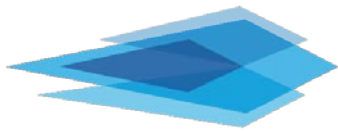
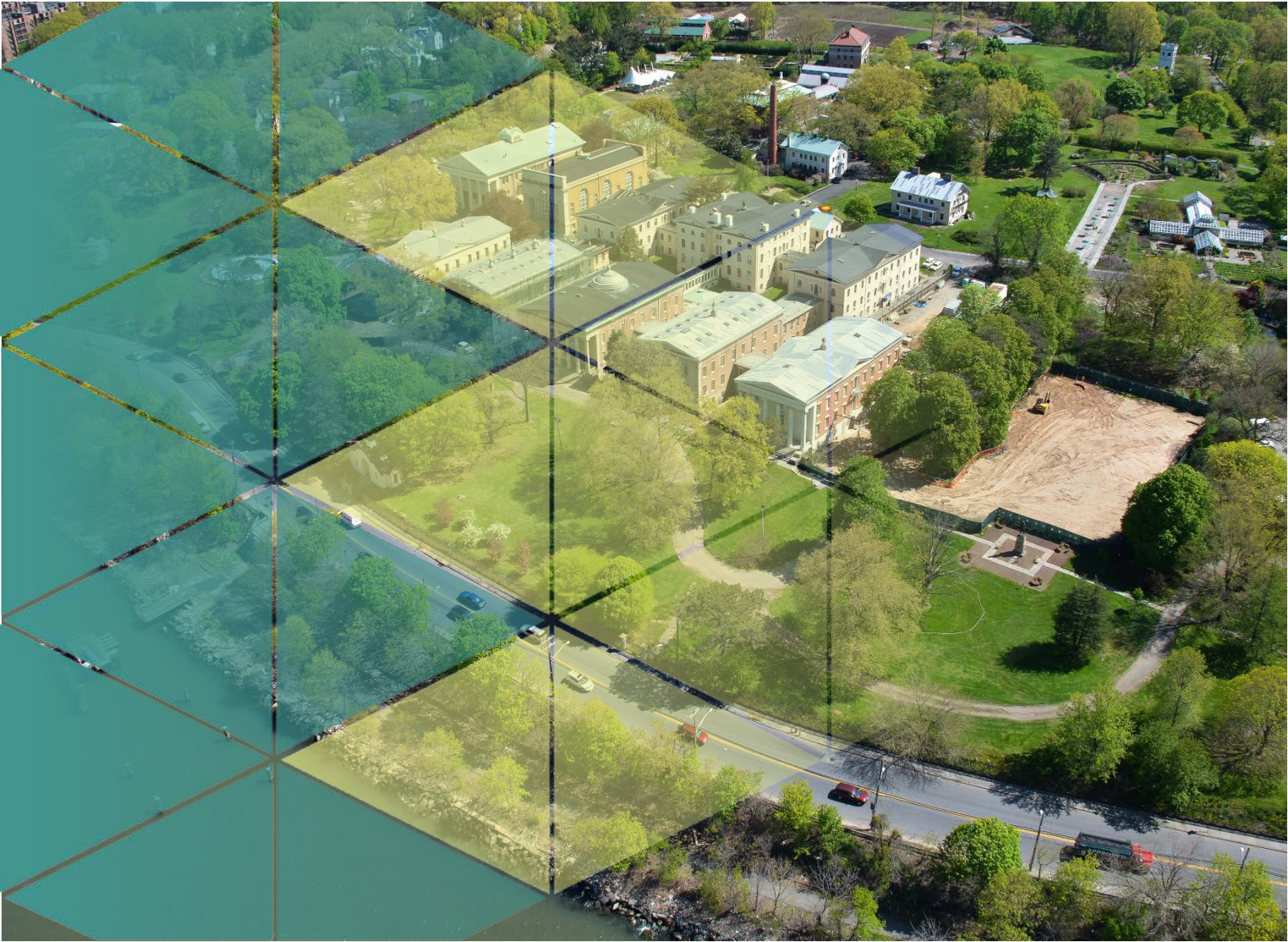


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## **Appendix B: St. George Terminal Access Evaluation**



STATEN ISLAND  
NORTH SHORE  
**BRT**

# St. George Terminal Access Evaluation

November 2018







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## Executive Summary

### Background

In August 2012, MTA New York City Transit (MTA-NYCT) published the Staten Island North Shore Alternatives Analysis (SINSAA), which assessed the implementation of new or enhanced transit along Staten Island's North Shore from West Shore Plaza to St. George Terminal. Ultimately, after extensive analysis and community outreach, the SINSAA recommended a Bus Rapid Transit (BRT) system as the preferred alternative.

Originally, the proposed St. George BRT terminal station was planned to be situated within a former surface parking lot adjacent to the St. George Terminal. Since 2012, significant new development along the North Shore including the construction of the Empire Outlets as well as resiliency-related improvements have impeded access to St. George for the recommended BRT project, including its planned terminal. Accordingly, these recent changes have created a need to reconceptualize access to and a station at St. George for the BRT project. These concepts and their evaluation are presented in this report, building upon the substantial work undertaken in the SINSAA including consistency with the established goals and objectives.

### St. George Access Options

Seven conceptual, combined BRT access and terminal options at St. George were developed. These options were differentiated by their use of the former North Shore Railroad right-of-way (including areas beneath the NY Wheel Parking Garage, Ballpark Station, and Empire Outlets), Bank Street, Richmond Terrace, areas beneath the St. George Ferry Terminal, and areas adjacent to MTA-Staten Island Railway's (SIR) St. George Terminal and within MTA-NYCT's existing St. George Bus Terminal.

Of the seven options, three options were deemed viable to be carried forward for further consideration. A brief overview, physical and institutional considerations and a summary comparison of each option are provided below. Refer to Section 3.4 of the full report for a detailed comparative matrix of each option carried forward.



## Option 1

Option 1 is a dedicated two-lane busway along a former North Shore Railroad right-of-way (NSRR ROW) and SIR tracks to a 7-bay bus (40-foot buses) facility below the Empire Outlets and the existing elevated bus terminal. A variant of this concept, Option 1a, would involve creating a BRT turnaround providing additional berths and crew layover facilities at the former NY Wheel property just north of the NY Wheel parking garage.

### » Pros

- Cost: \$720M (\$349M more than SINSAA)
- Ridership: 13,061 AM

- Provides for a continuous, dedicated busway for the entire BRT from Arlington to St. George, consistent with the SINSAA preferred alternative
- Avoids Richmond Terrace east of Jersey Street including construction impacts to Richmond Terrace and its residents and businesses as well as travel time impacts to the BRT at signalized intersections
- No loss of Richmond Terrace parking or interference with existing surface bus operations
- No additional travel time as compared to 2012 SINSAA

### » Cons

- Structural alterations to columns and beams (Empire Outlets and bus deck)
- SIR operational impacts and displacement of Tracks 10, 11 & 12 with Track 9 reconfigured to accommodate the wye (maintains ability to turn trains)
- Potential impacts to St. George resiliency projects
- Separation of staging and operating areas leads to busway congestion (Option 1a)
- Inability to accommodate articulated buses
- Need for additional bus dispatch staff
- Potential emergency access/safety concerns

## Option 5

Option 5 would provide for two exclusive median BRT lanes along the former NSRR ROW and Richmond Terrace. Under this option, the BRT would utilize the NSRR ROW from Jersey Street to Nicholas Street. At Nicholas Street, a new BRT exclusive ramp would be provided to enable BRT buses to enter the 0.45-mile median busway within Richmond Terrace. An optional additional ramp could be provided at St. George





## STATEN ISLAND NORTH SHORE BUS RAPID TRANSIT

Terminal. Transit signal priority (TSP) would be installed at the new ramp entrance as well as at intersections along the Richmond Terrace busway.

### » Pros

- Cost: \$518M (\$147M more than SINSAA)
- Ridership: 11,732 AM

- New ramp at Nicholas Street allow for dedicated BRT operations
- Dedicated busway along Richmond Terrace provides for travel time advantage over operation in mixed traffic, provided busway exclusivity is enforced
- Makes use of the existing St. George bus terminal which facilitates transfers and is customer-friendly
- Does not require coordination with private developers or impacts to SIR

### » Cons

- Without St. George optional bus ramp, further deterioration of intersection of Bay Street and Richmond Terrace will impact BRT travel time
- Longer travel time than SINSAA BRT due to traffic signals along 0.45-mile busway
- Loss of 198 total parking spaces on Richmond Terrace and bicycle lanes
- Construction effects (Richmond Terrace reconstruction and potentially at St. George with optional BRT ramp)

## Option 6

Option 6 would provide an exclusive two-lane median BRT alignment along Richmond Terrace from Jersey Street to the existing NYCT St. George Bus Terminal (0.95-miles). Modifications at the Jersey Street intersection, including TSP, would be necessary to transition the BRT to Richmond Terrace. At the Terminal, a new BRT exclusive viaduct structure/ramp would provide direct access to the existing terminal bus facility. Exiting BRT buses would depart the facility through an existing bus ramp in the westbound direction on Richmond Terrace. TSP would be installed at intersections along the Richmond Terrace busway.

### » Pros

- New BRT exclusive ramp at St. George Terminal enables BRT priority and avoids travel time impacts at the Bay Street intersection



## STATEN ISLAND NORTH SHORE BUS RAPID TRANSIT

- Cost: \$606M (\$235M more than SINSAA)
- Ridership: 11,012 AM

- Dedicated busway along Richmond Terrace provides for travel time advantage over operation in mixed traffic, provided busway exclusivity is enforced
- Makes use of the existing St. George bus terminal which facilitates transfers and is customer-friendly
- Does not require coordination with private developers or result in impacts to SIR

### » Cons

- Need to coordinate ramp construction/phasing with NYCT Bus Operations, NYCDOT and any planned Terminal projects
- Loss of 368 total parking spaces on Richmond Terrace and bicycle lanes
- Longer travel time than SINSAA BRT due to traffic signals along the 0.95-mile busway
- Construction effects (Richmond Terrace reconstruction)

## Trade-Offs

A brief overview of the relative trade-offs associated with the options considered in this study are noted below. A comparative matrix for each concept follows.

Option 1 is the highest cost of all the options under consideration and would be comparable to the cost of the LRT alternative. While Option 1 is the most costly, it is the only concept which provides NYCT with the ability to maintain operational control and independence on a direct, dedicated continuous, right-of-way from Arlington to St. George. To that end, Option 1 avoids a number of impacts that would occur under Options 5 and 6 including vehicular traffic conflicts, travel time impacts at signalized intersections, permanent loss of on-street parking and construction-period impacts including community effects associated with the reconstruction of Richmond Terrace. Estimated ridership is projected to be higher for Option 1 as opposed to Options 5 and 6 due to reduced travel time and thus Option 1's projected ridership is most consistent with the travel time of the SINSAA BRT alternative. Additionally, operations for Option 1 would be the most reliable of the options due to the continuous, exclusive busway. The implementation



## STATEN ISLAND NORTH SHORE BUS RAPID TRANSIT

of Option 1 would require extensive structural modifications and column relocations to Empire Outlets, the egress ramp from the St. George bus deck and the St. George bus deck itself (which could compromise existing bus operations during construction). However, even with these structural modifications Option 1 would be unable to accommodate articulated buses due to restrictive turning radii and physical constraints present beneath the Empire Outlets and bus deck and it would not be able to accommodate the minimum of 10 bus bays at St. George Terminal (resulting in the need for a separate staging area). Option 1 would require vetting by NYPD and FDNY due to accessibility and emergency access concerns that are not present with Options 5 and 6. Additionally, Option 1 would result in operational impacts to SIR that would not occur under Options 5 and 6 including the loss of one operating track, modifications to another track, loss of storage space, the need to relocate facilities, and the loss of accessibility. In addition, Option 1 is likely to require modification of the St. George Resiliency project. This option would avoid the community and construction-period effects that would occur on Richmond Terrace (Options 5 and 6). Due to the fact that Option 1 stays “low” in St. George, it is most likely to be affected by flooding or other coastal concerns if not fully integrated into the St. George Resiliency project.

Options 5 and 6, would both utilize Richmond Terrace, respectively, and are lower in cost as compared to Option 1. However, NYCT would lose the ability to maintain right-of-way exclusivity enjoyed under Option 1 (e.g., coordination with NYCDOT on Richmond Terrace) and there is the potential that the busway would not be physically separated from the surrounding travel lanes and that the exclusivity of the bus lanes would not be adequately enforced. Options 5 and 6 would have lower travel times due to the multiple intersections (more for Option 6 than Option 5) and thus lower ridership than Option 1. Options 5 and 6 would accommodate articulated buses and provide 3 additional bus bays at St. George (on the bus deck) as compared to Option 1 (10 to 7). These options which would use the existing bus terminal would likely offer a more customer-friendly transfer experience as compared to Option 1. While Options 5 and 6 do not require the coordination with private developers or result in impacts to SIR that would be needed under Option 1, Options 5 and 6 would result in community impacts including the loss of significant surface parking on Richmond Terrace and construction-period impacts due to the installation of the dedicated busway on Richmond Terrace. Option 6, with the longest on-street busway (1 mile) would have the



## STATEN ISLAND NORTH SHORE BUS RAPID TRANSIT

lowest reliability of the three options. Option 5 would require construction of a new ramp at Nicholas Street, which would require coordination with the existing parking garage (formerly related to the NY Wheel). Due to the location of the ramp, and the use of the former North Shore RR ROW at St. George, Option 5 would have more resiliency concerns than Option 6 but less than Option 1.

### **Coordination & Next Steps**

NYCT has engaged in significant agency coordination specifically related to the evaluation of access options for St. George. Meetings have been held with the Staten Island Borough President (October 5, 2018) and a briefing for Elected Officials was held on October 23, 2018. In November 2018, a series of meetings were held with representatives of NYCT Operations Planning, Staten Island Department of Buses and Staten Island Railway to evaluate and further refine access options.

Upon the selection of an access option to St. George, the SINSAA will be refreshed before the project advances to the environmental review phase.





Table ES 1 – Comparative Matrix of Options

Screening Categories	Option 1/1a (Low)			Option 5 (Low/High Hybrid)			Option 6 (High)				
<b>Additional Bus Travel Time* (minutes)</b>	●	EB: 0	WB:0	●	EB: 2.5	WB: 1.1	◐	EB: 1.3	WB: 3.5		
<b>Bus Operations</b>	◐	<ul style="list-style-type: none"> <li>No. of signalized intersections: 0</li> <li>No. of BRT exclusive lanes: 2</li> <li>Location of BRT lanes: North Shore RR ROW</li> <li>Location of St. George Terminal: SIR level; Wheel staging area (1a)</li> <li>No. of St. George Bus Bays: 7</li> <li>Accommodate Artics? No</li> <li>Accommodates bus towing (40-foot bus, 45-foot tow)</li> </ul>		◐	<ul style="list-style-type: none"> <li>No. of signalized intersections: 6 EB; 8 WB</li> <li>No. of BRT exclusive lanes: 2</li> <li>Location of BRT lanes: North Shore RR ROW and Richmond Terrace</li> <li>Length of Richmond Terrace BRT lanes: 2,400 ft. with mountable curb separators</li> <li>New exclusive bus ramp at Nicholas St.</li> <li>Mixes with existing buses at St. George Terminal; TSP traffic light on bridge deck to be included for bus control</li> <li>Location of St. George Terminal: Upper bus level</li> <li>No. of St. George Bus Bays: 10</li> <li>Accommodate Artics? Yes</li> </ul>		◐	<ul style="list-style-type: none"> <li>No. of signalized intersections: 8 EB; 7 WB</li> <li>No. of BRT exclusive lanes: 2</li> <li>Location of BRT lanes: Richmond Terrace</li> <li>Length of Richmond Terrace BRT lanes: 5,000 ft. with mountable curb separators</li> <li>New exclusive bus ramp at St. George Terminal</li> <li>Mixes with existing buses at St. George Terminal Viaduct</li> <li>Location of St. George Terminal: Upper bus level</li> <li>No. of St. George Bus Bays: 10</li> <li>Accommodate Artics: Yes</li> </ul>			
<b>Parking Displacement</b>	●	No on-street parking loss		◐	EB: 92	WB: 106	Total: 198 (includes NYPD)	○	EB: 212	WB: 156	Total: 368 (includes NYPD)
<b>Effects</b>	◐	<ul style="list-style-type: none"> <li><b>Resiliency:</b> Within floodplain; need to coordinate with St. George SIR resiliency plans</li> <li><b>Community Effects:</b> No change to Richmond Terrace traffic or bicycle patterns</li> <li><b>SIR:</b> Loss of SIR Track 10 and relocation of North Shore wye. Truncation of track through Ballpark Station and removal of platforms/stairs/elevators. Shared bus and SIR station area. Loss of SIR equipment and materials storage capacity. Relocation of SIR utility infrastructure.</li> <li><b>NYCDOT St. George parking/traffic:</b> No impact</li> <li><b>Development:</b> Relocation of 11 columns for NYCDOT bus deck/ramp and 2 columns for Empire Outlets; need to coordinate emergency access with Empire Outlets, new traffic signal at the intersection of busway and turnaround at Bank Street (Option 1a)</li> <li><b>Service Planning:</b> Option 1: Two bays free; congestion at bays, not busway; Option 1a: Two bays free; congestion on busway, requires coordination of buses leaving &amp; returning to St. George from Wheel; operating cost impacts; Dwell times and operating plan to be confirmed.</li> <li><b>Institutional Issues:</b> Acceptability by NYPD and FDNY</li> </ul>		◐	<ul style="list-style-type: none"> <li><b>Resiliency:</b> Partially within floodplain; need to coordinate with St. George SIR resiliency plans</li> <li><b>Community Effects:</b> No change in # of Richmond Terrace traffic lanes; intersections modified with TSP; loss of exclusive bicycle lane</li> <li><b>SIR:</b> No impact</li> <li><b>NYCDOT St. George parking/traffic:</b> No impact</li> <li><b>Development:</b> Modification of signal timing at Nicholas Street entrance/exit from NY Wheel parking deck</li> <li><b>Institutional Issues:</b> None</li> </ul>		◐	<ul style="list-style-type: none"> <li><b>Resiliency:</b> Above floodplain; need to coordinate with St. George SIR resiliency plans</li> <li><b>Community Effects:</b> No change in # of Richmond Terrace traffic lanes; intersections modified with TSP; loss of exclusive bicycle lane</li> <li><b>SIR:</b> No Impact</li> <li><b>NYCDOT St. George parking/traffic:</b> Conversion of existing lower level ramp to two-way; removal of existing outbound ramp</li> <li><b>Development:</b> Need to coordinate ramp construction and phasing with NYCT Bus Ops and any planned Terminal projects</li> <li><b>Institutional Issues:</b> NYCDOT lower level impacts</li> </ul>			
<b>Construction Effects</b>	●	Impacts to SIR, NYCDOT bus deck and ramp and Empire Outlets		◐	Impacts from reconstruction of Richmond Terrace; Wheel parking /Bank Street and St. George Bus Depot			○	Impacts from reconstruction of Richmond Terrace; to NYCDOT parking/terminal access		
<b>Potential Ridership</b>	●	No change; travel time is the same. BRT: 13,061 AM users; LRT: 10,590 AM users		◐	BRT: 11,732 AM users; LRT: 10,590 AM users			○	BRT: 11,012 AM users; LRT: 10,590 AM users		
<b>Total Cost (increment over 2012 BRT)</b>	◐	\$720M (\$349M more than AA); \$75M more than LRT		●	\$518M (\$147M more than AA); \$127M more than LRT			○	\$606M (\$235M more than AA); \$39M lower than LRT		

○ Most Change    ◐ Moderate Change    ● Least Change

\* as compared to 2012 SINSAA



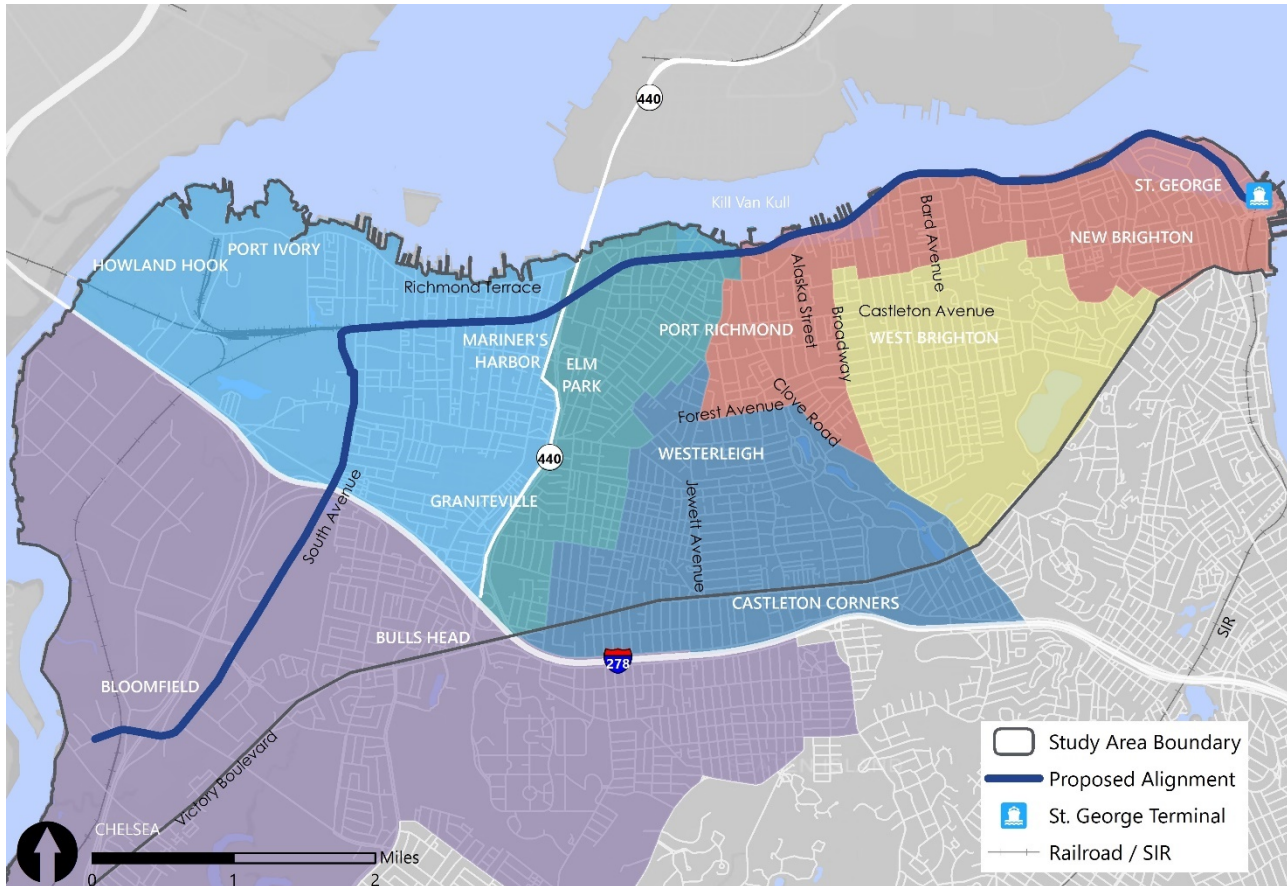
## 1 Background

In August 2012, MTA New York City Transit (MTA-NYCT) published the NYCT Staten Island North Shore Alternatives Analysis (SINSAA). The purpose of the SINSAA was to assess implementation of new or enhanced transit service along the North Shore of Staten Island (Richmond County, New York), primarily using the former North Shore Railroad right-of-way. The SINSAA identified a Purpose and Need as well as project Goals and Objectives resulting from an extensive review of existing and future conditions as well as coordination with numerous public agencies, private organizations and the public. The general study area for the SINSAA is shown in Figure 1. The SINSAA identified and evaluated the following Long List Alternatives:

- » Transportation Systems Management (TSM)
- » Heavy Rail along the Staten Island Railway (SIR – St. George to Arlington)
- » Electric Light Rail (LRT – St. George to Arlington)
- » Diesel Light Rail (DLRT – St. George to Arlington)
- » Electric Light Rail (LRT – St. George to West Shore Plaza)
- » Diesel Light Rail (DLRT – St. George to West Shore Plaza)
- » Bus Rapid Transit (BRT – St. George to West Shore Plaza)
- » Ferry/Water Taxi (Kill Van Kull from St. George Terminal to Mariner’s Harbor)



Figure 1 – Study Area



The Long List Alternatives were evaluated against the project goals and objectives and a Short List of Alternatives was presented at a Public Outreach meeting held in September 2011. The three alternatives advanced to the Short List included:

- » Transportation Systems Management (TSM)
- » Electric Light Rail (LRT - St. George to West Shore Plaza)
- » Diesel Bus Rapid Transit (BRT - St. George to West Shore Plaza)

The SINSAA presented a detailed analysis of the three short-listed alternatives. These alternatives were further refined and reviewed against the project's goals and objectives. Additionally, ridership forecasts were developed utilizing the MTA Regional Transit Forecasting Model (RTFM).



Based on the results of this detailed analysis it was determined that the TSM Alternative offered the lowest cost and fewest negative impacts on the natural environment, natural resources, and open space. However, the TSM Alternative, was also determined to be the least effective in terms of improving mobility and meeting the project goals and objectives. Both the LRT and BRT Alternatives resulted in mobility improvements and would create some potential environmental impacts. However, the BRT and LRT Alternatives differed in the categories of capital cost and ridership. The BRT Alternative had a substantially lower capital cost as compared to the LRT Alternative and was forecasted to attract higher ridership.

The SINSAA concluded that the BRT Alternative had the potential to reduce travel time, improve access to key locations, and attract new riders while having a lower capital cost than the LRT Alternative. Based on these considerations, the BRT from St. George to West Shore Plaza was recommended for advancement.

## **1.1 Recent Considerations at St. George**

As documented in the SINSAA, the St. George BRT terminal station was originally planned to be located just west and north of the St. George Terminal on a former surface parking lot, providing convenient pedestrian access between the two facilities (Figure 2). Since the SINSAA was published, more than six years ago, the portion of St. George near NYCDOT's St. George Ferry Terminal has undergone significant changes. Two specific projects, the Empire Outlets Mall and the New York Wheel (NY Wheel) were approved by the City for development in 2013 (Figure 3). The addition of the Empire Outlets and associated parking has precluded access to the site of the planned BRT terminal. The NY Wheel and its associated structured parking facility, just west of the Richmond County Bank Ballpark also complicated BRT access to the ferry terminal. However, in October 2018 NYCEDC officially announced that the NY Wheel project was no longer viable and was not advancing. To date, the fate of the constructed parking garage and other completed NY Wheel elements is unclear.





## STATEN ISLAND NORTH SHORE BUS RAPID TRANSIT

Additionally, in October 2012, the New York metropolitan area was severely impacted by Superstorm Sandy. As a result of those impacts, resiliency measures were designed and are currently being constructed to protect key transportation assets, including the Staten Island Railway (SIR) St. George Terminal Station and the NYCDOT's St. George Ferry Terminal. These measures include the installation of flood walls, shifting of key infrastructure assets such as power substations, and other physical improvements that impede accessibility to and along the former North Shore Railroad right-of-way in St. George.



Empire Outlets, Richmond Terrace



Lighthouse Point Construction



Raised SIR Signal House

Figure 2 - 2012 SINAA BRT Alternative St. George Terminal

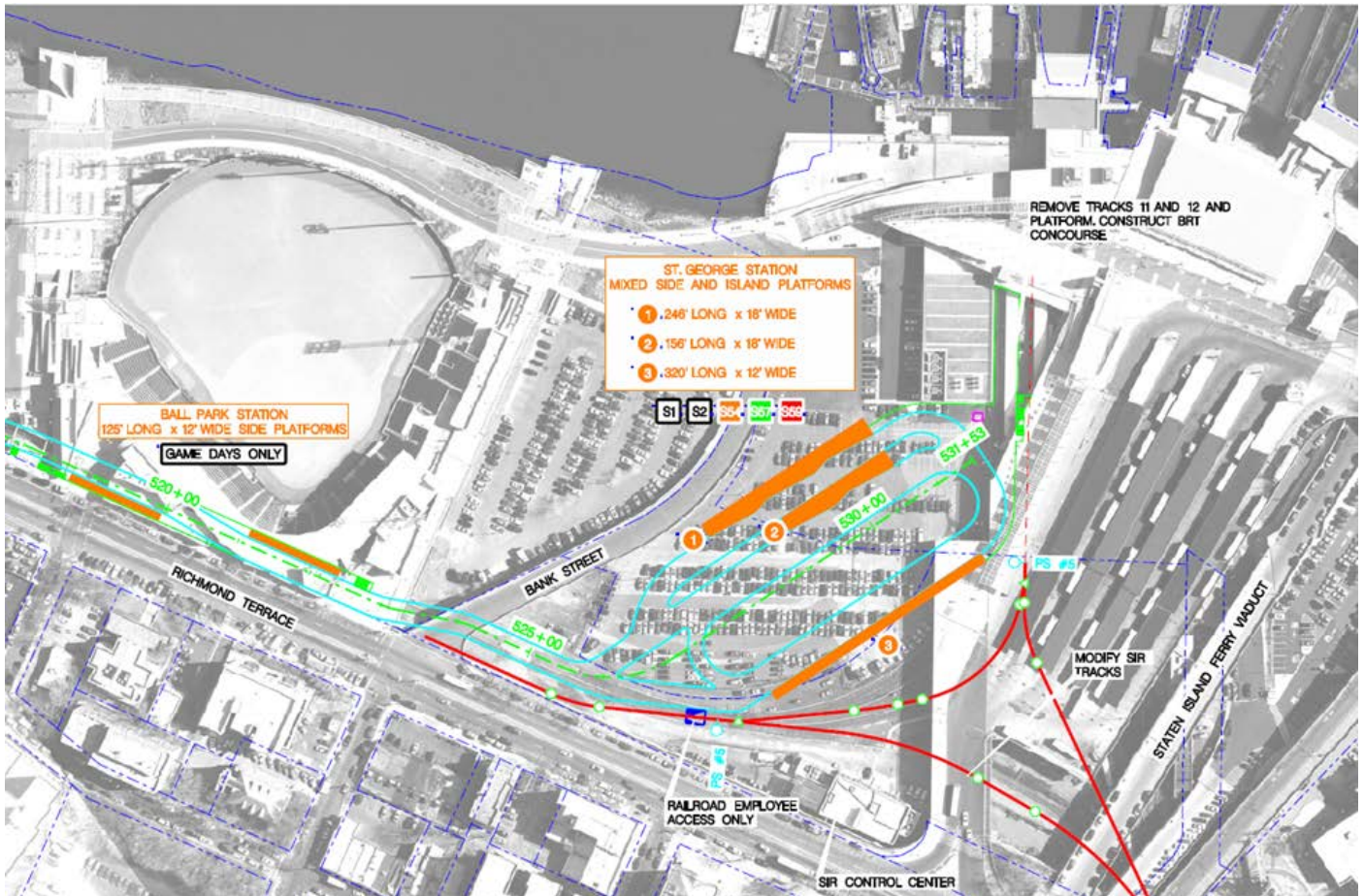






Figure 3 – Recent Developments in St. George



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These developments require reconsideration of the BRT access in the area east of the intersection of Jersey Street and Richmond Terrace as well as the location and configuration of the BRT terminal at St. George.

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## 1.2 Intent of this Document

The intent of this document is to build on the substantial work undertaken and documented in the August 2012 NYCT Staten Island North Shore Alternatives Analysis. This document is intended to reconsider BRT access to the St. George Terminal in the area east of Jersey Avenue as well as the access, configuration and operation of the BRT Terminal. Access and terminal layout alternatives have been developed and evaluated so that the best performing option can be included as part of the updated BRT alternative on a refreshed SINSAA.



## STATEN ISLAND NORTH SHORE BUS RAPID TRANSIT

The 2012 SINSAA established a series of goals against which alternatives were evaluated. Consistent with this previous analysis the goals of this current screening effort are:

- » Improve mobility (as represented by reduced travel time for transit users)
- » Preservation and enhancement of the environment, natural resources and open space
- » Maximize limited financial resources for the greatest public benefit (as represented by estimated capital cost)

Once the BRT Alternative has been updated, the 2012 SINSAA will be refreshed, with a focus on the Short List alternative development and screening. The updated BRT will again be evaluated and compared with the Electric LRT Alternative to determine the best alternative for advancement in the environmental documentation phase of the project. The TSM Alternative will not be re-evaluated since it is no longer a Federal Transit Administration (FTA) requirement and its previous SINSAA evaluation proved it to be substantially inferior to either the BRT or LRT alternatives.





## 2 BRT Access to St. George Options Development & Description

After review of existing constructions plans, field work along the SIR and North Shore Railroad ROWs, and review of on the ground conditions, a series of conceptual alternative access options were developed for the BRT between Jersey Street and St. George Terminal. These options considered access along Richmond Terrace, the former North Shore RR ROW and Bank Street. They all advanced the original principles of the recommended BRT Alternative that included a one-seat ride from West Shore Plaza, the provision of sufficient layout area to support original headways, the use of dedicated ROW to the maximum extent possible, and the siting of the BRT terminal at or near the St. George Ferry Terminal. Physical feasibility, institutional feasibility and effectiveness at meeting the original SINSAA goals and objectives were all factors that were considered in this screening document.

More specifically, the two major areas of feasibility that were explored are specific to physical feasibility and institutional feasibility. The former relates to the ability to avoid physical impediments/structures or reconfigure such impediments that prevent the BRT alternative from accessing its destination at or near the St. George Terminal. These impediments could include but are not limited to: lack of ROW; insufficient vertical or horizontal clearance, physical barriers that cannot be altered or displaced; and incompatible operational requirements. Institutional feasibility is related to potential impacts resulting from the BRT alignment that might prove unacceptable to interested parties or stakeholders such as displacement of parking, property takings, security considerations, impacts to existing bicycle and pedestrian facilities, or reduction in roadway capacity, etc.



Descriptions and key features of each option as well as the respective physical and institutional considerations associated with each option are presented below.

### 2.1 Option 1

This option provides a direct one-seat ride to a terminal BRT facility which would be located beneath the NY Wheel Garage, Ballpark Station, Empire Outlets and the elevated St. George Bus Terminal in the area where the SIR Tracks 11 and 12 separate at the wye. Currently, these former North Shore Railroad tracks are not utilized by the SIR. As the two-lane exclusive BRT alignment approaches Jersey Street from the west, just north of Richmond Terrace, it would continue across Jersey Street into an exclusive eastbound/westbound two-lane BRT ROW beneath Richmond Terrace and adjacent to Bank Street. This alignment would lead to the former North Shore Railroad/current SIR alignment now situated below the NY Wheel parking facility. The eastbound and westbound lanes would travel south below the NY Wheel parking facility, the Ballpark (on both sides of the existing SIR Ballpark station) to an area where the Empire Outlets forms the northern boundary of the SIR St. George Station (Figure 4). A seven-bay bus terminal would be provided in place of Tracks 10, 11 and 12 (tracks would be removed along with the existing Platform 6) and some portion of SIR's storage areas with sufficient space for buses to turn around for the return northbound/westbound journey. MTA-NYCT would require a new dispatcher for the BRT buses at this lower level.

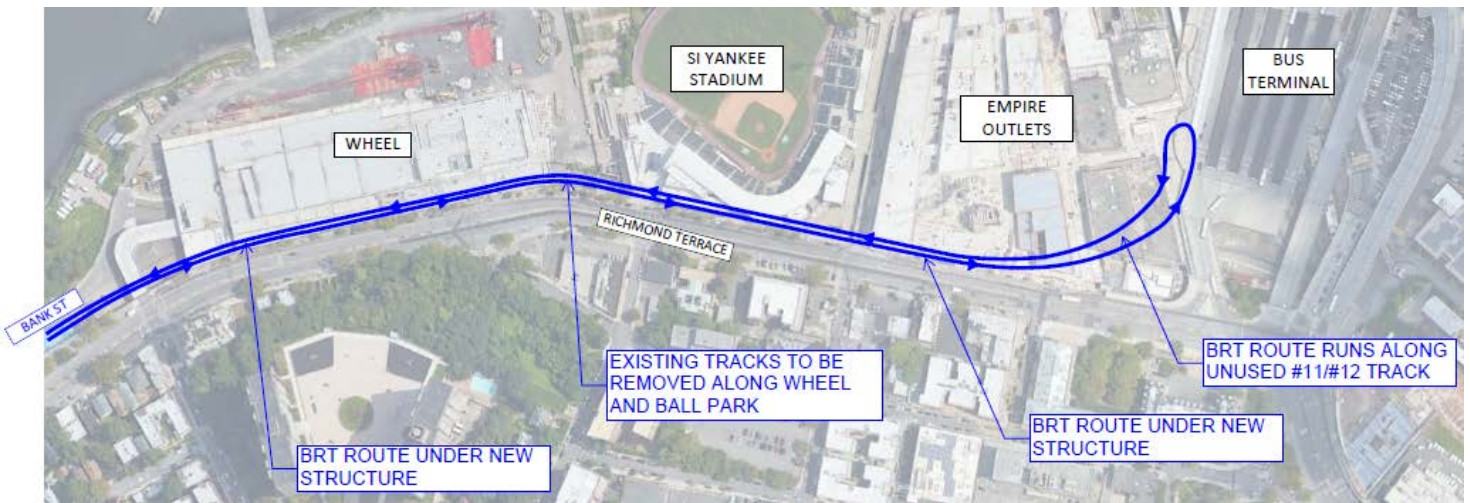
The existing SIR Track 9 beyond the platform would be adjusted along with the wye. More specifically, the SIR track extending to the North Shore right-of-way through the Ballpark Station would be removed to a point approximately 300 feet from the wye signal, which would enable SIR to use Track 9 to continue to turn trains in St. George. Platforms and some vertical circulation areas at Ballpark Station would be removed. Buses would follow the same route westbound adjacent to Bank Street and back to Richmond Terrace at Jersey Street. An ADA-compliant ramped pedestrian walkway would be provided in this area, with direct access to the St. George Ferry Terminal at the lower SIR level. The terminus/bumping block of this track would be moved sufficiently south of the southern Ballpark Station portal to enable the two-way busway to use all available right-of-way (both bays) of the station.



## STATEN ISLAND NORTH SHORE BUS RAPID TRANSIT

Crash walls would be installed where required. A connection from the proposed busway would also be provided to the existing SIR access road on the west side of the track. In addition, to accommodate the seven-bay bus terminal, eleven columns supporting the overhead busway would be relocated in coordination with NYCDOT and SIR, and two columns from Empire Outlets would also need to be relocated. The busway design would need to be coordinated with planned resiliency projects in the St. George area.

Figure 4 – Option 1



### Option 1a

Option 1a is a variant of Option 1 which involves creating a turnaround at the former NY Wheel property which would provide additional bus layover capacity (Figure 5). The turnaround space would also incorporate crew and restroom facilities for use by NYCT personnel during layovers. This option would also incorporate a new traffic signal with TSP features at the intersection controlling the proposed busway crossing at Bank Street providing turnaround access.



Figure 5 – Option 1a



### Features & Considerations

Option 1 is like the Recommended BRT Alternative identified in the 2012 SINSAA as it provides BRT access to St. George on the lower SIR level of St. George Terminal. A major advantage to this alternative is that it would be situated within an exclusive BRT alignment along the former North Shore Railroad and SIR ROWs. Key features of Option 1 include:

- » Avoidance of Richmond Terrace east of Jersey Street including the heavily trafficked Richmond Terrace/Bay Street intersection
- » No parking loss along Richmond Terrace
- » Minimal property takings (at the NY Wheel garage access point for bus staging).
- » No disruption to Richmond Terrace traffic from BRT exclusive ROW or additional BRT TSP phases at signals
- » Sufficient space exists for buses to turn around below the Empire Outlets and existing St. George Bus Terminal
- » No BRT operational interference with existing St. George Bus Terminal operations
- » Sufficient ROW along former North Shore Railroad to accommodate two bus lanes
- » Repurposes the area of Tracks 11 and 12 which are currently underutilized





Table 1 – Option 1 Considerations

Physical Considerations
Structural alterations to columns and/or transfer beams related to Empire Outlets (11) and existing St. George Bus Terminal (2)
Disposal of stored soil/spoils along Bank Street alignment in accordance with applicable regulations
Need to maintain bus and SIR operations/related activity occurring on platform above while conducting major structural modifications necessary to accommodate Option 1 below
Relocation of an existing SIR wye to allow space for BRT access while maintaining ability to turn trains
Relocation of SIR signal infrastructure, radio cabinets, electrical utilities, and storage areas
Need to ensure operational viability of both NYCT and SIR due to physical adjacencies including employee access from Empire Outlets garage
Need to maintain physical separation between bus area and tracks for safety
Need to maintain sufficient turning radii and clearances to accommodate tow truck, bus, and SIR track and switch inspections
Need to maintain coordination with St. George Resiliency project plans
Institutional Considerations
Potential need for access easements may be required from the NY Wheel, the Ballpark and/or Empire Outlets
Track removal/modifications would limit SIR materials storage and equipment, revenue car and covered storage and access capabilities
Coordination with NYPD and FDNY to maintain emergency life safety access below the Empire Outlets
Coordination with NYCDOT for new signal installation at Wheel layover space intersection with busway



Existing spoils along Bank Street



Track 10 looking towards Tracks 11 and 12 below Empire Outlets

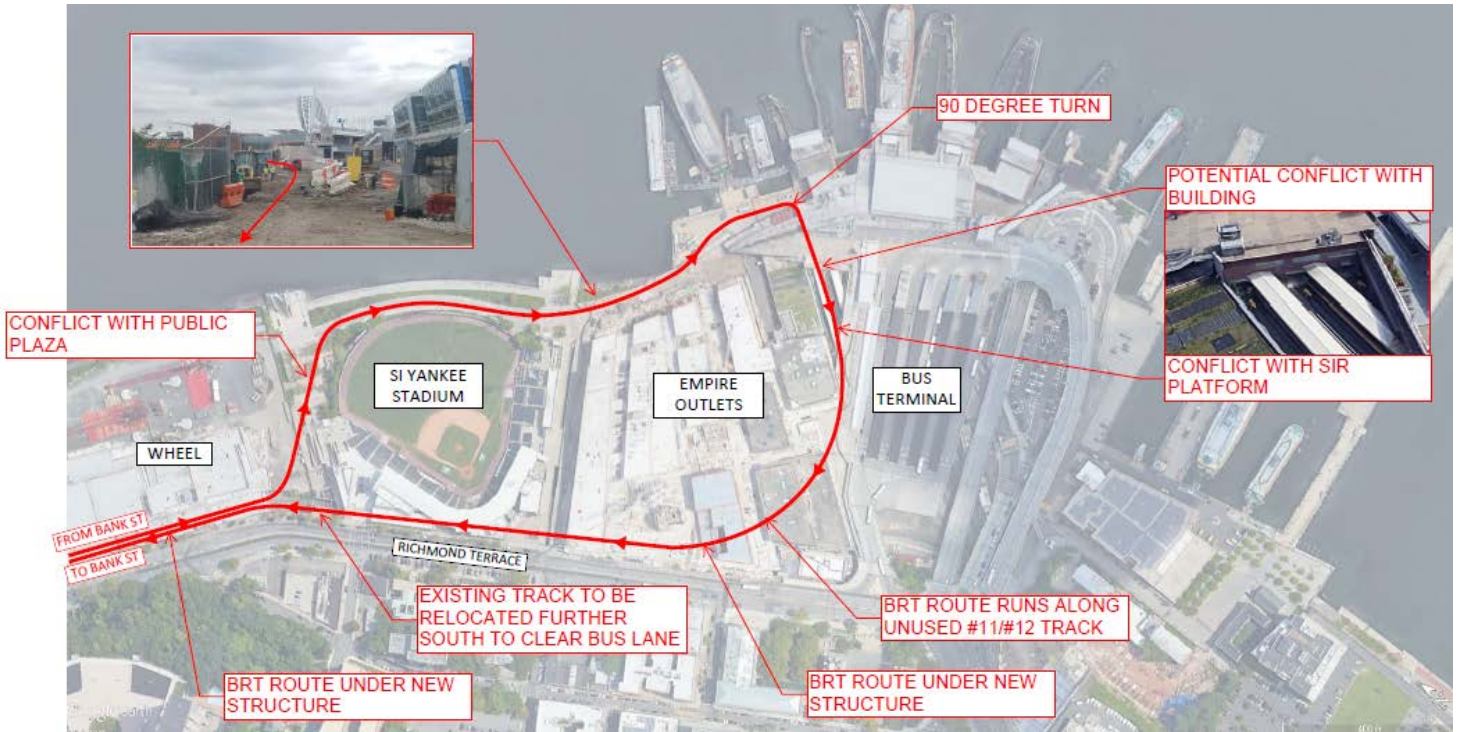
## 2.2 Option 2

This option provides a direct one-seat ride to a terminal BRT facility located at Tracks 11 and 12 of the current SIR platform area (Figure 6). These former North Shore Railroad tracks are not currently utilized by the SIR. As the two-lane, exclusive BRT alignment approaches Jersey Street from the west just north of Richmond Terrace, it would continue across Jersey Street into an exclusive eastbound/westbound two-lane BRT ROW beneath Richmond Terrace and adjacent to Bank Street. This alignment would lead to the former North Shore Railroad/current SIR alignment below the NY Wheel parking facility. The two-lane BRT would exit the SIR alignment and split prior to the SIR Ballpark Station (which would require removal of platforms and vertical circulation elements) with a single lane turning east through the area of the existing Staten Island September 11 Memorial (9/11 Memorial) and along the waterfront at the rear of the Empire Outlets. Upon approaching the St. George Terminal, the single-lane BRT would enter a proposed access way below the terminal (through an existing NYCDOT garage, storage building, freight elevator, and crew quarters which would be relocated) to access the area currently occupied by SIR Tracks 11 and 12, which are no longer in use. Passenger loading and unloading would occur at a bus terminal at this location with direct access to St. George Terminal on the SIR level. The single lane would continue beneath the Empire Outlets, through a single bay of the



Ballpark Station, before rejoining the two-way busway at the point of divergence near the 9/11 Memorial.

Figure 6 – Option 2



### Features & Considerations

A benefit of the loop configuration of Option 2 is that it would eliminate the need to provide a BRT turnaround. This option also avoids impacts to Richmond Terrace but requires the BRT to travel through a secure area identified by NYCDOT as being unavailable for use. Key features of Option 2 include:

- » Avoidance of Richmond Terrace east of Jersey Street
- » No parking displacement along Richmond Terrace
- » No property taking along Richmond Terrace except in the vicinity of Jersey Street to allow Bank Street access for the BRT
- » No BRT operational interference with existing St. George Bus Terminal operations
- » Avoidance of the heavily trafficked Richmond Terrace/Bay Street intersection





- » Sufficient ROW along former North Shore Railroad to allow for two bus lanes
- » Repurposes Tracks 11 and 12 which are currently underutilized
- » BRT loading and unloading would be proximate to ferry operations and SIR platforms
- » No/fewer impacts to SIR tracks 9 and 10, SIR storage areas or access
- » Impacts to NYCDOT Ferry Terminal and SIR station spaces
- » Buses would not need to be turned due to head-in/head-out configuration
- » Impacts to 9/11 Memorial
- » Impacts to Ballpark Station

Table 2 – Option 2 Considerations

Physical Considerations
Utilizes southeast corner of the NY Wheel property
Redesign and/or relocation of existing 9/11 Memorial and the western stairs/ADA ramps related to the Ballpark
Use of Bank Street north of the Ballpark and the Empire Outlets which could create conflicts with private vehicles accessing the mall and pedestrians related to the Ballpark and outlets
Tight radius turn required to pass beneath the northeast corner of the Ferry Terminal
New passage required for BRT to access Tracks 11 and 12 through SIR grade level hallway beneath the Ferry Terminal. The creation of this passage would result in potential impacts to existing NYCDOT and SIR functions such as a CCTV room, crew facilities and an elevator core
Tracks 11 and 12 and associated platform are insufficient for sawtooth bus facility and one passing lane (and possible crash wall). As a result, the adjoining Track 10 would potentially be compromised
Institutional Considerations
Access easement may be required from the NY Wheel, the Ballpark and Empire Outlets
New passage through the Terminal from Tracks 11 and 12 to Bank Street would infringe upon a secure area that includes the adjacent ferry fueling area. NYCDOT has indicated that this access would not be permitted
Coordination with NYPD and FDNY to maintain emergency life safety access below the Empire Outlets and St. George Terminal



## STATEN ISLAND NORTH SHORE BUS RAPID TRANSIT



Lower level surface parking at St. George Terminal



Existing crew facilities

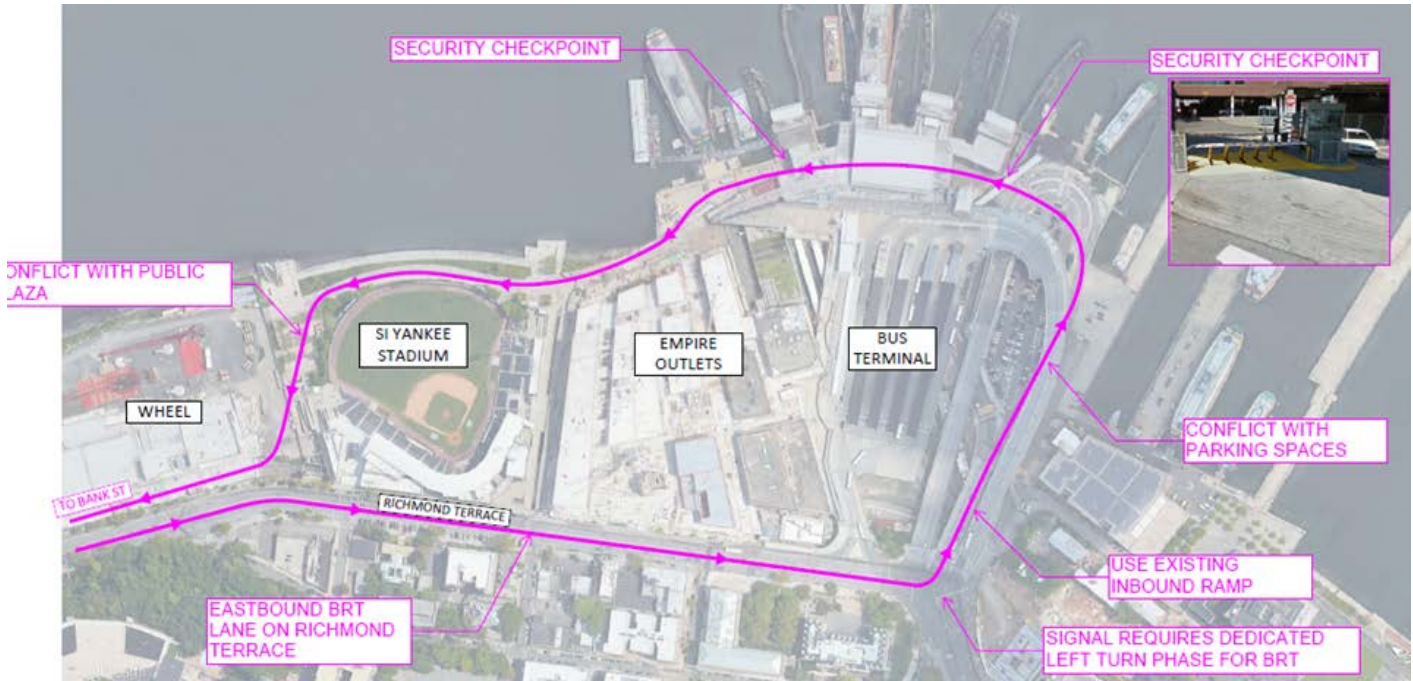


## 2.3 Option 3

Option 3 provides a direct one-seat ride to a terminal BRT facility located in the area of the St. George Terminal's existing surface parking area and drop-off loop at the facilities eastern side (Figure 7). Leaving the BRT exclusive alignment on the north side of Richmond Terrace at Jersey Street, the eastbound lane would transition into a single, center running, BRT exclusive lane along/within Richmond Terrace. The BRT would travel eastbound along Richmond Terrace to the existing inbound ramp of the St. George Terminal that accesses the existing lower level surface parking and vehicular pickup/drop-off circle. At the intersection of Richmond Terrace and Bay Street the BRT would utilize this existing ramp to access a bus terminal with direct access to the St. George Terminal on the SIR level in place of the existing surface parking and drop off area. Upon exiting the area, the BRT would travel below the St. George Terminal through an existing surface parking area to the existing waterfront roadway located at the rear of the Empire Outlets Mall and the Ballpark. At the western side of the Ballpark, the BRT alignment would turn south, crossing the existing 9/11 Memorial to reenter the westbound former North Shore Railroad/current SIR alignment below the NY Wheel. Continuing along this alignment the BRT would exit on to a westbound exclusive BRT lane within the NSRR ROW adjacent to Bank Street where it would eventually rejoin the BRT alignment parallel to Richmond Terrace just west of Jersey Street.



Figure 7 – Option 3



### Features & Considerations

The single BRT lane along Richmond Terrace under Option 3 can be achieved with minimal operational impact to the roadway. Similar to Option 2, access below the St. George Terminal is required for the BRT to return in the westbound direction as is the need to utilize a secure zone identified by NYCDOT as being restricted for use. Key features of Option 3 include:

- » Requires only a single exclusive BRT lane on Richmond Terrace
- » No property taking along Richmond Terrace except in the vicinity of Jersey Street to allow Bank Street access for the BRT
- » Parking and bicycle lanes will remain in place along Richmond Terrace
- » No interference with existing St. George Bus Terminal operations
- » Existing ramp to grade level parking at the St. George Terminal can be used without major alterations or reversing traffic
- » BRT loading and unloading would be proximate to ferry operations and SIR platforms
- » Utilizes existing roadway under Ferry Terminal
- » Impacts to 9/11 Memorial



- » Travel time impacts due to use of the exclusive one-way bus lane on Richmond Terrace, especially if there are enforcement issues

Table 3 – Option 3 Considerations

Physical Considerations
Utilizes southeast corner of the NY Wheel property
Redesign and/or relocation of existing 9/11 Memorial and the western stairs/ADA ramps related to the Ballpark
Use of Bank Street north of the Ballpark and the Empire Outlets which could create conflicts with private vehicles accessing the mall and pedestrians related to the Ballpark and outlets
Requires reconstruction of Richmond Terrace to accommodate single, dedicated BRT lane
BRT would operate in mixed traffic on the existing ramp to the St. George Terminal surface parking and drop-off area
Reconfiguration of grade-level parking and drop-off on east side of the Ferry Terminal and loss of parking
Institutional Considerations
Access easement may be required from the NY Wheel, the Ballpark and Empire Outlets
Loss of lower level surface parking at the St. George Terminal
Requires BRT to travel through a security zone beneath the Ferry Terminal. NYCDOT has indicated that this access would not be permitted
Coordination with NYPD and FDNY to maintain emergency life safety access below the NY Wheel property and St. George Terminal



View of Staten Island September 11 Memorial Plaza





View of Staten Island September 11 Memorial Plaza, and western stairs/ADA ramps to Ballpark

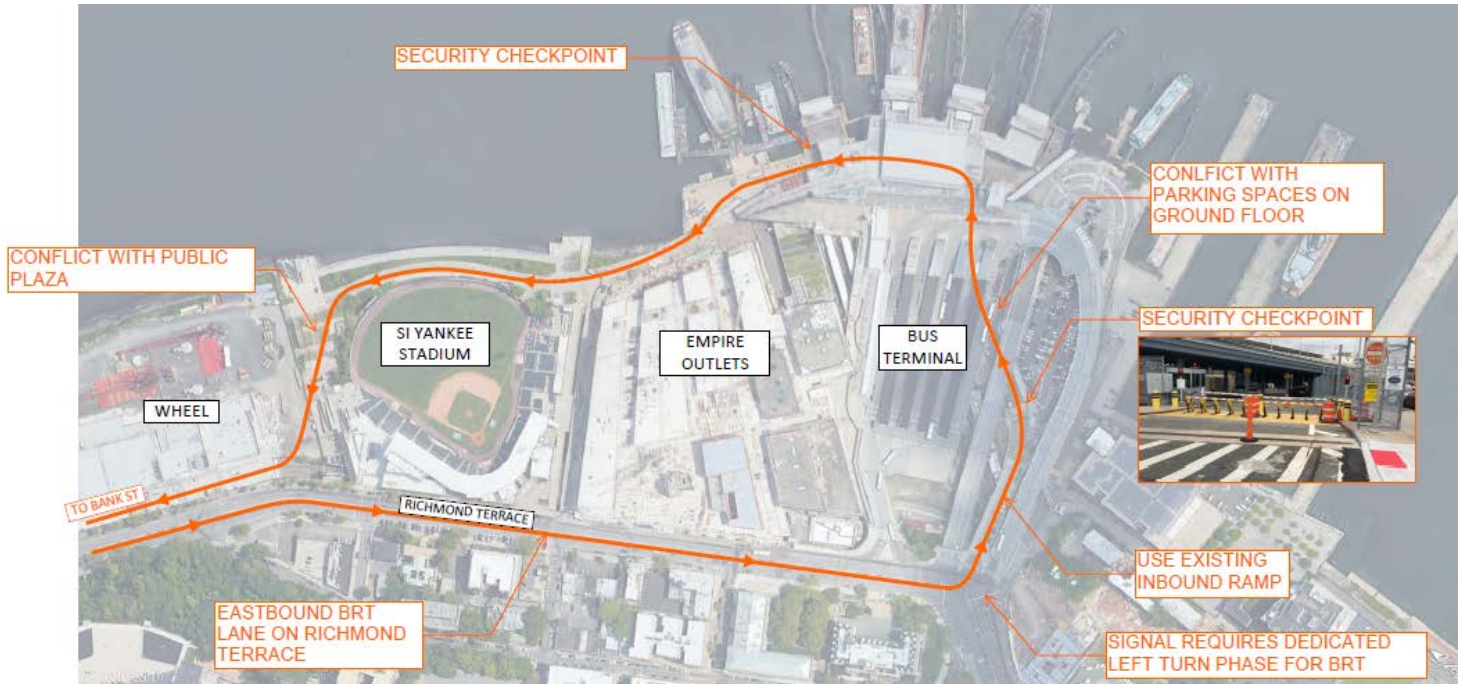
## 2.4 Option 4

Option 4 offers a variation on Option 3 related to where it loads and unloads beneath the existing St. George Bus Terminal (Figure 8). This option provides a direct one-seat ride to a BRT terminal facility located at grade level below the existing St. George Bus Terminal in an area currently demarcated as secure and occupied by surface parking. Leaving the BRT exclusive alignment on the north side of Richmond Terrace, the eastbound lane would transition into a single, center running, BRT exclusive lane along Richmond Terrace. The BRT would travel eastbound along Richmond Terrace to the inbound ramp of the terminal that accesses the existing surface parking and vehicular pickup/drop-off circle. At the intersection of Richmond Terrace and Bay Street the BRT would utilize this ramp to access a bus terminal with direct access to the St. George Terminal on the SIR level in place of the existing surface parking. Upon exiting the area, the BRT would travel below the St. George Ferry Terminal to the waterfront roadway at the rear of the Empire Outlets and the Ball Park. At the western side of the Ballpark, the BRT alignment would turn south, crossing the existing 9/11 Memorial Plaza to re-enter the westbound SIR alignment below the NY Wheel. Continuing along the SIR alignment the BRT would exit on to a westbound exclusive BRT lane



adjacent to Bank Street where it would eventually rejoin the BRT alignment parallel to Richmond Terrace just beyond Jersey Street.

Figure 8 – Option 4



### Features & Considerations

Option 4 utilizes a one-way counterclockwise loop along Richmond Terrace, Bank Street and the former North Shore Railroad ROW. This Alternative differs from 3 in the location of its passenger facility. Again, access below the Ferry Terminal, necessary for the BRT to return westbound would need to utilize a secure zone identified by NYCDOT as not being available. Key features of Option 4 include:

- » Requires only a single exclusive BRT lane on Richmond Terrace
- » No property taking along Richmond Terrace except in the vicinity of Jersey Street to allow Bank Street access for the BRT
- » Parking and bicycle lanes will remain in place along Richmond Terrace
- » No interference with existing St. George Bus Terminal operations
- » Existing ramp to grade level parking at the St. George Terminal can be used without major alterations or reversing traffic





- » BRT loading and unloading would be proximate to ferry operations and SIR platforms
- » Utilizes existing roadway under Ferry Terminal
- » Impacts to 9/11 Memorial
- » Travel time impacts due to use of the exclusive one-way bus lane on Richmond Terrace, especially if there are enforcement issues

Table 4 – Option 4 Considerations

Physical Considerations
Utilizes southeast corner of the NY Wheel property
Redesign and/or relocation of existing 9/11 Memorial and the western stairs/ADA ramps related to the Ballpark
Requires reconstruction of Richmond Terrace to accommodate single, dedicated BRT lane
BRT would operate in mixed traffic on the existing ramp to the St. George Terminal surface parking and drop-off area resulting in increased travel time
Reconfiguration of grade-level parking and drop-off on east side of the Ferry Terminal and associated loss of parking
Institutional Considerations
Access easement may be required from the NY Wheel, the Ballpark and Empire Outlets
Operating agreements with the SIR may be required
Potential loss of lower level surface parking at the St. George Terminal
Requires BRT to travel through a security zone beneath the Ferry Terminal. NYCDOT has indicated that this access would not be permitted
Coordination with NYPD and FDNY to maintain emergency life safety access below the NY Wheel property and St. George Terminal



Existing passageway below terminal

## 2.5 Option 5

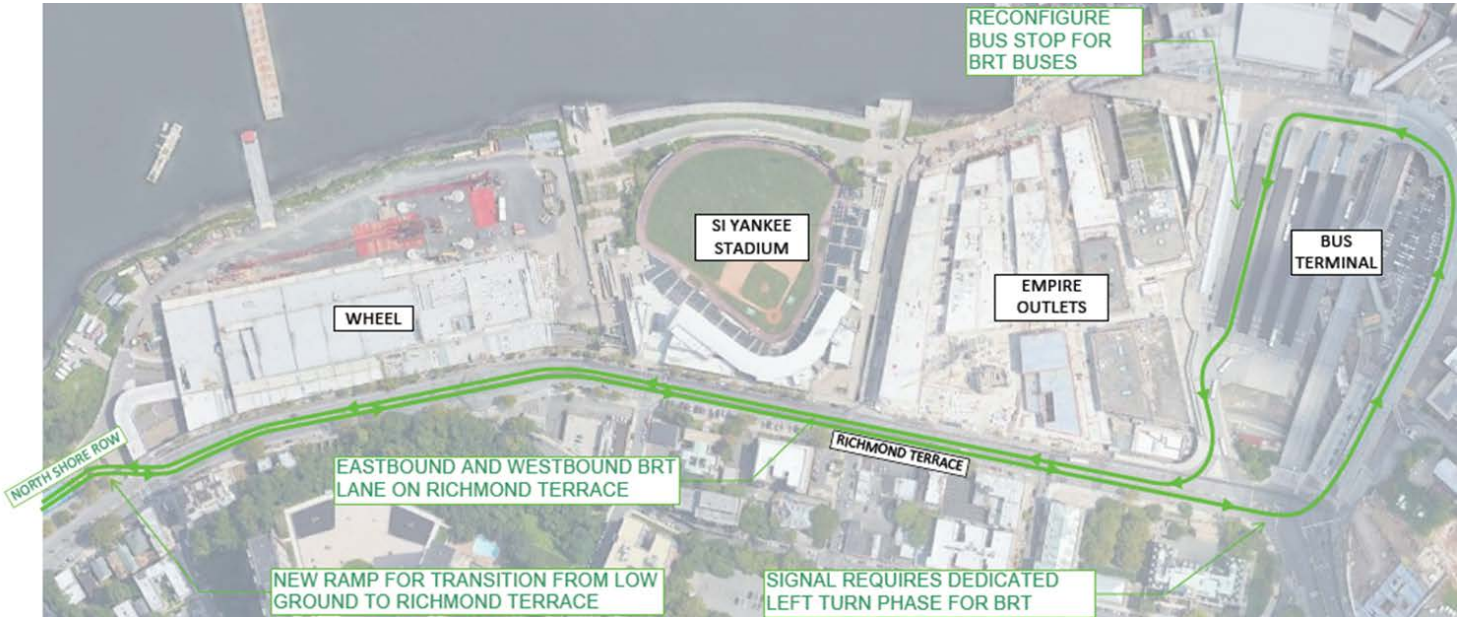
This option provides for access to the St. George Ferry Terminal in an exclusive two-lane ROW with mountable curb separators along Richmond Terrace (Figure 9). It provides a direct one-seat ride to a reconfigured joint BRT/local bus facility at the current St. George Bus Terminal. As the eastbound BRT approaches Jersey Street running in an exclusive ROW just north of Richmond Terrace, it would continue into an exclusive two-way BRT alignment within the former NSRR ROW adjacent to Bank Street to an exclusive ramp structure that would connect to Richmond Terrace at Nicholas Street. At that intersection, the BRT would enter an exclusive two-way median alignment on Richmond Terrace with a TSP-enabled traffic signal. The BRT would travel east within Richmond Terrace for approximately ½ mile to Bay Street where it would either utilize the existing ramp or a new ramp parallel to the existing ramp. The remaining bus platform area would also be reconfigured to maximize efficiency and safety. A new TSP traffic would be provided on the deck for bus control.

Exiting the facility, the BRT would enter the exclusive westbound center BRT lane on Richmond Terrace where it would travel to the Nichols Street ramp to continue along the alignment adjacent to Bank Street. Upon reaching the



Jersey Street intersection, Alternative 5 would enter the BRT exclusive ROW on the north side of Richmond Terrace and continue travelling west.

Figure 9 – Option 5



### Features & Considerations

Option 5 is anticipated to result in on-street parking impacts and the loss of the Richmond Terrace bicycle lanes for approximately ½ mile. This alternative would also utilize the existing bus ramps via the heavily trafficked Bay Street intersection, which provide access to the St. George Bus Terminal. Consequently, the BRT vehicle(s) would be required to mix with other buses. Under Option 5, an optional additional ramp could also be provided at St. George Terminal. While the BRT would operate in exclusive ROW, it would encounter traffic signals which would impact travel time. Key features of Option 5 are as follows:

- » Requires a ramp from the former NSRR ROW to Richmond Terrace at Nicholas Street
- » Implements TSP at all Richmond Terrace signals along busway
- » Requires two exclusive BRT lanes with mountable curb separators on Richmond Terrace
- » Uses a reconfigured, existing bus platform area at St. George Terminal



- » Potential, new exclusive BRT ramp at St. George Terminal could mitigate travel time impacts at Bay Street intersection/existing bus ramp



Existing Nicholas Street intersection with Richmond Terrace and NY Wheel Garage

Table 5 – Option 5 Considerations

Physical Considerations
Requires reconstruction of Richmond Terrace to accommodate two median, dedicated BRT lanes
Loss of bicycle lanes on Richmond Terrace
Loss of approximately 200 parking spaces along Richmond Terrace including parking related to the police station and the existing court house
Requires coordination of optional St. George exclusive ramp construction and phasing with NYCT Bus Ops and any planned Terminal projects
Requires coordination with NYCDOT for signal timing modification at Nicholas Street entrance/exit from NY Wheel parking deck
Institutional Considerations
On-street parking and bicycle lane loss along Richmond Terrace could be a community concern
Enforcement of exclusive busway is required to maintain travel time advantage over mixed traffic operations
Construction impacts/community effects related to the reconstruction of Richmond Terrace to accommodate BRT service



## 2.6 Option 6

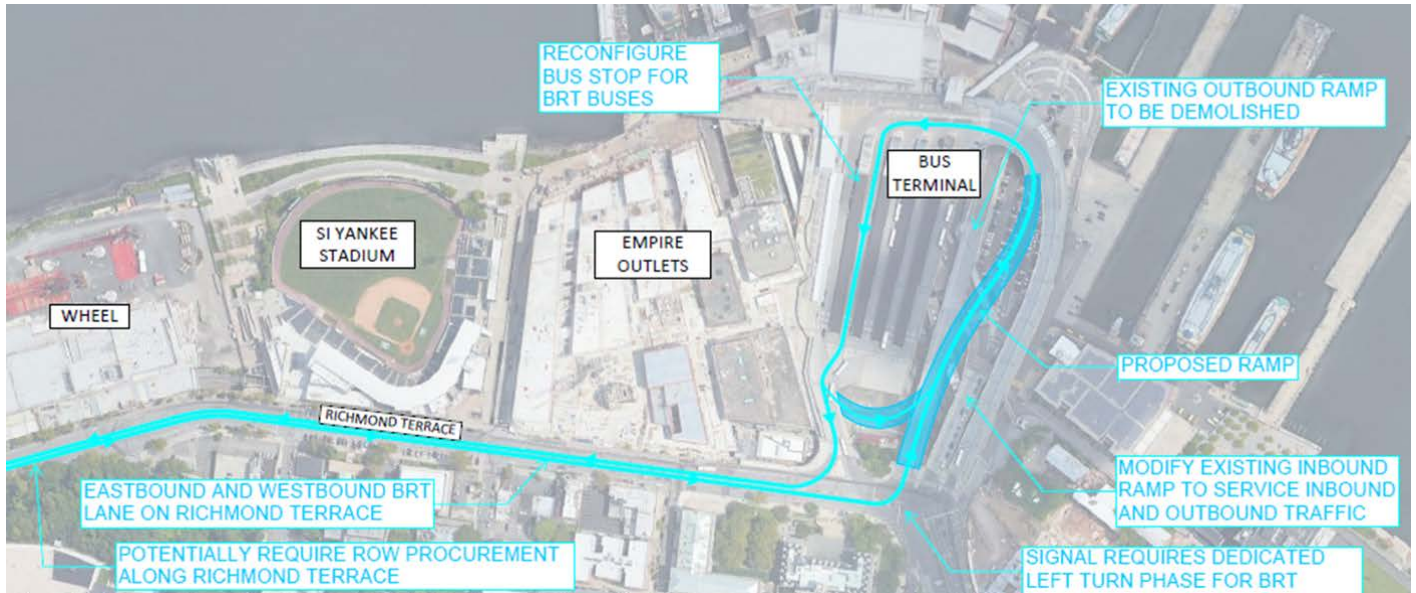
This option provides for access to the St. George Ferry Terminal in an exclusive two-lane ROW along Richmond Terrace (Figure 10). It provides a direct one-seat ride to a terminal BRT facility located in a reconfigured joint BRT/local bus facility at the current St. George Bus Terminal. As the eastbound BRT approaches Jersey Street running in an exclusive ROW just north of Richmond Terrace, it would continue into the Jersey Street and Richmond Terrace intersection via an exclusive entry and traffic signal phase to enter the median busway. The BRT would travel eastbound along Richmond Terrace for approximately 1 mile to the currently outbound ramp accessing the at-grade vehicular drop-off/pick-up circle just north of the St. George Terminal. This ramp would be removed and replaced with a new inbound, bus exclusive, viaduct structure connecting to the existing bus platforms. (the existing inbound ramp just to the east would be restriped and converted to a two-way ramp to allow vehicles access and egress to the at grade parking and drop-off portions of the Terminal). An additional structure that would allow buses to loop from the St. George Bus Terminal to the BRT ramp would also be installed to provide operational flexibility within the Bus Terminal. Once in the bus platform area, the BRT would loop to the western side of the platform where a loading and unloading area would be provided. The remaining bus platform area would also be reconfigured to maximize efficiency and safety.

Exiting the facility through the existing viaduct to Richmond Terrace, the BRT would enter the exclusive westbound median busway where it would travel to the Jersey Street and Richmond Terrace intersection. Passing through that intersection it would enter the BRT exclusive ROW on the north side of Richmond Terrace and continue travelling west.





Figure 10 – Option 6



### Features & Considerations

Similar to Option 5, this option would result in on-street parking impacts to Richmond Terrace, as well as potential property takings and parkland impacts. Key features of Option 6 are as follows:

- » Requires two exclusive BRT lanes with mountable curb separators on Richmond Terrace
- » Requires reconfiguration of the Jersey Street and Richmond Terrace intersection
- » Uses a reconfigured, existing bus platform area at St. George Terminal
- » New BRT exclusive access ramp to the St. George Bus Terminal

Table 6 – Option 6 Considerations

Physical Considerations
Loss of approximately 400 parking spaces along Richmond Terrace including parking related to the police station and the existing court house
Loss of Richmond Terrace bicycle lanes for approximately 1 mile
New viaduct ramp would require piers within SIR St. George Terminal area





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Removal of existing outbound ramp to St. George Terminal surface parking and drop-off area and repurposing of existing inbound ramp for two-way traffic

---

Reconfiguration of the Richmond Terrace and Jersey Street intersection to allow for access to exclusive center running BRT lanes

---

#### Institutional Considerations

Loss of on-street parking and bicycle lanes along Richmond Terrace and loss of St. George ramp parking and loss could be a potential community concern

---

Construction impacts/community effects related to the reconstruction of Richmond Terrace to accommodate BRT service

---

Maintaining bus and rail operations at St. George Terminal during construction of proposed ramp

---

Need to coordinate new ramp with St. George resiliency project

---

Enforcement of exclusive busway is required to maintain travel time advantage over mixed traffic operations

---



Existing outbound bus ramp at St. George Terminal, distant view of inbound loop ramp

## 2.7 Option 7

Option 7 provides a direct one-seat ride to a terminal BRT facility located in a reconfigured joint BRT/local bus facility at the current St. George Bus Terminal (Figure 11). Leaving the BRT exclusive alignment on the north side of Richmond Terrace at Jersey Street, the BRT alignment would transition into a single lane, median, reversible exclusive busway along Richmond Terrace. This single BRT lane would be reversible and would allow the BRT to travel



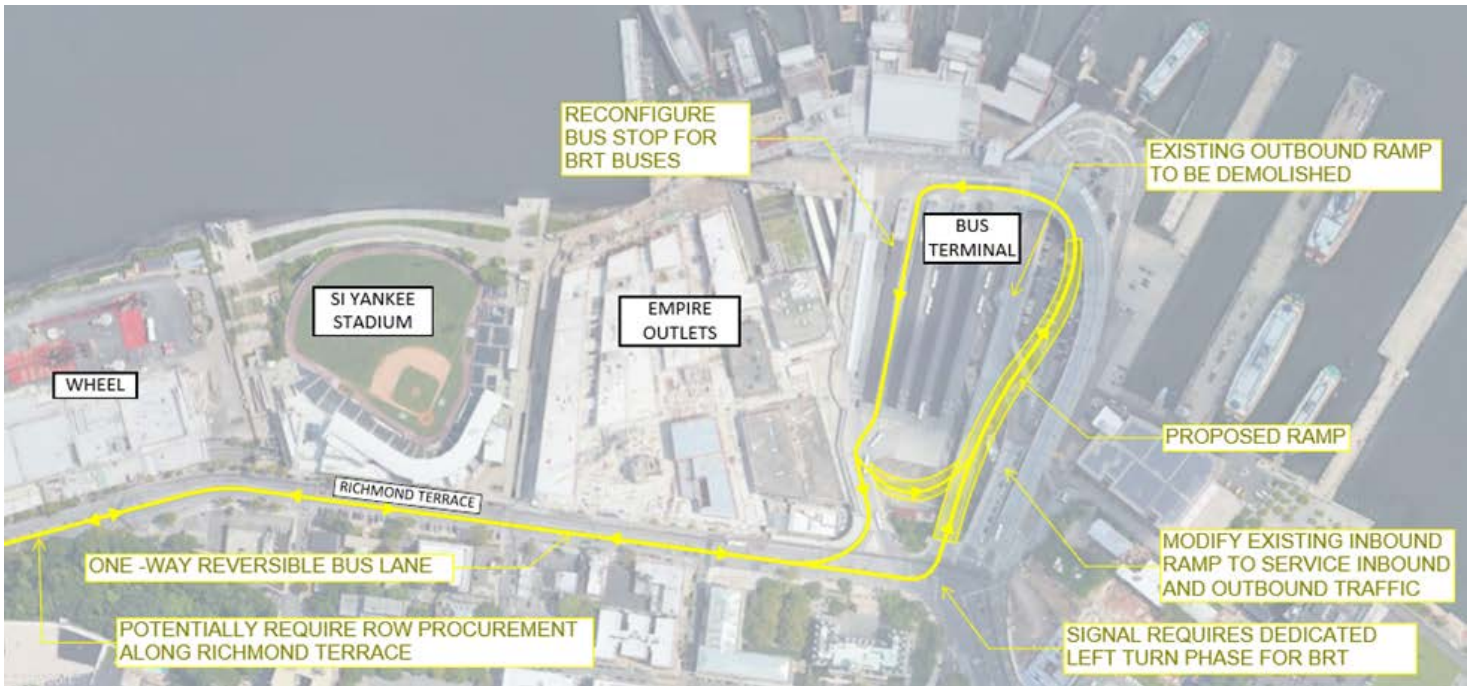
## STATEN ISLAND NORTH SHORE BUS RAPID TRANSIT

with the peak traffic flow (eastbound in the AM, westbound in the PM). BRT vehicles moving in the non-peak traffic direction (westbound in the AM and eastbound in the PM) would travel in mixed traffic lanes between the St. George Terminal and Jersey Street. The Richmond Terrace busway would continue from Jersey Street for approximately 1 mile to the current outbound ramp accessing the at-grade vehicular drop-off/pick-up circle just north of the St. George Terminal. This ramp would be removed and replaced with a new inbound, bus exclusive, viaduct structure connecting to the existing bus platforms. The existing inbound ramp just to the east would be restriped and converted to a two-way ramp to allow vehicles access and egress to the at-grade parking and drop-off portions of the Terminal. An additional structure that would allow buses to loop from the St. George Bus Terminal to the BRT ramp would also be provided to provide operational flexibility within the Bus Terminal. Once in the bus platform area, the BRT would loop to the western side of the platform where a platform would be provided. The remaining bus platform area would also be reconfigured to maximize efficiency and safety.

Exiting the facility through the existing viaduct to Richmond Terrace, the BRT would merge into mixed traffic (or the single reversible BRT lane depending on the peak direction of traffic) and travel west to Jersey Street where it would rejoin the BRT exclusive ROW.



Figure 11 – Option 7



### Features & Considerations

This option is advantageous as it would have minimal impacts along Richmond Terrace. Key features of Option 7 are as follows:

- » Single, reversible BRT lane along Richmond Terrace
- » Uses a reconfigured, existing bus platform area at the St. George Terminal
- » Provides for new BRT access ramp at St. George

Table 7 – Option 7 Considerations

Physical Considerations
New viaduct ramp would require piers within SIR St. George Terminal area
Removal of existing outbound ramp to St. George Terminal surface parking and drop-off area and repurposing of existing inbound ramp for two-way traffic; new viaduct required to access the bus platform area
Removal of existing outbound ramp to St. George Terminal surface parking and drop-off area and repurposing of existing inbound ramp for two-way traffic
Maintaining operations at the existing St. George Bus terminal during development of bus platform area and new BRT ramp inbound ramp for two-way



Reconfiguration of the Richmond Terrace and Jersey Street intersection to allow for access to exclusive median bus lane

---

Reversible BRT lane would result in increased travel time for passengers traveling in the non-peak traffic flow direction

---

Loss of use of exclusive bus lane while it was cleared so the direction could be reversed

---

Difficulty in delivering high frequency and reliable BRT service with reversible lane and mixed traffic combination

---

#### **Institutional Considerations**

Construction impacts/community effects related to the reconstruction of Richmond Terrace to accommodate BRT service

---

Maintaining bus and rail operations at St. George Terminal during construction of proposed ramp

---

Need to coordinate new ramp with St. George Resiliency project

---

Enforcement of exclusive busway is required to maintain travel time advantage over mixed traffic operations

---



## 3 Options Advanced for Further Consideration

### 3.1 Overview

A total of seven options were conceptually developed and initially reviewed as part of this first level screening effort. The screening focused on identifying any fatal flaws that might result in that particular option not being feasible.

These options are consistent with the foundational principles of the BRT Alternative recommended in the original Alternatives Analysis (2012) including:

- » sufficient layout space and busway capacity to support original headways;
- » use of dedicated ROW to the maximum extent possible;
- » siting of the BRT terminal facility in or proximate to the St. George Ferry Terminal; and
- » a one-seat ride from West Shore Plaza

As previously mentioned, these options considered access along Richmond Terrace, Bank Street and the former North Shore Railroad right-of-way using alignment scenarios that varied from “low” concepts operating entirely beneath existing structures such as the NY Wheel, Empire Outlets, and Ferry Terminal properties (Options 1 and 2) to hybrid “high/low” concepts which utilized a combination of surface roadways (e.g., Richmond Terrace and Bank Street) while running along SIR right-of-way and beneath the NY Wheel, the Ballpark, Ferry Terminal properties, and Empire Outlets (Options 3 and 4). Several alternatives were considered that operated within Richmond Terrace. More specifically, Alternative 5 is a “low/high” option that would use the former North Shore Railroad right-of-way before transitioning to Richmond

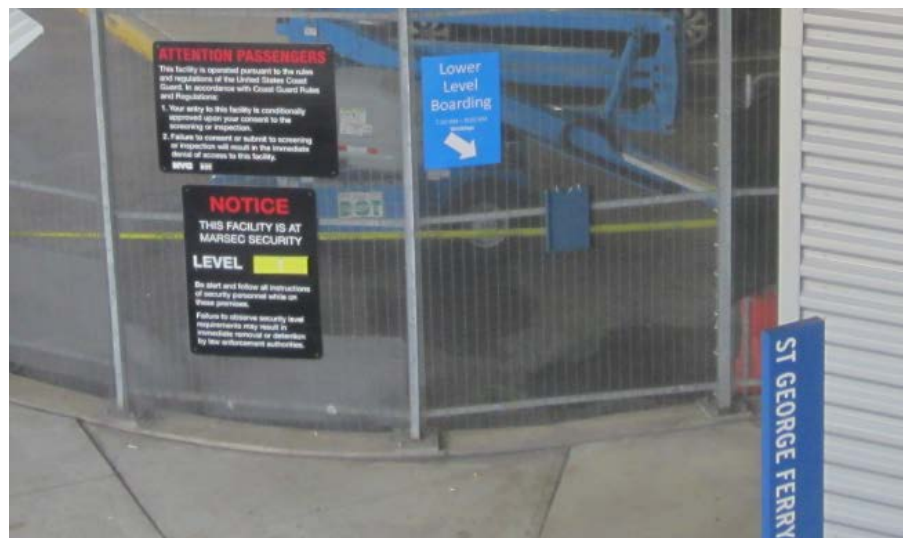




Terrace south of the NY Wheel property. The Richmond Terrace “high” options utilize eastbound and westbound exclusive BRT lanes (Option 6) and a single reversible lane (Option 7) accessing the St. George Bus Terminal via a new exclusive access ramp.

### 3.2 Options Not Carried Forward

Based on the initial review conducted as part of this screening effort and in consultation with New York City Department of Transportation, it was determined that an alignment that travelled beneath the Ferry Terminal and its associated retail corridor was not considered feasible primarily due to security restrictions and to a lesser extent the inability to relocate critical equipment. More specifically, the restricted access designation for the Terminal facility was based on multiple comprehensive risk and vulnerability assessments which were conducted in accordance with 33 CFR Chapter 1, Sub Chapter 8, for compliance with the Maritime Transportation Security Act 2002. The St. George Ferry Terminal and its immediate surroundings are designated as a Maritime Security (MARSEC) Level 1 facility. MARSEC refers to the United States Coast Guard’s (USCG) three-tiered security levels which are scaled to reflect the prevailing threat environment to maritime elements of the nation’s nautical transportation infrastructure such as ports, vessels, passenger facilities and critical infrastructure/assets situated on or adjacent to the waters of the United States. Given the need to maintain a secure area as well as access for life safety service providers, Options 2, 3 and 4 were eliminated from further consideration.



Security signage lower level of St. George Ferry Terminal



Option 7, which features a single reversible BRT lane would have less impact to Richmond Terrace (e.g., parking, bicycles, shorter construction period duration). In addition, Option 7 would not have been able to maintain NYCT's bus service plan since buses would have to travel in mixed traffic in the reverse direction on Richmond Terrace, impacting the overall cycle time and headway. Reliability would be impacted, and safety issues related to pedestrian crossing of a reversible lane and the time to clear out the lane to reverse it would need to be overcome. Accordingly, Option 7 was not carried forward for further evaluation.

### 3.3 Options Carried Forward

Of the seven alternatives, three options were deemed viable to be carried forward for further consideration. These included:

- » Option 1 (Low)
  - Dedicated busway on former North Shore Railroad and SIR right-of-way
  - Potential for bus turnaround space and crew layover facilities at the NY Wheel (Option 1a)
- » Option 5 (Low/High Hybrid)
  - 0.45-mile busway on Richmond Terrace
  - New ramp at Nicholas Street
  - Utilizes existing ramp at St. George Terminal with option for new ramp
- » Option 6 (High)
  - 0.95-mile busway on Richmond Terrace
  - Enters Richmond Terrace at Jersey Street via new access loop
  - New dedicated BRT ramp at St. George Terminal

Conceptual preliminary schematics for the three options noted above are contained in Appendix A.

### 3.4 Screening Considerations

This section provides a comparison of the conceptual options advanced for further consideration relative to the screening factors considered for this project. The goals of this screening effort and corresponding screening categories are noted below, and build upon the physical and institutional



considerations identified in the BRT Access to St. George Options Development & Description (Chapter 2). As previously mentioned, the goals of this current screening effort are consistent with the goals identified in the 2012 SINSAA (Section 1.2).

### **Improve Mobility**

#### **Vehicle Travel Time**

Travel time relative to the conceptual BRT options was also considered as a means of comparison. Cursory intersection delays were estimated using a combination of relevant traffic and delay data identified in the NYCEDC's North Shore Transportation Improvement Strategy (2017) and supplemented by preliminary speed runs conducted by VHB in October 2018 (Appendix B). Estimated initial travel times are approximate and provided for comparison purposes only. Assumptions regarding travel times are also noted in Appendix B. Travel times noted in the comparative matrix below represent the additional bus travel time for each option as compared to the Preferred Alternative in the 2012 SINAA.

#### **Bus Operations**

The ability to maintain efficient bus operations as required by NYCT was considered as part of this screening. For the purposes of this screening effort, the ability to operate in an exclusive BRT lane rather than in mixed traffic was considered preferable. On balance, the exclusive BRT lane offers higher travel speeds (especially with the inclusion of Transit Signal Priority) and less potential for vehicular conflict. In addition, the ability to minimize signalized intersections was considered advantageous relative to bus operations. Consequently, alternatives that operated on existing roadways as compared to an off-road exclusive right-of-way would generally be less preferable with respect to bus operations.

Additionally, the SINSAA service plan for the BRT alternative called for the use of articulated buses. Alternatives that accommodate articulated vehicles are generally preferable to those that do not considering the continued potential for ridership growth. The SINSAA service plan also called for five routes accessing the St. George Terminal resulting in the need for at least 10 bus bays for optimal operation.



Additional considerations related to bus operations included service planning and horizontal and vertical clearance restrictions (especially for Option 1). See Appendices A and C.

### **Preservation and enhancement of environment, natural resources, and open space**

#### **Parking and Bicycle Lane Displacement**

The removal or alterations to vehicular on-street parking were considered for Alternatives 5 and 6 which traverse Richmond Terrace. Estimations of potential parking loss are provided, as applicable, in order to provide a general means of comparison across alternatives. These estimates were based on both an aerial reconnaissance and a review of NYSDOT parking regulations for the area and should be reassessed as conceptual design/preliminary engineering advances. Additionally, in both alternatives, to achieve an adequate median plus busway separation from general traffic lanes, the Richmond Terrace bicycle lanes would need to be removed. Bicycle lanes along Bank Street would be provided.

#### **Effects**

Potential environmental/community issues including effects to social, economic and built environment (e.g., ability to maintain or improve economic conditions; potential right-of-way or community context impacts) have also been considered during this screening.

Construction-related effects to the surrounding community relative to each alternative as well as the ability to maintain access to the surrounding area and properties during the construction period have also been considered.

NYCT Department of Bus and SIR institutional effects resulting from the physical alignment and operation of the BRT were also taken into consideration and noted in Table 8.

### **Maximize limited financial resources for the greatest public benefit**

#### **Potential Ridership**

An estimate of potential ridership is provided for each conceptual option contained in Table 8. As part of this effort the ridership forecasting methodology and model from the 2012 SINSAA was re-created and similar



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(but not exact) results to those from the 2012 SINSAA model were generated. The results were close enough to proceed with the tool to forecast the ridership impact of the new BRT access options. See Appendix D for more detail.

### **Cost**

Estimated order of magnitude construction costs are provided for each conceptual alternative, where applicable (Appendix E).





Table 8 – Comparative Matrix of Remaining Options

Screening Categories	Option 1/1a (Low)			Option 5 (Low/High Hybrid)			Option 6 (High)				
<b>Additional Bus Travel Time* (minutes)</b>	●	EB: 0	WB:0	●	EB: 2.5	WB: 1.1	◐	EB: 1.3	WB: 3.5		
<b>Bus Operations</b>	◐	<ul style="list-style-type: none"> <li>No. of signalized intersections: 0</li> <li>No. of BRT exclusive lanes: 2</li> <li>Location of BRT lanes: North Shore RR ROW</li> <li>Location of St. George Terminal: SIR level; Wheel staging area (1a)</li> <li>No. of St. George Bus Bays: 7</li> <li>Accommodate Artics? No</li> <li>Accommodates bus towing (40-foot bus, 45-foot tow)</li> </ul>		◐	<ul style="list-style-type: none"> <li>No. of signalized intersections: 6 EB; 8 WB</li> <li>No. of BRT exclusive lanes: 2</li> <li>Location of BRT lanes: North Shore RR ROW and Richmond Terrace</li> <li>Length of Richmond Terrace BRT lanes: 2,400 ft. with mountable curb separators</li> <li>New exclusive bus ramp at Nicholas St.</li> <li>Mixes with existing buses at St. George Terminal; TSP traffic light on bridge deck to be included for bus control</li> <li>Location of St. George Terminal: Upper bus level</li> <li>No. of St. George Bus Bays: 10</li> <li>Accommodate Artics? Yes</li> </ul>		◐	<ul style="list-style-type: none"> <li>No. of signalized intersections: 8 EB; 7 WB</li> <li>No. of BRT exclusive lanes: 2</li> <li>Location of BRT lanes: Richmond Terrace</li> <li>Length of Richmond Terrace BRT lanes: 5,000 ft. with mountable curb separators</li> <li>New exclusive bus ramp at St. George Terminal</li> <li>Mixes with existing buses at St. George Terminal Viaduct</li> <li>Location of St. George Terminal: Upper bus level</li> <li>No. of St. George Bus Bays: 10</li> <li>Accommodate Artics: Yes</li> </ul>			
<b>Parking Displacement</b>	●	No on-street parking loss		◐	EB: 92	WB: 106	Total: 198 (includes NYPD)	○	EB: 212	WB: 156	Total: 368 (includes NYPD)
<b>Effects</b>	◐	<ul style="list-style-type: none"> <li><b>Resiliency:</b> Within floodplain; need to coordinate with St. George SIR resiliency plans</li> <li><b>Community Effects:</b> No change to Richmond Terrace traffic or bicycle patterns</li> <li><b>SIR:</b> Loss of SIR Track 10 and relocation of North Shore wye. Truncation of track through Ballpark Station and removal of platforms/stairs/elevators. Shared bus and SIR station area. Loss of SIR equipment and materials storage capacity. Relocation of SIR utility infrastructure.</li> <li><b>NYCDOT St. George parking/traffic:</b> No impact</li> <li><b>Development:</b> Relocation of 11 columns for NYCDOT bus deck/ramp and 2 columns for Empire Outlets; need to coordinate emergency access with Empire Outlets, new traffic signal at the intersection of busway and turnaround at Bank Street (Option 1a)</li> <li><b>Service Planning:</b> Option 1: Two bays free; congestion at bays, not busway; Option 1a: Two bays free; congestion on busway, requires coordination of buses leaving &amp; returning to St. George from Wheel; operating cost impacts; Dwell times and operating plan to be confirmed.</li> <li><b>Institutional Issues:</b> Acceptability by NYPD and FDNY</li> </ul>		◐	<ul style="list-style-type: none"> <li><b>Resiliency:</b> Partially within floodplain; need to coordinate with St. George SIR resiliency plans</li> <li><b>Community Effects:</b> No change in # of Richmond Terrace traffic lanes; intersections modified with TSP; loss of exclusive bicycle lane</li> <li><b>SIR:</b> No impact</li> <li><b>NYCDOT St. George parking/traffic:</b> No impact</li> <li><b>Development:</b> Modification of signal timing at Nicholas Street entrance/exit from NY Wheel parking deck.</li> <li><b>Institutional Issues:</b> None</li> </ul>		◐	<ul style="list-style-type: none"> <li><b>Resiliency:</b> Above floodplain; need to coordinate with St. George SIR resiliency plans</li> <li><b>Community Effects:</b> No change in # of Richmond Terrace traffic lanes; intersections modified with TSP; loss of exclusive bicycle lane</li> <li><b>SIR:</b> No Impact</li> <li><b>NYCDOT St. George parking/traffic:</b> Conversion of existing lower level ramp to two-way; removal of existing outbound ramp</li> <li><b>Development:</b> Need to coordinate ramp construction and phasing with NYCT Bus Ops and any planned Terminal projects</li> <li><b>Institutional Issues:</b> NYCDOT lower level impacts</li> </ul>			
<b>Construction Effects</b>	●	Impacts to SIR, NYCDOT bus deck and ramp and Empire Outlets		◐	Impacts from reconstruction of Richmond Terrace; Wheel parking /Bank Street and St. George Bus Depot			○	Impacts from reconstruction of Richmond Terrace; to NYCDOT parking/terminal access		
<b>Potential Ridership</b>	●	No change; travel time is the same. BRT: 13,061 AM users; LRT: 10,590 AM users		◐	BRT: 11,732 AM users; LRT 10,590 AM users			○	BRT: 11,012 AM users; LRT: 10,590 AM users		
<b>Total Cost (increment over 2012 BRT)</b>	◐	\$720M (\$349M more than AA); \$75M more than LRT		●	\$518M (\$147M more than AA); \$75M more than LRT			○	\$606M (\$235M more than AA); \$39M lower than LRT		

○ Most Change    ◐ Moderate Change    ● Least Change

\* as compared to 2012 SINSAA

# Appendices

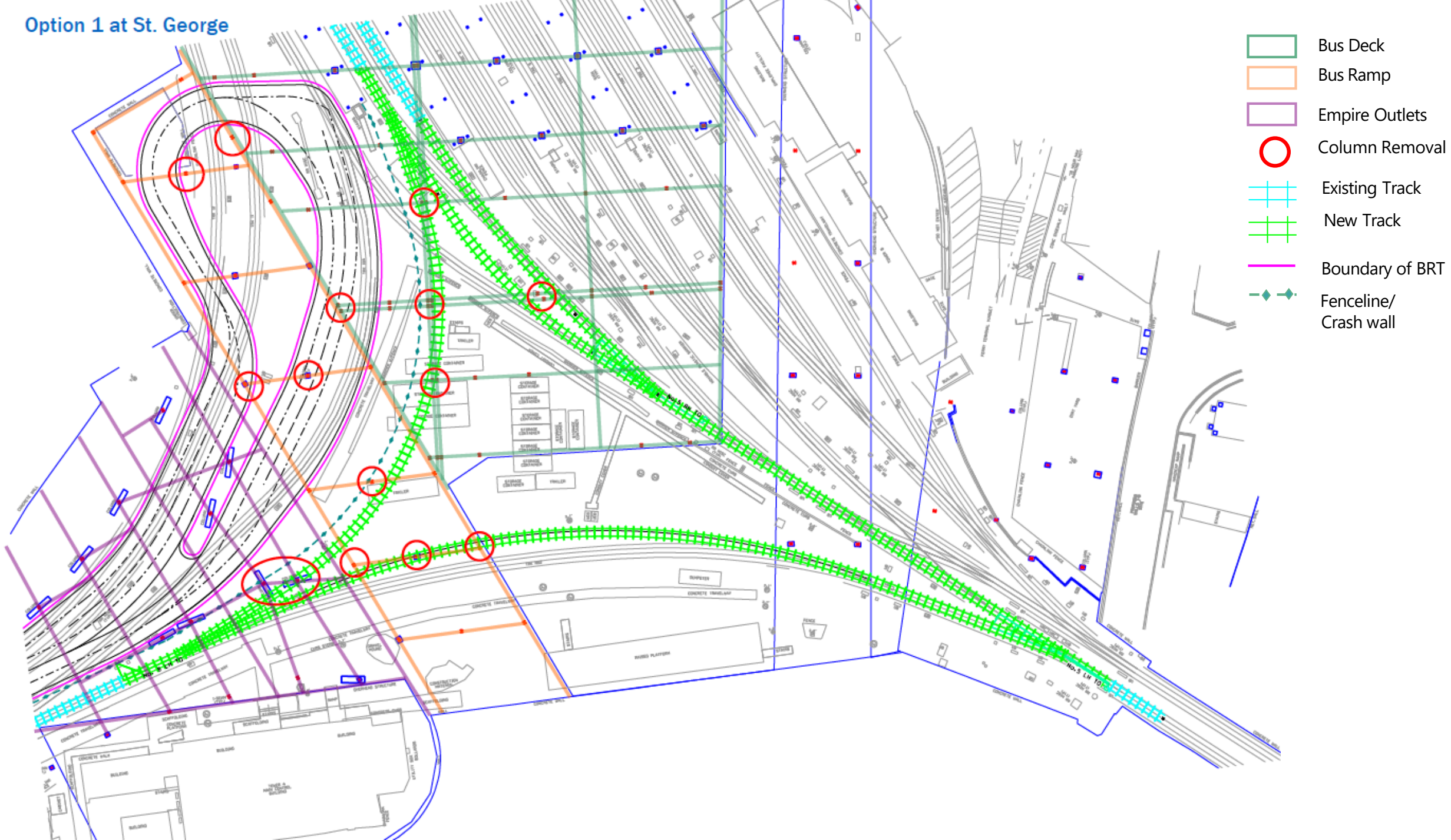




## Appendix A

### Plan Sheets for Conceptual Options

# Option 1 at St. George



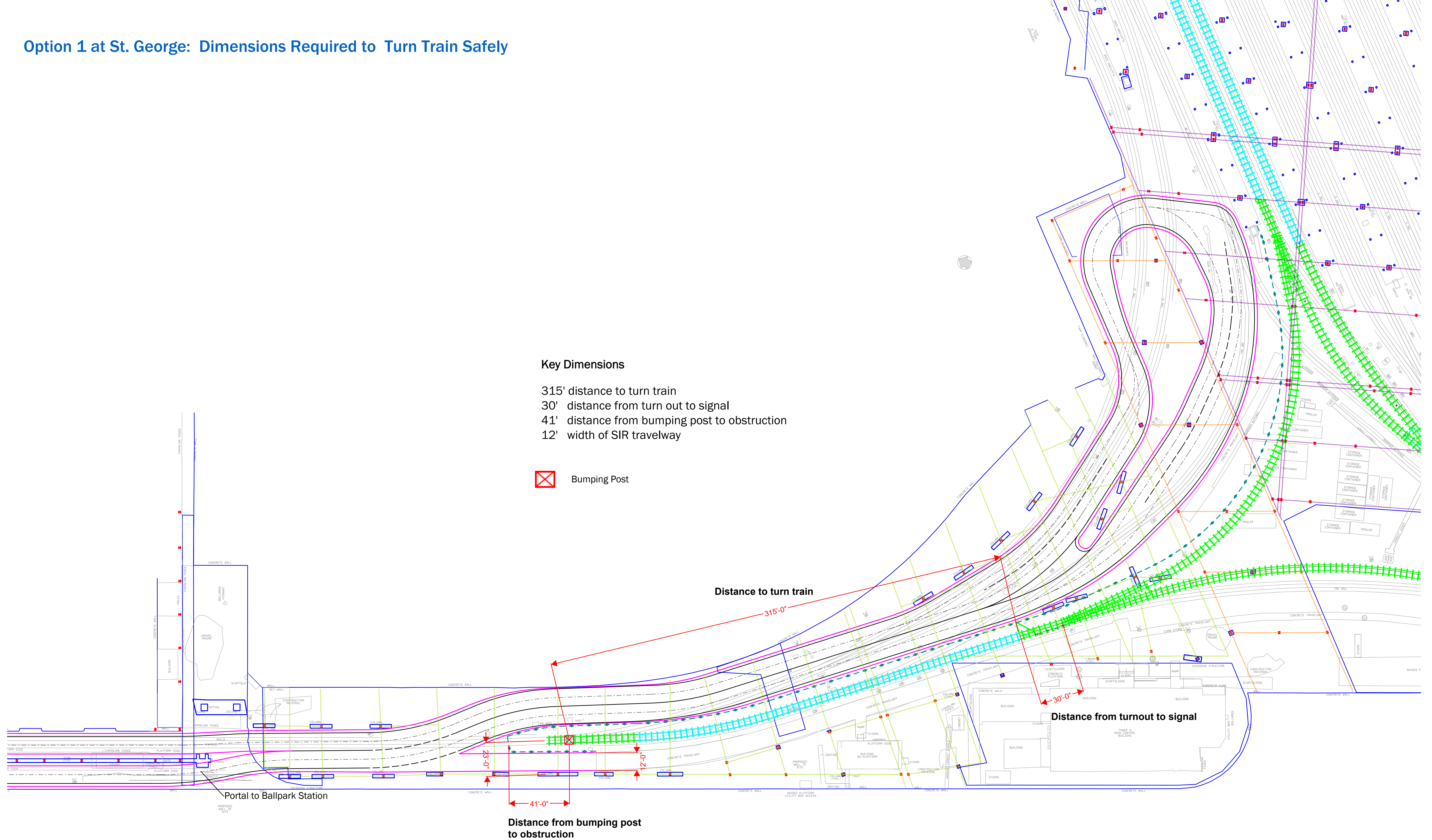


# Option 1 at St. George: Dimensions Required to Turn Train Safely

## Key Dimensions

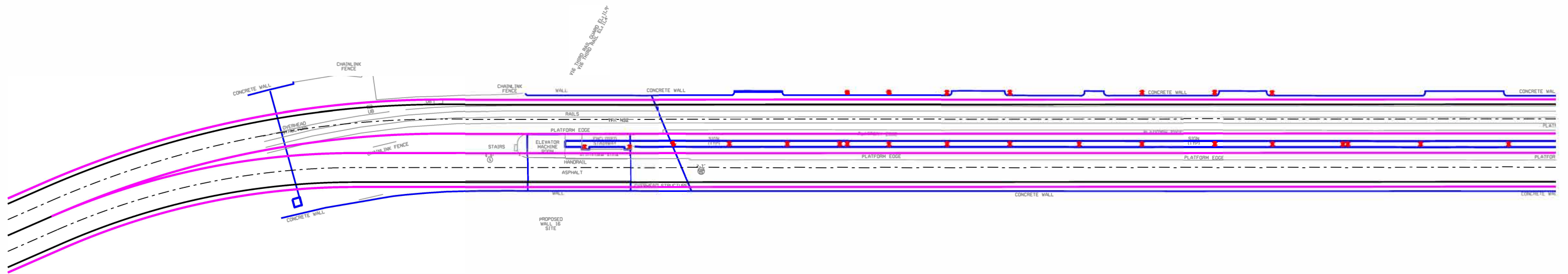
- 315' distance to turn train
- 30' distance from turn out to signal
- 41' distance from bumping post to obstruction
- 12' width of SIR travelway

 Bumping Post





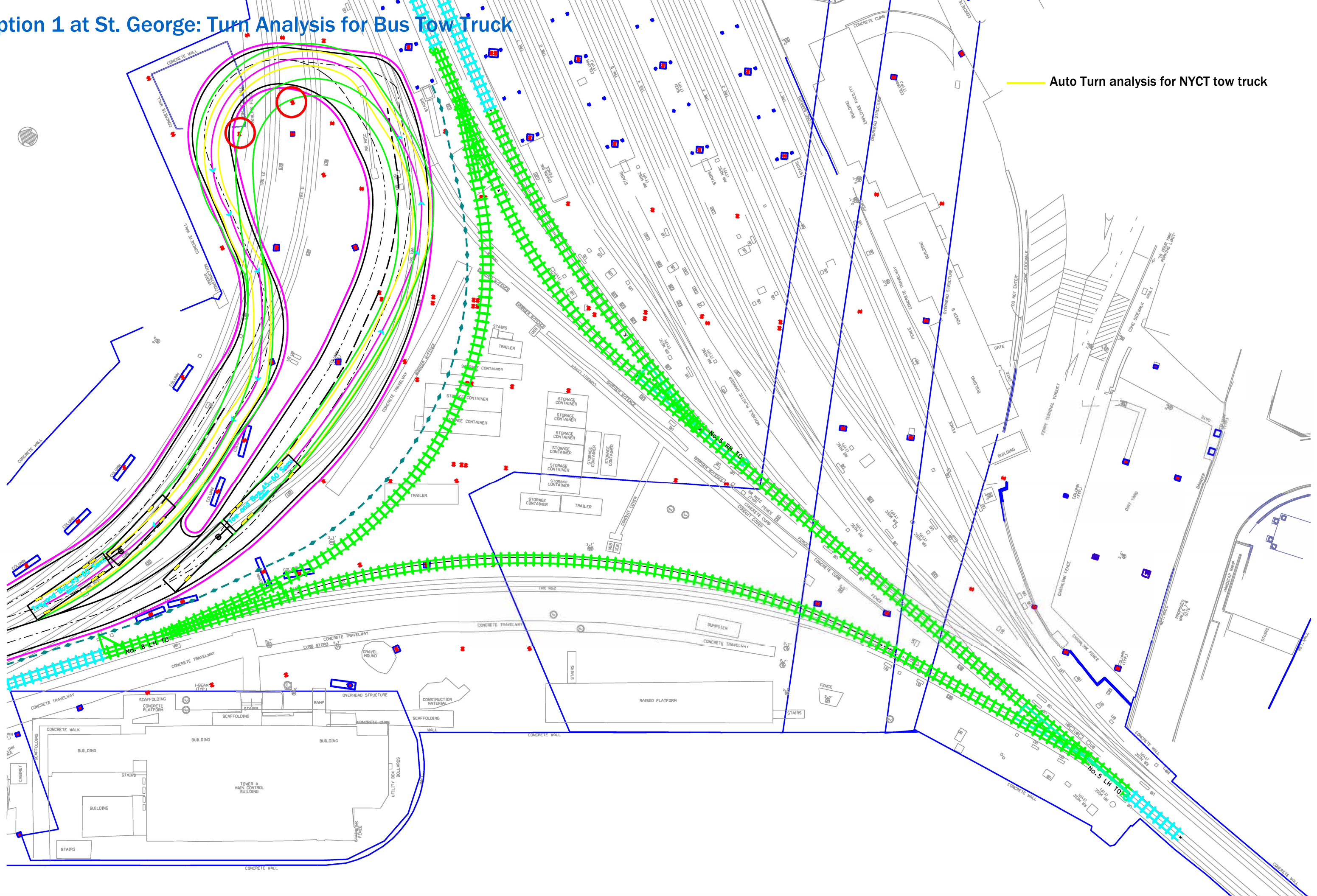
# Option 1 at Ballpark Station





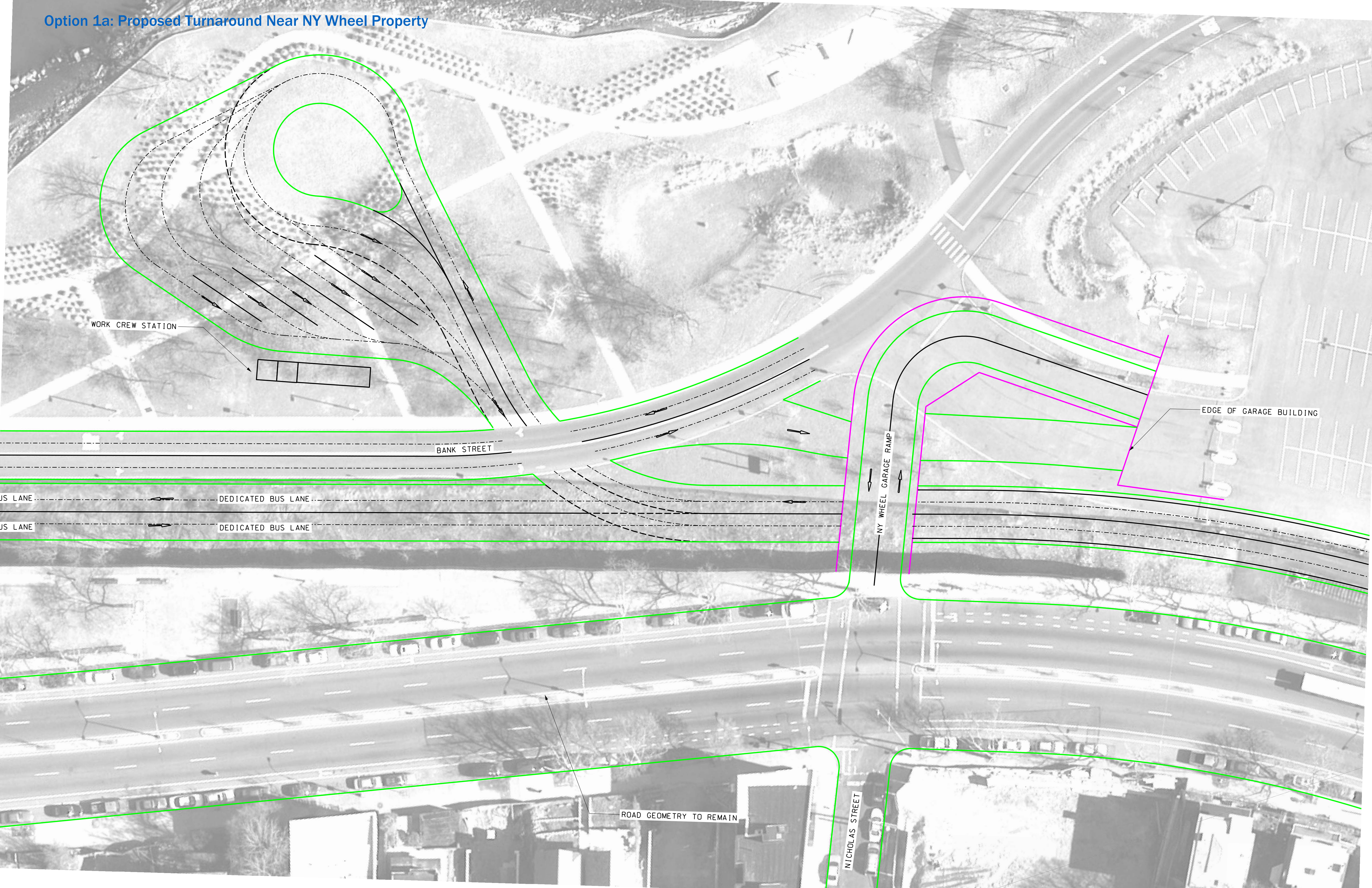
# Option 1 at St. George: Turn Analysis for Bus Tow Truck

Auto Turn analysis for NYCT tow truck





Option 1a: Proposed Turnaround Near NY Wheel Property



WORK CREW STATION

BANK STREET

NY WHEEL GARAGE RAMP

EDGE OF GARAGE BUILDING

US LANE

DEDICATED BUS LANE

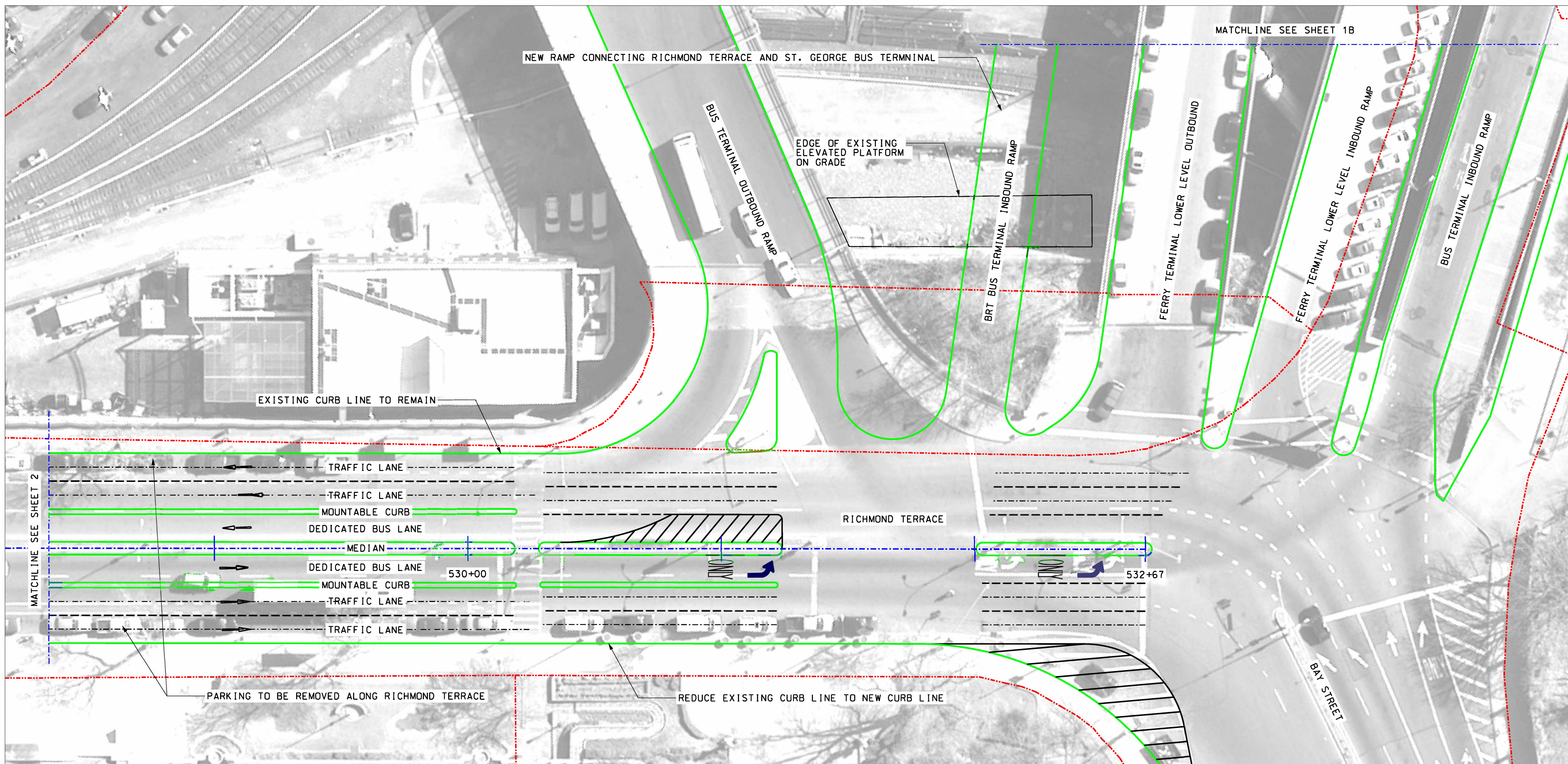
US LANE

DEDICATED BUS LANE

ROAD GEOMETRY TO REMAIN

NICHOLAS STREET





LANE WIDTHS ON RICHMOND TERRACE

TRAFFIC LANE	11 FT
MOUNTABLE CURB	2 FT
DEDICATED BUS LANE	11 FT
MEDIAN	5 FT

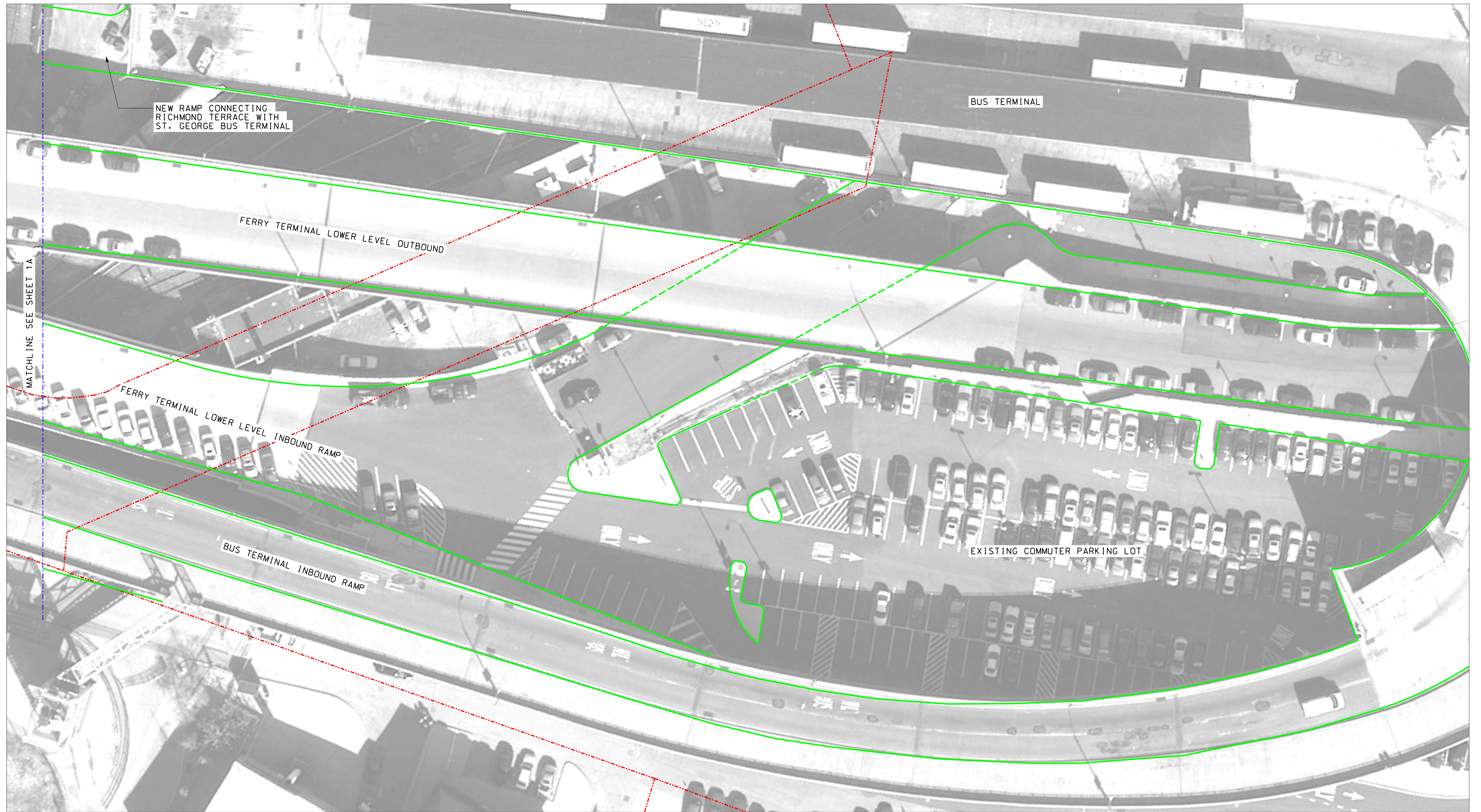
APPROXIMATE NUMBER OF PARKING SPACES TO BE REMOVED

WEST BOUND	
FROM BAY ST TO MATCHLINE	16
EAST BOUND	
FROM MATCHLINE TO BAY ST	16

ALTERNATE #5

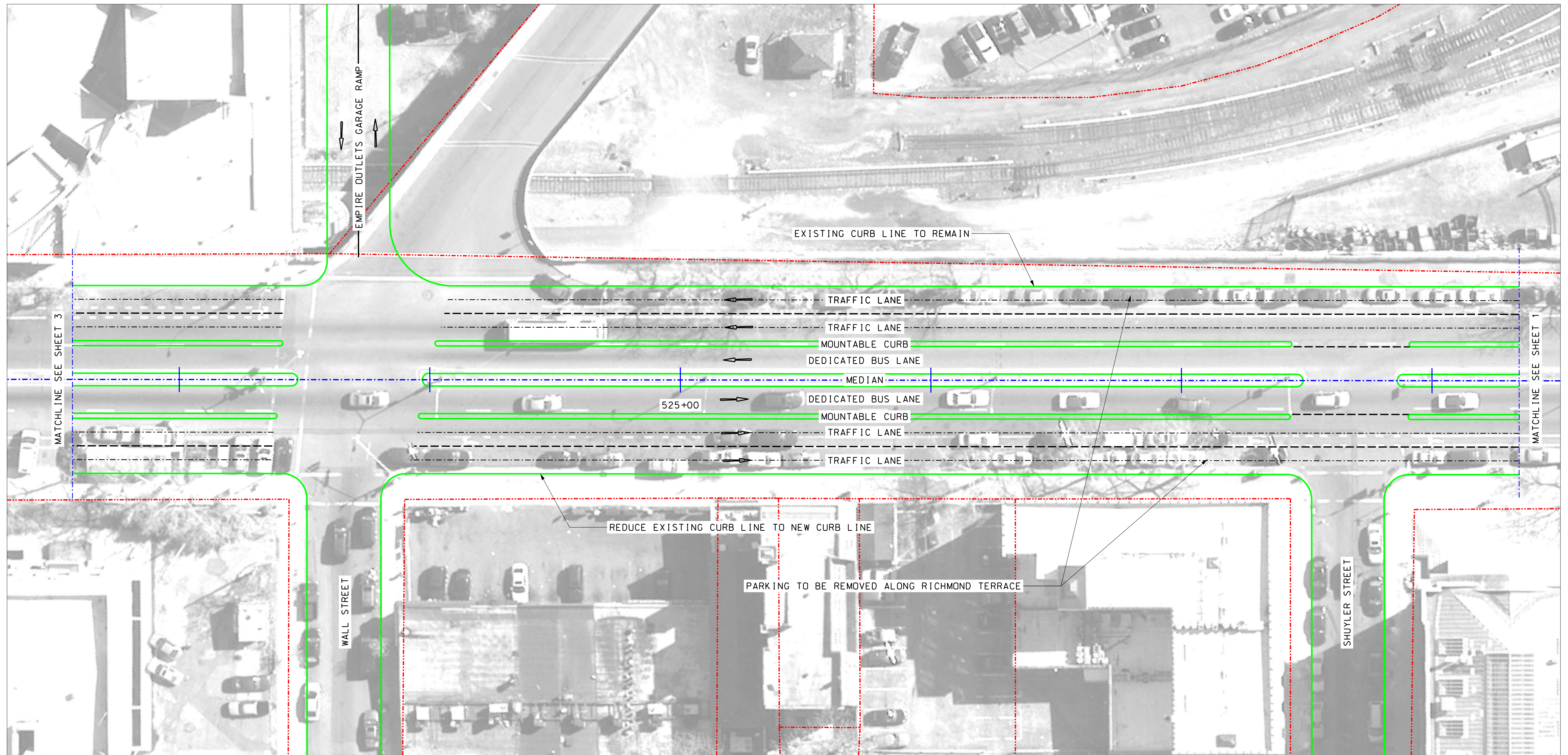
SHEET 1A





ALTERNATE #5  
SHEET 1B





LANE WIDTHS ON RICHMOND TERRACE

TRAFFIC LANE	11 FT
MOUNTABLE CURB	2 FT
DEDICATED BUS LANE	11 FT
MEDIAN	5 FT

APPROXIMATE NUMBER OF PARKING SPACES TO BE REMOVED

WEST BOUND		
FROM MATCHLINE TO EMPIRE OUTLETS RAMP	22	
FROM EMPIRE OUTLES RAMP TO MATCHLINE	4	
EAST BOUND		
FROM WALL STREET TO SHUYLER STREET	18	
FROM SHUYLER TO MATCHLINE	2	

ALTERNATE #5

SHEET 2





LANE WIDTHS ON RICHMOND TERRACE

TRAFFIC LANE	11 FT
MOUNTABLE CURB	2 FT
DEDICATED BUS LANE	11 FT
MEDIAN	5 FT

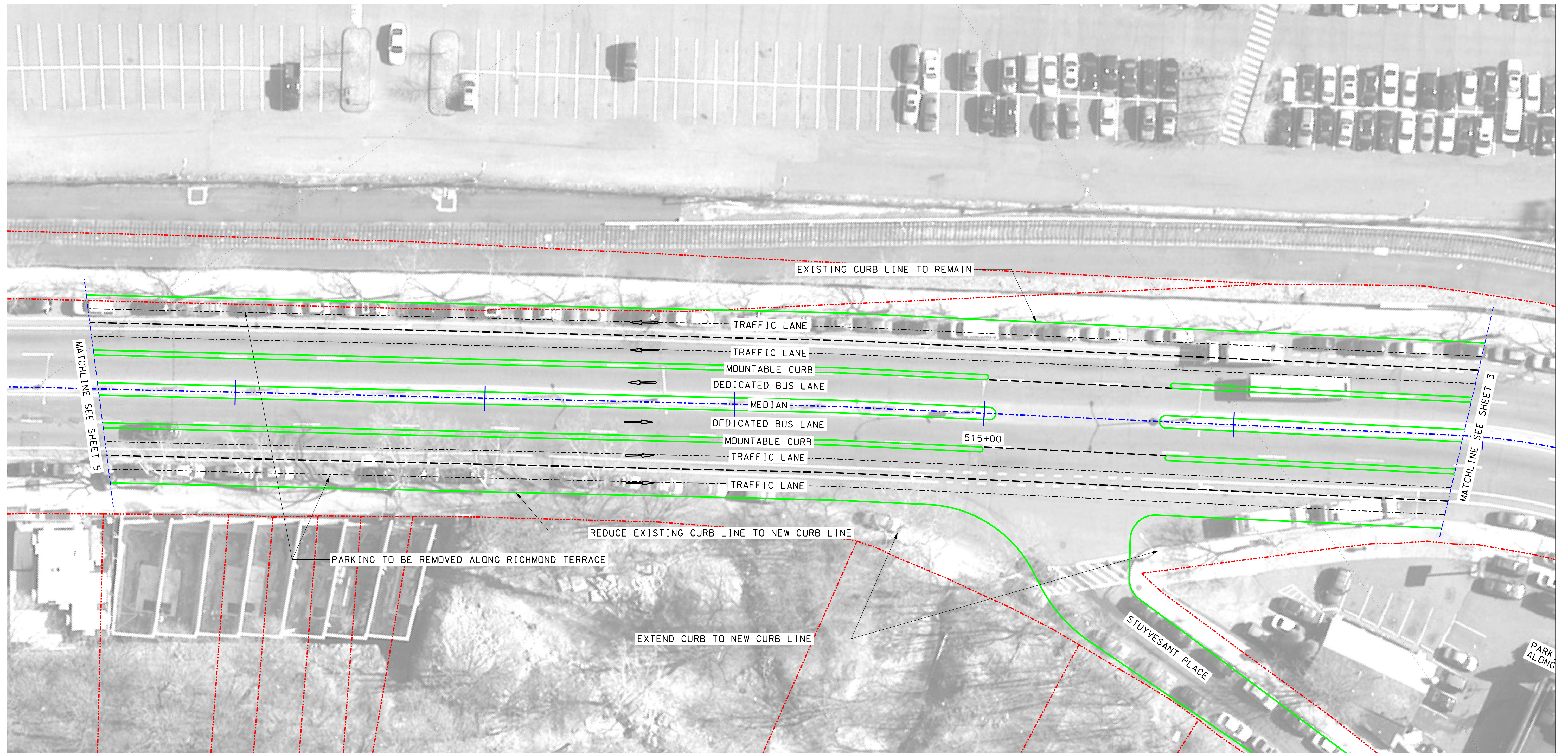
APPROXIMATE NUMBER OF PARKING SPACES TO BE REMOVED

WEST BOUND	
FROM MATCH LINE TO MATCHLINE	28
EAST BOUND	
MATCHLINE TO HAMILTON AVENUE	10
FROM HAMILTON AVENUE TO MATCHLINE	16

ALTERNATE #5

SHEET 3





LANE WIDTHS ON RICHMOND TERRACE

TRAFFIC LANE	11 FT
MOUNTABLE CURB	2 FT
DEDICATED BUS LANE	11 FT
MEDIAN	5 FT

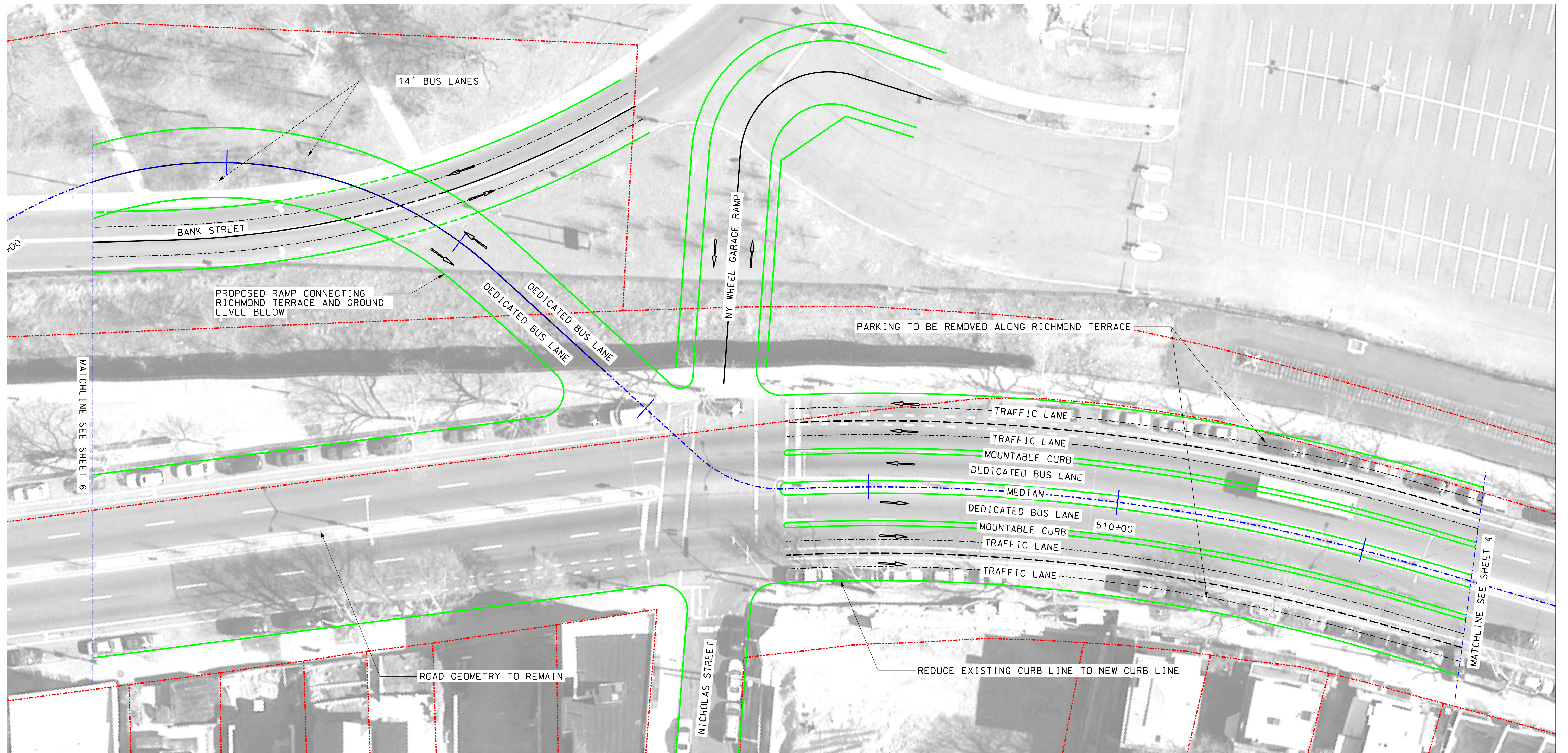
APPROXIMATE NUMBER OF PARKING SPACES TO BE REMOVED

WEST BOUND	
FROM MATCHLINE TO MATCHLINE	29
EAST BOUND	
FROM MATCHLINE TO STUYVESANT PLACE	17
FROM STUYVESANT PLACE TO MATCHLINE	6

ALTERNATE #5

SHEET 4





LANE WIDTHS ON RICHMOND TERRACE

TRAFFIC LANE	11 FT
MOUNTABLE CURB	2 FT
DEDICATED BUS LANE	11 FT
MEDIAN	5 FT

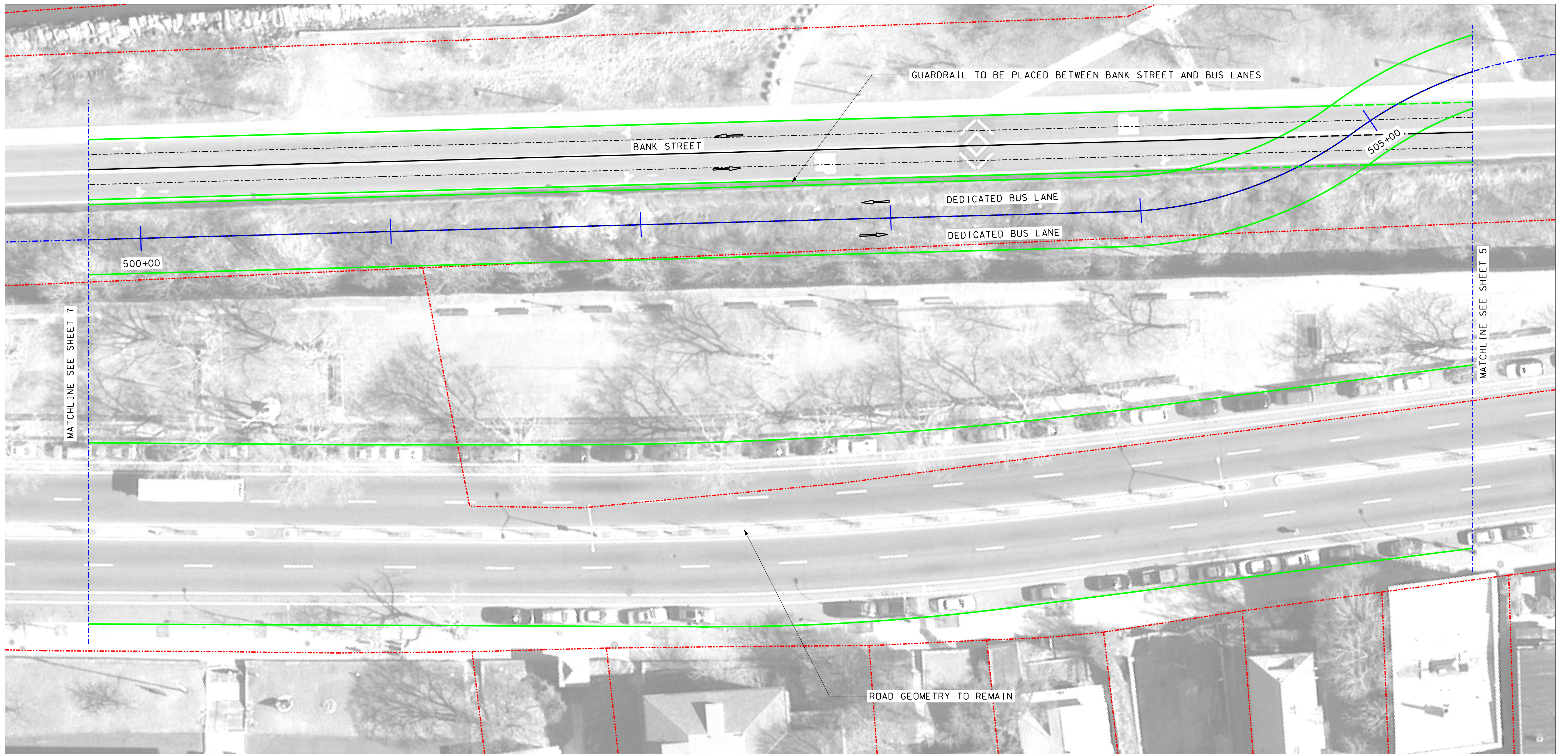
APPROXIMATE NUMBER OF PARKING SPACES TO BE REMOVED

WEST BOUND	
FROM MATCHLINE TO NY WHEEL RAMP	14
EAST BOUND	
FROM NICHOLAS STREET TO MATCHLINE	14

ALTERNATE #5

SHEET 5

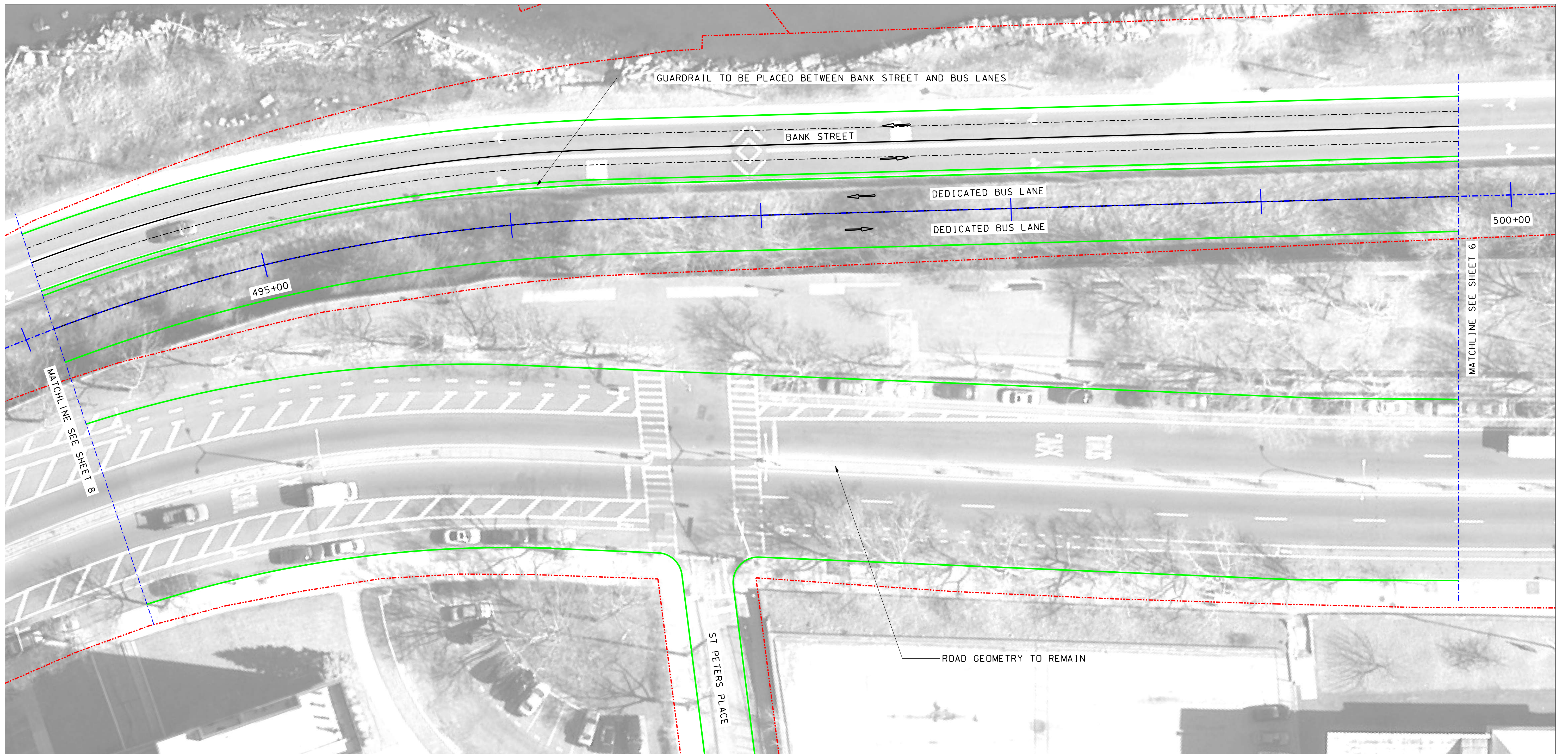




LANE WIDTHS ON ROW  
 DEDICATED BUS LANE 14 FT

ALTERNATE #5  
 SHEET 6

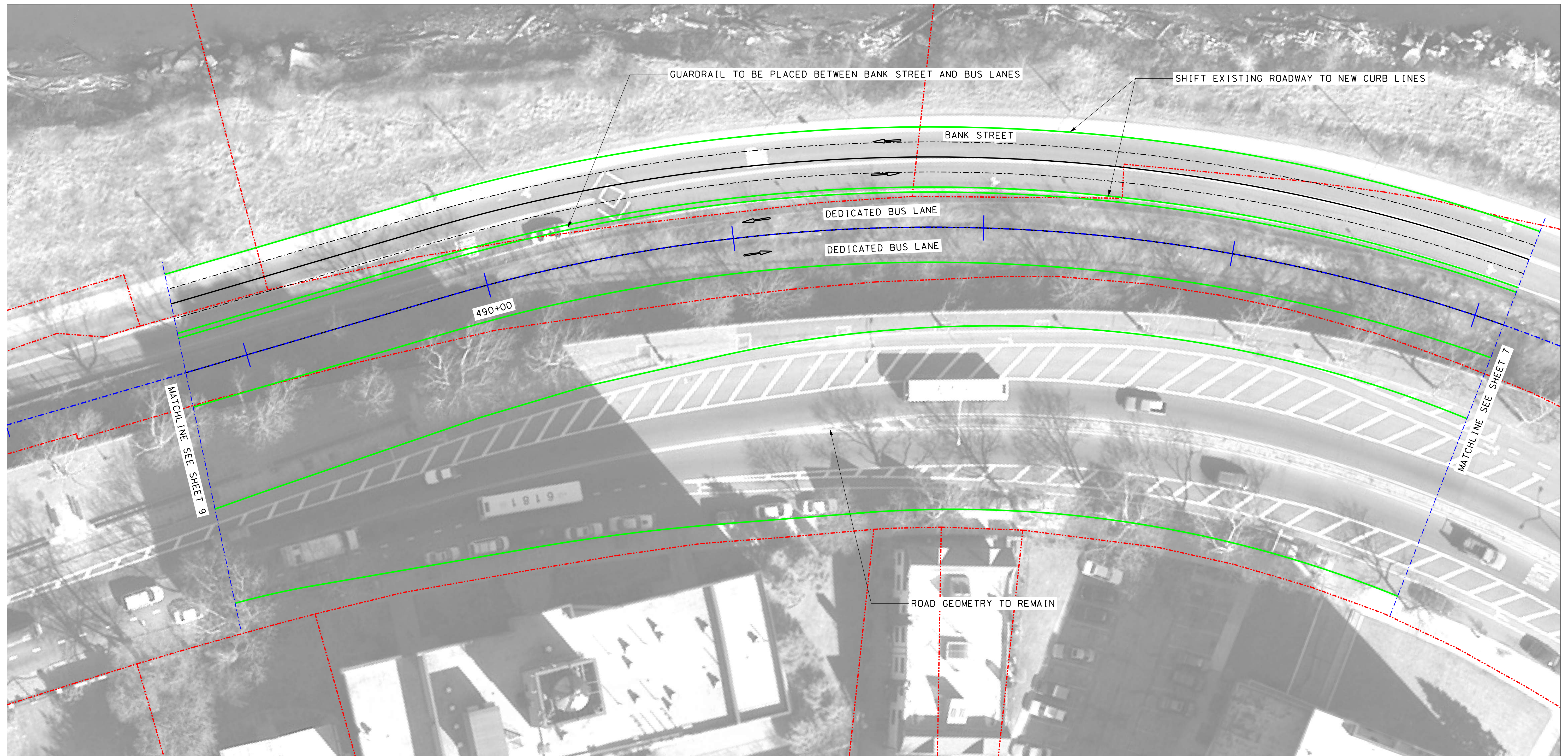




LANE WIDTHS ON ROW  
 DEDICATED BUS LANE 14 FT

ALTERNATE #5  
 SHEET 7

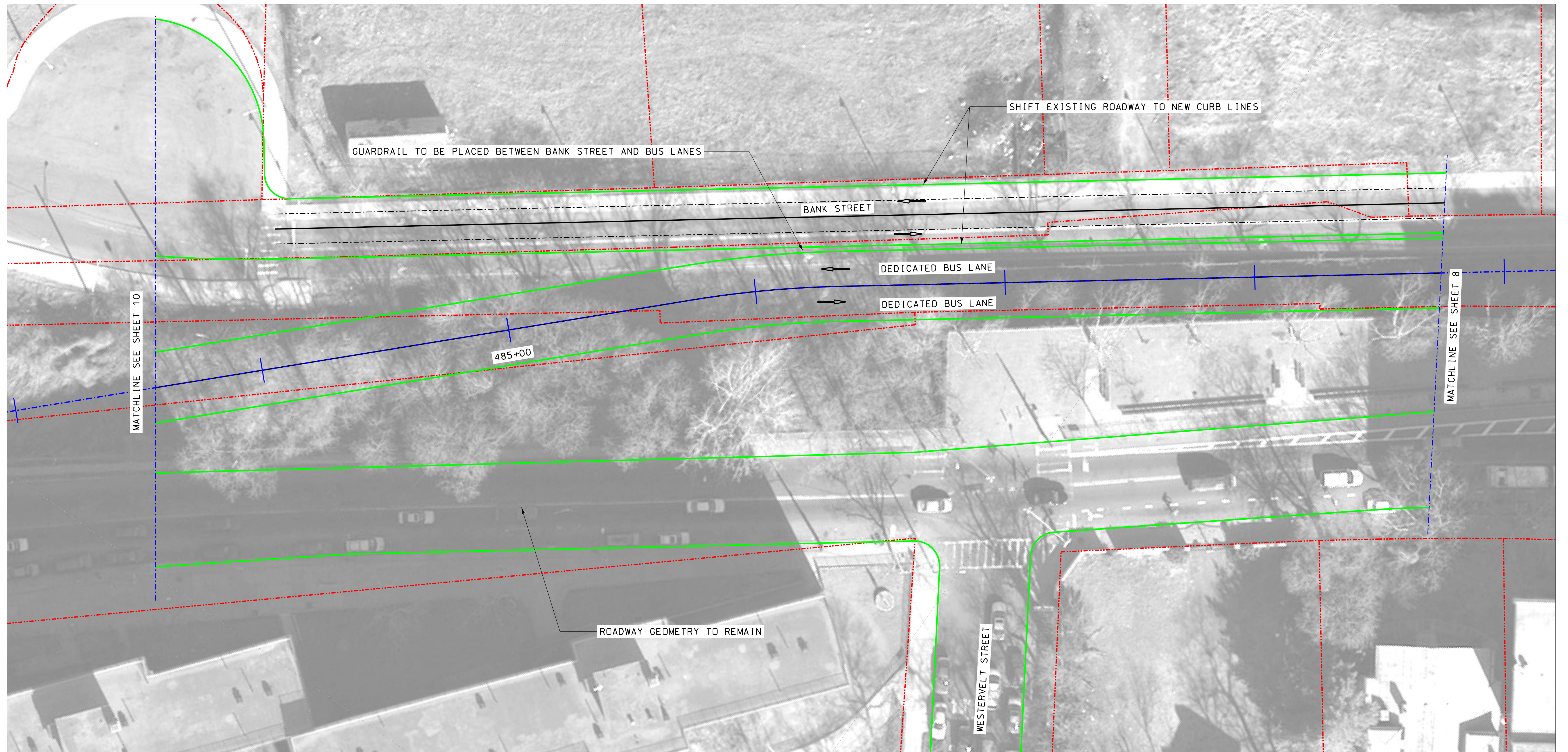




LANE WIDTHS ON ROW  
 DEDICATED BUS LANE 14 FT

ALTERNATE #5  
 SHEET 8





LANE WIDTHS ON ROW  
 DEDICATED BUS LANE 14 FT

ALTERNATE #5  
 SHEET 9

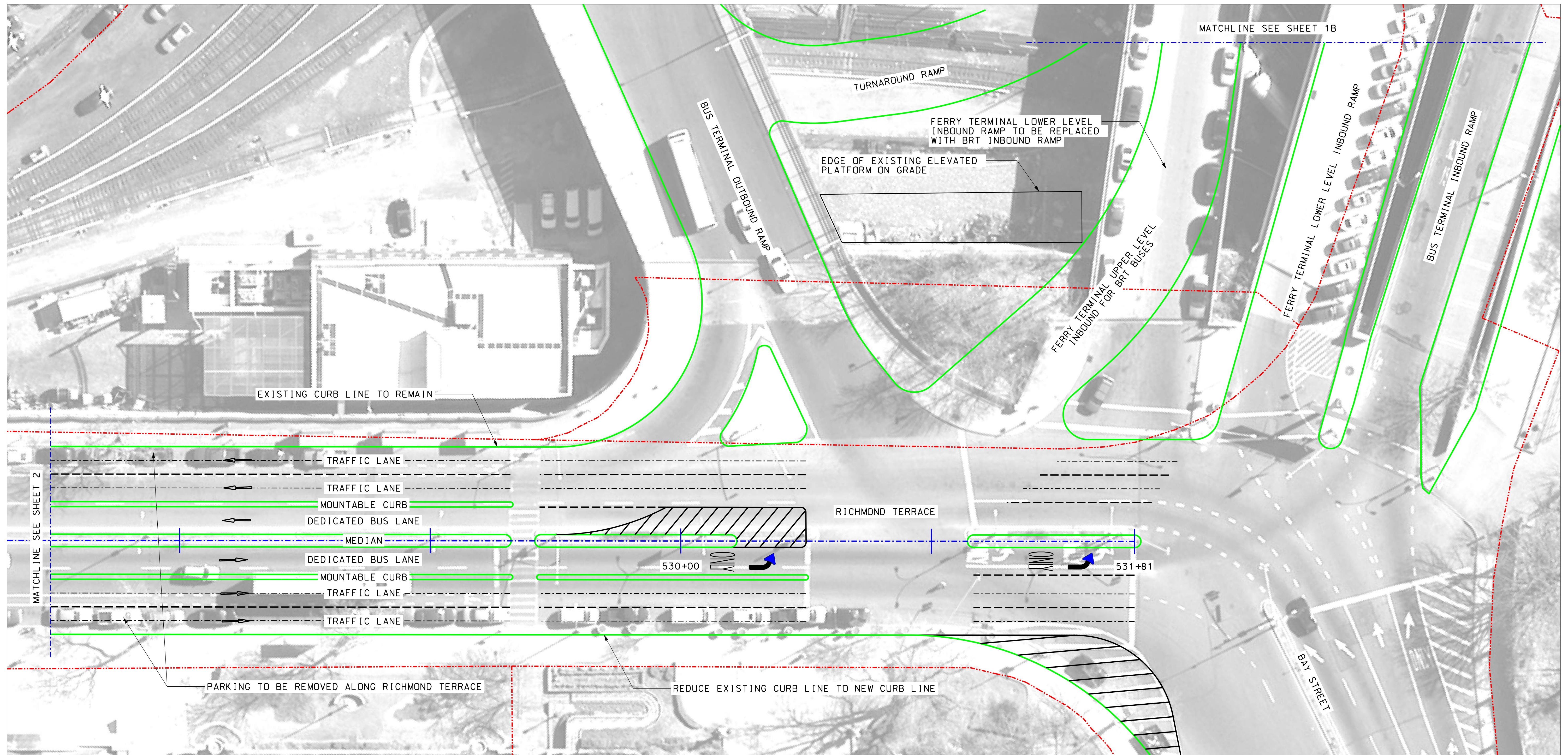




LANE WIDTHS ON ROW	
DEDICATED BUS LANE	14 FT

ALTERNATE #5  
SHEET 10





LANE WIDTHS ON RICHMOND TERRACE

TRAFFIC LANE	11 FT
MOUNTABLE CURB	2 FT
DEDICATED BUS LANE	11 FT
MEDIAN	5 FT

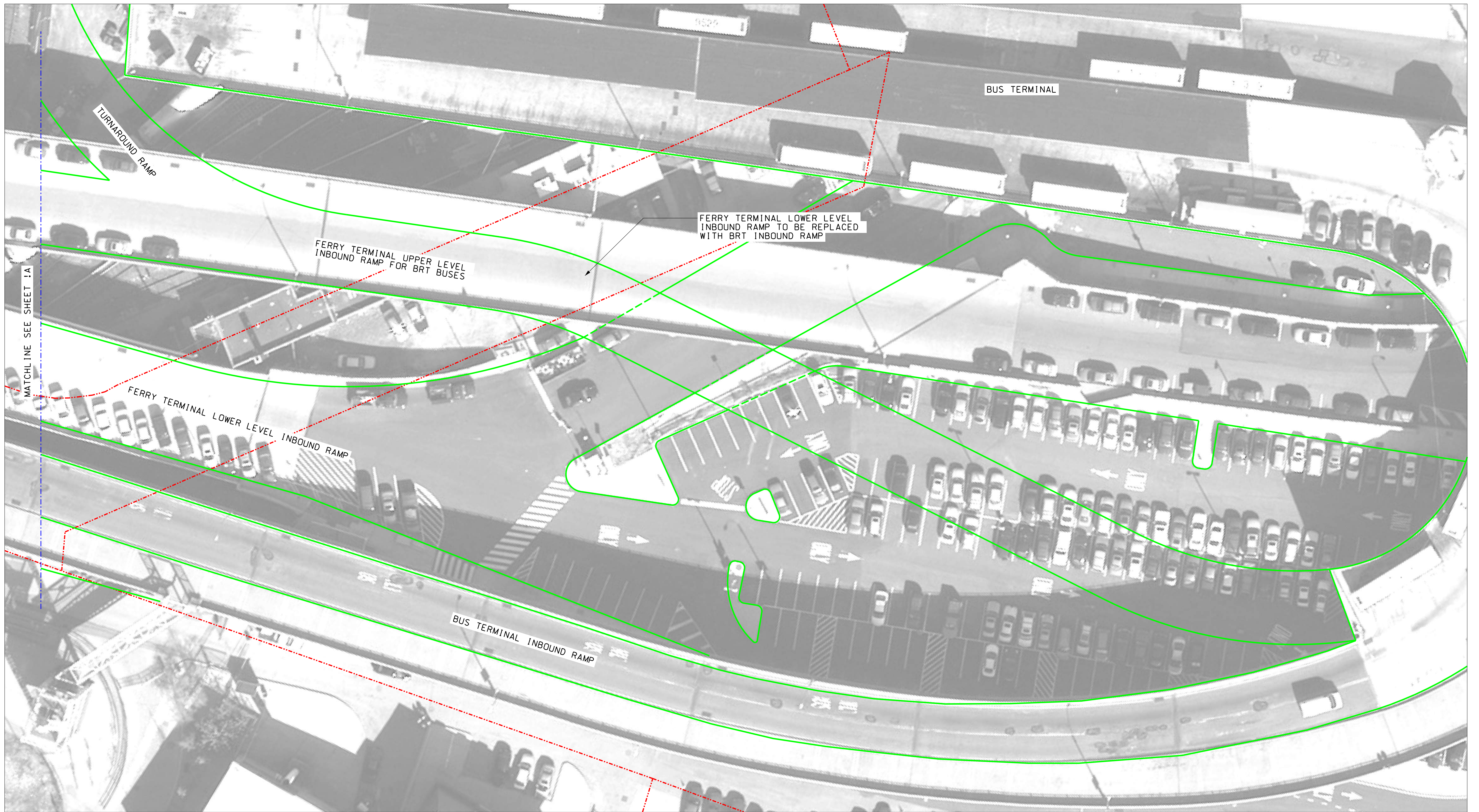
APPROXIMATE NUMBER OF PARKING SPACES TO BE REMOVED

WEST BOUND	
FROM BAY ST TO MATCHLINE	16
EAST BOUND	
FROM MATCHLINE TO BAY ST	16

ALTERNATE #6

SHEET 1A

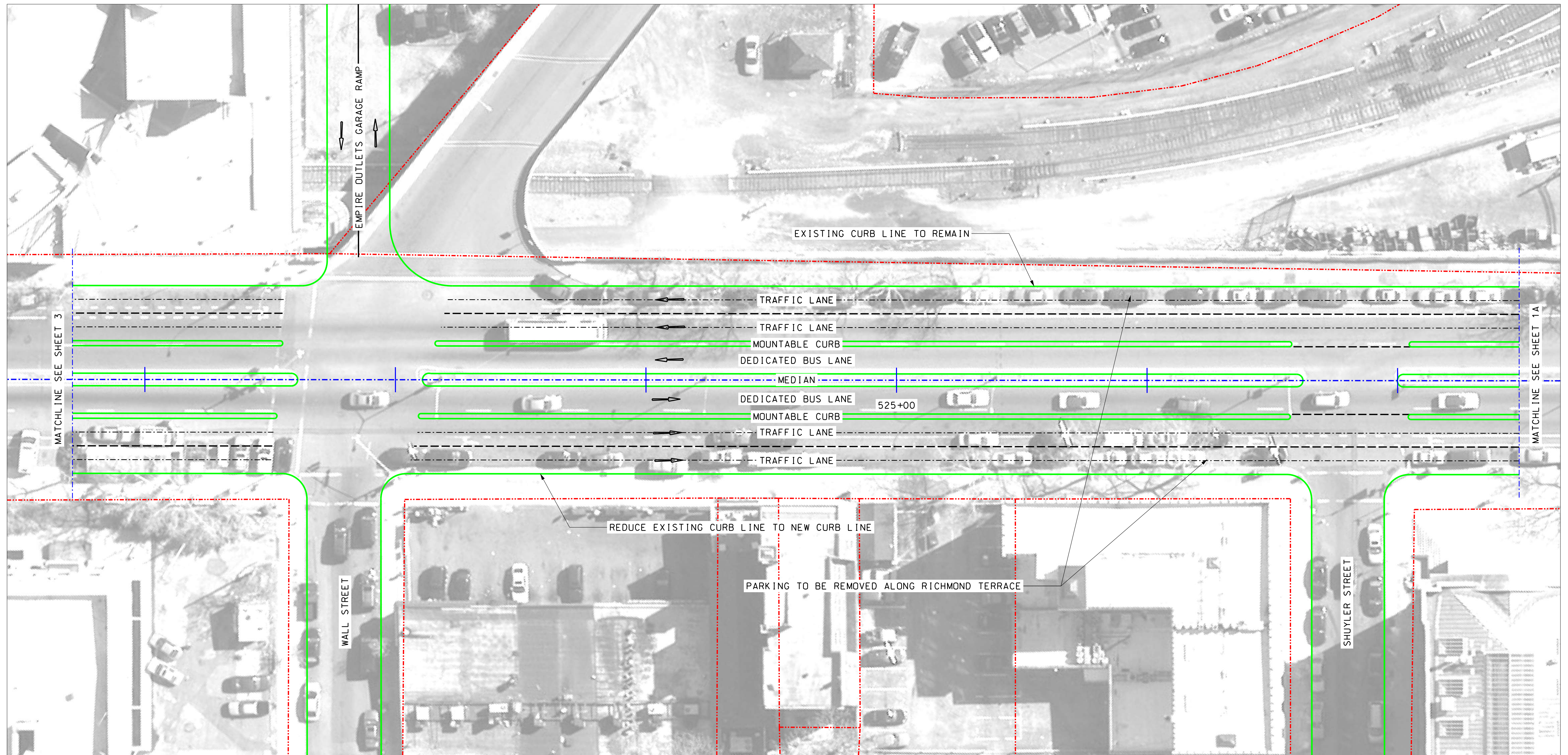




ALTERNATE #6

SHEET 1B





LANE WIDTHS ON RICHMOND TERRACE

TRAFFIC LANE	11 FT
MOUNTABLE CURB	2 FT
DEDICATED BUS LANE	11 FT
MEDIAN	5 FT

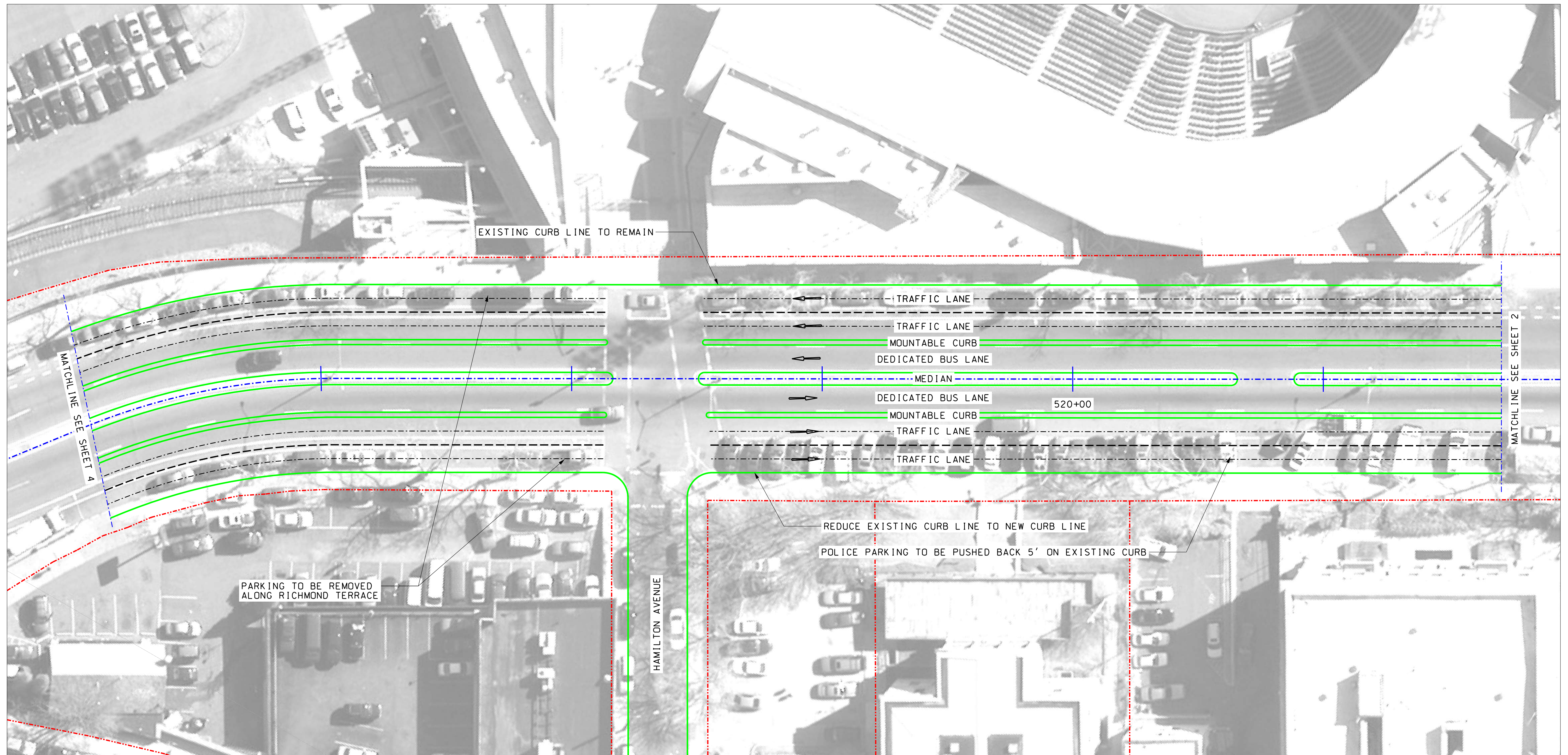
APPROXIMATE NUMBER OF PARKING SPACES TO BE REMOVED

WEST BOUND		
FROM MATCHLINE TO EMPIRE OUTLETS RAMP	22	
FROM EMPIRE OUTLES RAMP TO MATCHLINE	4	
EAST BOUND		
FROM WALL STREET TO SHUYLER STREET	18	
FROM SHUYLER TO MATCHLINE	2	

ALTERNATE #6

SHEET 2





LANE WIDTHS ON RICHMOND TERRACE

TRAFFIC LANE	11 FT
MOUNTABLE CURB	2 FT
DEDICATED BUS LANE	11 FT
MEDIAN	5 FT

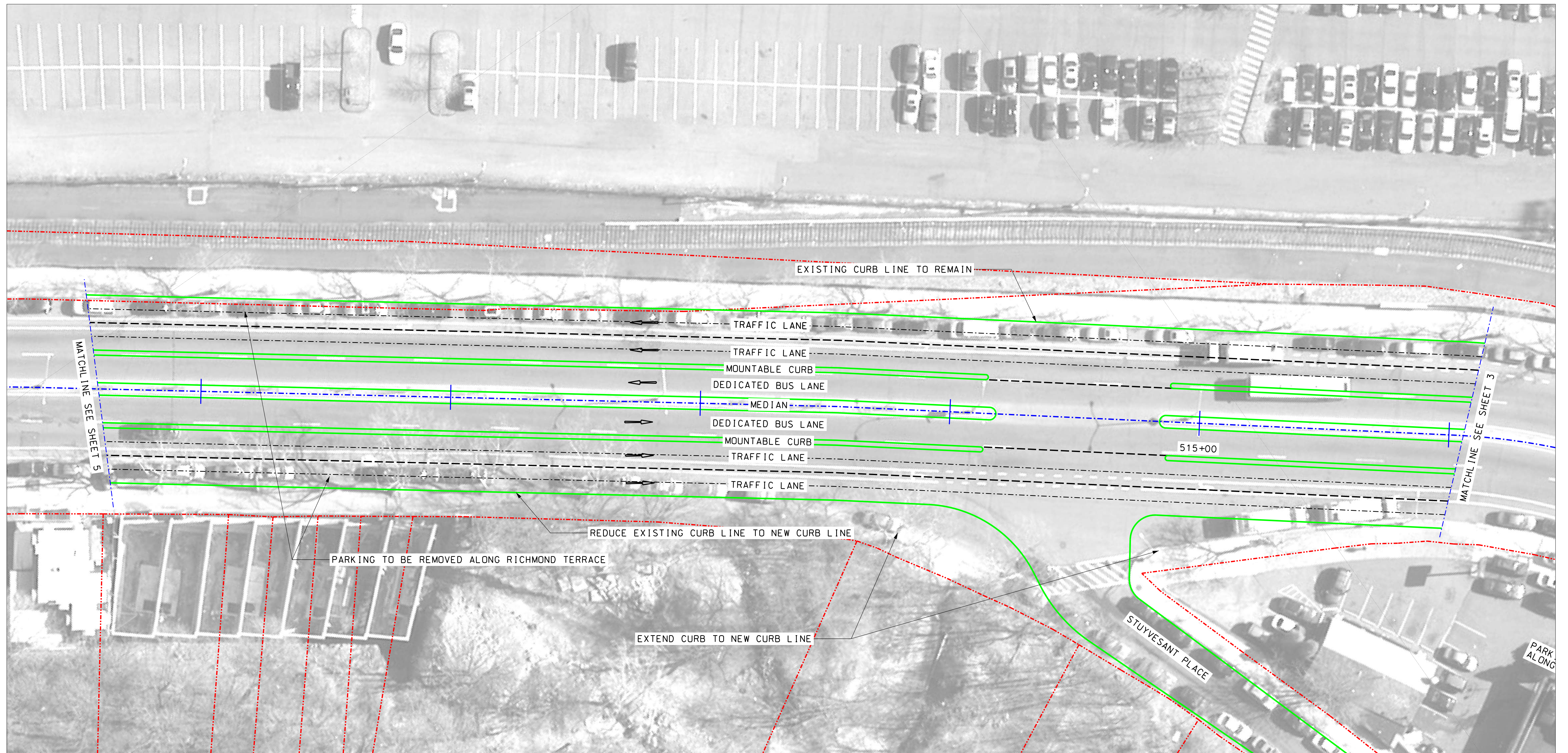
APPROXIMATE NUMBER OF PARKING SPACES TO BE REMOVED

<u>WEST BOUND</u>	
FROM MATCH LINE TO MATCHLINE	28
<u>EAST BOUND</u>	
MATCHLINE TO HAMILTON AVENUE	10
FROM HAMILTON AVENUE TO MATCHLINE	16

ALTERNATE #6

SHEET 3





LANE WIDTHS ON RICHMOND TERRACE

TRAFFIC LANE	11 FT
MOUNTABLE CURB	2 FT
DEDICATED BUS LANE	11 FT
MEDIAN	5 FT

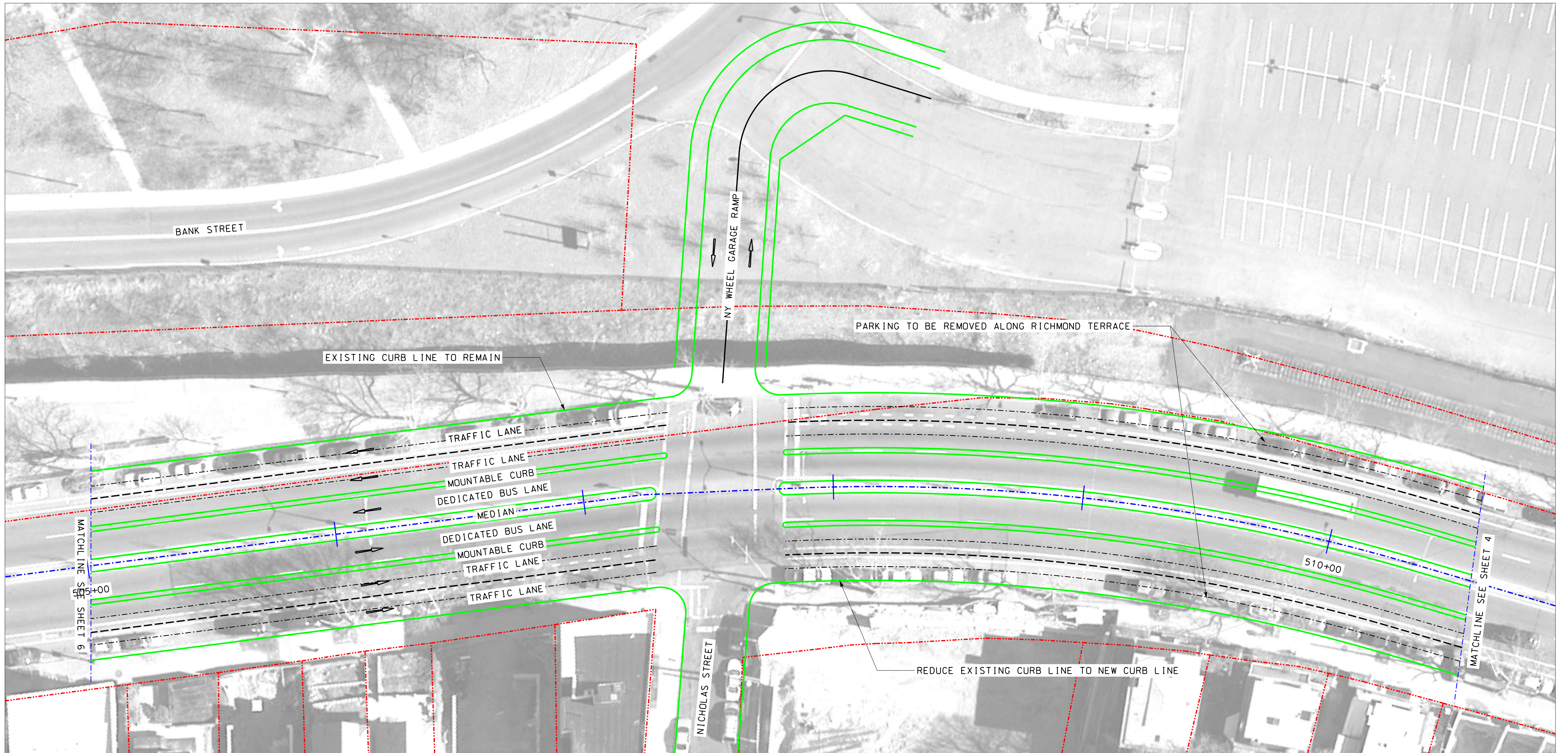
APPROXIMATE NUMBER OF PARKING SPACES TO BE REMOVED

WEST BOUND	
FROM MATCHLINE TO MATCHLINE	29
EAST BOUND	
FROM MATCHLINE TO STUYVESANT PLACE	17
FROM STUYVESANT PLACE TO MATCHLINE	6

ALTERNATE #6

SHEET 4





LANE WIDTHS ON RICHMOND TERRACE

TRAFFIC LANE	11 FT
MOUNTABLE CURB	2 FT
DEDICATED BUS LANE	11 FT
MEDIAN	5 FT

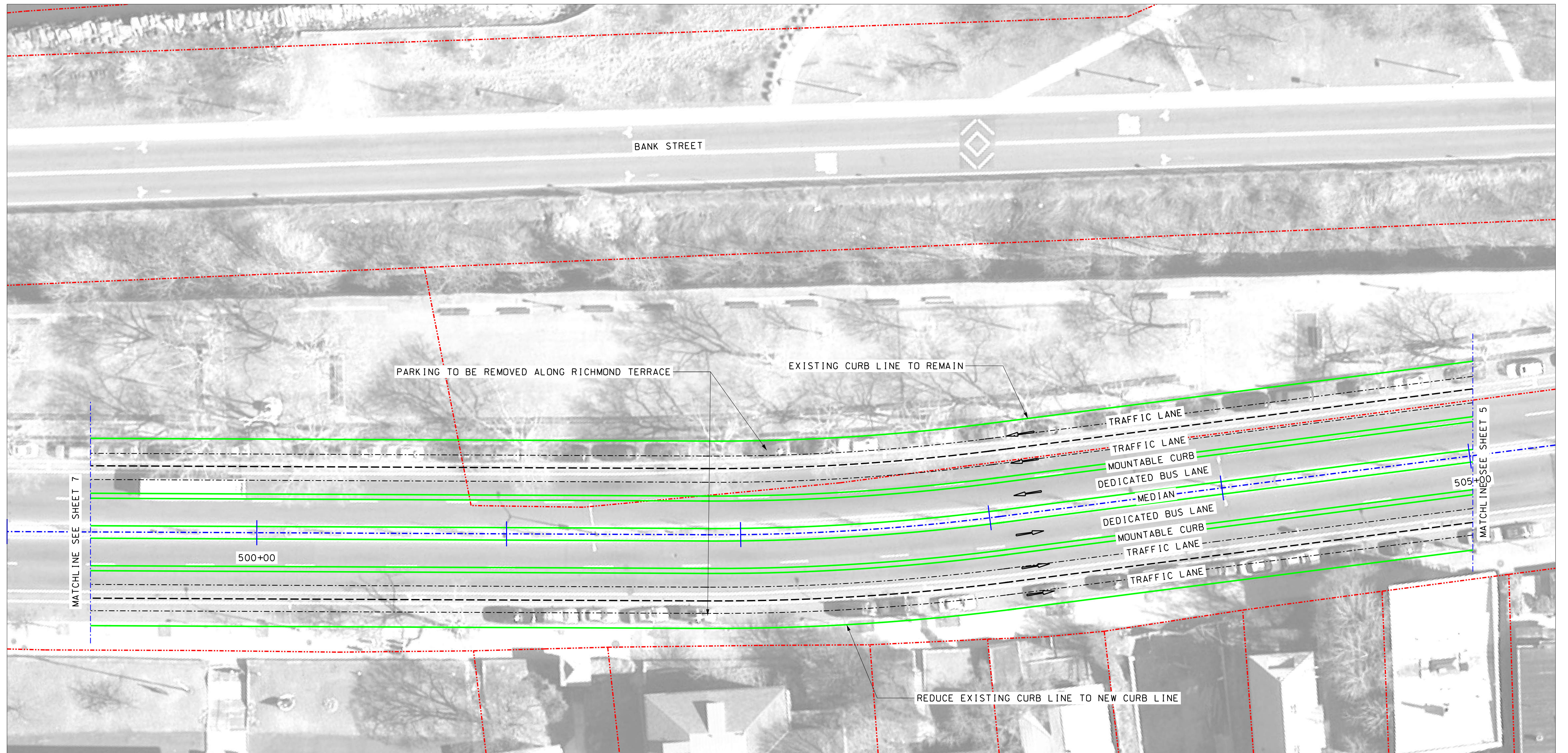
APPROXIMATE NUMBER OF PARKING SPACES TO BE REMOVED

WEST BOUND	
FROM MATCHLINE TO NY WHEEL RAMP	14
FROM NY WHEEL RAMP TO MATCHLINE	12
EAST BOUND	
FROM MATCHLINE TO NICHOLAS STREET	12
FROM NICHOLAS STREET TO MATCHLINE	14

ALTERNATE #6

SHEET 5





LANE WIDTHS ON RICHMOND TERRACE

TRAFFIC LANE	11 FT
MOUNTABLE CURB	2 FT
DEDICATED BUS LANE	11 FT
MEDIAN	5 FT

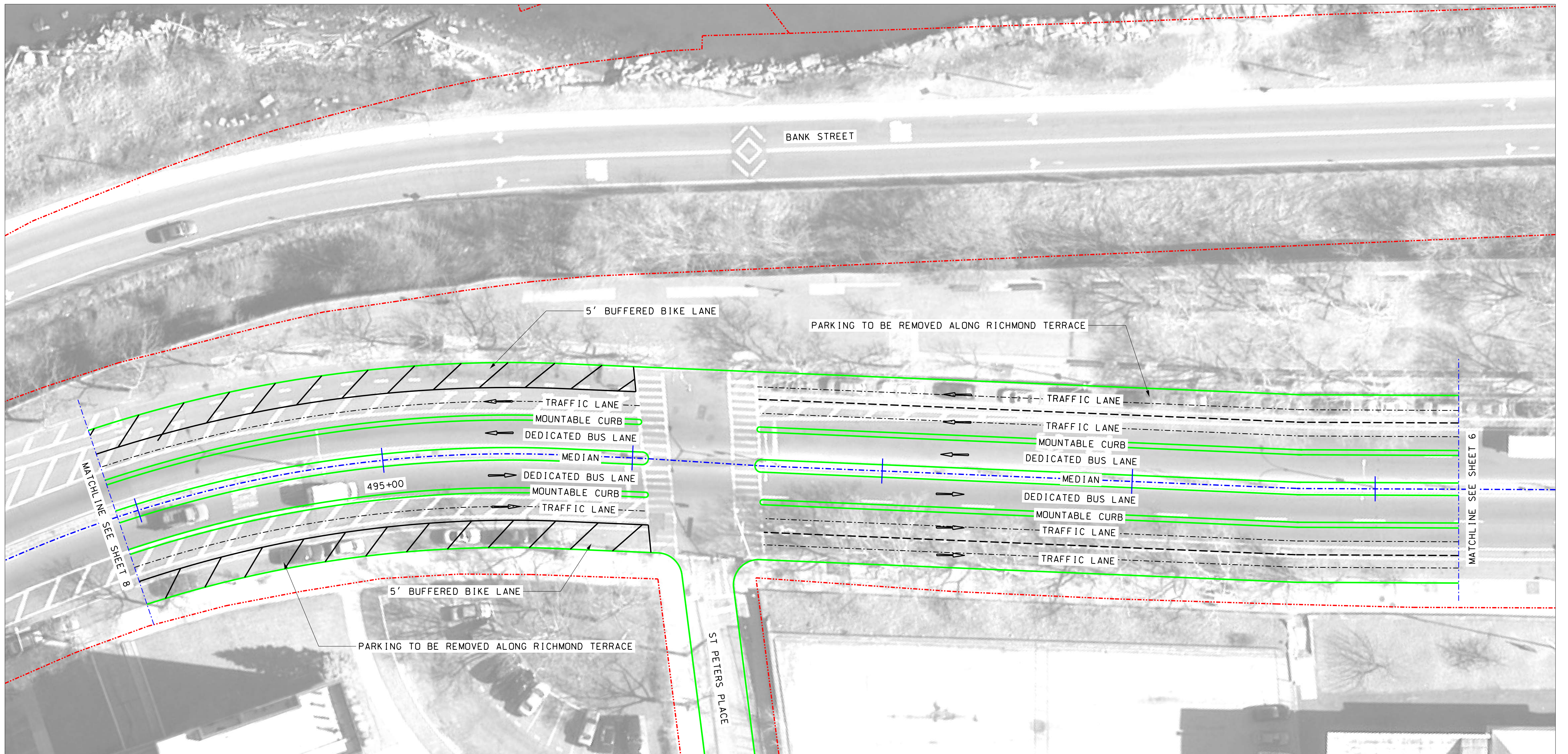
APPROXIMATE NUMBER OF PARKING SPACES TO BE REMOVED

WEST BOUND	
FROM MATCHLINE TO MATCHLINE	29
EAST BOUND	
FROM MATCHLINE TO MATCHLINE	29

ALTERNATE #6

SHEET 6





LANE WIDTHS ON RICHMOND TERRACE

TRAFFIC LANE	11 FT
MOUNTABLE CURB	2 FT
DEDICATED BUS LANE	11 FT
MEDIAN	5 FT

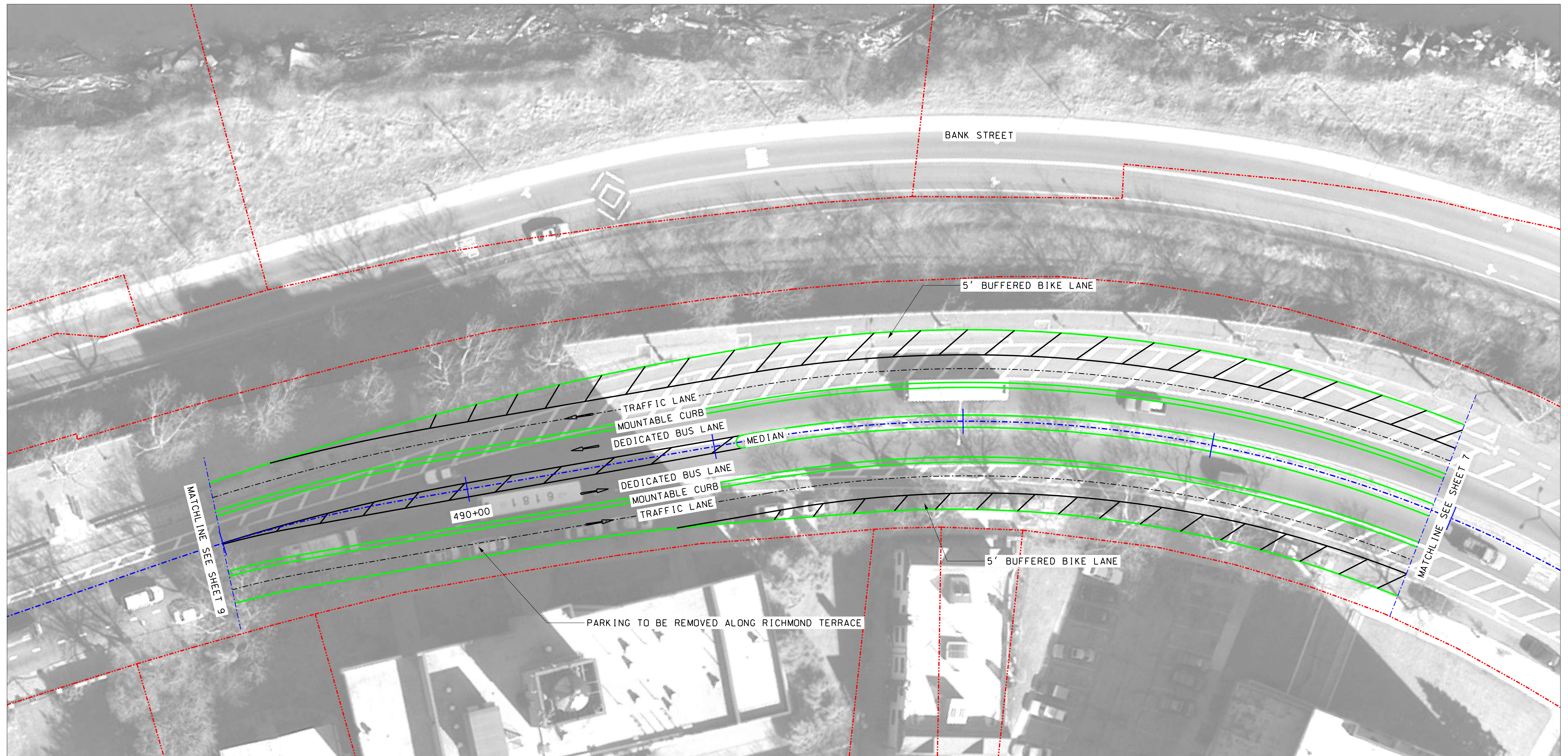
APPROXIMATE NUMBER OF PARKING SPACES TO BE REMOVED

WEST BOUND	
FROM CROSSWALK TO MATCH LINE	9
EAST BOUND	
FROM MATCHLINE TO ST PETERS PLACE	10
FROM ST PETERS PLACE TO MATCHLINE	14

ALTERNATE #6

SHEET 7





LANE WIDTHS ON RICHMOND TERRACE

TRAFFIC LANE	11 FT
MOUNTABLE CURB	2 FT
DEDICATED BUS LANE	11 FT
MEDIAN	5 FT

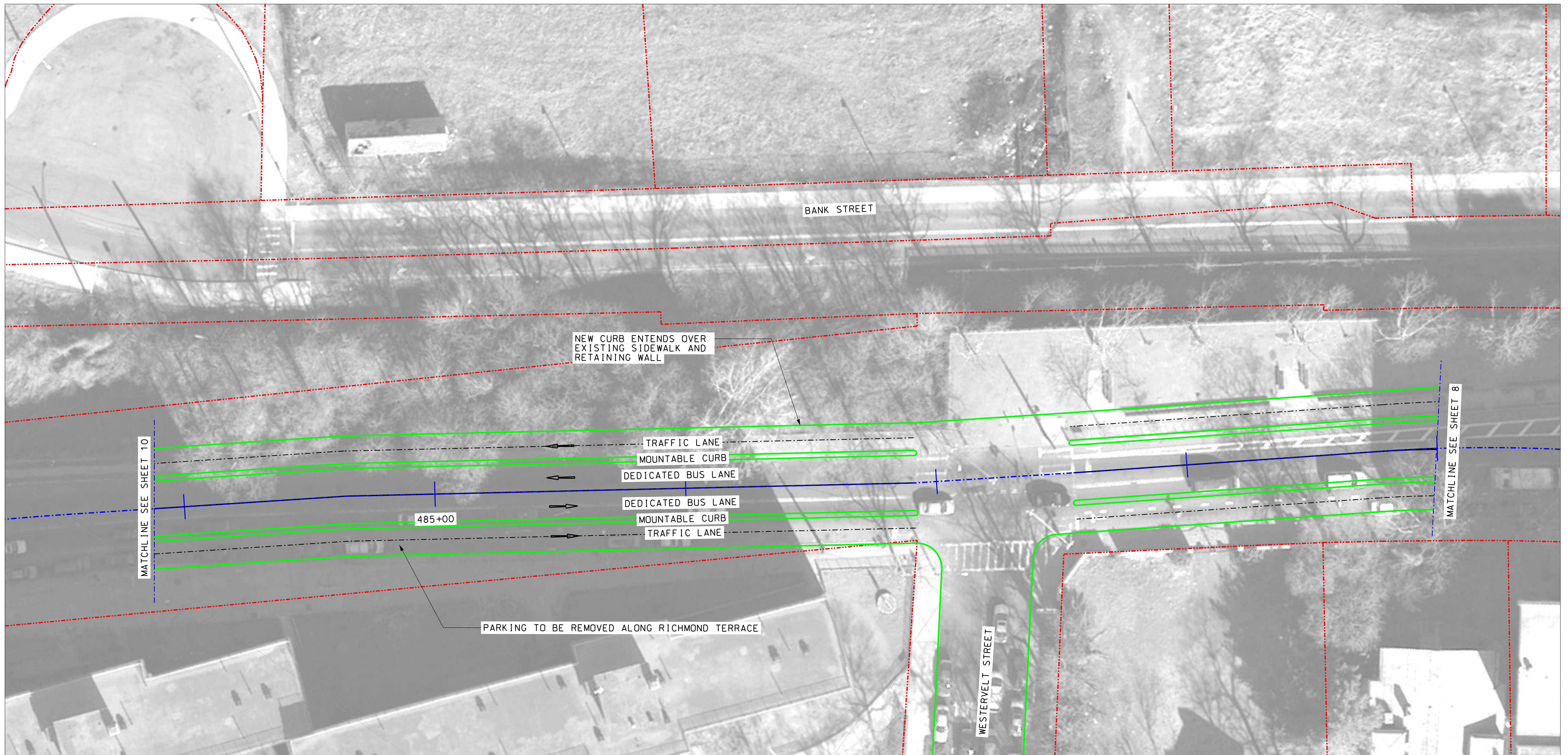
APPROXIMATE NUMBER OF PARKING SPACES TO BE REMOVED

EAST BOUND	
FROM MATCHLINE TO MATCHLINE	24

ALTERNATE #6

SHEET 8





LANE WIDTHS ON RICHMOND TERRACE

TRAFFIC LANE	11 FT
MOUNTABLE CURB	2 FT
DEDICATED BUS LANE	11 FT

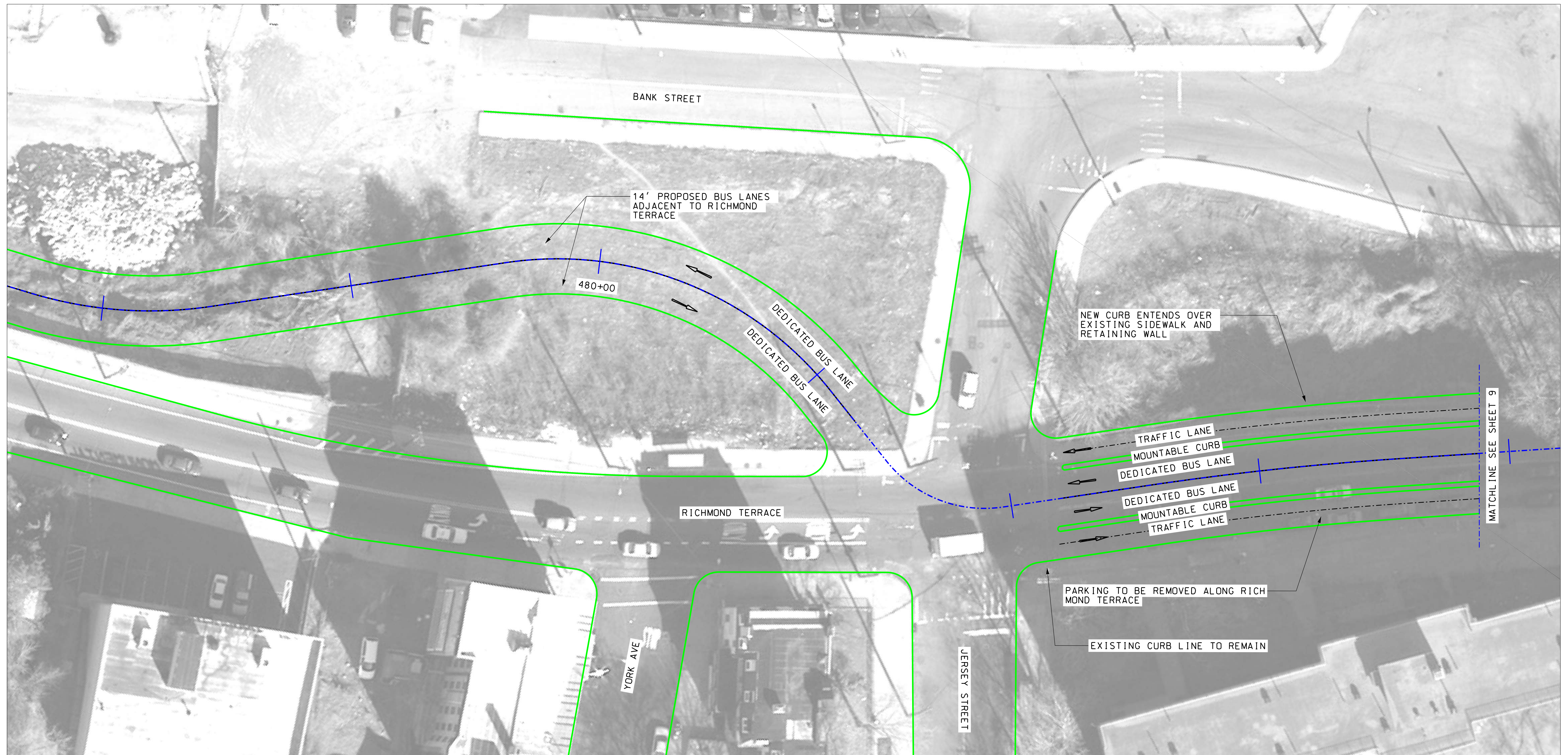
APPROXIMATE NUMBER OF PARKING SPACES TO BE REMOVED

EAST BOUND		
FROM MATCHLINE TO WESTERVELT STREET	15	
FROM WESTERVELT STREET TO MATCHLINE	7	

ALTERNATE #6

SHEET 9





LANE WIDTHS ON RICHMOND TERRACE

TRAFFIC LANE	11 FT
MOUNTABLE CURB	2 FT
DEDICATED BUS LANE	11 FT

APPROXIMATE NUMBER OF PARKING SPACES TO BE REMOVED

EAST BOUND  
FROM JERSEY STREET TO MATCHLINE 9

9

ALTERNATE #6

SHEET 10





## Appendix B

### Preliminary Travel Time Data

**Comparison of Travel Time Estimates by Alternative (between Franklin St. & Bus Terminal)**

Alternative	Direction	Travel Time (seconds)				Travel Time (minutes)				Travel Time Delta to 2012 AA BRT Alternative (minutes)			
		AM	MD	PM	SAT	AM	MD	PM	SAT	AM	MD	PM	SAT
No Bus Lane (existing conditions)	WB	370.8	284.4	450.2	324.5	6.2	4.7	7.5	5.4	3.4	1.9	4.7	2.6
	EB	426.4	386.9	411.0	361.6	7.1	6.4	6.8	6.0	4.1	3.4	3.8	3.0
Alt. 1: "Low" Alternative adjacent to Bank St	WB	167.8	167.8	167.8	167.8	2.8	2.8	2.8	2.8	0.0	0.0	0.0	0.0
	EB	182.8	182.8	182.8	182.8	3.0	3.0	3.0	3.0	0.0	0.0	0.0	0.0
Alt 5: Dual Bus Lanes on Richmond Terrace to Nicholas St (Systra Alt)	WB	234.5	214.3	235.3	210.7	3.9	3.6	3.9	3.5	1.1	0.8	1.1	0.7
	EB	334.4	315.0	329.4	309.3	5.6	5.3	5.5	5.2	2.5	2.2	2.4	2.1
Alt 6: Dual Bus Lanes on Richmond Terrace to Jersey St & Reconfigured St George Terminal Ramp (VHB Alt)	WB	287.2	216.2	380.2	227.2	4.8	3.6	6.3	3.8	2.0	0.8	3.5	1.0
	EB	262.7	243.0	257.6	215.1	4.4	4.1	4.3	3.6	1.3	1.0	1.2	0.5

Notes:

1. On the busway, free flow operations are assumed to be 35 mph
2. Within bus lanes on Richmond Terrace, free flow bus operations are assumed to be 30 mph
3. In general purpose lanes on Richmond Terrace, free flow bus operations are assumed to be 25 mph
4. For each signalized intersection on Richmond Terrace, a 5 second TSP credit was taken for each of the build alternatives
5. For the reversible bus lane alternative, it is assumed to run into the St. George Terminal except for during the PM period
6. Please note that all travel times are approximate and are provided for comparison purposes only
7. Travel times were estimated assuming existing delays along Richmond Terrace apply. Under BRT alternatives, a 5 second TSP credit is taken at each intersection.





## Appendix C

### High Level Service Planning (Option 1/1a)

Without Wheel Layover

	Bay A	Bay B	Bay C	Bay D	Bay E	Bay F	Bay G
Bus 1 Arrive	6:43	6:54	6:56	6:57	6:58	Free	Free
Bus 1 Depart	7:00	7:04	7:06	7:07	7:08	Free	Free
Bus 2 Arrive	7:09	7:11	7:12	7:12	7:13	Free	Free
Bus 2 Depart	7:19	7:21	7:22	7:23	7:24	Free	Free
Bus 3 Arrive	7:24	7:26	7:27	7:28	Free	Free	Free
Bus 3 Depart	7:38	7:38	7:40	7:41	Free	Free	Free
Average Time	7.00	6.00	5.50	5.00	5.00		

\*Average Time represents the average time between the departing bus and the arrival of the subsequent bus at the same bus bay.

With Wheel Layover

	Bay A	Bay B	Bay C	Bay D	Bay E	Bay F	Bay G
Bus 1 Arrive	6:43	6:55	6:56	6:57	6:58	Free	Free
Bus 1 Depart	6:45	7:00	6:58	6:59	7:00	Free	Free
Bus 2 Arrive	6:54	7:08	7:09	7:10	7:13	Free	Free
Bus 2 Depart	6:56	7:10	7:11	7:12	7:15	Free	Free
Bus 3 Arrive	7:06	7:11	7:12	7:13	7:25	Free	Free
Bus 3 Depart	7:08	7:13	7:14	7:15	7:27	Free	Free
Bus 4 Arrive	7:09	7:23	7:24	7:25	Free	Free	Free
Bus 4 Depart	7:11	7:25	7:26	7:27	Free	Free	Free
Bus 5 Arrive	7:21	7:26	7:27	7:28	Free	Free	Free
Bus 5 Depart	7:23	7:28	7:29	7:30	Free	Free	Free
Bus 6 Arrive	7:24	7:38	7:39	7:40	Free	Free	Free
Bus 6 Depart	7:26	7:40	7:41	7:42	Free	Free	Free
Bus 7 Arrive	7:36	Free	Free	Free	Free	Free	Free
Bus 7 Depart	7:38	Free	Free	Free	Free	Free	Free
Average Time	6.83	6.00	6.60	6.60	5.00		

\*Each color indicates one unique bus





STATEN ISLAND NORTH SHORE BUS RAPID TRANSIT

Detail No Wheel Layover							Number of Buses	Status
Time	A	B	C	D	E	F		
6:43	1	0	0	0	0	0	0	1 Not Full
6:44	1	0	0	0	0	0	0	1 Not Full
6:45	1	0	0	0	0	0	0	1 Not Full
6:46	1	0	0	0	0	0	0	1 Not Full
6:47	1	0	0	0	0	0	0	1 Not Full
6:48	1	0	0	0	0	0	0	1 Not Full
6:49	1	0	0	0	0	0	0	1 Not Full
6:50	1	0	0	0	0	0	0	1 Not Full
6:51	1	0	0	0	0	0	0	1 Not Full
6:52	1	0	0	0	0	0	0	1 Not Full
6:53	1	0	0	0	0	0	0	1 Not Full
6:54	1	2	0	0	0	0	0	2 Not Full
6:55	1	2	0	0	0	0	0	2 Not Full
6:56	1	2	3	0	0	0	0	3 Not Full
6:57	1	2	3	4	0	0	0	4 Not Full
6:58	1	2	3	4	5	0	0	5 Not Full
6:59	1	2	3	4	5	0	0	5 Not Full
7:00	0	2	3	4	5	0	0	4 Not Full
7:01	0	2	3	4	5	0	0	4 Not Full
7:02	0	2	3	4	5	0	0	4 Not Full
7:03	0	2	3	4	5	0	0	4 Not Full
7:04	0	0	3	4	5	0	0	3 Not Full
7:05	0	0	3	4	5	0	0	3 Not Full
7:06	0	0	0	4	5	0	0	2 Not Full
7:07	0	0	0	0	5	0	0	1 Not Full
7:08	0	0	0	0	0	0	0	0 Not Full
7:09	6	0	0	0	0	0	0	1 Not Full
7:10	6	0	0	0	0	0	0	1 Not Full
7:11	6	7	0	0	0	0	0	2 Not Full
7:12	6	7	8	9	0	0	0	4 Not Full
7:13	6	7	8	9	10	0	0	5 Not Full
7:14	6	7	8	9	10	0	0	5 Not Full
7:15	6	7	8	9	10	0	0	5 Not Full
7:16	6	7	8	9	10	0	0	5 Not Full
7:17	6	7	8	9	10	0	0	5 Not Full
7:18	6	7	8	9	10	0	0	5 Not Full
7:19	0	7	8	9	10	0	0	4 Not Full
7:20	0	7	8	9	10	0	0	4 Not Full
7:21	0	0	8	9	10	0	0	3 Not Full
7:22	0	0	0	9	10	0	0	2 Not Full
7:23	0	0	0	0	10	0	0	1 Not Full
7:24	11	0	0	0	0	0	0	1 Not Full
7:25	11	0	0	0	0	0	0	1 Not Full
7:26	11	12	0	0	0	0	0	2 Not Full
7:27	11	12	13	0	0	0	0	3 Not Full
7:28	11	12	13	14	0	0	0	4 Not Full
7:29	11	12	13	14	0	0	0	4 Not Full
7:30	11	12	13	14	0	0	0	4 Not Full
7:31	11	12	13	14	0	0	0	4 Not Full
7:32	11	12	13	14	0	0	0	4 Not Full
7:33	11	12	13	14	0	0	0	4 Not Full
7:34	11	12	13	14	0	0	0	4 Not Full
7:35	11	12	13	14	0	0	0	4 Not Full
7:36	11	12	13	14	0	0	0	4 Not Full
7:37	11	12	13	14	0	0	0	4 Not Full
7:38	0	12	13	14	0	0	0	3 Not Full
7:39	0	0	13	14	0	0	0	2 Not Full
7:40	0	0	0	14	0	0	0	1 Not Full
7:41	0	0	0	0	0	0	0	0 Not Full





STATEN ISLAND NORTH SHORE BUS RAPID TRANSIT

Detail Wheel Layover

Time	A	B	C	D	E	F	Number of Buses	Status
6:43	1	0	0	0	0	0	0	1 Not Full
6:44	1	0	0	0	0	0	0	1 Not Full
6:45	0	0	0	0	0	0	0	0 Not Full
6:46	0	0	0	0	0	0	0	0 Not Full
6:47	0	0	0	0	0	0	0	0 Not Full
6:48	0	0	0	0	0	0	0	0 Not Full
6:49	0	0	0	0	0	0	0	0 Not Full
6:50	0	0	0	0	0	0	0	0 Not Full
6:51	0	0	0	0	0	0	0	0 Not Full
6:52	0	0	0	0	0	0	0	0 Not Full
6:53	0	0	0	0	0	0	0	0 Not Full
6:54	2	0	0	0	0	0	0	1 Not Full
6:55	2	1	0	0	0	0	0	2 Not Full
6:56	0	1	3	0	0	0	0	2 Not Full
6:57	0	1	3	4	0	0	0	3 Not Full
6:58	0	1	0	4	5	0	0	3 Not Full
6:59	0	1	0	0	5	0	0	2 Not Full
7:00	0	0	0	0	0	0	0	0 Not Full
7:01	0	0	0	0	0	0	0	0 Not Full
7:02	0	0	0	0	0	0	0	0 Not Full
7:03	0	0	0	0	0	0	0	0 Not Full
7:04	0	0	0	0	0	0	0	0 Not Full
7:05	0	0	0	0	0	0	0	0 Not Full
7:06	2	0	0	0	0	0	0	1 Not Full
7:07	2	0	0	0	0	0	0	1 Not Full
7:08	0	3	0	0	0	0	0	1 Not Full
7:09	6	3	4	0	0	0	0	3 Not Full
7:10	6	0	4	5	0	0	0	3 Not Full
7:11	0	7	0	5	0	0	0	2 Not Full
7:12	0	7	8	0	0	0	0	2 Not Full
7:13	0	0	8	9	10	0	0	3 Not Full
7:14	0	0	0	9	10	0	0	2 Not Full
7:15	0	0	0	0	0	0	0	0 Not Full
7:16	0	0	0	0	0	0	0	0 Not Full
7:17	0	0	0	0	0	0	0	0 Not Full
7:18	0	0	0	0	0	0	0	0 Not Full
7:19	0	0	0	0	0	0	0	0 Not Full
7:20	0	0	0	0	0	0	0	0 Not Full
7:21	6	0	0	0	0	0	0	1 Not Full
7:22	6	0	0	0	0	0	0	1 Not Full
7:23	0	7	0	0	0	0	0	1 Not Full
7:24	11	7	8	0	0	0	0	3 Not Full
7:25	11	0	8	9	10	0	0	4 Not Full
7:26	0	12	0	9	10	0	0	3 Not Full
7:27	0	12	13	0	0	0	0	2 Not Full





# STATEN ISLAND NORTH SHORE BUS RAPID TRANSIT

7:28	0	0	13	14	0	0	2 Not Full
7:29	0	0	0	14	0	0	1 Not Full
7:30	0	0	0	0	0	0	0 Not Full
7:31	0	0	0	0	0	0	0 Not Full
7:32	0	0	0	0	0	0	0 Not Full
7:33	0	0	0	0	0	0	0 Not Full
7:34	0	0	0	0	0	0	0 Not Full
7:35	0	0	0	0	0	0	0 Not Full
7:36	11	0	0	0	0	0	1 Not Full
7:37	11	0	0	0	0	0	1 Not Full
7:38	0	12	0	0	0	0	1 Not Full
7:39	0	12	13	0	0	0	2 Not Full
7:40	0	0	13	14	0	0	2 Not Full
7:41	0	0	0	14	0	0	1 Not Full





## Appendix D

### Estimated Ridership



## MEMO

**TO:** Lisa DiTaranti  
**FROM:** Bill Woodford.  
**CC:**  
**DATE:** November 14, 2018  
**SUBJECT:** **DRAFT** Staten Island North Shore Project – Initial Ridership Results for New BRT Options Using NSAA-like Methodology.

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This memorandum documents the process used to prepare ridership forecasts for new BRT options that have emerged since the completion of the Staten Island North Shore Alternatives Analysis (NSAA).

These latest forecasts were developed using a version of MTA's Regional Transit Forecasting Model (RTFM) that is similar to the version of the RTFM that was used for the NSAA. In particular:

- The input data to the latest model runs is identical to those used during the NSAA. These data include socioeconomic assumptions, tables of total trip-making, highway levels-of-service, and transit operating plans. In each case, input data from the NSAA archives were used without modification in the current analysis.
- The version of the RTFM that was used for the current analysis is similar to but not identical to that used during the NSAA. Adjustments to the RTFM were required since the version of the underlying transportation planning software used the NSAA (TransCAD v4.5) is no longer operational due to changes in software licenses. As a consequence, the RTFM had to be updated to a version that would operate with our current license--TransCAD v4.8. This later version introduces several different parameters and procedures that result in similar but not identical results when compared to forecasts from the NSAA.

Fortunately, results are sufficiently similar between Version 4.5 and Version 4.8 to support a meaningful comparison of old and new alternatives at a BRT-wide level-of-detail. The assignment of trips to individual bus routes shows a higher level of differences due, in part, to the fact that many trips can use one of several different BRT routes and the assignment of these trips to individual routes is somewhat arbitrary for both versions of the model.





## STATEN ISLAND NORTH SHORE BUS RAPID TRANSIT

This memo documents the model results for the initial assessment of model compatibility and forecasts of future year ridership for the original NSAA definition of the BRT and three BRT options.

### Process of Implementing a Staten Island Version of the RTFM in TransCAD v4.8

The following steps were taken to implement the Staten Island NSAA version of the RTFM within a TransCAD v4.8 software environment:

- Begin with the full Staten Island version of the model from the NSAA. This includes:
  - Input data sets and control files
  - TransCAD scripts (compatible with TransCAD v4.5)
  - Supplemental applications (executable programs) used by the RTFM to perform certain key data processing steps
- Update the alternative control file (jf06v19newparmv2030e2\_test.rsc) to refer to current drive letters and directory locations.
- Update TrnSkims4.rsc to the TransCAD Version 4.8 version of the package but reset as many of the parameters as possible to be compatible with the Version 4.5 Staten Island settings. These changes include:
  - Valueoftimetrn reset from 0.22 (original version 4.8) to 0.10 (SI version 4.8)
  - Valueoftimecr reset from 0.18 (original version 4.8) to 0.13 (SI version 4.8)
  - Walkweightcr reset from 1.5 (original version 4.8) to 1.1 (SI version 4.8)
  - Inter-Mode XferCost reset from "None" (original version 4.8) to "mode\_xf\_vw+COST (SI version 4.8)
  - Global XferWeight reset from 1.0 (original version 4.8) to 1.1 (SI version 4.8)
- Update TrnAssns4.rsc (transit assignment module) to the TransCAD Version 4.8 version of TrnAssns4.rsc. No other changes were performed since all parameters are set in TrnSkims4.rsc.
- Update Assnmerg.exe (transit assignment data merge program) to a program file that is compatible with TransCAD Version 4.8.
- Confirm that the recalibrated mode choice control files from the original Staten Island model (December 2010 version) are used instead of the standard Version 4.8 control files (i.e., those used for non-Staten Island applications).





**Comparability of Version 4.5 and Version 4.8 Results**

RSG ran the 4.8 version of the Staten Island RTFM for the NSAA version of the BRT alternative definition and compared the results of the current model run to previously published values. The results of this comparison are presented in this section.

The first and most basic test is a comparison of modeled and published weekday person trips (trips made by automobile and transit) by geographic area. This comparison appears in Table 1 and shows that the current model and published results agree exactly for total person trips to/from/within Staten Island and Manhattan.

**Table 1. Comparison of Current Modeled and Published NSAA Year 2035 Weekday All-Mode Person Trips by Region**

VERSION	NSAA CORRIDOR	REST OF STATEN ISLAND	MANHATTAN
<b>CURRENT MODEL RUN (V4.8)</b>			
NSAA Corridor	165,129	122,370	45,177
Rest of Staten Island	173,284	441,010	112,038
Manhattan	3,719	4,277	2,889,867
<b>PUBLISHED NSAA (V4.5)</b>			
NSAA Corridor	165,129	122,370	45,177
Rest of Staten Island	173,284	441,010	112,038
Manhattan	3,719	4,277	2,889,867

The second test is a comparison of modeled and published weekday linked transit trips by geographic area. This comparison appears in Table 2 and shows that estimated overall transit ridership to and within Staten Island are very similar between the current model implementation and the original NSAA version. However, Staten Island-to-Manhattan has higher estimated ridership and Intra-Manhattan travel has lower ridership with the current model implementation than what is reported in the NSAA.

The fact that there are slight differences between the current model implementation and the published results suggests that there are small inconsistencies between transit paths and/or mode choice parameters which are generating differences in ridership forecasts between the present implementation and the NSAA version of the model. Nevertheless,





these variations are relatively small and should not present an obstacle to estimating the impact that revised transit alternatives would have on ridership results

**Table 2. Comparison of Current Modeled and Published NSAA Year 2035 Weekday Transit Trips by Region**

VERSION	NSAA CORRIDOR	REST OF STATEN ISLAN	MANHATTAN
<b>CURRENT MODEL RUN (V4.8)</b>			
NSAA Corridor	11,439	6,083	34,100
Rest of Staten Island	14,811	11,596	78,640
Manhattan	3,519	2,279	1,291,686
<b>PUBLISHED NSAA (V4.5)</b>			
NSAA Corridor	11,265	6,041	33,211
Rest of Staten Island	14,865	11,247	74,015
Manhattan	3,515	2,280	1,296,917

The current model's estimates of total BRT ridership (for all six routes operating on the BRT facility considered together) are quite similar to the NSAA results (13,499 BRT segment trips with the current model versus 13,061 trips in the NSAA, a difference of less than 4 percent). This outcome is shown in Table 3 in the right-most pair of columns.

At the same time, this table also shows that the current model has notable differences in assignment of individual trips on a route-by-route basis and for each direction-of-travel. This difference is a reflection of the fact that since several BRT routes can serve the same station-to-station pairs, the assignment of trips to any particular route can be somewhat arbitrary. As long as comparability of overall BRT ridership between old and new processes is sufficient, model results should be presented from the new forecast model. These results are most consistent with the current understanding of the markets for BRT service in the area.





**Table 3. Comparison of Route-Level Year 2035 AM Peak Ridership Estimates for the Current Model and Results in the NSAA Report**

ROUTE	ALL ROUTE TRIPS (BRT AND LOCAL BUS) INBOUND		ALL ROUTE TRIPS (BRT AND LOCAL BUS) OUTBOUND		ALL ROUTE TRIPS (BRT AND LOCAL BUS) BOTH DIRECTIONS		BRT RIDERSHIP	
	NSAA Report	Current Model	NSAA Report	Current Model	NSAA Report	Current Model	NSAA Report	Current Model
S1	2,250	1,742	857	1,080	3,107	2,823	3,009	2,754
S2	1,627	1,409	1,714	2,020	3,341	3,429	3,341	3,429
S53	6,482	4,315	4,198	3,510	10,680	7,824	1,082 <sup>1</sup>	1,501
S54	657	330	1,027	360	1,684	690	1,186	358
S57	2,334	2,274	2,285	2,943	4,619	5,217	2,670	3,426
S59	2,083	2,273	688	1,059	2,771	3,332	1,773	2,031
Total	15,433	12,343	10,769	10,972	26,202	23,315	13,061	13,499

**BRT Alternative Definition**

Four optional BRT runs were created to estimate the ridership impacts of changes to the alternative definition. These alternatives are defined by adjusting the BRT alternative from the NSAA to add extra time to eastbound station-to-station times arriving at St. George and to westbound station-to-station times departing from St. George. These times and the resulting adjusted links are shown in Table 4.

<sup>1</sup> Note: Route 53 was reported in the NSAA as 135 BRT Segment Trips in the AM Peak. A review of the procedures used to estimate BRT segment ridership results from the NSAA phase (i.e., V4.5 version of the model) suggests that 1,082 riders is a more accurate estimate of this quantity. All results in this report have been updated to reflect this revision.





**Table 4. BRT Alternatives Definition (Times and Adjustments in Minutes)**

Statistic	NSAA Version of BRT	Sensi- tivity Test	Option "5" Low/ High Hybrid	Option "6" High
Westbound Additional Time for Trips leaving St. George	0	1.0	1.1	3.5
WB S1 St George-Port Richmond	7.6	8.6	8.7	11.1
WB S2 St George-New Brighton	3.0	4.0	4.1	6.5
WB S54 St George-New Brighton	3.0	4.0	4.1	6.5
WB S57 St George-New Brighton	3.0	4.0	4.1	6.5
WB S59 St George-Albion Place (last local stop before BRT)	13.13*	14.13	14.23	16.63
Eastbound Additional Time for Trips arriving at St. George	0	1.0	2.5	1.3
EB S1 Port Richmond-St George	7.6	8.6	10.1	8.9
EB S2 New Brighton-St George	3.0	4.0	5.5	4.3
EB S54 New Brighton-St George	2.1**	3.1	4.6	3.4
EB S57 New Brighton-St George	3.0	4.0	5.5	4.3
EB S59 Post Ave.-St George- (last local stop before BRT)	13.19*	14.19	15.69	14.49

\*Estimated by the RTFM using time procedures for local bus.

\*\*Documentation suggests that this time should have been 3.0 minutes. Current model runs preserved this small error for consistency with earlier results





### **BRT Alternative Ridership Results**

This section presents results from the Version 4.8 model for the NSAA version of the BRT Alternative and each BRT variant from that original operating plan. Table 5 presents the results of this analysis. To create results from Version 4.8 that are compatible with results from the NSAA (Version 4.5), these ridership estimates have been adjusted from raw model outputs as follows:

1. The Version 4.8 model was run for the BRT definition from the NSAA and each new BRT operating plan
2. Results from step 1 were used to compute overall percentage changes in ridership for BRT segment riders for each alternative in comparison to the NSAA version of the BRT.
3. These percentage changes are applied to the NSAA results to forecast ridership statistics for each alternative. All results from the NSAA for a given alternative are adjusted by the same percentage change to preserve consistency of the reported results within a given alternative.

As Table 5 shows, ridership for the test scenario (1 minute additional time to or from St. George) is approximately 7 percent lower than the ridership estimated for the NSAA version of the BRT. Option 5 attracts 10 percent fewer riders and Option 6 attracts 16 percent fewer riders. These outcomes are all consistent with initial estimates of ridership impacts prepared by VHB.





**STATEN ISLAND NORTH SHORE BUS RAPID TRANSIT**

**Table 5. Year 2035 AM Peak BRT Segment Ridership by Alternative**

<b>ROUTE</b>	<b>NSAA BRT DEFINITION</b>	<b>SENSITIVITY TEST (EXTRA 1 MIN.)</b>	<b>OPTION 5 (LOW/HIGH HYBRID)</b>	<b>OPTION 6 (HIGH)</b>
S1	3,009	2,784	2,703	2,537
S2	3,341	3,091	3,001	2,817
S53	1,082	1,001	972	912
S54	1,186	1,097	1,065	1,000
S57	2,670	2,470	2,398	2,251
S59	1,773	1,640	1,593	1,495
<b>Total</b>	<b>13,061</b>	<b>12,083</b>	<b>11,732</b>	<b>11,012</b>
<b>Change vs. NSAA Alternative Definition</b>	<b>0%</b>	<b>-7%</b>	<b>-10%</b>	<b>-16%</b>

Note: Ridership forecasts are from the Version 4.8 model with post-model adjustments for consistency with NSAA results prepared with the Version 4.5 model.





## Appendix E

### Estimated Conceptual Cost Summary

<b>MAIN WORKSHEET - BUILD ALTERNATIVE</b>					
NYCT - MTA				Today's Date	<b>11/21/18</b>
Staten Island North Shore Alternatives Analysis				Yr of Base Year \$	2012
Summary of Alternatives - Jersey Street to St George				Yr of Revenue Ops	2020
	North Shore AA BRT Alternative (West Shore Plaza to St. George)	Alternative 1 Low/Low (2018)	Alternative 5 High/ Low (2018)	Alternative 6 High/High (2018)	
10 GUIDEWAY & TRACK ELEMENTS (route miles)	\$ 48,687,900	\$ 18,097,056	\$ 23,096,495	\$ 27,973,158	
20 STATIONS, STOPS, TERMINALS, INTERMODAL (number)	\$ 31,775,081	\$ 6,500,000	\$ -	\$ -	
30 SUPPORT FACILITIES: YARDS, SHOPS, ADMIN. BLDGS	\$ 1,300,000	\$ -	\$ -	\$ -	
40 SITEWORK & SPECIAL CONDITIONS	\$ 106,921,843	\$ 228,265,093	\$ 91,190,087	\$ 146,874,578	
50 SYSTEMS	\$ 10,054,800	\$ 702,800	\$ 742,000	\$ 742,000	
<b>Construction Subtotal (10 - 50)</b>	<b>\$ 198,739,624</b>	<b>\$ 253,564,949</b>	<b>\$ 115,028,582</b>	<b>\$ 175,589,736</b>	
60 ROW, LAND, EXISTING IMPROVEMENTS	\$ 21,770,000	\$ 4,200,000	\$ 4,200,000	\$ 4,200,000	
70 VEHICLES (number)	\$ 30,861,600	\$ -	\$ -	\$ -	
80 PROFESSIONAL SERVICES (applies to Cats. 10-50)	\$ 57,699,500	\$ 71,433,948	\$ 32,815,759	\$ 49,849,386	
<b>Subtotal (10 - 80)</b>	<b>\$ 309,070,724</b>	<b>\$ 329,198,898</b>	<b>\$ 152,044,342</b>	<b>\$ 229,639,122</b>	
90 UNALLOCATED CONTINGENCY	\$ 30,907,072	\$ 82,299,724	\$ 38,011,085	\$ 57,409,780	
<b>Subtotal (10 - 90)</b>	<b>\$ 339,977,796</b>	<b>\$ 411,498,622</b>	<b>\$ 190,055,427</b>	<b>\$ 287,048,902</b>	
100 FINANCE CHARGES	\$ 4,719,747	\$ 4,492,087	\$ 2,106,581	\$ 3,158,774	
<b>Total Project Cost (10 - 100)</b>	<b>\$ 344,697,543</b>	<b>\$ 415,990,709</b>	<b>\$ 192,162,008</b>	<b>\$ 290,207,677</b>	
<b>BASE WITH DEDUCTIONS (2012)</b>	<b>\$344,697,543</b>	<b>Alternate 1</b>	<b>Alternate 5</b>	<b>Alternate 6</b>	
<b>ALTERNATES WITHOUT BASE (2012)</b>		<b>\$ 375,223,619</b>	<b>\$173,330,131</b>	<b>\$ 261,767,325</b>	
<b>ALTERNATES WITH BASE (2012)</b>		<b>\$ 719,921,162</b>	<b>\$518,027,674</b>	<b>\$ 606,464,868</b>	