Invitation for Bids Number: 16-16
Addendum 2
Date: March 22, 2016

Acknowledgment of Addenda

The undersigned acknowledges receipt of the following addenda to the bidding document:

THE COMPLETED ACKNOWLEDGEMENT OF ADDENDA FORM SHOULD BE RETURNED WITH BID RESPONSE PACKAGE: NOT SENT TO RIPTA SEPARATELY

NOTE: Failure to acknowledge receipt of all addenda may cause the bid to be considered non-responsive to the solicitation. Acknowledged receipt of each addendum must be clearly established and included with the bid.

_____
Name of Bidder

_____
Street Address

_____
City, State, Zip

_____
Signature of Authorized Official

_____
Date

Invitation for Bids Number: 16-16
Addendum 2
Date: March 22, 2016

Attached please find the minutes of the Pre-Proposal Meeting held March 18, 2016

The meeting came to order at 10:02 a.m. Michael J. M^c^Grane, RIPTA Contracts Manager welcomed all those present. Mr. McGrane introduced RIPTA Personnel present. Mr. M^c^Grane gave a brief background of the specifications for the Proposal Package and the purpose of this meeting. Mr. McGrane asked those present to identify themselves when asking questions.

Michael M^c^Grane cautioned prospective bidders to be diligent when completing the required forms, to pay attention to the details such as the required number of copies needed. Vendors need only to submit the required forms listed in the Proposal Package on page 40. Vendors having difficulty completing the required forms are encouraged to contact the Michael McGrane for guidance.
He also cautioned bidders not to procrastinate when filling out the paperwork. RIPTA Staff have busy schedules, therefore may not always be available for last minute questions
Michael M^c^Grane also reminded those present to pay particular attention to the Insurance Requirements listed on Page 62 and 63 of the Proposal Package. They are not the same requirements utilized by other State Agencies.

The Disadvantaged Business Enterprise Goal for this project is Twenty Percent. The Authority takes DBE Goals seriously. Proposers must meet the goal or demonstrate a Good Faith Effort on their attempts to meet the goal. The Good Faith Effort will be reviewed by RIPTA's Compliance Officer, who shall determine the validity of the Good Faith Effort. If he feels the Good Faith Effort is not adequately documented, the proposal will be deemed non-responsive

Proposers must submit one original and six copies of their proposals.

Michael M^c^Grane informed the Attendees that an Addenda will be issued shortly with the Minutes of this Meeting and responses to any questions submitted prior to the Meeting. **It should be noted that the written responses to questions will supercede any verbal comments made at the meeting in the event of a discrepancy between the two.**

Michael Vendetti, Project Manager gave a brief synopsis of the project.

A. The scope of work will include complete architectural and engineering/design services and preparation of contract documents for the proposed East Side Tunnel Improvements.
B. Preparation of a preliminary construction timeline,

C. Preparation of a refined construction budget including potential contingencies, and a one-year review after the completion date of construction.
D. Specific design services may include the following design disciplines: architectural; civil; structural; mechanical; electrical; industrial; traffic; geotechnical; quality assurance/quality control; and tunnel specific issues.
E. Selected consultant shall make recommendations on various improvement schemes and order of magnitude construction cost estimates.
F. It is anticipated that the design services contract shall provide RIPTA's framework for project implementation. In addition to RIPTA, the selected consultant will be required to work closely with other state agencies and local approval agencies.
G. Work with the Stakeholders in the area.
H. The Goal of this project is to provide an independent analysis of the condition of the Tunnel

Pare Engineering submitted the following questions

- On Page 40 under VII. REQUIRED PROPOSAL SUBMISSIONS, does the second line: Must be completed by Prime and All Subcontractors, refer to the form listed above that (i.e. the Required Company Information Form) or the forms listed below? If the former, please verify that subconsultants need only provide the Required Company Information Form, the Certification of a Subcontractor Form on page 71, and Attachment C, Letter of Intent to Perform as a Subcontractor (if they are a DBE/MBE/WBE).
  The Required Company Information Form must be completed by the Prime and All subcontractors.
  The Certification of a Subcontractor Form must be completed by all Subcontractors,
  Attachment C letter of Intent to Perform as a Subcontractor must be completed by all DBE/WBE Subcontrators
- The General Guidelines state "Proposal must be submitted pre-punched for standard three-ring binders." Does this mean you want the original and all six copies to be punched but unbound? Or do you actually want them in binders? Or do you want just the original punched and unbound?
  The Original and all six copies must be punched, they need not be in a binder, but they must be secured in such a way to keep the pages together
- On page 5, B.4., it says "the corporate seal shall be affixed to the contract." There is no contract being submitted. Should this refer to the "Offer Form" on page 42 or one of the other forms? Or maybe to our cover letter?
  This refers to the Offer Form

- Please clarify what you mean by "RFPs must be limited to 25 pages, double sided." Does this mean 25 sheets of paper totaling 50 pages of information? Or 13 sheets of paper containing 25 pages of information?
  RFP Responses must be limited to a total of 25 pages of text.
  Are there certain items that can be excluded from the page limitation, such as required forms, professional licenses, résumés?
  The 25 page limit does not include the following
  Copies of relevant professional licenses
  Resumes
  The Required Forms
  Reference Information
- On Page 78 under XXXIV. SCOPE OF SERVICES, Part D. Specific design services may include the following design disciplines: architectural; civil; ……. In that statement you have included mechanical and industrial, do you have a sample of what might be included as part of those disciplines?
  Due to the nature of this project; there may be unforeseen issues that require these disciplines, therefore Proposers should have them available if needed.

- Does RIPTA envision the need for Construction Phase Services as part of this Project?
  Proposers should be able to provide these services as requested by the Authority.

The meeting was opened to questions from the various participants:

Mr. James Caroselli of CD Maguire Group raised the following questions:

- Can the deadline for submission of question be extended to allow submission of questions after the Tunnel Tour.
  The Deadline for submission of questions will be extended until 1:00 pm on March 22, 2015
- Is Air Quality Analysis part of this project?
  No.
- Is this part of the New Proposed Transit Connector Project?
  No
- Are plans for the Tunnel Available?
  Not to the best of our knowledge
- Is there a budget for this project?
  The Budget for this project has not been finalized
- What is the Tunnel Constructed of?

The Authority does not possess any accurate information.

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Mr. Peter Wu of CD Maguire Group raised the following question:

- Will this project have an effect on the Adjacent Buildings?
  Due to the nature of the Tunnel, there will be some impact on the Adjacent Buildings.

Mr. Edward Parker of A&I Engineering raised the following question

- When was the last time the Tunnel was inspected?
  RIPTA had a needs assessment of the Tunnel conducted recently. This is not considered a thorough Inspection of the Tunnel. It should be noted that this project consists of Architectural and Engineer Services for the Tunnel. These services should be performed independent of the Needs Assessment.

- Will this Needs Assessment be made available?
  It will be made available as part of the Addenda. It will be for informational purpose only. This project should be conducted independent of the Needs Assessment.

Sandra Cleary of McMahon Associates raised the following questions

- Will this sign-in sheet be made available?
  It will be included in the Addenda
- Will the public be involved in this process
  There will be some public input with this project, primarily with the Bus Stops
- Are the Bus Stops and Shelters located at both ends of the Tunnel Included?
  Yes, be advised there is no structural analysis available for the Shelters
- Will the Proposer be required to develop a Transit Operations plan for the Tunnel as part of the Project?
  The Authority has detour plans available which will be provided as the need arises.

Mr. Kevin Hanley of Surveying and Mapping Construction raised the following question:

- Will this project involve night work?
  This project may involve off hour work to insure that the Tunnel is kept in service.
  There being no further business, the meeting adjourned at 11:45 a.m.

Samson Liao of Parsons Brickenhoff submitted the following questions

- Given the amount of information that we learned about the project and our desire to provide a truly comprehensive proposal, we request an extension of your 4/4/2016 deadline to 4/14/2016. Please advise if that will be possible.

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Due to an aggressive Project Schedule, the Authority cannot extend the Proposal Response Deadline.

- The RFP calls for 25 pages, double sided printing. Please clarify if that mean 25 sheets of paper printed on both sides, or 25 pages?
  RFP Responses must be limited to a total of 25 pages of text.

Anna Wallace of Gannet Fleming submitted the following questions

- Please confirm whether or not the resumes will be counted towards the proposal's page limit.
- Please confirm whether or not the required forms will be counted towards the proposal's page limit.
  The 25 page limit does not include the following
  - ***Copies of relevant professional licenses***
  - ***Resumes***
  - ***The Required Forms***
  - ***Reference Information***

Respectfully submitted
Michael J. M^c^Grane
Contracts Manager

Rhode Island Public Transit Authority

705 Elmwood Avenue
Providence, Rhode Island 02907

Pre Bid (Proposal) Meeting Sign-In Sheet

Date: March 18, 2016

or Proposal Number and Name: RFP 16-16: Architectural and Engineering Services: East Side Tunnel

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Michael McGrane	RIPTA		
Michael Vendetti	RIPTA		401-784-9500 x147
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PARE Project No. 15036.00

PRELIMINARY REPORT OF FINDINGS

COLLEGE HILL BUS TUNNEL

PROVIDENCE, RHODE ISLAND

Submitted August 2015

PARE
CORPORATION

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Appendix A – Location Map
Appendix B – "Needs Assessment, Thayer Street & North Main Street" by DHK Architects, Inc.
Appendix C – "Security And Safety Needs Analysis Report" by DVS

1.0 PROJECT DESCRIPTION

Pare Corporation (PARE), in conjunction with DHK Architects (DHK) and DVS Security Consulting and Engineering (DVS), have been tasked with observing conditions in the Rhode Island Public Transit Authority's (RIPTA) College Hill Bus Tunnel (Tunnel) and providing preliminary recommendations for repairs and improvements to the tunnel. The Tunnel, located in Providence, Rhode Island, runs from the west at South Main Street to the east at Thayer Street. The tunnel was originally built in 1914, and the last major maintenance to the tunnel occurred in 1992.

The tunnel investigation focuses on areas outlined by RIPTA including, but not limited to, the passenger boarding areas at the east and west ends of the tunnel, structural integrity of the tunnel, condition of the drainage and pavement in and around the tunnel, bus operations, street car readiness, and security and safety. Interviews with RIPTA personnel were conducted to provide the Team (PARE, DHK, DVS) with information on known areas of concern. Site visits were completed by the Team to gather information and document issues and areas of concern.

The information gathered by the Team is presented in this report along with the recommended repairs and improvements based on this information. Each recommendation is accompanied by a preliminary opinion of the probable engineering and construction costs. Based on these recommendations and costs, RIPTA and the Team can finalize a prioritized repair plan that will best fit RIPTA's areas of concern and budget.

2.0 TUNNEL STRUCTURE

2.1 Description of Tunnel Investigation

Under the supervision of RIPTA, PARE observed visible structural components of the Tunnel on May 12, 2015. Observations began at the South Main Street (west) portal and proceeded east. The work consisted of photographing and measuring areas of concern and hammer sounding potential areas of concern along the walls of the tunnel. The arch and upper portions of the tunnel walls were out of reach during this inspection and could not be measured or sounded. No destructive testing was completed during this inspection.

To supplement the field inspection of the tunnel, research in to the construction of the tunnel was conducted to obtain original plans of the tunnel. RIPTA did not have any plans of the tunnels original construction due to the age of the tunnel which supersedes the establishment of RIPTA. The City of Providence, whose construction records date farther in the past then RIPTA's, was contacted to obtain any plans or other construction information. No plans could be obtained but the city archivist uncovered an article from an engineering publication about the design and construction of the tunnel.

2.2 Tunnel Observations

The west portal consists of an arch with brick façade on the exterior of the entrance. The arch is covered in gunite and the makeup of the underlying structure is unclear. The gunite has map cracking with some efflorescence and signs of leakage throughout. No loose or missing gunite was apparent.

Photo 2.1: Typical Underside of Tunnel Portal (South Main Street End, Northern Portal Shown)

Photo 2.2: Deteriorated Steel Members at Joint between South Main Street Portal and Tunnel

Photo 2.3: Typical Steel Framing in Tunnel

To the inside of the portal there is a flat concrete ceiling supported by a steel frame with vertical concrete walls. This portion of the tunnel extends approximately 95' into the tunnel. The joints at either end of the steel framed portion of the tunnel show significant signs of leakage, cracking with visible efflorescence, and signs of delamination in the concrete ceiling and gunite coated walls. The leakage has caused heavy section loss and delamination in the steel beams supporting the ceiling near the joints and the steel column closest to the portal. The transverse steel beams also show moderate section loss at the beam seats in the north and south walls. The bottom of the steel framing is encased in a cast-in-place concrete median barrier approximately 4'-6" high by 2' wide. There are isolated hairline cracks in

Photo 2.4: Spalled Areas of Gunite on Southern Wall with Exposed Concrete Walls

Photo 2.5: Exposed Concrete with Deteriorated Joints at Spalled Areas of Gunite

Photo 2.6: Leakage and Possible Delamination at Ceiling/North Wall Joint

Photo 2.7: Typical Signs of Leakage and Delamination, Efflorescence and Cracking at Crown of Arch

the concrete, but the concrete is covered in grime and dirt making it difficult to observe some portions of the concrete surfaces.

The northern and southern walls are coated in gunite with areas of delamination and spalling throughout. There are 3 large spalls in the gunite coating on the southern wall approximately 3' wide by 8'-10' high and one smaller spall approximately 18" wide by 3' high surrounded with 6" to 12" of delaminated gunite around the spalled areas. The spalls revealed this portion of the tunnel structure consists of concrete walls covered in ½" to 1" thick gunite. The exposed areas of the concrete walls revealed joints having spalls up to 1" deep throughout and showing signs of leakage, especially toward the bottom of the visible portions of the joint. The gunite beneath the seats of the transverse steel beams showed signs of leakage, cracking, and delamination at the north and south walls.

The concrete ceiling showed signs of leakage and delamination at the joints with the portal and the main arched portion of the tunnel, and at the joints between the ceiling and walls. On the westbound side of the tunnel, the ceiling had spalling with exposed reinforcing steel, and heavier signs of delamination and leakage near the northern ceiling/wall joint in the two eastern most bays affecting areas approximately 18" to 3' from the wall in the one bay, and 12" from the wall and extending up to the full bay width in the bay closest to the arch entrance. The portions of the ceiling away from joints appear to be in good condition.

The main part of the tunnel consists of approximately 9' tall vertical walls up to the springline of the arch which spans the two lanes of traffic. The tunnel structure was not visible because the walls and arch are coated in gunite. The condition of the gunite was overall poor with signs of leakage, areas of delamination covering approximately 25% of the gunite surfaces, efflorescence, and cracking throughout the tunnel walls and arch. The gunite coating on the walls has isolated areas of delamination throughout the tunnel with the worst areas near damaged vertical drain pipes that allow water to leak onto the gunite.

The arch has transverse cracks approximately every 10' along the full length of the tunnel. Active leakage was visible at some locations during the inspection with efflorescence coating most of the cracks. One small spall at the crown of the arch approximately 200 feet into the arch exposed a small portion of the underlying concrete as shown in Photo 2.7. The spall and cracking coincides with a joint in the concrete arch. The concrete joint shows signs of leakage and light spalling. The gunite areas could not be sounded at the time of inspection, so it is not known if there are additional delaminated areas around the cracks or deterioration of the underlying structure. At the crown of the arch there is significant longitudinal cracking and leakage over the entire length of the tunnel. Over long stretches of the tunnel there was further longitudinal cracking near the quarter points of the arch showing signs of leakage with

efflorescence, though this cracking was not as severe as the cracking at the crown. Due to the height of the arch it was not possible to sound these areas.

Photo 2.8: Typical Transverse Cracking in Arch

Photo 2.9: Spall at Crown of Arch with Exposed Concrete Joint

3.0 TUNNEL PAVEMENT AND DRAINAGE

During the May 12, 2015 field meeting, PARE observed the conditions of the pavement and drainage structures. Based on coordination with the City of Providence, no formal records of the tunnel plans or details are available. However, coordination through the City Archivist yielded an article that provided some details of the tunnels fabrication and geometry. Additionally, there is no information available regarding the pavement composition or any right-of-way. As such, it is uncertain where the limits of the facility ownership are or when improvements were made throughout its history. The following summarizes our investigation and assessment of the pavement structure and the drainage system within the tunnel limits as well as our recommendations.

3.1 Pavement, Striping and Signage Investigations

South Main Street End

The College Hill Bus Tunnel is generally comprised of a two-lane roadway with one travel lane in each direction, with the travel lanes separated by a solid double yellow line throughout the tunnel. The section of roadway from South Main Street to the start of the tunnel is comprised of two 12-feet lanes. Traffic loops and signal equipment are present along westbound Tunnel approach to South Main Street.

The segment of roadway immediately within the tunnel provides for two 11-feet wide travel lanes, with no shoulders and a concrete median barrier along the center of the roadway which provides delineation between the ingress and egress lanes. This section of roadway extends approximately 95' into the structure. A narrow concrete sidewalk is formed along the toe of the wall and is further described in the **Sidewalk and Curbing Investigation** section. Improvements for the bus shelter at this opening are discussed further in section 4.0 of this report. The project roadway was first constructed in 1914 through the City of Providence Assembly. The pavement structure appears to consist of 2 to 3 inches of bituminous asphalt over a rigid concrete base. No information is available to indicate the thickness of this existing concrete base nor if it contains steel reinforcement. The pavement immediately inside the tunnel structure is in poor condition, with a number of pavement patches present for pot holes and pavement delamination. There are visible fatigue cracking and rutting along the bus wheel paths, which is

Photo 3.1: Tunnel Opening at the Passenger Boarding Area (South Main Street End)

Photo 3.2: Condition of Roadway along South Main Street Tunnel Opening

exacerbated by the frost heave conditions during the winter seasons. There is also damage to the pavement structure along the areas adjacent to the catch basin grates.

A "DO NOT ENTER" sign is placed on the wall facing buses travelling towards the ingress. Two site specific signs are also present to prohibit public access. The signs provide the following messages: 1. "Private Property Keep Out", 2. "No Thru Traffic". The conditions of these signs are poor. The section of roadway immediately outside the tunnel structure is also striped with a double yellow centerline. There is a stop bar and crosswalk along this roadway as it approaches South Main Street. There are no posted speed limit signs as the tunnel is prohibited for public traffic.

Photo 3.3: Conditions of Pavement at Catch Basin (South Main Street End)

Photo 3.4: Section of Pavement with Delamination (South Main Street End)

Tunnel Structure General Section

Beyond the ingress and egress sections of the tunnel, the typical roadway section consists of two 12-foot travel lanes with no shoulders and is approximately 1,694 feet long. The concrete sidewalk or apron is typically 15-inches wide throughout the main tunnel section. The pavement is in fair to poor condition along this main tunnel section. From historical data, the tunnel profile was constructed at a 4.8% grade, as shown in Figure 3.1.

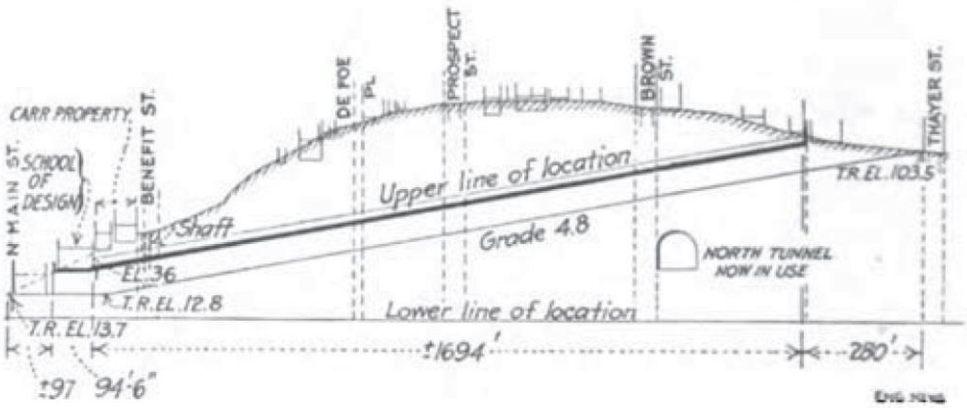


Figure 3.1: Tunnel Profile and Opening Locations

The typical roadway cross slope ranges between 1.5-2.0% and allows for adequate stormwater sheet flow to the side of the road. There are numerous catch basins structures constructed beneath the sidewalk/apron area. Further discussion of these catch basins is provided under the **Drainage and Utilities Investigation** Section. Cold patch pavement material was observed to be present at several locations along the tunnel roadway. However, the severity and frequency of pavement failure is significantly less than those observed along the South Main Street end of the tunnel. Additionally, despite the steep profile grade, there is not a significant amount of rutting or pavement shoving typically experienced from heavy/large vehicles on bituminous pavement.

Photo 3.5: Typical Section of Main Tunnel Section

Photo 3.6: Overhead Lighting and Catch Basin Orientation along Main Tunnel Section

A crash cushion attenuator is located at the start of this main tunnel section shows signs of impact damage. This system has been compromised from the impacts and is not fully functional due to damages to the individual crash module units. RIPTA workers have straightened this crash cushion attenuator and fastened it in its original place outside of the travel lanes.

Thayer Street End

The bus tunnel structure ends approximately 275-ft west of Thayer Street. The roadway cross section width is approximately 27 feet which is similar to the main tunnel section. However, the double yellow centerline is worn and does not provide clear delineation of the east and west bound travel lanes. This segment of the tunnel corridor is comprised of retaining walls, one each along the north and side sides. The concrete sidewalk continues along the road and terminates at concrete pillars located at the end of the retaining walls.

Overall, the pavement is in fair condition with reflective cracking present along the joints of the concrete base. This section of roadway is exposed to snow and rainfall and is the most upgradient section of roadway within the project limits. Outside the areas of reflective joint cracking, there are only minimal amounts of fatigue cracking. Photos 3.7 & 3.8 depicts that this section of the tunnel roadway is exposed to the various weather conditions.

Two "DO NOT ENTER" signs are placed on light poles located on top of the concrete pillars. A RIPTA sign is also present to indicate that the tunnel corridor is a RIPTA designated route.

Photo 3.7: Typical Section of Thayer Street Section

Photo 3.8: Pavement Conditions of Thayer Street Section

3.2 Drainage and Utilities Investigation

Catch basins exist along the gutters of the roadway. A visual inspection was conducted for most of the 26 existing drainage structures. The catch basins along the main tunnel section resemble Type "D" catch basins, which collect storm water gutter flow through inlet openings facing the roadway. These catch basins are situated beneath the sidewalk/apron with access provided along the top of sidewalk apron using a cast-iron grate. These catch basin structures are shallow in nature and have no sumps for collecting sediment or trash. Pipes connect each catch basin structure to the next downgradient structure. Photos 3.9 & 3.10 illustrate the typical conditions of these catch basins. It was discussd with RIPTA that the majority of these existing catch basins were filled with sediment, debris and trash and were recently cleaned and vacuumed. As such, during PARE's site investigation, there were only minimal amounts of trash and debris remaining after cleaning by RIPTA.

Photo 3.9: Type of Existing Catch Basin along Main Section of Tunnel

Photo 3.10: Conditions of Existing Catch Basin Structures

Most of the catch basins present along the tunnel have broken grates. Approximately 25% of these catch basins also have broken or deteriorated rail bars that form the frames. The existing catch basin inlet openings are approximately 3-4" high. The curb reveal along the catch basins are approximately 6" high, but are only 3-4" high along the typical sections as further discussed in the **Sidewalk and Curbing Investigation** section. The pavement also depresses approximately 0.1' at the catch basins in order to provide enough reveal and to, allow gutter flow to enter into the structures. It appears that the existing grates do not serve to collect stormwater due to rainfall since they lie within the tunnel, but serve to connect the sidewalk apron as a walkable surface.

The South Main Street tunnel opening is situated on a sag vertical curve and receives all the by-pass gutter flow from the upgradient areas. As verified by discussions with RIPTA officials, snow present along the openings, combined with uncollected runoff and freezing conditions during the winter seasons, create a frost heave situation. This was observed during the winter months and is shown in Photos 3.11 & 3.12.

Most of the existing pipes connecting each catch basin are either an 8 or 10-inch PVC or clay pipe. A few of the 10-inch clay pipes were half pipes, that formed semi-circular channels. No flooding

Photo 3.11: Frost along gutters of roadway

Photo 3.12: Snow Piles along Sidewalk and Access Wells

was observed as the field investigation was performed under dry conditions. Overall, it appears that the pipes are adequate in size to convey the

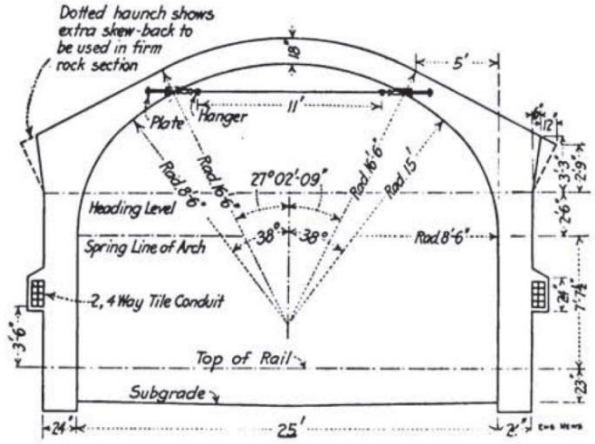


Figure 3.2: Typical Section of Tunnel

Photo 3.13: View of 2 x 4 Tile Conduits

minor drainage area from the 275' section of open roadway between the end of the tunnel and Thayer Street. The remaining length of tunnel roadway is closed off from receiving direct rainfall, and therefore minimal stormwater gutter flow is experienced within the tunnel section.

Downspouts were also observed to exist throughout the entire length of the tunnel structure. Most were broken due to what appears to be impact by buses. In some instances, the downspouts were sheared completely off at the base of the wall. The remaining that exist are held in place by steel rods and collars. These downspout pipes appear to drain groundwater from the soil above the tunnel arch down into the ground below the roadway grade. It is uncertain if these downspouts connect into the existing catch basins. In total, there are 64 of these downspout pipes (32 eastbound, 32 westbound).

Overhead lighting is present throughout the corridor and is powered by electrically. These luminaires are spaced evenly and centered along the top of the tunnel arch directly over the yellow centerline. The lighting can be observed in the previous Photos 3.5 and 3.6. Further details regarding this item is addressed in Section 4.0.

Existing tile conduits are present in both the north and south walls of the tunnels and is shown below in Figure 3.2. Each set of tile conduits is 2' X 4' and contain eight openings that appear to be open-ended access wells adjacent to catch basin, for possibly for future utility access.

3.3 Sidewalk and Curbing Investigation

Sidewalks are present along both sides of roadway within the project limits. These sidewalks are typically 15-inches in width and are cast-in place concrete. Due to the narrow width of the sidewalks, they should more appropriately be referred to as aprons and not utilized as a normal walkway. Further information is addressed in DHK's summary. There is no curbing present, as the reveal between the roadway surface and the sidewalk apron consists of cast-in place concrete. Despite the age of these sidewalk aprons, they appear to be in fair condition with little to no cracking. Some concrete spalling exists where the catch basin frame and grates connect to the sidewalk at the rail bar supports.

This reveal is generally 3-4-inches in height throughout the project site. The typical cross slope of this sidewalk generally ranges from 3-4% toward the roadway. This provides proper conveyance of storm water along the roadway gutter line. The cross slope towards the roadway gutter also allows for any trash or debris to collect along the roadway gutter.

4.0 BUS STOPS ADJACENT TO TUNNEL PORTALS

The following section summarizes DHK Architects "Needs Assessment, Thayer Street & North Main Street." For further details and information of the investigation and recommendations, the full report is provided in Appendix B.

4.1 Description of Bus Stop Investigations

This section contains an overview of the current locations of both bus stops in regards to pedestrian and vehicular traffic and the adjacent streets and the communities they serve. The location of the bus stop within the public transit network is critical for passengers, bus operators, traffic management, and overall performance of the public transit network.

Numerous factors define every bus stop. The site-specific characteristics of a stop provide the opportunity to create an aesthetic that will allow the station to seamlessly intergrade into its surrounding environment and become a fundamental piece of the surrounding community. The surrounding attractions and facilities need to be assessed, in most cases; they define the users and capacity of the station.

4.2 Thayer Street Stop

At the top of the east entrance/exit of the ESTT and contiguous to its intersection with Thayer Street, are located two bus stops – an inbound and an outbound (Photo 4.1 and Figure 4.1). The stops are located in the heart of Thayer Street, an area with heavy pedestrian and vehicular traffic. The stops service Brown University as well as the neighboring commercial area, while providing access to and from the RISD campus and parts west.

Photo 4.1: Entrance to East Transit Tunnel

Photo 4.2: Inbound Bus at Crosswalk

Advantages of the existing stops' locations:

- Designated passenger loading area off of the main street minimizes the traffic interference on Thayer Street.
- The driver going outbound has the advantage of viewing the full intersection activity at Thayer Street.
- Access to and from the surrounding road network is direct and limits the circuitous routing of buses.

Disadvantages of the existing stops' locations:

- Inbound buses are not always able to pull all the way through after turning off of Thayer Street and block the crosswalk (Photo 4.2). This becomes a safety issue for the passengers and pedestrian traffic as they have to walk around the back of the bus and into the intersection to cross the bus-way. This interferes with vehicular traffic on Thayer Street, as cars have to wait on pedestrians to move out of the street.
- A bus stopped near the intersection may block sight lines for pedestrians crossing the intersection.
- Multiple buses queuing during peak hours going inbound block Thayer Street traffic due to inadequate space. This interferes with pedestrian and vehicular traffic as well.
- Due to wide turning radius of the buses, the bus may arrive several feet from the passenger loading area. When this condition happens boarding/alighting occurs in the bus-way.
- Inbound buses have limited visibility of the stop prior to turning into the bus-way.
- Buses need to cut across two lanes merging onto Thayer Street or turning off of Thayer Street due to large turning radius, this interferes with vehicular traffic.
- There is no intersection control at this location. The vehicular traffic on Thayer Street is the primary circulation and takes priority at this intersection. This does not provide for bus priority. This condition increases the dwell time and overall delays bus services.
- No shelter to protect passengers from the weather is provided.
- During the winter the boarding and waiting areas are not maintained, causing passengers to wait in the bus-way instead of on the sidewalk. This is a safety concern.
- Due to the stops having no cover or enclosure, snow accumulates at the boarding/alighting area effecting accessibility.
- Snow accumulation in the bus-way inhibits the buses ability to pull fully to the curbside area, compromising accessibility.

Figure 4.1: Bus Stop Location

4.3 Washington Street at North Main Street Stop

At the west entrance/exit to the ESTT and contiguous to its intersection with North Main Street are two bus stops – an inbound and outbound (Photo 4.3 and Figure 4.2). The stops are located in a prominent vehicular intersection and dense pedestrian area, establishing an area of high activity. The stop services Rhode Island School of Design [RISD] as well as the neighboring residential and commercial areas providing access to parts east, including Brown University.

Photo 4.3: West Entrance to East Transit Tunnel

Advantages of the existing stops' locations:

- Designated bus area off of the main street minimizes the traffic interference on North Main Street.
- The driver has the advantage of viewing the full intersection activity at North Main Street.
- Access to and from the surrounding road network is direct and limits the circuitous routing of buses.
- Traffic lights manage the bus and vehicular traffic.
- A designated bus lane with traffic signals allows for minimal interference with vehicular and pedestrian traffic.
- Some passenger amenities are provided on the outbound stop to improve the passenger environment.

Disadvantages of the existing stops' locations:

- A bus stopped near the intersection may block sight lines for pedestrians crossing the intersection.
- Multiple buses queuing during peak hours going outbound block the crosswalk and intersection.
- Inbound stop does not have an accessible boarding/alighting area
- Inbound stop has no protection against the elements.
- Enclosed shelters are not provided for the winter and colder months.
- Snow accumulation prohibits access to the stops, requiring passengers to walk into the bus-way.

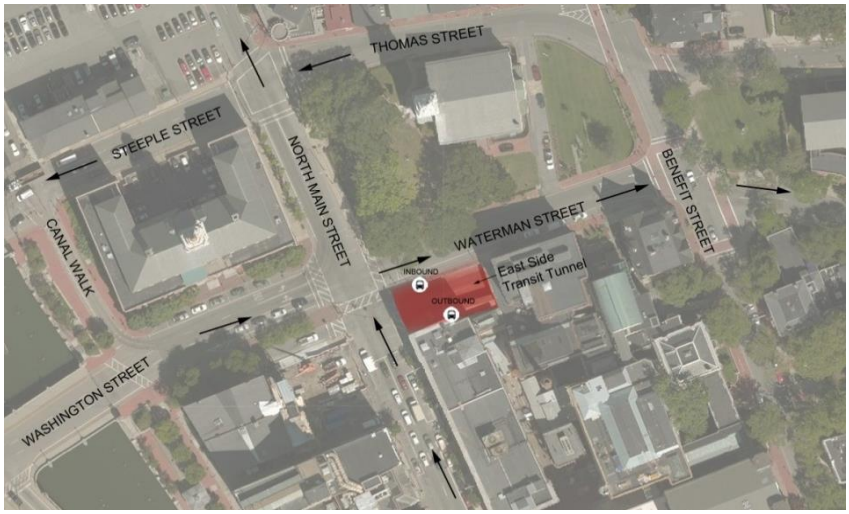


Figure 4.2: Bus Stop Location

5.0 SAFETY & SECURITY

The following section summarizes the tunnel investigation from DVS's "Security and Safety Needs Analysis Report". For further details and information of the investigation and recommendations, the full report is provided in Appendix C.

5.1 Description of Safety & Security Investigation

This study is intended to investigate the current state of security and safety features at the College Hill Tunnel, identify upgrades to existing systems, recommend a preferred solution in terms of scope and provide a magnitude of probable cost for the identified recommendations.

If the identified recommendations are approved, a systems designer should review the study and satisfy themselves as to the accuracy of the contents before proceeding into an actual design. However, it is expected that the study should save time and expense by avoiding unnecessary duplication of pre-design activities.

Photo 5.1: Close-up of South Main Street Entrance & Signage

5.2 Existing Conditions Investigation

On June 3, 2015, DVS participated in a site survey of the existing College Hill Tunnel in Providence, RI. DVS met with Jim Cunningham from RIPTA and evaluated the current conditions of the tunnel including the two entry points on South Main Street and Thayer Street. DVS found that the current signage at both tunnel entry points is inadequate and some signs are illegible due to graffiti and weathering. Current lighting at both tunnel entry points was minimal (Photos 5.1 and 5.2).

There is currently no existing electronic access control or intrusion detection system equipment servicing the tunnel. Additionally, there are no video surveillance cameras or video recording equipment for the

Photo 5.2: Thayer Street Entrance & Signage

Photo 5.3: Damaged Crash Attenuator

vehicle access roadway, which precludes the remote monitoring and digital recording of unauthorized use by pedestrians or vehicular traffic.

Upon further review of the tunnel's interior, DVS noted that the existing crash attenuator at the South Main Street entrance was severely damaged and no longer functions as it was designed (Photo 5.3). Lastly, DVS noted that the tunnel was lacking a center lane delineator between the two lanes of traffic.

6.0 RECOMMENDED IMPROVEMENTS & COST ESTIMATES

6.1 Recommended Structural Improvements & Cost Estimate

Based on the observed tunnel conditions, the following recommendations are presented:

1. Remove all loose and delaminated gunite. Removal will prevent this material from falling to the roadway, vehicles, or workers below. It also has the additional benefit of exposing additional concrete for further inspection of the underlying structure. The estimated quantity for this work is 25% of the tunnel area based on the inspection of the tunnel. The preliminary opinion of probable construction cost for this work is $24,000.

2. Remove gunite at selected transverse cracks at approximately 300-foot intervals and further observe conditions at joints in the concrete structure. This will allow for identifying needed repairs at the exposed areas and estimating needed repairs in other areas of the structure without extensive gunite removal. The preliminary opinion of probable construction cost for this work is $10,000.

3. Further inspection should be completed on the delaminated and cracked portions of the gunite that coats all of the tunnel walls and arch. Based on the small portions of the concrete walls and arch that were visible in spalled areas, the poor condition of the gunite appears to be caused by leakage between joints in the concrete structure of the tunnel. The best method to repair the tunnel would be to remove the worst areas of the gunite and seal the cracks and joints at these locations. The cost estimate for this recommendation includes sealing and repairing the concrete at locations where the gunite coating is loose and delaminated. The removal of the gunite coating associated with repairing the concrete is covered in the estimate of Recommendation 1. Similar to Recommendation 1, this estimate will assume that 25% of the arch will need concrete repairs. The preliminary opinion of probable construction cost for this work is $65,000.

4. Power wash the concrete median and tunnel walls to remove dirt, grime, salt, and other materials that have built up on the surfaces. Washing will show the deterioration of the concrete structures and gunite coating. In addition, cleaner surfaces will facilitate future inspections, as smaller cracks and other deterioration will be easier to identify. The preliminary opinion of probable construction cost for this work is $28,100.

5. Repair the western-most column of the steel framing at the west end of the tunnel. This column showed significant section loss and delamination along the length of the column. It is recommended that steel plates be bolted to the flanges of the column to restore the original column capacity. As the section loss occurs at the top of the concrete median barrier, it is necessary to remove a portion of the top of the barrier around the column to make this repair. The preliminary opinion of probable construction cost for this work is $15,000.

6. Clean and paint all steel framing to protect the framing from further deterioration due to leakage through joints and cracks in the concrete and gunite. The preliminary opinion of probable construction cost for this work is $36,000.

6.2 Recommended Pavement and Drainage Improvements & Cost Estimates

Based on the observed tunnel pavement and drainage conditions, the following recommendations are being provided for both Short Term and Long Term improvements.

Short Term Improvements

1. Since no records of the existing pavement structure were found during our investigation, pavement cores and testing of the gravel subbase material should be performed prior to finalizing any design improvements for pavement rehabilitation to the existing tunnel's roadway structure. The preliminary opinion of probable construction cost for this work is $15,000.

2. The section of roadway from South Main Street to the start of the tunnel should be milled and overlaid, with the existing traffic loops replaced. Additionally, the 300-feet section of roadway immediately within this end of the tunnel should be resurfaced. The necessity of work is contingent on any project limit overlap from the RIDOT's South Main Street resurfacing project. The preliminary opnion of probable construction cost for this work is $55,000.

3. Sections of pavement repaired by *Perma-Patch* should be cut, removed and repaired. If the concrete rigid base is compromised and in need of repair, then provide full depth repair with bituminous pavement base course to avoid long closure times for the concrete patch to cure. The preliminary opinion of probable construction cost for this work is $12,000.

4. For larger sections of the roadway pavement where fatigue cracking or rutting exists and the concrete rigid sub pavement is not compromised, mill and overlay the bituminous pavement for the entire section of the roadway. The preliminary opinion of probable construction cost for this work is $20,000.

5. All plowing practices should be amended to not allow blockage of the catch basin inlets as observed in Photo 6.2.1. The suggested practices should be to manually clear the plowed snow away for the blocked basin inlets shortly after plowing has been completed. This work is coordinated in-house and there is no project-related cost involved with this work.

6. Replace all the broken grates and damaged frame rail bars that support the grates. Also recommend cleaning, flushing, and video inspection of all structures and accessible drain pipes. The preliminary opinion of probable construction cost for this work is $25,000.

7. Furnish and install a trash rack on the opening of all inlet openings. The preliminary opinion of probable construction cost for this work is $6,000.

Photo 6.2.1: View of Snow Bank Across Catch Basin Inlet Opening

8. Repair all damaged/broken downspouts, including steel rods and collars. The preliminary opinion of probable construction cost for this work is $8,000.

9. Replace the existing crash cushion attenuator. Also provide a similar one along the face of wall at the South Main Street end. The preliminary opinion of probable construction cost for this work is $30,000.

10. Further investigate the filling of the catch basin (shown in Photo 6.2.2) along the southerly side of the tunnel at the South Main Street tunnel opening that appears to impede pipe flow. Recommend to remove fill material and make repairs to the catch basin. There is no cost assigned to this work as further coordination will be performed to determine its repair.

Photo 6.2.2: Catch Basin Filled In

11. Provide new pavement striping and traffic sign upgrades as part of any pavement repair work. The preliminary opinion of probable construction cost for this work is $6,000.

12. Provide crack sealing of joints of the roadway along the Thayer Street end (approximately 260 LF in length) exposed to the environment. The preliminary opinion of probable construction cost for this work is $2,500.

13. Provide crack sealing of joints of the roadway within the tunnel. The preliminary opinion of probable construction cost for this work is $15,000.

14. The section of roadway immediately outside of the South Main Street tunnel is anticipated to be resurfaced by RIDOT next year. As such, the project limit for roadway repairs shall start outside of this section of roadway.

Long Term Improvements

1. Since the condition of the roadway pavement within the tunnel was found to be in fair condition and only requiring isolated areas of pavement repairs, any full depth pavement milling and pavement overlaying along the entire roadway limits of the tunnel should be considered as a long term improvement. Also since the Providence Trolley Car Project is currently at the early stages of design, any full depth roadway reconstruction improvements should be delayed until the design of Trolley Car system has been completed, approved and funded. At that time, any trolley car rail systems proposed within the tunnel for final design can be incorporated with more extensive roadway improvements within the tunnel at that time. No cost consideration has been assigned to this implementation yet.

2. Likewise, if extensive roadway improvements are proposed in the future due to the addition of trolley cars, considerations should be made to provide for more extensive drainage improvements.

6.3 Recommended Bus Stop Improvements & Cost Estimates

6.3.1 Thayer Street Bus Stop Improvements

Minimal Improvements

The minimum components of a transit stop include:
- Boarding and alighting area
- Waiting area
- Accessible pedestrian path
- Signage

Designated bus stop location allows for a higher visibility and awareness to the public transit. Introduction of informational signage helps to identify the stop and provide passengers with a greater understanding of the public transit network. This will help strengthen public transit and raise awareness of the systems that are currently provided, minimizing the amount of private vehicular transportation. With the existing active alley being blocked off, the inbound stop at Thayer Street can remain in its current location. Alterations to the stop are recommended to be done to reduce safety concerns and have an accessible boarding and alighting area. The boarding and alighting area will need to be leveled to comply with ADA section 810.2.4 Slope which specifies parallel to the roadway, the slope of the bus stop boarding and alighting area shall be the same as the roadway, to the maximum extent practicable. Perpendicular to the roadway, the slope of the bus stop boarding and alighting area shall not be steeper than 1:48.

Enhanced Improvements

The enhanced improvement recommendations include:
- Additional ground tactile surface area.
- Additional bus stop specific lighting.
- Fully enclosed shelters.
- Additional seating.
- Additional signage.
- Trash and recycling receptacles at inbound and outbound stops.
- Alternative ground paving to aid in stop identity.
- Tactile ground surface area at boarding/alighting to aid visually imparted.

These recommendation features help to improve the user experience and provide layering of the streetscape in which the bus stop no longer disappears into its context, but is a clearly discernable element within the streetscape. This will improve the identification of the stop and the alternative option of transportation. By providing a similar language for all stops, users can begin to identify stops based on grouping of the elements within the stop. Creating a uniform image for the bus network heightens the users understanding of the network.

The current location for Thayer Street's outbound stop has a sufficient amount of space but requires adjustments to comply with code and safety concerns. This includes leveling the boarding and alighting area to comply with ADA section 819.2.4. The retaining wall adjacent to the inbound stop and active alley will need to be partially removed and cut back in order to provide enough space for the buses to pull up further and not block the crosswalk at the street entrance to the ESTT.

The vehicular traffic for this option will be reestablished, as the active alley adjacent to the tunnel will be blocked off. This will prevent vehicular traffic from interfering with the waiting and boarding area and reduce the safety concerns at this location. In addition the intersection control at the intersection can be examined to give bus priority through an additional traffic signal at this location. This will decrease the dwell time for the buses and reduce the overall delays in bus services.

6.3.2 Washington Street at North Main Street Improvements

Minimal Improvements

The minimum components of a transit stop include:
- Boarding and alighting area,
- Waiting area,
- Accessible pedestrian path
- Signage

Designated bus stop location allows for a higher visibility and awareness to the public transit. Introduction of informational signage helps to identify the stop and provide passengers with a greater understanding of the public transit network. This will help strengthen public transit and raise awareness of the systems that are currently provided, minimizing the amount of private vehicular transportation. The boarding and alighting area will need to be leveled to comply with ADA section 810.2.4 Slope which specifies parallel to the roadway, the slope of the bus stop boarding and alighting area shall be the same as the roadway, to the maximum extent practicable. Perpendicular to the roadway, the slope of the bus stop boarding and alighting area shall not be steeper than 1:48.

Enhanced Improvement Recommendations

The enhanced improvement recommendations include:
- Relocation of the bus stop.
- Additional ground tactile surface area.
- Additional bus stop specific lighting.
- Fully enclosed shelters.
- Additional seating.
- Additional signage.
- Trash and recycling receptacles at inbound and outbound stops.
- Alternative ground paving to aid in stop identity.
- Tactile ground surface area at boarding/alighting to aid visually imparted.

These additional amenities and wayfinding features help to improve the user experience and provide layering of the streetscape in which the bus stop no longer merged into its context but is a standalone element within the streetscape. This will improve the identification of the stop and the alternative option of public transportation. By providing a similar language from one stop to another, the users begin to identify stops based on the elements within the stop. Creating a uniformed image for the bus network heightens the users understanding of the network.

RELOCATION OF BUS STOPS

The North Main Street inbound stop does not provide adequate space on the existing curb edge to comply with ADA, as well as not complying with required slopes for the boarding area. Due to these conditions it is recommended to relocate the stop or reallocate space to provide for the required width for

the boarding and alighting area. Two options are recommended; relocate the inbound stop to Washington Street or relocating the outbound stop to the west side of North Main Street.

Option One: Relocation of outbound stop and shifting the street entrance into the ESTT southward to provide adequate curbside area to become ADA-accessible (Figure6.1).

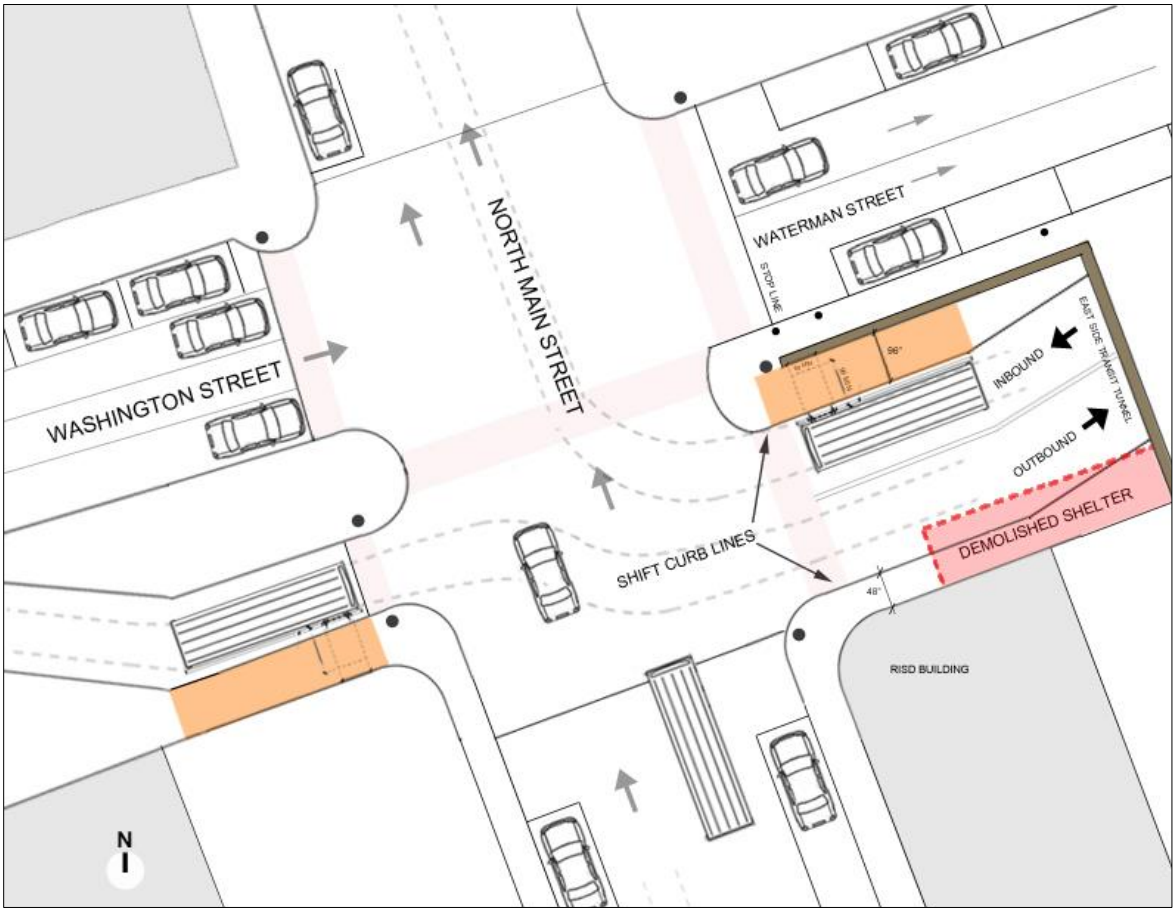


Figure 6.1: North Main Street Proposed Relocation – Option One

The outbound stop will be relocated to the bus only lane adjacent to Washington Street prior to the intersection at North Main Street. This area will need to be leveled to meet boarding and alighting requirements for slope, but will be wide enough to comply with requirements for the boarding and alighting area. With the relocation of the stop, identification of the new location will be of high importance to reduce the confusion that can be brought about through the change.

The inbound stop will remain in its present location, but the curbside area will be increased and leveled when the shifting of the entrance occurs. To meet boarding and alighting dimensional needs the new curbed area will increase by approximately 4’-0”. This will allow for adequate boarding area for passengers; however the accessible route will be through the boarding and alighting area.

Advantages to option one:

- Designated bus area off of the main street minimizes the traffic interference on North Main Street.
- The driver has the advantage of viewing the full intersection activity at North Main Street.
- Access to and from the surrounding road network is direct and limits the circuitous routing of buses.
- Traffic lights manage the bus and vehicular traffic.
- A designated bus lane with traffic signals allows for minimal interference with vehicular and pedestrian traffic.
- An accessible boarding and alighting area can be designated in this location.
- Re-routing the buses that service the stop will not be necessary, as it is along the same travel route the buses are currently taking.

Disadvantages to option one:

- Accessible pedestrian paths to and from the bus stop interfere with the designated waiting or boarding areas. This may cause delays in services.
- Stop identification and additional signage may be necessary.
- The current shelter in front of the ESTT will no longer be used, and may need to partially or completely remove to allow enough space to shift the entrance to the ESTT.

Option Two: Creating a bus only counter flow lane on Washington Street and relocating the inbound bus stop to after the intersection of North Main Street and Washington Street will provide adequate curbside area to become ADA-accessible (Figure 6.2).

The outbound stop will remain in its current location with minimal improvements are required. The inbound stop will be relocated to the bus only lane on Washington Street. Both areas will need to be leveled to meet boarding and alighting requirements for slope. With the relocation of the stop, identification of the new location will be of high importance to reduce the confusion that can be brought about through the change.

By introducing a counter flow lane on Washington Street vehicular traffic will be impacted. The traffic lights will need to be re-signaled to provide bus priority and reduce the impact that will occur with the removal of one lane of vehicular traffic. Some parking spaces will be lost along Washington Street due to the new location of the stop, and additional signage will be required to advice vehicular drivers of the bus lane. In order to park along the north side of Washington Street cars will need to cross the bus lane, which may cause interference with the buses including possible delays in overall bus transit services.

Advantages to option two:

- The driver going outbound has the advantage of viewing the full intersection activity at North Main Street.
- Access to and from the surrounding road network is direct and limits the circuitous routing of buses.
- Traffic lights manage the bus and vehicular traffic.
- An accessible boarding and alighting area can be designated in this location.
- The current shelter in front of the ESTT will be used.
- Accessible pedestrian paths to and from the bus stop do not interfere with the designated waiting or boarding areas.

Disadvantages to option two:

- The driver going inbound does not have the advantage of viewing the full intersection activity at North Main Street and has a reduced view.

- Stop identification and additional signage will be necessary.
- By creating a bus only lane, one current lane for vehicular travel is lost and may interfere with traffic patterns in the area.
- Re-routing the buses that service the inbound stop will be necessary, as it is no longer along the same travel route the buses are currently taking. This may cause circuitous routing of buses.

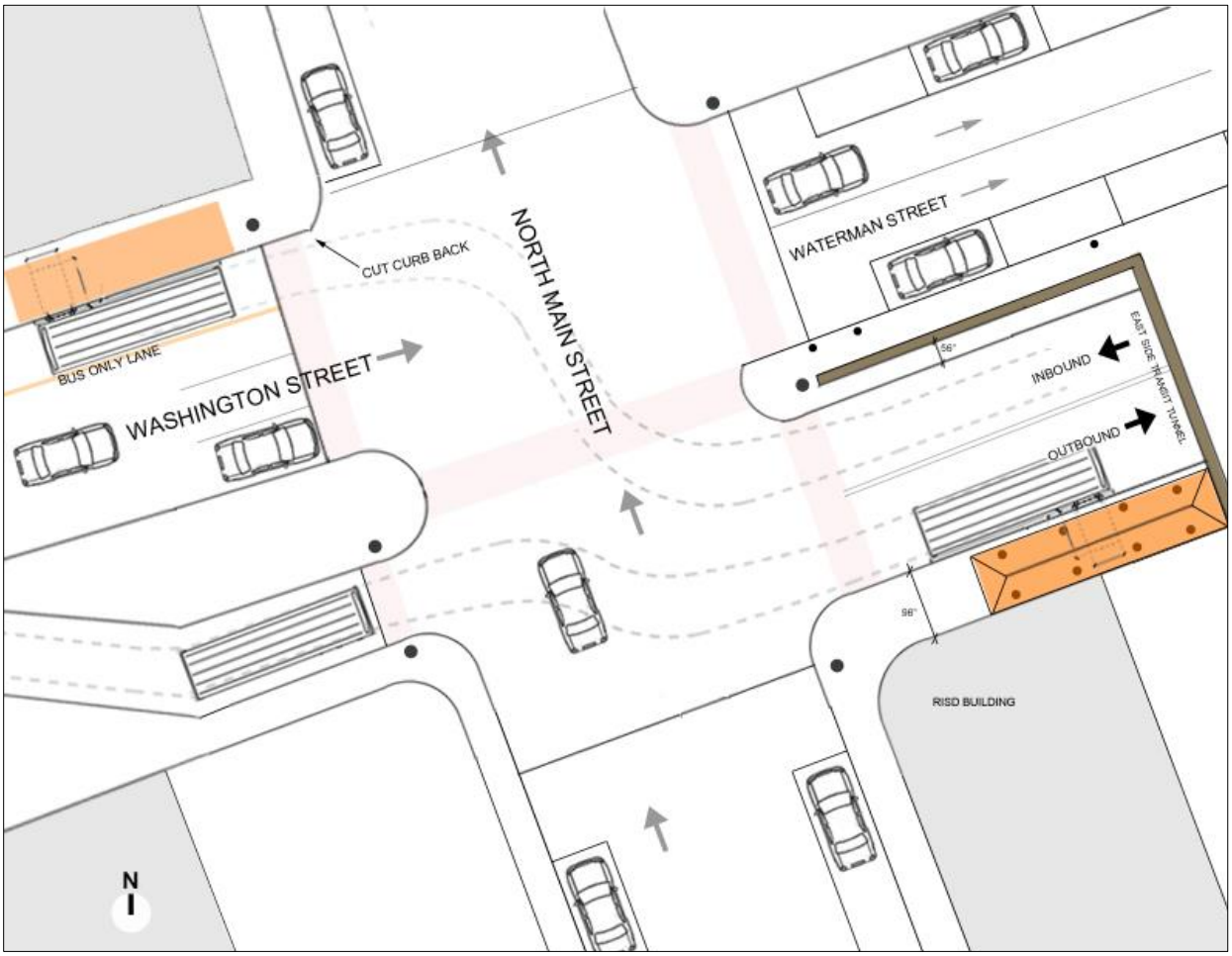


Figure 6.2: North Main Street Proposed Relocation – Option Two

6.4 Security Improvements

Based on the findings related to the existing site security and safety conditions at the College Hill Tunnel, as identified within Sections 5.2 of this report, DVS has the following recommendations:

1. Provide new signage at both entrances clearly stating that the roadway is for authorized personnel only and is not for pedestrian traffic. Signage should be visible from the sidewalk and oncoming traffic.

2. Provide an enhanced level of lighting at both entrances to better illuminate the new signage and provide better situation awareness for bus drivers, in the event that someone is walking in front of the tunnel as a bus is entering or exiting. Lighting levels within the tunnel should also be increased to provide better situational awareness for bus drivers and a safer experience for the bus passengers.

3. Provide a new "in-the-ground" center lane delineator reflectors, so that bus drivers can operate safely within the tunnel; especially when there are buses driving in both directions at the same time.

4. Replace the damaged crash attenuator at the South Main Street entrance.

5. Provide a new motion detection alarm system to alert oncoming traffic when a vehicle has entered the tunnel and/or a disabled vehicle is trapped within the tunnel. This system would include an alarm control panel, tri-technology exterior rated motion detectors and local sounders with light signals to indicate that an abnormal driving condition exists within the tunnel.

Providing the above identified safety and security system equipment will deliver an increased level of situational awareness within the tunnel and surrounding area. It is anticipated that by implementing the above identified recommendations, RIPTA can reduce the unauthorized use of the tunnel, improve the safety of RIPTA bus drivers and enhance the overall passenger experience.

6.5 Summary of Costs for Recommended Improvements

Table 6.1: Summary of Cost Estimates for Recommended Improvements

Type of Repair	Repair Alternative	Cost
Structural	Removal of Loose Gunite	$30,000
	Removal of Gunite at Select Transverse Cracks	$10,000
	Concrete Repair and Crack Sealing	$65,000
	Power Wash Tunnel	$30,000
	Steel Column Repairs	$ 15,000
	Painting Steel Framing	$36,000
Pavement and Drainage	Pavement Cores	$15,000
	Resurfacing of South Main St End	$55,000
	Replace Pavement Patches	$12,000
	Replace Rutted and Fail Areas	$20,000
	Replace Grates, Flush and TV Inspection of Pipes	$25,000
	Furnish and Install Trash Racks	$6,000
	Remove/Replace Downspouts	$8,000
	Remove and Replace Existing Crash Cushion	$30,000
	Signing and Striping	$6,000
	Crack Sealing (Thayer Street End)	$2,500
	Crack Sealing (Tunnel)	$15,000
Bus Stops Thayer Street	Outbound Option A	$16,000
	Outbound Option B	$42,000
	Inbound Option A	$16,000
	Inbound Option B	$43,000
Bus Stops North Main Street	Outbound Option A	$42,000
	Outbound Option B	$27,000
	Inbound Option A	$16,000
	Inbound Option B	$46,000
Safety & Security	New Signage at Both Entrances	$4,400
	Enhanced LED Lighting Within Tunnel and Entrances	$10,400
	In-Ground Center Lane Delineators	$4,750
	New South Main Street Entry Crash Attenuator	$30,000
	Vehicular Motion Detection Alarm System	$12,750

7.0 ADDITIONAL CONSIDERATIONS

1. A discussion was held with RIPTA about the feasibility of constructing shoulders along the Thayer Street end. This may require the elimination of the end sections of the existing retaining walls. Due to the location of an existing parking area and steep grades of both the southerly and northerly walkways, reducing the length of the retaining walls without more significant impacts to the walls and grading would be limited to about five feet. In addition to reducing the length of the retaining wall, the curbing along the eastbound travel lane can be shifted to better provide a shoulder for buses to pull over. The roadway currently widens from approximately 26' at the end of the wall to approximately 36' at the crosswalk. Shifting the curbing at the end of the wall would allow the roadway to widen to approximately 30', which could provide two (2) twelve foot travel lanes and one (1) six foot shoulder for the eastbound buses.

2. Further length for widening the tunnel corridor at Thayer Street could be made available by relocating portions of the retaining walls and reconfiguring the existing sidewalks and driveway. The walls would be realigned closer to the adjacent buildings to provide a longer, relatively level area for the stops. The primary benefit is providing sufficient width for buses to pull over onto the shoulder while still allowing other traffic to pass. Also, the additional length would provide greater accommodations for trolley stops. Pedestrian and vehicle access to private parking spaces on the north and south sides of the tunnel corridor would be restricted and possibly eliminated. Further investigation is required to determine the feasibility of relocating the walls. Considerations include impacts to adjacent buildings, drainage, utilities, light poles, and grading. Construction considerations requiring further study include temporary relocation of the stops, rerouting buses, maintenance of traffic and signals, the potential for uncovering unknown subgrade structures, and cost.

3. At the North Main Street end of the tunnel, additional width for the inbound stop could be made available by shifting the existing retaining wall behind the stop northward and eliminating a portion of the south shoulder of Waterman Avenue adjacent to the wall. Parking spaces along Waterman Avenue may be affected as well. This option would retain the existing curb lines of the tunnel roadway and maintain the existing sidewalk width for the outbound stop. The primary benefit is providing sufficient width for an ADA compliant inbound stop without having to relocate either existing stop to locations proposed in the DHK Associates report in Appendix B. Further investigation is required to determine the feasibility of relocating the walls. Considerations include drainage, utilities, light poles, traffic signals, and impacts to Waterman Avenue. Construction considerations requiring further study include temporary relocation of the stop, rerouting buses, maintenance of traffic and signals, the potential for uncovering unknown subgrade structures, and cost.

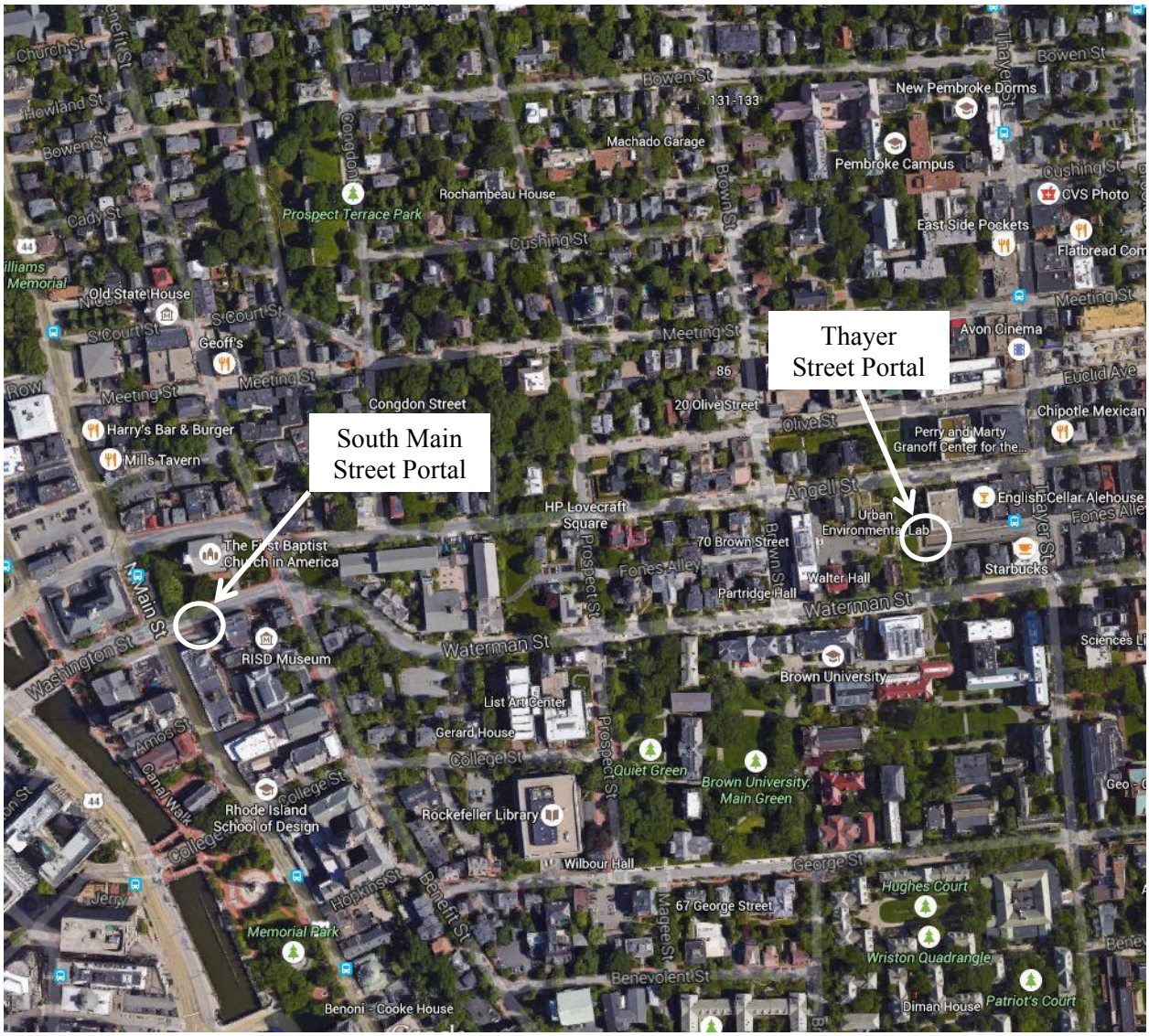
4. As previously mentioned, the Providence Trolley Car Project is currently at the early stages of design and consideration for any pavement improvements should be either delayed or coordinated further to determine its scope of work. Pavement cores determine the condition of the existing concrete rigid base and it's suitable for this Trolley Car implementation.

5. Based on the implementation of any of the listed recommendations, detouring of the RIPTA buses is likely for a short period of time. The use of Waterman Street and Angell/Thomas Street is a viable detour route, or if preferred by RIPTA, one lane alternating traffic can be an option with work proposed on one lane at a time.

6. Preliminary research was conducted to determine the ventilation requirements for tunnels. Based on the Federal Highway Administration's (FHWA) Road Tunnel Manual (FHWA-NHI-10-034, Dec. 2009) tunnels must maintain an acceptable air quality level for short-term exposure in the tunnel and properly remove smoke in the event of a fire inside the tunnel. To determine if ventilation is required, the air quality of the tunnel would need to be analyzed and a computational fluid dynamics analysis would need to be performed to determine the tunnels performance under fire conditions. The governing factor from the analysis would then determine the need for ventilation, if any. Although a formal analysis of the tunnel would need to be performed to more accurately determine the need for ventilation, there are some initial observations that can be made about the factors that affect the requirements of ventilation. The air quality in the tunnel is not diminished as a result of civilian vehicle access, which is one factor, and the alignment of the tunnel is on a grade, although minor, which encourages air flow, is another factor. Ultimately, a formal analysis of the tunnels air quality and air flow would need to be performed to determine if ventilation is required.

8.0 APPENDICES

APPENDIX A – Location Map



APPENDIX B – "Needs Assessment, Thayer Street & North Main Street"
by DHK Architects Inc.

NEEDS ASSESSMENT

Thayer Street & North Main Street

Prepared by DHK Architects Inc.

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1.0 PROJECT DESCRIPTION

1.1 INTRODUCTION & PURPOSE

Public transit's infrastructure is a significant part of the operation and function of an efficient and safe public transportation system. Establishing appropriate infrastructure is a vital part of the customer experience and assists in making public transportation a competitive, viable alternative to personal vehicles.

The East Side Transit Tunnel [ESTT], originally built in 1914, is a two lane tunnel running east/west under College Hill connecting Thayer Street to North Main Street. This document provides a needs analysis for the bus stops adjacent to the ESTT. For the purpose of this study, we have divided the ESTT environment into these areas

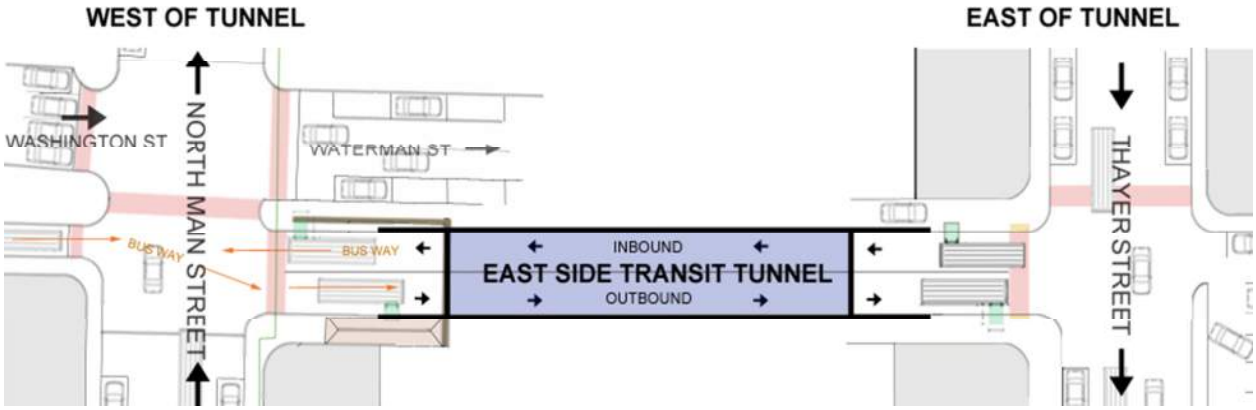


Figure 1: Adjacent Bus Stops to East Transit Tunnel

ESTT Environment composed of:

- Tunnel Proper
- East access bus-way (Thayer Street connection)
- West access bus-way (North Main Street connection)

1.2 OBJECTIVES

The objectives of this report are to:

- Create a comprehensive list of all issues related to the adjacent bus stops to the ESTT. Areas for improvement include, but are not limited to bus operations, security and safety, accessibility, stop identity, and passenger environment.

- Prioritize the issues based on critical level of need, funding availability for improvements, and RIPTA's input.

1.3 STRUCTURE OF REPORT

The first section of this report will summarize the current conditions of the bus stops; North Main Street bus stops west of the tunnel, and Thayer Street bus stops east of the tunnel entrance – both servicing inbound and outbound. The latter section will provide preliminary recommendations based on analysis of the existing conditions. The analysis of the bus stops comprise of four [4] essential elements:

1. **Curbside Area Assessment:** The area designated for passengers to wait and to exit/board the bus.

2. **Identification/Location:** A stop's placement in regards to the nearest intersection, bus route direction and community it serves.

3. **Information Features:** Includes wayfinding and informational signage for passengers and vehicular traffic.

4. **Passenger Amenities:** Includes elements to provide comfort for passengers. These elements include but are not limited to shelter and seating.

2.0 CURRENT CONDITION OF CURBSIDE AREA

2.1 INTRODUCTION

This section provides an overview of the curbside areas' current dimensions, relationship to the curb, characteristics, and accessibility.

The design of the curbside area should have the ability to accommodate passenger movements while boarding and alighting. Passengers will board from the front end of the platform, warranting different design considerations for queuing and waiting passengers *[Figures 2-4]*. The pedestrian circulation is one of the principle concerns for the curbside area which is identified by three primary elements:

1. **Boarding and Alighting Area:** Allocate a designated space for boarding and un-boarding passengers. Loading areas should comply with ADA requirements and be a minimum of 60 inches wide and 96 inches deep adjacent to the curb. Locating this area at the front of where the bus stops is ideal to allow for easier movement on and off the bus. The boarding and alighting can happen at all sets of doors on the bus, but the typical circumstance at these stops only provides boarding and alighting at the front door of the bus. These areas should be easily identified by both the bus drivers and passengers to speed up passengers' movements and decrease dwell time.

   The Department of Transportation's ADA standards, section 810.2.2 specifies a bus boarding and alighting areas to provide a clear length of 96 inches [2440 mm], measured perpendicular to the curb or vehicle roadway edge, and a clear width of 60 inches [1525 mm], measured parallel to the vehicle roadway.

   ADA standards, section 810.2.4 specify a bus boarding and alighting area to have a slope parallel to the roadway. Perpendicular to the roadway, the slope of the bus stop boarding and alighting area shall not be steeper than 1:48.

2. **Waiting Area**: Adjacent to the boarding and alighting area for passengers to wait for their bus without interfering with pedestrian circulation.

3. **Accessible Pedestrian Path**: A clear path of travel to and from the bus boarding/alighting and waiting areas should be provided. Special attention should be given in providing convenient and safe access to and from the bus waiting area, boarding and alighting area, and surrounding neighborhood. This provides the primary connection between the stop and the immediate surrounding environment.

   To comply with ADA the clear width of a walking surface should be 36 inches minimum. With an exception to be reduced to 32 inches minimum for a length of 24 inches maximum provided that the reduced width segment are separated by segments that are 48 inches long minimum and 36 inches wide minimum.

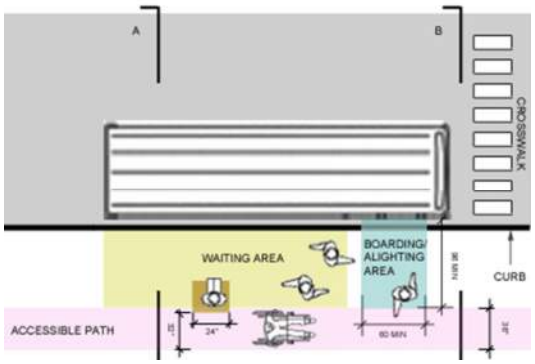


Figure 2: Curb Side Assessment Plan

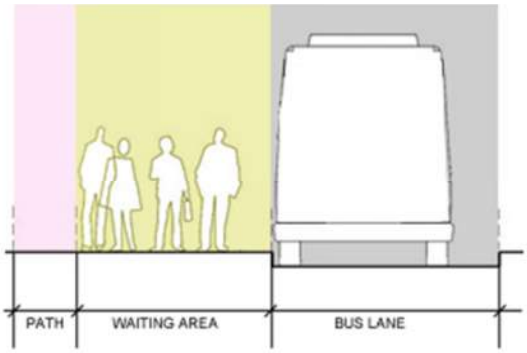


Figure 3: Curb Side Assessment - Section A

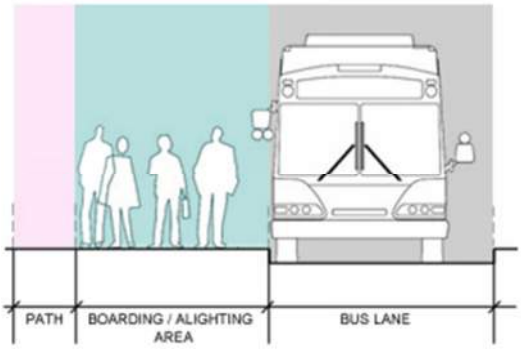


Figure 4: Curb Side Assessment - Section B

2.2 THAYER STREET STOP

2.2.1 BOARDING AND ALIGHTING AREA

The Thayer Street stops have designated locations for boarding and alighting. These are indistinguishable from the streetscape. On the inbound side, passengers board the bus from a shared vehicular and pedestrian area in front of the retaining wall *[Figure 6]*. The resulting condition is unsafe for passengers and vehicular traffic as cars drive through this shared area where pedestrians wait and cut across the bus-way to turn onto Thayer Street. As a result, the passengers who are waiting for the bus to have to move out of the way, some moving into the bus-way itself to allow for vehicular traffic. Though the width of the alley at the location passengers currently board is approximately 13'-0" from edge of curb, and could accommodate a boarding and alighting area to meet the dimensions required, it is not designated, nor protected for pedestrian use only.

The inbound traveling buses; due to their large turning radius and the pedestrian and vehicular activities within the intersection, cannot always pull up to the curb. This causes passengers to board at street level, several inches below the bus, compromising accessibility. There is minimal to no curbing at or adjacent to the boarding/alighting area to provide for accessible level boarding.

The outbound traveling buses boarding and alighting area is inadequate as well. There is no clearly designated area for boarding and alighting. Passengers are boarding and exiting the bus from the bus way as opposed to a sidewalk or allocated bus stop pad. The boarding level is at the same elevation as the bus way. The buses do lower down to allow for easier transition from street to bus, but those requiring additional assistance will still have difficulty boarding and exiting the bus.

Figure 5: Thayer Street Boarding/Alighting Area

Figure 6: Thayer Street Boarding/Alighting Area

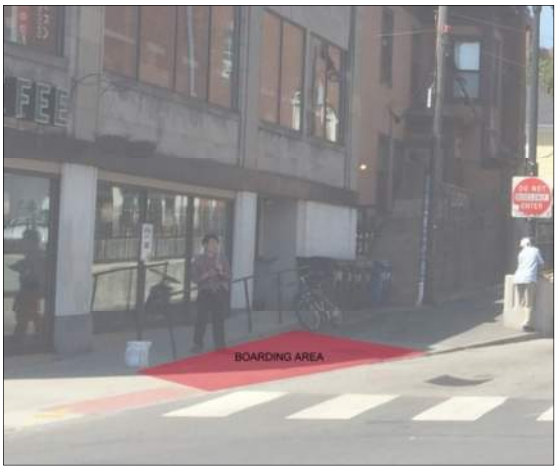


Figure 7: Thayer Street Boarding/Alighting Area

2.2.2 WAITING AREA

The Thayer Street stops' waiting areas are currently lacking identity as they are not distinguishable from the surrounding context. The Inbound side also lacks a protected waiting area, as it is a part of an active alley way. Access to and from the surrounding community is direct with walking paths and sidewalks linking the bus stop to other areas. *Figure 7* depicts where passengers gather on both stops.

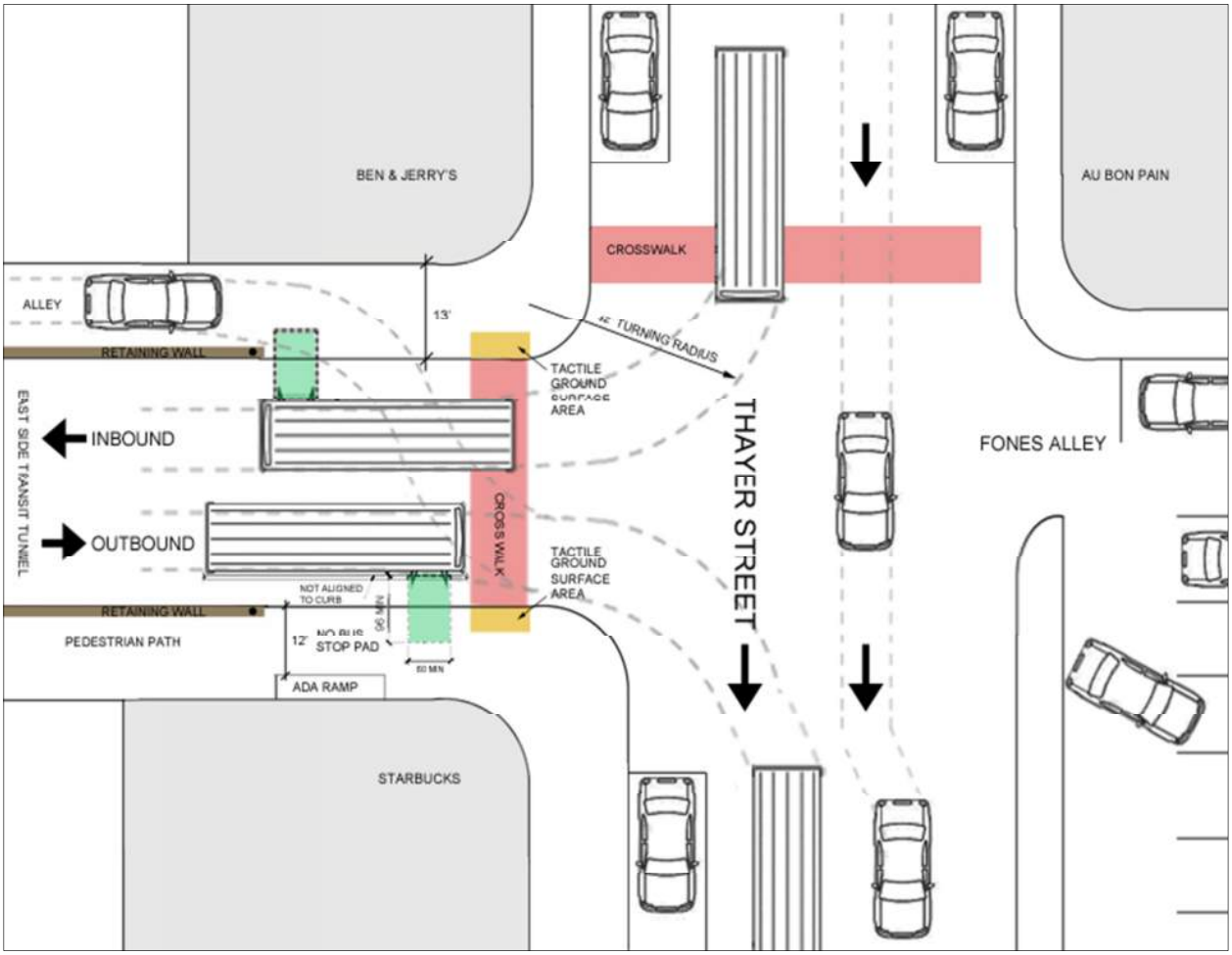


Figure 8: Thayer Street Bus Stop Locations

On the outbound side, passengers generally gather in two distinct areas. The first is at the corner on Thayer Street, number 1 in *Figure 9*. As noted in the previous section, the boarding and alighting area also occurs at this location. More than one line is serviced at this stop, so passengers who are waiting for other bus routes interfere with the movement of passengers exiting and entering other buses, potentially causing delays in service. The second location for waiting passengers is at the end of the Starbucks entrance [number 2]. Passengers waiting here block the pedestrian circulation of users coming in and out of Starbucks.

The inbound side at Thayer Street contains insufficient passenger amenities as well. As discussed in the previous section, the waiting area on this side is part of an active alley. This is an unsafe condition and does not provide an allocated waiting area for passengers. The lack of amenities prompts passengers to sit on the adjacent buildings window sills, or lean on the concrete retaining wall. Passengers primarily gather at the same location as the boarding and alighting area [number 3]. This again can cause interferences and delay travel times. Other passengers gather on Thayer Street corner [number 4]. This is due to the lack of visibility of approaching busses and lack of weather protection from the current stop location. Waiting under the awnings at Ben & Jerry's provides shade and protection against weather conditions. This location also allows a better vantage point of the approaching buses.

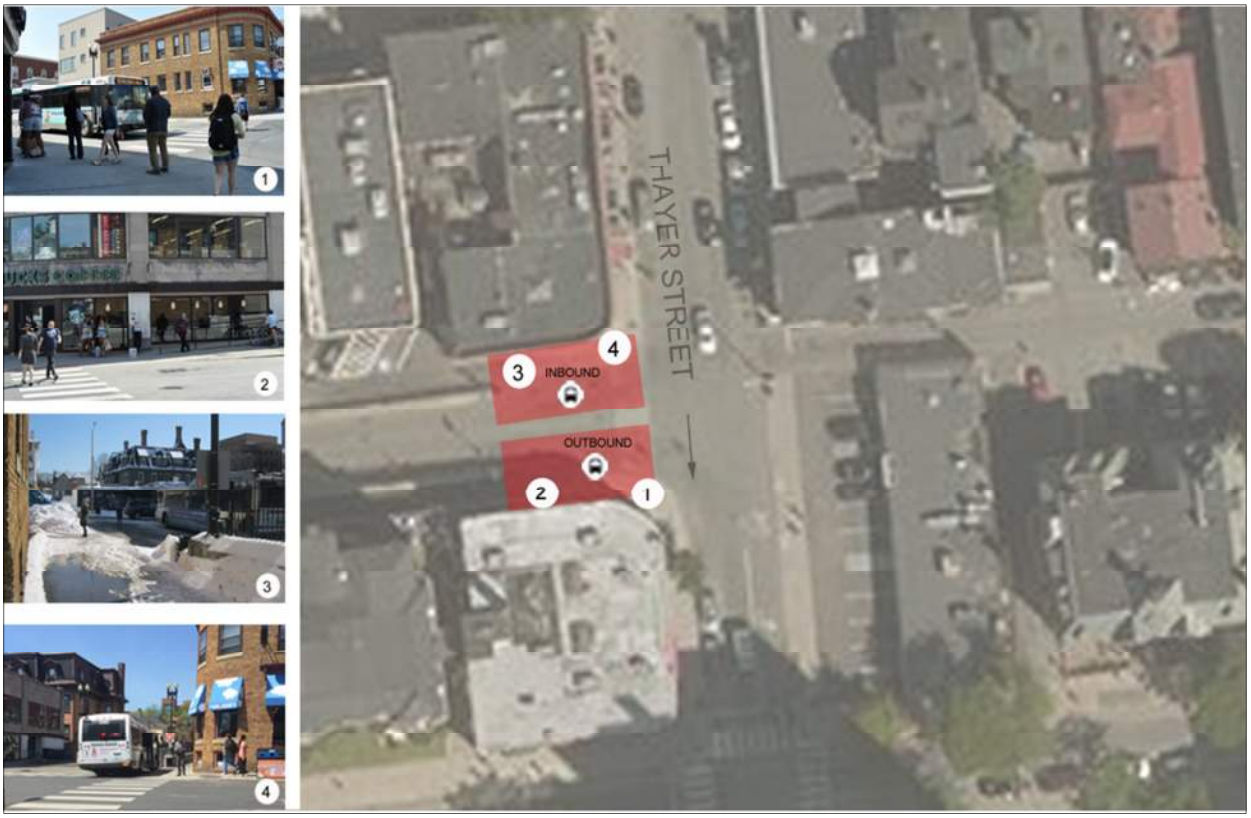


Figure 9: Waiting Area Map and Images

2.2.3 ACCESSIBLE PEDESTRIAN PATH

The Thayer Street outbound stop has a clear path of travel from the waiting area and bus loading area to the surrounding neighborhood. As shown in *Figure 10,* there exists a pedestrian path from the west that runs from the park parallel to the ESTT to the bus stop. This secondary path connects the stop with Brown University academic halls. From the north and south there are accessible paths leading to and from the bus stop alongside Thayer Street.

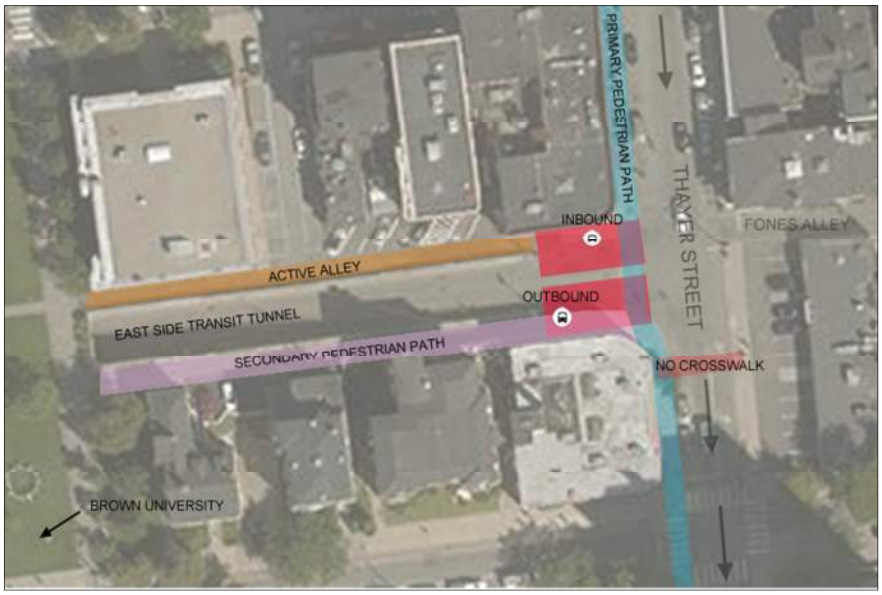


Figure 10: Accessible Pedestrian Path

There is no crosswalk, nor traffic control mechanism at the intersection of Thayer Street to the outbound stop. Pedestrians currently cross the intersection, interfering with vehicular traffic and causing an unsafe condition for themselves and others. Additional crosswalks may be advisable in order to minimize the impact on the local area and create a direct accessible path to all surrounding areas.

The inbound side does not have a protected path, as it is currently located in a vehicular alley. There is no safe pedestrian approach to the bus loading and alighting area. Solutions for this will be addressed in section 6.0 Preliminary Recommendations.

2.3 NORTH MAIN STREET STOP

2.3.1 BOARDING AND ALIGHTING AREA

The outbound stop at North Main Street contains a designated location for boarding and alighting. Passengers board the bus from under the shelter adjacent to the tunnel entrance *[Figure 11]*. This area has a clear width of 60 inches by 96 inches long. The outbound side is at street level for the boarding and alighting area. The buses do lower too allow for easier transition from street to bus, but those requiring additional assistance will have difficulty boarding and exiting the bus. The columns holding up the shelter may act as obstacles for the mobility of a wheelchair.

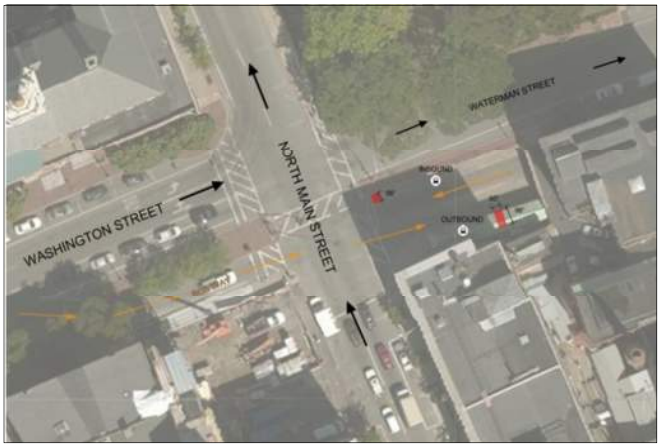


Figure 11: North Main Street Boarding/Alighting Area

The inbound boarding and alighting area is inadequate. No area is designated for boarding and alighting. The width of the side walk where the buses are currently stopping is only 56" wide from curb edge, which is not deep enough to comply with ADA requirements. The boarding elevation varies, depending how far back the bus stops prior to the crosswalk as the curb height changes significantly. Passengers requiring additional assistance will have difficulty boarding/alighting the bus.

Figure 12: North Main Street Boarding/Alighting Area

2.3.2 WAITING AREA

The outbound side provides sufficient space for waiting. Passengers gather in two [2] primary locations *[Figure 14]*. The first is under the shelter [number 1], providing some weather protection and additional seating. This waiting area is large enough where it does not interfere with the boarding and alighting area, and is accessible to the surrounding neighborhood. The second gathering area is adjacent to the shelter on the sidewalk [number 2]. This area is not protected from the exterior elements, but individuals tend to migrate here due to a ledge on the adjacent building acting as an alternative place to sit. The waiting area can accommodate the number of users and has some passenger amenities, which will be discussed in a later section. It can be enhanced with additional amenities to improve the user experience and repairs can be done to the existing conditions.

Figure 13: North Main Street Boarding/Alighting Area

The inbound side lacks a definable waiting area. There is minimal identification of the stop and no amenities. The waiting area is inadequate does not promote public transit. The primary gathering location occurs at the corner of Waterman Street and North Main Street [number 3]. As noted in the previous section, the boarding and alighting also occurs at this location. More than one line is serviced at this stop, consequently passengers who are waiting for other bus routes interfere with the movement of passengers exiting and entering other buses. This condition can cause delays in service increasing bus dwell time. The boarding and alighting of passengers interferes with the pedestrian traffic along North Main Street, causing individuals to walk into the intersection. This is a high traffic area and is a safety concern. A well-defined designated accessible waiting area needs to be established for this stop in order to promote increased passenger movement and safety for pedestrians.

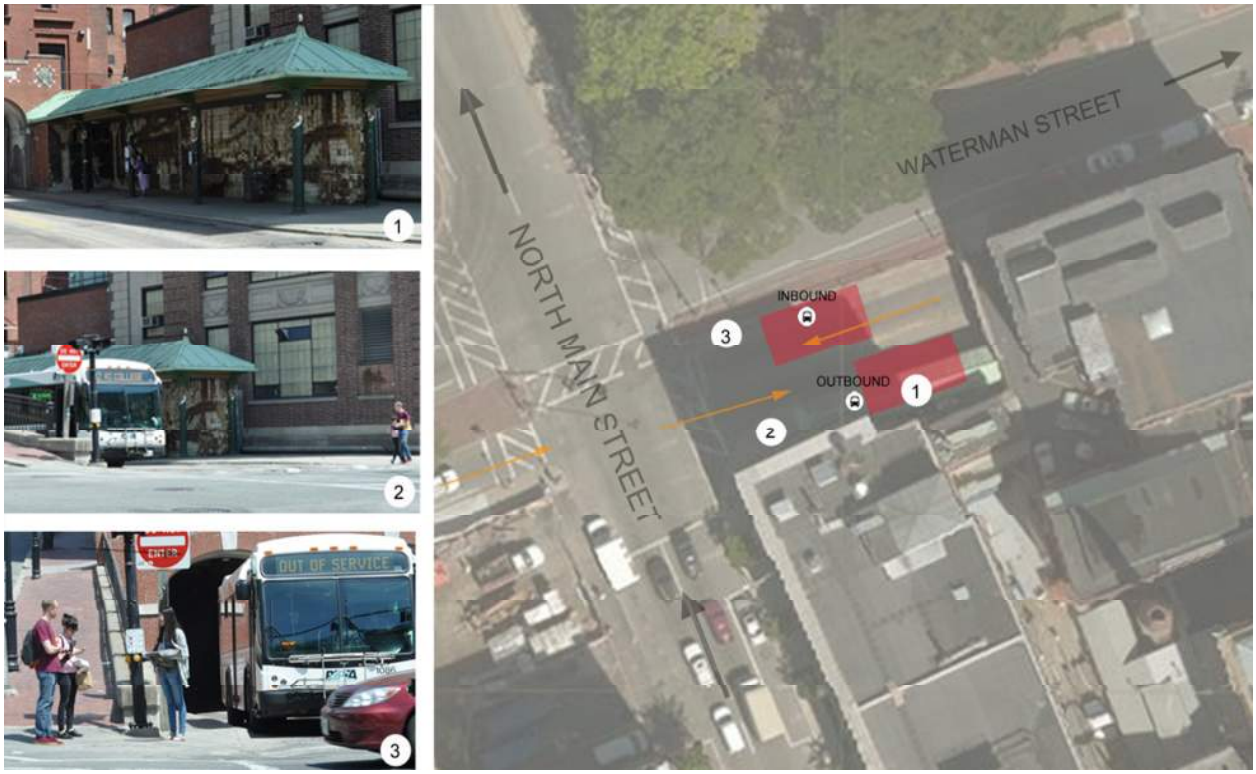


Figure 14: Waiting Area and Images

2.3.3 ACCESSIBLE PEDESTRIAN PATH

The outbound stop does have a clear path of travel from the waiting area and bus loading area to the surrounding neighborhood. As shown in *Figure 15,* the stop is perpendicular to the primary pedestrian travel path along North Main Street. There is a wide sidewalk that intersects with the primary circulation path, allowing direct access to the stop and the surrounding area. There is however no crosswalk for pedestrians at this intersection to cross North Main Street directly. They need to cross the bus-way to the other side of the stop in order to cross North Main Street. This can affect travel time for the buses going inbound as they have to wait for pedestrians to cross in front of them prior to turning out of the bus-way. An additional crosswalk may be required.

Figure 15: Accessible Pedestrian Path

The cross walk at the bus-way however is in poor condition and will need to be repaired and repainted for pedestrians. Currently individuals in wheel chairs need to go into the street and around potholes in the crosswalk in order to cross the bus-way. This is a hazard for both vehicles and pedestrians.

The inbound passengers have direct connections to the surrounding area; however these paths are not accessible. The crosswalk as mentioned previously is in poor condition and not accessible. The sidewalk is narrow at the intersection, with the pedestrian cross signal hindering the accessible path and allows minimal space to pass. This limits the amount of space allocated for individuals to wait to cross the street and still allow others to maneuver around them.

3.0 CURRENT CONDITION OF IDENTIFICATION & LOCATION

3.1 INTRODUCTION

This section contains an overview of the current locations of both bus stops in regards to pedestrian and vehicular traffic and the adjacent streets and the communities they serve. The location of the bus stop within the public transit network is critical for passengers, bus operators, traffic management, and overall performance of the public transit network.

Numerous factors define every bus stop. The site-specific characteristics of a stop provide the opportunity to create an aesthetic that will allow the station to seamlessly intergrade into its surrounding environment and become a fundamental piece of the surrounding community. The surrounding attractions and facilities need to be assessed, in most cases; they define the users and capacity of the station.

3.2 THAYER STREET STOP

3.2.1 TRANSIT STOP CHARACHTERISTICS

At the top of the east entrance/exit of the ESTT and contiguous to its intersection with Thayer Street, are located two bus stops – an inbound and an outbound *[Figure 16]*. The stops are located in the heart of Thayer Street, an area with heavy pedestrian and vehicular traffic. The stops service Brown University as well as the neighboring commercial area, while providing access to and from the RISD campus and parts west.

Figure 16: Thayer Street Bus Stop Characteristics

Thayer Street proper is composed of two lanes of one-way vehicular traffic and two parking lanes *[Figure 17]*. Vehicles travel in the north to south direction. Businesses along Thayer Street are primarily commercial, made up of small shops and restaurants serving the University population. Both pedestrian and vehicular traffic along the Thayer Street sidewalks and roadways can be characterized as heavy. There are times of the day when Thayer Street vehicular traffic can be characterized as congested.

RIPTA buses currently stop at the designated passenger loading areas at the top of the access road to the tunnel. The passenger loading area, illustrated in *Figure 18*, comprised of two lanes of two-way traffic designated for buses only. Adjacent to the tunnel are an active alley to the north with one-way vehicular traffic, and a pedestrian path to the south. The outbound buses stop just in front of the crosswalk before moving onto Thayer Street. The Inbound buses turn into the designated passenger loading area and stop in front of the retaining walls at the entrance to the ESTT.

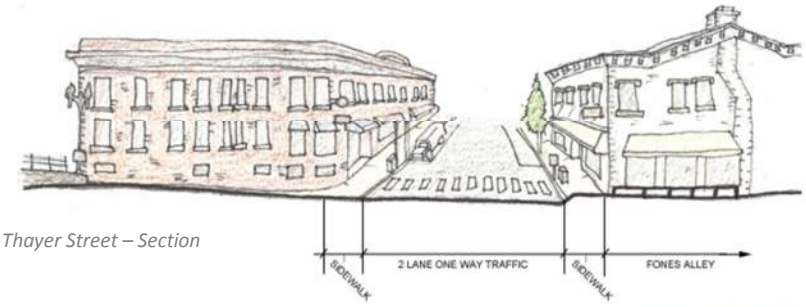


Figure 17: Thayer Street – Section

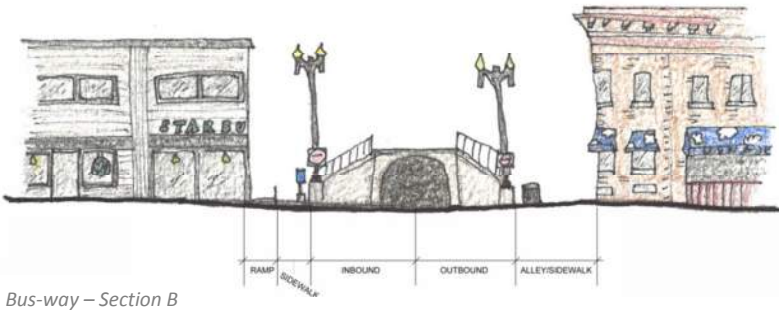


Figure 18: Thayer Street Stop Bus-way – Section B

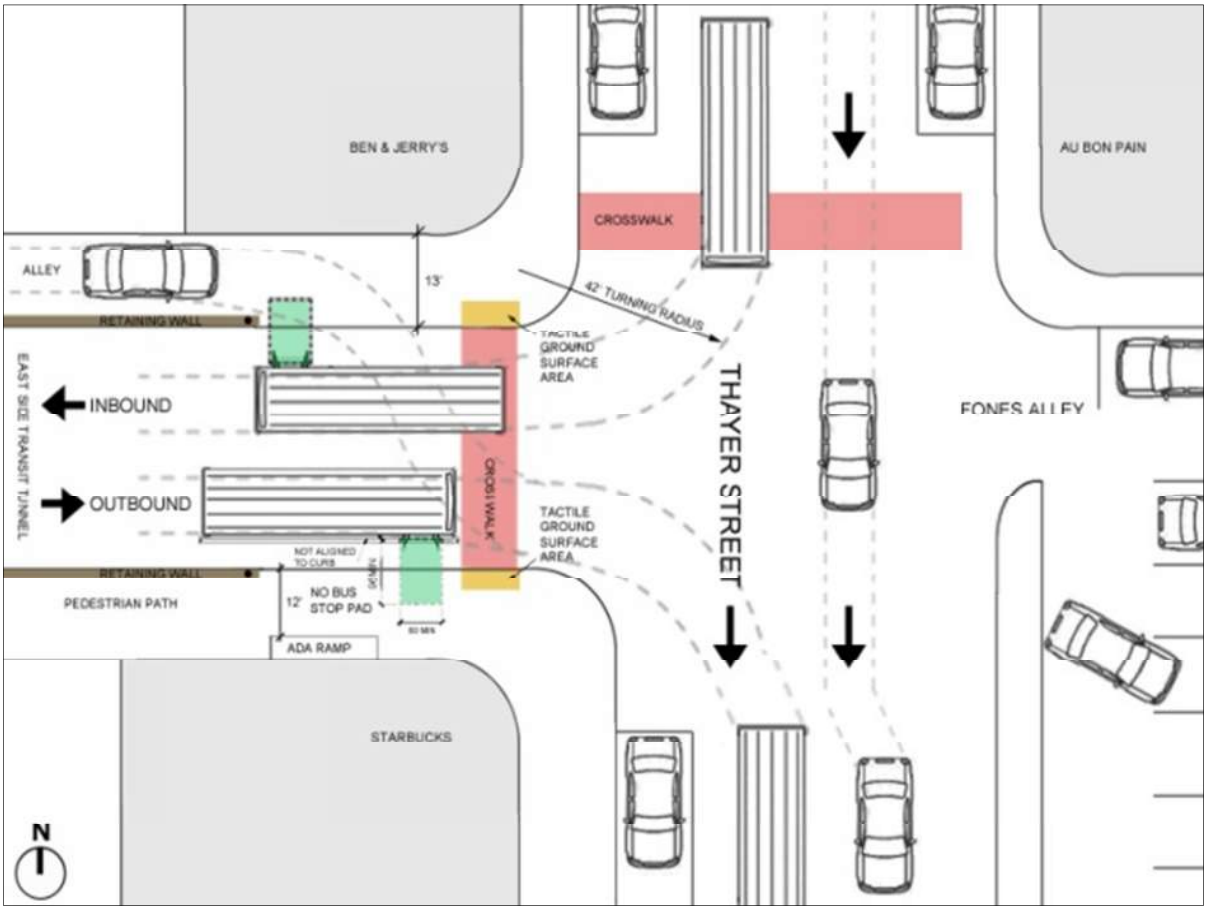


Figure 19: Thayer Street Bus Stop Locations

Advantages of the existing stops' locations:

- Designated passenger loading area off of the main street minimizes the traffic interference on Thayer Street.
- The driver going outbound has the advantage of viewing the full intersection activity at Thayer Street.
- Access to and from the surrounding road network is direct and limits the circuitous routing of buses.

Disadvantages of the existing stops' locations:

- Inbound buses are not always able to pull all the way through after turning off of Thayer Street and block the crosswalk *[Figure 20]*. This becomes a safety issue for the passengers and pedestrian traffic as they have to walk around the back of the bus and into the intersection to cross the bus-way. This interferes with vehicular traffic on Thayer Street, as cars have to wait on pedestrians to move out of the street.
- A bus stopped near the intersection may block sight lines for pedestrians crossing the intersection.
- Multiple buses queuing during peak hours going inbound block Thayer Street traffic due to inadequate space. This interferes with pedestrian and vehicular traffic as well.
- Due to wide turning radius of the buses, the bus may arrive several feet from the passenger loading area. When this condition happens boarding/alighting occurs in the bus-way.

Figure 20: Inbound Bus Stop

Figure 21: Outbound bus Stop

Figure 20: Unmaintained Inbound Stop

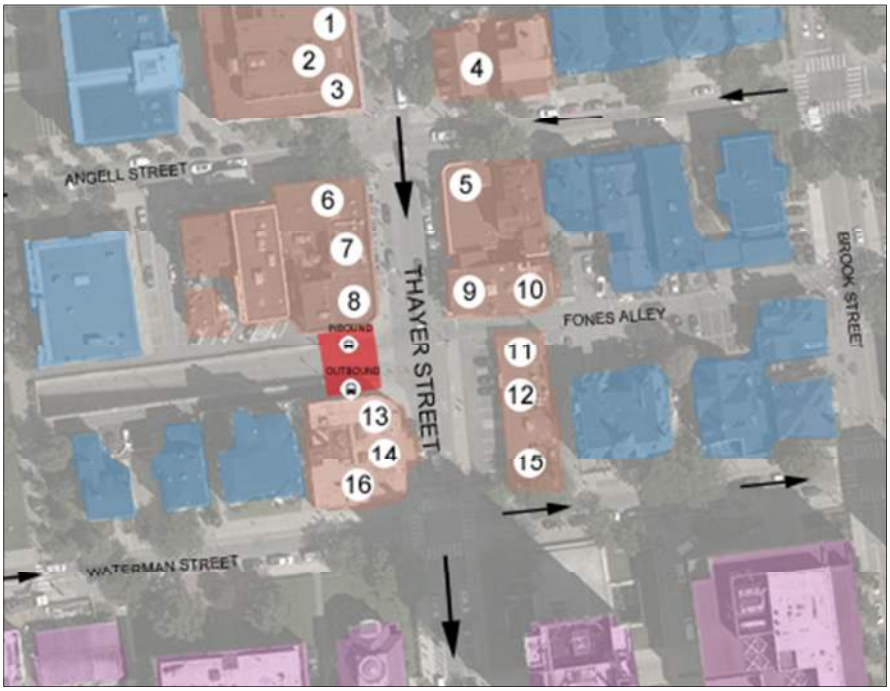
- Inbound buses have limited visibility of the stop prior to turning into the bus-way.
- Buses need to cut across two lanes merging onto Thayer Street or turning off of Thayer Street due to large turning radius, this interferes with vehicular traffic.
- There is no intersection control at this location. The vehicular traffic on Thayer Street is the primary circulation and takes priority at this intersection. This does not provide for bus priority. This condition increases the dwell time and overall delays bus services.
- No shelter to protect passengers from the weather is provided.
- During the winter the boarding and waiting areas are not maintained, causing passengers to wait in the bus-way instead of on the sidewalk. This is a safety concern.
- Due to the stops having no cover or enclosure, snow accumulates at the boarding/alighting area effecting accessibility *[Figure 21 & 22].*
- Snow accumulation in the bus-way inhibits the buses ability to pull fully to the curbside area, compromising accessibility *[Figure 23]*.

Figure 22: Snow Accumulation

Figure 23: Snow Accumulation

3.2.2 ADJACENT PROPERTIES

Thayer Street is a central gathering node for students and locals. It is an exceedingly high density area for both pedestrian and vehicular traffic due to the multitude of independent shops and commercial chains. The neighborhood has several university owned buildings as well as residential buildings. Adjacent to the stops are a Starbucks and Ben & Jerry's store *[Figure 24]*. These two businesses generate a large volume of pedestrian movement throughout the day. This creates a dynamic atmosphere as customers frequently come in and out of the businesses. These businesses, as well as others on Thayer Street, act as destination spots for individuals and entice people to the area. This improves the potential use of public transportation by increasing the amount of potential passengers at the stops in this area. A stronger presence of the stops can be developed in order to highlight them amongst the copious storefronts that make up the streetscape.



LEGEND

- Residential
- Commercial
- Institutional -Brown University
- Bus Stop

1 College Hill Cafe
2 Blue State Coffee
3 Kool Edge
4 Chipotle Mexican Grill
5 Tealuxe Inc.
6 Cafe Paragon
7 Viva Restaurant
8 Ben & Jerry's Ice Cream
9 Au Bon Pain
10 La Creperie
11 Metro Mart
12 Froyoworld
13 Starbucks
14 Better Burger Company
15 Verizon Wireless Zone
16 Santander Bank

Figure 24: Adjacent Properties

3.3 NORTH MAIN STREET STOP

3.3.1 TRANSIT STOP CHARACHTERISTICS

At the west entrance/exit to the ESTT and contiguous to its intersection with North Main Street are two bus stops – an inbound and outbound *[Figure 25].* The stops are located in a prominent vehicular intersection and dense pedestrian area, establishing an area of high activity. The stop services Rhode Island School of Design [RISD] as well as the neighboring residential and commercial areas providing access to parts east, including Brown University.

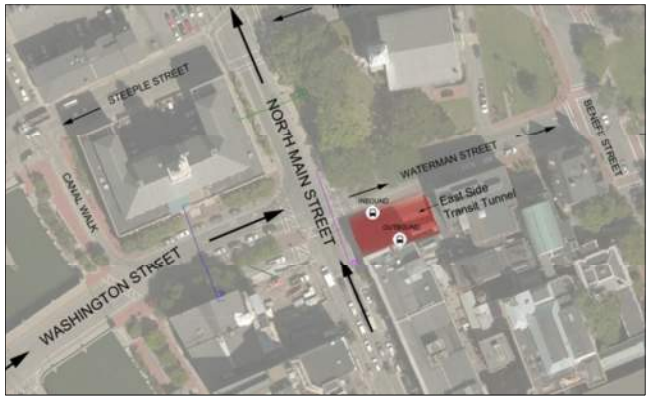


Figure 25: North Main Street Bus Stop Characteristics

The pedestrian traffic along North Main Street can be characterized as heavy. This is associated with its location within the RISD campus and the *Independence Trail* that runs along North Main Street. Washington and Waterman Street contribute moderate amount of pedestrian traffic as well. This area contains very dense vehicular traffic and pedestrian traffic as it services a multitude of programs including university buildings, tourist attractions, residential areas, and commercial buildings.

The buses at this location currently stop in their own designated area directly in front of the entrance/exit into the ESTT *[Figure 26].* The outbound buses stop before the tunnel entrance. The inbound buses stop after exiting the ESTT prior to the crosswalk.

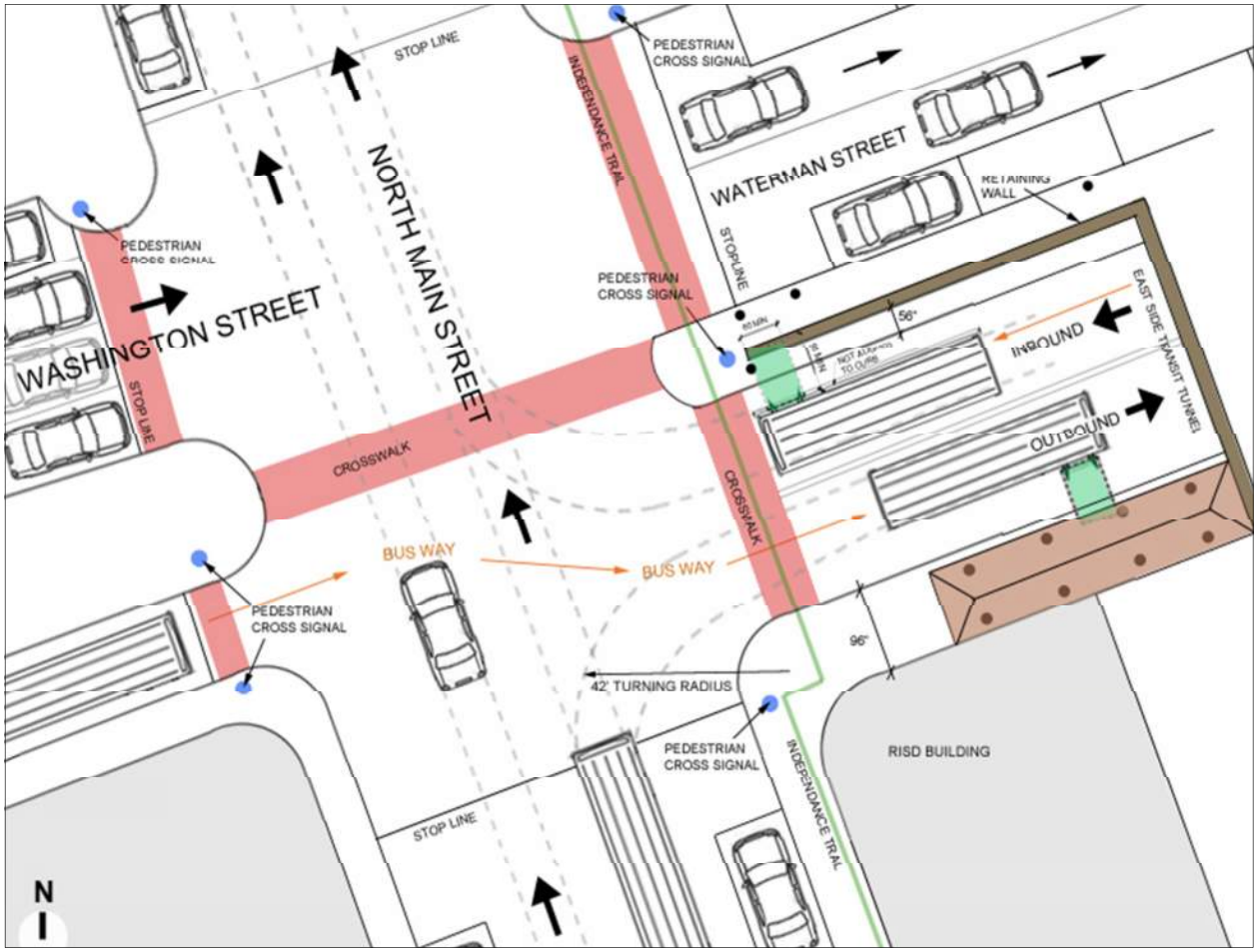


Figure 26: North Main Street Bus Stop Locations

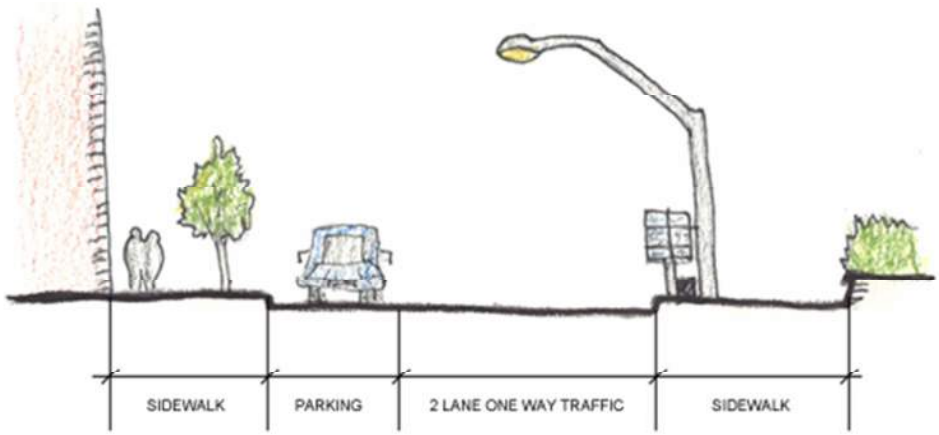


Figure 27: North Main Street

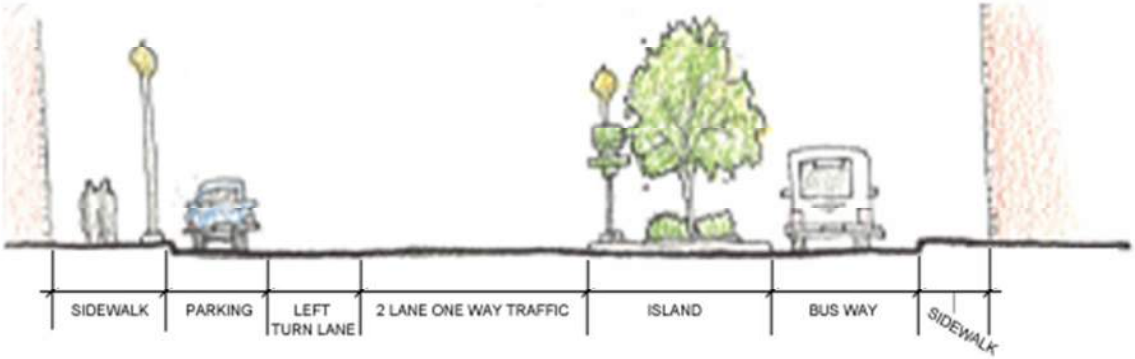


Figure 28: Washington Street

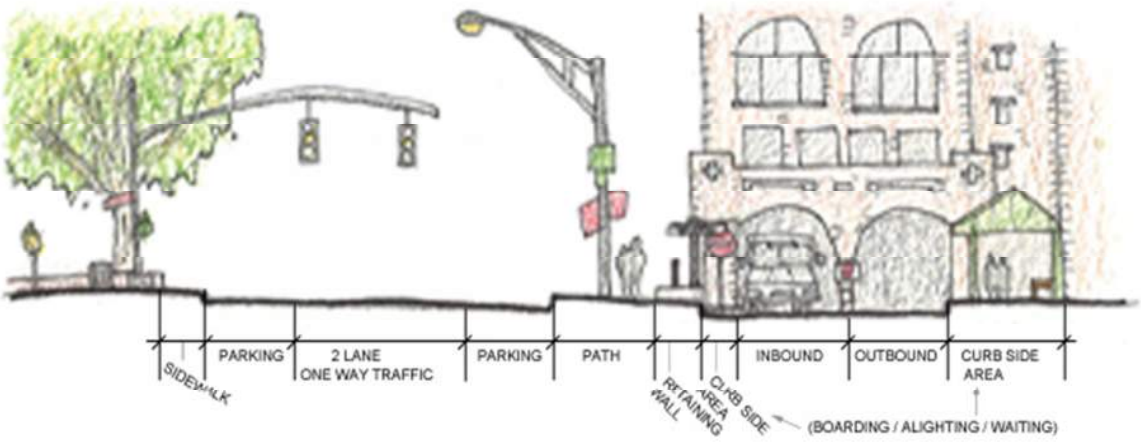


Figure 29: Waterman Street

North Main Street comprises of two lanes of one-way vehicular traffic and two parking lanes *[Figure 27]*. Vehicles travel in the south to north direction. Washington Street is composed of three lanes of one-way vehicular traffic, a designated bus lane, and one parking lane *[Figure 28]*. Vehicles travel in the west to east direction. Waterman Street contains two lanes of one-way vehicular traffic and two parking lanes, traveling in the west to east direction *[Figure 29]*.

Advantages of the existing stops' locations:

- Designated bus area off of the main street minimizes the traffic interference on North Main Street *[Figure 30]*.
- The driver has the advantage of viewing the full intersection activity at North Main Street.
- Access to and from the surrounding road network is direct and limits the circuitous routing of buses.
- Traffic lights manage the bus and vehicular traffic.
- A designated bus lane with traffic signals allows for minimal interference with vehicular and pedestrian traffic.
- Some passenger amenities are provided on the outbound stop to improve the passenger environment.

Figure 30: Full View of Intersection

Disadvantages of the existing stops' locations:

- A bus stopped near the intersection may block sight lines for pedestrians crossing the intersection.
- Multiple buses queuing during peak hours going outbound block the crosswalk and intersection.
- Inbound stop does not have an accessible boarding/alighting area
- Inbound stop has no protection against the elements.
- Enclosed shelters are not provided for the winter and colder months.
- Snow accumulation prohibits access to the stops, requiring passengers to walk into the bus-way. *[Figures 31 & 32]*

Figure 31: Snow Accumulation on Outbound

3.3.2 ADJACENT PROPERTIES

The immediate area around the North Main Street stops primarily services Rhode Island School of Design [RISD]. The neighborhood contains restaurants, coffee shops, and institutional buildings. *Figure 33* depicts the nearby attractions and amenities around the stop. This area is heavily used by students, and is a tourist area with the Providence Independent Trail along North Main Street sidewalk. The College Hill Tunnel is one of the identified stops along the trail, as well as the First Baptist Church, number 5. The implementation of the building typologies and programs near the bus stops is a very diverse node within the city. The heavily trafficked area presents an opportunity to promote public transit as opposed to private individual vehicular transit.

Figure 32: Snow Accumulation on Inbound

Figure 33: Adjacent Properties

LEGEND

- Residential
- Commercial
- Institutional -Brown University
- Bus Stop

1	Providence Art Club
2	Cafe Choklad
3	New Rivers
4	Fat Belly's Pub
5	First Baptist Church
6	RISD Museum
7	RISD Store
8	RISD Auditorium
9	The Chace Center
10	RISD Works
11	Gelman Gallery

4.0 CURRENT CONDITION OF INFORMATION FEATURES

4.1 INTRODUCTION

In order to provide a successful public transportation system for passengers, its parts that relate to human use should be easily identified and understood. To achieve this goal, design features and components should aid in the identification of the bus stop and its condition as a part of a network. Designating identifiable and appropriate locations for signage ensures easy access and navigation for passengers. This section identifies four primary information feature types:

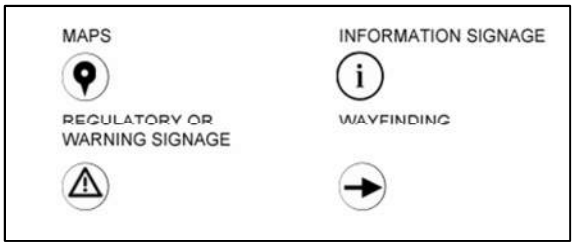
1. **Maps**: Generally provided on the bus stop post—however, additional maps may be needed at other locations if visibility to local landmarks is constrained. These should be located at landmarks that are easily identifiable and marked as information points.

2. **Regulatory or Warning Signage**: Should be suitable and visually discernable so as to catch attention without dominating or detracting from the aesthetics of the stop. Wherever possible, regulatory or warning signage should be placed on their own away from other signs.

3. **Information Signage**: Will likely be in relation to the use of the specific facility. Typically informational signage will only be placed within the transit stop's waiting area.

4. **Wayfinding**: Includes non-text or map based indicators that help facility pedestrian movement. These can include but are not limited to; paving patterns, arrows, vistas, colors and shapes, and path widths.

Bus stops should include both route and service time information for transit customers at a minimum. Additional signage may include signs directing passengers to nearby public facilities that are permanent, major civic attractions in proximity to the station.



4.2 THAYER STREET STOP

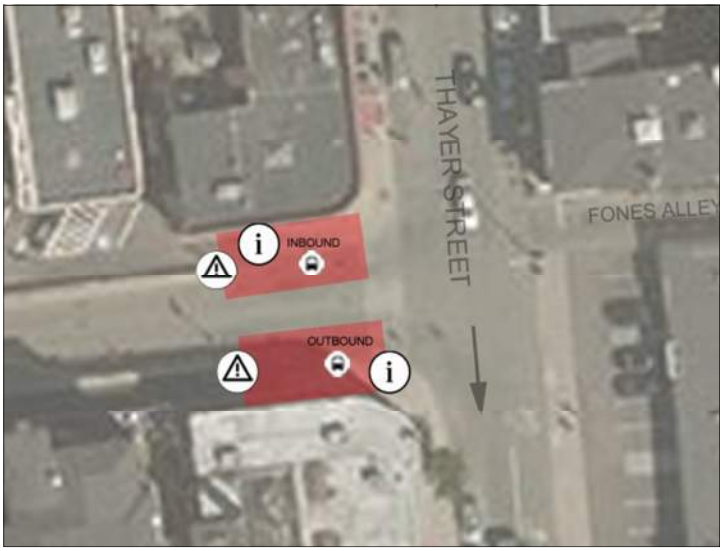


Figure 34: Thayer Street Information Features

Figure 35: Bus Only Sign

4.2.1 MAPS

The Thayer Street bus stops currently do not have any maps. This prevents users from identifying their location to the area's points of interest and location within RIPTA's transit network.

4.2.2 REGULATORY OR WARNING SIGNAGE

Thayer Street bus stops have two "DO NOT ENTER BUSES ONLY" signs mounted on the light poles at the end of the tunnels concrete retaining walls. The one on the outbound stop is in moderate condition. Several stickers are on the bottom half of the sign, but information is still visible. The second sign on the right inbound stop is in poor condition. The sign has been vandalized and is not legible. Additional regulatory signage should be introduced. Drivers of non-bus vehicles cannot identify the 'DO NOT ENTER" signage from Thayer street and enter the bus only zone blocking the entrance and exits to the bus way. Additional signage and indicators may be required to prevent unauthorized entry to the bus way.

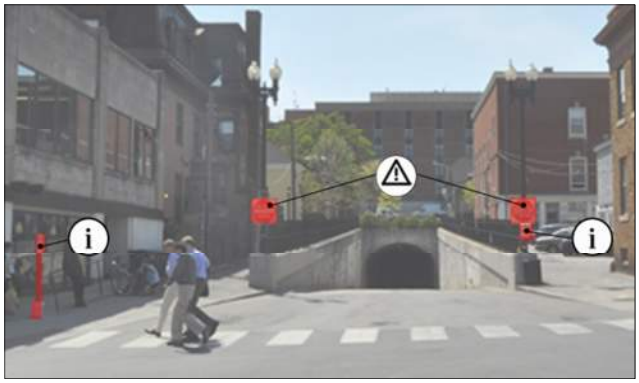


Figure 36: Regulatory/Warning Signage

4.2.3 INFORMATIONAL SIGNAGE

The Thayer Street bus stops currently have two informational signs as marked on *Figure 36*. These two signs are "Bus Stop" signs identifying the stops. The sign on the outbound side of the stop is mounted on a temporary post. It is visible from only one direction and does not significantly identify the transit stop. The second sign is mounted to the light post on the right of the tunnel entrance, inbound side. This sign is not legible as it has been vandalized. Informational signage should be replaced at both stops for users to be able to identify the routes and services at these locations.

4.2.4 WAYFINDING

The Thayer Street bus stops currently do not contain any wayfinding material or information. There is no distinction made between the transit stop, adjacent alley, or adjacent pedestrian path. The transit stop is homogenous and disappears within the environment. Users who are not familiar with the stop may have trouble identifying the stop. Additional wayfinding designs should be provided to increase identification of both bus stops.

4.3 NORTH MAIN STREET STOP

4.3.1 MAPS

The North Main Street bus stops currently do not have any maps. This prevents users of identifying their location to the area's points of interest and location within RIPTA's transit network.

4.3.2 REGULATORY OR WARNING SIGNAGE

As shown in *Figure 38*, the North Main Street bus stops have four regulatory or warning signs. The first *[*red*]*, is a "THRU TRAFFIC" sign at the exit of the East Transit Tunnel. This sign is faded and in moderate condition. The second sign type *[*blue*]*, is a "DO NOT ENTER" sign. The sign near the sidewalk is in good condition and is visible. *[Figure 38].* The sign near the tunnel entrance has minor damage and graffiti. It is in visually poor condition and is no longer mounted fully to the tunnel entrance. The third sign type *[*green*]* is a "PRIVATE PROPERTY" sign and is in moderate condition. Visibility of signage from North Main Street is poor. Drivers of non-bus vehicles cannot identify the 'DO NOT ENTER" signage from north main street and enter the bus only zone blocking the entrance and exits to the bus way. Additional signage and indicators may be required to prevent unauthorized entry to the bus way.

4.3.3 INFORMATIONAL SIGNAGE

The North Main Street bus stops currently have four informational signs *Figure 38.* The first sign [orange] is a "Bus Stop" sign. As depicted in *Figure 41*the sign is in poor condition. The sign has been vandalized and is partial covered with stickers making it difficult to view the information on the sign. This sign faces east towards the tunnel entrance/exit and is not visible to approaching pedestrians along the sidewalks of North Main Street. For an individual who is not familiar with the neighborhood, they may not be able to identify the bus stop. The second sign type *[*gray*]* is the outbound bus schedule. The schedule signs are in poor condition. They have been vandalized and are almost illegible. The third sign type [pink] is a "RISD RIDES" sign. There is minor vandalism and damage on the sign but no additional information is provided on the sign such as identifying which routes the stop services. This does not appear to be a RIPTA sign. Informational signage should be replaced for users to be able to identify the routes that service the stop.

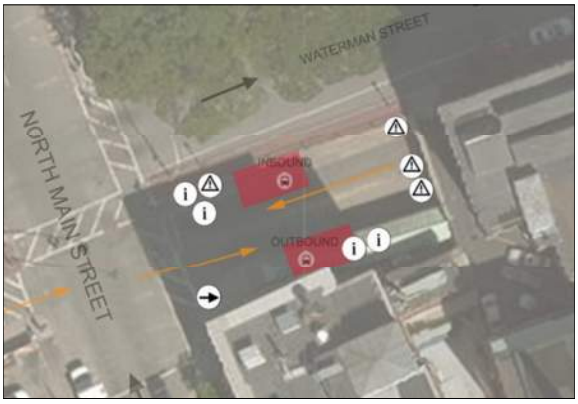


Figure 37: North Main Street Stop Information Features

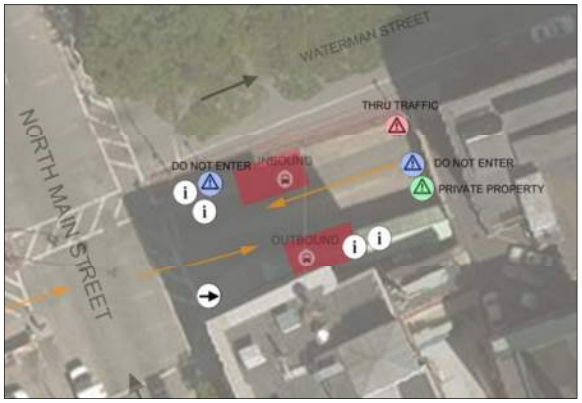


Figure 38: Regulatory/Warning Signage

Figure 39: Regulatory/ Warning Signage Images

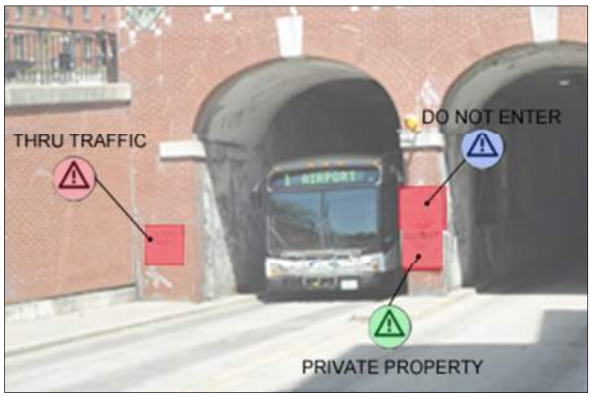


Figure 40: Regulatory/ Warning Signage Images

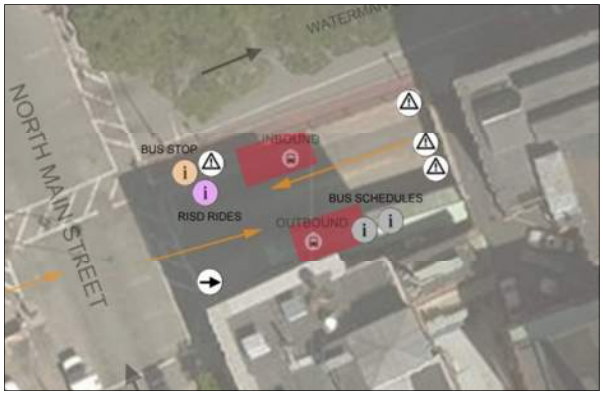


Figure 41: Information Signage

4.3.4 WAYFINDING

The North Main Street bus stops currently do have some wayfinding elements for the outbound side *[Figure 44]*. The wider sidewalk assists in highlighting the allocated space for gathering, which is emphasized by the shelter adjacent to the ESTT entrance/exit. The inbound side however is not distinguishable from its surrounding as no designated area has been defined for this stop. Users who are not familiar with the stop may have trouble identifying the stop. Additional wayfinding designs should be provided to improve stop identification.

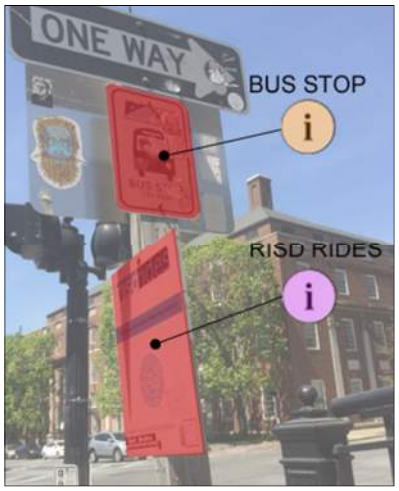


Figure 42: Information Signage

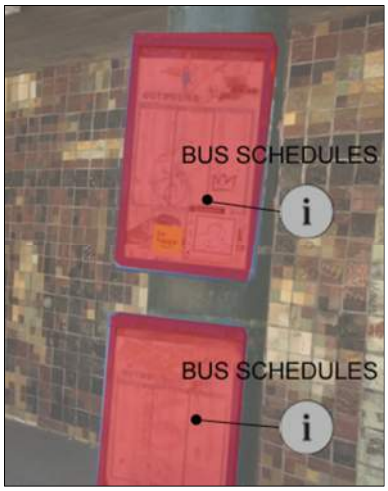


Figure 43: Information Signage

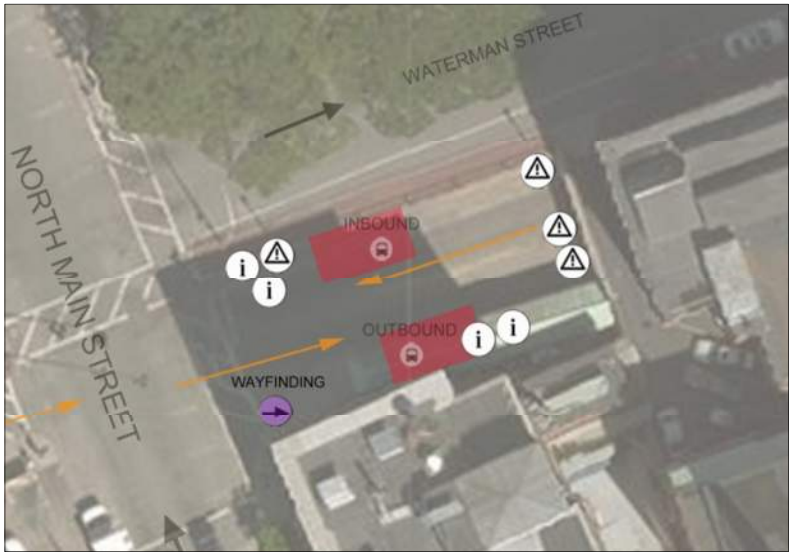


Figure 44: Wayfinding

Figure 45: Wayfinding Image

5.0 CURRENT CONDITION OF PASSENGER AMENITIES

5.1 INTRODUCTION

Passenger amenities are the stops' features that enhance it and provide additional convenience and comfort to passengers. The amenities help to improve the visibility of a transit stop, which raises awareness of the alternative mobility option of public transit as opposed to individual vehicles.

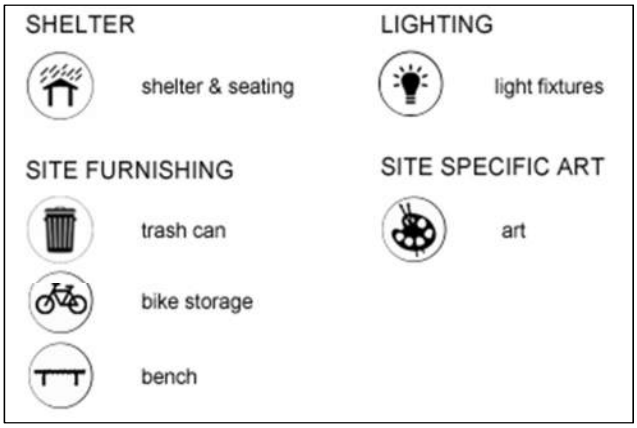
1. **Shelter**: Provides protection for the passengers from weather conditions while waiting. The shelter should be located along an accessible path and have a clear view to the bus loading pad.

2. **Site Furnishing**: Exterior site furnishing options can be provided to enhance the passenger experience. This can include but is not limited to; benches, resting or leaning rails, trash and recycling receptacles, bollards, and bicycle parking. When present, the site furnishing should be ADA-compliant and the location of the site furnishing should not impede with accessibility to and from the transit stop.

3. **Lighting**: Should provide amble amount of lighting to provide a safe, comfortable, and functional transit stop.

4. **Site Specific Art**: Enhances the transit stop quality and attractiveness. Where possible, public art should be integrated into the functional elements of the station. It can complement the facility and the surrounding environment in which it is located. Art work can enhance the identity and cultural significance of a place.

AMENITIES LEGEND



5.2 THAYER STREET STOP

5.2.1 SHELTER

Thayer Street bus stops currently have no shelters provided for passengers. For protection against the weather passengers wait for their bus under the awnings of the adjacent businesses to the stop. This interferes with the circulation of users going in and out of those businesses during peak hours. Others wait inside Starbucks for their bus. The current condition does allow these passengers to see the buses when they arrive at the stop but may cause travel delays if the bus is made to wait longer for them to reach the bus and board. During rain or winter months there is no protection against the harsh elements.

5.2.2 SITE FURNISHING

As shown in *Figure 46,* there are minimal site furnishings at Thayer Street bus stops. There is a trash receptacle on the inbound side of the stop, not the outbound. This receptacle is in front of the concrete retaining walls of the ESTT, and interferes with boarding. Additional trash and recycling receptacles are located on Thayer Street at the corner proceeding to the bus stop and across the street at the corner of Thayer Street and Fones Alley. *[Figure 47].*

There is no seating provided on either the inbound or outbound side of the stop. There is a rail that passengers use as a place to rest on the outbound side. The concrete retaining walls of the ESTT are used by passengers to lean on as well on both the inbound and outbound sides of the stop. On the Inbound side, due to no seating being provided, passengers sit on the windowsills of the adjacent building for relief. This is not an ideal condition for users.

Shown in *Figure 48* users use the rail as bicycle storage. However, this rail is for the ramp into Starbuck's entrance.

5.2.3 LIGHTING

There are two lights at the end of the concrete retaining walls of the tunnel, as shown in *Figure 49.* This will not be adequit lighting for the transit stop and should be reviewed further.

5.2.4 SITE SPECIFIC ART

There is currently no site specific art at Thayer Street stop.

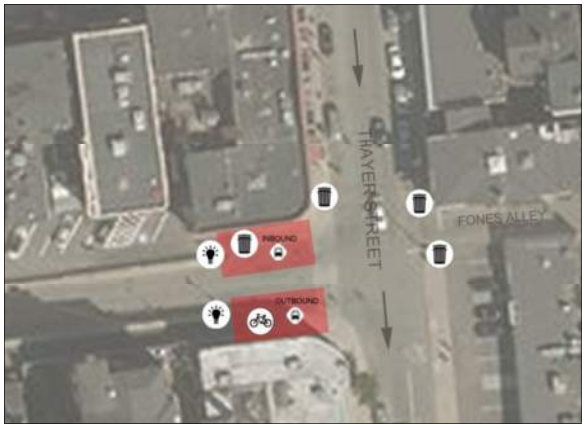


Figure 46: Thayer Street Stop Passenger Amenities

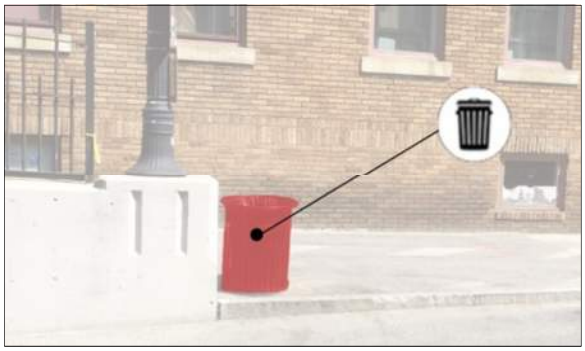


Figure 47: Location of Trash Can Receptacles

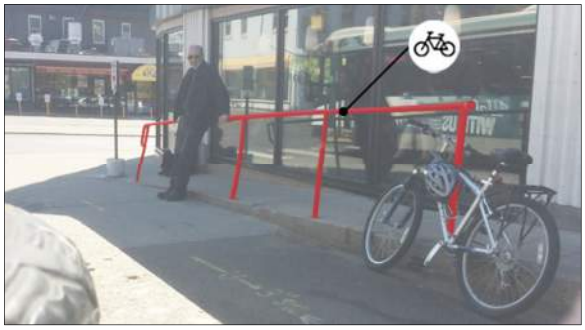


Figure 48: Railing used as Bicycle Storage

Figure 49: Light Features

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5.3 NORTH MAIN STREET

5.3.1 SHELTER

The North Main Street bus stops currently have one shelter for the outbound passengers. The shelter is enclosed on two sides and provides protection against sun and rain. The shelter is in fair condition, but can be refurbished. It is accessible and covers the waiting and boarding areas, with amble enough room for passengers during peak hours. The inbound stop does not have a shelter, leaving patrons with no protection against the elements.

5.3.2 SITE FURNISHING

Identified in *Figure 50* and highlighted in and *Figure 51* are the site furnishings on the outbound stop. Under the shelter there is a trash receptacle, in poor condition. It has been vandalized and diminishes the aesthetic appeal of the stop. The receptacle is a movable element and may be considered for replacement. In addition identified in both *Figures 50* and *51* is a steel framed wooden bench underneath the shelter for the outbound stop. It is in moderate condition and should be replaced.

There is no site furnishing provided for the inbound stop, and is overall absent of most amenities. Due to the lack of amenities the stop lacks definition. Additional site furnishing should be considered to improve the existing conditions to encourage more individuals to use the transit stop.

5.3.3 LIGHTING

Figures 51 and *52* identifies the locations where there are light fixtures for the outbound and inbound bus stops are located.

There are currently three light fixtures on the ceiling of the outbound stop's shelter. There are however no dedicated lights outside of the shelter for the curbside area. Additional lighting here will benefit the environment to make it more welcoming and safe to passengers. The inbound side does not contain stop specific lighting. There are two street lights however on the sidewalk adjacent to the stop that provides light. Additional stop dedicated lighting will be required.

5.3.3 SITE SPECIFIC ART

Incorporated into the shelter on the outbound stop is an art piece *[Figure 53]*. The piece comprises two full walls of ceramic tiles. Each tile is unique in its color and design, creating a large mosaic mural within the streetscape. This aids in enhance the identity of the transit stop and improve the passenger experience. The tiles are beginning to come off of the walls and will need to be repaired.

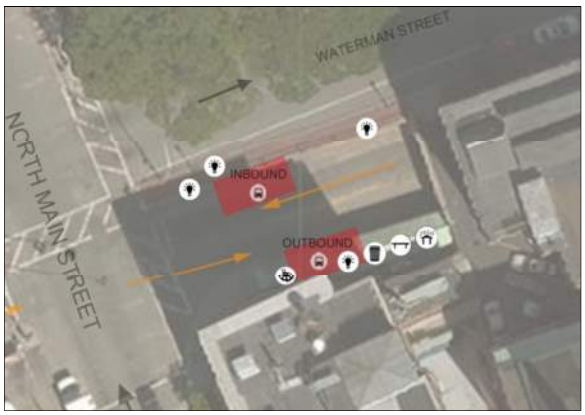


Figure 50: North Main Street Stop Passenger Amenities

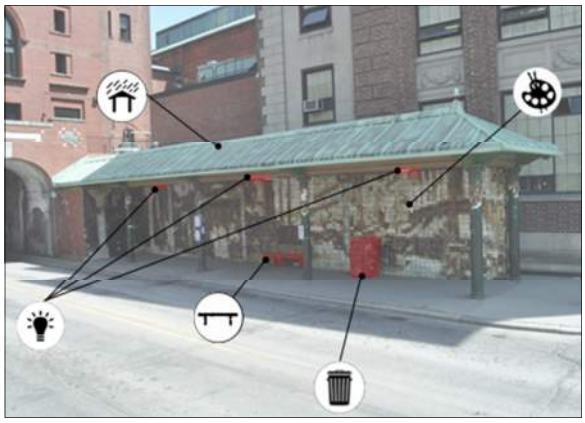


Figure 51: North Main Street Stop passenger Amenities Images

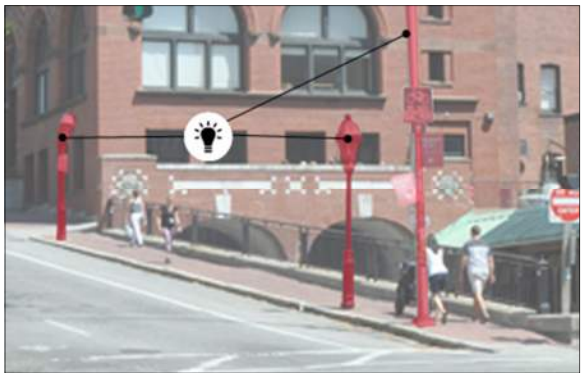


Figure 52: North Main Street Stop passenger Amenities Images

Figure 53: Site Specific Art

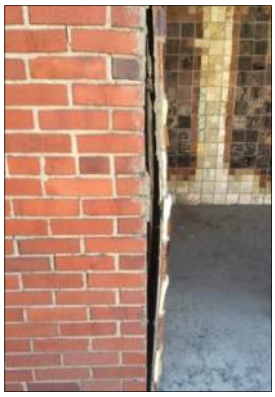


Figure 54: Damaged Tile

6.0 PRELIMINARY RECOMMENDATIONS

6.1 INTRODUCTION

Each section, 6.2 and 6.3, is broken into three subsections in order to outline and clearly define the current issues with the bus stops at Thayer Street and North Main Street – inbound and outbound, and recommendations on how to resolve these problems. The three subsections are:

1. **Identification of Issues:** Outlines the major issues that were identified in *Section 2.0 – 5.0* for the inbound and outbound bus stops at Thayer Street and North Main Street. These are preliminary findings that have not been prioritized, and represent the initial review of the site conditions.

2. **Minimum Improvement Recommendations:** Are improvements that are required by code and good practice. The elements that are identified in this section for improvement are; boarding/alighting area, waiting area, accessible pedestrian path, and signage.

3. **Enhanced Improvement Recommendations:** These improvements will improve the environment of the stops, but are not required. These are possible solutions that can be entertained to improve and enhancing the transit stops.

It is important to identify what makes a successful bus stop when prioritizing improvements. There are many point of views to consider when deciding what defines a desirable transit stop. These include:

- Passengers
- Adjacent businesses
- Residents
- Transit agencies

Passengers expect a transit stop to be comfortable, convenient, and safe. These are essential aspects of every stop and should be weighed heavily when reviewing and improving transit stop. Though the passenger's perceptions and needs are essential in the success of public transportation, transit stops must also meet operational objectives. The efficiency and maintenance of the transit system should be considered when making changes to the bus stops.

6.2 THAYER STREET RECOMMENDATIONS

6.2.1 IDENTIFICATION OF ISSUES

Table 6.2.1 Thayer Street Bus Stops' Issues presents the issues identified in the preliminary findings in the previous sections. The issues that have been identified have not been prioritized, and represent the initial review of the sites conditions. These recommendations will improve the environment for the passengers and surrounding community and help to identify and promote public transit.

Table 6.2.1: Thayer Street Bus Stops' Issues

CATEGORIES	ELEMENT/ISSUE	INBOUND	OUTBOUND
Curbside Area	**Boarding and Alighting Area:**		
	• Designated area is not well defined.	X	X
	• Level boarding not available.	X	X
	Waiting Area:		
	• Not clearly defined.	X	-
	• Not easily identifiable.	X	X
	Accessible Pedestrian Path:		
	• A designated pedestrian path from the curbside area of the bus stop to the surrounding neighborhood is not provided.	X	-
Identification & Location	**Pedestrian Safety:**		
	• Crosswalk is blocked by bus; pedestrians must walk into the street.	X	-
	• Bus stopped at intersection may block sight line for pedestrians.	X	X
	Vehicular Traffic:		
	• The large turning radius of the buses requires them to cut across multiple vehicular lanes, interfering with traffic.	X	X
	• Intersection control is not provided.	X	X
	• During peak hours while one bus is dwelling there is no allocated space for queuing bus. They currently wait midway into the intersection and interfere with the vehicular traffic.	X	-
	• Drivers have limited visibility from Thayer Street to the bus stop prior to turning into bus-way.	X	-
Information Features	**Maps:**		
	• No maps provided.	X	X
	Regulatory/Warning Signage:		
	• Moderate to poor condition of existing signs.	X	X
	Information Signage:		
	• Moveable Bus Stop identification sign.	-	X
	• Minimal visibility of identification signage.	X	X
	• Sign damage/vandalized.	X	-
	• Signage for bus routes that service the stop is not provided.	X	X
	• Signage for bus schedule times is not provided.	X	X
	Wayfinding:		
	• No distinction made between the transit stop and the surrounding area.	X	X
Passenger Amenities	**Shelter:**		
	• No protection from the elements is provided at the stop.	X	X
	Site Furnishing:		
	• Trash/recycling receptacle are not provided.	-	X
	• Seating is not provided.	X	X
	• Bicycle storage is not provided.	X	X
	• Site furnishing (trash receptacle) interferes with accessible path/boarding area.	X	-
	Lighting:		
	• Minimal lighting of bus stops provided via non-stop light fixtures.	X	X
	• No stop specific lighting provided.	X	X

6.2.2 MINIMUM IMPROVEMENT RECOMMENDATIONS

The minimum components of a transit stop include;

- Boarding and alighting area
- Waiting area
- Accessible pedestrian path
- Signage

Designated bus stop location allows for a higher visibility and awareness to the public transit. Introduction of informational signage helps to identify the stop and provide passengers with a greater understanding of the public transit network. This will help strengthen public transit and raise awareness of the systems that are currently provided, minimizing the amount of private

vehicular transportation. With the existing active alley being blocked off, the inbound stop at Thayer Street can remain in its current location. Alterations to the stop are recommended to be done to reduce safety concerns and have an accessible boarding and alighting area. The boarding and alighting area will need to be leveled to comply with ADA section *810.2.4 Slope* which specifies parallel to the roadway, the slope of the bus stop boarding and alighting area shall be the same as the roadway, to the maximum extent practicable. Perpendicular to the roadway, the slope of the bus stop boarding and alighting area shall not be steeper than 1:48.

Including passenger amenities is recommended but not required. *Table 6.2.2: Thayer Street Bus Stops' Recommendations* identifies the components to improve for both the inbound and outbound transit stops at Thayer Street. These are in response to the issues identified in *Table 6.2.1: Thayer Street Bus Stops' Issues.* A final decision on individual components and/or requirements for the bus stops will be determined upon future input from RIPTA.

Table 6.2.2: Thayer Street Bus Stops' Recommendations

CATEGORIES	COMPONENT	RECOM	INBOUND	OUTBOUND
Curbside Area	• Designated/marked boarding and alighting area.	M	X	X
	• Provide level boarding/alighting area.	M	X	X
	• Designated/marked waiting area that is easily identifiable.	M	X	X
	• Pedestrian refuge/crossing provided at intersection for pedestrians to cross Thayer Street and bus-way.	M	X	X
	• Provide a designated pedestrian accessible path to/from curbside area and surrounding neighborhood.	M	X	X
	• Tactile ground surface area to aid visually impaired.	E	X	X
Identification & Location	• Provide designated/marked curbside area that does not interfere with pedestrian paths or visibility.	M	X	X
	• Provide a traffic light at the intersection and allow for bus priority to minimize delays in service.	M	-	X
	• Relocation of transit stops.	E	X	-
	• Designated/marked bus queuing area.	E	X	-
Information Features	• Provide transit stop location, number/name	M	X	X
	• Provide fare zone information.	E	X	X
	• Stop specific timetable (departure/arrival times).	M	X	X
	• Identify the routes serving the transit stop.	M	X	X
	• Route destination and stops location within the overall public transit network.	E	X	X
	• Real-time information provided.	E	X	X
	• Public transportation locality map identifying neighborhood amenities and important location within the vicinity of the stop.	M	X	X
	• Bus Zone signage.	M	X	X
	• Stop Identification sign (marker).	E	X	X
	• RIPTA branding signage or elements.	E	X	X
Passenger Amenities	• Additional stop designated lighting.	E	X	X
	• Provide fully enclosed or covered shelter.	E	X	X
	• Provide seating.	E	X	X
	• Provide additional trash/recycling receptacle.	E	X	X
	• Bicycle rack/storage.	E	X	X
	• Site specific public art to improve stop environment.	E	X	X

M - Minimum Recommended changes. E - Enhanced changes to improve the passenger experience.

6.2.3 ENHANCED IMPROVEMENT RECOMMENDATIONS

The enhanced improvement recommendations include;

- Additional ground tactile surface area.
- Additional bus stop specific lighting.
- Fully enclosed shelters.
- Additional seating.
- Additional signage.
- Trash and recycling receptacles at inbound and outbound stops.
- Alternative ground paving to aid in stop identity.
- Tactile ground surface area at boarding/alighting to aid visually imparted.

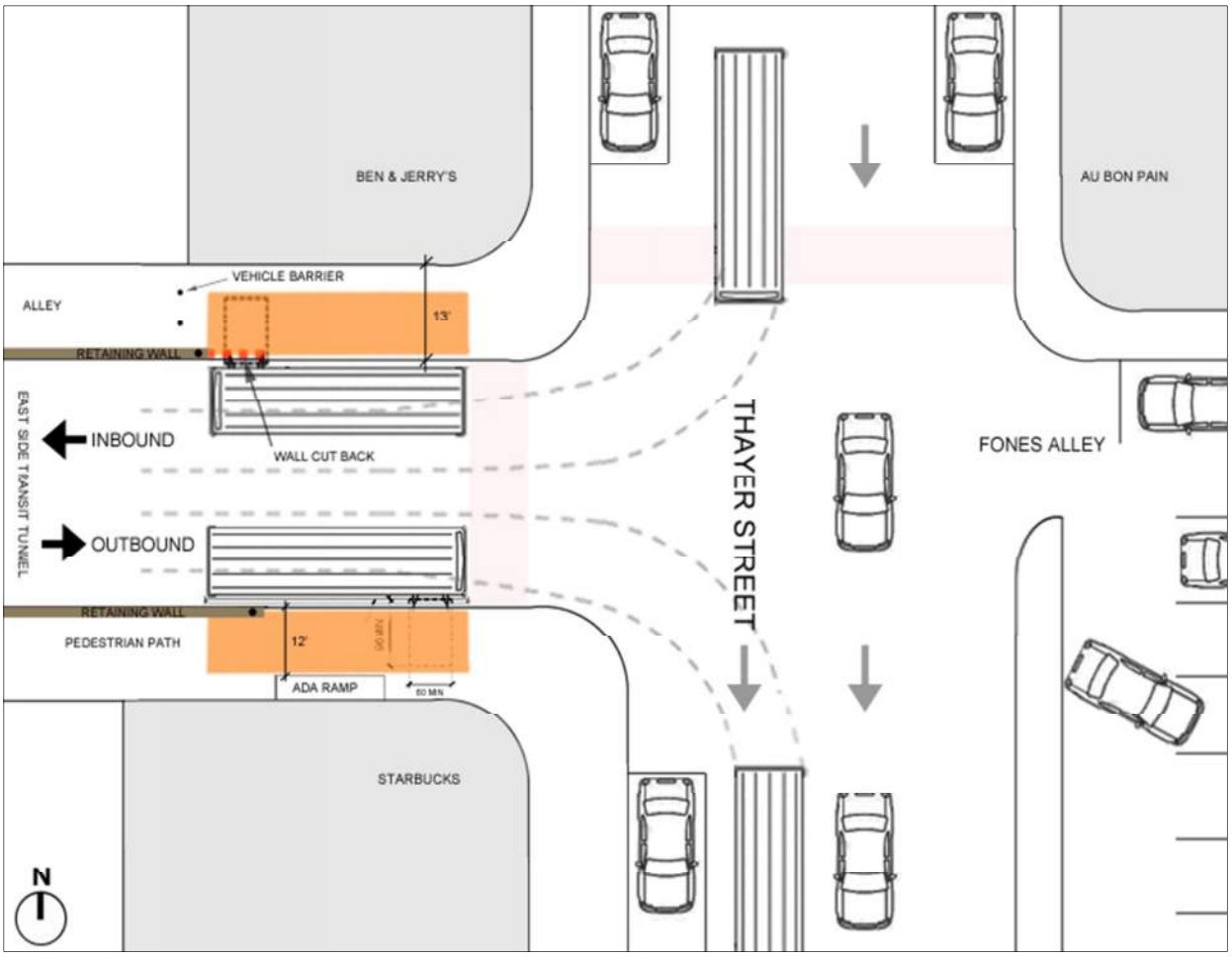


Figure 55: Thayer Street Stop Locations

These recommendation features help to improve the user experience and provide layering of the streetscape in which the bus stop no longer disappears into its context, but is a clearly discernable element within the streetscape. This will improve the identification of the stop and the alternative option of transportation. By providing a similar language for all stops, users can begin to identify stops based on grouping of the elements within the stop. Creating a uniform image for the bus network heightens the users understanding of the network.

The current location for Thayer Street's outbound stop has a sufficient amount of space but requires adjustments to comply with code and safety concerns. This includes leveling the boarding and alighting area to comply with ADA *section 819.2.4.* As shown in *Figure 55* the retaining wall adjacent to the inbound stop and active alley will need to be partially removed and cut back in order to provide enough space for the buses to pull up further and not block the crosswalk at the street entrance to the ESTT.

The vehicular traffic for this option will be reestablished, as the active alley adjacent to the tunnel will be blocked off. This will prevent vehicular traffic from interfering with the waiting and boarding area and reduce the safety concerns at this location. In addition the intersection control at the intersection can be examined to give bus priority through an additional traffic signal at this location. This will decrease the dwell time for the buses and reduce the overall delays in bus services.

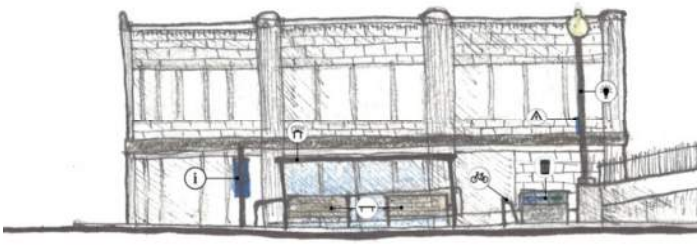


Figure 56: Thayer Street Proposed Elevation (Outbound)

Figure 57: Thayer Street Proposed Plan (Outbound)

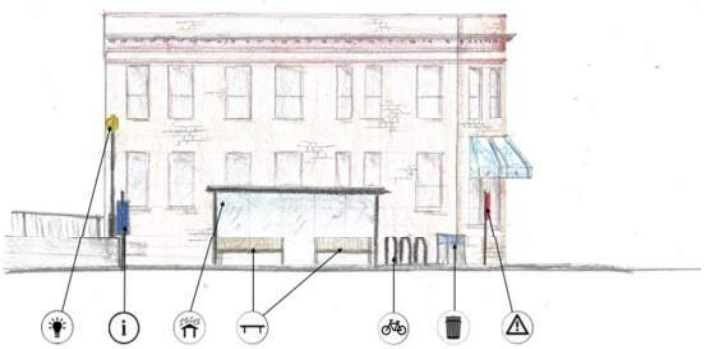


Figure 58: Thayer Street Proposed Elevation (Inbound)

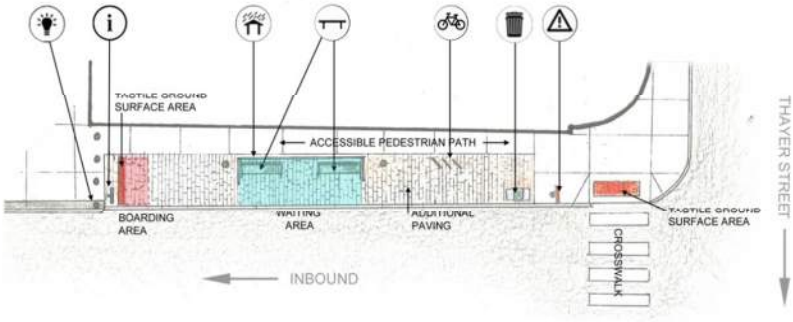


Figure 59: Thayer Street Proposed Plan (Inbound)

6.3 NORTH MAIN STREET RECOMMENDATION

6.3.1 IDENTIFICATION OF ISSUES

Table 6.3.1 North Main Street Bus Stops' Issues presents the issues identified in the preliminary findings in the previous section. The issues that have been identified have not been prioritized, and represent the initial review of the sites conditions. These recommendations will improve the environment for the passengers and surrounding community and help to identify and promote public transit.

Table 6.3.1: North Main Street Bus Stops' Issues

CATEGORIES	ELEMENT/ISSUE	INBOUND	OUTBOUND
Curbside Area	**Boarding and Alighting Area:**		
	• Designated area is not clearly identifiable.	X	-
	• Existing curb edge is not wide enough to comply with ADA.	X	-
	• Level boarding not available.	X	X
	Waiting Area:		
	• Not clearly defined.	X	-
	• Current location where passengers wait interferes with the current boarding and alighting area.	X	-
	Accessible Pedestrian Path:		
	• Crosswalk in bus-way is in poor condition, causing pedestrians to walk into the street.	X	X
	• Limited sidewalk space to maneuver.	X	-
	• Pedestrian cross signal interferes with accessible path.	X	-
Identification & Location	**Pedestrian Safety:**		
	• Bus stopped at intersection may block sight line for pedestrians.	X	X
	Vehicular Traffic:		
	• Queuing during peak hours interferes with intersection due to inadequate space.	-	X
Information Features	**Maps:**		
	• Neighborhood maps are not provided.	X	X
	Regulatory/Warning Signage:		
	• Moderate to poor condition of existing signs.	X	X
	Information Signage:		
	• Poor visibility of identification signage.	X	X
	• Sign damage/vandalized.	X	X
	• Signage for bus routes that service the stop is not provided.	X	-
	• Signage for bus schedule times is not provided.	X	-
	Wayfinding:		
	• No distinction made between the transit stop and the surrounding area.	X	-
Passenger Amenities	**Shelter:**		
	• Protection from the elements is not available at the stop.	X	-
	• Open shelter; does not protect against the cold.	-	X
	Site Furnishing:		
	• Trash/recycling receptacle are not provided.	X	-
	• Trash receptacle in poor condition.	-	X
	• Seating is not provided.	X	-
	• Minimal seating in moderate condition.	-	X
	• Bicycle storage is not provided.	X	X
	Lighting:		
	• Minimal lighting of bus stops provided via non-stop light fixtures.	X	-
	• No stop specific lighting provided.	X	-
	Site Specific Art:		
	• Art is damaged.	-	X

6.3.2 MINIMUM IMPROVEMENT RECOMMENDATIONS

The minimum components of a transit stop include;

- Boarding and alighting area,
- Waiting area,
- Accessible pedestrian path
- Signage

Designated bus stop location allows for a higher visibility and awareness to the public transit. Introduction of informational signage helps to identify the stop and provide passengers with a greater understanding of the public transit network. This will help strengthen public transit and raise awareness of the systems that are currently provided, minimizing the amount of private vehicular transportation. The boarding and alighting area will need to be leveled to comply with ADA *section 810.2.4* Slope which specifies parallel to the roadway, the slope of the bus stop boarding and alighting area shall be the same as the roadway, to the maximum extent practicable. Perpendicular to the roadway, the slope of the bus stop boarding and alighting area shall not be steeper than 1:48.

Including passenger amenities is recommended but not necessary. *Table 6.3.2: North Main Street Bus Stops' Recommendations* identifies the components to improve for both the inbound and outbound transit stops at Thayer Street. These are in response to the issues identified in *Table 6.3.1: North Main Bus Stops' Issues* The components are recommendations only. A final decision on individual components and/or requirements for the bus stops will be determined upon future input from RIPTA.

Table 6.3.2: North Main Street Bus Stops' Recommendations

CATEGORIES	COMPONENT	RECOM	INBOUND	OUTBOUND
Curbside Area	• Designated/marked boarding and alighting area.	M	X	X
	• Provide level boarding/alighting area.	M	X	X
	• Designated/marked waiting area that is easily identifiable.	M	X	X
	• Pedestrian refuge/crossing provided at intersection for pedestrians to cross North Main Street.	M	X	X
	• Repair crosswalk and repaint.	M	X	X
	• Pedestrian accessible path to/from curbside area and surrounding neighborhood.	M	X	X
	• Tactile ground surface area to aid visually impaired.	E	X	X
Identification & Location	• Provided designated/marked curbside area that does not interfere with pedestrian paths or visibility.	M	X	X
	• Relocation of transit stops.	M	X	-
	• Designated/marked bus queuing area.	E	-	X
Information Features	• Provide transit stop location, number/name	M	X	X
	• Provide fare zone information.	E	X	X
	• Stop specific timetable (departure/arrival times).	M	X	-
	• Identify the routes serving the transit stop.	M	X	-
	• Route destination and stops location within the overall public transit network.	E	X	X
	• Real-time information provided.	E	X	X
	• Public transportation locality map identifying neighborhood amenities and important location within the vicinity of the stop.	M	X	X
	• Bus Zone signage.	M	X	X
	• Stop Identification sign (marker).	E	X	X
	• RIPTA branding signage or elements.	E	X	X
Passenger Amenities	• Additional stop designated lighting.	E	X	-
	• Provide fully enclosed or covered shelter.	E	X	X
	• Provide seating.	E	X	-
	• Provide additional seating.	E	-	X
	• Provide trash/recycling receptacle.	E	X	X
	• Bicycle rack/storage.	E	X	X
	• Provide site specific public art to improve stop environment.	E	X	X

M - Minimum Recommended changes. E - Enhanced changes to improve the passenger experience.

6.3.3 ENHANCED IMPROVEMENT RECOMMENDATIONS

The enhanced improvement recommendations include;

- Relocation of the bus stop.
- Additional ground tactile surface area.
- Additional bus stop specific lighting.
- Fully enclosed shelters.
- Additional seating.
- Additional signage.
- Trash and recycling receptacles at inbound and outbound stops.
- Alternative ground paving to aid in stop identity.
- Tactile ground surface area at boarding/alighting to aid visually imparted.

These additional amenities and wayfinding features help to improve the user experience and provide layering of the streetscape in which the bus stop no longer merged into its context but is a standalone element within the streetscape. This will improve the identification of the stop and the alternative option of public transportation. By providing a similar language from one stop to another, the users begin to identify stops based on the elements within the stop. Creating a uniformed image for the bus network heightens the users understanding of the network.

6.3.4 RELOCATION OF BUS STOPS

The North Main Street inbound stop does not provide adequate space on the existing curb edge to comply with ADA, as well as not complying with required slopes for the boarding area. Due to these conditions it is recommended to relocate the stop or reallocate space to provide for the required width for the boarding and alighting area. Two options are recommended; relocate the inbound stop to Washington Street or relocating the outbound stop to the west side of North Main Street.

<u>Option One:</u> Relocation of outbound stop and shifting the street entrance into the ESTT southward to provide adequate curbside area to become ADA-accessible.

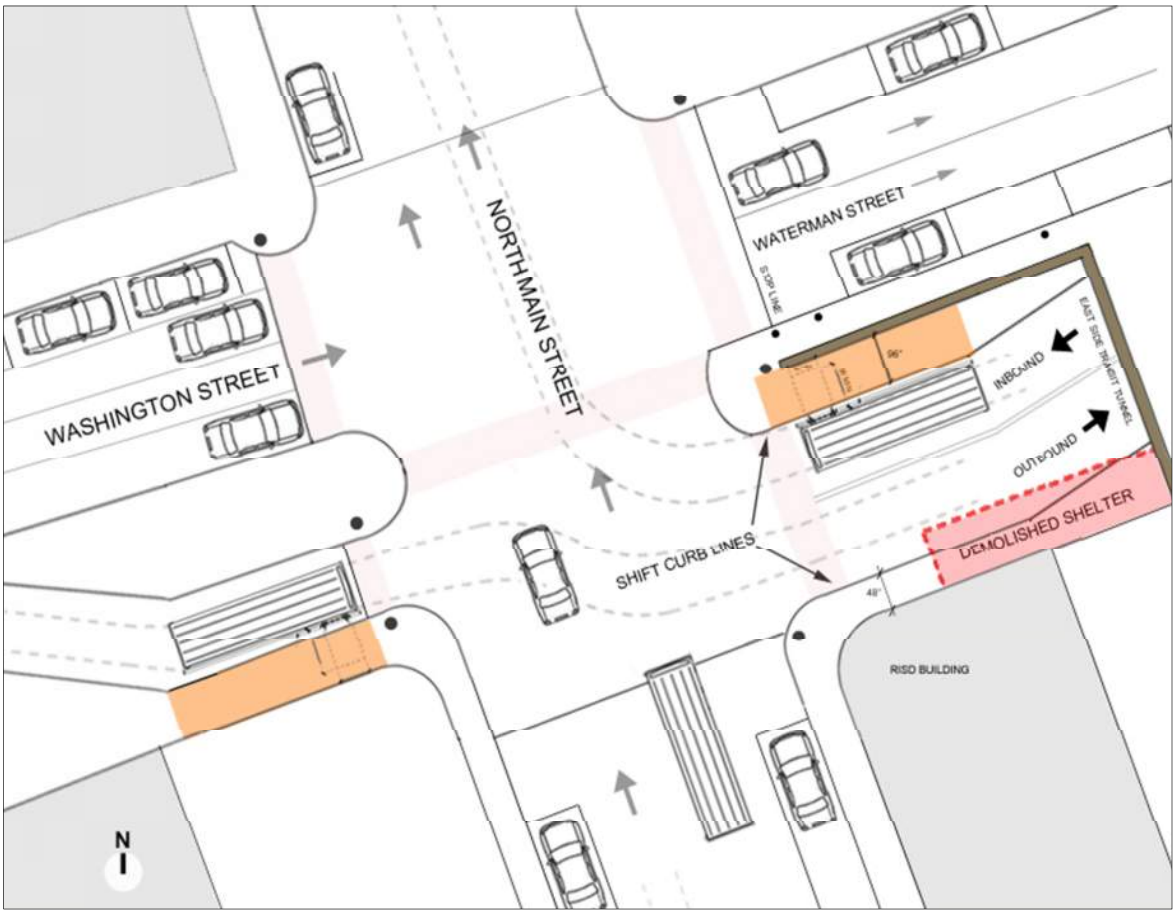


Figure 60: North Main Street Proposed Relocation – Option One

The outbound stop will be relocated to the bus only lane adjacent to Washington Street prior to the intersection at North Main Street. This area will need to be leveled to meet boarding and alighting requirements for slope, but will be wide enough to comply with requirements for the boarding and alighting area. With the relocation of the stop, identification of the new location will be of high importance to reduce the confusion that can be brought about through the change.

The inbound stop will remain in its present location, but the curbside area will be increased and leveled when the shifting of the entrance occurs. To meet boarding and alighting dimensional needs the new curbed area will increase by approximately 4'-0". This will allow for adequate boarding area for passengers; however the accessible route will be through the boarding and alighting area.

Advantages to option one:

- Designated bus area off of the main street minimizes the traffic interference on North Main Street.
- The driver has the advantage of viewing the full intersection activity at North Main Street.
- Access to and from the surrounding road network is direct and limits the circuitous routing of buses.
- Traffic lights manage the bus and vehicular traffic.
- A designated bus lane with traffic signals allows for minimal interference with vehicular and pedestrian traffic.
- An accessible boarding and alighting area can be designated in this location.
- Re-routing the buses that service the stop will not be necessary, as it is along the same travel route the buses are currently taking.

Disadvantages to option one:

- Accessible pedestrian paths to and from the bus stop interfere with the designated waiting or boarding areas. This may cause delays in services.
- Stop identification and additional signage may be necessary.
- The current shelter in front of the ESTT will no longer be used, and may need to partially or completely remove to allow enough space to shift the entrance to the ESTT.

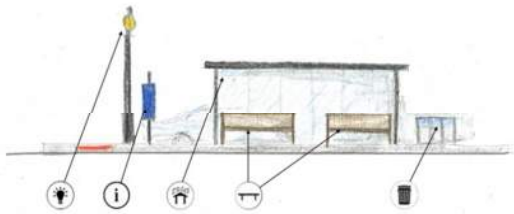


Figure 61: North Main Street Proposed Elevation – Option One (Outbound)

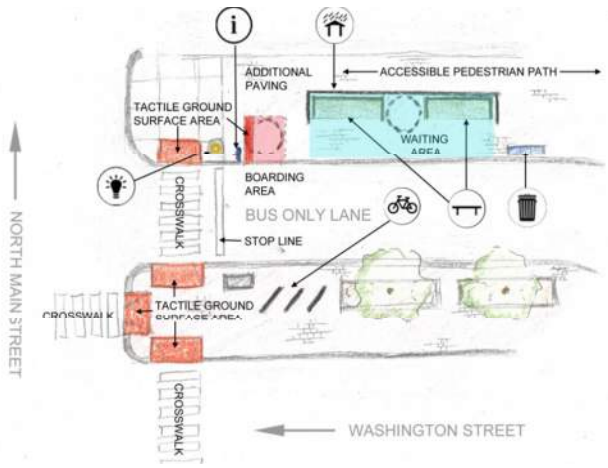


Figure 62: North Main Street Proposed Plan – Option One (Outbound)

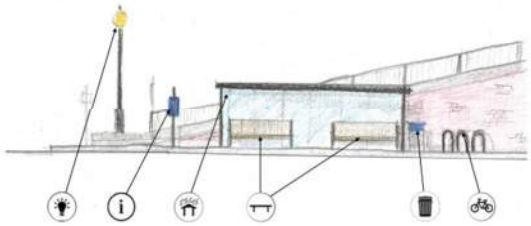


Figure 63: North Main Street Proposed Elevation – Option One (Inbound)

Figure 64: North Main Street Proposed Plan – Option One (Inbound)

Option Two: Creating a bus only counter flow lane on Washington Street and relocating the inbound bus stop to after the intersection of North Main Street and Washington Street will provide adequate curbside area to become ADA-accessible.

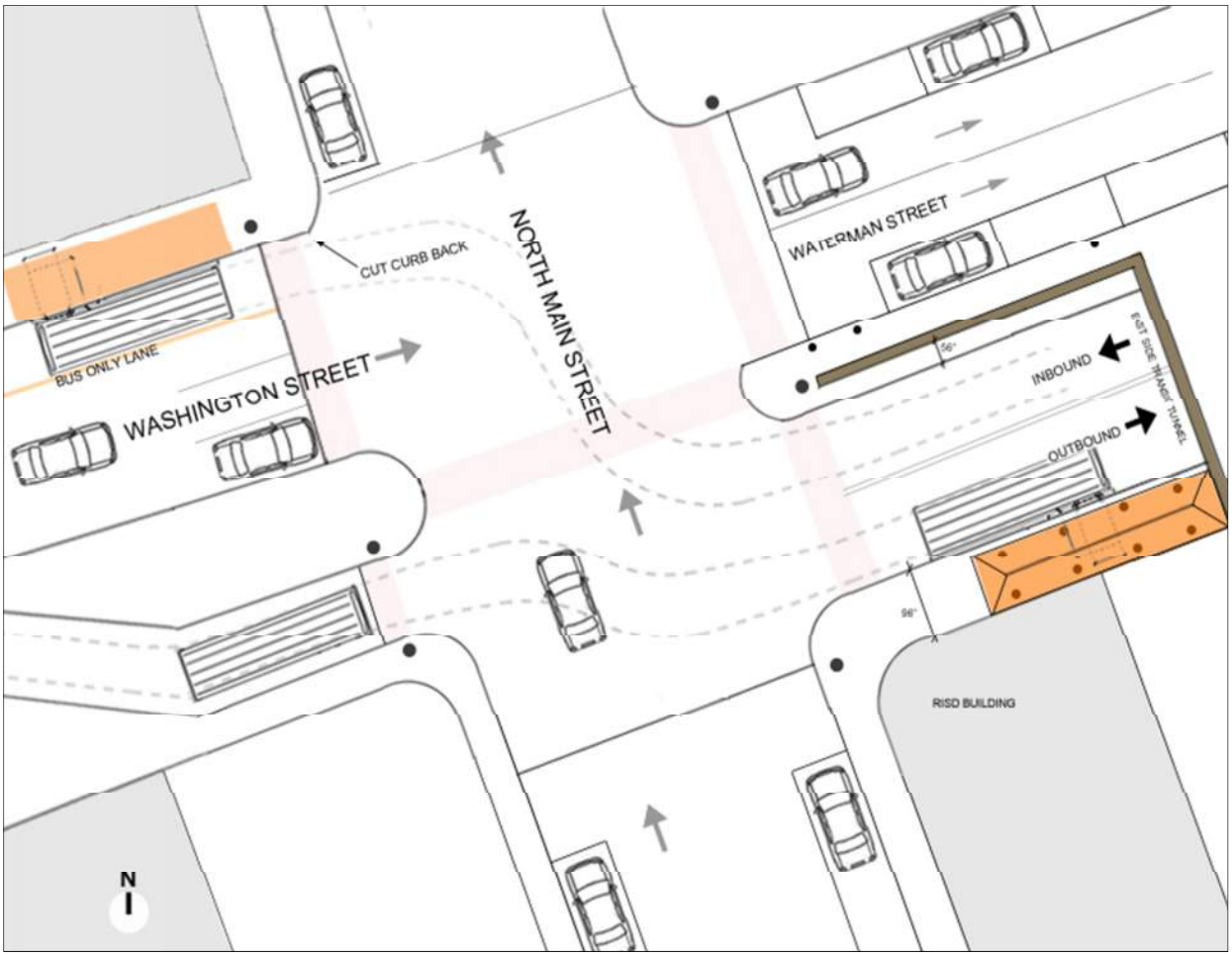


Figure 65: North Main Street Proposed Relocation – Option Two

The outbound stop will remain in its current location with minimal improvements are required. The inbound stop will be relocated to the bus only lane on Washington Street. Both areas will need to be leveled to meet boarding and alighting requirements for slope. With the relocation of the stop, identification of the new location will be of high importance to reduce the confusion that can be brought about through the change.

By introducing a counter flow lane on Washington Street vehicular traffic will be impacted. The traffic lights will need to be re-signaled to provide bus priority and reduce the impact that will occur with the removal of one lane of vehicular traffic. Some parking spaces will be lost along Washington Street due to the new location of the stop, and additional signage will be required to advice vehicular drivers of the bus lane. In order to park along the north side of Washington Street cars will need to cross the bus lane, which may cause interference with the buses including possible delays in overall bus transit services.

Advantages to option two:

- The driver going outbound has the advantage of viewing the full intersection activity at North Main Street.
- Access to and from the surrounding road network is direct and limits the circuitous routing of buses.
- Traffic lights manage the bus and vehicular traffic.
- An accessible boarding and alighting area can be designated in this location.
- The current shelter in front of the ESTT will be used.
- Accessible pedestrian paths to and from the bus stop do not interfere with the designated waiting or boarding areas.

Disadvantages to option two:

- The driver going inbound does not have the advantage of viewing the full intersection activity at North Main Street and has a reduced view.
- Stop identification and additional signage will be necessary.
- By creating a bus only lane, one current lane for vehicular travel is lost and may interfere with traffic patterns in the area.
- Re-routing the buses that service the inbound stop will be necessary, as it is no longer along the same travel route the buses are currently taking. This may cause circuitous routing of buses.

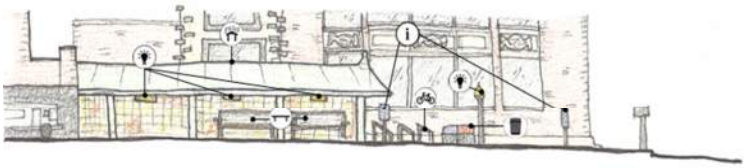


Figure 66: North Main Street Proposed Elevation – Option One (Outbound)

Figure 67: North Main Street Proposed Plan – Option One (Outbound)

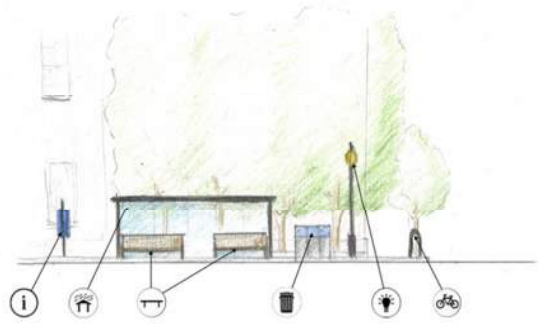


Figure 68: North Main Street Proposed Elevation – Option One (Inbound)

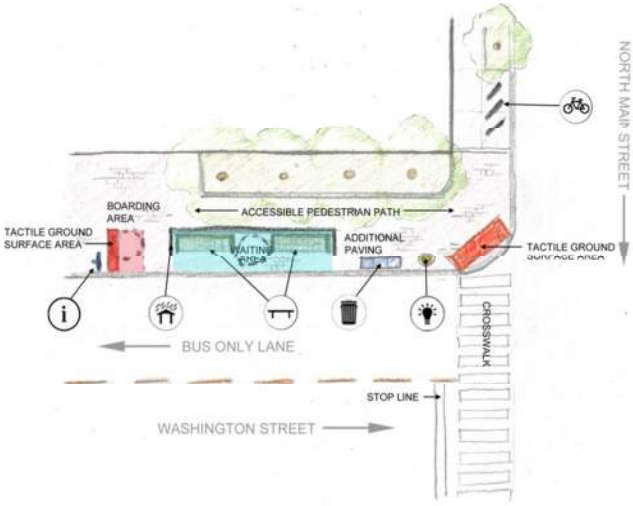


Figure 69: North Main Street Proposed Plan – Option One (Inbound)

7.0 RELEVANT CODES

INTERNATIONAL BUILDING CODE
SECTION 1104 ACCESSIBLE ROUTE

1104.1 Site arrival points. Accessible routes within the site shall be provided from public transportation stops; accessible parking; accessible passenger loading zones; and public streets or sidewalks to the accessible building entrance served.

SECTION 1110 SIGNAGE

1110.1 Signs: Required accessible elements shall be identified by the International Symbol of Accessibility at the following locations:

2. Accessible passenger loading zones.

1110.4 Variable message signs: Where provided in the locations in Sections 1110.4.1 and 1110.4.2, variable message signs (VMS) shall comply with the VMS requirements of ICC A117.1.

1110.4.1 Transportation facilities: Where provided in transportation facilities, variable message signs conveying transportation-related information shall comply with Section 1110.4.

ICC A117.1
CHAPTER 4 ACCESSIBLE ROUTE

SECTION 402 ACCESSIBLE ROUTE

402.1 General: Accessible routes shall comply with Section 402.

402.2 Components Accessible routes shall consist of one or more of the following components: walking surfaces with a running slope not steeper than 1:20, doorways, ramps, curb ramps excluding the flared sides, elevators, and platform lifts. All components of an accessible route shall comply with the applicable requirements of Chapter 4.

> Advisory 402.2 Components: Walking surfaces must have running slopes not steeper than 1:20, see 403.3. Other components of accessible routes, such as ramps (405) and curb ramps (406), are permitted to be more steeply sloped.

SECTION 403 WALKING SURFACES

403.1 General: Walking surfaces that are a part of an accessible route shall comply with Section 403.

403.3 Slope: The running slope of walking surfaces shall not be steeper than 1:20. The cross slope of a walking surface shall not be steeper than 1:48.

403.5 Clear Width: The clear width of an accessible route shall be 36 inches (915 mm) minimum.

SECTION 406 CURB RAMPS

406.1 General: Curb ramps on accessible routes shall comply with 406, 405.2 through 405.5, and 405.10.

406.2 Counter Slope: Counter slopes of adjoining gutters and road surfaces immediately adjacent to the curb ramp shall not be steeper than 1:20. The adjacent surfaces at transitions at curb ramps to walks, gutters, and streets shall be at the same level.

406.3 Sides of Curb Ramps: Where provided, curb ramp flares shall not be steeper than 1:10.

406.4 Width: Curb ramps shall be 36 inches (915 mm) minimum in width, exclusive of flared sides.

406.6 Location: Curb ramps and the flared sides of curb ramps shall be located so they do not project into vehicular traffic lanes, parking spaces, or parking access aisles. Curb ramps at marked crossings shall be wholly contained within the markings, excluding any flared sides.

406.7 Landings: Landings shall be provided at the tops of curb ramps. The clear length of the landing shall be 36 inches (915 mm) minimum. The clear width of the landing shall be at least as wide as the curb ramp, excluding flared sides, leading to the landing.

406.8 Obstructions: Curb ramps shall be located or protected to prevent their obstruction by parked vehicles.

406.10 Diagonal Curb Ramps: Diagonal or corner-type curb ramps with returned curbs or other well-defined edges shall have the edges parallel to the direction of pedestrian flow. The bottoms of diagonal curb ramps shall have 48 inches (1220 mm) minimum clear space outside active traffic lanes of the roadway. Diagonal curb ramps provided at marked crossings shall provide the 48 inches (1220 mm) minimum clear space within the markings. Diagonal curb ramps with flared sides shall have a segment of curb 24 inches (610 mm) minimum in length on each side of the curb ramp and within the marked crossing.

406.13 Detectable Warnings at Curb Ramps: Where detectable warnings are provided on curb ramps, they shall comply with Sections 406.13 and 705.

ADA STANDARDS FOR TRANSPORTATION FACILITIES [As issued by the Department of Transportation]

CHAPTER 2: SCOPING REQUIREMENTS

SECTION 206 ACCESSIBLE ROUTES

206.1 General: Accessible routes shall be provided in accordance with 206 and shall comply with Chapter 4.

206.2 Where Required: Accessible routes shall be provided where required by 206.2.

206.2.1 Site Arrival Points: At least one accessible route shall be provided within the site from accessible parking spaces and accessible passenger loading zones; public streets and sidewalks; and public transportation stops to the accessible building or facility entrance they serve.

SECTION 209 PASSENGER LOADING ZONES AND BUS STOPS

209.1 General: Passenger loading zones shall be provided in accordance with 209.

209.2 Type. Where provided, passenger loading zones shall comply with 209.2.

209.2.1 Passenger Loading Zone: Passenger loading zones, except those required to comply with 209.2.2 and 209.2.3, shall provide at least one passenger loading zone complying with 503 in every continuous 100 linear feet (30 m) of loading zone space, or fraction thereof.

209.2.2 Bus Loading Zones: In bus loading zones restricted to use by designated or specified public transportation vehicles, each bus bay, bus stop, or other area designated for lift or ramp deployment shall comply with 810.2.

> Advisory 209.2.2 Bus Loading Zones: The terms “designated public transportation” and “specified public transportation” are defined by the Department of Transportation at 49 CFR 37.3 in regulations implementing the Americans with Disabilities Act. These terms refer to public transportation services provided by public or private entities, respectively. For example, designated public transportation vehicles include buses and vans operated by public transit agencies, while specified public transportation vehicles include tour and charter buses, taxis and limousines, and hotel shuttles operated by private entities.

209.2.3 On-Street Bus Stops: On-street bus stops shall comply with 810.2 to the maximum extent practicable.

CHAPTER 8: SPECIAL ROOMS, SPACES, AND ELEMENTS

SECTION 810 TRANSPORTATION FACILITIES

810.1 General: Transportation facilities shall comply with 810.

810.2 Bus Boarding and Alighting Areas: Bus boarding and alighting areas shall comply with 810.2.

Advisory 810.2 Bus Boarding and Alighting Areas. At bus stops where a shelter is provided, the bus stop pad can be located either within or outside of the shelter.

810.2.1 Surface: Bus stop boarding and alighting areas shall have a firm, stable surface.

810.2.2 Dimensions: Bus stop boarding and alighting areas shall provide a clear length of 96 inches (2440 mm) minimum, measured perpendicular to the curb or vehicle roadway edge, and a clear width of 60 inches (1525 mm) minimum, measured parallel to the vehicle roadway.

810.2.3 Connection: Bus stop boarding and alighting areas shall be connected to streets, sidewalks, or pedestrian paths by an accessible route complying with 402.

810.2.4 Slope: Parallel to the roadway, the slope of the bus stop boarding and alighting area shall be the same as the roadway, to the maximum extent practicable. Perpendicular to the roadway, the slope of the bus stop boarding and alighting area shall not be steeper than1:48.

810.3 Bus Shelters: Bus shelters shall provide a minimum clear floor or ground space complying with 305 entirely within the shelter. Bus shelters shall be connected by an accessible route complying with 402 to a boarding and alighting area complying with 810.2.

810.4 Bus Signs: Bus route identification signs shall comply with 703.5.1 through 703.5.4, and 703.5.7 and 703.5.8. In addition, to the maximum extent practicable, bus route identification signs shall comply with 703.5.5.

> **EXCEPTION:** Bus schedules, timetables and maps that are posted at the bus stop or bus bay shall not be required to comply.

APPENDIX C – "Security and Safety Needs Analysis Report" by DVS

A division of Ross&Baruzzini

08/14/2015

Security and Safety Needs Analysis Report

Rhode Island Public Transit Authority

College Hill Bus Tunnel

Providence, RI

Prepared By:

DVS

Security Consulting and Engineering

1020 Sherman Avenue

Hamden, CT 06514

Table of Contents

Section 1 Preface

Section 2 Acknowledgements

Section 3 Existing Conditions Investigation and Analysis

Section 4 Existing Conditions Photographs

Section 5 Security and Safety Improvement Recommendations

Section 6 Magnitude of Probable Cost

Section 1 – Preface

This study is intended to investigate the current state of security and safety features at the College Hill Tunnel, identify upgrades to existing systems, recommend a preferred solution in terms of scope and provide a magnitude of probable cost for the identified recommendations.

If the identified recommendations are approved, a systems designer should review the study and satisfy themselves as to the accuracy of the contents before proceeding into an actual design. However, it is expected that the study should save time and expense by avoiding unnecessary duplication of pre-design activities.

Section 2 – Acknowledgements

The following individuals and firms contributed to this report:

Rhode Island Public Transit Authority (RIPTA)

James Pereira

Jim Cunningham

Study Design Team

Pare Corporation

DHK Architects

DVS Security Consulting and Engineering

Section 3 – Existing Conditions Investigation and Analysis

The College Hill Tunnel in Providence, RI was originally built for trolley use in 1914 and converted in 1948 for public bus use in 1948. The tunnel currently serves six RIPTA bus routes and emergency vehicle access.

RIPTA has engaged the professional services of Pare Corporation and DVS to evaluate the existing security and safety conditions within and surrounding the tunnel. On June 3, 2015, DVS participated in a site survey of the existing College Hill Tunnel in Providence, RI. DVS met with Jim Cunningham from RIPTA and evaluated the current conditions of the tunnel including the two entry points on South Main Street and Thayer Street. DVS found that the current signage at both tunnel entry points is inadequate and some signs are illegible due to graffiti and weathering. Current lighting at both tunnel entry points was minimal.

There is currently no existing electronic access control or intrusion detection system equipment servicing the tunnel. Additionally, there is no video surveillance cameras or video recording equipment for the vehicle access roadway, which precludes the remote monitoring and digital recording of unauthorized use by pedestrians or vehicular traffic.

Upon further review of the tunnel's interior, DVS noted that the existing crash attenuator at the South Main Street entrance was severely damaged and no longer functions as it was designed. Lastly, DVS noted that the tunnel was lacking a center lane delineator between the two lanes of traffic.

Please refer to Section 4 for existing condition photographs that depict the above identified issues.

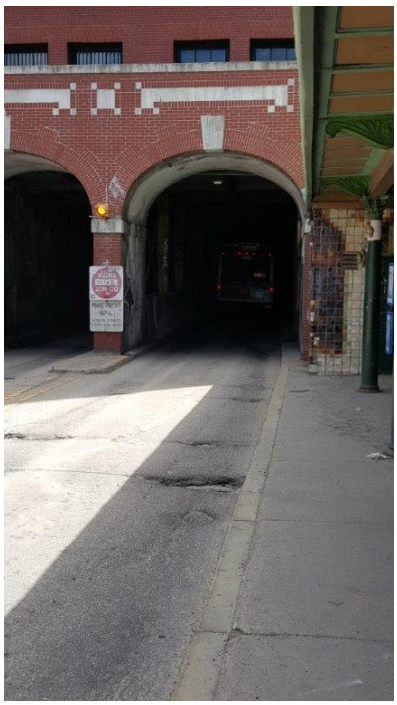
Section 4 – Existing Conditions Photographs

P.1 – South Main Street tunnel entrance

P.2 – Close-up of South Main Street entrance showing defaced and inadequate signage

P.3 – Inbound lane of South Main Street entrance showing damaged crash attenuator

P.4 – Poor lighting conditions on tunnel interior of South Main Street entrance



P.5 – Poor lighting conditions on tunnel interior of Thayer Street entrance

P.6 – Close-up of Thayer Street entrance showing defaced and inadequate signage

Section 5 – Security and Safety Improvement Recommendations

Based on our findings related to the existing site security and safety conditions at the College Hill Tunnel, as identified within Sections 3 and 4 of this report, DVS has the following recommendations:

Provide new signage at both entrances clearly stating that the roadway is for authorized personnel only and is not for pedestrian traffic. Signage should be visible from the sidewalk and oncoming traffic.

Provide an enhanced level of lighting at both entrances to better illuminate the new signage and provide better situation awareness for bus drivers, in the event that someone is walking in front of the tunnel as a bus is entering or exiting. Lighting levels within the tunnel should also be increased to provide better situational awareness for bus drivers and a safer experience for the bus passengers.

Provide a new “in-the-ground” center lane delineator reflectors, so that bus drivers can operate safely within the tunnel; especially when there are buses driving in both directions at the same time.

Replace the damaged crash attenuator at the South Main Street entrance.

Provide a new motion detection alarm system to alert oncoming traffic when a vehicle has entered the tunnel and/or a disabled vehicle is trapped within the tunnel. This system would include an alarm control panel, tri-technology exterior rated motion detectors and local sounders with light signals to indicate that an abnormal driving condition exists within the tunnel.

Providing the above identified safety and security system equipment will deliver an increased level of situational awareness within the tunnel and surrounding area. It is anticipated that by implementing the above identified recommendations, RIPTA can reduce the unauthorized use of the tunnel, improve the safety of RIPTA bus drivers and enhance the overall passenger experience.

Section 6 – Magnitude of Probable Cost

A Magnitude of Probable Cost (MOPC) was generated based on the recommendations identified within this report. The MOPC was completed with input from Pare Corporation and DVS.

Safety and Security Magnitude of Probable Cost

1.	New signage at both entrances:	$4,400.00
2.	Enhanced LED lighting within tunnel and entrances:	$10,400.00
3.	New in-ground center lane delineator reflectors:	$4,750.00
4.	New South Main Street entry crash attenuator:	$30,000.00
5.	Vehicular motion detection alarm system:	$12,750.00
Safety and Security MOPC:		**$62,300.00**

MEMORANDUM

DATE: December 16, 2015

TO: Gregory Nordin - RIPTA

FROM: Kevin Viveiros

RE: **Cursory Evaluation for the Replacement of the Storm Water Drainage System in the RIPTA College Hill Bus Tunnel**
PARE Project No. 15036.01

Pare Corporation (Pare) has completed a cursory evaluation of the storm water drainage system in the RIPTA College Hill Bus Tunnel. This memo provides a brief summary of data collection, the anticipated construction approach for recommended repairs, and an opinion of probable construction cost.

Existing Conditions Review

In the "Preliminary Report of Findings, College Hill Bus Tunnel", prepared by Pare and submitted August 2015, the following information was noted:

- There is no information available regarding the pavement composition in the tunnel. The pavement structure appears to consist of 2" to 3" of bituminous asphalt over a rigid concrete base. No information is available to indicate the thickness of this existing concrete base nor if it contains steel reinforcement.

- Based on coordination with the City of Providence and RIPTA, no record of the storm water drainage system through the tunnel is available.

- There are a total of 26 catch basins along the edge of pavement within tunnel.

- One of the recommendations of this report was to video inspect the drainage system to determine the condition of the pipes and structures and how the structures are connected and ultimately discharge from the tunnel.

Data Collection

A CCTV video inspection was conducted on October 18, 2015 by Inland Waters Inc. A copy of the video and report was provided to Pare by RIPTA. Through discussion with both RIPTA and Inland Waters Inc, the primary intent of the video inspection was to identify the three (3) drainage

manholes between Thayer Street and the entrance to the tunnel. Additional catch basins in the tunnel were inspected as time allowed. An Existing Conditions Plan showing the structures that were inspected is included as Attachment A.

The tunnel's storm water drainage system consists of groups of catch basin structures, manholes, and underground pipes. The catch basin structures (CB -1 through CB-7) are located along each side of the gutter line of the tunnel and are interconnected by a 6" Vitrified Clay Pipe (VCP) that discharges to an unknown location. The manholes (MH-1, MH-2 and MH-3) are located in the center of the Thayer Street side of the bus tunnel and are connected by a 12" VCP trunkline drain pipe with some sections of 12" Polyvinyl Chloride Pipe (PVC). The trunk line begins at MH-1 and dead-ends at MH-3. From the video inspection, it is unclear what this trunk line services, how it receives flow, or where it discharges.

The video inspection completed by Inland Waters Inc. includes audio notations regarding locations of broken, collapsed or damaged pipes, joint separations, obstructions or other major observations. A total of eight (8) video logs were recorded for drainage pipes associated with MH-1, MH-2, MH-3; and CB-1, CB-2, CB-5, CB-6 along the south side; and CB-3, CB-4, CB-7, CB8 along the north side. Several drainage pipes could not be fully inspected due to limited time and in-line obstructions (e.g., collapsed pipes or offset joints). The results of the video inspections are summarized below and shown in Attachment A.

Video Log No.1 (MH-1 to MH-2)
The portion of the pipe inspected (0.0 – 7.0 feet downstream) indicates PVC pipe at 0.0 feet, fractural PVC pipe at 0.0 feet, material change from PVC to VCP at 7.0 feet, however, the inspection was abandoned at 7.0 feet downstream of MH-1 due to the offset pipe joint.

Video Log No.2 (MH-2 to MH-1)
The portion of the pipe inspected (0.0 – 17.0 feet upstream) indicates PVC pipe at 0.0 feet, material change from PVC to VCP at 3.0 feet, however, the inspection was abandoned at 17.0 feet upstream of MH-2 due to the offset pipe joint.

Video Log No.3 (MH-2 to MH-3)
The portion of the pipe inspected (0.0 – 5.0 feet downstream) indicate PVC pipe at 0.0 feet, material change from PVC to VCP at 3.0 feet, broken VCP at 5.0 feet, however, the inspection was abandoned at 5.0 feet downstream of MH-2 due to the broken pipe blocking camera access to the drainage line.

Video Log No.4 (MH-3 to MH-2)
The portion of the pipe inspected (0.0 – 23.0 feet upstream) indicates PVC pipe at 0.0 feet, material change from PVC to VCP at 7.0 feet, broken VCP at 7.0 feet, collapsed VCP at 23.0 feet, however, the inspection was abandoned at 23.0 feet upstream of MH-3 due the collapsed pipe blocking camera access to the drainage line.

Video Log No.5 (CB-1 to CB-2)
The portion of the pipe inspected (0.0 – 136.0 feet downstream) indicates that this section consists of VCP, and has a visible hole at 119.0 feet. However, the inspection was abandoned at 136.0 feet downstream of CB-1 due to limited length of the video cable. In addition the inspection indicated

that a number of offset and separated pipe joints exist, and that sediment, perhaps due to infiltration, was observed at most joints along the drainage lines.

Video Log No.6 (CB-2 to CB-1)
The portion of the pipe inspected (0.0 – 24.0 feet upstream) indicates PVC pipe at 0.0 feet, broken PVC and VCP at 1.0 feet, material change from PVC to VCP at 1.0 feet, and broken VCP at 21.0 feet. However, the inspection was abandoned at 24.0 feet upstream of CB-2, due to a broken pipe. In addition offset/separated joints and sediments were observed at most joints along the drainage lines.

Video Log No.7 (CB-3 to CB-4)
The portion of the pipe inspected (0.0 – 86.0 feet downstream) indicate VCP at 0.0 feet and a broken pipe at 29.0 feet. However, the survey was abandoned at 86.0 feet downstream of CB-3, end of inspection CB-4 assess point. In addition offset/separated joints and sediments were observed at most joints.

Video Log No.8 (CB-4 to CB-7)
The portion of the pipe inspected (0.0 – 68.0 feet downstream) indicated tht this section of VCP had multiple fractured pipes at stations 1.0', 18.0', 52.0', 58.0', and 66.0' with many of the sections having visible soil present. However, the inspection was abandoned at 68.0 feet downstream of CB-4 because the pipe was blocked with soil and/or debris. In addition offset/separated joints and sediments were observed at most joints.

It was noted in the report that Inland Waters ran out of time during the video inspection. The remaining section of the drain line could not be completed between CB-2 to CB-6 and CB-7 to CB-8.

<u>Recommendations</u>
From the information presented above, Pare provides the following observations and recommendations:

The video inspection shows that the existing 12" VCP trunkline that connects MH-1, MH-2 and MH-3 is in poor condition, with a number of damaged, broken and collapsed sections of pipes. Most of the damaged sections occur at the pipe joints or in the vicinity of the pipe joints. The inspection however did not identify any entering or existing pipes; therefore it is unknown whether this system receives or conveys any storm water.

Similar pipe conditions exist for the 6" VCP pipe connecting within the tunnel that was inspected. However, since a majority of the pipes and structures within the tunnel were not inspected, it is unknown whether similar conditions exist throughout the tunnel.

The existing 12" VCP trunkline should be replaced if storm water is conveyed through this system. The most cost-effective means of replacing a failed pipe is to rehabilitate the pipe with a lining technique. This technique avoids expensive road restoration costs. However, to utilize the existing pipe for relining, the pipe cannot be broken or collapsed. In this case, pipe lining would not be possible because of the severity of the damaged pipes. If these pipes are abandoned and not receiving or conveying flow, it is possible that the pipes could be filled with flowable fill to prevent further collapse.

The 12” VCP could be replaced with a 12” high density polyethylene (HDPE) pipe with water tight joints. HDPE pipe is manufactured in longer lengths than RCP pipe resulting in fewer pipe joints. Also, HDPE pipe is corrosion and chemical resistant, flexible and fatigue resistant.

The work associated with the replacement of the 12” VCP pipe includes but is not limited to: saw cut and removal of existing pavement structure and concrete base, trench excavation and removal of existing pipe, installation of new HDPE pipe, backfill and compaction, installation of new concrete base dowelled in place to match existing, and the installation of bituminous asphalt surface course. In addition, traffic control will be required. It is estimated that replacement of 200 feet of 12” VCP is required. An opinion of probable construction cost for this work is $75,000 (see Attachment B).

Also from review of the inspection video, it appears that most of the inspected 6” VCP connecting the catch basins within the tunnel are in poor or damaged condition. Assuming a similar condition for the remainder of the pipe that wasn’t inspected, a similar scope of replacement for approximately 4,000 feet of 6” VCP with 6” HDPE pipe, including minor repairs to catch basins, is estimated to cost approximately $1,000,000 (see Attachment B).

Traffic Control Staging

The College Hill Bus Tunnel is comprised of a two-lane roadway with one travel lane in each direction, separated by a solid double yellow line throughout the tunnel. The typical roadway section on the Thayer Street side of the tunnel includes two 13.5-foot travel lanes, for a total pavement width of approximately 27 feet.

The existing 12 inch VCP trunkline runs directly on the center of the roadway where the double-yellow line exists. The proposed construction activities would require a minimum 10-foot wide work area, leaving only two 8.5-foot wide travel lanes on either side, which is not likely wide enough to accommodate bus traffic.

It is anticipated that during construction the tunnel will be fully closed. The work could be performed at night when bus traffic is at the lightest or non-existent. During the day (non-working hours) the trench could be backfilled or steel-plated and traffic could be restored to allow for bus traffic. The full closure has the potential to maximize workspace, increase productivity and expedite project completion. Construction is estimated to take approximately two to six months to complete.

Conclusion

From the information gathered, it appears that most of the drainage system within the tunnel may have reached the end of its useful life. These drainage pipes consist of mostly VCP with some repaired sections of PVC pipe. VCP, especially which is more than 50 years old, will often crack, leak, and ultimately collapse. Full collapse of the drainage pipe can potentially cause a collapsed roadway. Since only a portion of the actual drainage system within the tunnel was inspected, we recommend further evaluation to determine the location of the complete pipe network and to determine the condition of the pipes and structures.

We are available to review our findings with you at your convenience. If you have any questions, comments or would like to discuss moving forward, please feel free to contact me.

KV/sl

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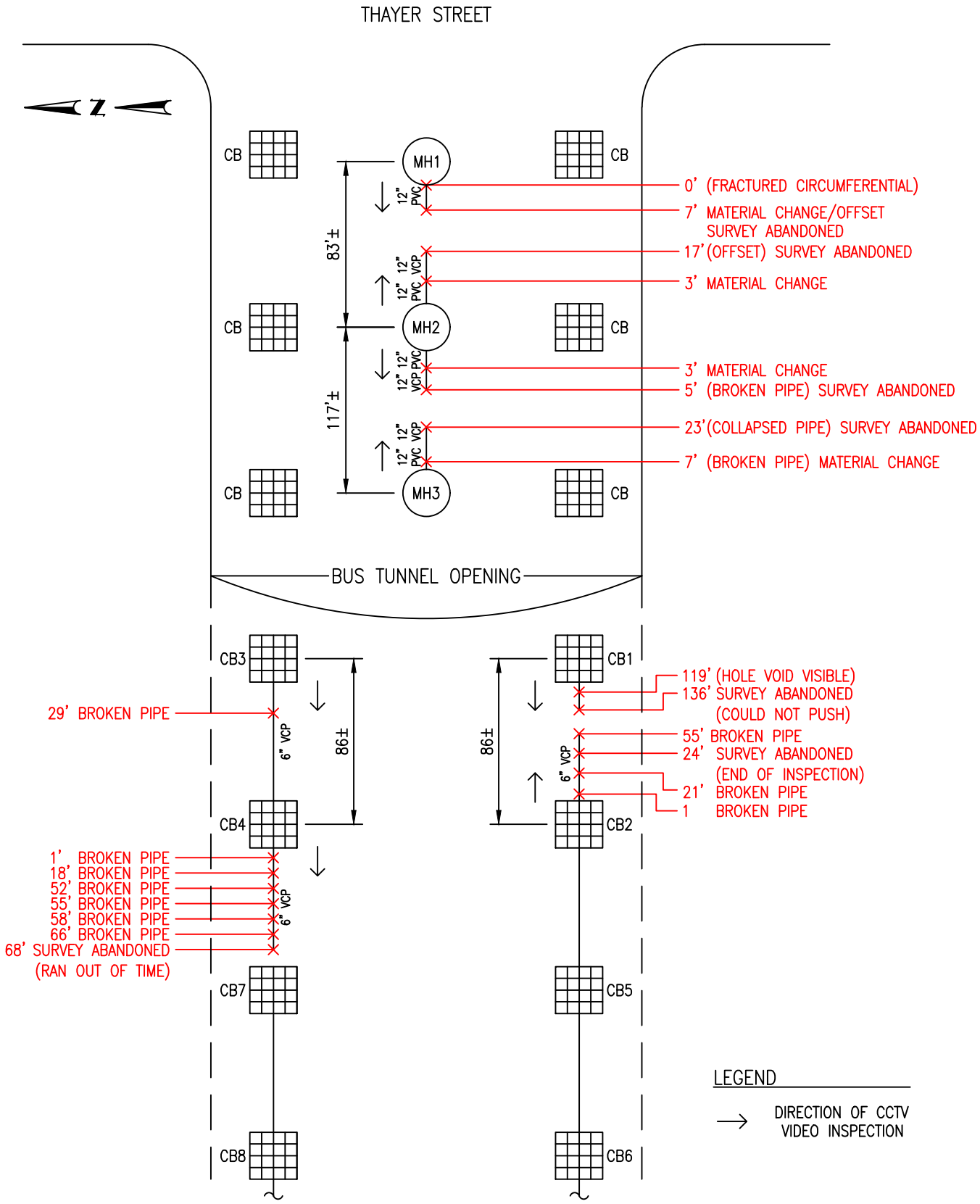

PROJECT NO. 15036.01

DATE: DEC. 16, 2015

PARE CORPORATION
ENGINEERS - SCIENTISTS - PLANNERS
8 BLACKSTONE VALLEY PLACE
LINCOLN, RI 02865
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EXISTING CONDITIONS PLAN

VIDEO INSPECTION FINDINGS

ATTACHMENT A

Project Name - Cursory Evaluation for the Replacement of the Storm Water Drainage System in the RIPTA College Hill Bus Tunnel

PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST

STORM WATER DRAINAGE SYSTEM

REPLACE 12" VCP DRAINAGE PIPES TRUNKLINE

Item	Code	Description	UM	Quantity	Unit Cost	Cost
1	201.0407	REMOVE AND DISPOSE PAVEMENT AND RIGID BASE	SY	67.00	$25.00	$1,675.00
2	201.0414	REMOVE AND DISPOSE PIPE - ALL SIZES	FT	200.00	$15.00	$3,000.00
3	401.2100	MODIFIED CLASS 12.5 HMA	TON	12.00	$200.00	$2,400.00
4	403.0300	ASPHALT EMULSION TACK COAT	SY	134.00	$1.00	$134.00
5	501.0103	PORTLAND CEMENT CONCRETE BASE	SY	67.00	$200.00	$13,400.00
6	701.5112	12 INCH SMOOTH INTERIOR CORRUGATED POLYPROPYLENE PIPE	LF	200.00	$95.00	$19,000.00
7	905.0110	EARTH EXCAVATION	CY	112.00	$30.00	$3,360.00
8	905.0115	GRAVEL BORROW	CY	112.00	$30.00	$3,360.00
9	906.9901	TEMPORARY TRAFFIC CONTROL	LS	1.00	$5,000.00	$5,000.00
10	936.0100	MOBILIZATION AND DEMOBILIZATION	LS	1.00	$5,000.00	$5,000.00
11	932.0210	FULL DEPTH SAWCUT OF BITUMINOUS PAVEMENT AND RIGID BASE	LF	406.00	$3.00	$1,218.00
					Subtotal	$57,547.00
					30% Miscellaneous	$17,265.00
					Total	$74,812.00
					Estimated Total	**$75,000.00**

REPLACE 6" VCP DRAINAGE PIPES @ GUTTER LINE OF TUNNEL

1	201.0407	REMOVE AND DISPOSE PAVEMENT AND RIGID BASE	SY	1,334.00	$12.00	$16,008.00
2	201.0414	REMOVE AND DISPOSE PIPE - ALL SIZES	FT	4,000.00	$13.00	$52,000.00
3	401.2100	MODIFIED CLASS 12.5 HMA	TON	225.00	$180.00	$40,500.00
4	403.0300	ASPHALT EMULSION TACK COAT	SY	2,668.00	$0.50	$1,334.00
5	501.0103	PORTLAND CEMENT CONCRETE BASE	SY	1,334.00	$180.00	$240,120.00
6	701.9901	6 INCH SMOOTH INTERIOR CORRUGATED POLYPROPYLENE PIPE	FT	4,000.00	$55.00	$220,000.00
7	701.9902	CLOSED CIRCUIT TELEVISION (CCTV) STORMWATER DRAINAGE	FT	4,000.00	$3.00	$12,000.00
8	905.0110	EARTH EXCAVATION	CY	2,223.00	$26.00	$57,798.00
9	905.0115	GRAVEL BORROW	CY	2,223.00	$26.00	$57,798.00
10	906.9901	TEMPORARY TRAFFIC CONTROL	LS	1.00	$25,000.00	$25,000.00
11	936.0100	MOBILIZATION AND DEMOBILIZATION	LS	1.00	$50,000.00	$50,000.00
12	932.0210	FULL DEPTH SAWCUT OF BITUMINOUS PAVEMENT AND RIGID BASE	LF	4,012.00	$2.00	$8,024.00
					Subtotal	$780,582.00
					30% Miscellaneous	$234,175.00
					Total	$1,014,757.00
					Estimated Total	**$1,000,000.00**

12/14/2015