design Height/Tunnel Lane Widths
- Construction/Environmental
- Tolling Strategies

The team identified “Increase Capacity”, “Reduce Congestion” and “Improve Connectivity” as the basic functions of this project. The team developed 13 recommendations for consideration as this project moves forward. Please note recommendation 8A & 8B are mutually exclusive.

**Recommendation 1 – Increase lane capacity in both directions, under the Brambleton Avenue Bridge, by removing the fill slope between the bridge piers and abutment walls; construct soil nail walls at the bridge abutments.**

The interchange in the area of the Brambleton Avenue Bridge will likely create a choke point for traffic that ties into the existing and proposed Midtown tunnel. Therefore, it is anticipated that some modifications and widening of the existing lanes will be needed to reduce this impact. Replacement and expansion of the existing bridge would be both costly and difficult due to historic properties and the hospital that are proximal to this area. One option is to consider the use of soil nailing to reconfigure the existing sloped abutments with a vertical abutment thus allowing an additional lane to be added on both sides of the road that crosses beneath the bridge. This application has been successful on other existing bridge projects within the Hampton Roads District. Advantages of this approach include: (1) improved maintenance of traffic with an increase in lane capacity; (2) increased flexibility in alignment of the proposed tunnel, where the access road to the tunnel ties in at the terminus point of the existing bridge structure; (3) enhanced operational performance with additional lanes and/or shoulder widths. In addition, soil nailing is a less expensive alternative to total bridge replacement.

There are no real disadvantages in providing this option. Up to about 35 ft of additional lane width could be gained beneath the east side of the bridge and an additional 30 ft under the west side. There was concern that the clearance under the existing bridge would not be sufficient to allow passage of a tractor-trailer truck thus requiring the new lanes be restricted to car traffic only. However, based on a visual observation of the bridge structure, it appears that sufficient clearance is available for truck traffic. The geometry of the existing on and off-ramps to Brambleton Avenue is the main constraint that may limit lane widening. In addition, any existing utilities within the soil nailing envelope would have to be relocated. Presently, there do not appear to be any utilities that would be impacted by soil nailing of the abutments, however this will need to be confirmed.

**Recommendation 2 – Eliminate a vehicle height restriction by establishing 18' as the minimum height for new Midtown Tunnel.**

The current proposal calls for a 16’ vertical height in the new tunnel. This recommendation proposes to construct the tunnel with 18’ height versus 16’. The additional two feet eliminates vehicle height restrictions, provides a design for future vehicles, matches Monitor Merrimac tunnel height, eliminates turnarounds for over height trucks traveling south/westbound and the associated bottlenecks that this restriction creates. It will incur an additional construction cost and must be completed with the proposed the additional clearance at the Brambleton Avenue Bridge to enjoy its full benefit.

**Recommendation 3 – Adjust typical section to meet current design standards by reducing width of the outside shoulder on the mainline Martin Luther King (MLK) Bridge and ramp structure from 12 feet to 10 feet.**

The roadway plans for the MLK Extension, as shown in the David Volkert & Associates Route 58 Conceptual Design Report, shows a 12' outside shoulder. It depicts a 12 foot outside shoulder on the Mainline MLK Bridge and ramp structure. The current bridge geometrics for an Urban Principal Arterial System roadway classification requires a 10 foot right shoulder on bridges with 2 thru lanes in the same direction (ref: Vol. V-2-06.02-6 of the Manual of the Structure and Bridge Division). This proposal recommends constructing a 10' versus 12' shoulder. It saves construction cost and meets current standards

**Potential savings/cost avoidance: $2,488,800**

**Recommendation 4 - Provide greater flexibility in both design and construction of the new Midtown tunnel by expanding the current proposed tunnel footprint.**

The conceptual plans for this project show a second tunnel to be constructed parallel to the north side of the existing tunnel at about 52 ft center to center. The shape and configuration of the new tunnel will be about the same size as the existing tunnel which is approximately 40 ft in diameter. Therefore, the annular space between the new and existing tunnel is expected to be less than 12 ft. The close proximity location of the new and existing tunnel in conjunction with the subsurface conditions that exist in this area will pose a high potential that damage to the existing tunnel may occur during construction of the new tunnel using the open trench method. Even if the tube for the new tunnel is installed utilizing boring techniques the risk is still very high. The construction of the proposed tunnel at this location will likely greatly inflate the overall cost to the project to account for this risk and add cost to assure the existing tunnel is stabilized from both lateral and vertical movement as well as damage due to vibration caused by construction of the new tunnel. In addition, if damage to the existing tunnel occurs it could have a major impact to the project and the region, especially if the damage is severe enough that it puts the tunnel temporally out of commission. To reduce the potential risk and cost to this project it is recommended the design-builders be given greater latitude to design and construct the new tunnel further away from the existing tunnel.

There is insufficient data available at this time to determine the optimal distance that should be provided between the new and existing tunnels. During the April 24, 2007 Industry Briefing, several firms expressed concern with the 12-foot separation distance and it was suggested that the new tunnel should be located at least 80 ft center to center from the existing tunnel to reduce the risk of construction impacts. Stabilization during construction of the second Downtown tunnel, although located in a similar geologic setting, was not an issue because the two tunnels are about 200 ft apart. The Environmental Impact Statement restricts the terminal points of the proposed tunnel project and requires an alignment that is "approximately parallel". This indicates some latitude in aligning the new tunnel between these two points. The terminus point on the Portsmouth side of the new tunnel is near the entry point of the existing tunnel. However, on the Norfolk side the terminus point is much further inland at the tie-in near the existing Brambleton Interchange. The entry point to the new tunnel could be shifted to the north as much as 300 ft from the present location and still provide adequate room to align the new approach road to the tunnel to tie into the terminus specified in the EIS. Therefore, this recommendation proposes to expand the limits of the tunnel footprint up to 300 ft from the existing tunnel with the end of the new facility tapered to tie back into the required terminus points.

There are a number of factors to consider in determining the optimal distance away from the existing tunnel where the new tunnel should be constructed. It will be the design-builders responsibility to determine the optimal location, design and construction of the tunnel that will best meet the needs of the project. The advantages for expanding the footprint in which the tunnel may be constructed and still meet the constrictions of the EIS document are as follows:

- Provides the design-builder greater flexibility in establishing the alignment of the new tunnel for ease of construction of the new tube especially in the areas of deep water.
- Less site constraints means a greater opportunity to reduce the time needed for construction of the new tunnel.
- Reduces risk and cost for contingencies associated with that risk in assuring adequate stability of existing tunnel while constructing the new tunnel.
- Minimize the potential impact the new tunnel may have on the safe operations of the existing tunnel during the time of construction.
- The area on land formed between the entry and exit points on the Norfolk side of the two tunnels will provide additional space within the acquired ROW that could be used for the installation of other tunnel facilities to improve operations such as a cargo inspection station and a diversion road.

There are no real disadvantages to expansion of the tunnel footprint other than the need to acquire some additional right-of-way and the possible impact the alignment of the new tunnel may have on an existing 30 inch water main the crosses the river about 100 ft downstream (north) of the tunnel footprint. This option will also require some environmental action to Federal Highway Administration (FHWA) to gain concurrence of the proposed shift, as FHWA just completed its re-evaluation of the Midtown Tunnel EIS in May 2007.

**Recommendation 5 - Coordinate with Corps of Engineers for using Craney Island as a disposal site.**

The most obvious dredge spoil disposal location for the tunnel is nearby at Craney Island, a federal facility that is owned by the Army Corps of Engineers (ACOE) and located downstream of the tunnel location. The ACOE recently restricted the use of Craney Island to disposal of spoils from navigation-related projects. It is recommended that the Department coordinate with the ACOE to get a determination that the tunnel is such a project. The premise for this position should be that a bridge at this location (which was once considered) is infeasible due to the constraints it would impose on naval and commercial vessel traffic (and consequently the tunnel actually aids navigation).

**Recommendation 6 – Preserve the Brambleton Avenue Interchange with as little reconstruction as possible by restricting truck traffic on Hampton Boulevard.**

There are no plans to restrict truck traffic from the Midtown Tunnel. This proposal recommends preserving the Brambleton Avenue Interchange with as little reconstruction as possible by restricting truck traffic on Hampton Boulevard volumes. Truck volumes dictate design features such as pavement depth, bridge clearances and ramp/loop geometry. If trucks are restricted from the Midtown Tunnel, design issues are simplified. Mobility Management figures indicate that only 1% trucks (Tractor Trailer) per 32,000 vehicles travel through the present Midtown Tunnel. Restricting trucks would improve quality of life for local residents and certain cost benefits related to tunnel ventilation and fire suppression systems. This proposal received a negative response from the

FHWA representatives. Since Hampton Blvd. (Rte. 58) is a primary roadway, it is possible that trucks cannot be legally restricted.

**Recommendation 7 – Ensure commonality of all tunnel controls and provide a centralized control facility for operations.**

Ensuring commonality of the new tunnel controls with existing controls is simply sound design. If the construction project installs traffic and equipment controls that are not compatible with the existing Pinners Point and tunnel controls then it will be ergonomically and functionally difficult, to near impossible, to operate with any degree of efficiency. Further more, if a common control design is not provided then it would render the new facility's controls incompatible with the Eastern Operations region mandated Contingency Operations Center. Also the new facility would be incompatible with the Hampton Roads Smart Traffic Center and incapable of up channeling traffic data to provide a regional traffic management function. A retrofit to provide commonality for these systems could easily cost as much as the basic control system itself and would likely run the range of one to seven million dollars.

If the construction project does not include a control room, then an alternate space would have to be located and equipped to provide the functions of the control room. Not having a control room is truly not an option and the cost of retrofitting the environmental systems, automation systems and necessary controls could be significant. The final cost would depend upon finding available space and the work required to equip the alternate space. Including a centralized control facility in this project could represent a cost savings of up to $750,000 to several million dollars.

**Recommendation 8A – Increase capacity and reduce congestion by eliminating ramps at High Street.**

The goals of the project as developed at the Value Engineering were to increase capacity, reduce congestion and improve connectivity. One of the goals as stated in the Interchange Justification report is to provide a direct freeway to freeway connection between the Midtown Tunnel, Pinners Point and Interstate I-264. In addition, this new connection is to provide system linkage between the existing and proposed port facilities and Interstate 264.

The proposed ramps at High Street do not contribute to the goals of increasing capacity, reducing congestion or improving connectivity to the port facilities. In addition, the proposed design injects some less than desirable design and operation features into the project.

The elimination of the ramps eliminates a substandard design concept of creating only a partial interchange. FHWA and AASHTO do not recommend the creation of interchanges at which all movements are not accommodated. Given that the MLK is on the National Highway System, all efforts should be made to comply with FHWA and AASHTO practices.

Elimination of the ramps will also eliminate the need for two design exceptions. AASHTO ramp to ramps spacing criteria are not met between the westbound I-264 ramp to northbound MLK and the ramp from northbound MLK to High Street. Similarly, the spacing between the ramp to southbound MLK from High Street and the ramp from southbound MLK to WB I-264 is substandard. This could cause weaving and congestion problems along MLK.

The elimination of the ramps will obviously reduce the design, right of way acquisition and construction time frames and costs. The ramps and their associated acceleration and deceleration lanes would require additional structure width on the elevated MLK, significant retaining walls on the ramps and additional right of way. Additionally, these ramps complicate any tolling schemes that might be introduced along the MLK.

The main disadvantage of the elimination of the ramps is that this cuts access to the City of Portsmouth from the MLK. The City desires that access be provided from the MLK to High Street, which is the City's main thoroughfare to Downtown.

Additionally, this would redirect traffic to other interchanges along I-264, which may cause congestion and other operational difficulties at those interchanges. Given that the recommended alternative in the Interchange Justification Report is recommending the removal of the partial interchange at Des Moines Avenue, this may put additional strain on the other two interchanges serving this portion of the City of Portsmouth.

**Recommendation 8B - Eliminate a sub standard loop interchange at London Boulevard by constructing a single point urban interchange at High Street.**

The east bound to north bound movement at the London Boulevard Interchange is substandard and cannot be corrected because of the interchange's proximity to Calvary Baptist Church, located in the south east corner. Much of the east bound to north bound movement appears to be occurring at High and MLK currently because of the inadequate ramp at London Boulevard. By building the MLK connector without an adequate high volume interchange at County Street, High Street or London Boulevard, the Portsmouth Central Business District (CDB) will be cut off from good access to and from the tunnels, VA 164 and I 264. Using High Street as the interchange point will complement the CBD and allow direct access to it. Using County Street to the south or London Boulevard to the north will create a zig zag movement to access the CBD which most likely will occur at Effingham. Effingham is already congested from the Naval Hospital and the Naval Shipyard. We do not need to deliberately build an interchange that will cause problems down stream from it.

The city is aware that an interchange located at High Street will mean that the substandard east to north bound ramp at London Boulevard will have to be removed. Also that there will be additional taking of property for right of way in the High Street area to accommodate a single point urban diamond at that location. That interchange will serve South Street via the High Street and Elm Avenue connections, which will assist the City of Portsmouth in restructuring access into the Prentice Park area after the removal of the Des Moines interchange.

**Recommendation 9 – Improve emergency operations by designing for directional traffic during hurricane evacuations or tunnel emergencies.**

It is very important to consider the directional features of the tunnel during the design phase. This feature has the following advantages:

1. If an incident occurs in the tunnel, and as a result one direction remains closed, traffic can flow in the other direction without any interruptions. This would reduce delay and queue resulting from major incidents inside the tunnel.
2. It would be very beneficial during any emergency conditions from an access and security point of view.

3. During hurricane evacuation, this design feature could be beneficial for traffic flow and movement of vehicles.

**Recommendation 10 – Provide a facility that can accommodate larger ships and has a longer service life by constructing a twin-tube tunnel structure on new alignment.**

The proposed design to construct a parallel two-lane tunnel to the existing Midtown Tunnel will be extremely risky. Some contractors might not even bid and if they do bid, the price might be economically exorbitant. This recommendation proposes to construct a new twin-tube tunnel (i.e., four lanes) a greater distance from the existing Midtown tunnel and abandon the existing tunnel once construction is complete. By constructing a new twin-tube tunnel away from the existing tunnel, the risks will be lower for the contractor and public safety will be enhanced. With a new twin-tube tunnel the state will be able to increase the crossing capacity, raise the portal elevation and reduce flooding risks. In addition, the channel can be widened and deepened for efficient operations of the Navy. This approach will incur a higher initial cost; however, with unconstrained design and new tunnel construction techniques and associated technologies, it may provide a longer life cycle cost. It will delay the NEPA document.

**Recommendation 11 – Provide capacity to meet future traffic demands, by constructing the new Midtown Tunnel as a multi-modal facility (Bus Rapid transit and/or Light Rail).**

Staff from the City of Portsmouth Planning Department collected and assembled the data outlined below. Sources for the data were taken from the Hampton Roads District Tunnel Traffic Volume and Stoppage Reports, 15-minute volume reports for the Downtown Tunnel furnished by Hampton Roads Tunnel personnel. The 2030 traffic volume for the Downtown tunnel was taken from an unofficial report by HRPDC and should be reexamined for accuracy before any of the projections can be presented as the best engineering/planning estimates. Methods and conclusions were guided by procedures in the Highway Capacity Manual as published by the Transportation Research Board.

BACKGROUND: This discussion focuses on the Portsmouth/Norfolk Downtown and Midtown Tunnels, since their operational conditions are not the same as other tunnels in the region. These two tunnels have two of their termini located in CBD's. The approaches to these tunnels include a bascule-type bridge, a residential area that borders the largest medical complex in Southeastern Virginia, and a complicated elevated interchange over a port facility. The other tunnels in the region have long approaches and widely spaced interchanges that do not dampen the carrying capacity to the same degree as the conditions at the two Portsmouth/Norfolk tunnels.

PURPOSE: Any proposal to improve the Midtown Tunnel crossing must include provisions for a mass transit (Bus Rapid Transit and/or Light Rail) crossing at this location. In the year 2030, the improved Downtown Tunnel, Martin Luther King Connector, and Midtown Tunnel Complex will be operating at approximately the same failure level that we are currently experiencing. Adding a second tube to the Midtown Tunnel alone will not solve the tunnel-crossing problem between Portsmouth and Norfolk.

ANALYSIS: The eight-month average weekday volume at the Downtown Tunnel is 103,300 vpwd and 41,600 vpwd at the Midtown Tunnel. Traffic is expected to increase to about 140,000 vpwd at the Downtown Tunnel by 2030. Assuming that the Midtown Tunnel increases at the same rate, the 2030 volume there would be 56,400 vpwd for a combined total of 196,400 vpwd. Assuming that the MLK serves as a perfect balancing connector between the two facilities and that the Midtown Tunnel is four lanes, then the volume in each would be 98,200 vpwd, or just a little less than what the Downtown

Tunnel is carrying at present but more the current volume of the Hampton Roads Bridge Tunnel (94,600vpwd). Both tunnels are considered over-capacity and transportation bottlenecks.

According to the HCM, a freeway 50 mph design speed with vehicles operation at 28 mph (LOS "D") carries 1,900 pcphpl and is considered the Maximum Service Flow. Two twelve-foot lanes with obstructions on both side at two feet from land edge will drop the Service Flow rate by 6%. Truck to car equivalent for a 5% truck volume going up a 6% grade for ¼ to ½ mile is 1 truck = 12 cars. Not applying any other correction factors and realizing that trucks are restricted to the outside lanes only, Service Flow (SF) for the outside lanes would be 804, while the inside lanes would have an SF of 1,786. Assuming that approaches to both tunnels are operating at max SF, the four tubes would have a capacity at LOS at "D" of 10,350 pcph. The Downtown Tunnel's average highest one-hour two-way weekday volume is 6,400. Assuming that the Midtown Tunnel will achieve the same flow rate then the actual total flow for the two tunnels in 2030 would be 12,800 vph, or an excess of 2,450 vph over the LOD capacity of "D".

Even though the numbers are "rough," adding two lanes of roadway capacity must be augmented by some other form of transportation in order to serve the involved cities adequately in the future.

**Recommendation 12 – Reduce potential tunnel flooding by improving off site drainage with or without pumping systems.**

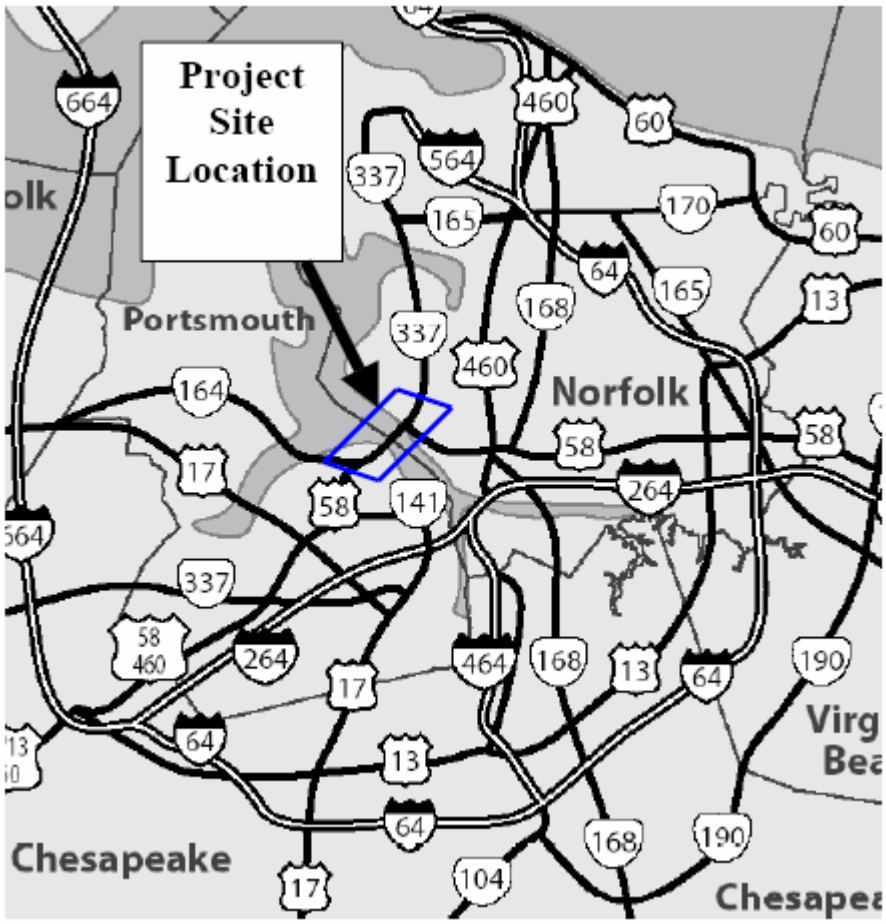
Much of the City of Norfolk is constructed on manmade fill. Drainage outfalls are often obstructed during high tide; and much of the drainage system is below the groundwater table. Drainage pipes often remain 50% to 75% full for the reasons stated above, and the lack of topographic relief prohibits grades that are conducive to positive flow characteristics. There is also the possibility that the existing system is antiquated and operating at a level above the original design capacity.

This recommendation proposes to reduce potential tunnel flooding by improving off site drainage with or without pumping systems**.** The City of Norfolk has a master plan in place to systematically renovate/replace the existing drainage system. The proposed Midtown project should tap into that plan by developing a partnership with the City of Norfolk to renovate the storm drain system on an area wide basis. Any future drainage design should be evaluated and consider the use of a closed pumping system to overcome the adverse conditions previously described.

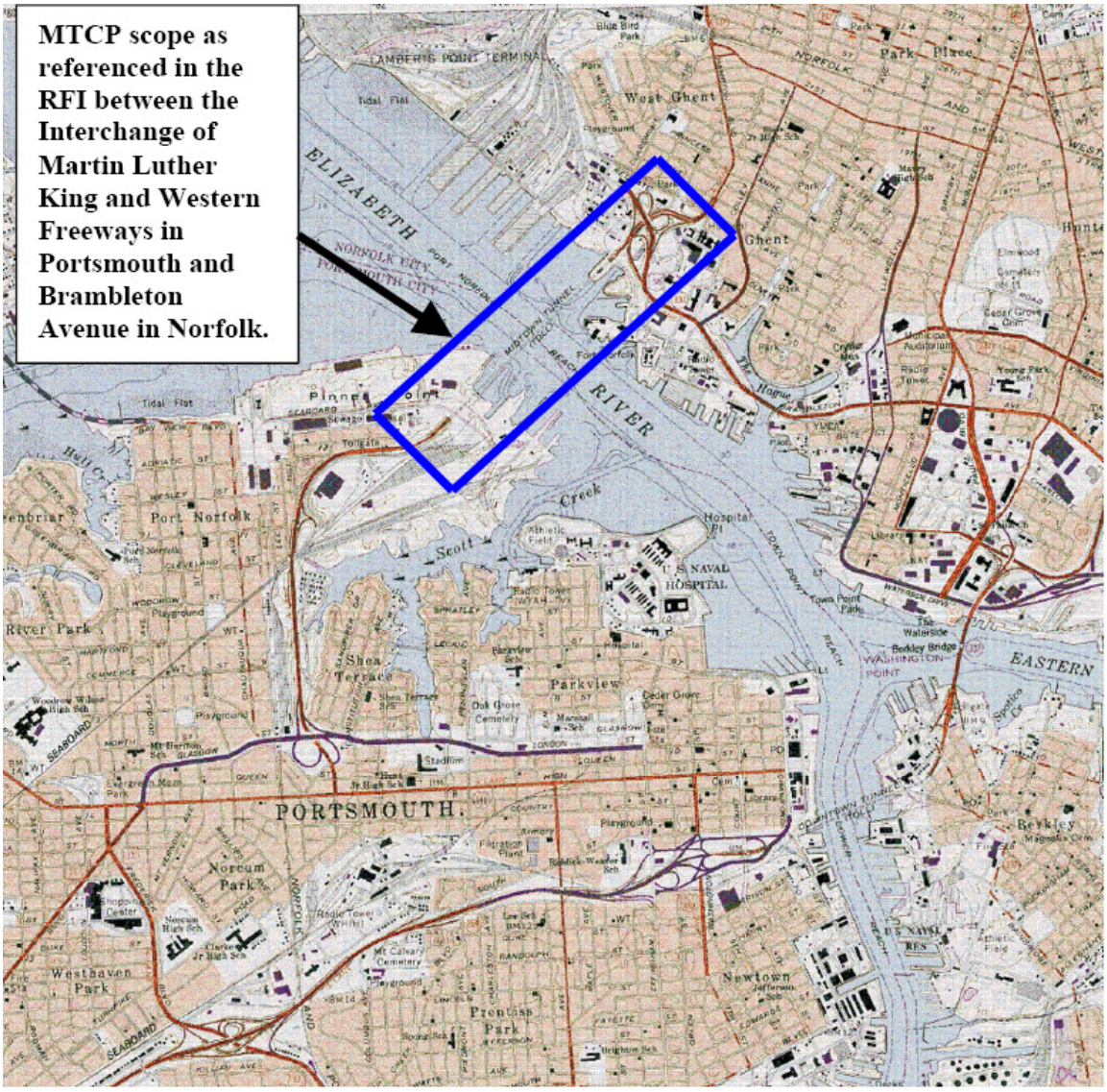
**Recommendation 13 - Minimize or eliminate duplication of effort by coordinating this project with the Hampton Roads District Flood Control Dike project.**

The Hampton Roads District has a Midtown Flood Control Dike project under development to limit or eliminate off site drainage from encroaching on the tunnel entrance. Since the proposed Midtown Tunnel Corridor project completion date is 2014, deferment of the dike project would delay any additional flood control measures by seven (7) years or longer This proposal recommends minimizing or eliminating duplication of effort by coordinating this project closely with the Hampton Roads District flood control dike project.

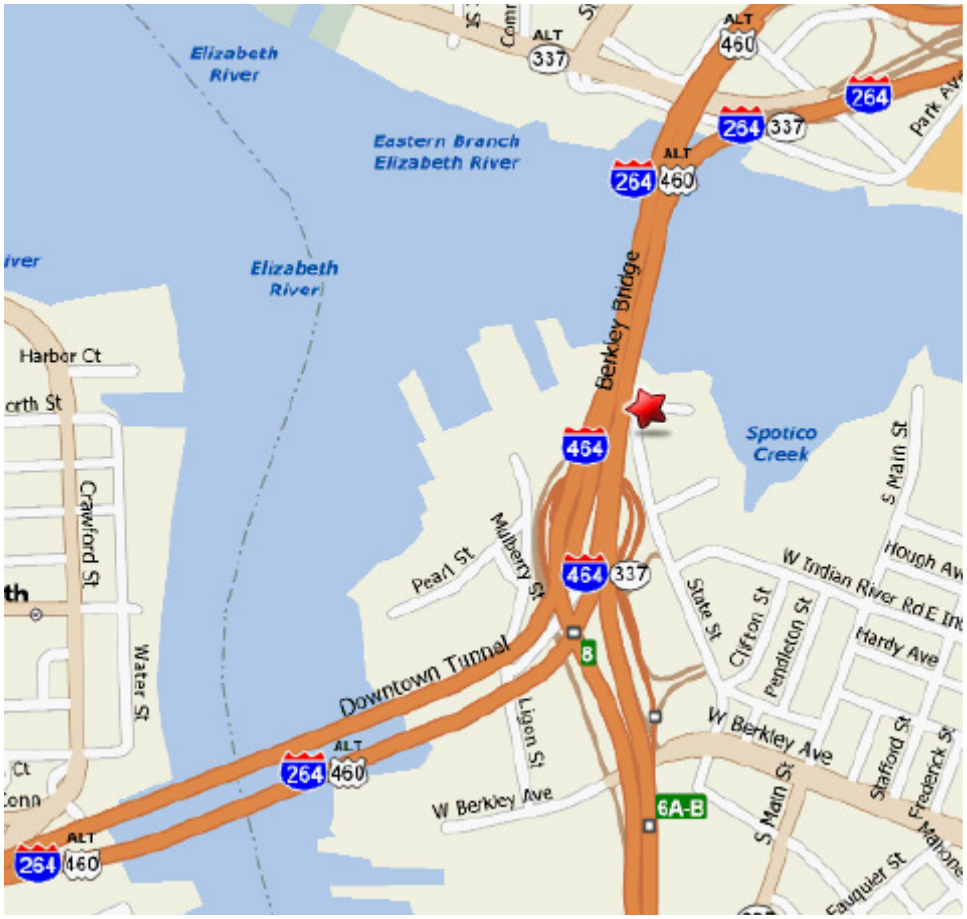
# Midtown & Project Site Connecting Roadways



# Project Location



# Connecting Roadways at Downtown Tunnel



# Midtown Tunnel Entrance

## Study Identification

| | |
|---|---|
| Project No. 0058-965-108, P101 | Study Date: 5/10/07 - 5/11/07 |
| Project locations: Midtown & Downtown Tunnels, Martin Luther King Freeway | Field Inspection Date: TBD |

## Project Description

| Length: | Total Project Cost: | Type of Funds: |
|---|---|---|
| Varies | Estimated: $1,500,000,000 | Federal/State/Private |
| Major Project Components: | | Functional Class: |
| New Tunnel Construction, Martin Luther King Expressway improvements, Mid-Town tunnel refurbishment. | | Various |

## Project Manager

| Name | Location | Phone |
|---|---|---|
| Raymond Partridge | Central Office | (804) 371-0128 |

## Authorizing Persons

| Name | Location | Phone |
|---|---|---|
| Dennis Heuer | Hampton Roads District Administrator | (757) 925-2511 |
| Mohammad Mirshahi | State Location & Design Engineer | (804) 786-2507 |
| Tom Pelnik | Director, Innovative Project Delivery | (804) 786-1103 |
| Earl Robb | Environmental Quality Division Administrator | (804) 786-4559 |

## SUMMARY OF RECOMMENDATIONS

| # | Description | Initial | Lifecycle | Total |
|---|---|---|---|---|
| 1 | Increase lane capacity in both directions, under the Brambleton Avenue Bridge, by removing the fill slope between the bridge piers and abutment walls; construct soil nail walls at the bridge abutments. | $0 | | $0 |
| 2 | Eliminate a vehicle height restriction by establishing 18' as the minimum height for new Midtown Tunnel. | $0 | | $0 |
| 3 | Adjust typical section to meet current design standards by reducing width of the outside shoulder on the mainline Martin Luther King (MLK) Bridge and ramp structure from 12 feet to 10 feet. | $0 | | $0 |
| 4 | Provide greater flexibility in both design and construction of the new Midtown tunnel by expanding the current proposed tunnel footprint. | $0 | | $0 |
| 5 | Coordinate with Corps of Engineers for using Craney Island as a disposal site. | $0 | | $0 |
| 6 | Preserve the Brambleton Avenue Interchange with as little reconstruction as possible by restricting truck traffic on Hampton Boulevard. | $0 | | $0 |
| 7 | Ensure commonality of all tunnel controls and provide a centralized control facility for operations. | $0 | | $0 |
| 8A | Eliminate ramps at High Street. | $0 | | $0 |
| 8B | Eliminate a sub standard loop interchange at London Boulevard by constructing a single point urban interchange at High Street. | $0 | | $0 |
| 9 | Improve emergency operations by designing for directional traffic during hurricane evacuations or tunnel emergencies. | $0 | | $0 |
| 10 | Provide a facility that can accommodate larger ships and has a longer service life by constructing a twin-tube tunnel structure on new alignment. | $0 | | $0 |
| 11 | Provide capacity to meet future traffic demands, by constructing the new Midtown Tunnel as a multi-modal facility (Bus Rapid transit and/or Light Rail). | $0 | | $0 |

| | | | | |
|---|---|---|---|---|
| 12 | Reduce potential tunnel flooding by improving off site drainage with or without pumping systems. | $0 | | $0 |
| 13 | Minimize or eliminate duplication of effort by coordinating this project with the Hampton Roads District Flood Control Dike project**.** | $0 | | $0 |

**Recommendation # 3**

Cost Worksheet Engineering: 12.00% Contingencies: 10.00%

| Construction Element | | | | Original Estimate | | New Estimate | |
|---|---|---|---|---|---|---|---|
| Item | Units | EC/UT | Cost/Unit | # Units | Total | # Units | Total |
| MLK Bridge | LS | EC | $1,800,000.00 | 1 | $2,196,000.00 | 0 | $0.00 |
| Ramp N | LS | EC | $240,000.00 | 1 | $292,800.00 | 0 | $0.00 |
| | | | | | Sub Totals: $2,488,800 | | $0 |
| | | | | | | Initial Cost Savings: | $2,488,800 |

**Calculations:**
MLK Bridge ~ 3000(4) ($150) = $1,800,000
Ramp N ~ 800(2) ($150) = 240,000
Total = $2,040,000

Function Analysis
Creative Idea Listing

| Item | Midtown Tunnel PPTA | Costs | |
|---|---|---|---|

| Function | Basic /Secondary |
|---|---|
| Increase Capacity | B |
| Reduce Congestion | B |
| Improve Connectivity | B |

| **Creative Idea Listing** |
|---|
| Pump Systems |
| Defer district midtown dike Project |
| Raise portal elevation (exist and new) |
| Design for directional traffic |
| Improve off site drainage |
| Twin tubes on new alignment |
| Single four lanes |
| Rail line for freight |
| Replace old tunnel (twin bore) |
| Tunnel with cars and trucks |
| Restrict trucks on Hampton Blvd |
| Revise Martin Luther King geometrics |
| Access for US 17 tie in |
| Forget new tunnel work on Martin Luther King |
| Separate downtown tunnel |
| Eliminate ramps to High Street |
| Extend northern side tunnel limits |
| New twin bore tunnel, old for multi-modal |
| twin bore for mix of highway and transit |
| Common systems in all tunnels |
| Need tunnel control room |
| Identify cargo restrictions |
| Standardize tunnel restrictions |
| Design to retrofit |
| Own and operate by regional auth vs. private |
| Use soil nail walls at Brambleton Interchange |
| Establish 18' height on new tunnel |
| Martin Luther King with shoulders at median |

| Creative Idea Listing |
| --- |
| Revise Martin Luther King to meet current stds |
| Shoulders on new tunnel |
| Analyze benefits of wider tunnel |
| Emergency pull out areas in tunnel |
| Increase size of box area of construction |
| Change terminus of midtown tunnel |
| Identify site conditions geotech/environ/pavement |
| Tunnel boring |
| Detailed truck traffic on all project areas |
| Alternate disposal Craney Island site |
| Route 264 Archeological design constraints |
| Prefab/rapid construction techniques |
| Consider shutting traffic down |
| Tolling and environmental justice |
| Start tolling now |
| Retain flexibility in tolling area |
| Penalties for toll crooks |
| Martin Luther King at-grade intersection |
| Close Des Moines Avenue ramp (diamond interchange) |
| Single point interchange at High Street |
| Toll Route 164 |
| Build tunnel in dry |