City of Madison

DEPARTMENT OF

TRANSPORTATION

DRAFT
East-West Bus Rapid Transit

Downtown Routing
October 31, 2019

Table of Contents

1. Introduction

The City of Madison is planning to implement its first Bus Rapid Transit (BRT) line in 2024 along the east-west corridor. BRT is a high-quality bus-based transit system that delivers fast, reliable, and cost-effective transit services. It does this through the provision of dedicated lanes, off-board fare collection, limited stops, and frequent service. With the right features, BRT is able to avoid the causes of delay that typically slow regular bus services, such as traffic congestion and waiting for people to pay as they board.

BRT is a key transportation strategy in the Imagine Madison Comprehensive Plan. The first stage implementation runs between the West Towne Mall area and East Towne, generally following Mineral Point Road or Odana Road, Whitney Way, University Avenue, and East Washington Avenue. The buses are planned to be electric 60-foot articulated buses which are both quieter and have more capacity that Metro Transit's current fleet.

BRT routing through downtown Madison is complex because of the constrained geography, network of one-way streets, frequent special events, and competing needs of other modes like autos and bikes. Interactions with the local bus system and planning for future BRT lines is also a factor. The purpose of this memo is to describe and evaluate the alternative routes in downtown Madison.

2. Goals and Objectives

The locally preferred alternative route, stations, and roadway changes downtown is chosen based on the following objectives.

- Ability to serve important regional destinations (State Street, Capitol Square, Monona Terrace, government offices)
  - BRT needs to serve where people are going. This also includes serving major employment centers such as city and state offices on Wilson Street.
- Ability to provide dedicated running way (bus lanes)
  - Dedicated running ways allow BRT to compete with, and even provide faster travel times than auto traffic. Having at least 50 percent dedicated running ways will help the project achieve an FTA Small Starts grant.
- Provide BRT stations in the best locations. The best locations:
  - Are logically spaced and located. Intuitively most riders tend to return to the stop where they got off. On one-way streets, sometimes station pairs are a block apart. However, station pairs that are more than one block apart add confusion to unfamiliar users. New and occasional users may get frustrated and have a poor experience if they cannot find the stations.
  - Are amply sized stations to serve potential riders. This includes the pedestrian environment and space at stations, including room to accommodate shelters, platforms, and sidewalk space.
  - Are located in visible, trafficked areas that promote security. One advantage of BRT is its increased frequency later into the night and it is important that riders are able to safely and comfortably walk to the stations.
  - Allow for convenient transfers from BRT to local Metro routes. Allowing easy transfers from regular Metro routes to BRT routes opens up the advantages of the BRT system to all residents served by Metro.
- Travel times of BRT
- Bike routing and changes to bike facilities associated with each alternative
- Impacts to on-street parking and parking revenue lost

3. Alternatives

West of the Capitol Square, BRT is planned to use the University Avenue and Johnson Street one-way couplet, and east of the Capitol Square, BRT will use East Washington Avenue. All other routes into and out of downtown are likely to be slow, circuitous, unreliable, and/or unbuildable. However, MPO and Metro staff recognized in the 2013 BRT feasibility study that there are several ways to route BRT through downtown Madison. This memo lays out the options identified in the area between Bassett Street and Blair Street.

A. Alternative 1: State Street and Capitol Square

Alternative 1 uses the route used by most bus routes today. From Johnson and Gorham Streets, the route follows State Street which is restricted to buses, bikes, and authorized vehicles, then continues around the Capitol Square, and to East Washington Avenue.

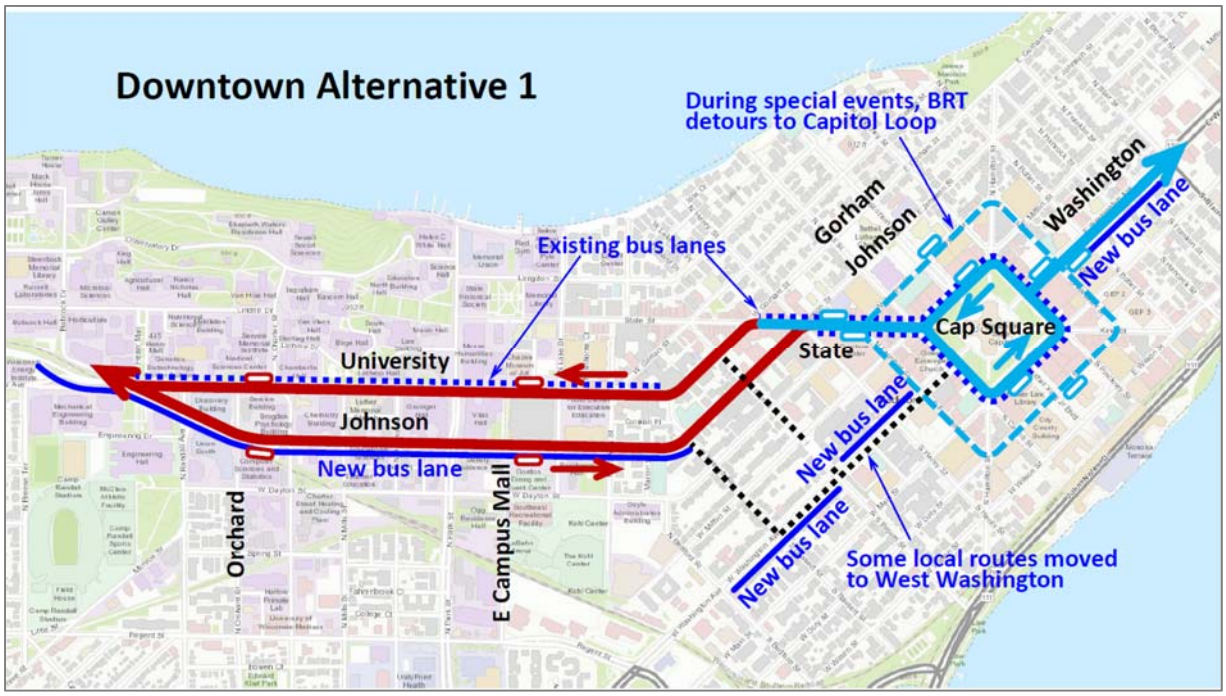

Figure 3-1 Downtown Alternative 1

The route is the most direct of the four alternatives, central to the downtown and isthmus, and uses existing facilities on State Street and the bus lanes on the Capitol Square. The stations would be at existing high use, prominent bus stops in central, pedestrian friendly locations. The route would be detoured about 70 times a year because of events on the Capitol Square and State Street, similar to the detours currently performed by Metro Transit. For some of the time, usually during the summer on weekends, BRT would be detoured to the Capitol Loop (Doty, Webster, Dayton, and Fairchild Streets), and to other streets for major events like marathons. The detour would require two auxiliary stations to be constructed at MLK and Wisconsin. The following graph illustrates times when Metro is routed off of the square, which amounts to about 10 percent of the time.

Figure 3-2 Detours events for Alternative 1

Few roadway changes would be associated with Alternative 1. Traffic signal timing would be reviewed to optimize it for bus progression between State Street and Blair Street and a new westbound transit activated left turn arrow would be added at State Street and Gorham Street. With these signal improvements, it would have similar travel times to Alternative 1A.

This alternative includes the rerouting of several bus routes. At least two routes currently serving the Capitol Square would be replaced with BRT. Additionally, about two thirds of the current bus traffic during weekday peak periods would be diverted from State Street to West Washington Ave to make room for BRT on State Street. State Street is saturated with buses during the peak periods, particularly westbound in the afternoon and BRT cannot be added without removing some local service. In order to manage transit volumes and delay on State Street, regional and commuter bus routes such as Routes 12, 14, 15, 29, 37, 47, 56, 57, 70, 71, and 72 would be rerouted from State Street to Broom/Bassett Street and West Washington Avenue. This change would result in a very high level of transit service on State with a bus every few minutes, but it would be much more consistent and there would no longer be three or more buses queued at signals idling. Further, some of the diesel buses would be replaced by electric BRT buses, which would improve the pedestrian and dining experience on State Street. The following graphic illustrates the bus traffic on State Street with the rerouted bus routes, and the added BRT routes. The net result is about a 50 percent reduction in State Street buses.

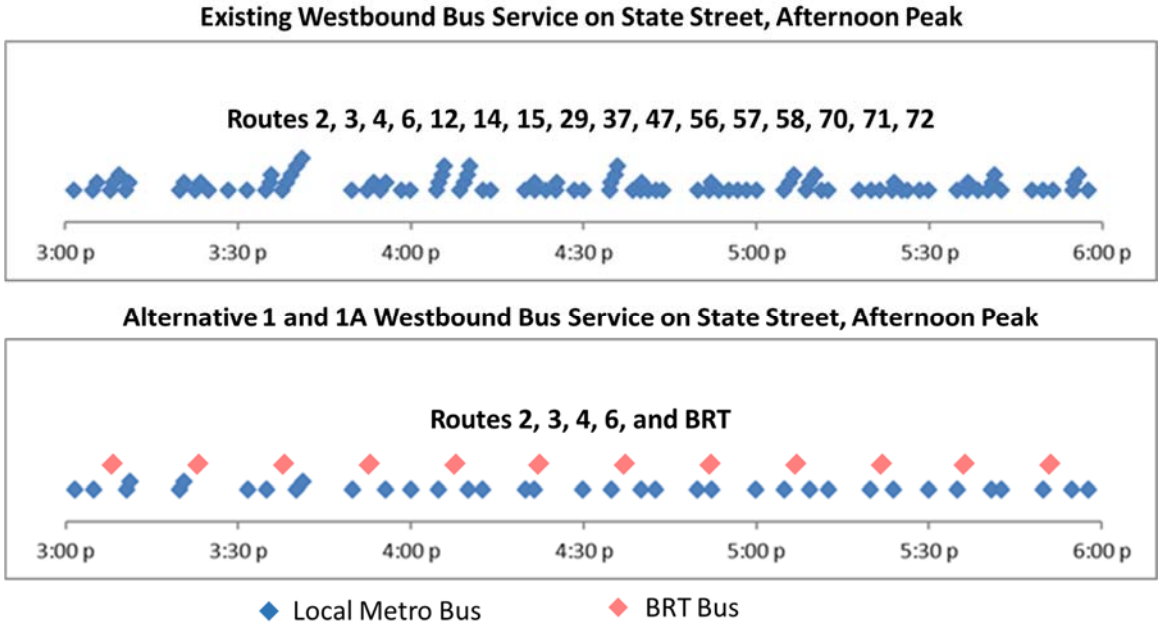

Figure 3-3 Bus Pulses (Occurrences) On State Street

West Washington Avenue would be restriped from its current configuration to one travel lane each way, plus a bus/bike/right turn lane in one direction and a bike lane in the other direction. The bus lane would be westbound from Fairchild to Broom, and eastbound from Bedford to Broom. This change would be needed to accommodate shifting bus service away from State Street.

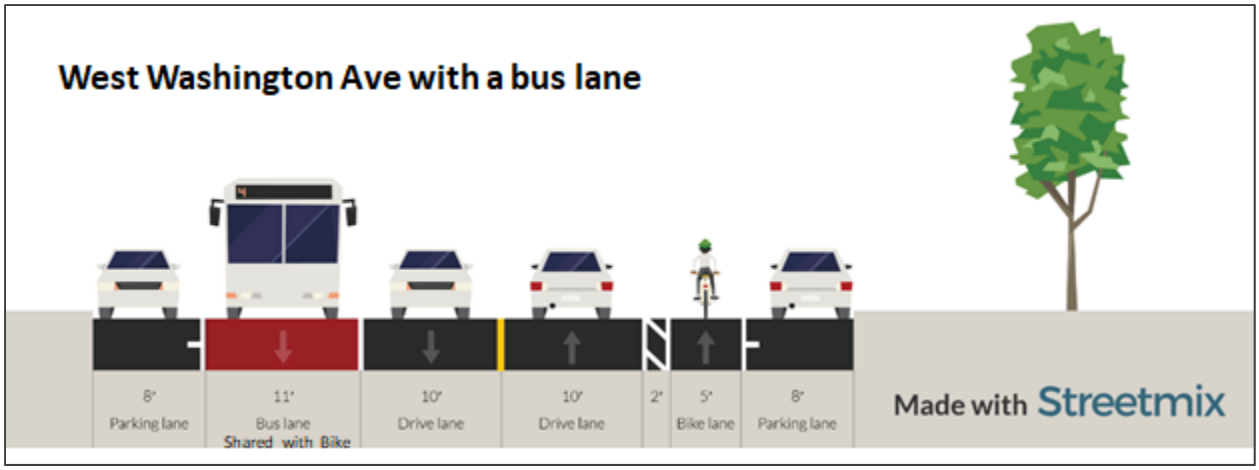

Figure 3-4 West Washington Avenue with a Bus Lane and Bike Lane

B. Alternative 1A: Outer Loop

Alternative 1A has the same route at Alternative 1 except that instead of using the outer loop detour only for special events, it would use it all the time. Parking would be removed from the right side of Webster, Doty, Dayton, and Fairchild Streets in order to add a new bus, bike, and right turn lane.

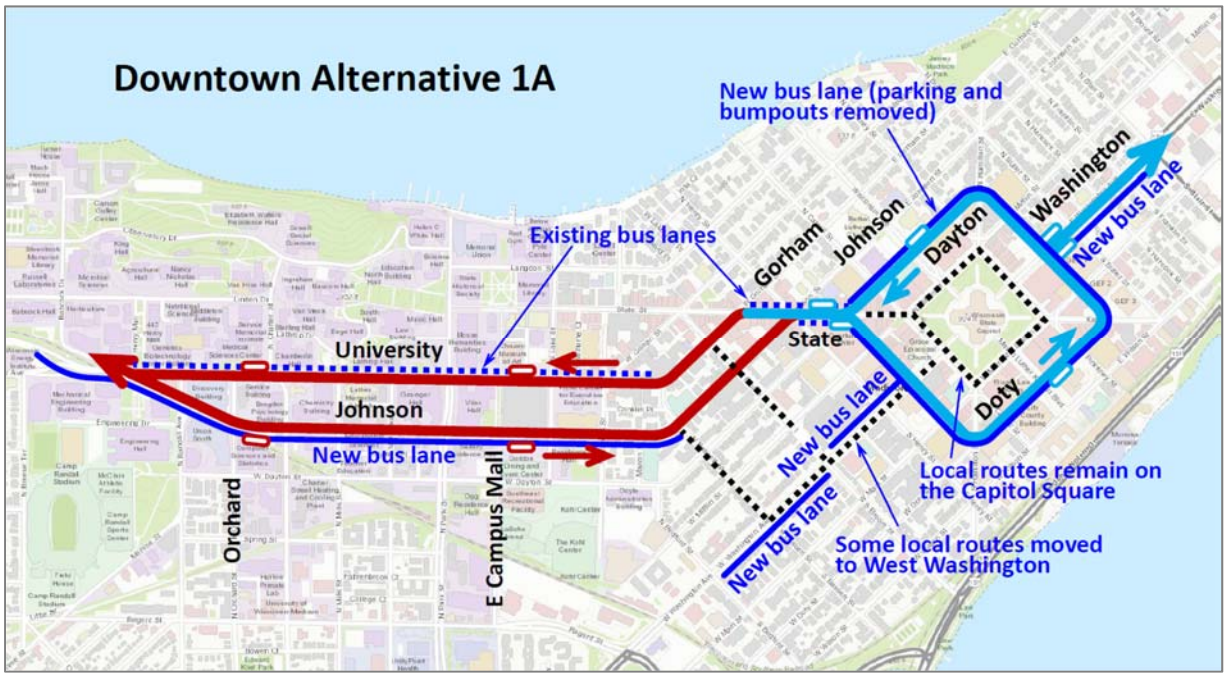

Figure 3-5 Downtown Alternative 1A

Routing BRT away from other local service will cause BRT to compete with the local service. Downtown riders would need to decide to take BRT and navigate to those stations or walk to the Capitol Square and use local routes. For example, a westbound rider may be happy using Route 2, 14, 15, 71, or 72 which stop on the Square, or BRT which stops on the Loop; since there will be more buses overall that they can catch on the Square, which is a shorter walk and is a nicer waiting environment, they will likely continue to use local service. This could suppress BRT ridership and increase waiting times, reducing the effectiveness of the city's investment in BRT. In contrast, with Alternative 1, the local and BRT routes would all be in one place and they could take whichever comes first.

With this option the complementing stations at MLK Jr Boulevard and Wisconsin Avenue are almost 0.4 miles apart walking – beyond the typical block or less between station pairs, and even beyond the normal 1/4 mile bus stop spacing limit for local buses. Very few if any transit lines are designed with this great of a distance between complementing stations.

Alternative 1A has significantly fewer detour events than Alternative 1 as it can operate normally during the Dane County Farmer's Market, Concerts on the Square, and other Capitol Square events. It is detoured when events close State Street, which is about 3 percent of the time.

C. Alternative 2: Broom/Henry and Wilson/Doty

Alternative 2 uses a series of one-way couplets (Broom/Henry Streets, Wilson/Doty Streets, and Webster/Butler Streets) to pass through downtown south of the Capitol Square. While less central to the downtown and Isthmus, this route was designed to minimize the number and severity of special event detours while serving the high demand employment area near MLK Jr Boulevard.

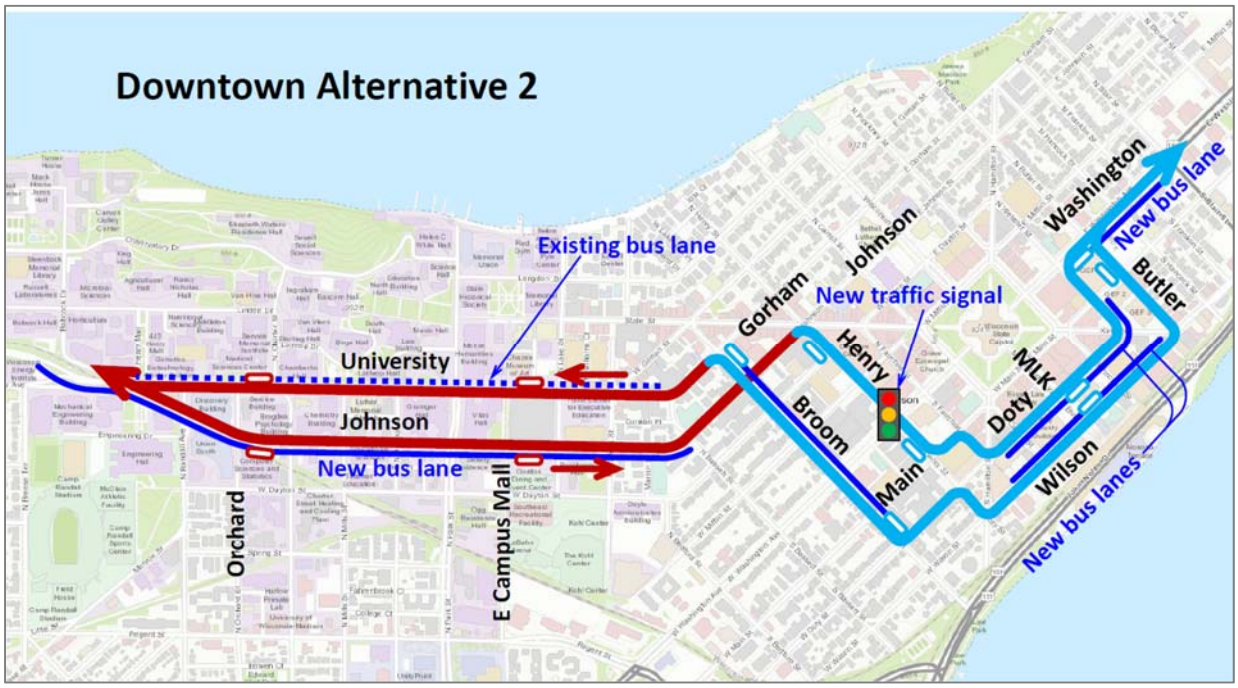

Figure 3-6 Downtown Alternative 2

Alternative 2 takes longer to travel than Alternative 1, adding at least a minute or two to every trip. Its stations are not as central and visible. For example, the stations near State Street are at Broom and Gorham westbound and Henry and Dayton eastbound – these station locations provide adequate service to the area but would be less prominent and more difficult to find.

Similar to Alternative 1A, routing BRT away from most local service on the Capitol Square will cause BRT to compete with the local service. Riders downtown would need to decide to take BRT and navigate to those stations or walk to the Capitol Square and use local routes. This may suppress BRT ridership and reduce the effectiveness of the city's investment.

Several roadway changes would be made in order to provide fast, reliable service on the Alternative 2 route.

- On Broom Street, parking would be removed between Main Street and Gorham Street to provide a bus, bike, and right turn lane.
- At Gorham Street, buses would use a new transit activated phase to make a left turn from the right lane.

- Parking would be removed on Doty and South Webster Streets around the Capitol Loop to provide a new bus lane; the bike lane would remain.
- The future cross section of Wilson Street is being studied independently of the BRT project and will include new bicycle facilities. If BRT is routed on Wilson Street, two travel lanes would be required, with one likely being bus and right turn only. This would require removing parking on the north side of Wilson Street.
- A new traffic signal would be installed on West Washington Avenue and Henry Street so that eastbound buses can make the through movement from North to South Henry Street, which would occur in mixed traffic.

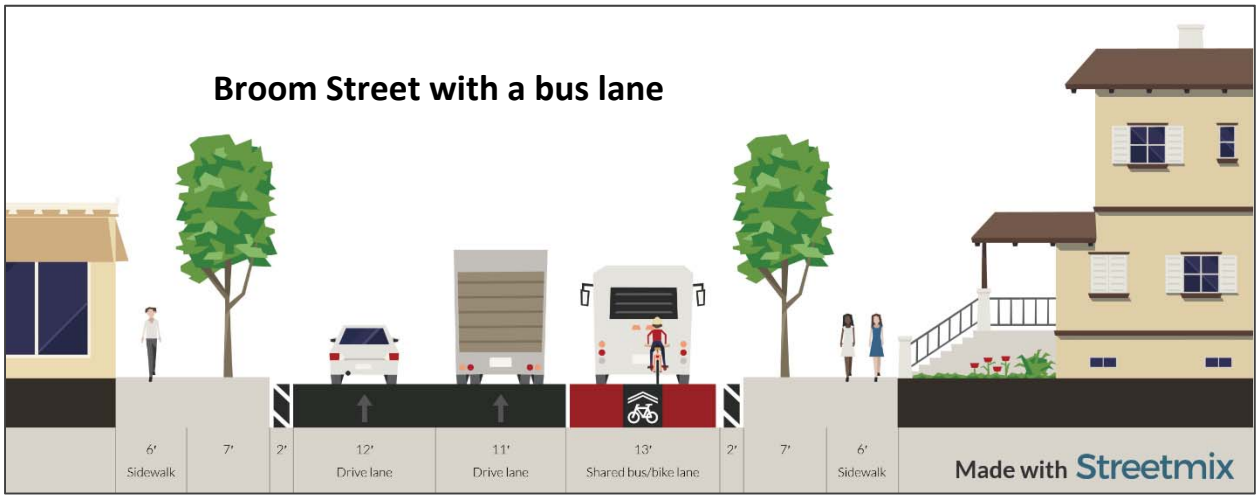

Figure 3-7 Broom Street with a Bus Lane

One advantage of Alternative 2 (and Alternative 3) is the provision of an additional station pair serving the Bassett neighborhood. This high-demand neighborhood would benefit from fast, frequent, all-day service. The blocks between Broom and Henry Street are long (1/8 mile) and Broom and Henry Streets are not a logical pair as Broom and Bassett Streets are, so this station pair may cause some confusion.

D. Alternative 3: Two-way Broom and Wilson/Doty

Alternative 3 is identical to Alternative 2 except that eastbound buses would use a new contraflow bus lane on Broom Street between Johnson Street and Main Street, rather than using Henry Street. While this reconfiguration of Broom Street would pose some challenges, it would locate the opposing stations closer to each other making the system easier to use and avoid potential operational issues on Henry Street.

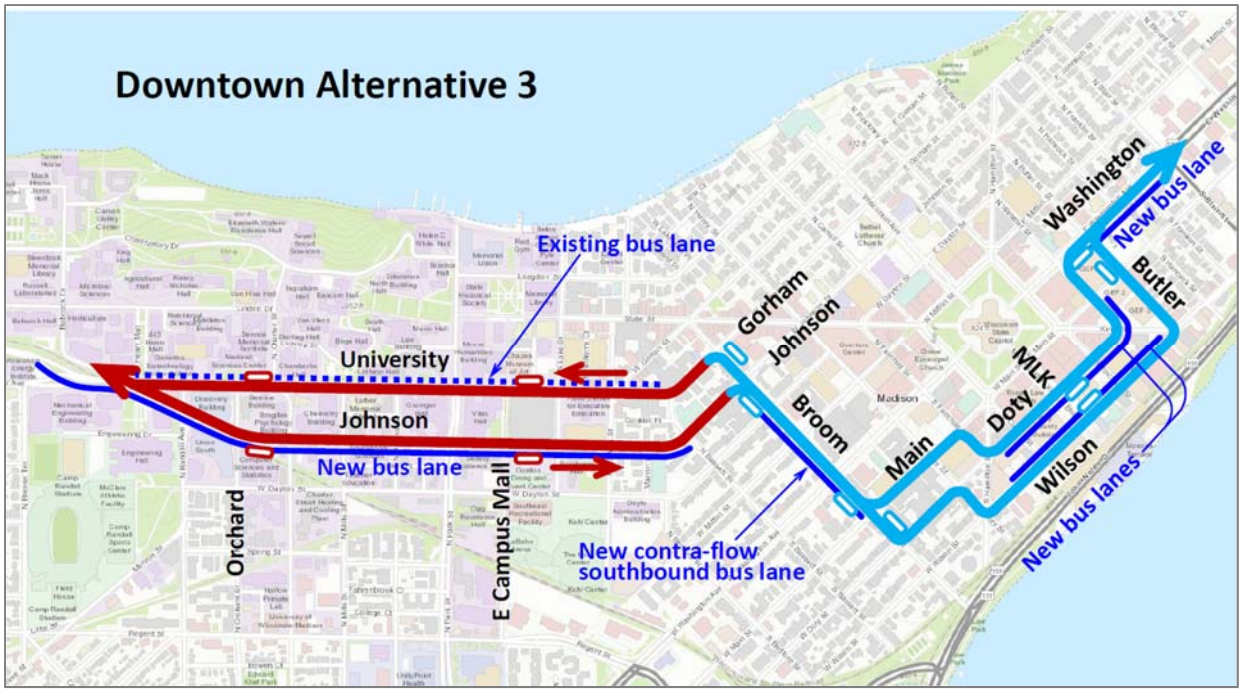

Figure 3-8 Downtown Alternative 3

To add the southbound contraflow lane on Broom Street, parking would be removed and the street would be restriped with a northbound bike lane, two northbound travel lanes, and one southbound bus-only lane. The bus lane would need to be well signed and marked with accompanying enforcement because buses will not have the ability to pass parked cars. At the northbound approach to Johnson Street, Broom Street would be widened by one lane to account for one through lane dedicated to the left turn at Gorham Street, one through lane toward Gilman Street, and one dedicated right turn lane to Johnson Street.

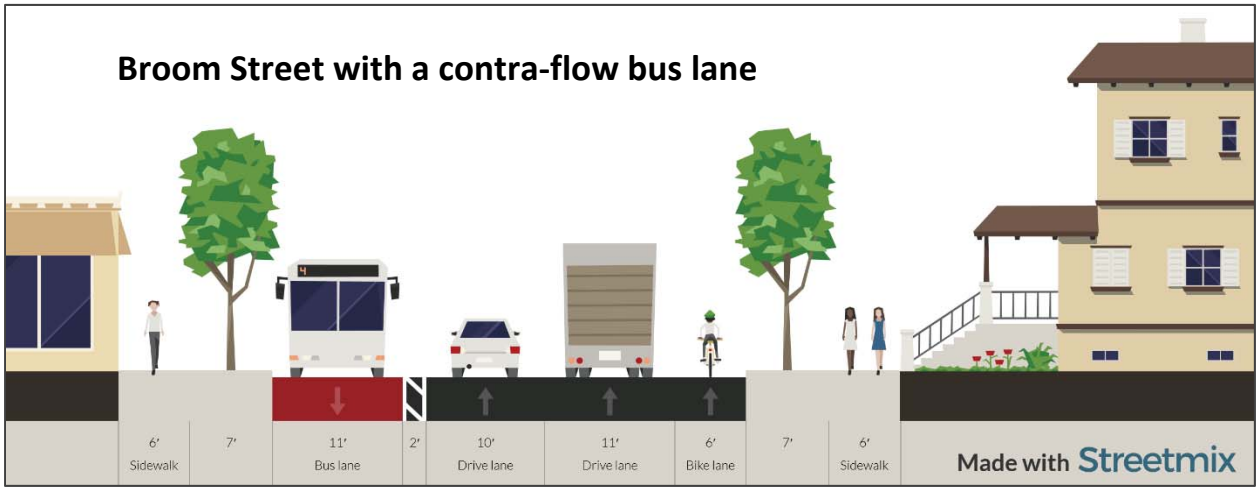

Figure 3-9 Broom Street with Contra Flow Bus Lane

E. Dismissed Alternatives

Many alternative routes were developed with the very general goals of being fast and reliable, avoiding frequent detours, and serving major downtown destinations. The route options below were dismissed from further analysis in order to focus on more likely routes.

Figure 3-10 Dismissed Alternatives

Tunnel from East Washington and Blair to West Washington and Henry or underneath University Avenue
A tunnel through downtown would eliminate congestion for BRT. It would be fast and free from detours. However, the cost would easily exceed $1 billion and therefore is unfeasible.

Johnson and Gorham Streets to Wisconsin and Blair Streets
Routing on the north side of the Capitol would provide inadequate service to employment areas on the south side of the Capitol Square.

Bassett Street
A Broom and Bassett Street couplet is logical for BRT because it avoids the unreliable State Street and Capitol Square area; however, it was dismissed from consideration because the eastbound route does not get close enough to State Street and the Capitol Square to effectively serve it.

West Washington Avenue
A BRT route on West Washington Avenue would eliminate detours and the unreliability of service on State Street but would be slower and would still rely on the Capitol Square and its many detours.

Two-way Wilson Street
A contraflow eastbound bus and bike lane on Wilson Street is attractive because it provides a two-way path around the south side of the Capitol Square free from most event detours. However, Wilson Street has a constrained cross section and a shared lane conflicts with the need for a high quality two-way bike facility.

Contraflow Main or Doty Street
A contraflow lane on Main Street would put the BRT station, and possibly the BRT running way, on State property where the city does not have jurisdiction. A contraflow lane on Doty Street would not fit within the cross section and would present sight-line issues for traffic exiting garages.

John Nolen Drive
John Nolen Drive was dismissed as a viable BRT corridor because it is frequently congested during peak periods and does not provide adequate service to the employment areas downtown.

4. Evaluation

A. Ability to Serve Important Regional Destinations

Alternative 1 provides direct access to major cultural destinations along State Street and serves employment and events around the Capitol Square.

Alternative 1A provides direct access to major cultural destinations along State Street. It also serves employment and events around the Capitol Square, although the station pair serving the Capitol are 0.4 miles apart from each other.

Alternative 2 provides less direct access to major cultural destinations along State Street. State Street patrons would need to alight one to two blocks away. Alternative 2 does not directly serve the Capitol Square, but serves stations one to two blocks southeast of it. Alternative 2 also favors employment areas on the south side of the Square, with the north portion of the Square not being served directly.

Alternative 3 has similar characteristics as Alternative 2. However, the eastbound State Street station is one block farther away at Broom Street but the eastbound Bassett Neighborhood station at Broom and Main Streets, are more central to the neighborhood and closely spaced.

B. Station Pairs

Many design manuals recommend locating bus stops/stations in pairs, typically with one stop on each side of the street along two-way route segments.[1] This helps simplify planning of the return trip. Some often think of a station as one bus stop with two platforms. As with light rail, a passenger will board and alight at the same location. Center running BRT and LRT systems often have one station in the median that serves both directions. Side running BRT systems, which Madison's is likely to be, seek to have the same consistency. Where you get on the bus is close to where you got off the bus. Midwest BRT lines, such as Cleveland's Healthline, Indianapolis' IndyGo, and Grand Rapids Silver Line all have opposing stations that complement each other and generally are within 400 feet of each other.

All alternatives would have complementing stops on the University Ave and Johnson St one-way pair that are about 450 feet apart, or 0.1 miles. This is not ideal, yet is common with transit stops that are in a grid or one-way pair system.

Around the Capitol Square the differences are more pronounced. Because of the State Capitol, complementing BRT stops cannot be closer than two blocks (0.2 miles) apart. Again, this is not ideal but has been part of Madison's transit system for over 100 years and is logical because of the one-way loop nature around the Capitol.

Alternative 1 would have stations on the Capitol loop at MLK Jr Boulevard and Wisconsin Avenue at or near Metro's highly used bus stops on Main and Mifflin Streets. For special events BRT as well as local buses would relocate to the outer loop, at Dayton and Wisconsin and at Doty and MLK Jr Blvd. This places the complementing BRT stations about 0.4 miles from each other, but is unavoidable. This rerouting would occur about for about 10 percent of the time, generally falls on weekends in the summer, and has been Metro's custom for the last couple of decades.

Alternative 1A would have BRT run on the outer loop all of the time with stations at Dayton and Wisconsin and at Doty and MLK. While eliminating the need to detour BRT buses for special events, it places the complementing BRT stations 0.4 miles from each other 100 percent of the time. This long distance is not a typical arrangement for BRT station pairing.[2]

[1] https://nacto.org/wp-content/uploads/2015/04/design_and_placement_of_transit_stops_kfh.pdf
https://nacto.org/wp-content/uploads/2015/04/service_design_guidelines_vta.pdf

[2] This arrangement would result in additional 55,000 pedestrian miles traveled each year if applied to our existing bus system. This could be considered good or bad, depending on the value placed on activity vs convenience.

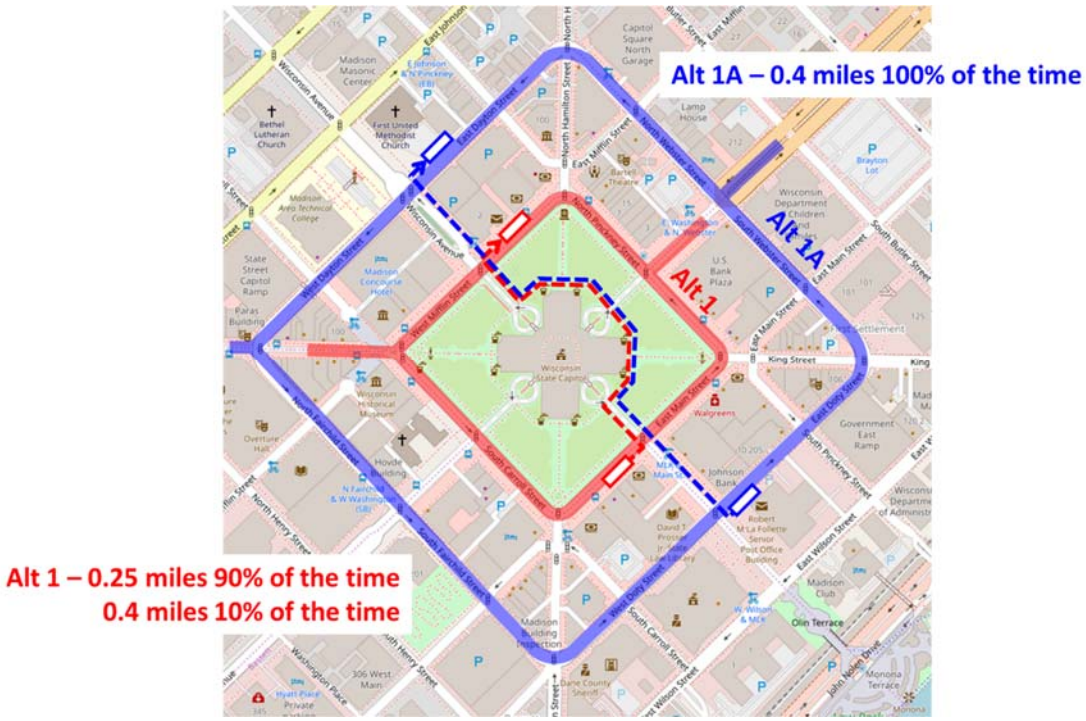

Figure 4-1 Station Pair Distance Alt 1 and Alt 1A

Alternative 2 has two station pairs that are not directly adjacent to each other. These include the two Broom and Henry Station pairs, one near State Street and one near Main Street. Both pairs would be about 0.2 miles apart and not intuitively connected because Broom and Henry Street are not a one-way couplet as say, University and Johnson or Mifflin and Main are. Regular users would learn and use these stations. Infrequent users or visitors could have difficulty finding where to board for the return trip. Alternative 3 solves this problem by placing both southbound stations on Broom Street.

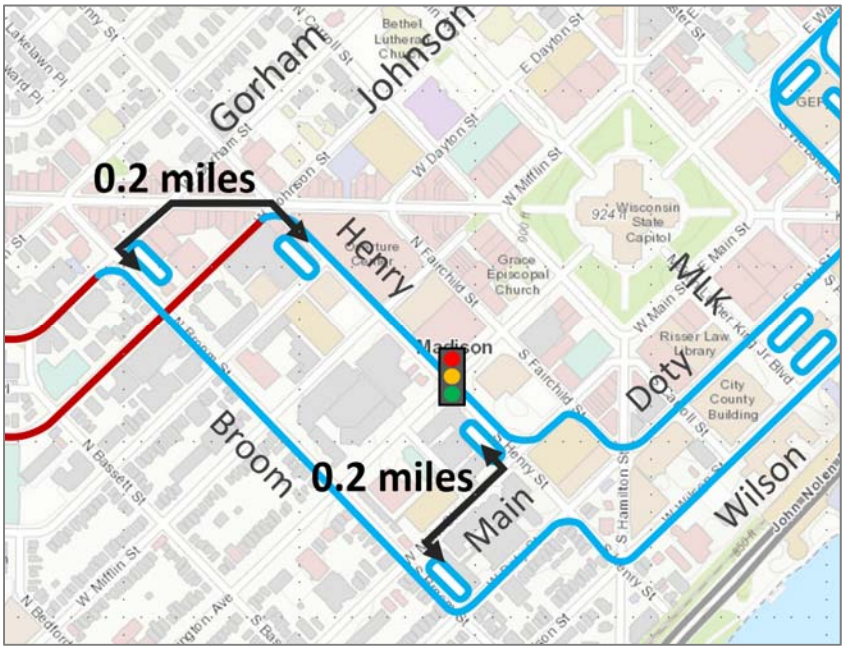

Figure 4-2 Station Pair Distance Alt 2

Alternatives 2 and 3 would also have bus stop pairs on Wilson and Doty Streets. While not on the same street, they would be one short block away, about 350 feet.

C. Station Areas

Figure 4-3 Bus Shelter Capitol Square

A defining characteristic between the alternatives is the space available for station amenities. The station accommodations between the alternatives vary greatly. A high quality station with protection from the weather and space for many people to circulate, particularly during afternoon peak periods when workers are heading home for the day, is highly desirable. The adjacent photo illustrates a current bus stop on the Capitol Square while it is raining. The 10-foot by 25-foot shelter is providing shelter for 18 people waiting for the bus. Near downtown, BRT stations are likely to be highly used. Because of the raised boarding area, shelter, and off board ticketing area, they will require more space. The minimum amount of space a small downtown BRT station would needs is 15 feet from face of curb to back of sidewalk, which allows a 5-foot boarding area, a 5-foot covered station area, and a 5-foot sidewalk.

Some locations may only be able to provide an overhang. These dimensions would provide minimum shelter and would be about the same width as Metro Transit's neighborhood bus shelters.

Larger stations characteristic of downtown areas generally require 20 feet or more. As mentioned, the current bus shelters on the square occupy about 20 feet including the boarding area in front and a 5-foot sidewalk behind.
The following graphic illustrates BRT stations in four locations. Note that even the smallest station (Grand Rapids, MI) still requires a considerable amount of room. Figure 4-4 illustrates the room needed for different types of stations.

BRT Station – Cleveland Healthline

BRT Station – IndyGo - Indianapolis

BRT Station – Grand Rapids MI

BRT Station – Viva - York Ontario

Figure 4-4 Size of BRT Stations

This quality of the stations could affect ridership, but it is difficult to predict this affect in quantitative terms.

1. State Street Stations

Alternatives 1 and 1A would place a station pair on the 200 block of State Street, westbound near side Johnson Street and eastbound near side Fairchild Street. These stations are in a highly visible location that is easy to find. The sidewalks are wide and there is a high volume of pedestrian traffic. See Figure 4-5.

Figure 4-5 State Street Bus Stop, Alternatives 1 and 1A

Alternative 2 would place an eastbound station at Henry Street and Dayton Street and the opposing westbound station on Broom Street just south of Gorham Street. These locations are one to two blocks from State Street. The station would be close to the central library, Overture Center, and other destinations on or near State Street. However, the station areas are less visible and less logical for people trying to find them. Henry Street in particular is a very low volume local street and may present security challenges. Additionally, the space available for a BRT station is limited, probably accommodating just an overhang type of shelter. Figure 4-6 illustrates the space constraints at Henry Street and the type of station that could be installed with this amount of space.

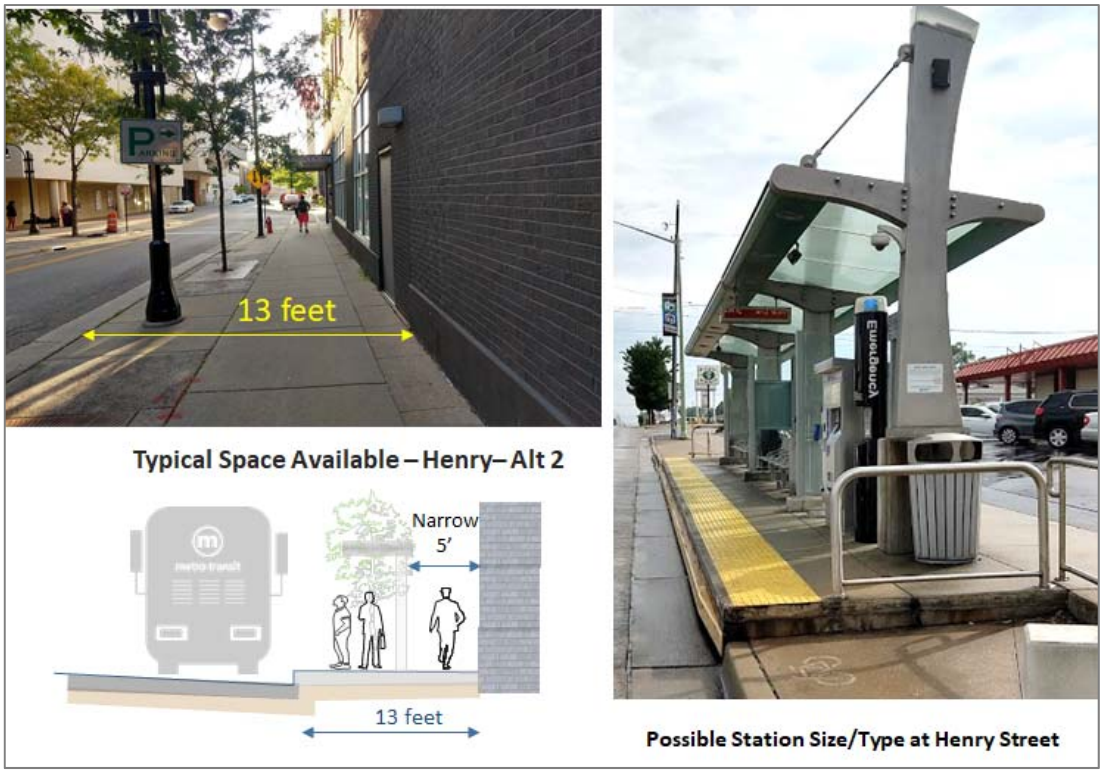

Figure 4-6 Possible Henry Street Station

Both Alternatives 2 and 3 would have a northbound station on Broom Street between Johnson and Gorham. This is a somewhat constrained location, with about 14.5 feet available for a BRT station. Figure 4-7 shows the location and probable station type at this location.

Alternative 3 would also have a southbound station on Broom Street just south of Johnson Street in the new contra flow lane and about two blocks south of State Street attractions. Depending on destination, State Street patrons would have none, one, or two high traffic volume streets to cross to access this station (Gorham and Johnson Streets). Although this location is on a higher trafficked street than Henry Street, it would have similar problems of being less visible and harder to find. Because of adjacent buildings, this location also has limited area for a station and could probably only accommodate an overhang type of shelter.

Figure 4-7 Possible Broom Street BRT Station

2. Capitol Square Stations

The Capitol Square stations will have the highest number of boardings and alightings, therefore larger stations and shelters are desirable. There is some advantage to BRT stations being proximate to the stops with local service in that a transit patron can go to one location to use either the BRT or the local Metro Transit Service. If located apart, then a rider will need to choose whether to use BRT or the local service, and then travel to that location.

All four alternatives would have stops at Martin Luther King Jr Boulevard. Two of the Alternatives (Alt 1 and 1A) would also have stops at Wisconsin Avenue.

Alternative 1 uses the existing Capitol Square. It would place BRT stations at the two existing prominent bus stops on the Capitol Square – Mifflin and Pinckney westbound, and Main and Carroll eastbound. These stops are already used by many bus routes. They are time points for all routes that serve them. They are both very large and visible, with wide sidewalks and low traffic volumes. The stations are two short blocks apart. During most Capitol Square detour events when BRT and other Metro bus routes are not able to use the Capitol Square, temporary stations will be opened on the Capitol Loop (Doty and Dayton Streets) at MLK Jr Boulevard and Wisconsin Avenue. The temporary stations may not have all the BRT features like raised platforms, but they will have real-time information so that it will be easier for riders to be redirected during the detours.

Figure 4-8 Possible Broom Street BRT Station

Alternative 1A would use the outer loop all of the time. If possible, this alternative would place a station near the Madison Municipal Building at MLK Jr Boulevard, and near the former Madison College campus at Wisconsin Avenue on the outer loop. There is probably sufficient space near the Municipal Building to install a quality stop.[3] The Wisconsin Avenue station would have greater challenges. Figure 4-5 shows Dayton Street near Wisconsin, there may be room near the Madison College sign, yet the driveway poses challenges.

[3] The Madison Municipal Building is on the National Register of Historic Places, and any change within its historic boundary needs approval by the State Historic Preservation Officer.

Alternatives 2 and 3 will have Capitol Square area stations at MLK Jr Boulevard on Doty and Wilson Streets. Because the Madison Municipal Building is on the National Register of Historic Places, these stations would be subject to the approval of the State Historic Preservation Officer. Figure 4-11 shows the station location on Doty Street, and a possible station type by the Madison Municipal Building, if approved by SHPO.

Figure 4-9 Mifflin and Pinckney Bus Stop

Most local buses will continue to use the Capitol Square stations on Main and Mifflin Streets. The MLK stations will effectively serve the government buildings (City County Building, Madison Municipal Building, Monona Terrace, and various state offices) on the south side of downtown. Businesses and offices on the Capitol Square are 0.1 to 0.3 miles away. As mentioned, because the BRT stations are separate from the square's local bus stops, riders downtown will have to choose whether to walk to Doty and Wilson Streets or to walk to the square. This split may suppress ridership on BRT.

Figure 4-10 Possible Dayton St BRT Station

Figure 4-11 Outer Loop Doty MLK Jr Blvd BRT Station

3. Webster Street Station

In all alternatives, a station pair will be provided in the area of East Washington Avenue at Webster Street. Eastbound, all alternatives have an eastbound station eastbound far side of Webster Street. Westbound, Alternative 1 stops westbound far side of Webster, Alternative 1A stops near side of Webster, and Alternatives 2 and 3 stop southbound on Butler Street at Main Street. The station pair is particularly important for Alternative 1 westbound because many riders from government buildings on the south side of the square will use Webster Street over the Wisconsin Ave station. The Webster Street station also serves the GEF buildings, the First Settlement neighborhood, and other areas and destinations.

4. Bassett Neighborhood Station

Alternatives 1 and 1A do not serve the Bassett neighborhood. However they relocate many routes from State Street to West Washington Avenue, which will improve access to the Bassett neighborhood.

Alternatives 2 and 3 both provide an additional BRT station in the Bassett neighborhood. Both alternatives have a westbound station at Broom Street and Doty Street. This is an existing very high use bus stop served by Routes 1, 10, 19, and 38. The stop serves about 280 people per day, many of whom are UW students. Eastbound, Alternative 2 provides a station at Henry and Main Street one long block and one short block away. Alternative 3 moves this station to Broom and Main, where the station would closer to its opposing westbound station and more central to the neighborhood.

D. Transfers and Local Route Integration

Transfers and access to the BRT are important in that it will be a couple of years before the north and south portions of the city will have the frequency and service levels of BRT. With Alternative 1, most transfers could occur on both the Capitol Square or on University Avenue and Johnson Street. This is illustrated in Figure 4-12.

For Alternatives 2 and 3, transfers to and from BRT would occur along University and Johnson Streets. Transfers are less likely to occur at the Capitol Square. This routing will generally mean employees boarding near the square will have to choose between going to a local route bus stop, or a BRT station.

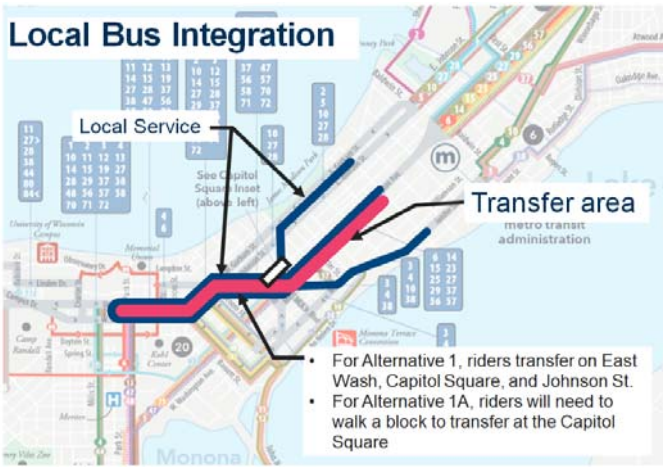

Figure 4-12 Local Bus Integration Alts 1 and 1A

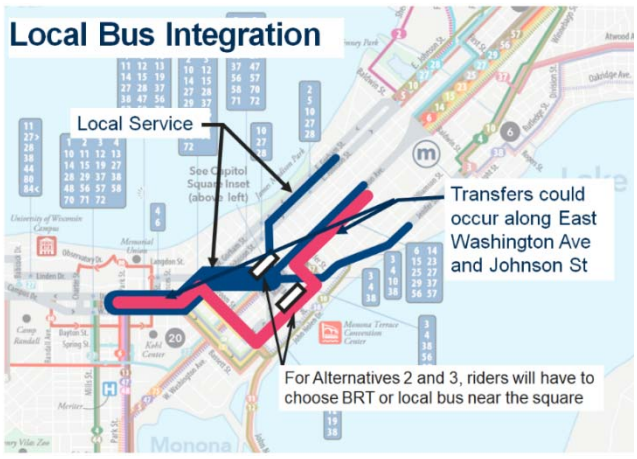

Figure 4-13 Local Bus Integration Alts 2 and 3

Table 4-1 provides a summary of station locations and characteristics.

Table 4-1 Comparison of BRT Station Pairs

	Alt 1	Alt 1A	Alt 2	Alt 3
Distance between Capitol Station Pair	0.25 miles	0.4 miles	0.1 miles	0.1 miles
Size of station serving State St	Moderate – 15 people	Moderate – 15 people	Small – 8 people	Small – 8 people
Size of station serving Capitol Square	Large – 30 people	Doty/MLK – Moderate 15 people Dayton/Wisc - Small 8 people	Doty/MLK – Moderate 15 people Wilson/MLK - Moderate 15 people	Doty/MLK – Moderate 15 people Wilson/MLK - Moderate 15 people
Integration with local routes	Easy	Difficult	Difficult	Difficult
Detours	10 percent	3 percent	3 percent	1 percent

E. Travel Times of BRT

Travel times are difficult to model with software or other tools because of the unpredictable nature of downtown with traffic patterns, signal timing, bikes, turning maneuvers, buses, and other factors. To get a feel for the relative difference in travel times between the options, a bus test was completed on February 22, 2019. The bus drove Alternatives 1 and 3 in both directions without stopping for stations. The weather was fair and traffic patterns were normal. Times were recorded between Frances Street and Blair Street. This method does not take into account bus lanes and other operational improvements and it only records one sample run. Alternative 3 eastbound was not tried because it is not possible without the contraflow lane – but it would likely be slightly faster than Alternative 2 because Broom is a flatter, faster street with no stop signs. At the time, Alternatives 2 and 3 eastbound were assumed to be on West Washington rather than Main, so that route was driven, but the travel times between the West Washington route and the Main Street route should be about the same.

Table 4-2 BRT Route Travel Time

	Alternative 1		Alternative 1A		Alternative 2		Alternative 3	
	EB	WB	EB	WB	EB	WB	EB	WB
Bus test time	8:02	7:00	6:58	6:10	10:21	9:25	N/A	9:25
Distance (feet)	6,490	5,510	7,400	5,700	7,530	8,230	7,530	8,230
Turns	3	3	3	3	4	6	4	6
Traffic signals and stop signs	12	10	12	10	14	12	12	12
Stations	3	3	3	3	4	4	4	4

Alternative 1 is about two minutes faster than Alternatives 2 and 3 because it is shorter and has fewer turns, despite lower speed operations on State Street. Alternative 1A is the fastest, yet progressing signal timing around the square could make the two alternatives similar in travel time.

F. Traffic impacts

Very few traffic impacts would be felt by any of the alternatives because no travel lanes are being removed between Bassett Street and the Capitol Square. On Webster Street, a third travel lane currently opens in the afternoon peak period when parking is removed. This lane would be a bus lane at all times for Alternatives 1A, 2, and 3; however, this lane has been closed for most of 2019 for construction and impacts are expected to be minimal.

All alternatives include the planned transit activated westbound left turn arrow at State and Gorham Streets, which will reduce the green time for Gorham Street when activated. However, because Alternative 1 moves many buses off of State Street during the afternoon peak, the left turn arrow may be called less often.

All alternatives include converting the eastbound right lane of East Washington Avenue to bus, bike, and right turn only between Webster Street and Blair Street. Staff are evaluating the operational impacts of this change. During the summer of 2019, the reconstruction of Johnson Street and Williamson Street caused major delays on East Washington Avenue so it was not possible to evaluate the effect of removing one lane in the field. Staff may pilot the closure of the lane on a trial basis and evaluate the length of the queueing.

G. Parking impacts

Alternatives 2 and 3 remove about 100 parking spaces from the downtown area, while Alternative 1 has very minor parking impacts because it primarily uses existing bus lanes and bus stops. Estimating the impact to parking revenue is difficult because it is impossible to say in each scenario what the driver would have done if the on-street parking space was not available. If other metered spots were available, or if they would park in a ramp, there would be no impacts; but if they would have not made the trip or parked in an unmetered space or private lot, the city would lose that revenue. The revenue impacts below assume all revenue from that space is lost.

1. Alternative 1 (4 total spaces removed)
   About four metered parking stalls would be removed eastbound on East Washington Avenue at the Webster Street approach. This improvement would allow buses and through traffic to bypass a vehicle making the eastbound left turn. The elimination of these four stall would reduce parking revenue by about $8,000 on an annual basis.

1A. Alternative 1A (85 total spaces removed)
   About 85 spaces, all of which are metered spaces, would be removed along Doty, Webster, Dayton, and Fairchild Streets. For comparison purposes, the current Government East ramp has 516 spaces. The elimination of the 85 spaces would decrease parking revenue by about $170,000 each year.

2. Alternative 2 (110 total spaces removed)
   22 metered parking spaces would be removed on North Broom Street and about 10 two-hour permit spaces would be removed on South Broom Street for a new northbound bus lane.

   About 3 spaces would be removed on South Henry Street for the eastbound station at Henry and Main. About 39 metered spaces would be removed on Doty Street and South Webster Street for a new bus lane.

   There are currently 36 parking and loading spaces on the right side of Wilson Street between Butler Street and Henry Street. Although BRT would not require any parking removal on Wilson Street in its current configuration, the assumption is that one travel lane will be removed for a new bike facility pending the outcome of the ongoing Wilson Street transportation study. In that case, these 36 spaces would be removed and replaced with a second westbound bus-only lane.

   The removal of about 100 metered spaces would reduce parking revenue by $200,000 on a yearly basis.

3. Alternative 3 (107 total spaces removed)
   Alternative 3 would have the same impacts as Alternative 2 but would not remove any parking on Henry Street. As with Alternative 2, the revenue lost from the removal of 97 metered spaces would reduce parking revenue by about $195,000 on a yearly basis.

   Table 4-3 summarizes the parking impacts.

Table 4-3 Parking Comparison

	Alt 1	Alt 1A	Alt 2	Alt 3
Total Parking Spaces Removed	4	85	110	107
Total Metered Parking Spaces Removed	4	85	100	97
Total Parking Revenue Lost yearly	$8,000	$170,000	$200,000	$195,000

F. Bike Network

Alternatives 1 and 1A largely uses existing facilities and would have little effect on bikes; however, it would require a new bus lane on West Washington Avenue to accommodate moving local service off of State Street. This facility would be make West Washington better than it is today, but would not make it possible to have parking and protected bike lanes in both directions. Alternative 2 represents a degradation to bicycle facilities on Broom Street, but both Alternatives 2 and 3 allow the possibility of a potentially better bicycle facility on West Washington Avenue.

1. Alternatives 1 and 1A

State Street would remain unchanged with the existing bus, bike, and authorized vehicle restrictions. The more consistent bus service throughout the day may help reduce conflicts between buses and bikes compared to today, where several buses are sometimes going through at once and bikes often attempt to pass many at once in the oncoming lane.

The Capitol Square would remain unchanged with its shared bus, bike, and right turn lanes. The restricted lanes would be colored red which may be more effective at preventing through traffic from using them.

The Capitol Loop currently has bike lanes adjacent to parking on the entire loop, for the most part, with bikes mixing with right turns onto East Washington Avenue. In Alternative 1A, these lanes would be converted to bus, bike, and right turn lanes. The street width around the capitol loop is about 44 feet, which may leave room for a separate bike lane, but likely would not. Alternative 1 would have no impact on the Capitol Loop.

West Washington Avenue is currently one wide unchannelized travel lane between Bedford Street and Henry Street in each direction. It would be restriped with a shared bus, bike, and right turn lane westbound (downhill) and a new bike lane eastbound (uphill). This cross section would be an improvement over existing conditions. The shared lane would be in the downhill direction where bikes and buses are going about the same speed. Between Bedford Street and Broom Street, the cross section would be reversed with an eastbound bus lane and westbound bike lane.

East Washington Avenue would benefit from a new bus, bike and right turn lane eastbound (downhill) between Webster Street and Blair Street. While this shared lane is not the ideal bike facility, it would be an improvement over existing conditions. No improvements are planned with the BRT project in the westbound direction where bikes are currently in a traffic lane. The conditions on East Washington Avenue are the same for all four alternatives.

Currently there are plans to consider providing enhanced or protected bike facilities on Broom, Wilson, and Main Street. All alternatives would continue to allow the consideration of these enhanced or protected bike facilities, except that for Alternatives 2 and 3, protected bike lanes on Broom Street would not work north of Main Street. Figure 4-14 illustrates these effects.

2. Alternatives 2 and 3

Broom Street has an existing bike lane between Doty Street and Gorham Street between the travel lanes and parking lane, with a one gap where bikes share the lane with vehicles turning right on Johnson Street. In Alternative 2, the right lane would be a shared bus, bike, and right turn lane. This would likely be a lower quality bike facility compared to the existing lane. For Alternative 3, Broom Street would be restriped for a southbound bus lane and two northbound travel lanes, and a northbound bike lane between the northbound travel lanes and curb, with lanes slightly narrower than today. Southbound bikes would not be allowed in the southbound bus lane because buses would have no way to pass them.

Doty Street has an existing floating bike lane – most of the time, the bike lane is between the travel lanes and a parking lane, but during peak periods when parking is restricted, the lane is between the travel lanes and the curb. The parking restrictions would be permanent and there would be permanent bike lane between the bus lane and curb. Doty Street does not have regular bus service on it today, and bicyclists would have to pass buses at the BRT station at MLK Jr Blvd.

Wilson Street does not currently have bicycle facilities – bikes travel westbound with traffic in a shared lane and are restricted, like all traffic, from traveling eastbound. However, the need for better bicycle facilities on Wilson Street, including an eastbound bike lane, is understood, and the separate Wilson Street transportation plan will determine how to accommodate bikes on Wilson Street. Alternative 2 does not preclude the ability to have protected bike facilities on Wilson Street.

East Washington Avenue changes would be identical to Alternative 1 with a new eastbound bus, bike, and right turn lane between Webster Street and Blair Street.

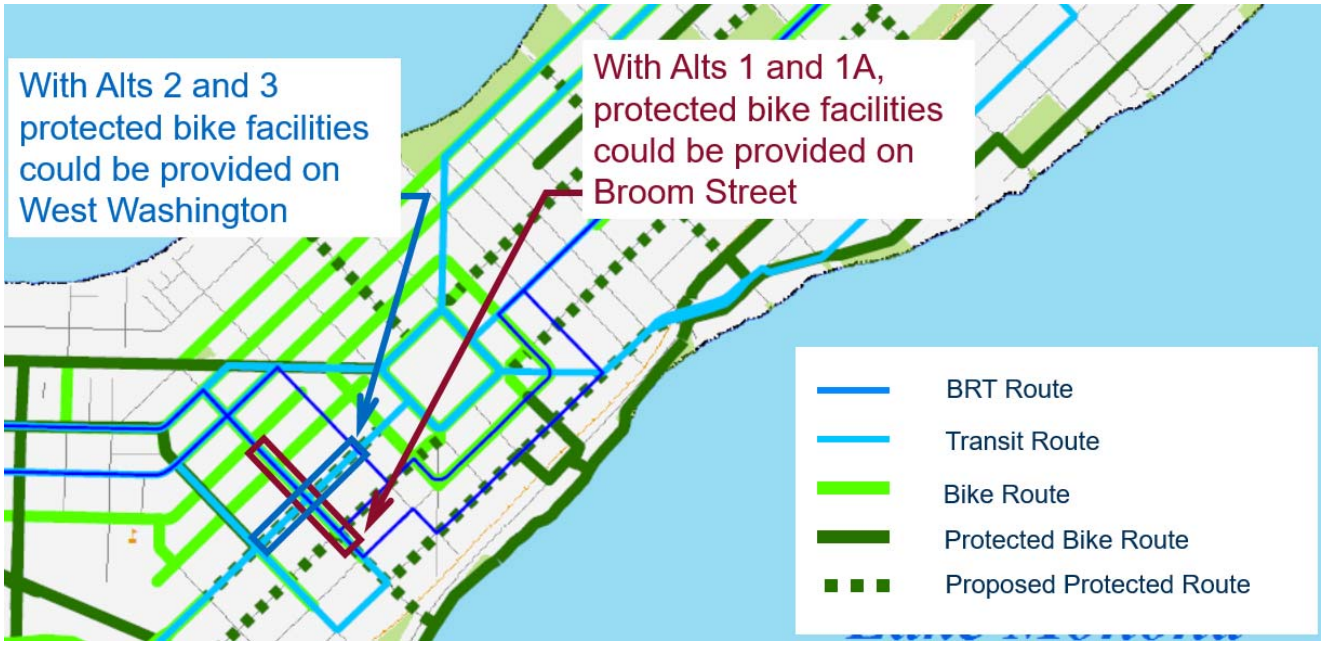

Figure 4-14 Bike Accommodations

Table 4-4 Summarizes the effects of all the alternatives.

Table 4-4 Effect Summary

Item	Alt 1	Alt 1A	Alt 2	Alt 3
Access to major destinations	State Street – Good Capitol Square – Good	State Street – Good Capitol Square – Fair	State Street – Fair Capitol Square – Fair	State Street – Fair Capitol Square – Fair
Maximum distance between Station Pairs	0.2 miles	0.4 miles	0.2 miles	0.2 miles
Size of station serving State St	Moderate – 15 riders	Moderate – 15 riders	Small – 8 riders	Small – 8 riders
Number of buses on State Street	~50% fewer	~50% fewer	Same as existing	Same as existing
Size of station serving Capitol Square	Large – 30 riders	Doty/MLK – Moderate 15 riders Dayton/Wisc - Small 8 riders	Doty/MLK – Moderate 15 riders Wilson/MLK - Moderate 15 riders	Doty/MLK – Moderate 15 riders Wilson/MLK - Moderate 15 riders
Safety/visibility	Stations are in highly trafficked visible areas	Stations are in highly trafficked areas	Henry St station in area with low visibility and traffic	Stations in moderately trafficked areas
Transfers and Local Route Integration	Good	Fair Local routes could compete with BRT	Fair Local routes could compete with BRT	Fair Local routes could compete with BRT
Detours	10 percent	3 percent	3 percent	1 percent
Travel Times	EB – 8:02* WB – 7:00*	EB – 6:58 WB – 6:10	EB – 10:21 WB – 9:25	EB – NA WB – 9:25
Traffic Impacts	None (no travel lanes removed)	None (no travel lanes removed)	None (no travel lanes removed)	None (no travel lanes removed)
Bike Routing	West Wash does not have protected bike lanes.	Bike lanes may be discontinued around a portion of the outer loop West Wash does not have protected bike lanes.	Broom St bike lanes converted to shared bus/bike lane. (Precludes protected bike lane.)	Precludes protected bike facilities for a portion of Broom St.
Total Parking Spaces Removed	4	85	110	107
Total Metered Parking Spaces Removed	4	85	100	97
Total Parking Revenue Lost yearly	$8,000	$170,000	$200,000	$195,000
* Could be improved with signal progression				

5. Observations

The following paragraphs discuss what appear to be the most advantageous BRT routing alternatives, and the specific benefits associated with the alternative listed.

Alternative 1 appears to provide the greatest number of advantages for BRT routing.

- It provides the most direct access to key destinations on State Street and the Capitol Square.
- Eastbound and westbound stations are within a block or two of each other – new and occasional users downtown will easily be able to find the correct station.
- There is generous space for stations – providing more shelter and better pedestrian circulation. Because of its routing, Alternative 1 also highlights BRT as prominent feature and transportation mode in the community.
- It provides the easiest way to transfer to and from local Metro Transit routes and avoids competition between BRT and local routes.
- Alternative 1 does not reduce parking revenue. Parking revenue is an important source of funding for Transportation initiatives.
- It reduces the number of buses on State Street during the PM peak and replaces some with electric buses.

With Alternative 1, BRT would be rerouted for events on the square. While inconvenient, it occurs mostly during weekend and off-peak hours. The majority of riders who use the system on weekdays will not be inconvenienced with the detours. Metro has used the outer loop detour for more than 30 years, and most Madison patrons are familiar with it.

If Alternative 1 was adopted, better communication through electronic message boards and other means should be implemented during event detours. The improved level of signage and communication would make it easier for people to find out where to go compared to today, where only one or two detour signs are placed on the shelter several days in advance and can easily be missed or misinterpreted.

Alternative 1 will also remove several regular (diesel bus) routes from the square and about twelve (diesel bus) routes from traveling down State Street, helping to address these concerns. These changes will make the bus volumes more consistent throughout the day and have a positive effect on the dining experience on upper State Street. During the afternoon peak period when people are walking or sitting outside, instead of having three or more westbound buses stack up at the Johnson and Gorham Street intersections filling much of the block and idling, there will normally be one bus that comes through at a time that serves the bus stop and goes.

If policy makers desire not to have BRT on the Capitol Square, then **Alternative 3** provides the next greatest number of advantageous. This alternative includes adding a southbound contraflow bus-only lane on Broom Street. Alternative 3 does not provide as many benefits as Alternative 1, but it does avoid the limitations of Alternatives 1A and 2. Primary benefits of Alternative 3 include:

- Complementing BRT station pairs are relatively close to each other, so finding the return trip station is somewhat more intuitive.
- Buses are only detoured for a few days per year.

Some of the disadvantages of Alternative 3 that should be considered include:

- Access to State Street and capitol square destinations will not be as direct,
- BRT stations will be smaller, less prominent, and may be harder to find.
- Transfers between BRT and local bus routes will be less convenient. Local routes may compete with BRT.
- Travel times on BRT will be 1-2 minutes longer.
- Up to $195,000 of parking revenue could be lost on an annual basis.

Alternative 2 has more disadvantages than Alternatives 1 and 3 yet is better than Alternative 1A.

- The 0.2 mile distance between two sets of paired stations on Broom and Henry is greater than desired. This distance also makes finding the boarding station vs the alighting station more difficult.
- Similar to Alternative 3, this routing has limited right of way, making the station size smaller – particularly for the stations serving State Street.
- The Henry Street route has two drawbacks. The first is the limited traffic Henry Street experiences during non-peak hours, which could make security an issue. Additionally, event buses and loading trucks associated with the Overture Center that stage on Henry Street could cause regular substantial detours and delays for BRT. There are no alternative sites for loading at the Overture Center.
- Up to $200,000 of parking revenue could be lost on an annual basis.

Alternative 1A has several disadvantages compared to Alternatives 1, 2 and 3.

- While detours are the often cited reason for preferring the outer loop for BRT route, it adds a substantial distance between the boarding and alighting locations. This:
  - The majority of People who use BRT (perhaps up to 95 percent) would have to walk 0.2 miles further (50 percent more distance) solely because the BRT route would have to be detoured 10 percent of the time. This is a disproportionate impact to the regular users of transit.
  - The added distance is not insignificant. For example, if this added distance was applied to existing Metro boardings on the square, it would amount to 55,000 miles of additional pedestrian travel per year.
  - The 0.4 miles between bus stop or BRT station pairs is much greater than the distance recommended in transit documents, or the actual distance observed with other BRT systems. Few to no BRT or rail stations exist more than a block or so apart because of the difficulty of using the system.
  - Because of the distance between stations, it may be difficult for first-time and occasional users to find the stations.
  - With BRT on the outer loop and local buses on the square, riders will have to choose whether to go to the square or loop. Many will continue to go to the square and use local service because the walk is shorter, facilities are better, and overall service levels are higher. As a result, BRT will compete, rather than compliment local service, and this will lead to longer wait times and lower use of the BRT system.
- The amount of space for BRT stations is more limited. Therefore, the system's most highly used stops may have smaller shelters and platform areas.
- Up to $170,000 of parking revenue could be lost on an annual basis.

A public meeting was held on October 30, 2019 to discuss downtown BRT route options. General input from the meeting are summarized in the bullets below.

- There was support for Alternative 1A. Some people liked the fact that it would be detoured less than Alternative 1.
- There was support for Alternative 1. Some stated that they would prefer better signage and use of technology to disseminate detour information.
- There was little support stated for Alternatives 2 and 3.