

VN-84 – The Verrazano-Narrows Bridge Master Plan

Shared-Use Access Study

August 2018

Submitted to:



Submitted by:



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Executive Summary

INTRODUCTION

In the spring of 2014, MTA Bridges and Tunnels (MTAB&T) commenced development of the Verrazano-Narrows Bridge (VNB) Master Plan (Project VN-84). The Master Plan reflects the MTAB&T's vision for rehabilitating the VNB's approach structures, and is the action plan for the Brooklyn side of the facility, the Upper Level Approach on the Staten Island side and the Lower Level Suspended Span. The Master Plan will enable the MTAB&T to make informed decisions and will result in the prudent use of financial resources to replace or reconstruct the VNB approaches and the ramps connecting with the Belt Parkway and Gowanus Expressway. The Master Plan includes projects that address bridge conditions and structural and State of Good Repair (SOGR) needs, as well as the functional, safety and access considerations for the ramps and approaches of the bridge.

As part of the Master Plan, the MTAB&T investigated the feasibility of constructing a Shared-Use Path (SUP) on the bridge to accommodate bicyclists and pedestrians. This report presents the results of that evaluation.

Rehabilitation of the Brooklyn and Staten Island Upper Level Approaches and Belt Parkway Ramps is required to maintain the VNB in a SOGR, update the facility to current standards, improve safety and traffic flow and provide the flexibility to maintain, inspect and rehabilitate the bridge without adversely affecting traffic. These improvements are essential to maintain the bridge's continued operations and functionality. They enable future work and are critical to allowing for the future reconstruction of the Lower Level deck. They also provide the capacity and operational flexibility to accommodate some traffic to be temporarily diverted from the Lower Level to the Upper Level during future construction while minimizing delays to customers. The initial phase of the ramp improvements will be implemented in the current (2015-2019) MTA Capital Program with other phases to follow in future Capital Programs.

The Lower Level Suspended Span deck will reach the end of its useful life in approximately the next 10-20 years and will require replacement along with supporting elements. The deck replacement must minimize any increased dead load on the bridge's main cables and, as such, will likely require use of a lightweight deck system if any additional structure such as a SUP is to be added to the bridge. Replacing the Lower Level deck will reduce the weight of the bridge, thereby creating the opportunity to potentially construct additional superstructure to support the SUPs on the bridge.

SHARED-USE ACCESS ALTERNATIVES CONSIDERED

Based on established goals, design standards and engineering feasibility considerations, and extensive feedback from bridge users, residents of Brooklyn and Staten Island, transportation advocacy groups, elected representatives, Community Boards, and agencies, the Project Team evaluated eight concepts to provide access for bicyclists and pedestrians between Brooklyn and Staten Island.

These concepts (Table ES-1) are broadly defined as:

- Separate paths that would be constructed outboard of the superstructure (six concepts)
- Concepts that would not affect the bridge's suspended span (two concepts)

The table below lists the concepts and the results of an extensive evaluation process. Fact sheets with further detail were prepared for several concepts and are shown on pages IV to VIII.

Table ES-1: Shared-Use Access Concepts

| CATEGORY/DESCRIPTION OF CONCEPT | | EVALUATION RESULTS (Refer to Fact Sheets) |
|----------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------|
| Outboard of Superstructure | | |
| 1 | Outboard of Lower Level <i>SUPs attached outboard of the Lower Level suspended span</i> | Further evaluation during preliminary design of Lower Level Suspended Span deck to determine engineering feasibility |
| 2 | Outboard of Lower Level-Brooklyn Approach in John J. Carty Park | No further evaluation (Approach structures have significant negative environmental impacts to John J. Carty Park) |
| 3 | Outboard of Upper Level <i>SUPs attached outboard of the Upper Level suspended span</i> | Further evaluation during preliminary design of Lower Level Suspended Span deck to determine engineering feasibility |
| 4 | Reconstructed Brooklyn Upper Level Approach Ramps-Belt Parkway Ramps | No further evaluation (Preliminary analysis in Chapter 5; concept is fatally flawed*) |
| 5 | Reconstructed Brooklyn Upper Level Approach Ramps-Eastbound Gowanus Expressway Approach to 92 nd Street | No further evaluation (Preliminary analysis in Chapter 5; concept is fatally flawed*) |
| 6 | Reconstructed Brooklyn Upper Level Approach Ramps-Eastbound Upper Level Exit to Belt Parkway | No further evaluation (Preliminary analysis in Chapter 5; concept is fatally flawed*) |
| Concepts that would not affect the VNB's Suspended Span | | |
| 7 | Separate Bicycle/Pedestrian Crossing of the Narrows | No further evaluation-not within MTAB&T's purview |
| 8 | New Ferry Service | No further evaluation-not within MTAB&T's purview |

*A fatally flawed concept cannot be implemented because of adverse impacts on safety, bridge operations and/or traffic.

FINDINGS

The SUP concept within MTAB&T's purview that best meets current design standards and security, operational and maintenance requirements is a path attached to the suspended span outboard of the Lower Level. There are two alternatives that are outboard of the Lower Level, but the preferred alternative is similar in all elements except it has less impact to John J. Carty Park in Brooklyn. The Outboard of Lower Level alternative is also preferred to the Outboard of Upper Level alternative for a number of reasons such as fewer impacts to parks in Brooklyn and Staten Island, shorter approach ramps, and lower overall cost. The remaining outboard alternatives that use the existing roadway network will not be further evaluated due their fatal geometric design and safety flaws.

For the preferred Outboard of Lower Level alternative, the SUPs outboard of the westbound and eastbound side of the Lower Level would connect to bicycle/pedestrian paths adjacent to the Brooklyn and Staten Island approaches to the bridge. Ramps that meet current design standards including Americans with Disabilities Act (ADA) requirements would connect the SUPs to grade. These ramps would be located in Gateway National Park requiring National Parks Service (NPS) approval on the Staten Island side, and the New York City Department of Parks and Recreation (NYCDPR) Shore Park and John Paul Jones Park on the Brooklyn side. The proposed location of the Brooklyn SUP in NYCDPR parkland would require obtaining an interim permit and license and a permanent easement from the NYCDPR. The form of approval from NPS would likely be a lease. NPS approval would trigger project compliance with Section 106 of the National Historic Preservation Act (NHPA). National Environmental Policy Act (NEPA) compliance would be triggered by federal approvals required for the project including NPS approval and approval under Section 106 of the NHPA. The level of NEPA documentation required is likely an Environmental Impact Statement (EIS) due the historic nature of the VNB (i.e., the bridge is eligible for listing on the National Register of Historic Places (NRHP), visual effects (SUP directly attached to the VNB affecting the look of the bridge), and strong community interest.

The estimated cost to construct SUPs outboard of the Lower Level, including approach ramps, is approximately \$320-\$340 million (2015\$).

Constructing a separate crossing parallel to the VNB for bicyclists and pedestrians or providing new ferry service to transport bicyclists and pedestrians between Staten Island and Brooklyn avoid many of the implementation issues of a SUP on the VNB, but are beyond MTAB&T's purview. These alternatives would entail consideration of jurisdictional restrictions, policies of other agencies and stakeholders, and other issues that are beyond the scope of this study. However, during the public outreach process many bicycle riders, bridge users and residents of Brooklyn and Staten Island expressed support for a new ferry service as a quicker and lower cost strategy (relative to implementing separate SUPs on the bridge) for bicyclists to travel between Brooklyn and Staten Island. NYC Ferry's South Brooklyn route and the considerable investments to further enhance Staten Island as a "destination" could incentivize expanded ferry service for bicyclists and pedestrians across the Narrows.

NEXT STEPS

To determine whether a SUP outboard of the bridge is structurally feasible, an evaluation of the effects on the structure of wind, local and global structural loading, seismic events, etc. is required. MTAB&T's future preliminary design study to replace the VNB Lower Level Suspended Span will include evaluating the feasibility of the outboard SUP concepts.

Figure ES-1: Outboard of Lower Level Fact Sheet (Alternative 1)



Alternative 1 Outboard Lower Level

DESCRIPTION

This alternative proposes a 12-14' wide two-way bike path and two-way pedestrian path along the north and south sides of the lower level of the VNB. The paths are supported on structures adjacent to the lower level of the bridge. Both paths can be accessed by emergency and maintenance vehicles. The pedestrian paths and their approaches are ADA compliant.

Access to Grade

Brooklyn: The bike and pedestrian approach ramps meet grade at the Shore Park mixed-use path. The bike approach is a ramp structure that loops in John Paul Jones Park, and the pedestrian approach has a set of switchback ramps that sits between the eastbound Belt Parkway and the approach ramp from 4th Avenue.

Staten Island: The bike and pedestrian paths meet grade along New York Avenue in Fort Wadsworth property. The bike path is north of the VNB, and the pedestrian path has a set of switchback ramps south of the VNB. An emergency/maintenance vehicle access ramp connects the facility service road into the pedestrian path before the Staten Island anchorage.

Environmental and Regulatory Review

An Environmental Impact Statement (EIS) is required due to property and parkland impacts and anticipated effects on built and natural environments, e.g., cultural resources, visual quality, floodplain, etc.

Next Steps

This concept will be further evaluated for feasibility during preliminary design of the VNB Lower Level Suspended deck. Requirements for further engineering study to confirm technical feasibility include: wind modeling, seismic investigations, structural analysis, and bridge profile analysis.

PROS:

- Meets security requirements
- Meets AASHTO standards for two-way bike and pedestrian paths
- Provides for emergency and maintenance access including snow removal
- Connection to existing path in Brooklyn and accessible by local streets in Staten Island

CONS:

- High cost
- Increased weight on structure; infeasible until load on VNB main cables is reduced
- Impacts to adjacent parkland and Army forts (John Paul Jones Park, Shore Park, Fort Wadsworth)
- Extensive grade elevation change and significant length of the SUP makes for a very challenging crossing

COST: \$320-\$340M (\$2015)

Figure ES-2: Outboard of Lower Level – Brooklyn Approach in John J. Carty Park Fact Sheet (Alternative 2)



Alternative 2 Outboard of Lower Level – Brooklyn Approach in John J. Carty Park

DESCRIPTION.....

This alternative is the same as the Outboard of Lower Level (Alternative 1) except for the Brooklyn approach. The approach in Staten Island and the paths adjacent to the VNB are the same. Therefore, the only differences with this alternative would be associated with the Brooklyn approach.

Access to Grade

Brooklyn: The shared bike and pedestrian approach ramp meets grade in John J. Carty Park. The pedestrian path meets with the bike path near the VNB Brooklyn anchorage, and the shared path meets grade near the various courts in John J. Carty Park. This approach ramp is shorter than the Outboard of Lower Level alternative, but no significant cost savings is anticipated because the SUPs on the main span and the approach structures in Staten Island comprise approximately 85 percent of the total cost and would remain. There would also be an additional switchback ramp, an extensive structural support system, and retaining wall in John J. Carty Park.

Environmental and Regulatory Review

Similar to the Outboard of Lower Level alternative, an Environmental Impact Statement will be required. Mitigation will be required for the impacts to the park facilities in John J. Carty Park, and there will be major impacts in the neighboring residential community along Fort Hamilton Parkway in Bay Ridge.

Next Steps

This concept will not be considered further due to the significant adverse impacts on John J. Carty Park and the adjacent neighborhood.

PROS:

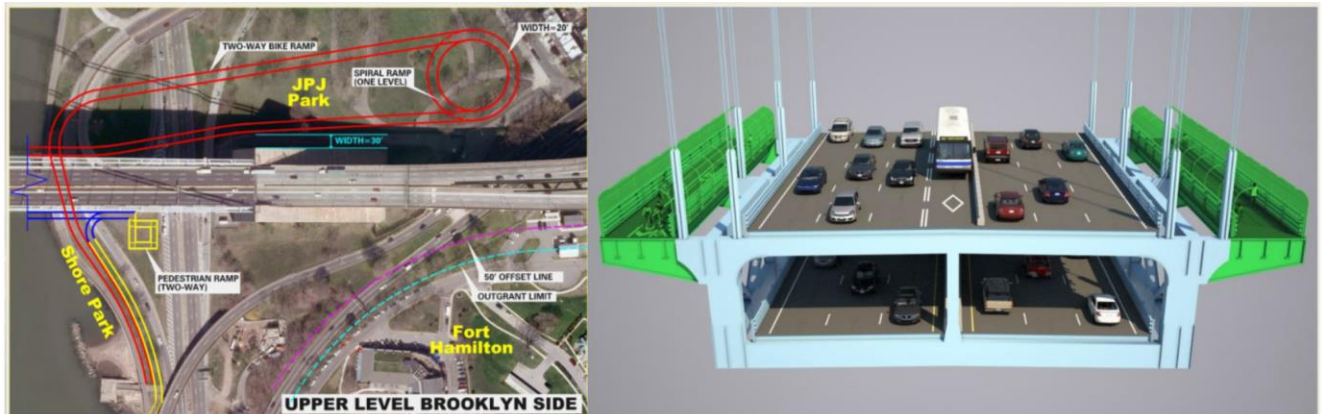
- Meets security requirements
- Meets AASHTO standards for two-way bike and pedestrian paths
- Provides for emergency and maintenance access including snow removal

CONS:

- High cost
- Increased weight on structure; infeasible until load on VNB main cables is reduced
- Impacts to adjacent parkland and Army forts (John J. Carty Park, John Paul Jones Park)
- Security concern with proximity to Fort Hamilton entrance
- SUP terminates in residential neighborhood rather than existing SUP
- Multiple switchback ramps required for bike and pedestrian path to meet

COST: \$320-\$340M (\$2015)

Figure ES-3: Outboard of Upper Level Fact Sheet (Alternative 3)



Alternative 3 Outboard Upper Level

DESCRIPTION.....

This alternative proposes a 12–14 feet wide two-way bike path and two-way pedestrian path along the north and south sides of the upper level of the VNB. The paths are supported on structures adjacent to the upper level of the bridge. Both paths can be accessed by emergency and maintenance vehicles. The pedestrian paths and their approaches are ADA compliant.

Access to Grade

Brooklyn: The bike and pedestrian approach ramps meet grade at the Shore Park mixed-use path. The bike approach is an elevated circular spiral ramp in John Paul Jones Park, and the pedestrian approach has a set of switchback ramps that sits between the eastbound Belt Parkway and the approach ramp from 4th Avenue.

Staten Island: The bike and pedestrian paths meet grade along New York Avenue in Fort Wadsworth property. The bike path is north of the VNB, and the pedestrian path has a set of switchback ramps south of the VNB. An emergency/maintenance vehicle access ramp connects the facility service road into the pedestrian path before the Staten Island anchorage.

Environmental and Regulatory Review

An Environmental Impact Statement (EIS) will be required due to property and parkland impacts and anticipated effects on built and natural environments (e.g., cultural resources, visual quality, floodplain, etc.).

Next Steps

This concept will be further evaluated for feasibility during preliminary design of the VNB Lower Level Suspended deck. Requirements for further engineering study to confirm technical feasibility include: wind modeling, seismic investigations, structural analysis, and bridge profile analysis.

PROS:

- Meets security requirements
- Meets AASHTO standards for two-way bike and pedestrian paths
- Provides for emergency and maintenance access including snow removal
- Connection to existing path in Brooklyn and accessible by local streets in Staten Island

CONS:

- High cost
- Approaches are approximately 500 feet longer than Outboard Lower Level concept due to 25 foot higher elevation across VNB
- Increased weight on structure; infeasible until load on VNB main cables is reduced
- Impacts to adjacent parkland and Army forts (John Paul Jones Park, Shore Park, Fort Wadsworth)

COST: \$340-\$370M (\$2015)

Figure ES-4: Separate Bicycle/Pedestrian Crossing of the Narrows Fact Sheet (Alternative 7)



Alternative 7

Separate Bicycle/ Pedestrian Crossing of the Narrows

DESCRIPTION.....

This alternative is a separate pedestrian bridge which is parallel to the VNB. It would be a fixed structure with a movable main span tall enough (lift height of 250 feet) to accommodate large ships. This concept avoids security, engineering and property impacts of options that require retrofitting the VNB.

Access to Grade

Brooklyn: Brooklyn and Staten Island access would link to existing SUPs on Shore Road in Brooklyn and Bay Street in Staten Island. There would be minimal change in vertical elevation between the new bridge and path, which will provide easier access.

Staten Island: Access point is to be determined.

Environmental and Regulatory Review

There would be environmental impacts for construction of a bicycle/ pedestrian path across The Narrows waterway. There are significant institutional issues to address including which agency owns, builds, operates and maintains the facility.

Next Steps

This concept will not be further evaluated since it is not within MTA Bridges and Tunnels' purview.

PROS:

- Meets security requirements
- Meets AASHTO standards for two-way bike and pedestrian paths
- Provides for emergency and maintenance access including snow removal
- No impacts to the VNB
- Improves overall transportation system resiliency
- May be possible to engineer as part of a larger flood protection system for New York City possibly in collaboration with United States Army Corps of Engineers

CONS:

- High cost
- Environmental impacts to The Narrows waterway

COST: \$490- \$525M (\$2015)

Figure ES-5: New Ferry Service Fact Sheet (Alternative 8)



Alternative 8 New Ferry Service

DESCRIPTION.....

This alternative calls for expanding ferry service and/or providing new service between Brooklyn and Staten Island. It is assumed that ferry landings will be at the Brooklyn Army Terminal and in Stapleton (Staten Island) and will be adjacent to existing Shared Use Paths.

Existing plans and development show that interest in expanding ferry service between Brooklyn and Staten Island is already underway. While a direct route between Staten Island and Brooklyn was not proposed in the current Citywide Ferry Service plan, this represents a potential opportunity to serve an additional stop in Brooklyn following the Stapleton stop. Renovation and updating of existing ferry docks and constructing new landings may be required.

Environmental and Regulatory Review

Renovating and constructing new ferry landings.

Next Steps

Further evaluation must be done by others since it is not within MTA Bridges and Tunnels' purview.

PROS:

- No impacts to the VNB
- Concept received wide support during public outreach
- Utilize existing ferry infrastructure (i.e. Brooklyn Army Terminal, St. George, Stapleton landings)
- All-weather alternative

CONS:

- Ferry service between Staten Island and Brooklyn is not currently part of Citywide Ferry Service Program
- Although this alternative provides a physical connection for cyclists, it does not provide a true bike path connection
- Renovation of existing infrastructure

COST:

One vessel: \$1 to \$5 Million
 Yearly Operating: \$2 to \$4 Million
 Landings: \$5 to \$10 Million

1 Introduction

1.1 OVERVIEW

Having celebrated its 50th anniversary in 2015, the Verrazano-Narrows Bridge (VNB) is the longest suspension bridge in the United States. Including approach roadways, the bridge is approximately 2.5 miles long. The 4,260-foot center span is more than 225 feet above the Narrows. The bridge's iconic towers are nearly 700 feet tall.

Figure 1-1: VNB from Brooklyn Looking towards Staten Island



Source: WSP

In 2014, MTAB&T started preparing the VNB Master Plan Study to assess the best way to address the bridge's long-term needs. The VNB Master Plan describes MTAB&T's vision and is the action plan for the Brooklyn side of the facility and the Upper Level approach on the Staten Island side. The Master Plan will enable MTAB&T to make informed investment decisions to replace or reconstruct the VNB approaches and the ramps connecting with the Belt Parkway. Reconstructing the bridge's approach ramps, Belt Parkway Ramps and Lower Level Suspended Span deck is the MTAB&T's next major investment program at the facility. The Master Plan projects will maintain the facility in a State of Good Repair (SOGR) and provide operational and safety improvements for the bridge's ramps and approaches.

While planning these necessary upgrades, MTAB&T is also assessing the feasibility of possibly providing a permanent Shared-Use Path (SUP) for pedestrian and bicycle access across the bridge.

This study evaluates many of the issues informing the feasibility of providing such a path. The potential effects of a SUP on neighboring communities; estimated costs; constructability, operational, maintenance, jurisdictional and safety issues; and the anticipated applicability and level of environmental review are presented. Feedback on the concept of a SUP on the bridge is provided from myriad public and private stakeholders. This report identifies the additional detailed analyses required to fully evaluate the feasibility of providing a SUP on the bridge. This report was prepared by WSP (formerly Parsons Brinckerhoff/WSP, Joint Venture) in conjunction with MTAB&T's Engineering and Construction Department (collectively referred to as the Project Team).

1.2 ORGANIZATION OF REPORT

The remainder of this report is organized as follows:

- **Chapter 2** describes the VNB's approach structures and adjacent roadways and the bridge's critical role in the regional, multi-modal transportation network.
- **Chapter 3** describes the goals and objectives, components, and implementation schedule of the Master Plan projects. This information establishes the technical and implementation contexts for the consideration of a SUP on the bridge.
- **Chapter 4** describes goals, requirements, design standards and engineering feasibility considerations for a SUP on the VNB.
- **Chapter 5** evaluates eight shared-use access concepts including pathways on the VNB and other options for providing bicycle and pedestrian access between Staten Island and Brooklyn. The characteristics of each concept, the anticipated effects of the SUP on bridge users, customers and on neighboring communities, and jurisdictional issues are described.
- **Chapter 6** presents capital cost estimates of the shared-use access concepts.
- **Chapter 7** summarizes feedback on the concept of shared-use access from: residents, elected representatives, Community Boards and civic organizations from areas of Brooklyn and Staten Island that would be affected by a SUP; from transportation advocacy groups; and from representatives of City, State and federal agencies. The results of an online survey of residents and bridge users are also presented.
- **Chapter 8** identifies the anticipated applicability and level of environmental review of a SUP.
- **Chapter 9** identifies next steps in the evaluation process.

2 Verrazano-Narrows Bridge Background and Existing Conditions

2.1 OVERVIEW

The VNB connects the Boroughs of Brooklyn and Staten Island (Figure 2-1). With links to the Gowanus Expressway, Belt Parkway and Staten Island Expressway (SIE), the bridge is a vital component of the Interstate 278 (I-278) corridor. The corridor serves passengers in automobiles, buses (multiple MTA New York City Transit [NYCT] local bus routes, S79 Select Bus Service, and MTA Express Bus routes), other high occupancy vehicles (HOVs) and trucks for goods movement. On a typical weekday in May 2016, the bridge carried approximately 110,000 vehicles eastbound (total both levels) and about 100,000 vehicles westbound. In 2013, the bridge carried about 9,000 vehicles (total both levels) eastbound in the morning weekday peak hour and slightly fewer vehicles westbound in the evening peak hour.

Figure 2-1: Project Area



Source: WSP

MTA New York City Transit (NYCT) provides bicycle racks on the front of buses on the S53 and S93 routes (Figure 2-2). A dedicated bus fleet was created for the S53 and S93 in order to limit bike racks to these routes and ensure that all buses operating in these routes have racks. The S53 and S93 routes connect Bay Ridge, Brooklyn with Port Richmond (S53) and the College of Staten Island (S93), respectively. These routes cross the VNB, allowing riders to connect with existing pedestrian and cycling paths in both Brooklyn and Staten Island. Customers are responsible for loading and unloading bicycles.

According to MTA NYCT, in the first year of service (September 2015-August 2016) average daily bike rack usage was less than five customers. The S53 had slightly more than four uses per day compared to less than one for the S93. Feedback on this service from customers has been positive, and there have not been operational or performance issues.

Figure 2-2: Bicycle Rack on S53 Route



Source: Google Images

The approaches of the bridge are on a portion of Fort Hamilton and Fort Wadsworth that the US Army allowed easement to the MTAB&T in the 1960's. Construction of the VNB was completed in 1964 at a cost of approximately \$320 million. At that time the bridge was the longest suspension bridge in the world. The Upper Level and Lower Level opened for traffic in 1964 and 1969, respectively. The bridge currently carries a total of six lanes of traffic on both the Upper Level and Lower Level. As described in Section 2.5, a seventh reversible lane for buses and HOVs is currently under construction on the Upper Level suspended span. The suspended deck spans are supported by two pairs of main cables. Many of the Upper Level approach structures and Belt Parkway ramps are the original construction. The VNB was not originally designed to accommodate bicyclists or pedestrians.

2.2 BROOKLYN VNB APPROACH

Both levels of the bridge connect with the Belt Parkway and Gowanus Expressway in both directions via a series of connecting structures known as the Brooklyn approach ramps. The Lower and Upper Level approach structures are the viaducts which connect the on-grade pavement on either side of the bridge to the suspended span. The Brooklyn approach extends from the anchorage to the on-grade pavement by the 92nd Street overpass and consists of several approach ramps and exit ramps in both directions. The Brooklyn approach abuts residential and commercial districts in Bay Ridge.

The Brooklyn approach structures abut Fort Hamilton and John J. Carty Park. The anchorage is located adjacent to John Paul Jones Park. Both John J. Carty Park and John Paul Jones Park are under the jurisdiction of the City of New York. The Brooklyn approach abuts Shore Park and the Belt Parkway. The portion of the Belt Parkway between the VNB and Bay Parkway is within land owned by the federal government and the City of New York. The New York City Department of Parks and Recreation (NYCDPR) maintains Shore Park, and the City's Department of Transportation (NYCDOT) maintains Shore Parkway.

2.3 STATEN ISLAND VNB APPROACH

The Staten Island approach extends to the Fingerboard Road overpass over the SIE. The Upper Level approaches link the VNB toll plaza and SIE. Several ramps provide access/egress to local streets. About half of MTAB&T's jurisdiction is within the portion of Fort Wadsworth referenced in the easement with the federal government. The Army reservation is now under the jurisdiction of the National Parks Service. Property jurisdiction is an important consideration in the evaluation of Shared-Use Access concepts because it influences the potential location of such structures and the required level of environmental review.

2.4 BICYCLE AND PEDESTRIAN FACILITIES NEAR THE VNB

On the Brooklyn side of the VNB, the Shore Parkway Greenway is a SUP located between the Narrows and Belt Parkway. The path passes under the bridge along the water's edge and traverses the communities of Bay Ridge, Fort Hamilton and Bath Beach. In Staten Island, bicyclists and pedestrians can access the South Beach Boardwalk and bikeway via the Lily Pond Ave bike lanes (a two-way bike lane). Both Brooklyn and Staten Island have a network of bicycle paths, city-provided bicycle racks as well as numerous bicycle rental and repair shops.

2.4.1 Bicycle and Pedestrian Facilities in Brooklyn

The area of Brooklyn near the VNB is well equipped for cyclists, with dedicated bike lanes running along the waterfront and various streets. The VNB crosses over the Shore Parkway Greenway (grade separated), and potential pedestrian/bicycle connections from the bridge's ramps could be made at the northern end of the Greenway at 67th Street and 7th Avenue. Figure 2-3 is from the NYCDOT bike map, showing the portion of Brooklyn in the vicinity of the VNB. The Shore Parkway Greenway is shown in green, curving around the western shore of Bay Ridge.

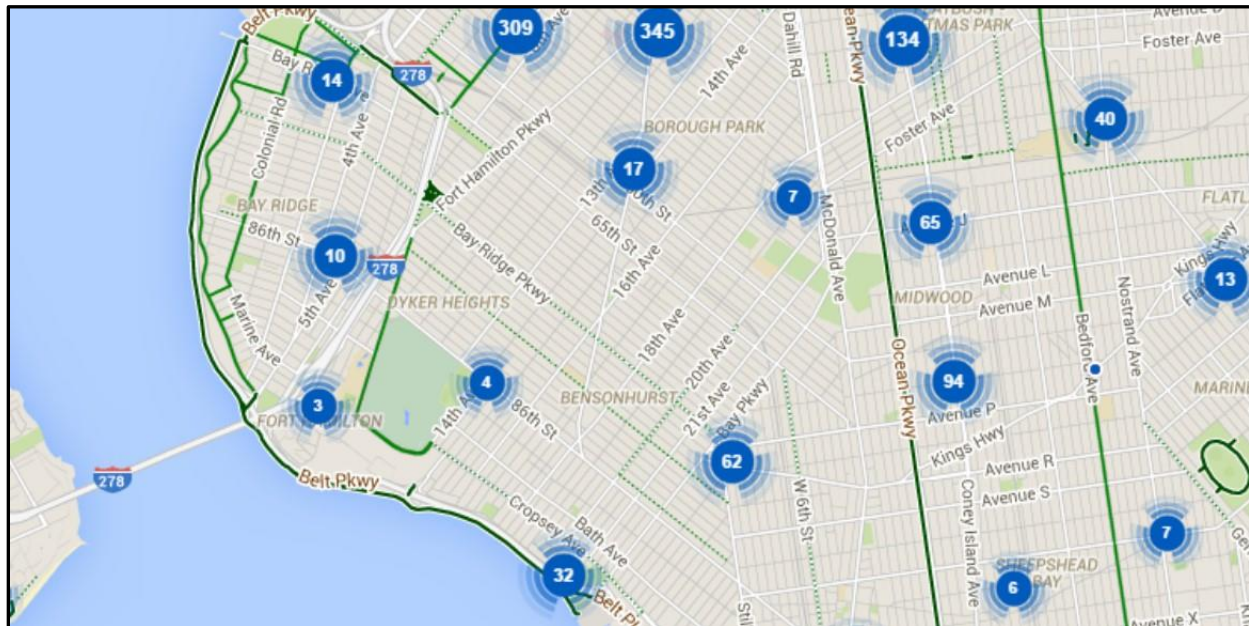
Figure 2-3: Bikeways in Brooklyn near the Verrazano-Narrows Bridge



Source: www.nyc.gov

In addition to bike routes and bikeways, Brooklyn has a high concentration of bike racks throughout the borough for users to chain their personal bicycles to. NYCDOT has mapped all bike racks throughout New York City and provides these on their website. As shown in Figure 2-4, there is a lower density of racks for personal bicycles available surrounding the Brooklyn end of the VNB in comparison to the significant bicycle rack availability in other portions of the borough. The white numbers within each blue circle represent the total number of city-provided bike racks in each neighborhood or section. The numbers adjust depending on the zoom of the view as shown on the website.

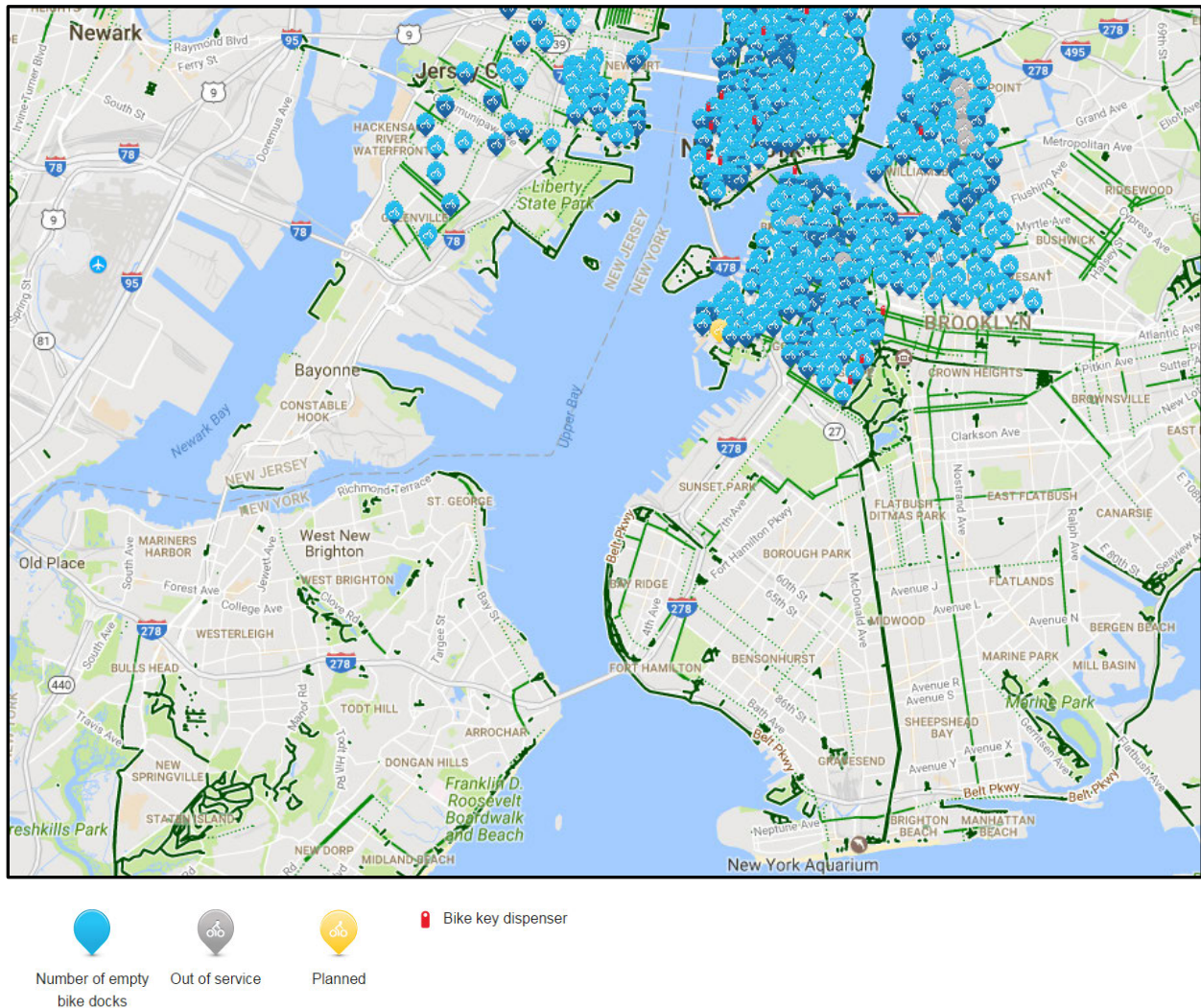
Figure 2-4: NYCDOT Bike Racks Available in Brooklyn near the Verrazano-Narrows Bridge



Source: www.nyc.gov

In addition to bike racks for locking up personal bikes, Citi Bike also serves Brooklyn. Citi Bike is a privately owned public bike sharing program that has bikes in various neighborhoods throughout New York City. Patrons of Citi Bike can purchase daily to yearly passes, which provide access to bikes at all of the Citi Bike docking stations. Citi Bike provides an additional transportation option since riders start their trip at one docking station and end it at their destination docking station. As shown in Figure 2-5, Brooklyn Citi Bike serves only the Downtown Brooklyn, Brooklyn Heights and Park Slope, areas well north of the VNB. While Citi Bike operates locations based on density and demand for bicycle travel, new locations are selected and tested based on public input.

Figure 2-5: Citi Bike Stations in South Brooklyn



Source: <https://www.citibikenyc.com/stations>

2.4.2 Bicycle and Pedestrian Facilities in Staten Island

The NYCDOT bike accessibility map indicates some bike lanes on the approach to the VNB, though these lanes are slightly less well connected to the rest of the borough. Facilities and infrastructure targeted at bicyclists are sparse, compared to other areas of the city. As of January 2017, there are no plans to expand Citi Bike to Staten Island. As described in Chapter 7, several members of focus groups were concerned about the lack of bicycle facilities or attractions on Staten Island and suggested possible extensions of bicycle lanes to the Staten Island Ferry Terminal and elsewhere. Figure 2-6 is from the NYCDOT bike map, showing the portion of west Staten Island in the vicinity of the VNB.

Figure 2-6: Bikeways in Staten Island near the Verrazano-Narrows Bridge

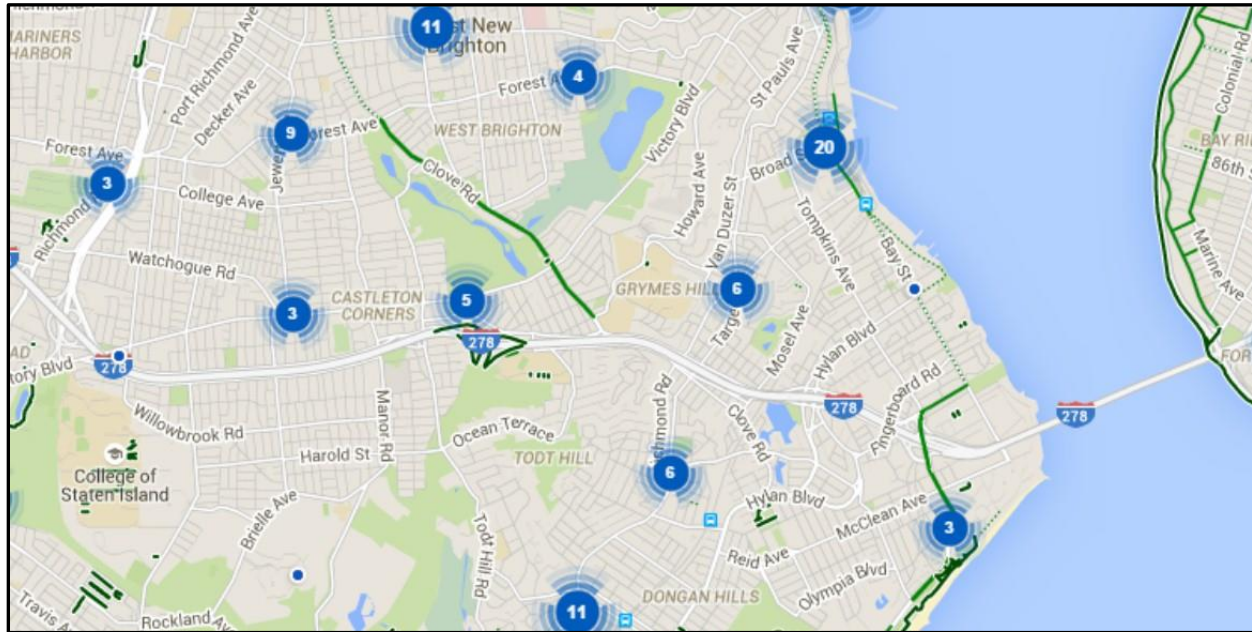


Source: www.nyc.gov

Figure 2-7 shows locations and totals of bike racks in Staten Island in the vicinity of the VNB. Compared to the Brooklyn side, the number of bike racks in Staten Island is significantly lower. The white numbers

within each blue circle represent the total number of city-provided bike racks in each neighborhood or section. The numbers adjust depending on the zoom of the view as shown on the website.

Figure 2-7: NYCDOT Bike Racks on Staten Island near the Verrazano-Narrows Bridge



Source: www.nyc.gov

Since there is currently not a bike share program in Staten Island, the City of New York Department of Parks & Recreation released a Request for Proposal (RFP) in February 2016 for the development, operation and maintenance of bicycle rental stations at five locations on Staten Island. These locations include St. George Ferry Terminal, Fort Wadsworth, Miller Field, Franklin D. Roosevelt Boardwalk, and Conference House Park. The RFP also discusses the opportunity for additional Staten Island locations to operate bicycle rental stations in the future. Wheel Fun Rentals was selected to operate the stations along the FDR Boardwalk at Jefferson Avenue and at Sand Lane. These facilities are generally open weekdays and weekends from mid-morning to sunset between May and October.

2.5 CURRENT AND PLANNED CAPITAL INVESTMENTS

In previous MTAB&T capital programs, investments at the VNB focused on rehabilitating the bridge's primary structural elements such as painting structural steel and concrete repairs; electrical system, drainage system and fire stand pipe system upgrades; seismic and wind improvements; the Lower Level approach structures in Brooklyn and Staten Island; and, most recently, replacing the Upper Level suspended deck span. Since the first Capital Program in 1992, MTAB&T has invested over \$960 million to maintain and preserve this iconic facility.

MTAB&T, in coordination with New York State Department of Transportation (NYSDOT), is implementing a long term strategic initiative to improve traffic flow in the I-278 corridor and to achieve the goal of a continuous Bus/HOV lane from Staten Island to Manhattan. The VNB serves a vital role in

this initiative. Planning began in the 1999-2004 capital program with the Project VN-03 feasibility study and Master Plan to improve the SIE approach to the VNB, remove the unused eastbound toll booths, and reconstruct the Staten Island Ramps. A Memorandum of Understanding (MOU) was established between MTAB&T and NYSDOT to reconstruct nearby entrances and exits between Narrows Road South, Narrows Road North and the SIE and to rehabilitate and widen the Fingerboard Road overpass to allow for new Bus/HOV lanes to be constructed on the SIE and the VNB approach. Collectively, these initiatives dramatically increase throughput, significantly reduce customer travel time, and facilitate more efficient Bus/HOV travel and goods movement thereby benefiting regional travel and the environment.

Two major construction projects on and adjacent to the Brooklyn Approach to the bridge are expected to be completed in 2018:

- Project VN-80B is a \$250 million project to rehabilitate the Upper Level suspended span by replacing the 50-year old concrete deck with a new stronger and lighter steel orthotropic deck. This project includes a reversible lane for Bus/HOV traffic. A movable barrier is being installed that will allow the VNB to accommodate Bus/HOV travel in the morning and evening peak travel periods by safely reversing traffic flow.
- Project VN-80C is an \$80 million project, which will construct a new Bus/HOV ramp on the Brooklyn approach to connect the Upper Level reversible Bus/HOV lane to the Gowanus Expressway resulting in uninterrupted Bus/HOV travel between Staten Island and Manhattan. As described in Chapter 7, Staten Island residents who use MTA Express Buses to travel between Staten Island and Manhattan strongly support the Bus/HOV lane because of the travel time savings it provides.

A MOU has also been established between MTAB&T and NYSDOT to implement an Advanced Traffic Management System (ATMS) in the Gowanus Brooklyn approach to the VNB, similar to the ATMS on the Staten Island approach. Additional improvements to this corridor are planned in the 2015-2019 capital program including reconfiguring the merge between the Upper Level and Lower Level of the VNB with the eastbound Gowanus Expressway to the Fort Hamilton Exit. Collectively, these MTA B&T- and NYSDOT-led initiatives are expected to reduce travel time for Bus/HOV commuters by 15 minutes or more; reduce delays and improve traffic flow in the I-278 corridor; and facilitate planned reconstruction of the Upper Level Brooklyn Approach (described in Chapter 3).

3 Verrazano-Narrows Bridge Master Plan

Project VN-84 began as a plan to reconstruct the 1960s-era Belt Parkway Ramps and Upper Level approach decks at the VNB Brooklyn and Staten Island Approaches based on their remaining useful life and to meet current operational and design standards. MTAB&T conducted a comprehensive update of the VNB Master Plan Study for the approach ramps to: 1) consider changes at the facility including constructing the Bus/HOV ramp and 2) address other traffic flow, capacity and safety issues at the Brooklyn approach. In January 2014, MTAB&T hired WSP to develop the VN-84 Master Plan to provide the framework for reconstructing the Brooklyn side of the facility and the Upper Level approaches on the Staten Island side.

Many of the Upper Level Approach structures and Belt Parkway Ramps are from the original construction, are expected to reach the end of their service life, and require reconstruction in the next 5 to 15 years. While many key structural elements at the VNB received significant capital investment in prior programs, the next few programs will focus largely on the extensive system of approach viaducts and ramps at either side of the bridge.

The VN-84 Master Plan includes multiple interdependent projects. The SUP is one of the VN-84 Master Plan Study projects and relies on the completion of projects associated with the VNB Lower Level deck, the Upper Level Approaches, Belt Parkway Ramps and the Belt Parkway.

3.1 MASTER PLAN GOALS AND OBJECTIVES

The Master Plan study analyzed the feasibility of various options for repair/replacements, capacity enhancements and safety improvements at the Brooklyn and Staten Island approaches, Belt Parkway Ramps, and Lower Level suspended span as well as access to/egress from the Gowanus Expressway and 92nd Street. Projects resulting from the Master Plan will address needs such as:

- Bring VNB Ramps to current load capacity standards
- Meet seismic standards
- Meet American Association of State Highway and Transportation Officials (AASHTO) geometric criteria, e.g., sight distance, curve radius, lane width, shoulder width, etc.
- Address traffic capacity and congestion at the VNB Approaches, i.e., reduce downstream bottlenecks on the Gowanus Expressway and Belt Parkway, which cause congestion and are directly correlated with collisions on the main span
- Improve traffic safety at the approach ramps, most notably to reduce collisions at the approach of the Belt Parkway exit ramp on the eastbound Upper Level by replacing the current left-hand configuration with a standard right-hand exit and meet current AASHTO criteria
- Reduce bottlenecks and weaving conditions with the eastbound Gowanus and Belt Parkway merge and improve operational flexibility during reconstruction

The Master Plan evaluates the best way to move forward and to determine the sequencing of projects that minimizes the impacts to traffic flow, to MTAB&T customers, to the environment and to neighboring communities during construction. The goals of the VN-84 Master Plan project are:

- Extend the lifespan and enhance the functionality of the Bridge and its approaches
- Improve traffic safety and operations for customers and MTAB&T personnel
- Minimize adverse customer, environmental and community impacts
- Optimize capital and operating investments

As described in the following sections, the Master Plan projects address structural deterioration, reduce seismic vulnerability, improve traffic safety, and improve regional mobility.

3.2 MASTER PLAN PROJECTS

There are two basic types of projects within the Master Plan: those that maintain the VNB in a state-of-good-repair and allow the bridge to safely carry traffic, and those that bring the VNB to modern standards and improve traffic flow and safety by addressing operational issues such as downstream congestion that affects traffic flow on the VNB. When reconstruction and improvements allow, the roadways and structures will be upgraded to current load capacity and seismic standards. Improvements to lighting, communication, and fire protection are included where possible.

The recommendations from the VN-84 Master Plan study will provide guidance to facilitate the order in which capital projects under VN-84 will be completed. Due to their condition the Upper Level approach ramps, Upper Level anchorage spans, 92nd St exit and Belt Parkway Ramps components of these structures will be in the 2015-2019 Capital Program. Additional analyses under the Master Plan resulted in several other capital projects to address remaining road and deck assets at the VNB (including reconstruction of the Lower Level deck), as well as off-property improvements to address traffic flow and safety issues that significantly impact operations at the VNB. Elements of the Master Plan proposed for implementation under Project VN-84 and other upcoming capital projects are depicted in Figure 3-1.

The VN-84 Master Plan will be implemented within the current (2015-2019) and subsequent Capital Programs. The Plan's projects are sequenced to address the most pressing needs on the Upper Level Approaches and Belt Parkway Ramps while also implementing critical enabling roadway improvements that will allow for future staging for replacing the VNB Lower Level deck.

Figure 3-1: VNB Master Plan Projects



Source: WSP

3.3 UPPER LEVEL APPROACHES

Rehabilitation of the Upper Level Approaches will be implemented in three phases as shown in Figure 3-2 and described below.

Figure 3-2: Brooklyn Upper Level Approach Ramps – Rehabilitation Phases



Source: WSP

3.3.1 Phase 1

Phase 1 addresses the most urgent needs and serves as an enabling project for ramp replacement and reconfiguration in subsequent phases. Phase 1 projects extend the service life of the Upper Level Approach roadways, improve their functionality, bring the structure to modern design standards and enable subsequent work to follow. These projects also:

- Address interim repairs needed for the structures to maintain a SOGR until they can be replaced/rehabilitated under future phases/ capital programs
- Rehabilitate and improve the geometry of the westbound Lily Pond Avenue Exit Ramp and its transition with Lily Pond Avenue in Staten Island
- Improve the transition and functionality of the VNB Bus/HOV lane with the Gowanus Expressway in the vicinity of 92nd Street

Phase 1 includes the following elements:

- Replacement of the elevated eastbound and westbound Upper Level Approaches in Staten Island (including anchorage decks), westbound Upper Level Approaches in Brooklyn (including anchorage decks) and the eastbound Upper Level Brooklyn Approaches anchorage decks
- Replacement and widening of the existing Lower Level eastbound connector ramp (Ramp D) from the VNB to the Belt Parkway to provide the flexibility of operating a two-lane exit ramp. Widening this ramp will accommodate all Belt Parkway-eastbound traffic when the Upper Level exit is closed such as during construction of subsequent projects on and adjacent to the Upper Level approaches
- Realignment of the westbound exit ramp to Lily Pond Avenue, thereby providing drivers a smoother and safer merge, reducing conflicts with bicycles and pedestrians and reducing back-ups on the toll plaza
- Construction of a median barrier from the Bus/HOV Lane terminus near 92nd Street in Brooklyn to the VNB Brooklyn property line, and reconfiguration of the median to maximize operation of the Bus/HOV lane

Phase 1 also includes reconstruction of the merge of the Brooklyn Lower Level and Upper Level Ramps with the eastbound Gowanus Expressway to improve traffic flow and alleviate back-ups on to the bridge. Phase 1 projects will be implemented in 2015-2019.

3.3.2 Phase 2

Phase 2 projects are planned to be implemented in the 2020-2024 Capital Program and include:

- Realignment of the Upper Level Eastbound Approach to the Gowanus Expressway
- Replacement of the Upper Level Eastbound left-hand Belt Parkway Exit ramp with a standard right-hand exit ramp
- Realignment of the Upper Level and Lower Level Exit Ramps to 92nd Street

Phase 2 also includes reconfiguring the merge between the eastbound exit ramp from the VNB and Belt Parkway. This “enabling” project will improve safety by alleviating congestion and back-ups on the bridge.

Once the initial approach work and VNB to Belt Parkway Lower Level exit ramp work is complete, the second phase will improve the alignment of the Upper Level Eastbound Gowanus Expressway approach; relocate the Upper Level Belt Parkway Exit from a non-standard left hand exit to the right hand side, and reconstruct the Upper and Lower Level 92nd Street Exits.

Key elements of Phase 2 include realigning the eastbound Gowanus Approach (Ramp E) to improve ramp geometry and allow room for replacement of the substandard left-hand Belt Exit Ramp H with a new right-hand exit. The reconfiguration will be designed to stay within the MTAB&T’s right-of-way to avoid impacting nearby Fort Hamilton property. Eliminating this substandard left-hand exit and providing a right hand exit will significantly improve traffic operations and customer/employee safety and meet current AASHTO design standards. The new ramp will be wide enough to carry two lanes of traffic during major construction staging, while operating as a single lane with standard shoulders during other times. This will be beneficial for improved maintenance access (obviating the need for complete ramp closures), and when the Lower Level of the VNB is closed for maintenance or for emergency situations. Also under Phase 2, the eastbound 92nd Street Upper and Lower Level exit ramps from the VNB will be realigned to eliminate substandard geometry and reconfigured to meet current AASHTO standards.

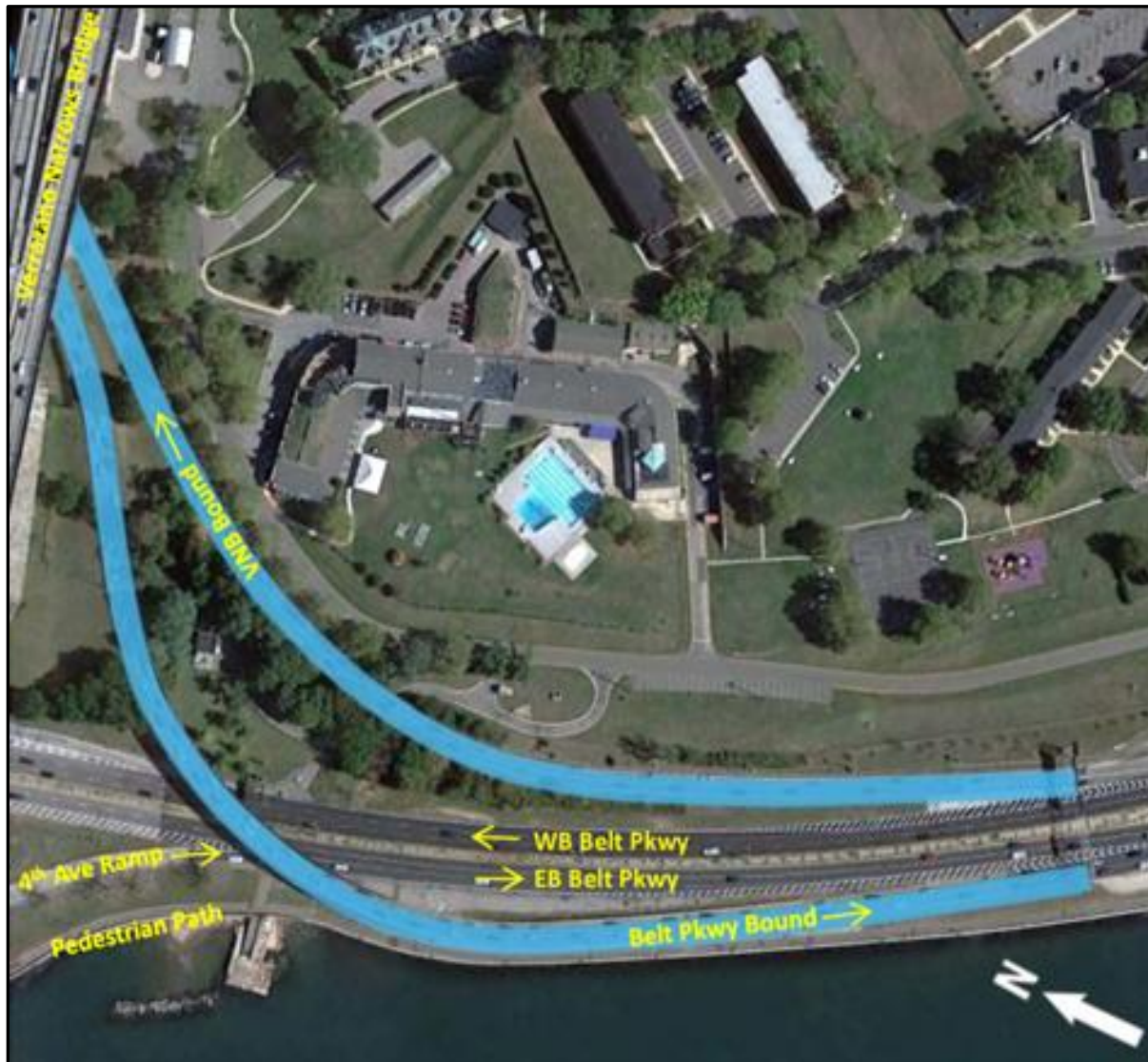
3.3.3 Phase 3

Phase 3 focuses on widening the “horseshoe” portion of the Belt Parkway Connector Ramps and the Belt Parkway structures adjacent to Fort Hamilton Parkway and connecting to and from the Belt Parkway (Figure 3-3).

This project is planned to be implemented following Phase 2. Until future reconstruction can fully address roadway, structural and operational capacity issues, interim repair work will continue to keep the ramps in a SOGR.

All three VN-84 phases also include general improvements such as utility relocation and rehabilitation including, but not limited to, electrical and lighting systems, communication systems, drainage, fire standpipe, sign gantries, and lane use signal systems as well as new deck and superstructure improvements to achieve seismic design standards and address bridge performance conditions.

Figure 3-3: Belt Parkway Ramps Connection



(“Horseshoe” portion of Belt Parkway Ramps adjacent to Fort Hamilton Avenue shown in orange in Figure 3-2)

Source: WSP

3.4 LOWER LEVEL SUSPENDED SPAN DECK REPLACEMENT

The Lower Level structural deck has been in service since the original construction in 1969, and has undergone limited localized repairs to address spalls on the underside and potholes on the riding surface. Based on an evaluation of the condition of the deck, the steel has a remaining design life of approximately 15 to 20 years. The objective of this project is to replace the concrete deck with a lightweight deck system that will decrease the dead load on the bridge’s main cables and provide wind and seismic improvements.

3.5 PROJECT STAGING

Due to the reconstruction of the Upper Level Approaches, temporary off-peak lane closures on the VNB will be the “norm” until such improvements are implemented. Adjacent lanes must remain open to avoid creating extensive congestion on the bridge, SIE, and Gowanus Expressway while providing access to disabled vehicles and other incidents that block traffic.

Reconstructing the Lower Level deck with a lighter, stronger material will be more complex than on the Upper Level Suspended Span due to: 1) restricted vertical clearance, which limits the types of construction equipment that can remove and install deck panels, and 2) presence of a center median and support columns, which greatly restrict the use of a movable barrier to stage construction and maintain traffic (Figure 3-4). To overcome these constraints, some traffic on the Lower Level will be temporarily diverted to the Upper Level. The capacity and flexibility to safely accommodate this traffic will only be possible after the improvements on the Upper Level Approaches are completed. This explains why the projects on the Upper Level Approaches and complementary enabling projects that improve the merge of ramps from the VNB with both the Gowanus Expressway and Belt Parkway must be completed first. These will bring the bridge to a SOGR, reduce congestion on the bridge and provide the necessary operational flexibility to accommodate some traffic diversion to the Upper Level when lanes on the Lower Level are closed for construction staging.

Figure 3-4: Lower Level Suspended Span



Source: Google Images

3.6 OPPORTUNITY FOR SHARED-USE PATHS

Replacing the Lower Level deck will reduce the dead load on the bridge’s suspender cables, thereby increasing the life span of the structure. As a result, the bridge might possibly be lightened enough to accommodate SUPs on the suspended span without compromising the safety factor of the main cables

or the facility's longevity. It is estimated that an overall weight reduction of approximately 12,000 tons is needed to compensate for the additional weight for SUPs on both sides of the VNB. Further engineering analyses of a possible SUP, including evaluating the effects of wind and seismic events, prototype testing, etc. will be conducted during the preliminary design study of the Lower Level deck, which will commence in the near future. The timeline for replacing the deck is shown in Table 3-1.

Table 3-1: Lower Level Suspended Span Deck Replacement Timeline

| Activity | Capital Program* |
|-----------------------------------------------------------------------------------------------|------------------|
| Preliminary Analysis | 2025-2029 |
| Wind Tunnel Testing/Analysis Prototype Design | 2025-2029 |
| Prototype Fabrication and Testing | 2025-2029 and |
| Interim Rehabilitation of Lower Level Finger Joints and other elements to extend service life | 2020-2024 |
| Final Design | 2025-2029 |
| Construction Start (Initial Phase) | 2030-2034 |

*Condition dependent-future condition assessments may require re-prioritizing projects

4 Shared-Use Access Feasibility Considerations

4.1 SHARED-USE ACCESS GOALS

Along with the framework of the Master Plan, the Project Team established goals to develop and subsequently evaluate Shared-Use Access concepts. This sequence is important to ensure these goals are integrated with those of the Master Plan. Shared-Use Access goals include:

- Provide safe access for pedestrians and cyclists between Brooklyn and Staten Island

This goal refers to providing a safe and secure environment for bicyclists and pedestrians such as by protecting and separating SUP users from adjacent traffic.

- Provide connections to existing pedestrian and bike paths

This goal refers to providing direct connections to existing bicycle/pedestrian paths adjacent to the bridge, such as the Shore Park Greenway in Brooklyn and to bicycle lanes adjacent to Fort Wadsworth and Lily Pond Avenue on Staten Island.

- Develop cost-effective solutions

This goal is a qualitative measure of the relative cost, ease and time frame to provide access across the VNB relative to other concepts.

- Minimize impacts to bridge operations, traffic capacity and bridge customers

This goal encompasses several items including, but not limited to: impacts on the natural and built environment; traffic on the bridge and approach roadways and in neighborhoods near the bridge; operating and maintaining the bridge, responding to incidents, etc. and the customer's experience in terms of safety, security, delays, etc.

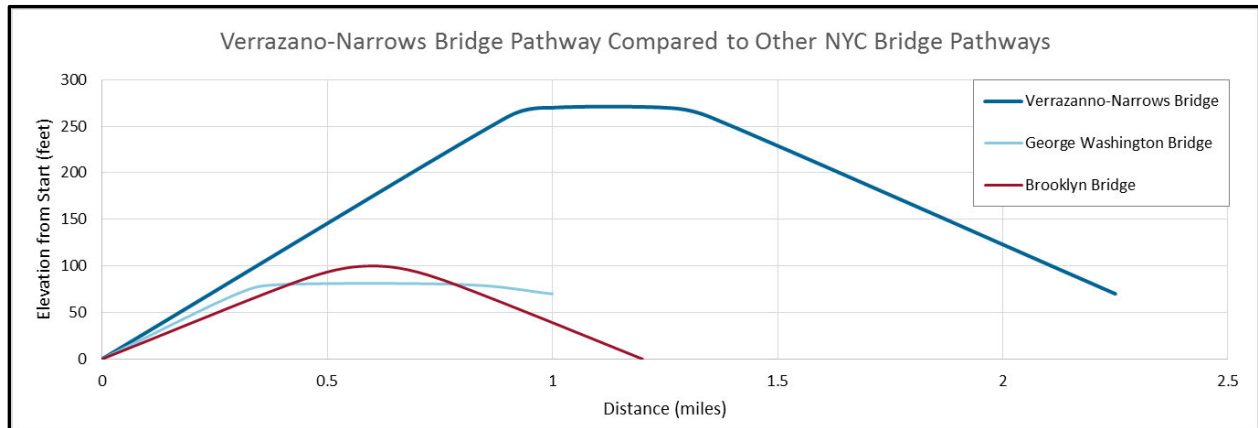
- Maintain structural integrity and functionality of the VNB and its approaches

This goal is a measure comparing each alternative's impact on the VNB from the perspective of loads, wind and seismic performance. Additionally, this goal rates each alternative's compliance with current design criteria standards.

4.2 SHARED-USE PATH REQUIREMENTS

As noted previously, the VNB was not designed to accommodate bicyclists or pedestrians. Although several large bridges in the United States have SUPs, none required retrofitting a long-span suspension bridge the length, or height above grade, of the VNB. To place VNB's size in context, Figure 4-1 shows the height and gradient of the VNB relative to two other New York City bridges. Providing a SUP on the VNB presents a significant challenge because loads must be balanced on both sides of the bridge to avoid compromising its structural integrity.

Figure 4-1: Height and Gradient of VNB Relative to the Brooklyn Bridge and George Washington Bridge



Source: RSG

A SUP on the VNB would need to be sufficiently wide to meet current design standards and structurally robust to accommodate wind, dynamic and seismic loads and provide sufficient access by maintenance, inspection and emergency response vehicles. It would need safety and security features and comply with requirements of the Americans with Disabilities Act (ADA). Approaches to the SUPs must accommodate the 140' and 60'+/- height differential between the bridge and grade on the Brooklyn and Staten Island approaches, respectively.

4.3 SHARED-USE PATH DESIGN STANDARDS

The following standards and reference manuals were consulted to establish design criteria for a SUP. Refer to Appendix A for the criteria.

- *NYS DOT Highway Design Manual, Chapter 17 – Bicycle facility design*
- *NYS DOT HDM Chapter 18 – Pedestrian Facility Design*
- *American Association of State Highway and Transportation Officials (AASHTO) Guide for the Development of Bicycle Facilities*
- *AASHTO Guide for the Planning, Design, and Operation of Pedestrian Facilities*
- *The Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities*
- *The New York City Bicycle Master Plan – Design Guidelines*

Within the context of evaluating SUP concepts that might have been viable a generation ago (refer to Section 4.4), it is important to note that several SUP design standards have changed since the bridge opened in 1964. These include: width and grade, design speed, compliance with ADA requirements, etc.

4.4 SHARED-USE PATH ENGINEERING/FEASIBILITY CONSIDERATIONS

Security requirements and the configuration of both levels of the suspended span have changed since the bridge opened. For example placing SUPs between the suspender ropes is not viable due to post 9-11 security concerns. In addition, to provide the new reversible Bus/HOV Lane on the Upper Level, the center median and maintenance walks will be removed. It is expected that the maintenance walks on the Lower Level will similarly be removed when the suspended span deck is replaced. Each of these factors needs to be considered when evaluating potential locations for a SUP on the bridge.

To place these considerations in context, in 1997, the New York City Department of City Planning (DCP) retained Ammann & Whitney to prepare *The Verrazano-Narrows Bridge Pedestrian/Bicycle Path Study*, which was part of a larger Pedestrian/Bicycle Path study conducted by the City. The study assessed alternative linkages between Staten Island and Brooklyn for cyclists, pedestrians, in-line skaters, and other non-motorized users. Ammann & Whitney evaluated several alternatives to determine the route feasibility across the VNB and approaches in Brooklyn and Staten Island. Cost estimates were also developed for each option.

The preferred alternative of the Ammann & Whitney study placed the path on the Upper Level between the suspender ropes. The path would be 10-feet wide with a horizontal clearance of less than eight feet at the suspender ropes. In Brooklyn, the pathway would use maintenance walks on the Brooklyn Approach to meet grade. At the Staten Island approach, a new pathway structure would need to be constructed to bring patrons from the VNB. For bridge weight equilibrium purposes, the study recommended that two paths be constructed on the VNB. The path on the north side of the bridge would carry pedestrians, and the path on the south side would carry bicyclists. MTAB&T did not sanction this 1997 study and raised numerous concerns, which went unaddressed.

Although the City's study focused on many of the design elements of the SUP, several factors were not considered. For example, the recommended concept was not wide enough for emergency response and maintenance vehicles. And as noted above, design criteria for pedestrian and bikeway paths have significantly changed in the nearly 20 years since the City of New York's feasibility study was prepared. The eight-foot wide path recommended in the City's study does not meet today's standards for two-way bicycle operations. Collectively, these issues explain why concepts that may have been considered a generation ago are not viable today.

In addition to the goals, requirements and design standards, the Project Team identified several engineering considerations for developing SUP concepts. These are listed in Table 4-1.

Table 4-1: Shared-Use Path Engineering Considerations

- Bridge modifications must not compromise structural integrity of the bridge.
- Any modifications necessary for SUPs must not increase the net weight of the bridge. This is required to maintain the bridge's structural safety and long-term viability.
- Paths of equal size and weight are needed on both sides of the bridge to maintain weight equilibrium.
- The wind effects of any modifications will require engineering testing and prototype analysis to ensure the bridge's stability and safe performance in high wind events.
- The bridge profile must be maintained to avoid reducing the height of the Narrows' navigation channel (to accommodate tall ships).

5 Shared-Use Access Concepts

Based on established goals, design standards and engineering feasibility considerations and extensive feedback from stakeholders (described in Chapter 7), the Project Team evaluated eight concepts to provide access for bicyclists and pedestrians between Brooklyn and Staten Island. These concepts are listed in Table 5-1 and are broadly defined as:

- Separate paths that would be constructed outboard of the superstructure (six concepts)
- Concepts that would not affect the bridge's suspended span (two concepts).

Table 5-1: Shared-Use Access Concepts

| Category/Description of Concept | | Section |
|----------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------|---------|
| Outboard of Superstructure | | |
| 1 | Outboard of Lower Level | 5.1.1 |
| 2 | Outboard of Lower Level – Brooklyn Approach in John J. Carty Park | 5.1.2 |
| 3 | Outboard of Upper Level | 5.1.3 |
| 4 | Reconstructed Brooklyn Upper Level Approach Ramps – Belt Parkway Ramps | 5.1.4 |
| 5 | Reconstructed Brooklyn Upper Level Approach Ramps – Eastbound Gowanus Expressway Approach to 92 nd Street | 5.1.5 |
| 6 | Reconstructed Brooklyn Upper Level Approach Ramps – Eastbound Upper Level Exit to Belt Parkway | 5.1.6 |
| Concepts that would not affect the VNB's Suspended Span | | |
| 7 | Separate Bicycle/Pedestrian Crossing of the Narrows | 5.2.1 |
| 8 | New Ferry Service | 5.2.2 |

The following sections of this chapter describe the concepts in detail.

5.1 CATEGORY: OUTBOARD OF SUPERSTRUCTURE

5.1.1 Outboard of Lower Level

The Lower Level Outboard alternative connects Brooklyn and Staten Island with a SUP on each side of the VNB Lower Level. These paths would be adjacent and outboard of the Lower Level VNB structure. They would span the entire length of the structure, which is approximately one mile. For the approaches to meet design standards and meet the elevation of the VNB, the south side of the bridge would be for pedestrians and the north side for bicycles. The north side has the space required to accommodate a bicycle ramp. Figure 5-1 shows a cross-section of the Lower Level Outboard concept.

User safety was paramount in developing this alternative. To accommodate an emergency vehicle, a clear width of 14 feet would be provided on both paths. This would allow emergency, maintenance and inspection vehicles, including snow removal vehicles, to access the paths. The paths would be wider around the VNB towers to allow emergency vehicles to navigate the path as it curves around the towers. Additionally, barriers with a curved safety fence would be constructed on both sides of each path to

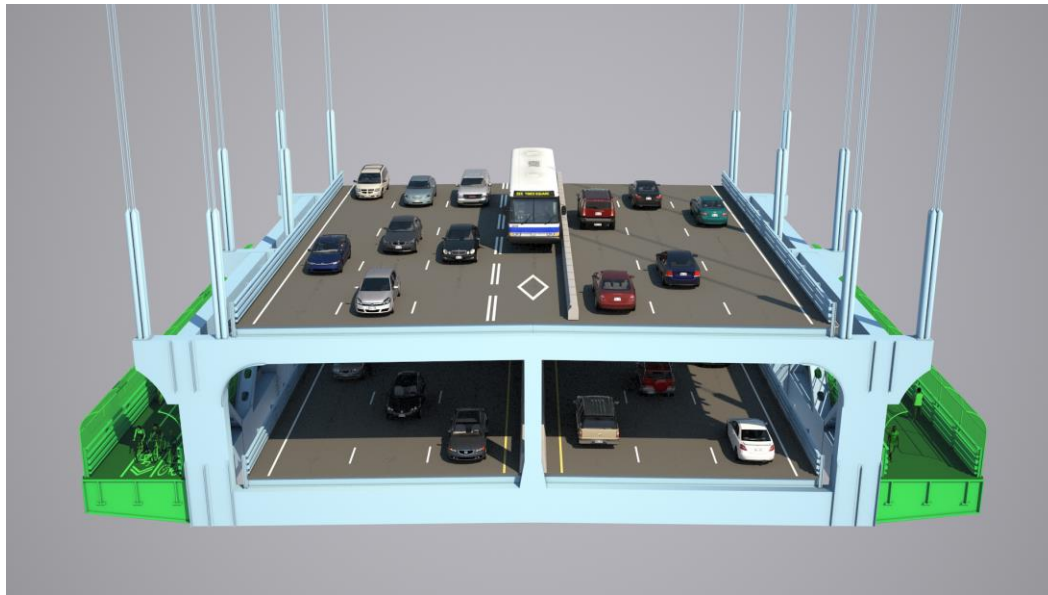
ensure safety of the users and security of the bridge. This would provide protection for users of the bicycle path and the pedestrian path from the adjacent roadway and the open side of the VNB. The bike path would also be striped to designate lanes for each direction of travel and a third small area to allow users that want to walk with their bikes, take a break and enjoy the views, or rest as they cross the lengthy spans of the VNB.

Both the bicycle and pedestrian paths would touch grade in Shore Park, near the existing path next to the Denyse Wharf historical site. To abide by AASHTO criteria, the bike path would have a maximum five percent grade, and would loop through John Paul Jones Park to reach grade. The bike path would be approximately 2,800 feet to compensate for the nearly 140-foot elevation difference. Figure 5-2 illustrates a plan view of the Brooklyn approach. On the south side of the bridge, the pedestrian path has vertical switchback ramps (Figure 5-3) in the infield between the eastbound Belt Parkway and the 4th Avenue entrance ramp. To meet in Shore Park, the pedestrian ramp would pass over the 4th Avenue entrance ramp before touching grade. The switchback ramp would be located on NYCDPR property.

The VNB Lower Level Staten Island approach is approximately 60 feet above grade. The bike path would turn north to touch grade on the shoulder of New York Avenue in Fort Wadsworth, a National Park. An approximately 1,200-foot long ramp would be required (with a maximum slope of five percent) to compensate for the difference in elevation between the bridge and New York Avenue. The pedestrian side of the path would require a vertical switchback ramp, and pedestrians would then meet grade south of the VNB on New York Avenue. The pedestrian path would also have an emergency/maintenance vehicular access ramp that connects the VNB Lower Level, near the existing toll plaza, to the pedestrian path adjacent to the VNB Lower Level. This connection would allow emergency vehicles to drive on the path since vehicles would not be able to drive up the vertical switchbacks. Figure 5-4 shows a plan view of the Staten Island approach.

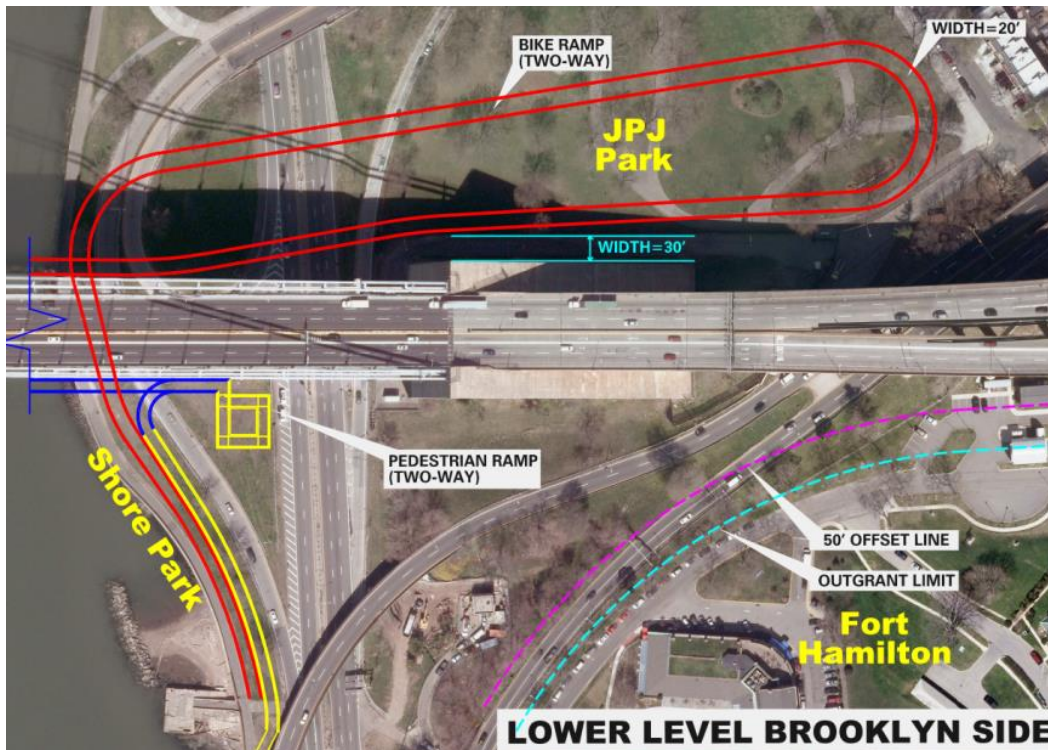
The estimated capital cost for this alternative is \$320-\$340 Million (\$2015). The details of this cost estimate are described in Chapter 6.

Figure 5-1: Lower Level Outboard Shared-Use Path – Cross-Section



Source: WSP

Figure 5-2: Lower Level Outboard Shared-Use Path – Plan View (Brooklyn)



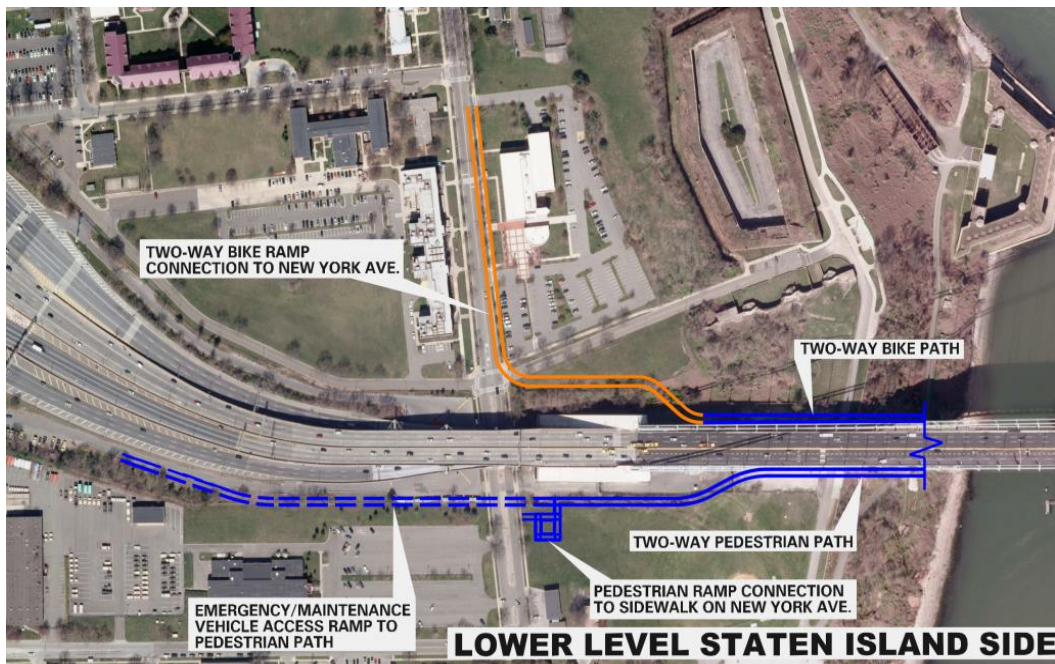
Source: WSP

Figure 5-3: Lower Level Outboard Shared-Use Path – Brooklyn Pedestrian Ramp Access



Source: WSP

Figure 5-4: Lower Level Outboard Shared-Use Path – Plan View (Staten Island)



Source: WSP

5.1.1.1 Evaluation Summary

The evaluation of this concept relative to the Shared-Use Access goals and feasibility considerations is summarized in Table 5-2 (see Appendix B for comparative matrix).

Table 5-2: Evaluation of Outboard of Lower Level

| Goal | Assessment | Score |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------|-------|
| Provide safe access for pedestrians and cyclists between Brooklyn and Staten Island (10=traffic and SUP are on separate structures; 5= traffic and SUP share the same structure with barrier between them; 0= traffic and SUP are mixed and in conflict) | Bike and pedestrian paths are on separate structures from roadway traffic. | 10 |
| Provide connections to existing pedestrian and bike paths in Brooklyn and Staten Island (10=Easily connects to existing paths; 5=Can safely access existing paths; 0=Does not connect to existing paths) | Paths in Brooklyn connect to existing path. Paths in Staten Island must use local street network to reach existing paths. | 8 |
| Develop cost-effective solutions Capital Costs (10=low; 5=medium; 1=high) | High cost to build new structures adjacent to VNB and approaches in Brooklyn and Staten Island. | 3 |
| Minimize adverse environmental and community impacts: NEPA/ SEQRA Evaluation (Possible EA/EIS); Parkland Impacts, Construction in Floodplain, Water Quality Impacted (10= minimal (temporary) impact; 5=moderate impact; 1=high (permanent) impact) | Permanent structures would be constructed in parks (John Paul Jones, Shore Park); increase in impervious area. | 3 |
| Minimize impacts to bridge operations, traffic capacity and bridge customers: Impacts to traffic congestion on the VNB, impacts to incident response time on VNB, and impacts to access/ safety for maintenance and construction personnel (10=improvements to existing/ minor impact; 1=degrades existing/ significant impact) | Deductions for difficulty of inspection and maintenance of separated paths adjacent to VNB. | 4 |
| Maintains structural integrity (loads, wind, seismic) and functionality of the VNB and its approaches; Compliant with current design criteria (10=improvements to existing/ minor impacts; 5=no change; 1=degrades existing/ significant impacts) | Infeasible until load on VNB main cables is reduced; meets design standards (wind impacts not known). | 4 |
| Total= | | 32 |

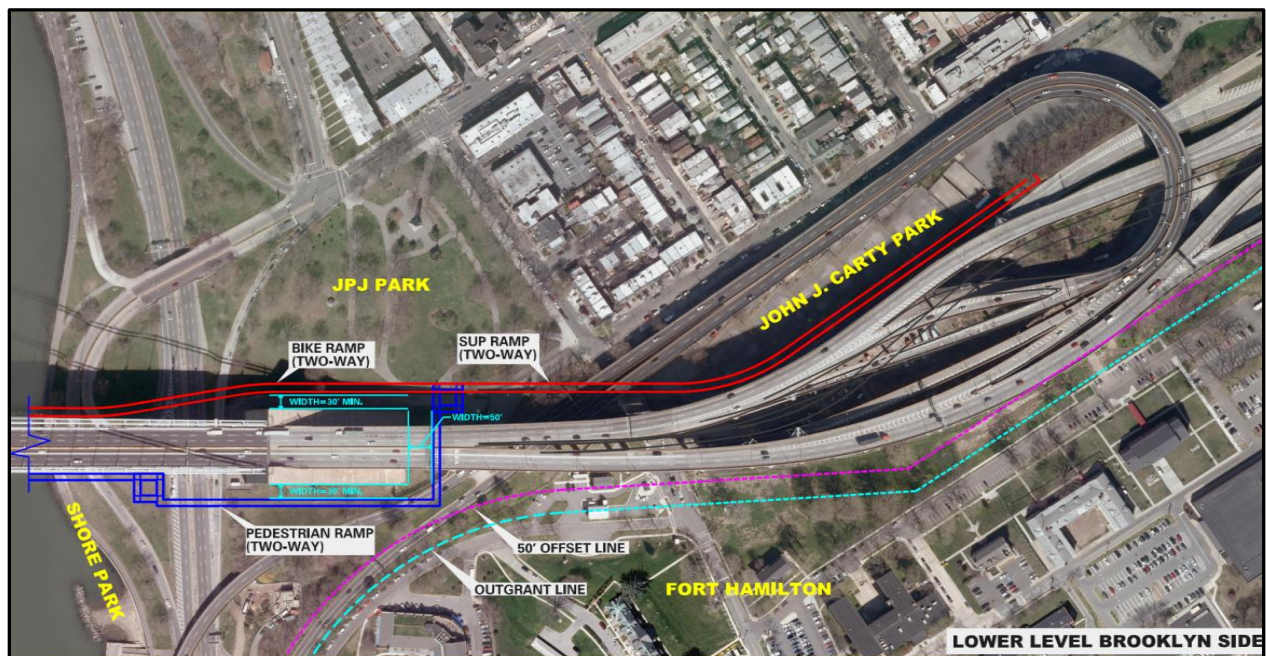
This concept will be further evaluated for feasibility during the preliminary design study of the VNB Lower Level Suspended Span deck.

5.1.2 Outboard of Lower Level-Brooklyn Approach in John J. Carty Park

To determine whether it would be possible to reduce the length and impacts of the ramps connecting the bridge and Shore Park, the Project Team evaluated an alternative originally presented in the 1997 *Bicycle Path Feasibility Study* for the City of New York based on the latest standards for an SUP. The bicycle and pedestrian paths across the VNB and the connections in Staten Island would remain the same as the Lower Level Outboard concept discussed previously.

Figure 5-5 shows the connection in Brooklyn for the approach to the SUP. The combined bicycle and pedestrian path would touch down to grade in John J. Carty Park. To meet AASHTO criteria, the bike path would have a maximum of five percent grade and be approximately 2,200 feet long to compensate for the nearly 110-foot elevation difference. The shared path would have a clear width of 15 feet, and would be striped for three 5 foot lanes. Two are unidirectional bicycle lanes. The third lane is for pedestrians and dismounting bicyclists. The SUP would allow emergency, maintenance and inspection vehicles, including snow removal vehicles, to access the path. A barrier with a curved safety fence would be constructed on both sides of the path.

Figure 5-5: Outboard of Lower Level-Brooklyn Approach in John J. Carty Park-Plan View



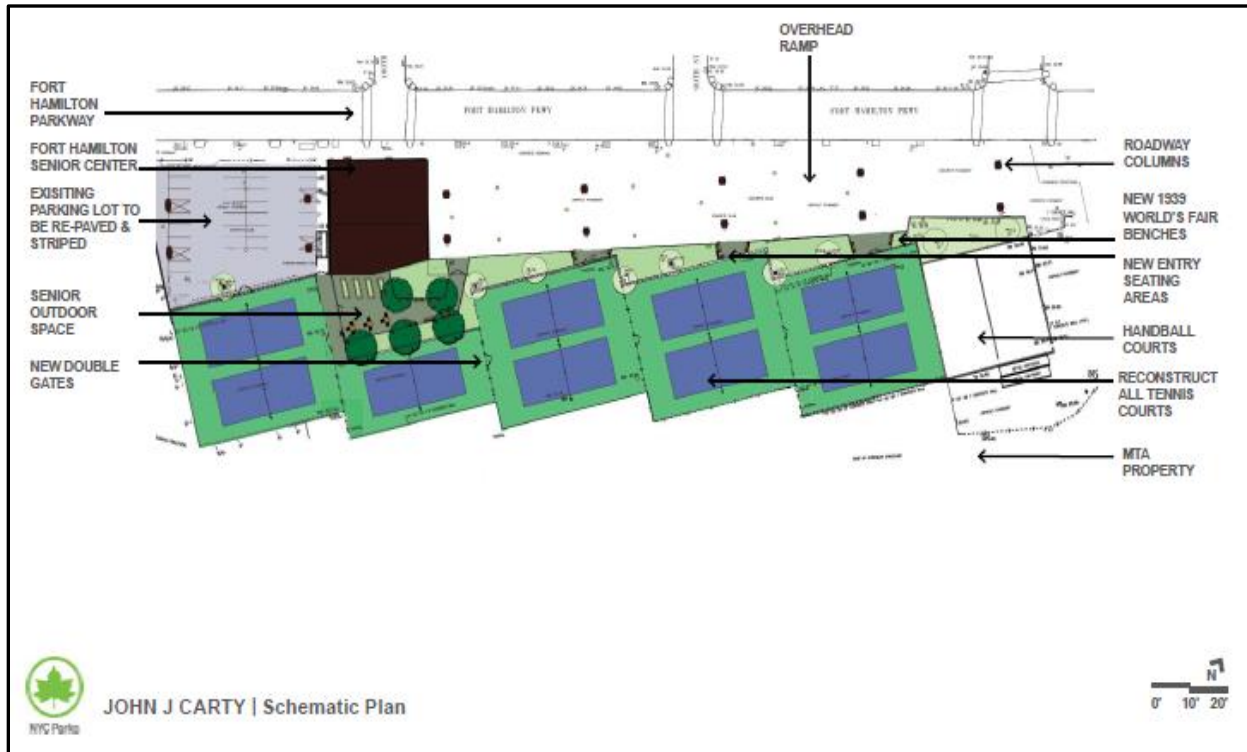
Source: WSP

The SUP would split into a separate bicycle and pedestrian path east of the Brooklyn anchorage. The bicycle path would continue on the north side of the VNB, and the pedestrian path would cross under the VNB approach to reach the south side of the VNB. A vertical switchback ramp is required when the paths separate for the pedestrian path to meet clearance requirements under the VNB approach roadway. The switchback system needs to be one-level of a loop to achieve the desired AASHTO vertical clearance of 10' for non-vehicle SUP structures. Similarly, another one-level vertical switchback ramp would be required between the eastbound Belt Parkway and Belt Parkway entrance ramp to accommodate the change in elevation. The SUP would not connect with the Shore Parkway Greenway bicycle and pedestrian path.

The SUP would be supported on columns through both John Paul Jones Park and John J. Carty Park. The SUP would supplant tennis courts and possibly other park facilities in John J. Carty Park. Displacing the tennis courts would likely require compensation to the Parks Department and may be very controversial with the local community. The recreational facilities in John J. Carty Park shown in Figure 5-6 would be

impacted on the side that is adjacent to the VNB approach ramp. Depending upon the final configuration, access to this portion of the Park from the adjacent neighborhood would be degraded or even possibly eliminated.

Figure 5-6: John J. Carty Park



Source: New York City Department of Parks and Recreation

The entrance to the SUP would require excavation and re-grading of a portion of John J. Carty Park. A retaining wall to support the VNB approach structure, which is on-grade near the location where the SUP would meet grade, would also likely be required. As discussed in section 7.3, during the public input process residents of the adjacent neighborhood strongly opposed the SUP terminating in the park due to security concerns and adverse impacts.

The SUP would also impact the Fort Hamilton Army property. Although the path would not infringe directly upon the facility, part of the elevated path would be over the Fort Hamilton entrance. Due to security concerns, U.S. Army personnel oppose construction over the Fort. Coordination with Fort Hamilton would be necessary to establish an acceptable location.

Although the combined length of the bicycle and pedestrian paths for the Outboard Lower Level-Brooklyn Approach in John J. Carty concept is shorter than the combined length of the paths for the Outboard Lower Level concept there would not be significant cost savings. For example, two separate switchback structures would need to be constructed to meet vertical clearance requirements compared to one switchback for the Outboard Lower Level concept. Since both of these switchback structures would be suspended, they would require a significant structural support system that would further

impact the various facilities below them. In addition, approximately 85 percent of the total cost of the SUP is attributable to the path on the suspended span and the Staten Island approach ramps. These costs would be incurred regardless of the concept for the Brooklyn approach. For these reasons the estimated capital cost for this alternative is approximately the same (\$320-\$340 Million (\$2015)) as the Outboard of Lower Level concept. More details on this cost estimate are described in Chapter 6.

5.1.2.1 Evaluation Summary

The evaluation of this concept relative to the Shared-Use Access goals and feasibility considerations is summarized in Table 5-3.

Table 5-3: Evaluation of Outboard of Lower Level – Brooklyn Approach in John J. Carty Park

| Goal | Assessment | Score |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------|-------|
| Provide safe access for pedestrians and cyclists between Brooklyn and Staten Island <i>(10=traffic and SUP are on separate structures; 5= traffic and SUP share the same structure with barrier between them; 0= traffic and SUP are mixed and in conflict)</i> | Bike and pedestrian paths are on separate structures than roadway traffic. | 10 |
| Provide connections to existing pedestrian and bike paths in Brooklyn and Staten Island <i>(10=Easily connects to existing paths; 5=Can safely access existing paths; 0=Does not connect to existing paths)</i> | Must use local street network to meet existing paths in Brooklyn and Staten Island. | 4 |
| Develop cost-effective solutions <i>Capital Costs (10=low; 5=medium; 1=high)</i> | High cost to build new structures adjacent to VNB and approaches in Brooklyn and Staten Island. | 3 |
| Minimize adverse environmental and community impacts: NEPA/ SEQRA Evaluation (Possible EA/EIS); Parkland Impacts, Construction in Floodplain, Water Quality Impacted <i>(10= minimal (temporary) impact; 5=moderate impact; 1=high (permanent) impact)</i> | Permanent structures would be constructed in parks (John Paul Jones, John J. Carty, Shore Park); increase in impervious area. | 1 |
| Minimize impacts to bridge operations, traffic capacity and bridge customers: Impacts to traffic congestion on the VNB, impacts to incident response time on VNB, and impacts to access/ safety for maintenance and construction personnel <i>(10=improvements to existing/ minor impact; 1=degrades existing/ significant impact)</i> | Deductions for difficulty of inspection and maintenance of separated paths adjacent to VNB. | 4 |
| Maintains structural integrity (loads, wind, seismic) and functionality of the VNB and its approaches; Compliant with current design criteria <i>(10=improvements to existing/ minor impacts; 5=no change; 1=degrades existing/ significant impacts)</i> | Infeasible until load on VNB main cables is reduced; meets design standards (wind impacts not known). | 4 |
| Total= | | 26 |

Due to the significant adverse impacts on John J. Carty Park and on the adjacent neighborhood this concept will not be considered further.

5.1.3 Outboard of Upper Level

The Upper Level Outboard alternative connects Brooklyn and Staten Island with a SUP on each side of the VNB Upper Level. Similar to the Lower Level Outboard alternative, the paths would span the VNB, and the north side would be for bicycles while the south side would be for pedestrians. Here again paths of equal size and weight would be needed on both sides of the bridge for weight equilibrium. Placing two paths outboard of the Upper Level would likely create a larger wind load than if they were on the Lower Level. As with the Lower Level Outboard concept, the effects on the bridge structure of an Outboard Upper Level SUP would be evaluated during the design study of the replacement of the Lower Level Suspended Span deck. Figure 5-7 shows the cross-section of the Upper Level Outboard alternative.

The same safety features would be implemented on the Upper Level Outboard alternative as for the Lower Level Outboard alternative. A clear path of 14 feet would be provided on both paths to accommodate emergency, maintenance, inspection and snow removal vehicles. Barriers and curved safety fences would also be utilized on both sides of both paths to protect users from the roadway and open side as well as to enhance security. The bike path would be striped to designate lanes for each direction of travel and an area for users that choose to walk with or without their bikes.

The major difference between the Upper Level and Lower Level Outboard alternatives is the approach length required to bring both paths from the VNB to grade in Brooklyn and Staten Island. The Upper Level Outboard alternative is approximately 25 feet higher than the Lower Level Outboard alternative. The bike path in Brooklyn has a maximum grade of 5 percent. As a result, 500 feet of additional path for a total Brooklyn ramp length of 3,300 feet would be necessary to compensate for the higher elevation. To accommodate the additional length of the bike path, a complete loop would be added to the structure constructed in John Paul Jones Park.

Figure 5-8 shows a plan view of the Brooklyn side approaches. To account for the higher elevation on the south side of the bridge, the pedestrian ramp would require additional switchback levels, although its location would be the same as for the Lower Level option. An extra loop is also required on the bike approach ramp to compensate for the additional height (Figure 5-9). Similar to the Lower Level Outboard alternative, both paths for the Upper Level Outboard alternative would touch grade in Shore Park near the Denyse Wharf historical site.

The length of the approaches in Staten Island would also need to be increased to compensate for the higher elevation of the Upper Level Outboard alternative. The bike path would be 500 feet longer for a total Staten Island ramp length of 1,700 feet and would meet grade farther into Fort Wadsworth. The path would turn north along New York Avenue, turn right into Fort Wadsworth and meet grade near an existing roadway in Fort Wadsworth. For the pedestrian path, more vertical switchbacks would be necessary to bring users from the VNB to New York Avenue. The pedestrian path would also have a roadway that connects to the VNB Upper Level approach. This connection would allow emergency vehicles to drive on the path since vehicles would not be able to drive up the vertical switchbacks. Figure 5-10 shows a plan view of the Staten Island approach.

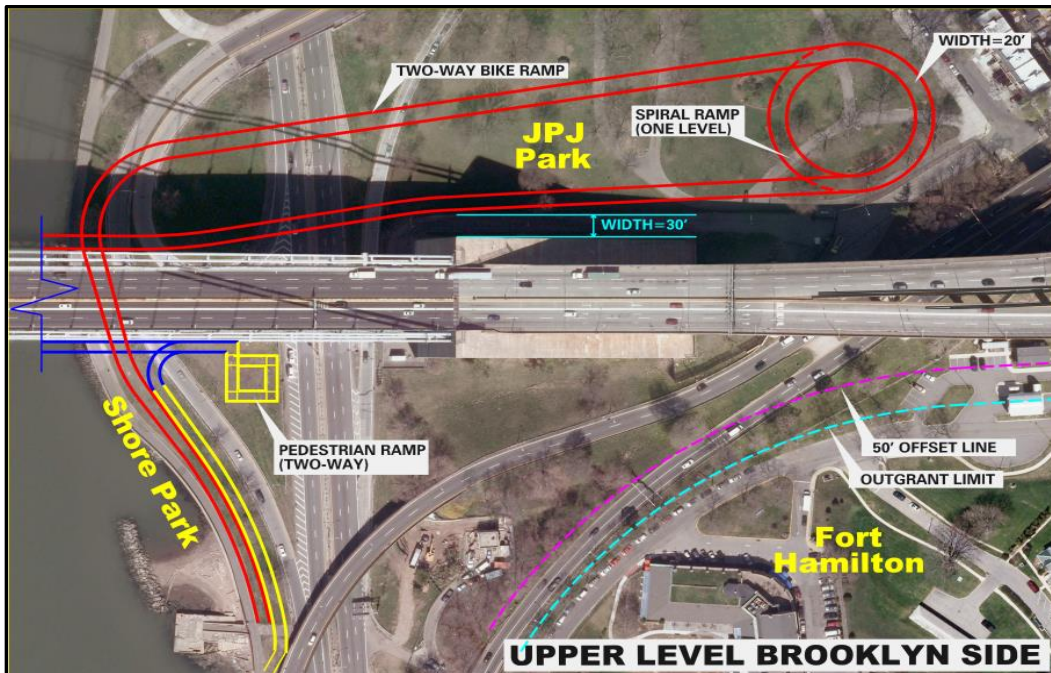
The estimated capital cost for this alternative is \$340-\$370 Million (\$2015). More details on this estimate are in Chapter 6.

Figure 5-7: Upper Level Outboard Shared-Use Path – Cross-Section



Source: WSP

Figure 5-8: Upper Level Outboard Shared-Use Path – Plan View (Brooklyn)



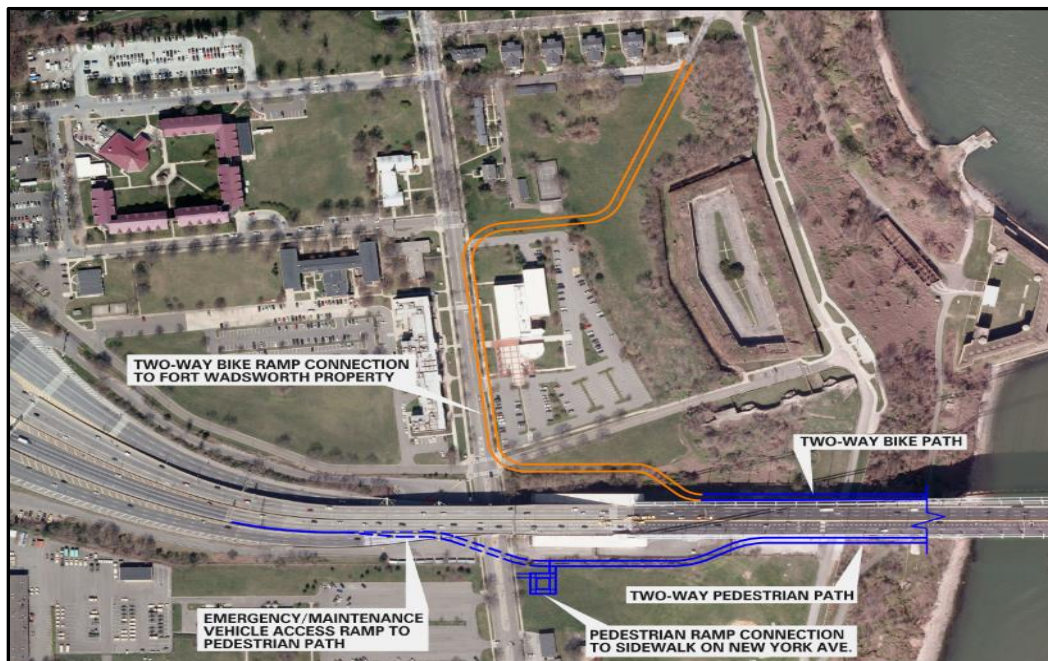
Source: WSP

Figure 5-9: Upper Level Outboard Shared-Use Path – Brooklyn Bicycle Ramp



Source: WSP

Figure 5-10: Upper Level Outboard Shared-Use Path – Plan View (Staten Island)



Source: WSP

As described in Chapter 4, design standards and requirements for a SUP have evolved since the *VNB Pedestrian/Bicycle Path Feasibility Study* was prepared in 1997. Table 5-4 compares the Upper Level

Outboard concept from this current study to the Upper Level Outboard concept described in the 1997 study.

Table 5-4: Comparison of “Between Upper Level Suspender Ropes” Concepts from 1997 Pedestrian/Bicycle Path Feasibility Study and Current Outboard Upper Level Concept

| Characteristic | Between Upper Level Suspender Ropes (1997) | Outboard Upper Level |
|-----------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Width of Paths | The bike and pedestrian paths were not wide enough for the current AASHTO design standards. The widths of the paths were either 7' or 10'. | The SUP is designed to current AASHTO standards with a minimum width of 14' to accommodate sight distance, allow for passing and provide adequate room for emergency vehicles or maintenance vehicles. |
| Accommodation of Emergency and Maintenance Vehicles | No vehicle access | Accommodates emergency and maintenance vehicles |
| Additional Strengthening | Utilized existing framing and stiffening truss chords to support the proposed bikeways. No accommodation for maintenance and emergency vehicles was incorporated into the bikeways. No consideration for additional strengthening due to wind or dynamic loading on the existing structural elements was included in the cost. | The Bridge is assumed to be strengthened for wind/dynamic loading. The path is wider and longer, has a deeper and stronger structure and a stronger deck to support emergency vehicles. The result is a much more robust design compared to the 1997 concept. |
| Connection to Grade | The concept had a design that suggested more narrow paths using existing roadways for the approaches and touching down with non-standard grades. | The concept connects the paths across the VNB to existing paths in Brooklyn and Staten Island, resulting in lengthy approaches. |
| Structural Framing | Did not account for complex framing at the towers | Incorporates necessary complex framing around the towers |
| Fencing and Barriers | Assumed simple railings | Security fencing and safety barrier are included |
| Security Hardening | Not considered | Includes measures for security hardening |

5.1.3.1 Evaluation Summary

The evaluation of this concept relative to the Shared-Use Access goals and feasibility considerations is summarized in Table 5-5.

Table 5-5: Evaluation of Outboard of Upper Level

| Goal | Assessment | Score |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| Provide safe access for pedestrians and cyclists between Brooklyn and Staten Island <i>(10=traffic and SUP are on separate structures; 5= traffic and SUP share the same structure with barrier between them; 0= traffic and SUP are mixed and in conflict)</i> | Bike and pedestrian paths are on separate structures from roadway traffic. Longer access ramps and higher wind loads compared to the Lower Level alternatives due to higher elevation. | 8 |
| Provide connections to existing pedestrian and bike paths in Brooklyn and Staten Island <i>(10=Easily connects to existing paths; 5=Can safely access existing paths; 0=Does not connect to existing paths)</i> | Paths in Brooklyn connect to existing path. Paths in Staten Island must use local street network to reach existing paths. | 8 |
| Develop cost-effective solutions <i>Capital Costs (10=low; 5=medium; 1=high)</i> | High cost to build new structures adjacent to VNB. Approaches in Brooklyn and Staten Island would be longer than Lower Level alternatives due to higher elevation. | 2 |
| Minimize adverse environmental and community impacts: NEPA/ SEORA Evaluation (Possible EA/EIS); Parkland Impacts, Construction in Floodplain, Water Quality Impacted <i>(10= minimal (temporary) impact; 5=moderate impact; 1=high (permanent) impact)</i> | Permanent structures would be constructed in parks (John Paul Jones, Shore Park); longer approaches than Lower Level alternatives for higher elevation; increase in impervious area. | 2 |
| Minimize impacts to bridge operations, traffic capacity and bridge customers: Impacts to traffic congestion on the VNB, impacts to incident response time on VNB, and impacts to access/ safety for maintenance and construction personnel <i>(10=improvements to existing/ minor impact; 1=degrades existing/ significant impact)</i> | Deductions for difficulty of inspection and maintenance of separated paths adjacent to VNB. | 4 |
| Maintains structural integrity (loads, wind, seismic) and functionality of the VNB and its approaches; Compliant with current design criteria <i>(10=improvements to existing/ minor impacts; 5=no change; 1=degrades existing/ significant impacts)</i> | Infeasible until load on VNB main cables is reduced; further engineering required to measure impacts of wind loads; meets design standards. | 3 |
| Total= | | 27 |

This concept will be further evaluated for feasibility during the preliminary design study of the Lower Level Suspended Span deck.

5.1.4 Reconstructed Brooklyn Upper Level Approach – Belt Parkway Ramps

5.1.4.1 Introduction

The Upper and Lower Level Outboard SUP options both require a set of independent ramp structures through Shore Park and John Paul Jones Park. As an alternative to these independent ramp structures, the Project Team evaluated three concepts that would utilize the reconstructed Belt Parkway Ramps (“Brooklyn Ramps”) for bicycle and pedestrian access.

The SUP concepts would either:

- Expand the Belt Parkway Loop Ramps approximately 20 feet to accommodate a separate SUP on the outside of the ramp structure (Alternative 4).
- Use the shoulder of the Brooklyn Ramps as a SUP to connect the SUP outboard alternatives and 92nd Street (Alternative 5).
- Use the shoulder of the Brooklyn Ramps as a SUP to connect the SUP outboard alternatives and the Belt Parkway (Alternative 6).

5.1.4.2 Belt Parkway Ramps

This concept would widen the ramp structure to/from the VNB to connect the Lower or Upper Level outboard SUPs to the existing path along Shore Park.

Due to vertical clearance constraints, it is infeasible to widen the Brooklyn Ramps to the inside of the loop ramp. Therefore, all widening of the Brooklyn ramps must be on the outside of the loop ramps. According to AASHTO, the desirable width of a two-way SUP is 15 feet. An additional two feet is required on each side of the path for placement of a concrete barrier and protective fence, for a total widening of approximately 19 feet. The SUP for this option would be nearly 6,000 feet long, approximately double the length of the Lower Level Outboard alternative.

This concept is fatally flawed for several reasons:

- Widening the eastbound approach means encroaching into Fort Hamilton’s no-build zone outside of MTAB&T’s easement. This violates the Fort’s security requirements and would also trigger environmental review under the National Environmental Policy Act (NEPA) due to impacts to Federal lands.
- The SUP would encroach into and over Fort Hamilton Parkway, causing adverse visual, air, and noise effects on the adjacent residences, Fort Hamilton Senior Recreation Center, and John J. Carty Park.
- Additional columns would be necessary to accommodate the widened Belt Parkway ramps structure where the loop ramps cross over the Brooklyn Approach roadways. Additional investigation is required to determine if space exists to construct these columns. It is likely that after more advanced design, space limitations could be deemed a fatal flaw.

- The piers supporting the elevated Belt Parkway Ramps prevent widening the shoulder where the Brooklyn Ramps cross under the VNB near the anchorage (Figure 5-11). For this reason the SUP cannot connect to the bike path along Shore Park.

As noted previously, paths are required on both sides of the bridge for loading symmetry. To reach the single SUP along the Brooklyn Ramps, the paths from each side of the VNB would need to combine into one path elevated above the existing roadways. To maintain the outboard SUPs adjacent to the VNB for the length of the bridge, the connection of two paths to one path must occur after the outboard SUPs past the Brooklyn Anchorage. It would be difficult structurally and geometrically to connect two SUPs coming from both sides of the VNB to a single SUP. The SUP path on the north side of the VNB would need to loop under the structures after the VNB anchorage. The geometric and structural aspects of this structure pose significant design and construction issues due to the numerous piers supporting the adjacent connecting roadways.

Figure 5-11: Limited Width Due to Brooklyn Ramps under the VNB near the Anchorage



Source: Google Maps

5.1.4.3 Evaluation Summary

The evaluation of this concept relative to the Shared-Use Access goals and feasibility considerations is summarized in Table 5-6. Goals that were fatally flawed received a score of zero.

Table 5-6: Evaluation of Belt Parkway Ramps

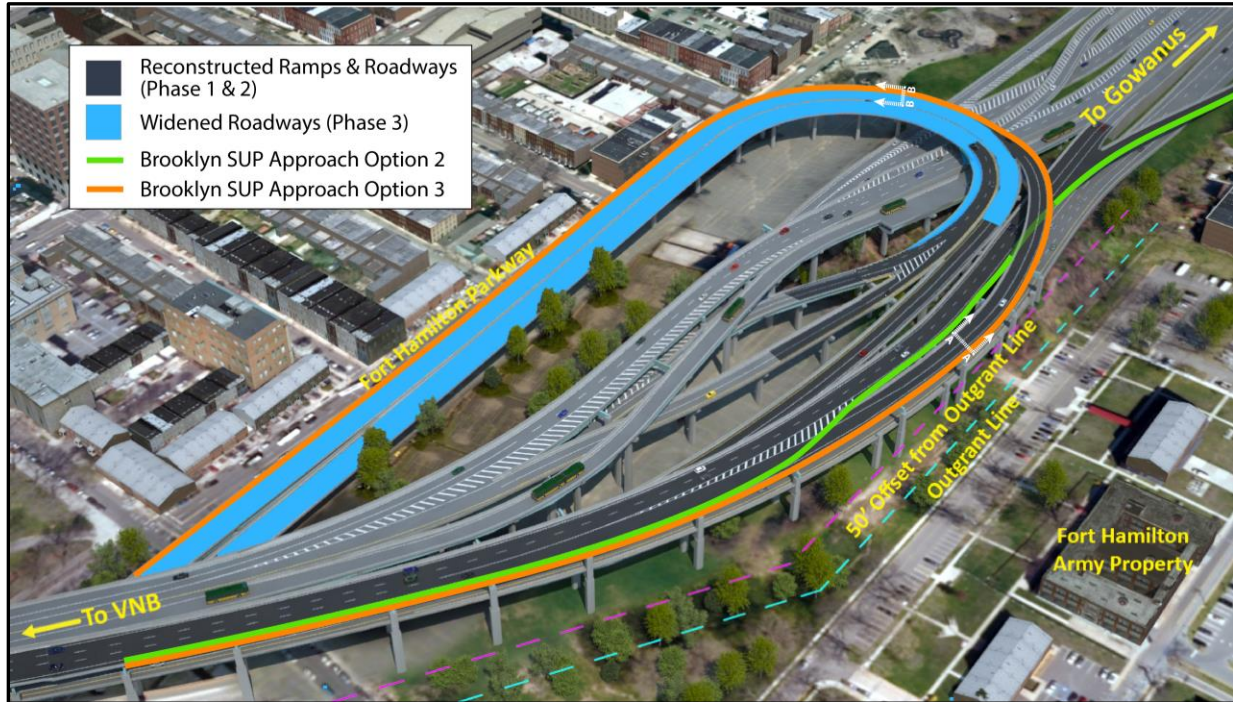
| Goal | Assessment | Score |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| Provide safe access for pedestrians and cyclists between Brooklyn and Staten Island <i>(10=traffic and SUP are on separate structures; 5= traffic and SUP share the same structure with barrier between them; 0= traffic and SUP are mixed and in conflict)</i> | Dedicated paths across VNB and in Staten Island; fatal flaw since cannot fit SUP between existing piers which support the VNB near the Brooklyn anchorage. | 0 |
| Provide connections to existing pedestrian and bike paths in Brooklyn and Staten Island <i>(10=Easily connects to existing paths; 5=Can safely access existing paths; 0=Does not connect to existing paths)</i> | Fatally flawed because does not connect to path in Brooklyn due to limited width of Brooklyn Ramps under the VNB near the anchorage. | 0 |
| Develop cost-effective solutions <i>Capital Costs (10=low; 5=medium; 1=high)</i> | High cost to build new structures adjacent to VNB and approaches in Brooklyn and Staten Island. | 4 |
| Minimize adverse environmental and community impacts: NEPA/ SEQRA Evaluation (Possible EA/EIS); Parkland Impacts, Construction in Floodplain, Water Quality Impacted <i>(10= minimal (temporary) impact; 5=moderate impact; 1=high (permanent) impact)</i> | Permanent structures would be constructed in John J Carty Park and in Fort Hamilton's no build zone; increase in impervious area. | 2 |
| Minimize impacts to bridge operations, traffic capacity and bridge customers: Impacts to traffic congestion on the VNB, impacts to incident response time on VNB, and impacts to access/ safety for maintenance and construction personnel <i>(10=improvements to existing/ minor impact; 1=degrades existing/ significant impact)</i> | Deductions for difficulty of inspection and maintenance of separated paths adjacent to VNB and separated paths on Brooklyn approach. | 2 |
| Maintains structural integrity (loads, wind, seismic) and functionality of the VNB and its approaches; Compliant with current design criteria <i>(10=improvements to existing/ minor impacts; 5=no change; 1=degrades existing/ significant impacts)</i> | Infeasible until load on VNB main cables is reduced; meets design standards except where the Brooklyn ramps cross under the VNB. | 3 |
| Total= | | 11 |

This concept is fatally flawed because of geometry and constructability issues.

5.1.5 Eastbound Gowanus Expressway Approach to 92nd Street

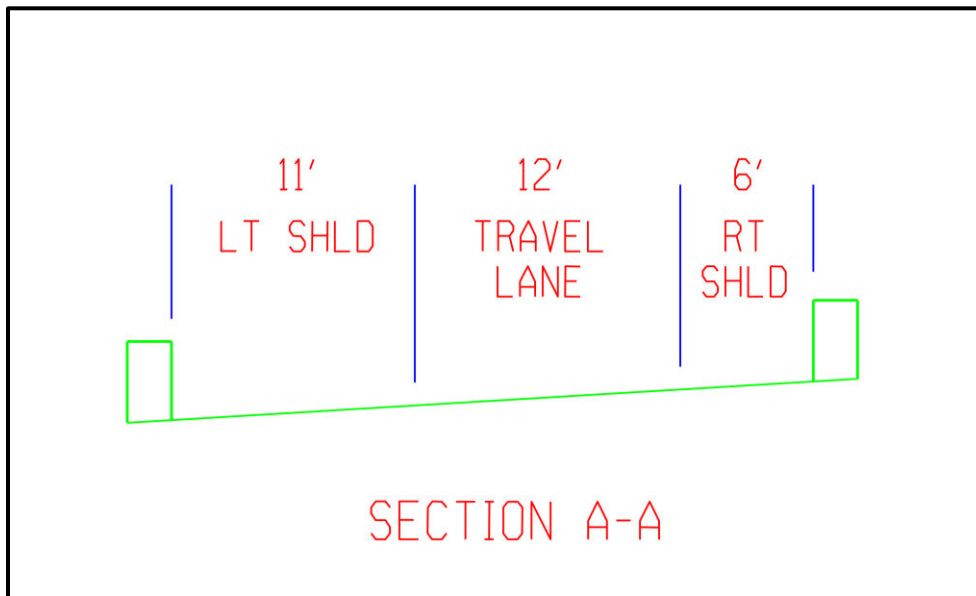
This concept proposes utilizing the shoulder of the eastbound approach to the Gowanus Expressway to connect the outboard SUPs to 92nd Street (Figure 5-12).

Figure 5-12: Brooklyn SUP Approach Alternative 5 (Option 2) and Alternative 6 (Option 3)



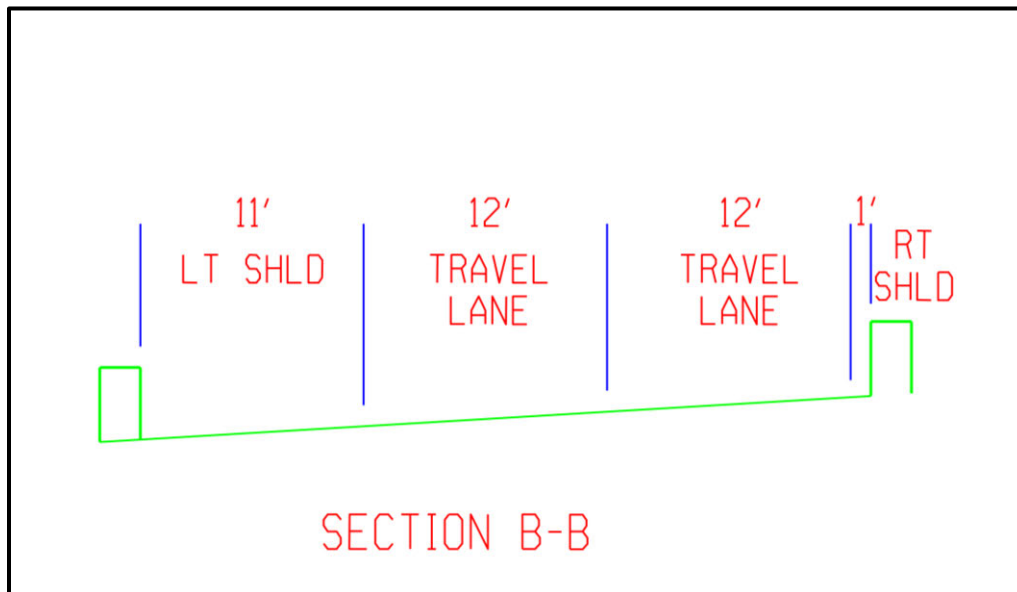
Source: WSP

Figure 5-13: Proposed Belt Parkway-bound Right Hand Exit Ramp-Cross Section A-A



Source: WSP

Figure 5-14: Proposed Eastbound Ramp to Belt Parkway-Cross Section B-B



Source: WSP

This concept is fatally flawed for several reasons:

- There is no continuous shoulder between the Upper Level eastbound approach to the Gowanus Expressway and the Upper Level 92nd Street Exit. Bicyclists would have to cross active traffic to travel from the right shoulder of the proposed Upper Level right-hand exit to the Belt Parkway to the realigned right shoulder of the Gowanus Expressway approach to access the Upper Level 92nd Street Exit.
- The Lower Level eastbound approach to the Gowanus Expressway does not have a right shoulder because the roadway is within the piers of the Upper Level. Therefore, there is no room for a shoulder to use as an SUP.
- The Brooklyn Ramps (after VN-84 Phase 2) will abut Fort Hamilton's No Build zone; the roadway cannot be widened further.
- Connecting the SUPs from both sides of the VNB (near the Brooklyn anchorage) and providing a connection to the main span SUPs would have similar structural issues as Alternative 4.
- Due to the configuration of the westbound Gowanus Expressway approach roadways and absence of shoulders on the 92nd Street entrance ramp to the VNB, a SUP on the westbound approach to the Bridge is not possible without reducing travel lanes. This would create extensive queuing and cause traffic to divert to local roadways and neighborhood streets in Bay Ridge. In meetings and focus groups that the Project Team conducted, residents living near the bridge and VNB customers opposed concepts that adversely affect traffic.

5.1.5.1 Evaluation Summary

The evaluation of this concept relative to the Shared-Use Access goals and feasibility considerations is summarized in Table 5-7. Goals that were fatally flawed received a score of zero.

Table 5-7: Evaluation of Eastbound Gowanus Expressway Approach

| Goal | Assessment | Score |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------|-------|
| Provide safe access for pedestrians and cyclists between Brooklyn and Staten Island <i>(10=traffic and SUP are on separate structures; 5= traffic and SUP share the same structure with barrier between them; 0= traffic and SUP are mixed and in conflict)</i> | Fatally flawed since SUP crosses active traffic while exiting VNB to 92nd Street exit. | 0 |
| Provide connections to existing pedestrian and bike paths in Brooklyn and Staten Island <i>(10=Easily connects to existing paths; 5=Can safely access existing paths; 0=Does not connect to existing paths)</i> | Fatally flawed because does not connect to existing paths in Brooklyn or Staten Island. | 0 |
| Develop cost-effective solutions <i>Capital Costs (10=low; 5=medium; 1=high)</i> | High costs to build structures adjacent to VNB and approaches in Staten Island. | 5 |
| Minimize adverse environmental and community impacts: NEPA/ SEQRA Evaluation (Possible EA/EIS); Parkland Impacts, Construction in Floodplain, Water Quality Impacted <i>(10= minimal (temporary) impact; 5=moderate impact; 1=high (permanent) impact)</i> | Permanent structures would be constructed adjacent to VNB and in Staten Island, increase in impervious area. | 4 |
| Minimize impacts to bridge operations, traffic capacity and bridge customers: Impacts to traffic congestion on the VNB, impacts to incident response time on VNB, and impacts to access/ safety for maintenance and construction personnel <i>(10=improvements to existing/ minor impact; 1=degrades existing/ significant impact)</i> | Deductions for difficulty of inspection and maintenance of mixed SUP and traffic paths. | 3 |
| Maintains structural integrity (loads, wind, seismic) and functionality of the VNB and its approaches; Compliant with current design criteria <i>(10=improvements to existing/ minor impacts; 5=no change; 1=degrades existing/ significant impacts)</i> | Infeasible until load on VNB main cables is reduced; fatally flawed since does not meet design standards in Brooklyn | 0 |
| Total= | | 12 |

This concept is fatally flawed because of significant adverse impacts on safety and on traffic.

5.1.6 Eastbound Upper Level Exit to the Belt Parkway

This concept would utilize the shoulder of the proposed Upper Level Belt Parkway-bound right hand exit and Belt Parkway "horseshoe" ramps. This concept has similar fatal flaws as Alternative 4 and Alternative 5 and is infeasible for the following additional reasons:

- There will not be a continuous wide shoulder to use as a SUP between the Upper Level eastbound approach to the Gowanus Expressway and the Belt Parkway. The right shoulder of the proposed Upper Level Belt Parkway-bound right hand exit is six feet wide, and the right shoulder of the Belt Parkway loop ramps is one foot wide. Due to sight distance requirements, the left shoulder at both

locations is wider (11 feet). Therefore, bicyclists would need to cross live traffic to access and remain within the wide shoulders. Plan view and cross sections depicting the layouts are shown in Figure 5-12 through Figure 5-14.

- It would not be possible to travel from the Lower Level Outboard SUP to the Belt Parkway without crossing live traffic. Bicyclists on the Lower Level outboard structure would need to cross traffic to reach the Lower Level Belt Parkway-bound exit.
- SUPs in the westbound direction have similar challenges as not having continuous paths and needing to cross live traffic to reach any proposed wide shoulders.

5.1.6.1 Evaluation Summary

The evaluation of this concept relative to the Shared-Use Access goals and feasibility considerations is summarized in Table 5-8. This concept is fatally flawed because of significant adverse impacts on safety and on traffic.

Table 5-8: Evaluation of Upper Level Exit to Belt Parkway

| Goal | Assessment | Score |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------|-------|
| Provide safe access for pedestrians and cyclists between Brooklyn and Staten Island (10=traffic and SUP are on separate structures; 5= traffic and SUP share the same structure with barrier between them; 0= traffic and SUP are mixed and in conflict) | Fatally flawed since SUP would cross active traffic to reach between VNB and loop ramp. | 0 |
| Provide connections to existing pedestrian and bike paths in Brooklyn and Staten Island (10=Easily connects to existing paths; 5=Can safely access existing paths; 0=Does not connect to existing paths) | Fatally flawed because does not connect to path in Brooklyn due to limited width of Brooklyn Ramps under the VNB near the anchorage. | 0 |
| Develop cost-effective solutions Capital Costs (10=low; 5=medium; 1=high) | High costs to build structures adjacent to VNB and approaches in Staten Island. | 5 |
| Minimize adverse environmental and community impacts: NEPA/ SEQRA Evaluation (Possible EA/EIS); Parkland Impacts, Construction in Floodplain, Water Quality Impacted (10= minimal (temporary) impact; 5=moderate impact; 1=high (permanent) impact) | Permanent structures would be constructed adjacent to VNB and in Staten Island, increase in impervious area. | 4 |
| Minimize impacts to bridge operations, traffic capacity and bridge customers: Impacts to traffic congestion on the VNB, impacts to incident response time on VNB, and impacts to access/ safety for maintenance and construction personnel (10=improvements to existing/ minor impact; 1=degrades existing/ significant impact) | Deductions for difficulty of inspection and maintenance of mixed SUP and traffic paths. | 3 |
| Maintains structural integrity (loads, wind, seismic) and functionality of the VNB and its approaches; Compliant with current design criteria (10=improvements to existing/ minor impacts; 5=no change; 1=degrades existing/ significant impacts) | Infeasible until load on VNB main cables is reduced; fatally flawed since does not meet design standards in Brooklyn. | 0 |
| Total= | | 12 |

5.2 CATEGORY: CONCEPTS THAT WOULD NOT AFFECT THE VNB'S SUSPENDED SPAN

The concepts described in the next two sections do not require any modifications to the VNB and are not within MTAB&T's purview. These concepts are a new crossing of Lower New York Harbor for bicyclists and pedestrians and new ferry service between Brooklyn and Staten Island.

5.2.1 Separate Bicycle/Pedestrian Crossing of the Narrows

This concept envisions construction of an independent lift bridge exclusively for bicyclists and pedestrians to connect Brooklyn and Staten Island. This shared pedestrian/ bicycle crossing would be parallel to the VNB and span the approximately one-mile width of the Narrows. This fixed structure would have a movable main center span that could vertically lift approximately 250 feet to accommodate large ships. A rendering of this crossing superimposed on the VNB is shown in Figure 5-15.

For cost estimating purposes it is assumed a clear path of 15 feet would be provided to accommodate bicyclists and pedestrians. The SUP would be striped to designate bicycle lanes for each direction of travel and a third lane for users that choose to walk with or without their bikes. The path would be wide enough to accommodate emergency, maintenance, inspection and snow removal vehicles. Barriers and curved safety fences would also be used on both sides of the path to protect users.

This structure does not affect the VNB, thereby avoiding the security, weight reduction, wind and structural equilibrium issues discussed previously. The Brooklyn and Staten Island approaches to the crossing would not require extensive vertical circulation facilities, e.g., ramps, pedestrian switch-backs, etc. because of the minimal change in elevation between the crossing's approach spans and the shore. The approaches to the crossing would connect directly to the recreational paths that are adjacent to the waterway in both boroughs. Additional engineering analyses would be required to establish the precise location of the structure in terms of cost, navigational requirements, visual impacts, effects on land use and environmental resources, etc.

Implementation of this concept is not within MTAB&T's purview. Therefore, many institutional issues would need to be addressed as part of a more extensive evaluation of feasibility. For example, the agency or agencies responsible for building, owning, operating, maintaining and/or financing the SUP structure would need to be established. A determination would also be required of whether this structure is compatible with the United States Army Corps of Engineers' (USACE) standards and plans for New York Harbor flood protection. And as noted above, a complete evaluation of the effects of this structure on the natural and built environment would be required.

The estimated capital cost for this alternative is \$490-\$525 Million (\$2015). Details on the cost of this alternative are in Chapter 6.

Figure 5-15: Rendering of Separate Bicycle/Pedestrian Crossing of the Narrows



Source: HNTB

5.2.1.1 Evaluation Summary

The evaluation of this concept relative to the Shared-Use Access goals and feasibility considerations is summarized in Table 5-9.

Table 5-9: Evaluation of Separate Bicycle/Pedestrian Crossing of the Narrows

| Goal | Assessment | Score |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------|-------|
| Provide safe access for pedestrians and cyclists between Brooklyn and Staten Island (10=traffic and SUP are on separate structures; 5= traffic and SUP share the same structure with barrier between them; 0= traffic and SUP are mixed and in conflict) | Bike and pedestrian paths are separate structures from roadway traffic. | 10 |
| Provide connections to existing pedestrian and bike paths in Brooklyn and Staten Island (10=Easily connects to existing paths; 5=Can safely access existing paths; 0=Does not connect to existing paths) | Connects to existing path in Brooklyn; connects to recreational path in Staten Island that would meet existing bike path. | 10 |
| Develop cost-effective solutions Capital Costs (10=low; 5=medium; 1=high) | High cost to build new structure across The Narrows waterway. | 1 |
| Minimize adverse environmental and community impacts: NEPA/ SEQRA Evaluation (Possible EA/EIS); Parkland Impacts, Construction in Floodplain, Water Quality Impacted (10= minimal (temporary) impact; 5=moderate impact; 1=high (permanent) impact) | New structure adds impervious area above The Narrows waterway. | 8 |
| Minimize impacts to bridge operations, traffic capacity and bridge customers: Impacts to traffic congestion on the VNB, impacts to incident response time on VNB, and impacts to access/ safety for maintenance and construction personnel (10=improvements to existing/ minor impact; 1=degrades existing/ significant impact) | Would not impact users on the VNB; inspection required for separate structure. | 8 |
| Maintains structural integrity (loads, wind, seismic) and functionality of the VNB and its approaches; Compliant with current design criteria (10=improvements to existing/ minor impacts; 5=no change; 1=degrades existing/ significant impacts) | Would not impact the VNB. | 5 |
| Total= | | 42 |

This concept is not within MTAB&T's purview. This alternative would entail consideration of jurisdictional restrictions, policies of other agencies/ stakeholders, and other issues which are beyond the scope of this study.

5.2.2 New Ferry Service

During the public outreach process (discussed in Chapter 7) many bicycle riders, bridge users and residents of Brooklyn and Staten Island expressed support for a new ferry service as a quicker and lower cost strategy (relative to implementing separate SUPs on the bridge) for bicyclists to travel between Brooklyn and Staten Island. Many Brooklyn and Staten Island residents and bridge customers expressed interest in new or expanded ferry service across the Narrows, which would connect bicycle paths on both

sides of the bridge. This service would complement the existing Staten Island Ferry, which operates between Manhattan and Staten Island. Focus group participants mentioned that a ferry option could help gauge overall demand for a SUP.

Operating ferry service or maintaining, constructing or funding ferry-related infrastructure is not within MTAB&T's purview. However for concept planning purposes one may envision either shuttle service between landings in both boroughs and/or service extensions of current or planned ferry routes. In fact, several development projects on Staten Island, such as the New York Wheel, Empire Outlets, etc. are already encouraging ferry operators to increase ferry capacity to Staten Island. For example, the New York Water Taxi has signed a letter of intent to add a St. George stop to its existing tour package, which also makes stops in Brooklyn, creating more routes from different parts of the city to Staten Island.

In 2015, Mayor de Blasio announced plans to dramatically expand subsidized ferry service in the City. The New York City Economic Development Corporation (NYCEDC) is responsible for NYC Ferry, which will operate five new ferry routes among Manhattan, the Bronx, Queens and Brooklyn. According to NYCEDC's website, 60 sites around the City were initially evaluated to determine their potential to support ferry service. The sites ultimately chosen were selected based on ridership potential for commuting trips, navigability and infrastructure needs. Routes were developed to effectively serve these locations while considering total ridership potential, financial viability and transit equity.

The existing and planned ferry routes are shown in Figure 5-16. The South Brooklyn route commenced service on June 1, 2017 and includes stops at Bay Ridge and at the Brooklyn Army Terminal. The Rockaway route started on May 1, 2017 and also serves Brooklyn Army Terminal. The new Bay Ridge ferry landing is along the Shore Parkway Greenway in the vicinity of Bay Ridge Avenue (Figure 5-17). The ferry landing at the Brooklyn Army Terminal (Figure 5-18) is a short distance from existing and potential future bicycle paths in the Sunset Park section of Brooklyn.

On Staten Island, a ferry landing site in Stapleton, near the Homeport, was considered in the *Citywide Ferry Study* (2013). As shown in Figure 5-19 and Figure 5-20, the Stapleton site is close to the VNB and adjacent to the SUP on Bay Street and the North Shore Greenway, which connect to destinations in St. George and the boardwalk along the South Shore beaches. In the SUP focus groups conducted for the VN-84 Master Plan bicycle riders strongly supported enhanced connectivity to the bicycle path network and enhanced access to destinations on Staten Island. Based on committed transportation investments and expanded development in Stapleton, the *Citywide Ferry Study* recommended that the costs and benefits of the potential amenity of additional ferry service directly to Homeport should be evaluated. Conceivably, the South Brooklyn and/or Rockaway routes could include a stop at Stapleton to serve bicyclists and pedestrians traveling between Staten Island and Brooklyn.

Although a ferry route between Brooklyn and Staten Island is not currently planned, the City's commitment to provide ferry service to South Brooklyn and the considerable investments being made to enhance Staten Island as a "destination" could incentivize expanded ferry service for bicyclists and pedestrians across the Narrows. More detailed analyses would be required to determine the feasibility and financial viability to provide this service.

The estimated costs for this alternative are (\$2015):

- One vessel: \$1-\$5 Million
- Yearly operating: \$2-\$4 Million
- Landings: \$5-\$10 Million (each)

More details on the costs of this alternative are in Chapter 6.

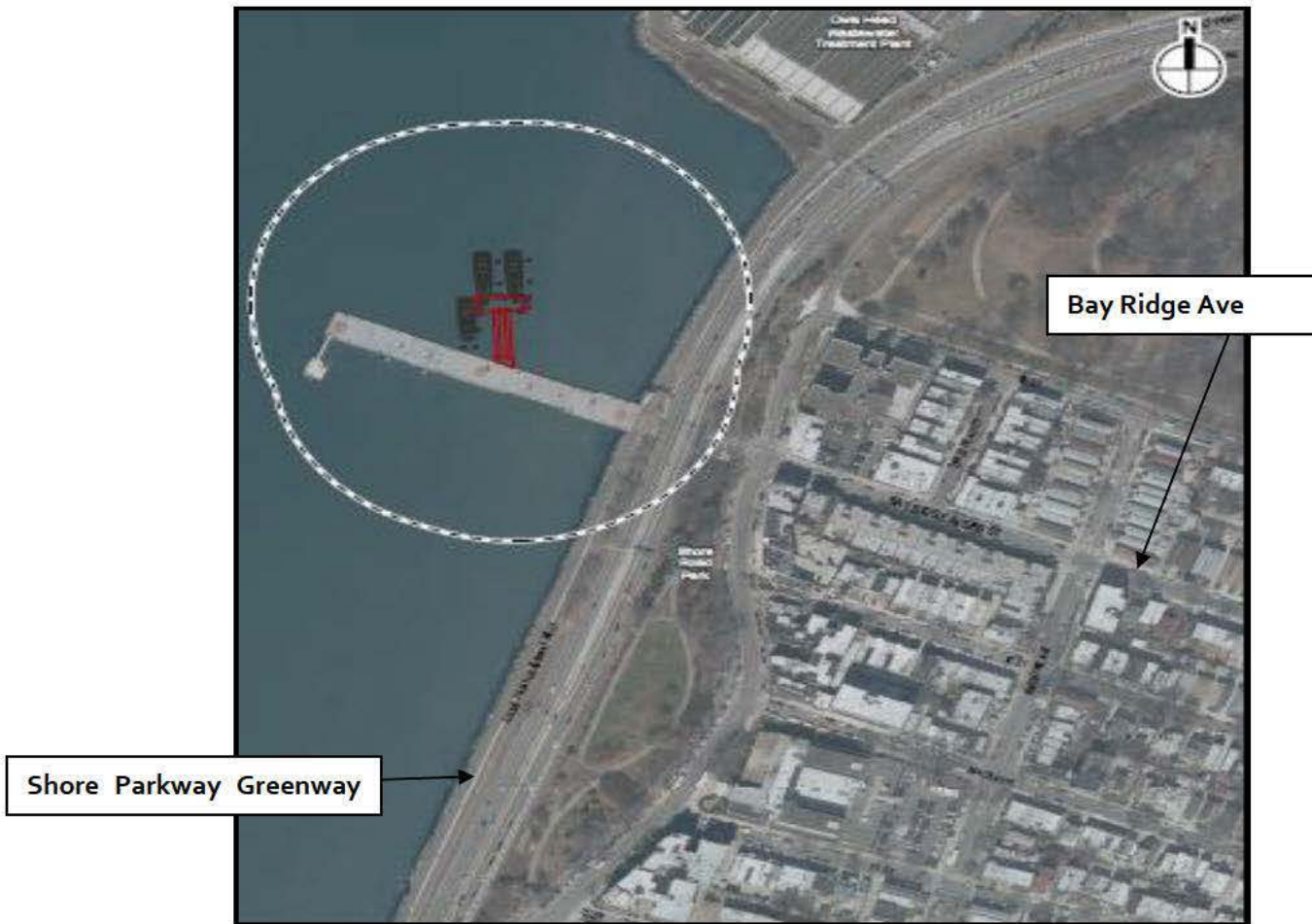
Figure 5-16: Existing and Planned NYC Ferry Routes



*= Operational as of May 2017; **=Operational as of June 2017

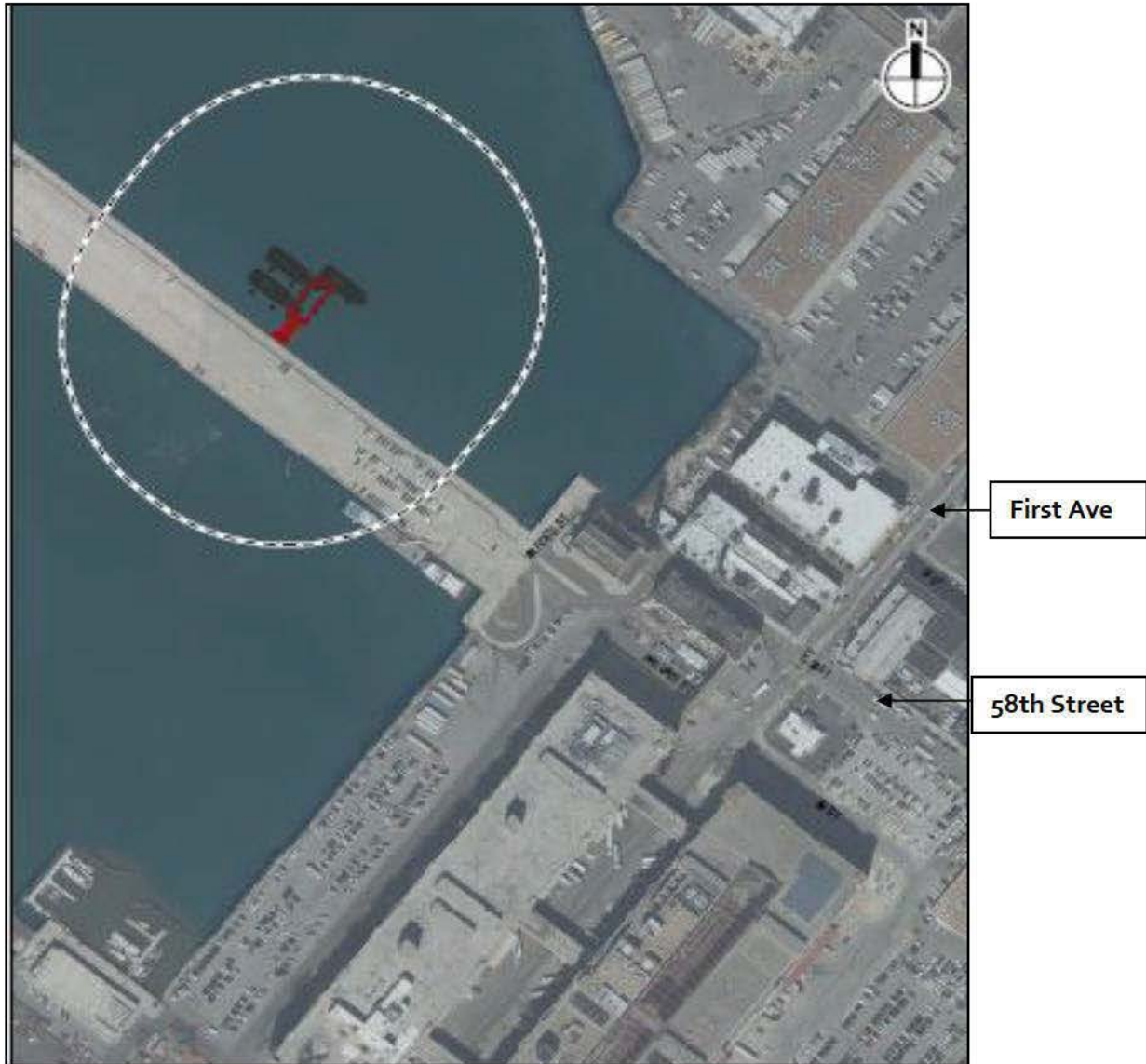
Source: NYCEDC

Figure 5-17: Bay Ridge Ferry Landing



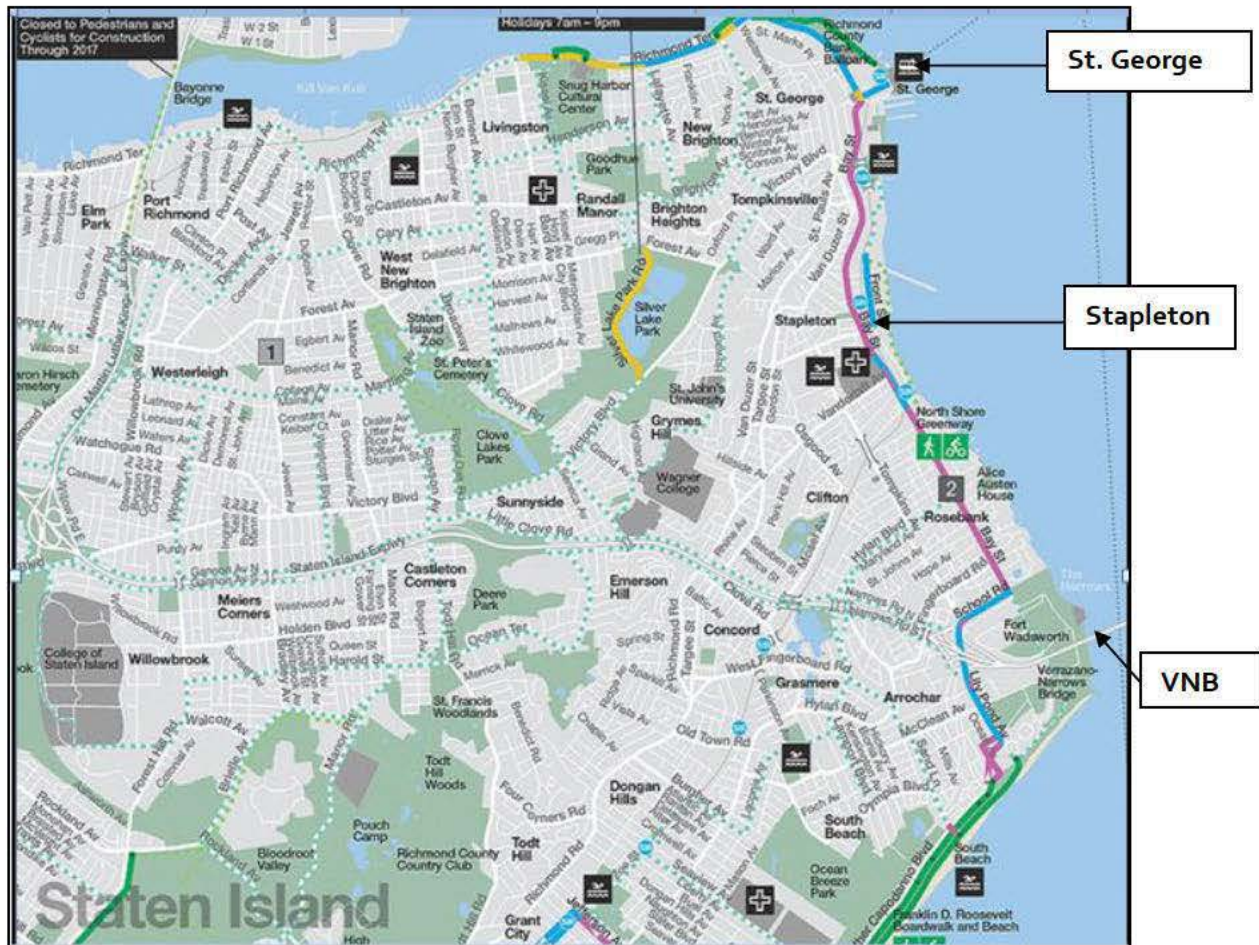
Source: NYCEDC

Figure 5-18: Brooklyn Army Terminal Ferry Landing



Source: NYCEDC

Figure 5-19: Bikeways in Staten Island near the Verrazano-Narrows Bridge



Source: www.nyc.gov

Figure 5-20: Stapleton Landing, looking toward the Verrazano-Narrows Bridge



Source: WSP

Evaluation Summary

The evaluation of this concept relative to the Shared-Use Access goals and feasibility considerations is summarized in Table 5-10.

Table 5-10: Evaluation of New Ferry Service

| Goal | Assessment | Score |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------|-------|
| Provide safe access for pedestrians and cyclists between Brooklyn and Staten Island (10=traffic and SUP are on separate structures; 5= traffic and SUP share the same structure with barrier between them; 0= traffic and SUP are mixed and in conflict) | SUP uses are not mixed with roadway traffic, but they must reach the ferry terminal in Brooklyn and Staten Island. | 8 |
| Provide connections to existing pedestrian and bike paths in Brooklyn and Staten Island (10=Easily connects to existing paths; 5=Can safely access existing paths; 0=Does not connect to existing paths) | Planned ferry locations in Brooklyn and Staten Island would be close to existing paths. | 7 |
| Develop cost-effective solutions Capital Costs (10=low; 5=medium; 1=high) | Cost to run ferry service between Brooklyn and Staten Island; cost to reconstruct ferry terminals. | 8 |
| Minimize adverse environmental and community impacts: NEPA/ SEQRA Evaluation (Possible EA/EIS); Parkland Impacts, Construction in Floodplain, Water Quality Impacted (10= minimal (temporary) impact; 5=moderate impact; 1=high (permanent) impact) | Restoring and construction of ferry terminals. | 9 |
| Minimize impacts to bridge operations, traffic capacity and bridge customers: Impacts to traffic congestion on the VNB, impacts to incident response time on VNB, and impacts to access/ safety for maintenance and construction personnel (10=improvements to existing/ minor impact; 1=degrades existing/ significant impact) | Would not impact users on the VNB; inspection required for ferry landings. | 8 |
| Maintains structural integrity (loads, wind, seismic) and functionality of the VNB and its approaches; Compliant with current design criteria (10=improvements to existing/ minor impacts; 5=no change; 1=degrades existing/ significant impacts) | Would not impact the VNB. | 5 |
| Total= | | 45 |

This concept is not within MTAB&T's purview. This alternative would entail consideration of jurisdictional restrictions, policies of other agencies/ stakeholders, and other issues which are beyond the scope of this study.

6 Capital Cost Estimate

This section summarizes how capital costs were estimated for the potentially feasible concepts. For a more comprehensive explanation refer to the *Shared-Use Path Capital Cost Estimate Summary* report in Appendix C. Table 6-1 summarizes these cost estimates.

Table 6-1: Capital Cost Estimate of Shared-Use Access Concepts

| Concept | Cost (2015 \$) |
|------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------|
| Outboard of Lower Level | \$320 - \$340 Million |
| Outboard of Lower Level- Brooklyn Approach in John J. Carty Park | \$320 - \$340 Million |
| Outboard of Upper Level | \$340 - \$370 Million |
| Separate Bicycle/Pedestrian Crossing of the Narrows | \$490 - \$525 Million |
| New Ferry Service | One Vessel: \$1 to \$5 Million Yearly Operating: \$2 to \$4 Million Landings: \$5 to \$10 Million |

During the public input process, MTAB&T was often asked to explain why the cost of a SUP on the bridge significantly exceeds the estimate prepared in 1997 as part of the *Bike Path Feasibility Study*. As described in Table 5-4, much has changed since 1997 including post 9/11 security concerns, revised SUP design standards, revised ADA requirements, and changes to the Upper Level configuration to include a Bus/HOV lane. In addition, the 1997 estimate did not address emergency response access, a path that accommodates maintenance and snow removal requirements, adjacent property impacts, and weight and wind impacts to the existing structure. The current estimate accounts for all of these issues and reflects the challenges and complexity of modifying the longest suspension bridge in North America.

The outboard cost estimates were prepared based on the conceptual design of the Outboard of Lower Level option with adjustments to compensate for the additional approach work required for the Outboard of Upper Level concept.

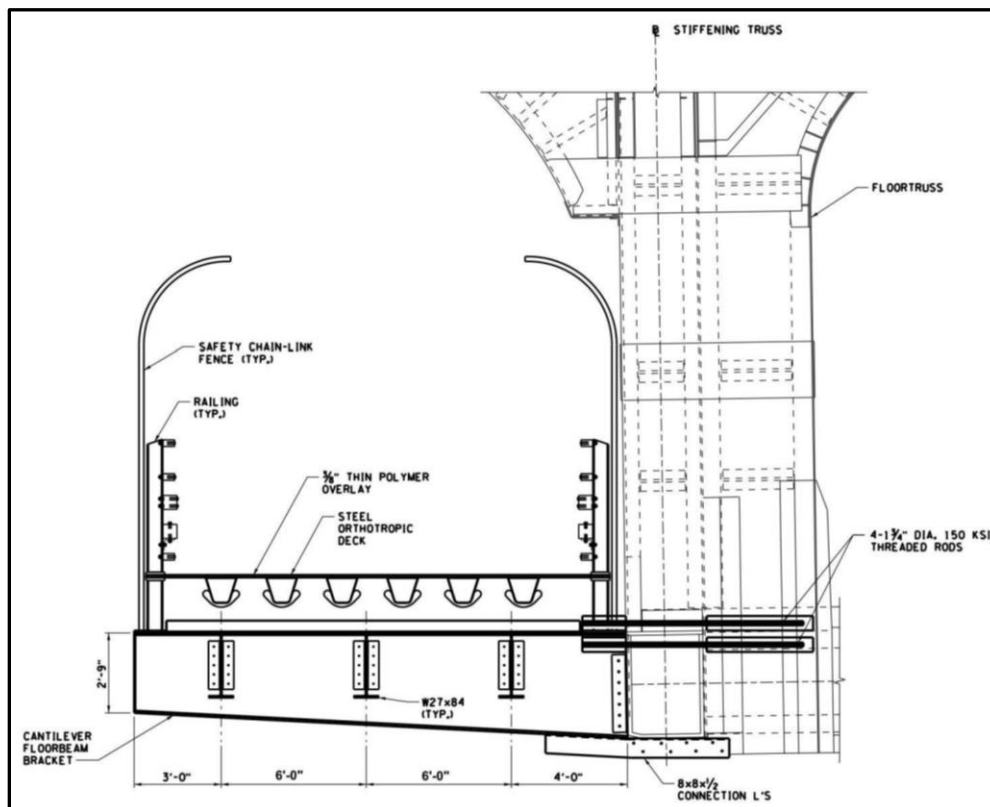
6.1 OUTBOARD OF LOWER LEVEL

For the Outboard of Lower Level alternative, a basic conceptual structural design was developed for the SUP to quantify items based on measurements from conceptual plan views and cross-sections. The new floor beams to be connected to the VNB were designed conceptually to determine approximate size and required related components. Steel beam and concrete pier types and sizes were also estimated based on the conceptual designs and bridge structures with similar configurations. Additionally, the quantity of other items such as connection types, types of fencing, railings, lighting, communications, expansion joints, structural retrofits, lane striping and drainage systems were included in the estimate. A typical SUP section on suspended spans and a typical SUP section at a tower is shown in Figure 6-1 and 6-2, respectively.

Base unit prices were established by considering the complexity of construction, while analyzing both engineers' cost estimates and contractor bid prices from local construction projects with similar structural elements. The height and length of the VNB are the catalyst for the complex construction methods. Traditionally, barges are placed in the water to act as construction staging areas. However, this would not be possible for these SUPs since the elevation of the VNB is 228 feet above the water at the mid-span. Therefore, lane closures on the VNB and specialized equipment would be necessary to construct the suspended span portion of the SUP for both the Upper and Lower Level Outboard alternatives.

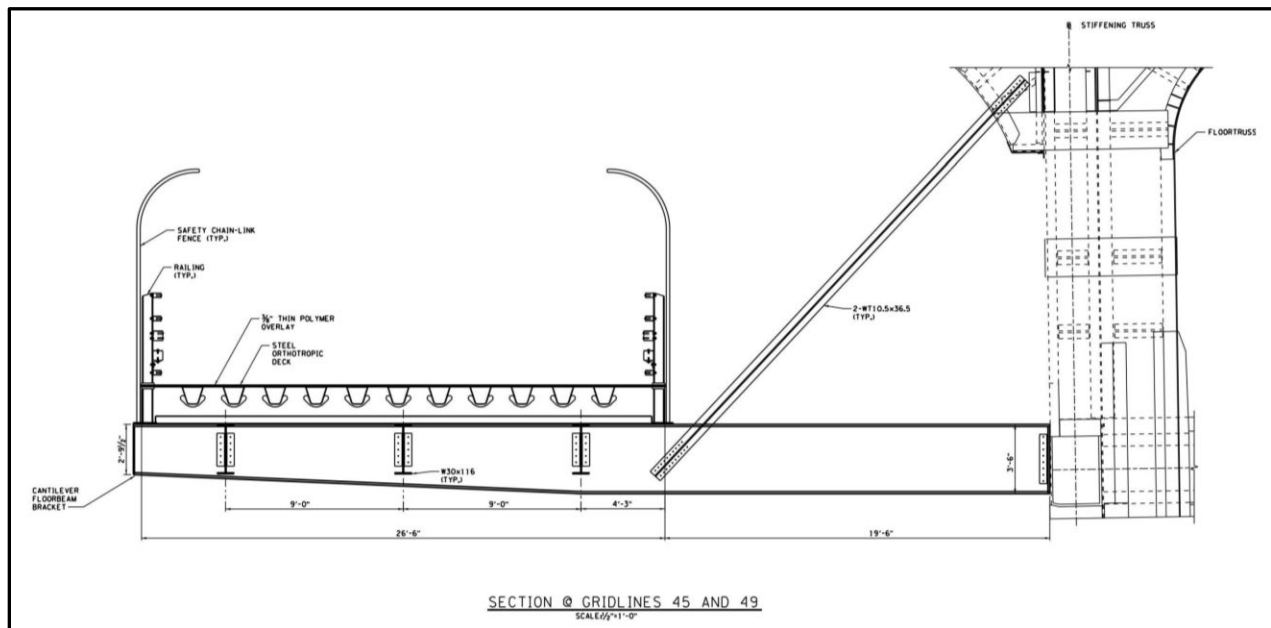
Lane closures would be necessary with challenging access requirements for construction along the main span. This would reduce productivity and increase overall construction costs. To account for the complexity and limited hours of construction, pro-rated labor rates for union workers and equipment rental rates were used in the estimate. These union rates and equipment rental rates were calculated by determining the tasks that need to be completed and the timeframe in which the work could be performed with the constraints of these alternatives. Additionally, the contractor's overhead and profit were added to the base cost, approximately 15 percent and 10 percent, respectively.

Figure 6-1: Typical SUP Section on Suspended Spans



Source: WSP

Figure 6-2: Typical SUP Section at Tower



Source: WSP

The approach structures in Brooklyn and Staten Island were assumed to be constructed from conventional materials and typical construction methods with less challenging access requirements. Therefore, the unit costs, union labor rates, and equipment rates were based on similar structures being currently constructed for the approaches. The base values from similar local construction projects were used to estimate the cost of construction for all of the approaches associated with the SUP alternatives.

The cost estimates also account for other features such as security measures required to safely protect the Bridge structure and emergency access requirements for vehicles to access the Bridge. Finally, contingency was added since this is a conceptual estimate and not every detail of the construction could be identified. A contingency of 30 percent was used to calculate the low range estimate, and a more conservative contingency of 40 percent was added to calculate the high range estimate. The contingency allowance accounts for such things as connections for emergency access, temporary roadways required to build the approaches, compensation for impact on parklands, soil erosion control, containment and disposal of any hazardous materials or soil disturbed during construction, and traffic control measures required during construction, as well as other miscellaneous items not captured in the estimate directly.

The cost estimates were calculated in 2015 dollars. It is important to note that the cost estimates do not include inflation to midpoint of construction, maintenance costs, design costs, construction management costs, or environmental permitting costs. These additional costs will need to be considered in the future. The estimated capital cost for this alternative is \$320-\$340 Million (\$2015).

As discussed in section 4.4 (Shared Use Path Engineering/Feasibility Considerations), in 1997 the engineering firm Ammann & Whitney prepared the *VNB Pedestrian/Bicycle Path Feasibility Study* for the

City of New York. The firm is intimately familiar with the VNB's design, construction and current operations. For these reasons MTAB&T retained Ammann & Whitney to independently review WSP's construction cost estimate of the Outboard Lower Level SUP concept.

Ammann & Whitney compared and contrasted the current Outboard Lower Level concept to the recommended option described in the 1997 Feasibility Study. This assessment highlighted that the Outboard Lower Level concept meets current design standards and reflects changes in bridge operations and security requirements that have developed in the past two decades. Ammann & Whitney also reviewed the Project Team's proposal for pathway geometry and features, structural systems and impacts on the approaches and suspended span, constructability, cost components and assumptions for items such as contingencies, general conditions, profit, etc.

Ammann & Whitney concluded that the Project Team's cost estimate for the Lower Level Outboard SUP concept is reasonable for the type of construction proposed. Ammann & Whitney's review is attached in Appendix D.

6.2 OUTBOARD OF LOWER LEVEL- BROOKLYN APPROACH IN JOHN J. CARTY PARK

Since this alternative is the same as the Outboard Lower Level alternative except for the Brooklyn approach, the costs are similar. Even though the overall length of the Brooklyn approach is shorter there would not be any significant cost savings. There would be additional costs associated with this alternative. For example, two separate switchback structures would need to be constructed. Since these structures do not meet grade, a significant structural support system is required. These structures will be located on either side of the VNB; one will be in John Paul Jones Park and the other will be located in the infield adjacent to Shore Park. Also, there will be an added cost associated with constructing a retaining wall where the SUP meets grade in John J. Carty Park.

It is also anticipated that there would be additional costs associated with disruption of John J. Carty Park. Since the SUP approach ramp would conflict with the tennis courts and possibly with others, replacement facilities would need to be constructed in a different location. Also, the usable Park space will practically be cut in half, which could lead to additional mitigation costs. And as noted previously, approximately 85 percent of the total cost of the SUP is attributable to the path on the suspended span and the Staten Island approach ramps. These costs would be incurred regardless of the concept for the Brooklyn approach ramp.

Therefore, for estimating purposes it is assumed that this alternative would cost approximately the same (\$320-\$340 Million (\$2015)) as the Outboard Lower Level alternative.

6.3 OUTBOARD OF UPPER LEVEL

To estimate the Outboard of Upper Level alternative, the Lower Level Outboard alternative costs were used as a base. It was assumed that the main span and general work scope costs would be the same. However, the approach costs were adjusted to account for the longer lengths required to touch grade

from the Upper Level of the bridge. The approaches for the Upper Level compared to the Lower Level are approximately 30 percent longer. Therefore, the costs for the Upper Level Brooklyn and Staten Island approaches were increased by 30 percent from the Lower Level Brooklyn and Staten Island approaches. The estimated capital cost for this alternative is \$340-\$370 Million (\$2015).

6.4 SEPARATE BICYCLE/PEDESTRIAN CROSSING OF THE NARROWS

The cost estimate for the Lift Bridge alternative was developed at a conceptual level generally based on square foot estimates for construction. A conceptual design was developed to take measurements of the proposed structure and unit costs were developed by analyzing similar lift-bridge and approach span structures. A conventional concrete deck with a lightweight deck for the main span and approach spans were used for estimating purposes. This estimate also accounted for the vertical lift section which would be a 1,000 foot navigable span for large ships to pass through. The difficulty of construction was also considered. It was assumed that traditional construction methods could be used since this structure would not be elevated as high as the outboard alternatives and that it would be an independent structure, thus allowing for less restrictive construction operations and no maintenance of traffic type issues.

It was assumed that that the maximum water depth where the lift bridge would cross the Narrows waterway is about 70 to 80 feet. The depth of the founding strata in the Narrows waterway was assumed to be 250 feet. These elevations were used to determine the type of bridge foundations.

To estimate elements of the Lift Bridge, components and unit prices from the new Tappan Zee Bridge were analyzed. Due to the length and elevation of this bridge, a Warren Deck Truss was used for this estimate. It was assumed that there would be nine spans separated by 500 feet, equaling a total structure length of 5,500 feet with the navigable span. For the foundations, like the Tappan Zee Bridge, it was assumed that steel pipe piles would be the preferred alternative. This estimate includes 6 foot diameter pipe piles driven to a depth of 225 feet.

Since this is a conceptual level estimate and not every detail of the construction could be captured, a 30 percent contingency was included for the low range estimate, and a more conservative 40 percent contingency was used for the high range estimate. This provides an allowance for unforeseen costs and more detailed cost elements that have not been fully evaluated at this level of design. The estimated capital cost for this alternative, including contractor's direct and indirect costs and contingencies is \$490-\$525 Million (\$2015).

6.5 NEW FERRY SERVICE

The capital and operating cost to provide new or expanded ferry service between Brooklyn and Staten Island depend upon several factors including, but not limited to:

- The type and number of vessels required
- Frequency of service and days and hours of operations
- Maintenance requirements

- Whether the service would operate as a “stand-alone” route or as an extension or variation of one or more NYC Ferry routes
- Cost to construct new or rehabilitate existing ferry landings and support facilities

Based on cost information provided in the *Citywide Ferry Study* and other sources, the approximate cost to operate a small (100 passengers) to mid-size (150 passengers) ferry ranges from \$300-\$500 per hour. Therefore operating two ferries 12 hours a day would cost roughly \$2-\$4 million annually. This estimate would need to be refined based on more specific operating characteristics.

Vessel costs vary depending upon size and type. A range of \$1-\$5 million per vessel is appropriate for planning purposes. The cost of new and rehabilitated landings would vary based on site conditions. A range of \$5-\$10 million per landing in 2013\$ was cited in the *Citywide Ferry Study*.

7 Stakeholder Engagement

MTAB&T implemented a stakeholder engagement program as part of the VNB Master Plan process. Objectives of this program included:

- Describe the planning framework and the individual projects that comprise the Master Plan
- Identify stakeholders' concerns and issues
- Obtain feedback on stakeholders' opinions, attitudes, and potential interest in the concept of a SUP on the VNB

The stakeholder engagement program consisted of three components:

- Meetings of the Project Team with public agencies having jurisdiction within the project area, elected representatives and other public officials, civic organizations and advocacy groups, and print and electronic media
- Focus groups of demographically diverse segments of the population that would be affected by or interested in the SUP, i.e., residents of neighborhoods in Brooklyn closest to the bridge (Bay Ridge, Fort Hamilton and Dyker Heights), residents from throughout Staten Island, VNB customers (toll paying passenger car drivers and bus commuters), and members of bicycle advocacy groups
- Online survey of Brooklyn and Staten Island residents and Bridge users

The results of the focus groups and online survey are described in *VNB Shared-Use Path Study-Focus Group Report*, March 2016 (Appendix E) and *VNB Shared-Use Path Online Survey Summary*, April 2016 (Appendix F).

7.1 MEETINGS WITH STAKEHOLDERS

Since the spring 2015, MTAB&T conducted approximately 25 meetings with various groups to present the findings and updates to the VNB Master Plan and/or the Shared-Use Access Study. At each meeting the Project Team conducted a presentation of the draft Master Plan and Shared-Use Access Study. The presentation generally consisted of the following elements:

- Background and context
- Goals and objectives
- Description of and interdependency among the Master Plan projects, including enabling projects
- Video simulation of the proposed sequencing of the reconstruction of the Brooklyn Upper Level Approach Ramps and Belt Parkway Ramps
- Feasibility considerations for the SUP
- SUP concepts, including outboard of the Lower Level of the bridge; outboard of the Upper Level of the bridge and a separate SUP structure
- Implementation schedule for the Master Plan projects and next steps

Table 7-1 lists the organizations with whom MTAB&T has met and the date of the meeting(s).

Table 7-1: Stakeholder Meetings

| Stakeholder Category | Stakeholders | Meeting Date |
|----------------------------|------------------------------------------------------------------|----------------------------------------------|
| New York City Agencies | Department of Transportation | 10/21/15 11/30/15 12/02/15 03/24/16 |
| | Department of Parks and Recreation | 12/10/15 |
| New York State Agencies | Department of Transportation | 10/08/15 |
| Federal Agencies | National Parks Service-Fort Wadsworth | 04/25/16 |
| | US Army-Fort Hamilton | 11/13/15 |
| | United States Coast Guard | 11/13/15 |
| | Army Corp of Engineers | 11/09/15 |
| Borough Presidents | Borough President (and staff)-Brooklyn | 09/30/15 |
| | Borough President (and staff)-Staten Island | 09/29/15 |
| Elected Representatives | State Senator - SI & Brooklyn District 23 | 09/29/15 |
| | Rep for State Senator - Brooklyn 22nd District | 09/30/15 |
| | Rep for State Senator - Staten Island District 24 | 09/29/15 |
| | State Assemblywoman - Brooklyn/SI District 64 | 09/29/15 |
| | State Assemblyman - Staten Island District 61 | 09/29/15 |
| | State Assemblyman - Staten Island District 62 | 09/29/15 |
| | State Assemblyman - Staten Island District 63 | 09/29/15 |
| | City Councilwoman - Staten Island District 49 | 09/29/15 |
| | Rep for City Councilman - Staten Island District 50 | 09/29/15 |
| | Rep for City Councilman - Brooklyn District 43 | 09/30/15 |
| | Congressman – Brooklyn (District Director) | 11/05/15 |
| | Rep for Congressman - Brooklyn & Staten Island | 09/29/15 |
| Community Boards | Brooklyn Community Board 10 Traffic and Transportation Committee | 11/09/15 03/15/16 |
| | Staten Island Community Board 2 Transportation Committee | 11/02/15 |
| | Staten Island Community Board 1 Transportation Committee | 12/14/15 |
| Focus Groups | VNB Users | 10/20/15 10/22/15 |
| | Staten Island Residents | 10/20/15 10/21/16 |
| | Brooklyn Residents | 10/21/15 10/22/16 |
| | Bicycle Advocates | 10/21/15 |
| Transportation Advocates | Transportation Alternatives/ Harbor Ring Committee | 10/06/15 11/03/15 06/07/17 |
| | Tri-State Transportation Campaign | 07/01/15 10/06/15 |
| Print and Electronic Media | Staten Island Advance | 10/06/15 |
| | New York 1 News | 10/06/15 |
| | Daily News | 10/06/15 |
| | amNew York | 10/06/15 |
| | The Home Reporter/Brooklyn Media | 10/06/15 |

7.2 FEEDBACK ON STATE OF GOOD REPAIR PROJECTS

Overall, stakeholders supported the rationale for and scope, safety, traffic flow benefits and sequencing of SOGR projects and enabling projects. They understand that undertaking this program is complex due to the inherent challenges of reconstructing or replacing numerous large, closely spaced, elevated structures. Overarching concerns focused on minimizing the duration of construction, maintaining traffic flow during construction and mitigating noise and dust.

City, State and federal agencies support the projects and committed to work with MTAB&T to address relevant jurisdictional issues. All stakeholders committed to work collaboratively to resolve permitting, property and technical issues and to coordinate construction.

Elected representatives universally endorse the program to maintain the bridge and its approaches in a SOGR. While appreciative of the safety and traffic benefits, some, however, expressed concern over the program's duration and for potential impacts to traffic. MTAB&T explained the complexity of maintaining traffic during construction and committed to maintain peak period traffic capacity on the bridge. Representatives appreciated MTAB&T's commitment to this objective.

The Staten Island Community Boards' Traffic and Transportation Committee endorsed the Master Plan projects. Brooklyn Committee members, as well as civic groups of residents living adjacent to the bridge, agree with the need for and benefits of the SOGR projects. However some members residing near the Brooklyn approaches raised concerns about noise (especially at night) and dust from construction projects on and adjacent to the bridge. Residents understand that to prevent lengthy peak period delays resulting from closing traffic lanes, nighttime construction is required. However some residents requested the evaluation of noise barriers. The civic groups remain vocal in seeking relief and appreciate the MTAB&T's commitment to enforce dust and mitigation measures on current and future construction projects.

The transportation advocacy groups support the SOGR projects. Some expressed concern about the timeframe for completion in the context of the SUP and question why a SUP cannot be implemented prior to replacing the Lower Level deck span. MTAB&T explained that the condition of the Upper Level approaches and construction staging issues necessitate completing the SOGR projects, and that the Lower Level reconstruction is necessary before further considering a SUP. Most view planned improvements on the Upper Level Approaches and Belt Parkway Ramps, such as providing standard width travel lanes and shoulders, as much needed improvements that will relieve congestion.

In summary, nearly every individual with whom MTAB&T met supports the need for and understands the urgency and complexity of the planned SOGR projects. While some (primarily Staten Island elected representatives and residents) expressed concern over potential impacts to traffic from the planned construction on the bridge, they understood that these improvements are critical to maintaining this iconic facility and providing safe and effective travel. Outside agency representatives strongly endorsed the Plan and are willing to work with the MTAB&T to implement the improvements.

7.3 FEEDBACK ON SHARED-USE ACCESS

Overall, stakeholders indicated that MTAB&T effectively communicated the technical issues (wind, weight), implementation challenges (security, emergency access, maintenance), cost, impacts (on adjacent neighborhoods and parks), and institutional issues (permitting and environmental approvals) to construct a SUP.

The New York State Department of Transportation and the City of New York's departments of Transportation and Parks and Recreation view the SUP favorably in the context of improving mobility and recreation. Staff also acknowledged the significant implementation challenges and impacts and limited funding available for competing transportation priorities. US Army personnel based at Fort Hamilton highlighted concerns arising from the proximity of the Fort's facilities to the VNB's access ramps and indicated that a SUP that encroaches on or is adjacent to the Fort is not acceptable due to security concerns. The National Parks Service supports a bicycle path to link the boroughs and is interested in the concept of providing a separate crossing of the Narrows. The Parks Department is primarily concerned that approaches to the SUP would displace parkland in Shore Park and in John Paul Jones Park.

Staten Island elected representatives generally oppose any SUP options on the bridge. They object to spending approximately \$300-\$400 million on a facility whose purpose they perceive to be solely recreational. They feel that because of the length of the path, height and gradient, few would use the path for commuting. For these reasons they do not believe the benefits of such an investment outweigh its cost. The representatives strongly prefer that limited financial resources should be spent to improve existing transportation facilities on Staten Island or to provide additional transit service to connect Staten Island with Manhattan and Brooklyn. Staten Island representatives unanimously oppose any SUP concept that reduces vehicular capacity on the VNB. Because express bus service is critical to their constituents, Staten Island representatives also reject any SUP concept that either supplants or diminishes the effectiveness of the bus/HOV Lane.

Some Brooklyn representatives expressed support for a SUP as a resilient transportation option to roads and subways. However the elected representatives acknowledged the considerable adverse impacts that the SUP's approach ramps would have in the residential neighborhoods and parks on the Brooklyn side of the VNB.

Several members of the Staten Island and Brooklyn Community Boards' Traffic and Transportation Committee do not consider the SUP to be an efficient use of toll revenue. Others questioned whether the gradient and wind on the bridge would affect usage and be a "deal breaker." Many objected to the adverse visual effects and physical impediment the Brooklyn approaches to the SUP would have on John Paul Jones Park. Still other members of the civic associations object to a SUP because of security concerns or because they view it as having potential negative impacts to their community. Others expressed interest in ferry access from Brooklyn to Staten Island and/or expanding MTA New York City Transit's bicycle rack on bus program to additional bus routes serving the Staten Island Ferry Terminal as a lower cost strategy to provide bicycle access across the bridge.

7.4 FOCUS GROUPS

The market research firm RSG used telephone and web-based techniques to recruit a demographically diverse group of participants to serve on one of seven different focus groups:

- Staten Island residents (2 groups)
- Brooklyn residents (2 groups)
- VNB customers (2 groups)
- Bicycle and pedestrian advocates (1 group)

Each of the seven focus groups consisted of approximately 10 individuals. The focus groups were held in Midtown Manhattan between October 20, 2015 and October 22, 2015. The Focus Group Report is in Appendix E.

The purpose of the focus groups was to:

- Educate participants on facts and trade-offs resulting from the SUP
- Obtain feedback on the SUP
- Gauge interest in alternatives to SUPs on the Bridge
- Test a questionnaire that was distributed to more than 1,000 individuals to gauge their interest in SUPs.

7.4.1 Pedestrian/Bike Use

Bike and pedestrian activity varied from group to group. Several groups contained serious cyclists who frequently ride long distances. Many in the bike-advocate group had ridden across the VNB during the Five-Borough bike tour; several members of the other groups had ridden or run across the VNB as well. Several participants who live on Staten Island mentioned that they currently drive across the VNB to access cycling routes in other areas. Other participants voiced concerns about traffic on Staten Island and that it is not cyclist-friendly, creating an unsafe environment. One participant mentioned that they currently commute from Staten Island to Manhattan by taking their bike on the ferry.

7.4.2 Shared-Use Path Knowledge

The level of prior knowledge of the project varied from group to group. Roughly half of each group of Staten Island residents had heard of the project. Many had seen a recent article in *The Staten Island Advance*. Some Staten Island participants thought that it would be “very expensive.” A 400 million dollar price for the SUP was described in an article in *The Staten Island Advance* a few days prior to the focus groups.

The group of bike advocates was most knowledgeable of the project. All ten participants had heard of the project. Several were familiar with the 1997 study that looked into the feasibility of the same SUP. One quoted a cost of “400 million dollars” for it.

Other participants' knowledge varied. One said that based on what he had heard so far, the SUP would be too long and he would not use it. Others thought it was a "done deal" and that it was a "20 year project."

7.4.3 Reactions to Shared-Use Path Information

The participants were given a brief presentation with information about the proposed plan options for the SUP. A belief that several participants voiced was that bike use over the VNB, if available, would be mainly for recreational purposes and not for commuting to work. When directly prompted as to whether they would consider using it for recreational purposes or commuting, many more participants indicated that they would consider it for recreational purposes. Very few participants mentioned that they would be interested in commuting on a bike over the VNB. Some considered the bridge too long, the paths too steep, and the biking overall too difficult. One participant suggested the only people who would ride over the bridge were "bike fanatics."

Many participants were concerned about the lack of bike facilities or attractions on the Staten Island side: the path "would go from nowhere to nowhere" in their opinion (some mentioned there wasn't much going on in that part of Brooklyn either, but most concern was on the Staten Island side). There was much discussion by some participants about connecting the SUP to a better bike network on Staten Island and/or easier connections to various attractions such as the SI Ferry Terminal, the new outlet mall development and New York Wheel. A few respondents said there should be Citi Bike on Staten Island to make the SUP more attractive and to give more reasons to use it.

Still others expressed concern about the weather and said they might use the path on nice weekends, but that it could be very dangerous and uncomfortable in bad weather. Many participants wondered how and whether it would get any use in the wintertime. One participant questioned, "How would they commute in the freezing snow?" Some pointed out that this would mean that for a significant part of the year the SUP would be underutilized. Similarly, several participants were concerned about potentially strong winds, especially given the high altitude of the bridge. Among bike advocates, a majority thought that closing down the SUP during bad weather was justified as long as there was some type of advance notice.

Participants also brought up several other perceived safety-related concerns. For instance, concern was raised that the access to the SUP may result in attracting suicide attempts and that a barrier or other mitigation would be needed to address this risk. Some participants were also concerned with crime on the bridge, especially at night. One person described the bridge as "the perfect location for crimes." Less frequently named safety concerns included how pedestrians could be prevented from using the bike path and vice versa. One participant described how he once had gotten out of his car on the VNB because of an accident and was scared of the height. As a result, he mentioned that he would not walk across the VNB if it were an option.

In several of the groups, participants were inquisitive about how to get on the access ramps and asked for further clarification. When presenting the renderings of the ramps, the moderators made sure to mention that the paths would be wide enough to accommodate emergency response, maintenance and

inspection vehicles. Even so, some respondents still voiced concern about emergency response accessibility and accessibility more generally and wanting to see some sort of escalator or elevator to help users. In that regard, participants in two groups also brought up wheelchair accessibility and ADA compliance. Others thought the switchback looked strange and that the ramps were a bit of an eyesore. There was also some concern about the steep incline of the ramps. One participant said, "People are going to be having heart attacks." Finally, one participant mentioned that he was generally fine with the ramp, but wondered whether the access ramps might become a shelter for the homeless.

Several participants wanted to ensure that the path would be easily accessible from Bay Ridge. Some groups suggested that access to the ramps be from not just the existing bike path, but also directly from neighborhood streets. Having easy access to and from the R train was also mentioned frequently.

One theme that emerged from all groups was that there should be no charge to use the SUP, no matter how small the fee. In fact, some felt even a low fee of, say, 50 cents would not generate enough revenue to pay for the act of collecting it. All groups felt that there should not be a charge for walking and biking anywhere in New York City. They were adamant about this and believed there was no precedent in NYC where people are charged to walk or bike.

There was also widespread opposition to an increase in the current VNB toll to help pay for the project. In fact, not one group supported this either. The sentiment that people (particularly Staten Islanders) "are paying enough already" was widespread, even by the bike advocates.

In addition, participants in almost all groups were not pleased with the 20-year potential timeline for the project. Generally, participants felt this is too far away and they might be so old by the time the project is built they could never use it ("we'll be in wheelchairs by then!") or that the entire concept might be obsolete at that point. Bike advocates were also very much disappointed about the timeline and some bike advocates questioned why it would take so long to build this SUP, citing a timeline of 3-4 years to build the entire Bayonne Bridge as an example. That said, most participants did not seem too concerned with the timeline as a make or break item. There was a strong sense this is a long-term project.

Participants appreciated how the bike users and pedestrians were separated on different paths so that pedestrians would not have to worry about speeding cyclists, but many expressed concern that pedestrians were not on the Manhattan side of the bridge. Many participants said that the view of Manhattan would be an attraction to visitors of the bridge and would therefore increase use. The view of the Atlantic was viewed as less appealing than the view of Manhattan. The bike advocates participants were so committed to the project that they said they would not care if they were on the Atlantic side of the bridge. Others discussed the fact that there are shared paths all around Manhattan and that those work out fine (though some discussed "road rage" on the Brooklyn Bridge between walkers and bikers).

7.4.4 Alternative Ways of Spending Money

When told about the estimated cost of the concept, some participants voiced their disapproval, stating that the costs would not justify the construction of the path. Other participants were especially concerned about the responsibility, and cost, to maintain the paths. Some wondered why so many tax

dollars would be going to accommodate a small group of cyclists. For instance, one participant voiced his frustration with what he perceived to be the disproportionate emphasis on bikers this way: “All of this effort is being done to accommodate bicyclists. That’s why I’m asking: How many bikers are out there to begin with? Everybody is going to pick up the tab to facilitate – what -- .01 percent of the population? [...] I’m just pointing that out there. At the end of the day, people are picking up the tab for it. And to facilitate what? That they are going to take it for... .. work? That is not going to happen.” Further, several participants questioned more generally whether this should be a priority over other infrastructure needs. For instance, participants mentioned that road improvement on Staten Island and more remote areas of Brooklyn should take priority over the pathway (including fixing potholes.)

Others thought that spending the money on creating a subway to Staten Island or building a separate bridge for pedestrians or bicyclists from Brooklyn to Staten Island, or at least adding more transit options to and from Staten Island would be wiser. Even so, bike advocates were heavily in favor of the path.

7.4.5 Alternative Shared-Use Access Concepts

Some potential alternatives to the VNB SUP were discussed, many of which were directly raised by participants. These include adding ferry service between Brooklyn and Staten Island, a subway/rail link between Staten Island and Manhattan and/or Staten Island and Brooklyn, and more bike racks on buses.

There was very little support for the idea of removing a lane of traffic and turning it into a bike lane. Participants said that the bridge was already too congested as is, and removing a lane would only intensify the problem. One participant claimed, “Traffic is bad enough!” when removing a lane was suggested. Participants who were avid cyclists liked the idea of removing a lane of traffic and were not concerned with impacts on traffic.

Participants perceived the new Bus/HOV Lane as very important and removing it was also universally disliked. There is strong interest in having priority lanes for buses from Staten Island to Manhattan. When the moderators brought up the idea of removing the bus lane over the VNB and instead implementing a ped/bike lane, it was simply a non-starter, and almost all participants felt it was a foolish idea. For instance, one participant who lives in Staten Island expressed it this way: “If you had an opportunity now to take the 40-, 50-, 60-thousand people [...] who ride the express buses every day, to give them an opportunity to slice even 15 minutes, 20 minutes off their commute -- and then you *didn’t* do that. I mean, you’d be [...] hated.”

The idea of a new ferry service from Staten Island to Brooklyn generally had support. Bike advocates also brought up that although a ferry link to Brooklyn would make bike access easier and might make a good interim solution, it would not offer the same experience as walking or riding from Staten Island. Bike advocates felt a ferry or a bus would force them to have to be on “someone else’s schedule” and would significantly alter their experience of just being able to travel when they want. The bike to them represents freedom (as many people feel about cars), thus, forcing them into a different mode (ferry) curtails that freedom and mobility.

Many participants liked the idea of rail – either subway, light rail, or a tram service connecting Staten Island to Brooklyn or Manhattan. Some also brought up the idea of a train across the VNB (rather than a SUP) or a link to Bayonne and the NJ TRANSIT rail system. Staten Islanders said they feel isolated from the rest of the city and this feeling of isolation was felt throughout the groups. Part of this feeling of isolation is that they do not have a direct subway connection to the other boroughs. The Staten Island ferry, for whatever reasons, does not feel like a strong enough link to them to alleviate their feelings of isolation.

The bus options, both the bike-racks and the special shuttle, did not generate much support (any support was tempered, at best). Participants mentioned that the bike-racks do not hold many bikes and slow the bus down. Again, as an interim step bike advocates did not mind it, but they did not want this to be a substitute for a full path. That said, some participants mentioned the bus or ferry options could be a good way to gauge overall demand for the facility.

7.5 ONLINE SURVEY

The Project Team conducted an online survey in an effort to understand the attitudes, support, and potential use for a SUP across the VNB. Respondents consisted of residents with home zip codes in the catchment area of the VNB (Staten Island and Brooklyn) or individuals who had used the VNB in the past, but do not necessarily live in the direct vicinity of the VNB. Data collection for the survey commenced on December 14, 2015 and finished on February 5, 2016 and resulted in 1,627 valid responses. The questionnaire collected information on respondents' travel and exercise behaviors, their opinions of the concept both before and after being shown a series of information screens, and concluded with a short series of debrief and demographic questions.

The survey showed that initial levels of favorability towards the SUP dropped precipitously as respondents learned more information about the concept. This was especially the case when cost and timeline information for the path were revealed, at which point favorability ratings dropped from 71% to 37%. When directly asked whether they supported the concept given all they know, approximately half of respondents (51%) supported it. As a whole, very few respondents perceived this concept to be of a higher priority than other infrastructure needs (13%). When asked whether they would use a potential path, almost equal percentages of respondents indicated that they would (33%), would not (32%), and would "maybe" use it (30%). Four percent indicated that they still needed more information. Among those who stated an interest in using it, the most commonly named purposes were for leisure (62%) or exercise (56%), and relatively few respondents thought that they would commute on it (14%).

Apart from these overall results, the analysis of the survey data also revealed that respondents varied in their perception of the SUP along lifestyle, geographic and behavioral differences. For instance, segments that remained most favorable towards the concept throughout the survey included cyclists (54%), respondents who exercise outside (44%), and Brooklyn residents (41%). However, even among these segments few perceived the concept to be a higher priority than other infrastructure needs. Some of the segments that were least favorable towards the concept included those who do not exercise outside (24%), non-cyclists (30%) and respondents who were not from the catchment area (32%). Taken

together, these results paint an uneven picture of the level of support that a SUP concept enjoys, in particular when considering that favorability ratings of the concept decreased dramatically when the reality of cost and construction complexity were revealed. The VNB Shared-Use Path Online Survey Study can be found in Appendix F.

8 Environmental Review Strategy

This section discusses the applicability and appropriate levels of National Environmental Policy Act (NEPA) and New York State Environmental Quality Review Act (SEQRA) reviews for the preferred option—the Outboard Lower Level alternative. The environmental analysis also included an assessment of whether this project can undergo separate environmental reviews under NEPA and SEQRA without risking segmentation. The SUP is evaluated against the three FHWA NEPA and eight SEQRA tests to determine the applicability of segmentation if the SUP project is constructed separate from the other VN-84 Master Plan projects. For the purpose of this assessment, it is assumed that these findings also apply to the Outboard Upper Level Concept.

8.1 ENVIRONMENTAL SCREENING SUMMARY

A screening-level assessment of environmental conditions in the study area was conducted as the basis for preliminarily identifying the potential for project impact (temporary or permanent) and permits and/or approvals that may be required to construct the SUP. Based on the cross-section and plan views, the Outboard Lower Level concept would potentially impact the following resources:

- Parkland (Brooklyn: Shore Park, John Paul Jones Park; Staten Island: Gateway National Park)
- Historic/archaeological resources
- Visual quality
- 100-year floodplain
- Water quality
- Contaminated materials (possible)
- Coastal zone management
- Wetlands and aquatic resources (shading and if construction of a drainage outfall is required, which is unknown at this time)

8.2 CONSTRUCTION IN PARKLAND

The proposed location of the Brooklyn SUP would be constructed on New York City Department of Parks and Recreation (NYCDPR) parkland (Shore Park and John Paul Jones Park) and would require obtaining an interim permit and license and permanent easement from the NYCDPR. The Staten Island location of the SUP would involve construction in Gateway National Park requiring National Park Service (NPS) approval, likely in the form of a lease.

8.3 NATIONAL ENVIRONMENTAL POLICY ACT (NEPA) REQUIREMENTS

The SUP would require federal approvals triggering NEPA. The federal approvals required include NPS approval due to construction within Gateway National Park, compliance with Section 106 of the National

Historic Preservation Act (NHPA) (see Section 8.4), and US Army Corps of Engineers (USACE) permit and National Marine Fisheries Service (NMFS) Essential Fish Habitat (EFH) approval if a new drainage outfall is required. The SUP will be directly attached to the VNB which is eligible for listing on the National Register of Historic Places (NRHP) and will directly affect the look of the VNB. The SUP will also impact NPS and NYCDPR parkland and has strong community interest. Therefore, the likely level of NEPA documentation required is an environmental impact statement (EIS).

8.4 SECTION 106 OF THE NATIONAL HISTORIC PRESERVATION ACT

Section 106 of the NHPA requires consultation regarding the effects of federal undertakings on historic properties. The VNB has been determined to be eligible for listing on the NRHP. Therefore, all projects that would directly affect the VNB itself or cause significant visual impacts to the VNB and require federal approval would need an assessment to determine if the project may result in an adverse effect to the VNB as a historic resource. Since the SUP would directly affect the VNB itself, and requires federal approvals (NPS approval and possibly a USACE permit), an assessment must be done to determine if the project may result in an adverse effect to the VNB. The SUP would be attached to the VNB and directly affect the look of the VNB, which potentially could be considered an adverse effect.

8.5 SECTION 4(f) OF THE DEPARTMENT OF TRANSPORTATION ACT OF 1966

Section 4(f) of the United States Department of Transportation (USDOT) Act of 1966 stipulates that USDOT agencies cannot approve the use of land from publicly owned parks, recreation areas, wildlife and water fowl refuges, or public and private historical sites for a transportation use unless there is no feasible and prudent alternative to the use of the land, and the action includes all possible planning to minimize harm to the property resulting from the use. The SUP project does not require a USDOT agency's action. Therefore Section 4(f) is not applicable.

8.6 STATE ENVIRONMENTAL QUALITY REVIEW ACT (SEQRA) APPLICABILITY

Since the SUP project is subject to NEPA, a single NEPA-compliant EIS could be used to document environmental review consistent with SEQRA requirements. New York's State Historic Preservation Office (SHPO) review will be required.

8.7 BUNDLING OF PROJECTS AND ENVIRONMENTAL REVIEW

Segmentation is the division of a project or action into component parts or phases and conducting individual environmental reviews of the separate parts or phases rather than conducting environmental review of the whole project or action. FHWA provides three tests to determine whether projects may be evaluated independently under NEPA without resulting in segmentation: 1) logical termini, 2) independent utility, 3) restricts consideration of alternatives or foreseeable transportation improvements. Independent utility also means that the project must be able to proceed on its own without the need for other actions to be taken prior to or simultaneously with the project. The SUP satisfies the FHWA NEPA tests allowing it to be evaluated separately without resulting in segmentation.

The SEQRA Handbook provides eight tests for segmentation including common purpose, timing, geographic location, project ownership, and plan, impact significance, independent utility, and inducement. The timing test has not been included in the evaluation since the project timeframe for the SUP is in a very preliminary stage of assignment and has not been assigned with reliable certainty. The SUP feasibility will not be fully determined until the design of the deck for the Lower Level Suspended Span deck is completed. The SUP project should be evaluated against the SEQRA tests for segmentation as more information about its design and timing become available.

In conclusion, the environmental review information described herein should be re-evaluated for applicability if detailed engineering studies conducted during preliminary design of the replacement of the Lower Level Suspended Span deck conclude that a SUP outboard of either the Lower Level or Upper Level concept is feasible and when the possible implementation timeframe is better defined.

9 Conclusion and Next Steps

This feasibility assessment indicates that the Outboard Lower Level and Outboard Upper Level SUP concepts generally meet the SUP and Master Plan goals. Ferry service, however, may provide a more cost-effective use of public resources. To determine whether a SUP outboard of the bridge is structurally feasible, an evaluation of the effects on the structure of wind, local and global structural loading, seismic events, etc. is required. MTAB&T's future preliminary design study to replace the VNB Lower Level Suspended Span will include evaluating the feasibility of the outboard SUP concepts.

Constructing a separate crossing of Upper New York Bay parallel to the VNB for bicyclists and pedestrians or providing new ferry service to transport bicyclists and pedestrians between Staten Island and Brooklyn would avoid many of the implementation issues of a SUP on the VNB but are beyond the MTAB&T's purview. These alternatives would entail consideration of jurisdictional restrictions, policies of other agencies/ stakeholders, and other issues which are beyond the scope of this study. During the public outreach process many bicycle riders, bridge users and residents of Brooklyn and Staten Island expressed support for a new ferry service as a quicker and lower cost strategy (relative to implementing separate SUPs on the bridge) for bicyclists to travel between Brooklyn and Staten Island.

Appendix A

Design Criteria

Appendix B

Shared-Use Path Evaluation Matrix

Appendix C

Shared-Use Path Capital Cost Estimate Summary

Appendix D

VNB Pedestrian/Bicycle Path Cost Estimate Review and Proposals Comparison

Appendix E

VNB Shared-Use Path Focus Group Report

Appendix F

VNB Shared-Use Path Online Survey Summary Report