transportation analysis 5

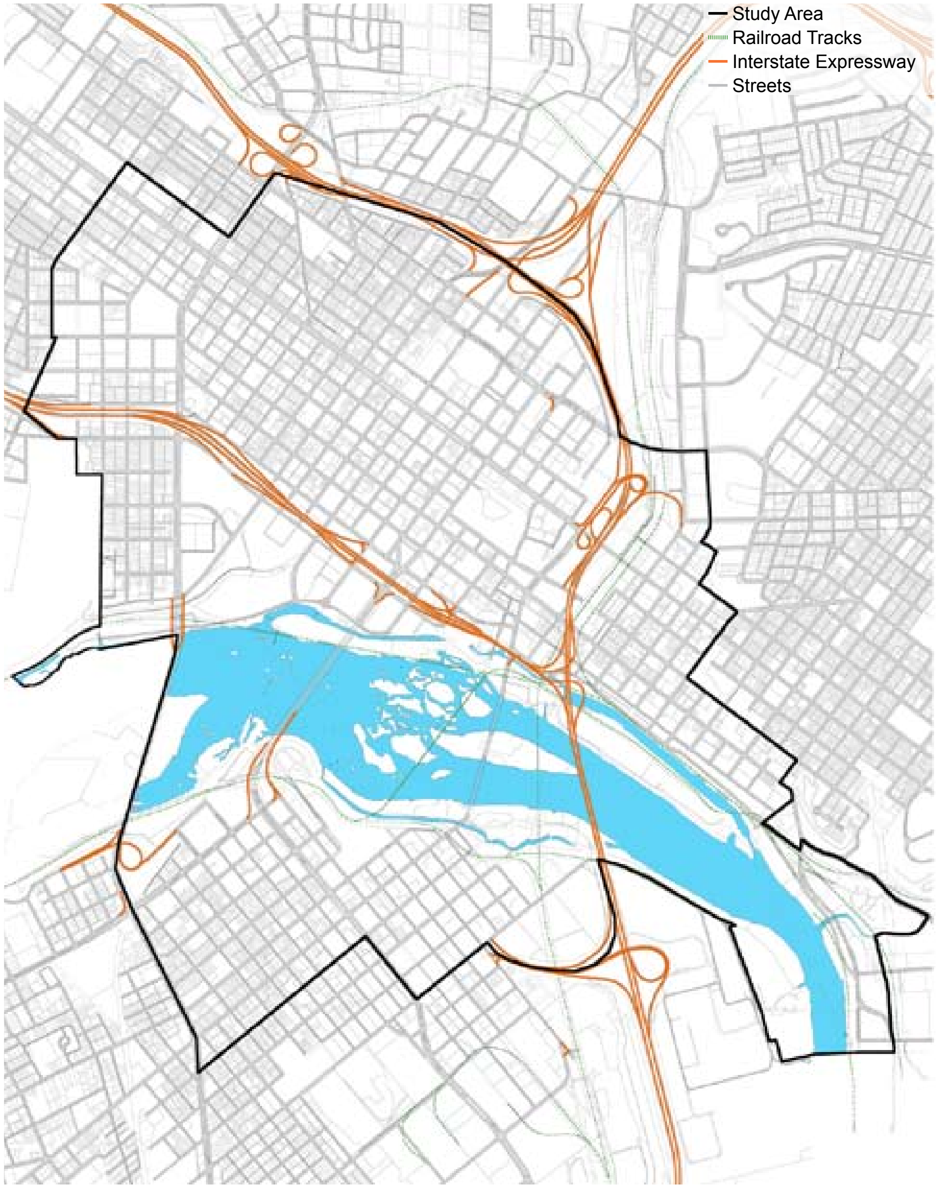


Figure 1. Downtown Richmond Street Network

During the July 2007 design charrette, transportation engineers from Hall Planning & Engineering (HPE) worked closely with the design team to create a strategy for transforming Downtown Richmond into a walkable destination that balances of the needs of pedestrians with those of bicyclists, motorists, and transit operators. During the charrette, HPE interviewed stakeholders such as City Public Works and Community Development staff, citizens and community groups to identify transportation and walkability issues. HPE combined these personal interviews with first-hand analysis of the Downtown transportation context. The team studied Downtown street designs and analyzed their impact on driver, pedestrian, bicyclist, and transit rider behavior. HPE then used this first-hand analysis to inform the reestablishment of a more balanced, multi-modal transportation system Downtown. HPE's recommendations are focused on improving walkability and providing multi-modal transportation options for Downtown residents, workers, and visitors. Emphasis is placed on the needs of pedestrians, bicyclists and transit riders in order to supplement existing transportation planning practices in Richmond and throughout the United States, which focus on automobile needs.

The Transportation Report for Downtown Richmond was prepared by Hall Planning & Engineering in November 2007. The following is a summary of the report; a complete version of the analysis is available at the City's Community Development Department.

The Transportation Challenge

Richmond has a long legacy of walkable streets and multi-modal transportation. In the 20th century, however, the rise of the automobile and changing settlement patterns have weakened the historically multi-modal transportation networks Downtown. Across the country, transportation planning and engineering has been given priority over land-use planning, resulting in streets that are at odds with the businesses and residences that front them. The results of these national trends are: street designs that are controlled by projected vehicle speeds, rather than used to control traffic speeds; streets that have been redesigned based on vehicle capacity and speed rather than on pedestrian needs; and two-way streets that have been converted to one-way, encouraging increased traffic speeds and requiring excessive circulation patterns for drivers, bicyclists and transit alike.

In Richmond, street car lines have been removed from the streets and replaced with a complex regional bus system, leaving Downtown without a reliable and efficient circulator system. A lack of clearly identified bike routes Downtown has forced bicyclist to ride dangerously on unmarked lanes and has frustrated uninformed drivers. Finally, cheap and abundant off-street parking has given residents, workers, and visitors little incentive to pursue alternatives to the automobile. Each of these challenges was addressed by HPE in an attempt to provide a safe, efficient and enjoyable system that meets the needs of all modes of transportation. It should be noted that implementing recommendations within this plan to improve transportation conditions for one user group such as pedestrians will impact the transportation conditions of other user groups such as motorists and transit riders. Therefore, each of the recommendations in the plan should be carefully reviewed with the public and phased to allow for a smooth transition prior to implementation.

The team identified the following transportation priorities for Downtown Richmond:

1. Tailor streets to respond to land use and context
2. Control traffic speeds through design
3. Prioritize pedestrian needs on Downtown streets
4. Return one-way streets to two-way operation
5. Provide efficient, reliable transit Downtown
6. Create designated bike routes on Downtown streets
7. Balance parking supply and demand

These priorities will be discussed in detail in the following pages; implementation steps are presented at the end of the chapter.

Broad Street looking east towards Downtown

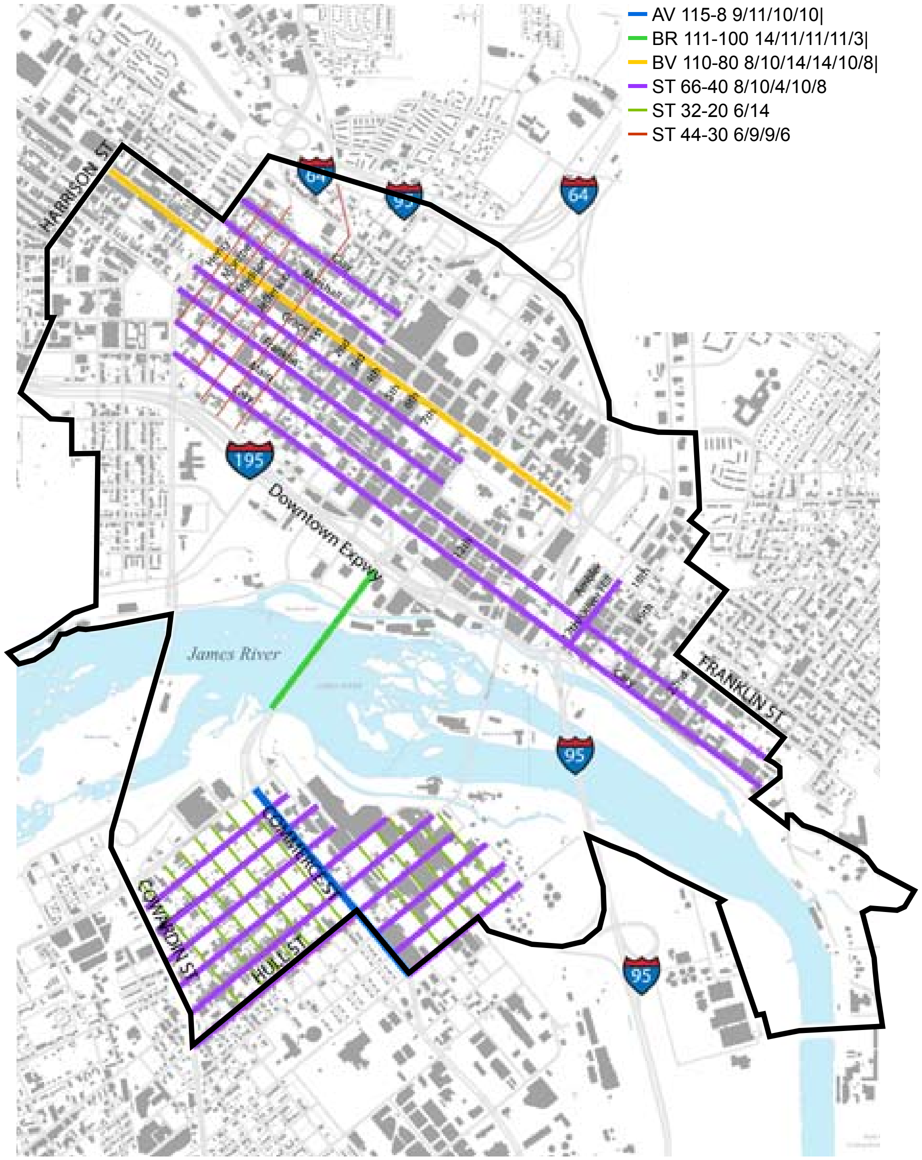


Figure 1. Thoroughfare Assignment Plan for Downtown Richmond

1. Tailor streets to respond to land use and context

Much of America's development in recent years has been dictated by one purpose: accommodating the automobile. Everything from street and block form to building design is dictated by vehicular needs, from high speed highways to parking garages.

In order to better integrate transportation with its context, the patterns of proposed development must be specified during the planning stage. Once the character of the proposed community has been determined, transportation plans for balanced mobility can be crafted with walkability considered first and vehicle mobility second. This is not to imply that motor vehicle mobility will be dramatically reduced, but rather that pedestrians are more vulnerable on the public street, and solutions for their comfort are more complex. Often, greater walkability yields only small reductions in vehicle capacity, even though vehicle speeds are lower.

Downtown Richmond has retained much of its historic grid, however some streets have been widened, intersections have been modified, and many of Downtown's two-way streets have been converted to one-way operation. These modifications encourage high vehicular speeds, complicate local travel patterns, and reduce the walkability of the area. These modifications serve to allow speedy access into and out of the Downtown area, essentially emptying the Downtown at 5:00 p.m.each weekday.

The vision for Downtown Richmond, as described by the community and refined by the design team during the charrette, is a return to the walkable city structure of the early 1900s. Downtown residences, places to shop and find entertainment, and workplaces are all components found in a walkable downtown. This urban design vision informs the transportation design criteria for Downtown Richmond. The return to a walkable downtown requires managing traffic speeds to pedestrian-friendly levels and ensuring connectivity of the street system. To accomplish this vision, HPE recommends the use of walkable thoroughfares for specific sections of the study area. The location and design of the walkable thoroughfares are described in greater detail under priorty three, Prioritize pedestrian needs on Downtown streets.

2. Control traffic speeds through design

Standard traffic engineering practice requires roadway design to be based upon the function of the thoroughfare. This function changes as the context of the street changes. In rural areas, for instance, the function of a road is to move vehicles. In an urban environment, however, the function includes providing public space where multiple modes of transportation occur such as walking, bicycling and transit, as well as automobile travel. A neighborhood street has a very strong public space function and will include on-street parking, sidewalks, shorter curb radii and related features to manage traffic speeds and provide for safe pedestrian travel and sharing of the thoroughfare by all modes.

A critical design parameter for walkable thoroughfares is vehicle speed. The speed of automobile traffic directly affects the walkability of a street. If a pedestrian is hit by an automobile traveling at 40 mph or more, the odds are better than even that the pedestrian will be killed, and at 30 mph the odds are almost 40% that the pedestrian will be fatally injured. Pedestrians know this instinctively. In order to encourage pedestrian traffic along a street and create a comfortable public space, vehicle speeds must be set between 15 and 30 mph. Neighborhood streets that support community activity require very low design speeds of 15-20 mph. City Center streets, with the need for large truck movements, will have higher design speeds of 20-25 mph, due to the larger dimensions required to accommodate larger vehicles. Walkable thoroughfares designed for longer travel, such as boulevards or avenues, will have the highest design speeds of 30 to 35 mph. These faster thoroughfare types have reduced levels of walkability and must be used carefully.

Traffic volumes are of secondary or tertiary concern when designing a walkable thoroughfare system. The critical volume issue is the number of lanes required to accommodate peak hour traffic flow, usually estimated at 700-900 vehicles per hour (vph) per lane. Depending on local travel patterns (K and D factors,) these peak hour volumes generally equate to 7,000-9,000 vehicles per lane per day. Consequently, a two-lane street is considered sufficient to support up to 14,000-18,000 vehicles per day, again depending on local travel patterns and peaking characteristics.

Provided this general amount of capacity exists, walkable thoroughfare design does not use traffic volume as a primary design parameter, a departure from conventional traffic engineering practices. A reduced level of Service (LOS) can occur in walkable, Downtown situations, reflecting a balance between an improved pedestrian environment and reduced vehicle capacities and speeds. In actuality, the additional porosity of the thoroughfare network in a city such as Richmond allows a wide variety of routing choices during congested traffic periods, and the high levels of internal capture (trips from one land use, such as housing, captured by another land use, such as a grocery store) mitigate the traffic impacts of a downtown area to a much greater extent than possible in conventional suburban development. Traffic volume is therefore not used as a design parameter for travel lane width, for instance; instead, design speed is the overarching design parameter for thoroughfare design.

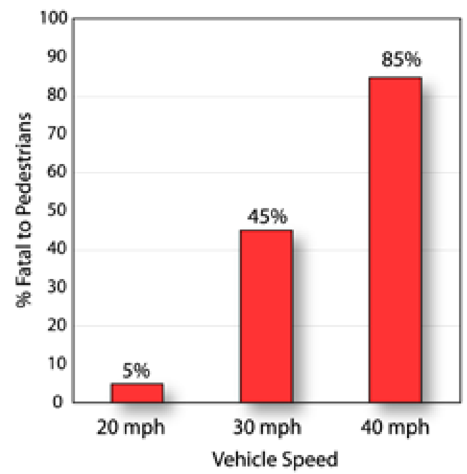


Figure 2: The Relationship Between Pedestrian Fatalities and Vehicle Speed.
Rudolph Limpert, Motor Vehicle Accident Reconstruction and Cause Analysis, 1994.

Design Speed Factors

Design speed is the most critical element of walkable thoroughfare design, and requires careful consideration. Lane width and curb radii play a key role in managing speed and reducing accidents in lower speed environments.[1] These elements are designed in response to the function and context of the roadway, which is defined by its spatial enclosure, block size, intersection arrangement, and level of pedestrian and automobile traffic, but these factors primarily set the context for the thoroughfare. The lane widths and curb radii are designed in response to the expected level of enclosure and intensity, not vice versa.

If the physical elements of the roadway are appropriate to its function and context, traffic speeds will be managed naturally, eliminating the need for redundant traffic calming devices such as speed humps, bulb-outs, and raised intersections. In fact, these traffic calming devices, when used on an appropriately designed urban thoroughfare system, can create access problems for utility and emergency services vehicles and should be avoided.

1 Residential Street Typology and Injury Accident Frequency, Peter Swift, P. E., Dan Painter, AICP, Matthew Goldstein; "Narrow Residential Streets: Do they really slow down speeds? James Daisa, P.E. and John Peers, P.E.

Typical Richmond One-way Street

Downtown Richmond Design Speeds

Applying these findings and principles to Richmond's street design, several things become clear. First, anything that contributes to higher vehicle speeds should be carefully considered and weighed against the goal of walkability. Second, the physical design of the street, with lane widths and curb radii the most critical elements, must be optimized to manage traffic speeds to appropriate levels. Third, the street must continue to function for the design vehicle appropriate to the context – typically an SU truck (such as a FedEx delivery truck) in general urban contexts, and a WB-50 tractor trailer in the town center context.

Conventional engineering practices evaluate a street network based upon its traffic capacity and speed rather than its balance of vehicular access and pedestrian comfort. If the street network is going to support Downtown in becoming a vibrant urban destination, pedestrian comfort must share equal priority with vehicular access. Any effort to improve vehicular movement should be carefully balanced with pedestrian needs. In all cases, the physical design of the street must be optimized to control traffic speed. The primary methods of controlling traffic speed in Downtown Richmond include reducing lane widths, examining curb radii, recovering the two-way street system, and adjusting traffic signal timing.

Lane width plays a primary role in managing traffic speed. The lane widths on primary streets (streets with 40' curb-to-curb dimensions) work against the goal of effective speed management. Even when 8' wide parallel parking lanes are placed on both sides of the street, the two remaining 12' travel lanes are highway-sized and with limited ability to control speeding. Therefore, it is essential that the travel lane width be reduced as far as practicable. Given the Downtown context of these streets, 10’ is the narrowest practicable lane width that can still accommodate the expected vehicle sizes.. Several methods of reducing to this travel lane width are illustrated in the Walkable Thoroughfare Standards. In addition, conversion of streets from one-way to two-way operation will manage traffic speeds.

Speeding can be attributed to a number of factors, including a one-way street pattern. This is logical, as the one-way streets are generally designed to move traffic quickly. These traffic patterns were often implemented across the country in the 1960’s when planners believed that allowing unrestricted traffic access in and out of the downtown area would stem the decline of these districts. Today, many cities have found that the one-way systems have the opposite effect. The higher travel speeds and convoluted travel patterns required by these systems serve to reduce walkability and the overall attractiveness of the downtown areas. It it recommended that a majority of these one-way streets should be returned to two-way operation over time to encourage a vibrant Downtown in Richmond. Additional information on one-way streets, including the recommended phasing program for one-way street conversion, is found later in this chapter.

The timing of traffic signals in Downtown has also been designed to optimize traffic movement. According to information provided by the City’s Public Works Department, the signals are timed to synchronize with traffic moving at 32 mph. Richmond’s one-way streets operate, based on HPE’s observations, near the posted 30 mph speed limit and in accordance with the 32 mph signal progression. This exceeds the maximum speed at which pedestrians feel comfortable. On the other hand, when synchronized traffic signals are set at 30 mph or less, some drivers may learn to “double” the signal – i.e., synchronization at 25 mph is also synchronization at 50 mph. These traffic signals will need to be adjusted to accommodate the new two-way traffic system and a slower travel speed. As traffic signals are replaced as part of the City’s Capital Improvement Program, more complex signal systems should be installed to accommodate this type of synchronization. Throughout all of these adjustments, the street must continue to serve the largest vehicle appropriate to the context – typically a delivery truck or a tractor trailer.

On-street parking and trees soften the wide lanes and one-way operation of Clay Street.


Traffic signals control vehicle speed on Leigh Street, City Center.

Multi-modal activity on Cary Street, Carytown.

3. Prioritize pedestrian needs on Downtown Streets

Conventional zoning and engineering standards tend to be focused on maximizing vehicle capacity and speed, rather than the creation of attractive pedestrian environments. These are not mutually exclusive goals; however, in many cases, conventional traffic engineering has created streets that are difficult or uncomfortable to walk along. Street design standards, for instance, typically require large (20' or greater) curb radii and wide (11' or wider) travel lanes. On-street parking may be restricted in some instances. While these standards may be appropriate in suburban areas, the creation of highly walkable places requires alternate standards. The thoroughfare types described in this report are tailored for walkable neighborhoods and include narrow lane widths, on-street parking, and shorter curb radii.

Following the philosophy of Land Use First/Transportation Second, or LU-1/TR-2, the design team identified areas for redevelopment and created specific land use designs for these areas. Walkable thoroughfares were then created or adapted from existing street sections to serve these areas with more appropriate vehicle speeds. The vast majority of streets can be redesigned using the existing curb lines, but a few will require more extensive reconstruction. These modifications are described below for each walkable area.

The title of each thoroughfare describes its function and lane arrangement. The first two letters of the title indicate the thoroughfare type, such as ST – Street, AV – Avenue, or BV – Boulevard. The numbers in the title describe the width of the roadway and its parts. An ST 66-40 8/12/12/8, for instance, is a street with a 66' right-of-way and 40' of pavement, arranged with two 8' parking lanes and two 12' vehicle lanes. All street widths are measured curb-face to curb-face. This "curb face" convention matches the practice of traditional street designers and stems from the majority of urban streets having on-street parking. Street lanes without parking are still measured to the face of curb, including the gutter pan. This does not assume vehicles will routinely travel in the gutter; just that the convention is uniformly applied in traditional street design.

Some features, such as planting strips and sidewalks, are not indicated in the Thoroughfare titles and must be determined by viewing the actual street section diagram. Bike lanes are not included in most of the walkable thoroughfare sections, due to the target speed of the thoroughfares being 30 mph or less. At these speeds, bicyclists can safely share the lane with motorists and are expected to do so. Biking in Richmond is discussed in more detail in section 6 of this chapter. The Americans with Disabilities Act (ADA) standards must be followed in the implementation off all the walkable thoroughfares.

Core/Downtown Walkable Thoroughfares
New, walkable thoroughfare definitions should be adopted for the Downtown study area. Transportation design engineers will have greater professional guidance when implementing the thoroughfares if the City adopts the Walkable Thoroughfare Definitions, which will be included as the recommended code modifications for Richmond. Richmond's recommended walkable thoroughfares are described on the following pages. A thoroughfare assignment plan is included as Figure 3 indicating the recommended location for each of the following walkable thoroughfares.

Richmond's existing downtown streets have a typical 66' ROW and curb-to-curb width of 40' on the streets parallel to the river. Cross streets west of 1st Street are typically 44' ROW and 30' curb-to-curb. In the Downtown area, which is the most dense and intense urban context, these street widths are more than sufficient. Specific thoroughfares for the core/downtown area are proposed on the following pages.

Walkable Thoroughfares often include on-street parking, shade trees, and wide sidewalks.

BV 110-80 8/10/10/24/10/10/8

A Boulevard thoroughfare type is proposed for Broad Street. This type is the widest and most traffic-intensive of the walkable thoroughfare designs. Boulevards typically have 4 to 6 central travel lanes, traverse long distances, and in many cases, accommodate transit within the right-of-way. Managing traffic speeds on a boulevard can be difficult, so narrow lanes are usually recommended, along with short blocks and, if possible, use of traffic signals for speed management. As shown in Figure 3 the boulevard section for Broad Street includes an 8’ parking lane and a 10’ “sharrow” lane, and a 10’ travel lane, mirrored around a 24’ dedicated transit median, which can accommodate two 12’ Bus Rapid Transit or Streetcar lanes. The outermost 10’ lane, placed against the on-street parking, is designed to be a slower, mixed-traffic lane that will accommodate both cars and bicycles. This lane has “sharrow” markings that indicate the presence of bicyclists in the travel lane. Further discussion of sharrows is found in section 6. The 10’ lanes will assist in reducing traffic speeds. In the center of the roadway, 24’ of dedicated transit lanes will be located on a separated, dedicated median. These lanes can accommodate a Bus Rapid Transit system in the short term, and a streetcar line in the long-term. Transit stops can be located at the far side of the intersection on enclosed, elevated platforms adjacent to the median. These platforms will allow efficient pickup by allowing riders to pay in advance at the platform. ADA compliance is achieved by providing a ramp within the platform that will lead up to the bus level. The dedicated transit median will taper away from the intersection to allow on-street parking throughout the block.

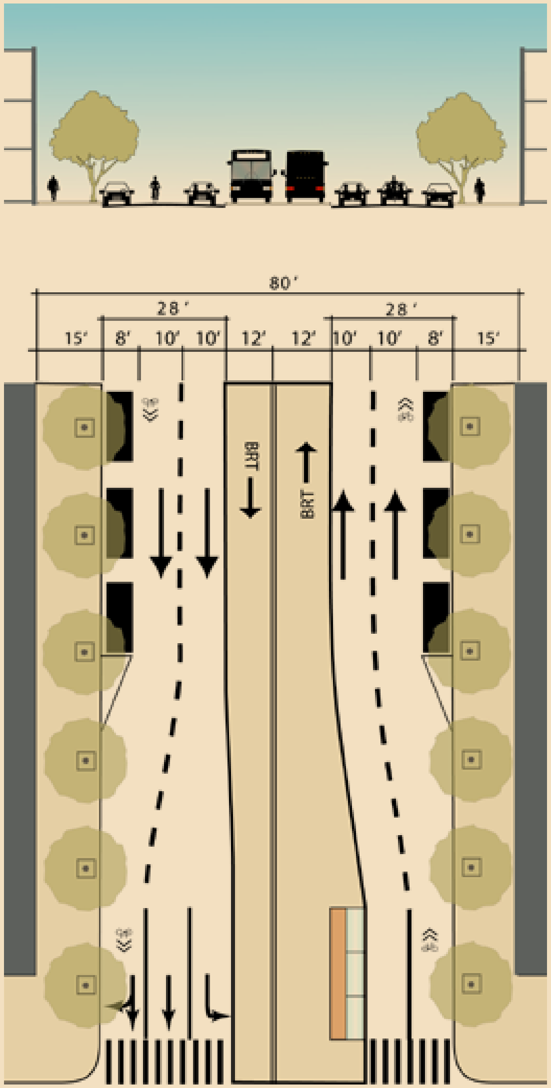


Figure 3. Proposed section for Broad Street

ST 66-40 8/10/4/10/8

The Downtown streets parallel to the River typically have a 66' right-of-way (ROW) and curb-to-curb width of 40'. This section provides ample sidewalk space, but is somewhat wide for effective speed management. An 8/12/12/8 arrangement, with two 8' parking lanes and two 12' travel lanes, would allow traffic speeds to be higher than desirable for good walkability. The proposed section has two 8' parking lanes, two 10' travel lanes, and a 4' "safety strip"/flush median between the travel lanes. The safety strip should be of a cobbled texture, making it possible, but uncomfortable, to drive over. In operation, the narrow 10' travel lanes provide speed management by keeping drivers close to the parked cars, but the safety strip provides room to carefully pass a parking vehicle or a bicyclist, or for emergency vehicle access. This section is shown in Figure 4.

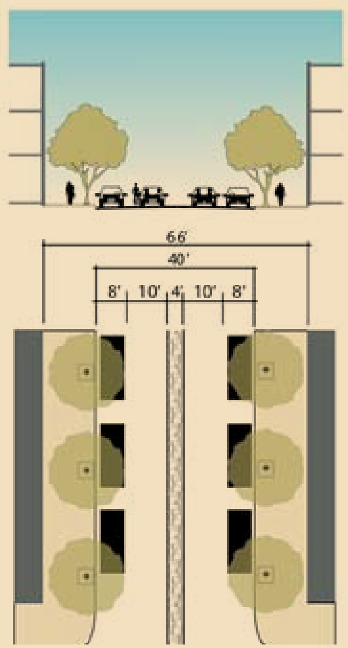


Figure 4. Typical section for an urban street (Two-way travel)

ST 44-30 6/9/9/6

West of 1st Street the cross streets have a 44' right-of-way and a 30' pavement width. Currently, most of these streets are one-way, with parking on one or both sides. The proposed section for most of these streets uses the same right-of-way and pavement width, but returns the streets to two-way operation. The proposed section has 6' parking lanes and two 9' travel lanes on each side. This arrangement will provide more convenient circulation and will manage traffic speeds to a walkable level. The typical section is shown in Figure 5.

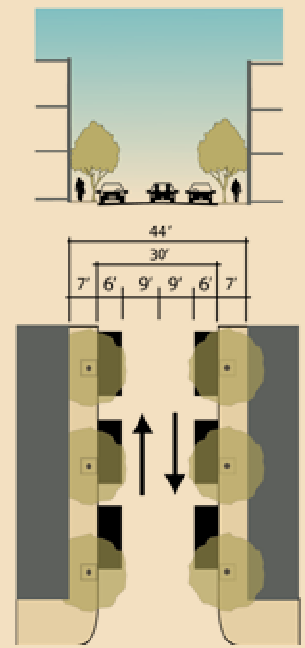


Figure 5. Slow street for urban areas

Manchester Walkable Thoroughfares

The design proposal for Manchester involves revitalizing the district by increasing the intensity of the neighborhood center areas using appropriately scaled new development and infill. The streets in these areas will carry primarily local traffic at relatively low volumes, with the exception of Commerce and Hull Streets. The local, neighborhood roadways in Manchester call for narrow streets to manage traffic speeds and encourage pedestrians.

HPE found that most streets in this area have either a 20' or 40' pavement width (in fact, the same 66' ROW/40' pavement section found north of the River.) The 20' wide streets are optimal for this location, but the width of the 40' streets encourages speeding. If the area redevelops as planned, additional traffic on these streets will only increase the impact of the faster speeds.

Manchester's 40' streets are designated with the same ST 66-40 8/10/4/10/8 section as the City Center area. This street section allows for the addition of a street car track, at some point in the future, if residents desire this transportation option. Sections are provided for Commerce Street and the 20' pavement width streets, described on the following pages.

Two-way yield street in a Richmond neighborhood.

ST 32-20 6/14

These narrow streets run perpendicular to the 40' streets and generally front the side of the block. The streets are currently one-way, requiring excessive vehicle circulation. The proposed retrofit has a 6' parking lane and a 14' yield lane, allowing travel in both directions. The parking lane should be striped or signed, and should swap sides from one block to the next. This will create a natural "chicane" pattern to help manage traffic speeds. This section does not provide room for street trees, which are normally included on all walkable thoroughfares. The narrow ROW and side-fronting lots preclude trees in the public ROW; they may be provided in the private ROW if desired. This section is shown in Figure 6.

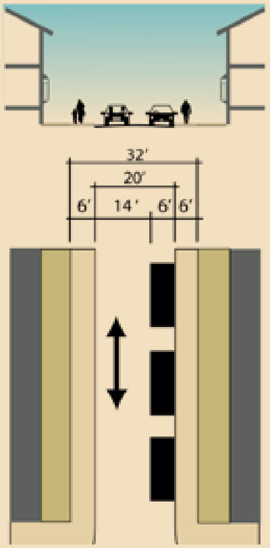


Figure 6. Yield Street

AV 115-80 9/11/10/10/10/10/11/9

Commerce Street divides the east and west portions of the Manchester study area. The street has the capacity of a highway, with six lanes that are 12 feet wide, however it serves very little traffic. Typically HPE would recommend a reduction in lanes for such a wide and underutilized road. In this case, however, they do not because the portions of Commerce Road directly north and south of the study area are six lanes wide. The street must be calmed, however, and traffic speeds must be reduced to increase pedestrian connections throughout Manchester.

The following section proposes a short Avenue for this urban portion of Commerce Street, with a central tree-planted median, on-street parking, and narrower travel lanes. The Avenue thoroughfare type is normally used for higher volumes of traffic and includes a planted median, but is designed to be more of grand place, rather than leading between two places. The Avenue type depends upon street-front buildings, an arrangement that already exists along Commerce Street and should continue to be encouraged. The proposed section has a planted central median flanked by two 10' travel lanes, an 11' travel lane, and a 9' parking lane. The section is shown in Figure 7.

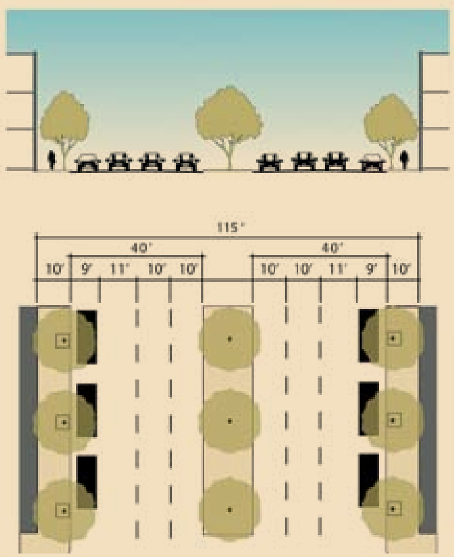


Figure 7. Section for Commerce Street


Intersection of Commerce Street and Hull Street

BR 111-100 14/11/11/11/3/3/11/11/11/14

The Manchester Bridge connects Old Manchester to Downtown. The interior of the bridge has an existing elevated pedestrian/bicycle path. Bicycle crossing of the bridge is problematic. The elevated central path is difficult to reach at either end of the bridge (the southern end is reached by a flight of stairs), and the high-speed entry and exit ramps are difficult to cross with bike lanes.

The proposed six lane bridge section has ample capacity for projected traffic. The outside lane is a 14' bike lane/breakdown lane. Going toward downtown, bicyclists can enter the bridge by riding up the ramp from Semmes Avenue and 7th Street. The ramp bike lane continues across the bridge, eliminating the merge movement. Exiting, cyclists will stay in the 14' outside lane, which will diverge at the Semmes Avenue exit. A proposed roundabout at the Semmes Avenue exit allows cyclists to disperse at low speed in whichever direction they are bound. This section is shown in Figure 8.

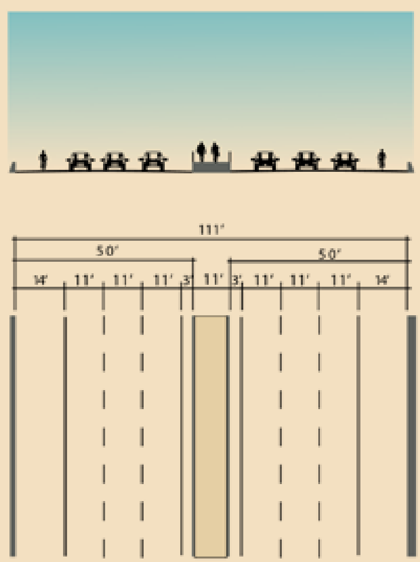


Figure 8. Manchester Bridge

4. Return One-way Streets to Two-way Operation

The Richmond study area has an excellent street network. The tight grid of small blocks provides multiple routes for pedestrians and vehicle operators and should provide high levels of accessibility and traffic capacity. However, the system does not operate at full efficiency, from a walkability and development perspective, due to the extensive one-way street designations and left turn regulations. These two issues result in unnecessary vehicle miles of travel (VMT), frustration to locally circulating traffic (pedestrian, bike, and transit as well as automobile) and increased operating speeds. Reversion to two-way traffic will improve the marketability of Downtown streets and reduce unnecessary circulation while sufficiently managing traffic speeds and accommodating current traffic volumes.

A number of adopted Downtown plans, including the 2004 Downtown Plan, the 2002 Shockoe Bottom transportation study, and the 1998 West Main Street Corridor Plan also recommended returning streets to two-way operation. Based on the recommendations of these adopted plans and the goals of the current Downtown Plan, all one-way streets within the Downtown study area were reviewed to determine the feasibility of one-way operation reverting to two-way operation. As a result of this analysis, HPE recommends converting most of these one-way pairs to two-way operations over time.

All one-way streets Downtown should be returned to two-way operation with the exception of the following streets: Byrd and Canal Streets, which are physically designed to operate one-way with the ramps connecting to the Expressway, 11th Street, which connects into the MCV Campus, and 3rd, 5th, and 7th Streets, which serve as access to the Interstate. Converting Downtown streets from one-way to two-way operation cannot be taken lightly. Streets considered for two-way conversion should be assessed for potential accidents, traffic volumes, traffic impacts, adjacent land uses, cost, and availability of funding.

Advantages of two-way traffic operation

Changing street directions, while perhaps not as expensive or difficult as moving curb lines or building completely new streets, is still a serious undertaking and requires detailed engineering and design work under the guidance of traffic engineering professionals. The costs for signalization and new traffic control devices, re-learning of the new circulation system by residents, and the planning and study that accompany the conversion from one-way to two-way operation are all additional expenses. These expenses can be reduced by staging the conversion to accompany planned signal upgrades. The following are some advantages associated with one-way street conversion. HPE bases its recommendations for two-way conversion on the vision for the Downtown area, as expressed by the community during the charrette.

1. Intuitive navigation for visiting drivers

People who move to or grew up around a one-way street system eventually incorporate the navigational requirements and find little difficulty with them. Visitors and guests, however, frequently experience the frustration of "seeing the destination but not being able to get there" due to one-way streets. Because the Downtown Richmond vision involves increasing tourism and business traffic, a two-way circulation system will be more intuitive and therefore preferable.

2. Easier circulation for cyclists and transit

One-way streets present greater difficulty for cyclists than almost any other user group. A bicyclist provides his or her own power for vehicle operation and typically tries to conserve that power by choosing the shortest path between destinations. Ideally, this path should also be safe and legal. One-way streets make all of these criteria more difficult to achieve. If bicyclists ride legally and safely on the street, one-way routing forces a more circuitous path to a destination, just as for buses and automobiles. The difference is that a hill, for instance, is not an inconvenience to a bus or car, but can make a big difference to a cyclist. Consequently, one-way streets encourage wrong-way riding, because that may be the most direct route to a destination, and sidewalk riding, for the same reason. Wrong-way riding and sidewalk riding are common causes of bicycle crashes.[2] A safe bicycling system should discourage this type of riding. Converting the one-way streets to two-way operation will, essentially, double the available routing options and cut in-half the distance required to reach many destinations by bicycle.

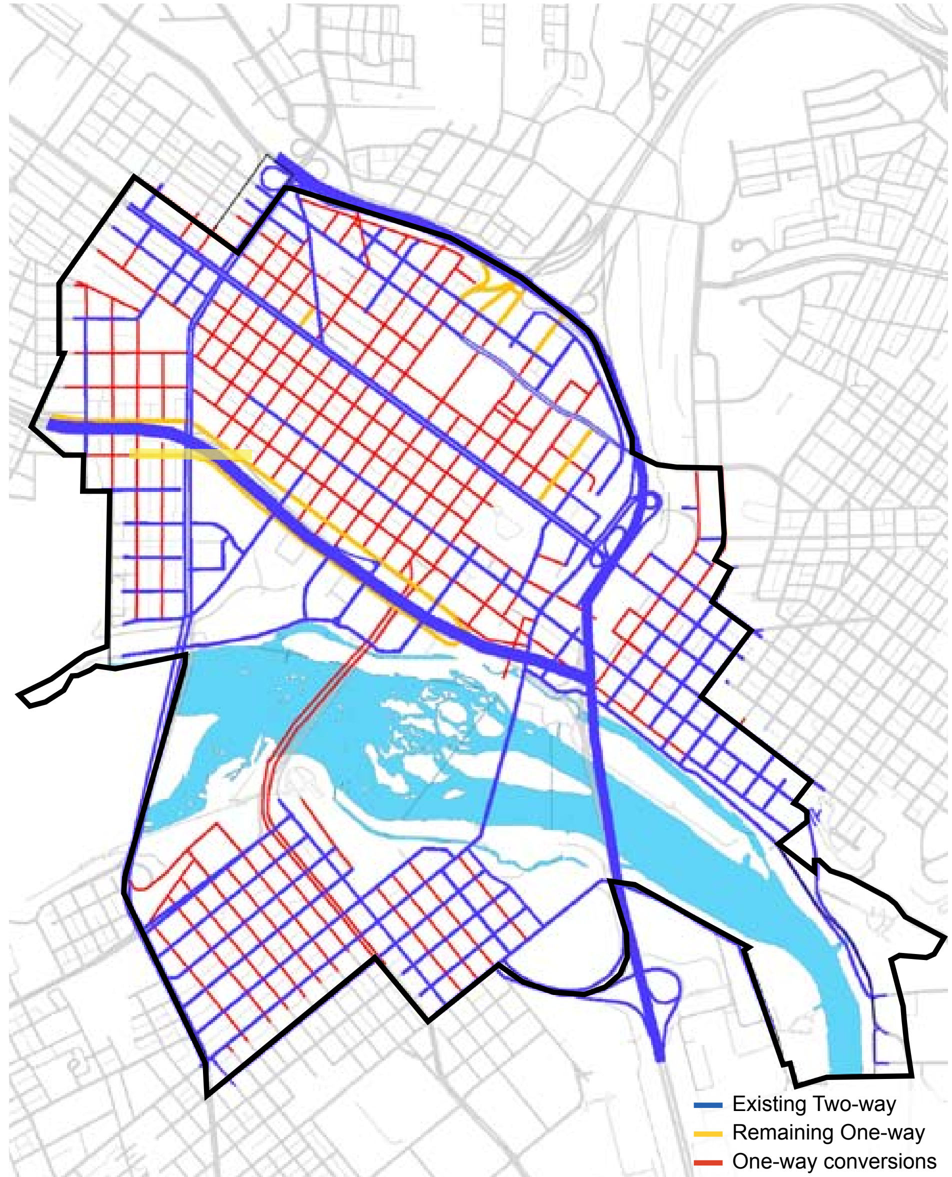


Figure 9. Proposed One-way to Two-way conversions

2 Orlando Area Bicyclist Crash Study: A Role-Based Approach to Crash Countermeasures, MetroPlan Orlando 2007

Transit buses face two dilemmas with one-way streets. First, the circuitous routing required to reach a destination means that often passengers have to be dropped off on one street and picked up on another, which can make routing confusing to passengers. Second, because buses have doors on only one side, buses are not able to access some locations, requiring unnecessary street crossings to reach a destination.

3. Positive reception from local businesses

As described in Walker, Kulash, and McHugh in "Downtown Streets: Are We Strangling Ourselves on One-Way Street Networks?," two-way streets are healthier for on-street retail businesses. This report describes the effect of "view shadows" in which business on the cross-street that front in the direction of the one-way street have less visibility, compared with a two-way street. A study conducted for the City of Kelowna found that introduction of a one-way system from an existing two-way system would definitely have a detrimental effect on Main Street type businesses, based on comparisons with other locations.[3] By comparison, another survey of businesses in Michigan having undergone one-way to two-way conversion found that local businesses were favorably impacted by the change.[4] HPE also queried reports of retail satisfaction or dissatisfaction with one-way to two-way conversions in Charleston, Lubbock, and Toledo, just to name a few cities of comparable size to Richmond, and found that retail along the newly-reverted two-way streets is thriving, based on research papers and newspaper accounts available on the internet. Each of these cities is planning to implement additional one-way conversions. Montgomery, Alabama, another southern capital city, is currently implementing a one-way to two-way conversion as part of its 2006 Downtown Master Plan, for these same reasons.

4. Pedestrian navigation and comfort

One-way streets may appear, at first glance, to be of little concern for pedestrian circulation. Pedestrians, after all, walk on the sidewalks, and sidewalks still go in both directions, even on a one-way street. However, there are several circulation issues associated with one-way streets and pedestrians. To begin with, street signs and traffic signals on one-way streets are oriented for the convenience of drivers and are not visible to pedestrians walking toward traffic. Secondly, pedestrians may find it safer to walk facing traffic, rather than away from traffic. One-way streets limit this option, affecting how pedestrians perceive safety on a street.

5. Reduced vehicle speed and fewer, less severe, pedestrian accidents

One-way streets encourage higher travel speeds which negatively impacts walkablity. Vehicle speed has serious consequences for pedestrian safety, as shown in Figure 2. In addition, a May 2000 article in the Canadian Journal of Public Health found that one-way streets constitute an increased risk especially for children.[5] This is a non-trivial finding if Richmond intends to increase residential development in the Downtown area. The Center for Problem-Oriented Policing found that vehicle speed is a major factor in pedestrian injury and fatalities as described in their website publication "Pedestrian Injuries and Fatalities" Guide No. 51 (2007) by Justin A. Heinonen and John E. Eck.

6. Improved intersection safety

A common argument in favor of one-way street operation is that the intersections of one-way streets are safer for pedestrians, due to the reduction in turning conflicts. In reality, complex intersections are often safer because they require drivers to focus on their environment, including pedestrians in the intersection. In low-speed street design such as that recommended for Richmond, the complexity of the intersection is in itself a safety feature. This counter-intuitive finding has been demonstrated by Hans Monderman, the late Dutch traffic engineer who pioneered this approach.[6]

7. Reduced vehicle miles of travel (VMT) due to more direct routing

One-way streets typically increase overall VMT, due to the circuitous routing required to reach a given address. HPE conducted a simple exercise to demonstrate this increase. As shown in Figure 10, HPE estimated the VMT needed to access locations along Main Street and Grace Street from 9th Street. The estimated mileage, based on the one-way street system, was 15.2 miles, due to the number of additional turns required. For

3 City of Kelowna Downtown Kelowna Association One Way Couplets Impact Analysis Final Report July 2003, Prepared by: Development Consulting Group

4 City of Alma Two-Way Street Project, http://www.downtownalma.com/twoway.php

5 Are child pedestrians at increased risk of injury on one-way compared to two-way streets?" Wazana A, Rynard VL, Raina P, Krueger P, Chambers LW.

6 Hans Monderman Presentation, CNU Transportation Summit, London England 2007

direct access to these locations on two way streets, the VMT required was only 12.3 miles. In this example, the one-way system required 23% more vehicle miles of travel to reach the same set of shops along the street. This figure is consistent with other estimates of additional travel required for one-way circulation, as described by Walker, Kulash, and McHugh in "Downtown Streets: Are We Strangling Ourselves on One-Way Street Networks?" and by Lum Kit Meng and Soe Thu in the Journal of the Institute of Traffic Engineers, Singapore, in their 2004 paper "A microscopic simulation study of two-way street network versus one-way street network" comparing one-way and two-way travel networks.

Disadvantages of two-way traffic operation

The primary advantage of one-way streets over two-way streets is the additional traffic capacity allowed by one-way operation. Allowing two lanes to operate in the same direction allows faster speeds, reduces friction between lanes, simplifies turning movements for motorists, and simplifies traffic signalization. As an accepted rule, one-way operation allows an additional 20% of traffic capacity compared to two way operation on the same street. In theory, the disadvantage of converting a street from one-way to two-way is a reduced ability to carry traffic.

In practice, however, this is usually not a problem within a grid network

Figure 10. Vehicle Miles of Travel Analysis

such as Downtown. If streets are converted as pairs, an eastbound and a westbound, for instance, the total number of lanes available remains the same. The lanes are simply moved to other streets. This has advantages as well, by allowing motorists to by-pass a congested street and choose the adjacent street, as it will be predictably moving in both directions.

The City of Lubbock, TX, underwent a one-way to two-way conversion in 1995. The City Traffic Engineer wrote a paper for the Institute of Traffic Engineers (ITE) detailing the process and the results.[7] The author asserts that despite expectation of traffic calamity, the conversion went smoothly. In fact, Lubbock continued with other one-way conversions after this initial effort. The author also reported that the change was well-received by downtown businesses.

The conversion from one-way to two-way operation is neither novel nor radical. It has been done in a countless number of cities throughout the United States, including San Francisco, CA, Hickory, NC, Toledo, OH, and Miami, Orlando, and Tallahassee in Florida. The effects and mechanics are well-understood, so there should be no confusion or misplaced expectations for Richmond's conversions. In places where two-way streets have been converted to one-way operation, as in Richmond, traffic moves faster and streets have a higher traffic capacity. In communities desiring this outcome, the change has been well-received. In communities where one-ways have been converted to two-way, as proposed in the Downtown Plan, businesses have benefited, residents welcomed the change, and traffic patterns adjusted accordingly. These communities expected these outcomes, and were supportive of them.

The one-way versus two-way debate in Richmond is, at heart, a debate over the vision for Downtown. The studies referenced here indicate that two-way streets help businesses thrive and create places where people want to live and work, balancing traffic movement with livability. HPE recommends two-way streets because the community expressed a vision of a livable, walkable Downtown where pedestrians can thrive.

7 Converting back to two-way streets in downtown Lubbock, Jere Hart, ITE Journal August 1998.

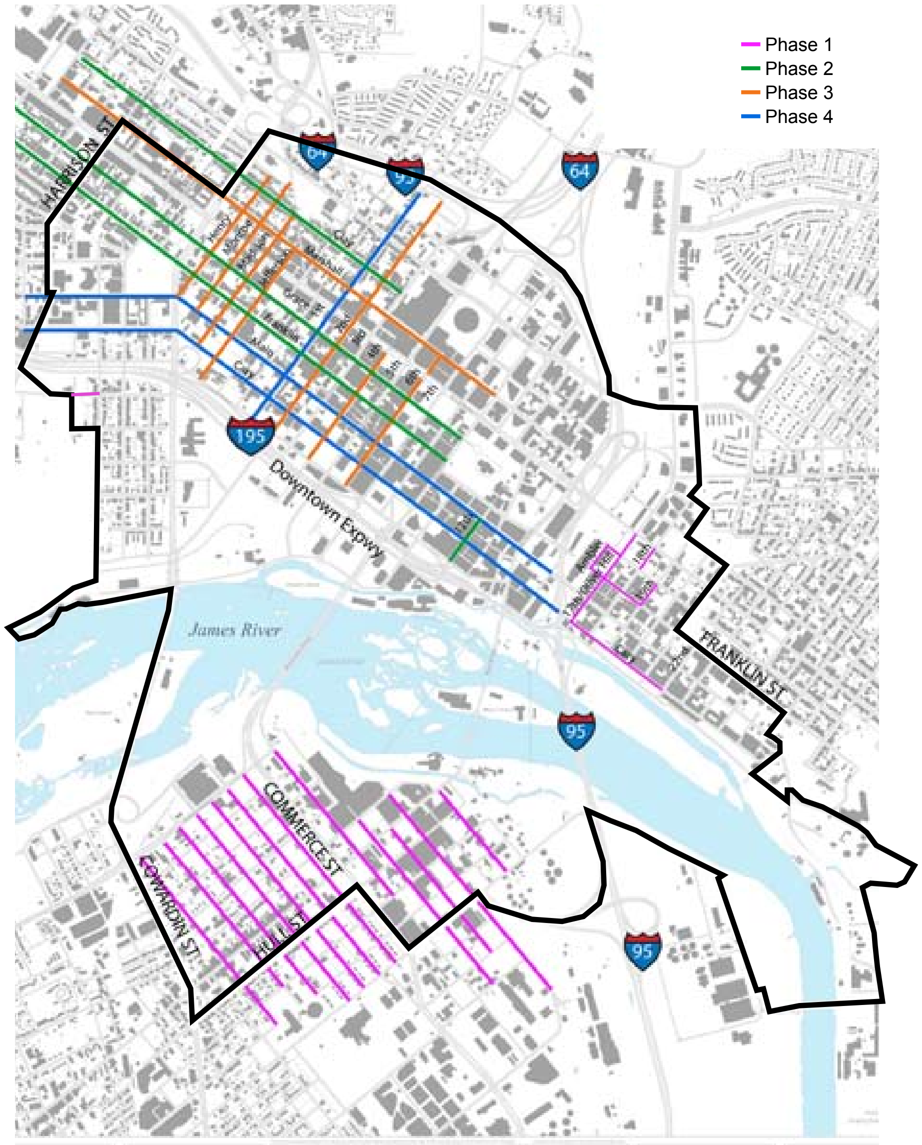


Figure 11. Phasing schedule for two-way conversion Downtown

Phasing

One-way streets should be converted to two-way operation in phases, based on the land-use goals of the Downtown Plan, and the feasibility of conversion. The conversion can take place in four phases over the next twenty years. The recommended conversion phasing schedule is shown in Figure 11, and described below:

Phase I: Shockoe and Manchester

Shockoe Bottom is experiencing a rebirth, and conversion of one-way to two-way streets would provide an immediate benefit for shops and businesses in the area. The recent Shockoe Bottom study recommended these conversions. The recommended conversions are Ambler Street, 17th Street/Oliver Hill Way, 18th Street between Grace Street and Broad Street, 19th Street between Grace Street and Franklin Street, Franklin Street between Ambler Street and 19th Street, and Cary Street between 17th Street and 22nd Street (not included in the Shockoe Bottom Study).

Manchester, across the river from Shockoe, is also a target area for redevelopment. The streets recommended for two-way conversion are the east-west streets between Cowardin and the river. Because these areas are largely vacant or underutilized today, the two-way conversion will cause minimal disruption and may improve the attractiveness of the area for reinvestment.

The development of a roundabout where the Downtown Expressway exit ramp currently merges with Idlewood Avenue would allow for the conversion of traffic flow from one-way to two-way between the proposed roundabout and Cherry Street.

Phase II: Clay, Grace, and Franklin Streets

These streets address the Downtown proper by providing more convenient access into downtown using the same number of lanes but a greater number of streets. Franklin and Grace, for instance, form a one-way pair with Franklin eastbound and Grace westbound. Each street has two lanes. Current estimates of performance (level of service) on these streets indicate they operate at LOS D in this configuration during their peak hours (AM peak for Franklin, PM peak for Grace.) This is a standard, acceptable LOS for urban streets. However, in this configuration the streets provide only one way in and one way out as a pair – in on Franklin, out on Grace. As two way streets, each street will have one lane in each direction, so there will be two ways in and two ways out of Downtown on Franklin and Grace Streets. These streets will continue to operate at LOS D as two lane streets, again based on preliminary, planning-level LOS analysis. The benefits of this arrangement are described in greater detail below. On Clay Street, the current configuration is one-way west bound, away from the Convention Center. Clay is recommended for two-way operation to provide better circulation around Jackson Ward and the Convention Center, and also to assist the general redevelopment of the northwest Downtown area.

Phase III: Marshall Street, Henry Street, Monroe Street, Madison Street, Jefferson Street, 2nd Street, 4thStreet, and 6th Street
Returning Marshall Street to two-way operation completes the conversion begun under Phase II with Clay Street, allowing Marshall and Clay to form the center of northwest downtown redevelopment area. The remaining Phase III streets are north-south connectors. Returning these streets to two-way operation will allow more convenient circulation around the Downtown area. The only north-south streets that are recommended to remain one-way are 3rd Street, 5th Street, and 7th Street, which provide access to and from I-64.

Phase IV: Main and Cary Streets
These two streets are also designated as state routes (SR 147/Cary and US 60/360/Main) and have been left as Phase IV, due to additional study that will be required to obtain state and federal permission to implement changes. However, there is no reason why these two streets could not be reverted to two-way operation first, if the City were inclined to pursue this change immediately. Otherwise, the Phase I-III modifications can be implemented first before addressing Main and Cary Streets.

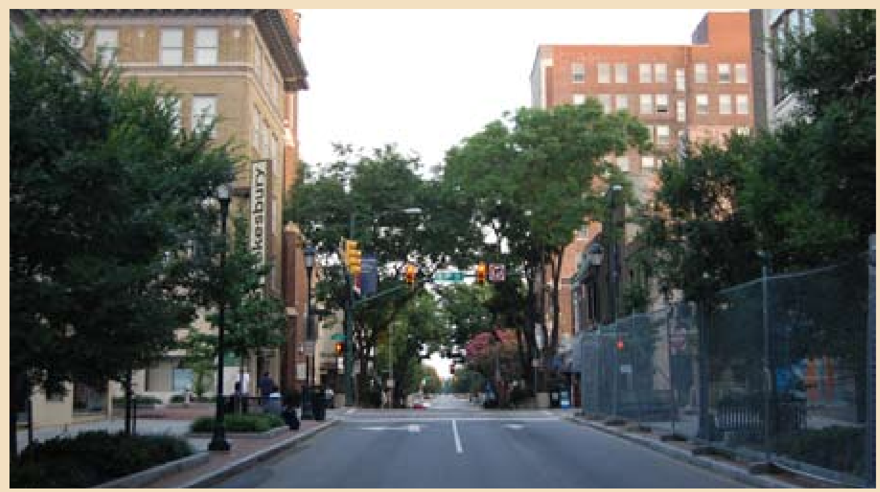
One-way operations on Oliver Hill Way

Case Study – Grace Street

HPE analyzed the section of Grace Street from Belvidere to Lombardy Street to better understand the one-way to two-way conversion process in Richmond. Prior to the 1980's, this street was one-way west-bound, as Grace Street is today from Belvidere to 9th Street. In the early 1980's, this section of Grace Street was returned to two-way operation at the request of business owners and residents along the street. The conversion was deemed successful by residents. A 1984 article from the Richmond Times Dispatch reported that, "Nightly drag races are impossible now" and "the traffic speeds and noise seem to be down markedly". City Public Works, on the other hand, opposed the conversion on the grounds of safety concerns. They reported an increase in crashes along Grace Street during the following few years, which is a typical occurrence any time a major change is made to a traffic pattern.

During the charrette, HPE spoke with a Richmond resident who lived on Grace Street during the transition period. This resident indicated that the conversion to two-way operation ushered in a renaissance of Grace Street. And indeed, HPE's own observations of this portion of Grace Street indicate an active street life, with people sitting on porches talking, students riding through on bicycles, and a buzz of activity. While taking pictures of the street, an HPE staff member was approached by residents, indicating a strong sense of community and ownership of the street. Although two-way operation has succeeded in transforming Grace Street into a livable place, and businesses on the two-way section of Grace Street are thriving, the City Public Works Department continues to view two-way operations on Grace Street as dangerous. Accordingly, City Traffic Engineering has a safety project funded to return Grace Street to one-way operation in the next two years.

The HPE team analyzed Richmond Police and Traffic Engineering's accident reports and came to an alternate conclusion that Grace Street operates as safely as any other street. While accident rates at some two-way Grace Street intersections are higher than their one-way Franklin Street counterparts, these accidents were almost always less severe, and can be attributed to higher activity levels- increased levels of pedestrians, bicyclists, businesses, and residences ultimately result in an increased likelihood of conflicts. Based on this research and the on-site analysis, HPE strongly recommends against the implementation of this Grace Street two-way to one-way conversion project. HPE's complete analysis of Grace Street and its current safety operations can be found in Appendix A.



Intersections of Grace and 5th Streets

5. Provide Efficient, Reliable Transit Downtown

In a revitalized Downtown area, The Greater Richmond Transit Company (GRTC) can expand its role of providing affordable public transportation for employees and residents. GRTC serves not only Richmond, but also the surrounding counties. The system map is included as Figure 12. In 2004, the most recent year for which data are available, GRTC carried 11.35 million passenger trips, using a maximum of 148 vehicles in service. The system recovers 27% of its revenue through the farebox, which is comparable to the national average. GRTC is the Designated Recipient of Federal Transit Administration (FTA) funds for transit operations in the Richmond area. This means GRTC is responsible for providing public transportation in the area and is the only agency that can receive Federal funding for this purpose. GRTC is currently completing a Comprehensive Operations Analysis (COA) intended to revise current missions, routes, and services. The COA is scheduled to be completed by the end of 2007.

As the Downtown continues to develop, parking will become a more valuable market good, and greater reliance must be placed on public transit. GRTC's regional connections will be a critical part of the multi-modal transportation system. If Downtown redevelopment is pedestrian-oriented, as supported by this Plan, it will also be transit-supportive. As shown in Figure 8, GRTC currently operates in a classic "hub and spoke" bus route system, focused on the Downtown area. The system does not have a Downtown transfer facility and transfers take place along city streets. This arrangement results in crowds of passengers waiting at bus stops along Broad Street, causing concern from merchants along the corridor. GRTC indicated that the location of one and possibly two dedicated transfer facilities is being considered. These facilities should mitigate the bus stop crowding problem.

The current bus system does not serve circulation needs within the Downtown. A transit strategy employed by some Downtowns to improve local circulation service is to use rubber-tired trolley-replica vehicles in addition to regional buses. These vehicles are regular rubber-tired bus or truck chassis skinned to resemble classic streetcar trolleys. They have several advantages over steel-wheel street cars in that they are cheaper to purchase and operate and are more flexible in their routing. This minimal investment and commitment has a downside as well. Routing flexibility, though it is convenient for planning purposes, fails to leverage land use investment. Nonetheless, such a system, if operated with sufficiently short headways of around 5 minutes between buses, could be a valuable part of the Downtown circulation system.

Pursue a Bus Rapid Transit system as a first step to bring back the Streetcar

A major part of GRTC's Comprehensive Operations Analysis is the introduction of Downtown bus transfer centers in combination with a dedicated-lane Bus Rapid Transit (BRT) system along Broad Street. Bus transfer

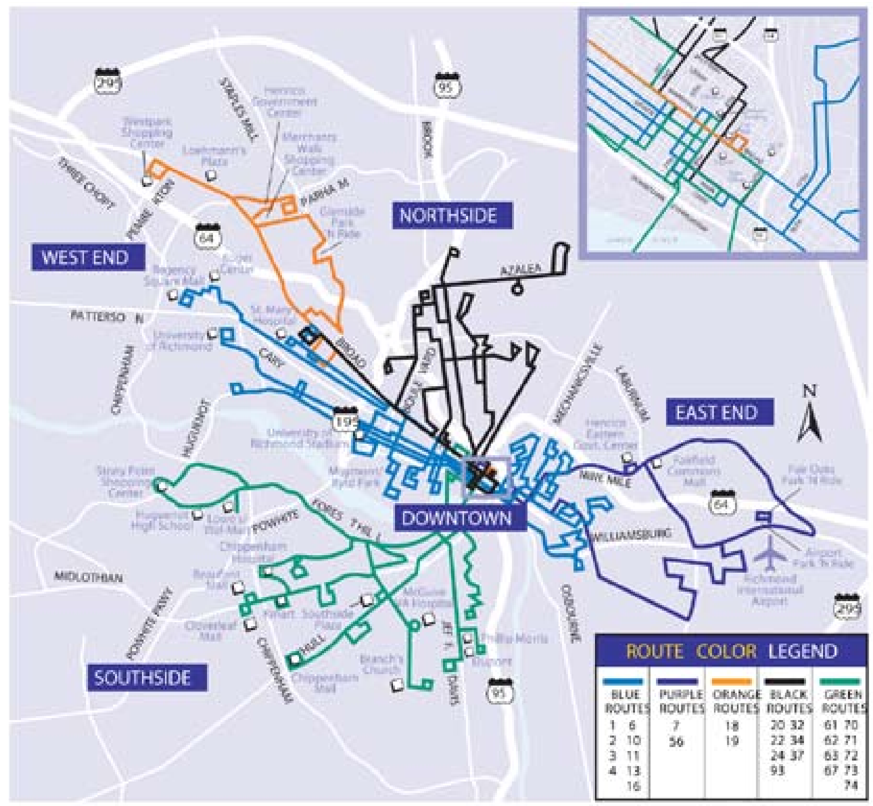


Figure 11. GRTC Regional System Map

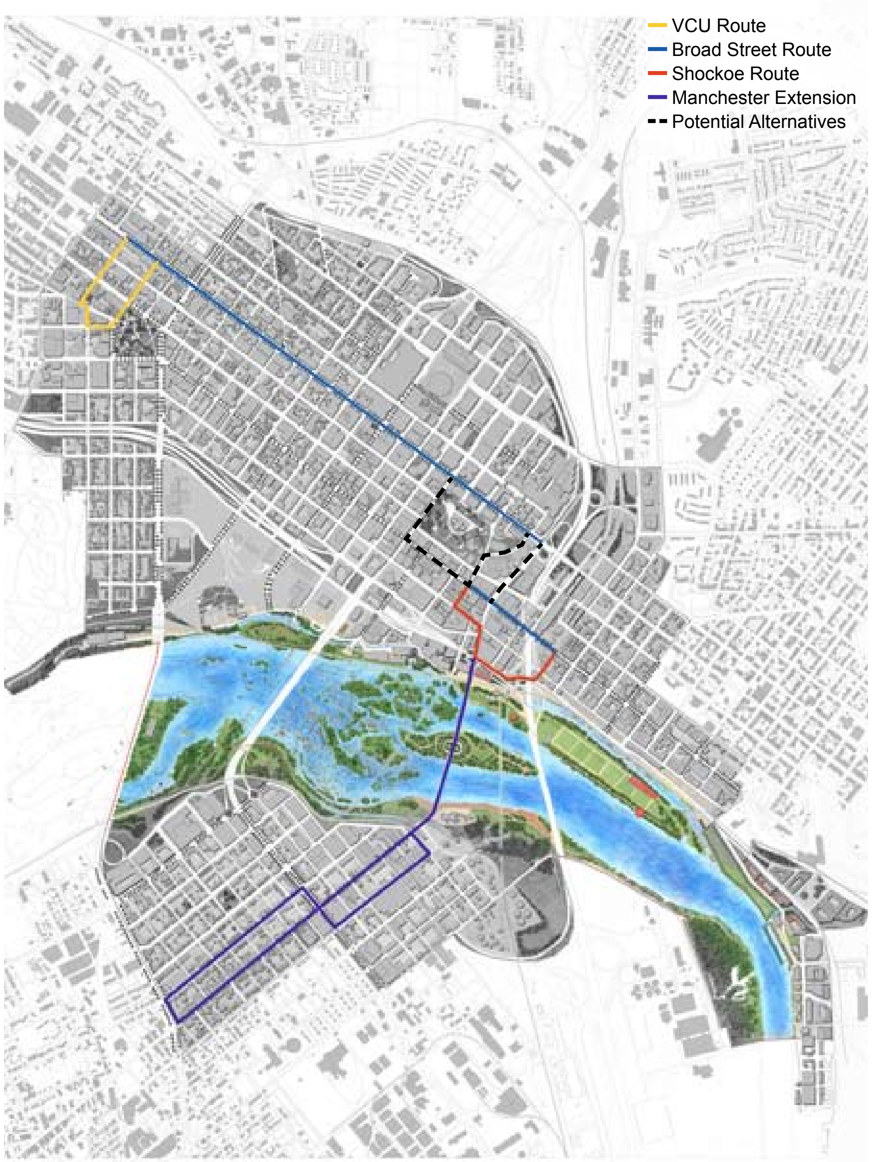


Figure 12. Proposed Streetcar Route

stations will improve transit in Downtown by consolidating all transfers into off-street, mixed-use facilities and reducing bus through-traffic on Broad Street. Transfer facilities are recommended near Main Street Station and the Convention Center. As Downtown transit grows, additional bus transfer stations can be considered, for example in Manchester. GRTC is pursuing Bus Rapid Transit as a pro-active first step towards bringing the streetcar back to Downtown. Bus Rapid Transit is an efficient, reliable, and low-cost strategy to begin regular transit service through Downtown, and it can be funded through an attainable federal grant from the Federal Transit Authority (FTA). After a 12-18 month operating period, GRTC will present BRT ridership levels to the FTA as grounds for funding a Downtown Streetcar system. Evidence of strong ridership levels will help Richmond to compete for limited Federal Streetcar funding. The BRT system is proposed to run in dedicated lanes in the center of Broad Street, where the existing median is located. These dedicated lanes can be transitioned into streetcar tracks when federal streetcar funding becomes available. A diagram of how Bus Rapid Transit could be accommodated along Broad Street is shown in Figure 3.

Revival of the Electric Streetcar System

A popular solution to Downtown's transit needs is an electric streetcar system. The advantages of a streetcar system are compelling. In terms of walkability, the recommendations for narrower streets, more on-street parking, and slower traffic speeds will tend to increase local traffic congestion. As Downtown redevelops, this pressure will only increase. A streetcar is an effective way to address congestion by providing access into and through the Downtown area. Much of Downtown Richmond was built around streetcar lines, so the city fabric is prepared for a return to this kind of transportation. A streetcar can accommodate greater numbers of Downtown residents and workers than personal vehicles can; this will help Downtown Richmond to achieve its development potential. In 2002, Greater Richmond Transit Company and the Metropolitan Planning Organization funded a Downtown Streetcar Study that provided detailed information on the projected costs and routing of a new streetcar line. The study, conducted by Burgess & Niple Inc., identified two conceptual 2.54-mile routes that connected major activity centers Downtown.

It is important that the streetcar system be viewed as a complement to, and not a competitor with, the existing bus system. Studies indicate that bus transit and streetcars serve different markets, and can work together to meet shared needs. The routing system and the low cost of bus transit makes it the preferred choice for regional commuters and more diverse populations. Streetcar service would provide local circulation through the Downtown, and could also be used by tourists.

Feasibility

The reintroduction of streetcar lines is no longer a novel idea but is becoming a key feature for cities interested in restoring life to their downtown areas. Over the past twenty years, many U.S. cities have reintroduced light rail and electric streetcar systems, including Portland, Oregon, St. Louis, Missouri, Little Rock, Arkansas, Tampa, Florida, and Memphis, Tennessee. The principles underlying the Downtown Richmond Plan are very supportive of public transportation, so the plan itself is an important step toward making an electric streetcar line feasible. Other feasibility factors include space for streetcar rails within the existing right-of-way, which Downtown has, and cost.

Routing

The proposed initial route for the streetcar, developed during the charrette, is shown in Figure 10. This route differs slightly from the 2002 Streetcar Study proposed route, due to recent modifications to the street system and proposed circulation changes. The route shown in blue and red in Figure 10 goes down Broad Street, Main Street, and Canal Street, providing service to Shockoe Bottom and the multimodal Main Street Station. The route shown in gold is a much more long-term proposal to connect to the VCU Monroe Park campus, providing access across Downtown to the VCU MCV Campus. The route shown in green is another long-term proposed route crossing the river on the historic Mayo Bridge and providing service to Old Manchester. As the Commonwealth's plans for a new street through the Capitol Square Complex develop, this street, along with City streets adjacent to the Capitol Square Complex, should be considered as route options for a future streetcar line.

Cost

The 2002 Downtown Richmond Streetcar Study provided projected costs for constructing and operating the streetcar system. These costs correlate

Market Street, San Francisco
Here transit loading platforms are incorporated into the street design by removing on-street parking at the intersection and moving the thru-right travel lane adjacent to the curb, and placing a loading platform in the street adjacent to the transit lanes. Loading platforms of this type can be used on Broad Street for the Bus Rapid Transit stops.

with the cost of such systems in similar communities. HPE finds that the Little Rock, AR system may be the most similar to Richmond's system, in terms of scale and available ROW. That system cost $7.6 million/mile to construct and $230,000 per year to operate (per 2004 the National Transit Database report, for two service vehicles.). However, costs rise annually and the budget will need to be revisited when the Richmond community is prepared to start investing in the streetcar system. The 2002 study calls for the streetcar to be funded under the FTA transit funding program, meaning that GRTC would be the responsible agency. To avoid a conflict with existing transit programs, funding for the streetcar could be identified from new transit funding sources, rather than reallocating current transit funding to the streetcar system.

Due to its expense, the streetcar concept is sometimes dismissed as improbable; however, nothing could be further from the truth. In the world of transportation funding, the layout and operation of a streetcar system is no more expensive than the acquisition of right-of-way and construction for a major road or street. In an industry where numbers are rounded to the nearest million, streetcar systems are not unreasonably expensive. Cost alone should not deter Richmond from pursuing a streetcar system. Experience in other cities has shown that streetcars have an ability to leverage investment and redevelopment that rubber-tired vehicles simply do not have. From this perspective, investment in a streetcar system is actually an investment in the economic development of the city, should the city decide to pursue this option.

The advantages of a streetcar system are compelling. In terms of walkability, the recommendations for narrower streets, more on-street parking, and slower traffic speeds will tend to increase local traffic congestion. As the city redevelops, this pressure will only increase. A steel-wheel trolley is an effective way to address congestion by providing access into and through the Downtown area. All of old Richmond was essentially built around streetcar lines, so the city is spatially very adaptable for a return to this kind of transportation. Only a streetcar will be able to carry sufficient passengers to support the intensity of development possible in Downtown Richmond.

Restore Main Street Station as an inter-modal center

Main Street Station was built in 1901 as a grand terminal to welcome travelers into Downtown. The chateau-style station and generous train shed was once a bustling center of transportation and commerce. By 1975, however, the interstate system and automobile usage had eclipsed the railroad system, and the train station closed due to flood damage and lack of passengers.

In 2003, Main Street Station's fortunes turned. The station was fully restored and re-opened to limited Amtrak service, serving two trains per day. Parts of the train shed are dedicated to cultural exhibitions; however, Main Street Station remains underutilized. The City should take advantage of this great asset by restoring is role as the center of the community.

The City is considering options for Main Street Station and the surrounding properties. There are opportunities for both transportation-related functions and other types of uses for the existing buildings and grounds, but any development plan for the property should include a new street through the two-block long train shed, in order to increase connectivity in the area and enhance pedestrian access. It is important that the City fully explore the options for revitalizing the property while maintaining its eligibility for current and future transportation-related grant funding.

An important component of the future of Main Street Station is to consider it for a multi-modal transportation hub for Downtown. A multimodal transportation hub could include increased passenger rail service, commuter rail service, light rail or streetcar, buses, bus rapid transit (BRT), shuttles, taxis, and bicycle/pedestrian facilities. This would provide a tremendous benefit to Downtown, as it does not currently have an integrated transportation center, thus preventing most residents and workers from using transit. Main Street Station is an excellent choice for such a transportation center, as the station is a grand entrance to the city, and its location provides direct access to the City Center and Downtown neighborhoods. The impact of any such use on the existing residential/commercial nature of the surrounding neighborhood should be carefully evaluated in consultation with representatives of the neighborhood prior to actively considering any such potential use.


Main Street Station has become a focal point of redevelopment plans for Shockoe Bottom.

A short-term strategy for such a transportation hub would be to provide bus service, airport shuttles, taxi and limousine service at the train station. As urban transit matures, a streetcar could be integrated into the system, and ultimately, increased rail service could serve the station, making Main Street Station a local and regional transportation destination. If these proposals do not take hold, another interim option would be to lease the train shed space as a unique location for a diverse range of local and national retailers.

The development of Main Street Station as a multi-modal hub does offer the opportunity to consider transit-oriented development (TOD) within the surrounding area. TOD allows for increased levels of density for commercial and residential uses within an area due to the anticipated use of transit and the reduced reliance on automobiles. Increased levels of density beyond what is generally recommended in this plan for the area surrounding the train station should only be considered if Main Street Station is developed into a multi-modal transportation hub.

As additional information is gathered regarding the extent of historic sites, including Lumpkin's Jail and others associated with the slave trade, on and adjacent to the Main Street Station property, impacts of any proposed development on the historic site(s) should be carefully considered. Development that interprets the African American historical experience, such as a visitor center or viewing stations, is appropriate for the site.

6. Plan for Bicyclists

Although today we talk about transit planning, pedestrian planning, traffic engineering and bicycle planning as separate entities, at one time these needs were addressed holistically through city planning. The principles of the Downtown Plan are based on this holistic approach, therefore transit, pedestrian, automobile, and bicyclist needs are addressed with every recommendation of the plan. Accordingly, the only part of this plan that contains specific "bicycle and pedestrian planning" and dedicated bike lanes are street sections where vehicle speeds exceed 30 mph, such as the Manchester Bridge. In all other areas, walkable street designs inherently provide for pedestrians and bicyclists.

HPE's recommendations for bicycle accommodation are based on years of bicycling experience with bike commuting and bike touring, as well as observations and measurement of bicycle facilities and usage around the nation. The principle that underlies bicycle riding on low-speed, traditional urban streets such as those Richmond study area, is called "vehicular cycling" and is based on the work of John Forester, author of "Effective Cycling". This principle is also the core of the League of American Bicyclists (LAB) "Bike Ed" program. Stated simply, the principle is that cyclists fare best when they behave and are treated as the operators of vehicles. HPE's staff includes a League Cycling Instructor, certified by the LAB to conduct bicycle education and training classes using the LAB materials. This background informs the recommendations included below.

More important than bike lanes, from the perspective of encouraging walkability and bikeability, is the provision of adequate bicycle parking at either end of the bicyclist's trip. Bicycle parking is often overlooked but critical to encouraging bicycle usage. Ideally, bicycle parking should be provided in the front of a store or building, in plain sight, easily visible from inside the store or building. HPE recommends the simple "u" rack for bicycle parking. Based on Richmond's sidewalk configurations, these bike racks should be placed on the sidewalk between tree wells, so that the sidewalk will remain open for pedestrians.

Bike Lanes

Dedicated bike lanes are not recommended for most Downtown streets. While bike lanes are the primary method of encouraging safe bike riding on suburban and higher-speed roadways, they are problematic in urban, walkable areas such as Downtown. They create their own special set of safety concerns, as detailed below.

Conflicts
The addition of a new lane on the right side of the street immediately creates an entirely new set of turning conflicts at any intersection. This is not a serious issue on arterial streets with few intersections, but it can be a real problem if bike lanes are used in areas with small blocks and frequent intersections, such as Downtown. Anyone trained to operate a motor vehicle on the street already knows much of what is required for safe bicycle operation in traffic, but the addition of a bike lane onto the street creates an entirely new set of issues and conflicts for cyclists as well as motorists. For instance, many motorists, and cyclists, do not know that a motorist is supposed to merge into the bicycle lane before turning right. Doing so is technically correct, from a traffic operations perspective requiring all right turns to be made from the right-most lane, but it feels "weird" and is counterintuitive to cyclists as well as motorists.

Motorist Attention
Motorists who would fail to pay attention to a cyclist in the regular travel lane may be even less likely to pay attention to a cyclist in a bicycle lane, resulting in lane encroachment and sometimes fatality for the cyclist legally using the bike lane. After all, the bike lane is simply a 6" wide stripe of paint; if either the cyclist or the motorist fails to follow the rules of the road, trouble can occur. Sharrows, by comparison, make cyclists impossible to ignore and thereby command the attention of motorists more effectively.

Bike Lane Invulnerability
The bike lane is simply another lane on the street, and all the rules of the road still apply. Novice cyclists may not recognize this, and fatalities have occurred because fast-moving cyclists failed to pay attention to the traffic around them and respond appropriately to a motorist's error in judgment.

Passing distance
Motorists generally allow much less passing distance for a cyclist in a bike lane, versus a cyclist in the regular travel lane, adding to the sense of discomfort some cyclists associate with bicycle lanes.[8]

On-street Parking
On roadways with on-street parking, a standard 5' bike lane places bicyclists directly in the middle of the "door zone" of parked cars. If a parked motorist opens their door as a bicyclist is passing, the bicyclist will collide head-on with the car door. A 1999 FHWA report, conducted by the University of North Carolina at Chapel Hill, videotaped over 2,500 cyclists riding in bike lanes and concluded that bike lanes adjacent to on-street parking was positively correlated with an increase in collisions between cyclists and parked cars.[9]

8 "Evaluation of Shared Use Facilities for Bicycles and Motor Vehicles", Florida Department of Transportation/University of North Carolina at Chapel Hill, 1996

9 FHWA FHWA-RD-99–034 A COMPARATIVE ANALYSIS OF BICYCLE LANES VERSUS WIDE CURB LANES: FINAL REPORT


"U" bicycle rack

Speed management
On-street parking, in conjunction with 10’ or narrower travel lanes, calms traffic by increasing the alertnessof the passing motorist.[10] There is no way to avoid a suddenly-opened car door, so motorists must travel more slowly and pay attention. If a 5’ bike lane is striped next to the parked car, however, motorists in the adjacent travel lane can safely ignore the parked cars entirely, which eliminates the speed-management benefits of on-street parking. The Institute of Transportation Engineers recognized in their “Residential Street Design and Traffic Control” (1989) report that travel lanes wider than 10’ limit the ability to achieve design speeds of 25 mph or lower; a 10’ lane with a 5’ bike reads as a 15’ wide lane to a motorist (p. 23, p. 68) The walkable thoroughfare sections described earlier in this chapter are carefully calibrated to Richmond’s existing streets and do not include bike lanes, with the exception of Manchester Bridge, due to this “road widening” effect of bike lanes. Essentially, bike lanes and on-street parking are incompatible. On-street parking has a greater traffic calming effect and so is the preferred treatment in walkable areas.

Shared Lanes
Based on the nationally-adopted practice of “vehicular cycling,” HPE recommends that on the majority of Downtown streets, bicyclists should share the narrow, outer traffic lanes with cars. This will help to manage traffic speeds while maximizing bicyclist safety. These shared lanes should be marked with “sharrow” markings to signal to both bicyclists and drivers the presence of mixed traffic. The use of mixed-traffic “sharrow” lanes is becoming a preferred solution for accommodating bicycles on urban streets. In 2004, the California Traffic Control Devices Committee (CTCDC) approved the use of this marking in the State of California, where it is used extensively in San Francisco and smaller cities such as Chico. In January 2007, the National Committee on Uniform Traffic Control Devices (NCUTCD) endorsed the shared lane marking concept, and has recommended its inclusion in the Federal Manual on Uniform Traffic Control Devices (MUTCD). Several cities are currently participating in a Federally-approved program of using shared lanes with “sharrow” marking, including Flagstaff, Arizona, Fort Collins, Colorado, Louisville, Kentucky, Ithaca, New York, Portland, Oregon, Pittsburgh, Pennsylvania, Salt Lake City, Utah, and Sheboygan, Wisconsin.

Sharrows fit more naturally into the traffic system and eliminate the confusion that dedicated bike lanes can cause. Sharrows are specifically recommended on Broad Street, but may be used anywhere that the cycling community or local government finds them appropriate. Because they do not alter the width of the street, sharrows fit seamlessly into the walkable thoroughfare designs described in section 3 of this chapter.

Shared-lane biking is the preferred strategy for urban biking, as seen here in San Francisco.

10 “Narrow Residential Streets: Do they really slow down speeds? James Daisa, P.E. and John Peers, P.E.

What is a Sharrow?

A “sharrow” or shared laned marking consists of a standard bicycle symbol with two chevrons on top, indicating the direction of travel. It’s placed at intersections and every 250’ thereafter. It’s designed for places where bike lanes are inappropriate but where cyclists like to be, are expected to be, or are intended to be. The sharrow is designed for use on streets with speeds below 35 mph and indicates that cyclists need to take the lane. It also indicates to motorists that cyclists will be taking the lane. “Take the lane” means that a cyclist rides near the center of the lane, effectively taking up the entire lane. This prevents motorists from trying to squeeze by the cyclist and either running over the cyclist or forcing them off the road, into a curb, or into a parked car, as is likely to happen if the lane is less than 14’ wide (or 15’ wide next to parked cars).

The sharrow is placed several feet from parked cars, placing cyclists safely out of the “door zone.” Also, unlike a bike lane, the sharrow doesnot restrict cyclists’ movement on the street. An unintended consequence of bike lanes is a tendency for novice cyclists to stay in the bike lane, “no matter what”.

Exerpt from the Draft Manual on Uniform Traffic Control Devices, U.S. Department of Transportation, Federal Highway Administration Section 9C.07 Shared Lane Marking:

Option:
The Shared Lane Marking may be used to:

A. Assist bicyclists with lateral positioning in a shared lane with on-street parallel parking in order to reduce the chance of a bicy clist’s impacting the open door of a parked vehicle,
B. Assist bicyclists with lateral positioning in lanes that are too nar row for a motor vehicle and a bicycle to travel side by side within the same traffic lane,
C. Alert road users of the lateral location bicyclists are likely to oc cupy within the traveled way,
D. Encourage safe passing of bicyclists by motorists, and
E. Reduce the incidence of wrong-1 way bicycling.

Guidance:
The Shared Lane Marking should not be placed on roadways that have a speed limit above 50 km/h or 35 mph.

Standard:
Shared Lane Markings shall not be used on shoulders or in designated bicycle lanes. If used in a shared lane with on-street parallel parking, Shared Lane Markings shall be placed so that the centers of the markings are at least 3.4 m (11 ft) from the face of the curb, or from the edge of the pavement where there is no curb.

Guidance:
If used on a street without on-street parking that has an outside travel lane that is less than 4.3 m (14 ft) wide, the centers of the Shared Lane Markings should be at least 1.2 m (4 ft) from the face of the curb, or from the edge of the pavement where there is no curb.

If used, the Shared Lane Marking should be placed immediately after an intersection and spaced at intervals not greater than 75 m (250 ft) thereafter.

The MUTCD standard graphic for sharrow lanes includes a bicycle with two chevrons marking the direction of moving traffic. Sharrow are used on a busy street in San Francisco.

7. Balance Parking Supply and Demand

Parking availability and pricing are the two greatest influences on the use of transportation other than the single-occupant automobile. Study after study since the 1980's has indicated that rates of carpooling, transit, and to a lesser extent walking and bicycling, are closely correlated to parking pricing and availability. As the cost of parking goes up (and availability goes down), people shift to other modes of transportation. Those who cannot shift to other modes will often shift travel times to take advantage of cheaper or more available parking at different times of day.

Consequently, urban areas with high levels of transit accessibility and walkability, such as the future vision for Downtown, are expected to have fewer parking spaces and/or more expensive parking spaces, compared to areas that are less urban and have lower levels of transit and walkability. This means that residents in the study area should not expect to have the level of parking accessibility that residents and employees in lower-density, less-urban parts of Richmond experience. The trade-off is that Downtown residents will have much higher access to transit and will enjoy a vibrant, walkable community.

Several recent studies, reviewed by HPE during the charrette, have examined the Downtown parking situation. The studies, including the Shockoe Bottom Transportation Study, indicate that parking demand is met through on-street parking, garage facilities, and surface lots. This parking is limited, however, by the removal of on-street parking during evening rush hour, and many surface lots are in poor condition. Given the low levels of residency and high levels of storefront vacancy in Downtown, parking is generally oversupplied in most areas. As redevelopment occurs, on-street parking should be maximized first, followed by off-street parking in garages or shared surface lots. The necessary square footage for parking exists, but it may need to be renovated to attract users.

If additional parking availability is needed as redevelopment occurs, the City could invest in structured parking, require additional parking as part of new development, and encouraging transit use, bicycling, and walking. Additional parking demand will be mitigated by the ability to share parking between land uses and by the use of paid parking standards. The ULI shared-parking methodology or the New Urbanist/SmartCode parking standards can be used to estimate parking demand as new develop-

A number of parking garages have been built Downtown in recent years.

Where off-street parking is necessary, garages should be located mid-block and wrapped with a liner building, such as this mixed-use building Downtown.

ment comes online. Paid parking should be implemented when demand exceeds 85% of supply, or when this is projected to occur, for instance, if a block redevelops and several large land uses move in, such as a large corporation or retailer. At this point, structured parking becomes viable and may be provided for either through negotiation with the developer, bonds, or other City financing mechanism.

Shared Parking

Conventional parking standards require a certain number of parking spaces for each land use, calculated per square foot, number of tables, or, for instance, number of washing machines. These standards assume that each land use is stand-alone. According to conventional standards, a laundromat customer who gets a sandwich at the restaurant next door will require a parking space at both the laundromat and at the restaurant. These assumptions are based on parking needs in suburban, non-walkable locations.

Shared parking standards, on the other hand, recognize that walkable locations such as Downtown Richmond do not require large amounts of separate parking for each land use. Instead, land uses share parking. For example, an office building requires parking for its employees during business hours, but not during the evening when the office is closed. A dinner restaurant requires parking in the evening, but not during the day when the restaurant is closed. Under conventional parking demand, each land use would require its own parking supply, even if they were located adjacent to one another. Shared parking standards allow the same parking lot to serve both uses.

The Urban Land Institute publishes a shared parking guide that can be used to estimate the level of shared parking availability for various mixes of land uses. In addition, New Urbanists utilize the SmartCode, which incorporates shared parking principles, to determine parking demand. As the area develops, the City should utilize these shared parking methodologies to estimate parking requirements. Using conventional standards would result in overestimation of parking requirements.

The City of Richmond's Parking Overlay Districts, as described in Article IX Division 1 of the Municipal Code, actually provide the groundwork for this type of analysis. Much of the data required for the Parking Overlay District parking determination can also be used for a shared parking analysis. The greatest modification is that rather than use a standard number of parking spaces per 1,000 square feet (such as 3 per thousand in Richmond's code), the shared parking analysis goes into greater detail to determine peak parking demands by time of day. This can result in a more realistic estimate of parking demand.

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Paid Parking

Parking management practices generally consider parking to be at capacity when 85% of available parking spaces are full. At this point, users of the parking spaces will complain about a lack of parking. If a parking survey indicates that parking is at 85% of capacity or higher, the recommended option is to implement paid parking. Under paid parking, users of the parking spaces pay a fee to park. The fee can be collected in a variety of ways, including meters, debit and credit cards, pass programs, smart cards, or parking attendants. Parking meters are more customer-friendly than ever, according to Ralph Rhudy in the City Traffic Engineering Division. Richmond parking meters can be paid by coin, tokens, smart cards, and even telephone calls to provide a credit card number. In addition, the “smart” meters used in Richmond provide a five minute grace period for parkers who overstay their time slightly. HPE agrees that parking meter technology has entered a new phase of customer-friendliness and profitability, and encourages the use of on-street parking and paid parking to address parking concerns. Parking meters that allow real-time adjustment of parking rates, for instance, allow the parking fee to be adjusted to control the demand for parking and keep demand at about 85% of capacity.

The critical parking concepts to remember are to let the urban form, including a mix of uses, on-street parking, and walkable streets, help mitigate the demand for parking; then use shared parking to accommodate the demand. When available shared parking and on-street parking reach 85% of capacity, implement paid parking strategies. These strategies will ensure that adequate parking always exists in the area, but that parking facilities will not define the area or be the most obvious land use, as is the case along downtown Cary Street and Canal Street at the present time.

Another parking concern is the spillover from large parking generators, such as universities and business centers, onto residential streets. Many towns and cities address this problem through residential parking permits, allowing non-residents to be easily spotted and ticketed or towed from residential parking streets. The Oregon Hill neighborhood, for instance, could use this method to protect residential parking from incursion by nearby commercial or university land uses. Representatives from VCU have been encouraging of residential parking permits for neighborhoods near the university.

During the charrette, HPE analyzed the Shockoe Bottom Parking Management Plan. This plan has, according to the information presented at the charrette, already been completed and can be implemented once approved by City Council. The plan includes many of the strategies described above, as well as a parking management company to oversee the entire operation. HPE recommends that this plan be implemented as the most expedient and cost-effective way to provide for parking needs.

Pay and Display Parking Meter

GETTING THERE

Cost Estimates

General cost unit cost estimate assumptions are provided below in the table. These estimates are based on Virginia DOT estimates per recent VDOT studies, City of Richmond Traffic Engineering Project estimates, and estimates from the Shockoe Bottom plan, grown from 2004 dollars to 2007 dollars at 4% annually. Note that 15% is the new inflation rate per VDOT in 2007. Inflation past 2007 should include this new rate. New street construction modifications required by this plan are minimal. Primarily, the plan calls for re-striping, resignalization, and some cases, the construction of brick or cobble safety strips.

Table 1: Unit Cost Estimates	
ITEM	COST ESTIMATE (2007 Dollars)
Brick Safety Strips	$200-$250/yd2
Milling of street to expose cobble (alternative to safety strip construction)	$6-$10/yd2
4" Paint Striping	$1.25-$1.50/lineal foot
Intersection Signalization	$90,000-$120,000 intersection: Total cost depends on size and complexity of intersection and whether the intersection is receiving a new signal or an upgrade of an existing signal
Pay and Display Parking Meter	$7,000-$9,000 each, one per side per block
Bicycle U-racks for bike parking	$170 -$200 per rack, installed, for surface-mounted racks; assume four racks per block for a single side of a street.

Phasing

Some of the recommendations in this report can be implemented immediately; others require more time due to cost or developer initiative required. For instance, a stop-controlled one-way street can be returned to two way operation very quickly. Similarly, left turn restrictions can be lifted at some intersections quickly. Installation of new traffic signals to permit two-way operation, however, is expensive, so it should be carefully considered in the Capital Improvement Plan over the next 5-10 years. With these provisions in mind, HPE recommends the following phasing program:

Less than five years

- Road diet and installation of bike lanes on Manchester Bridge
- Initial two-way reversion pilot in Shockoe and Old Manchester (Phase I conversion)
- Installation of Pay and Display parking system (or similar system to manage downtown parking)
- Start-up of rubber tire trolley circulator system
- Installation of bicycle racks in front of commercial venues
- Conversion of Broad Street for BRT operation

Five to ten years

- Implement Phase II and Phase III conversion of one-way to two way
- Implementation of recommended street sections on Grace, Franklin, and Clay
- Implementation of Commerce Boulevard revised street section
- Begin return of street car system, per Streetcar Study

Ten to 15 years

- Implement Phase IV conversion of one-way Streets
- Complete reconfiguration of downtown streets per Thorough fare Plan

Opportunistic Improvements

- Old Manchester Street modifications
- Extension of streetcar to Manchester
- Implement Downtown street sections
- Implement parking management programs

Converting Franklin Street

Phase I of the two-way conversion calls for Franklin Street between Ambler and 19th Street to be converted to two-way operation and converted to the ST 66-40 8-10-4-10-8 thoroughfare design (8' parking lane, 10' travel lane, 4' safety strip, 10' travel lane, 8' parking lane.) The average block length of this street is 290'. Using the unit costs above, the project cost estimates per block would be:

Safety Strip Installation :	$25,800-$32,250
Paint (stop bars, edge lines):	$860-$1,032
Pay and Display Parking Meter (2 per block):	$14,00-$18,000
Bike Racks (8 per block, 4 on each side):	$1,360-$1,600
Total Estimate Range:	$29,420-$52,882

For the complete three blocks of this project, the thoroughfare conversion improvements above would be estimated at $88,260-$158,646. Signal modernization costs are estimated at $90,000-$120,000 per intersection. For three intersections, the estimated cost would be $270,000-$360,000.

Total Project Cost estimate for thoroughfare conversion plus one-way conversion is $358,260 - $515,646

CONCLUSION

Everything the City of Richmond needs to know to build its future is contained in the bones of its traditional Downtown area. Small blocks, small streets, sidewalks, and buildings that create enclosure and a sense of place are the primary elements. The Downtown was designed before the automobile appeared on the scene, and in rebuilding Richmond's Downtown, designers must consciously return to that type of planning. Put aside the past 100 years of automobile-oriented development, and treat the vital automobile as a servant to the pedestrian, not vice versa. The transportation proposals in this report are all based on this concept. A return to this type of transportation planning requires cooperation among City departments, thorough planning, analysis and design, ongoing public input, and reinforcement from policymakers.

Citizens conveyed the clear message during the charrette that they would like to revive the economic life of Richmond's historic Downtown area. Richmond residents further envision a return to the walkable city structure of the early 1900's, with Downtown residences, places to shop and find entertainment, and restoration of the civic centers in the area. The traffic engineering and transportation planning approach taken during the charrette respects that vision and suggests that managing speeds to pedestrian-friendly levels and ensuring connectivity of the street system will accomplish this vision. HPE recommends the use of walkable thoroughfares for specific sections of the study area, reawakening Manchester, reviving the electric street car system and returning most of the Downtown's one-way streets to two-way operation.